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Mapping knowledge domains of non-biomedical modalities: A large-scale co-word analysis of literature 1987–2017



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ABSTRACT

This paper presents a systematic mapping of the disparate literature on non-biomedical therapeutic modalities using co-word analysis. Non-biomedical modalities are defined in this paper as therapeutic modalities that exist in separation, but not isolation from, biomedicine. Bibliometric visualisation based on co-word analysis, a method sensitive to the configuration of socio-cognitive networks of knowledge, is employed to create a semantic topography of thirty years' literature from across different disciplines. The proliferation of terminologies to describe non-biomedical modalities from different disciplines raises important issues about the structure of scholarly knowledge about this area, particularly with regards to domains of meaning and conceptual spaces that lay dormant within this discourse. Drawing from a bibliographic dataset of 17,163 peer-reviewed publications written in English between 1987 and 2017 (retrieved on September 31, 2018), this paper presents a rigorous map with which to navigate the highly complex and interdisciplinary literature on non-biomedical knowledge and practices. Arguing that knowledge production about non-biomedical modalities in scholarly literature resembles that of problematic networks of interest, this paper substantiates the separation from biomedicine that contradistinguishes non-biomedical modalities. It does so by analysing the semantic trajectories of the most widely used terminologies in this domain, namely traditional medicine, alternative medicine, herbal medicine, and unclassified drug. Although all equally problematic, these contested terminologies are unlikely to replace one another in any form of paradigmatic shift in the foreseeable future. Their persisting conceptual usefulness is anchored in their own respective clusters of meaning, and researchers wishing to engage in the production of knowledge in this domain should be mindful of the pitfalls associated with their terminology use. Non-biomedical modalities as a term might be better equipped to capture the diversity as well as the historical continuities and discontinuities of therapeutic traditions and practices at the margin of mainstream scientific medicine.

1. Introduction

“... in the middle of the quadrilateral of language, the name appears both as the point upon which all the structures of a language converge (for the name is its most secret, most closely guarded figure, the pure internal result of all its conventions, rules, and history), and as the point from which all language in general can enter into a relation with the truth according to which it will be judged.” (Foucault, 1966, p.129)

The naming of things matters. What we decide to call a thing, however arbitrarily, does not merely provide us with a convenient point of reference for that thing; the act of naming enlists the empirical subject in a web of meanings that both precedes it and produced by it. When a foreign exchange student from Japan decides to call herself Lucy instead of Setsuko, she is doing more than just politely relieving the burden of her American classmates who cannot seem to pronounce

her name correctly; she is entering a new relationship with her identity, whose emergence is anchored in an already existing network of meanings, norms, and values. The naming of the scientific subject transforms this subject in the same way. For example, calling a range of therapeutic modalities ranging from acupuncture and taichi to Ayurveda and Unani ‘complementary’ and ‘alternative’ has the effect of clarifying and solidifying what it means to be ‘scientific’, while at the same time alienating and marginalising what lies outside of this scientific framework. Once a naming convention has become stabilised, the semantic network built around this name is anything but arbitrary; once we have decided that a medicine is ‘unorthodox’ or ‘traditional’, for example, it is less straightforward to associate it with things like ‘rigour’, ‘efficacy’, or ‘government funding’. Names represent the empirical object as they designate general qualities and substances that sustain the possibility of discourse about that object; it is through this discursivity of language that the construction of knowledge becomes

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possible. Names as signifiers, similar to all of language, are not always perfect; their imperfections and errors, however, record what has been learned and allow for the progression of knowledge through judgment of what is being proposed, articulated, and derived from naming conventions.

Some naming activities are more formal and formalised than others. The naming of specialties within scientific medicine, for example, has grown increasingly systematic and narrowly focused. The Medical Schools Council in the UK records more than 60 specialties in formal biomedical pedagogy; the Association of American Medical Colleges records more than 120 specialties and subspecialties, while the Medical Board of Australia recognises over 80 scientific medical specialties and field of specialty practice (AAMC, 2018; MSC 2018; MBA 2018). The naming of specialties inevitably informs practice; by the mid-1950s, medical specialisation had become a fundamental characteristic of biomedicine (Weisz, 2006). At the same time, the naming of non-Western, non-scientific therapeutic modalities in scholarly literature proliferates in a much less systematic manner. This contrast is not incidental; it is the result of a structural reordering of medical epistemology at the dawn of clinical sciences.

1.1. The birth of biomedicine and the marginalisation of non-biomedical modalities

In the 1963 book *The birth of the clinic*, Foucault characterised a critical 'turning point' in the history of 18th century Western medicine that came with the institution of the *clinique*, in which the medical gaze created an epistemic break between medical knowledge and non-knowledge (Foucault, 1963). The advent of the clinical science of medicine is part and parcel of a wider reorganisation of the structure of knowledge that champions empiricism, which subsequently shapes what gets included in medical discourse and constrains the very possibility of discourse about disease. The 18th century medical gaze did not simply direct itself towards the human body in a more refined manner as a result of accumulated scientific progression. Between the Morgagnian gaze towards the sick body as a local host of organ-level diseases and the Bichatian gaze towards pathological tissues and membranes is an epistemic rupture that stabilised the body as a site for temporal readings of disease.

The stethoscope as an early 19th century medical technology further endowed this medical gaze with a 'plurisensorial' structure that renders the body invisible visible, transforming the medical gaze into a totality that designates anything outside its purview as beyond the domain of knowledge. Medical technologies have since grown increasingly sophisticated; the panoptic surveillance of the human body has evolved to include X-ray machine, MRIs, CT scans, DXA scans, sonograms, and emerging 3D interactive visualisation techniques. Sophisticated medical imaging techniques are only part of a wide array of modern biomedical technologies, however. Lock and Nguyen (2010), for example, remind us that biomedical sciences are actively constructed by biomedical technologies, which straddle sociotechnical institutions such as hospitals, laboratories, biotech companies, and the state. The mundane, everyday biomedical technologies that pervade modernity also include techniques and activities ranging from basic physical examination and patient history-taking to administration of injection and prescription of medication. Biomedicine exercises an authoritative control over the human body as it displaces and marginalises non-biomedical practices (Lock and Nguyen, 2010). This subjugation, however, is neither linear nor comprehensive; non-biomedical knowledge and practices continue to exist across the world, and the interaction between the biomedical and the non-biomedical continues to evolve in both clinical and non-clinical settings (Tovey et al., 2017; Shorofi and Arbon, 2017; Lindquist et al., 2018).

Non-biomedical knowledge and practices are defined in this paper as therapeutic modalities that exist in separation, but not isolation from, biomedicine. This separation is multiple. It is epistemological,

with non-biomedical knowledge usually lacking epistemic 'virtues' such as precision, certainty, and replicability, while biomedical knowledge lacking certain aspects of the ontologies that support the epistemologies of various non-biomedical practices. It is also historical (with biomedical knowledge inextricably linked to modernity and modernisation), social (access and subscription to non-biomedical regimens are socially stratified and stratifying), cultural (with biomedical knowledge supposedly freed from value and emotions, allowing it to be wholesale transported across cultures), and institutional (with the professionalisation of biomedicine consolidating its credentials and market opportunities while excluding non-biomedical practices).

Partly existing outside the formal and highly regulated health sector, non-biomedical therapeutic practices persist as living cultures that also often incorporate biomedical technologies and techniques. Examples of these hybrid practices include X-ray scanning use among chiropractors (Ernst, 1998), eclectic combining use of Viagra and traditional Chinese medicine among men treating impotence (Zhang, 2007), use of traditional medicine among cancer patients in India (Broom et al., 2009), and agnostic evaluation of blood test results in conjunction with Eastern medical diagnosis among Vietnamese women treating infertility (Pashigian, 2012). In other cases, hybridity is negotiated and less straightforward. An example of this is the case of the *haad vaidya* (bone doctors) in India, where, despite these doctors' assertion of manual diagnosis as their core competence, patients bring along X-ray scans to consultation on their own initiative (Lambert, 2012). Living practices of non-biomedical therapies are guided by an acute pragmatism that allows both non-biomedical practitioners and their patients to navigate a highly complex landscape of medical pluralism. This navigation allows patients to negotiate individualised treatments that reflect culturally and politically conditioned understandings and circumstances of health and illness. As such, non-biomedical modalities are practices that managed to escape the totality of the 20th century biomedical gaze only insofar as they partially reject, and are rejected by, scientifically circumscribed sites of biomedical knowledge.

1.2. Knowledge production as problematic networks

Since the mid-19th century, doctors increasingly rely on laboratory sciences to inform their practice (Löwy, 2011). Post-World War II marks a period of 'biomedicalisation', wherein biomedicine as a term coined during the interwar period is used as a shorthand for the intermingled practices of doctors and scientists (Löwy, 2011). Even though the processes of biomedicalisation are heterogeneous – some medical disciplines were faster than others in turning to the laboratory – increasingly dense networks of doctors, scientists, and industrialists were mobilised as a result of healthcare funding, government regulation, and patient activism (Bell and Figert, 2015).

The centrality of the laboratory as a locus that exercises power over the shaping of development and the transformation of post-industrial society is recognised in sociological writings (Touraine, 1971, 1977; Latour, 1993). Displacing the industrial firm in the same way that the industrial firm downgraded the state, and in the same way that the state displaced religious organisations that came before, knowledge organisations such as laboratories, hospitals, and research centres are what Touraine (1971) considers to be the strategic loci of social change. The production of knowledge within these knowledge organisations is always politically charged; it is not possible to lean on the 'ivory tower' model and paint an accurate picture of scientific innovation (Latour, 1988 & 1993).

Scientific knowledge production, therefore, does not happen within 'specialist communities' who carve out 'research areas' that are independently defined and delimited (Latour and Woolgar, 1979; Callon et al., 1986; Latour, 1988). Knowledge production in the sciences is better described as problematic socio-cognitive networks of hybrid communities, whose interests are aggregated and funneled through

translations of scientific publications as *literary inscriptions* (Callon et al., 1983). In this translation process, all actors involved build around them complex and changing networks of elements that are linked together and made dependent upon the actors themselves. These actors are heterogeneous in nature; they can be individuals, organisations, or concepts. Translation as well as counter-translation of and by these actors make network associations possible; they constitute a language better equipped to identify knowledge production in multidisciplinary and transdisciplinary research than the Kuhnian ‘paradigms’ of highly focused scientific disciplines, or the Mertonian ‘clusters’ of scientific authority. Within this framework, words as they are positioned and stabilised within literary inscriptions act as *translation operators* (Callon et al., 1983) that allow actors to navigate and consolidate webs of interests. Translation operators, identified and extracted from their inscriptions and subsequently reassembled without relying on pre-established classification schemes, can reveal poles of interest, their convergence or intersection, relationships that are developed around them, and the general configuration of the problematic network (Callon et al., 1983).

As the next section will show, understanding knowledge production as problematic networks is particularly useful to the task of uncovering the knowledge structure of English-language scholarly literature on non-biomedical modalities. Lacking terminology consensus and established authority while being the results of multiple disciplinary inquiries, scholarly knowledge about non-biomedical modalities is organised in neither definitive paradigms nor stable and discrete clusters. In a sense, production of scholarly knowledge about knowledge that escapes the totality of the scientific gaze seems to reflect what Daston and Galison (2007) refer to as the plurality of ‘visions of knowledge’. This plurality of visions will remain a permanent feature of the scientific enterprise due to its capacious commitment to fidelity to ‘nature’ – in this case the therapeutic modalities that exist outside of the highly ordered scientific way of knowing. This commitment, however, could be detrimental to its subject if these plural visions of knowledge impose partial and politically fraught views of what constitutes the subject of scientific inquiry (Daston and Galison, 2007). The proliferation of problematic terminologies used to describe non-biomedical modalities in literature is an example of such a commitment.

1.3. Contested terminologies on non-biomedical modalities: a literature review

Since the turn of the millennium, a number of attempts have been made to categorise the various concepts surrounding non-biomedical therapeutic modalities, although none has been exhaustive or conclusive. Nigenda et al. (2001), for example, developed a heuristic scheme of three non-biomedical categories based on their survey on medical pluralism in Morelos, Mexico, comprising traditional medicine, alternative medicine, and faith healing. However, this heuristic scheme is highly specific to the context of Mexican medical pluralism and cannot be generalised. For example, traditional medicine is defined within this typology as “the outcome of the syncretic union between pre-Hispanic concepts and health care practices” (p.12), whereas alternative medicine is defined as “a wide variety of concepts and practices which have distinct and non-indigenous origins, ranging from Chinese acupuncture to European homeopathy” (p. 12). Nigenda et al. (2001) also mentioned a range of terminologies from existing literature that are neither clearly defined nor sufficiently analysed, such as herbal medicine, indigenous medicine, complementary medicine, unconventional medicine, unorthodox medicine and religious healing – which are conceptualised in opposition to ‘technologised medicine’ and ‘pharmaceutical medicine’. The ease with which terminologies seem to proliferate in this domain is indicative of a lack of consensus and an absence of established disciplinary authority. This proliferation, however, also suggests a diverse range of perspectives from which non-biomedical modalities become interesting to scholarly research. The

semantic plurality that results from these perspectives might not come from a lack of precision or engagement; it might hold the key to unveiling the overlapping conceptual spaces that lay dormant in the literature.

A close look at published papers citing Nigenda et al. (2001) yields an even more diverse set of vocabularies, including natural medicine, national medicine, popular medicine, ethnomedicine, ethnobotany, plant-based medicine, and integrative medicine. These terms are conceptualised against ‘dominant medicine’ and ‘modern medicine’ (Napolitano and Mora Flores, 2003, Han and Ballis, 2007; Waldstein, 2010; Gale, 2014; Olson, 2016). Waldstein (2010) also mentioned *materia medica* as the European codification of medicinal plants both introduced and native to the context of Mexico. There also seems to be dissatisfaction among researchers with existing terminologies; this is largely due to the ideological undertone that informs much of research about the marginalised non-scientific. Reflecting on the evolving status of non-biomedical modalities in the United States, Cassidy (2008) demonstrates how non-biomedical modalities evolved from being referred to as ‘unorthodox’ in the first Chantilly Conference organised by the National Health Institute in 1992 to subsequent labels of ‘alternative’, ‘complementary’ (adapted from the European *Komplementarmedizin*), and most recently, ‘integrative’. What remains unchanged in this decade-long evolution of terminologies in the US, argued Cassidy (2008), is the latent “Us vs. Them” dichotomy which fails to recognise a moral economy that regulates this discourse in favour of the ontological privilege of biomedicine. Furthermore, Murphy et al. (2003) illustrates that optimal retrieval of literature on complementary and alternative medicine is highly difficult due to inconsistent thesaurus use among popular databases. This inconsistency is partly attributable to the fact that terms used to denote non-biomedical modalities are defined differently across different countries and even among different research groups within the same country (Wootton, 2005).

The proliferation of terms in this domain is also reflective of the highly insular discourse that happens on a disciplinary level. Kaptchuk and Eisenberg (2001), for example, developed a taxonomy of what they called ‘unconventional healing practices’. This taxonomy contains two main taxa, namely complementary and alternative medicine (CAM) and parochial unconventional medicine (Fig. 1). They explicitly built this taxonomy based on the level of appeal ascribed to different therapeutic modalities, determined by the size of their subscription base. Based on these criteria, non-biomedical modalities can either appeal to the general public (CAM) or to specific ethnic or religious groups (parochial unconventional medicine). Despite drawing on a diverse set of therapeutic approaches, Kaptchuk & Eisenberg’s taxonomy is constructed from a biomedicine-centric worldview and is heavily motivated by the logic of ‘taming’ patient behaviour. The taxonomy was developed primarily as a guide for physicians to understand patients’ reactions to illness and assist them in ensuring compliance. A taxonomy of this kind is not without its own disciplinary merit; what it fails to recognise however, is the politics of the subject matter at hand. Bates (2000), for example, pointed out that it makes just as much sense to call biomedicine or modern medicine ‘alternative medicine’, given its unique position in history and culture as a therapeutic approach. Recognising the fact that a historical anomaly came to be understood as the ‘standard’ against which all other past and present medical practices are measured does not diminish its worth. Clarifying the historical ontology of biomedicine can help uncover the hegemonic processes that marginalise the medicines which escaped the ‘biomedical turn’, while problematising the modernist fallacy that fails to explain the continuing persistence and popularity of non-biomedical practices.

Elsewhere, Caspi et al. (2003) call for a turn to the patient to combat ‘societal mega-stereotypes’ that permeate the confusions surrounding definitions of CAM. Arguing that it is fallacious to lump hundreds of heterogeneous therapeutic modalities under the same label, Caspi et al. (2003) point out inconsistencies in what constitutes CAM across different US national statistics organisations, among doctors with

Unconventional healing practices: taxonomy with examples

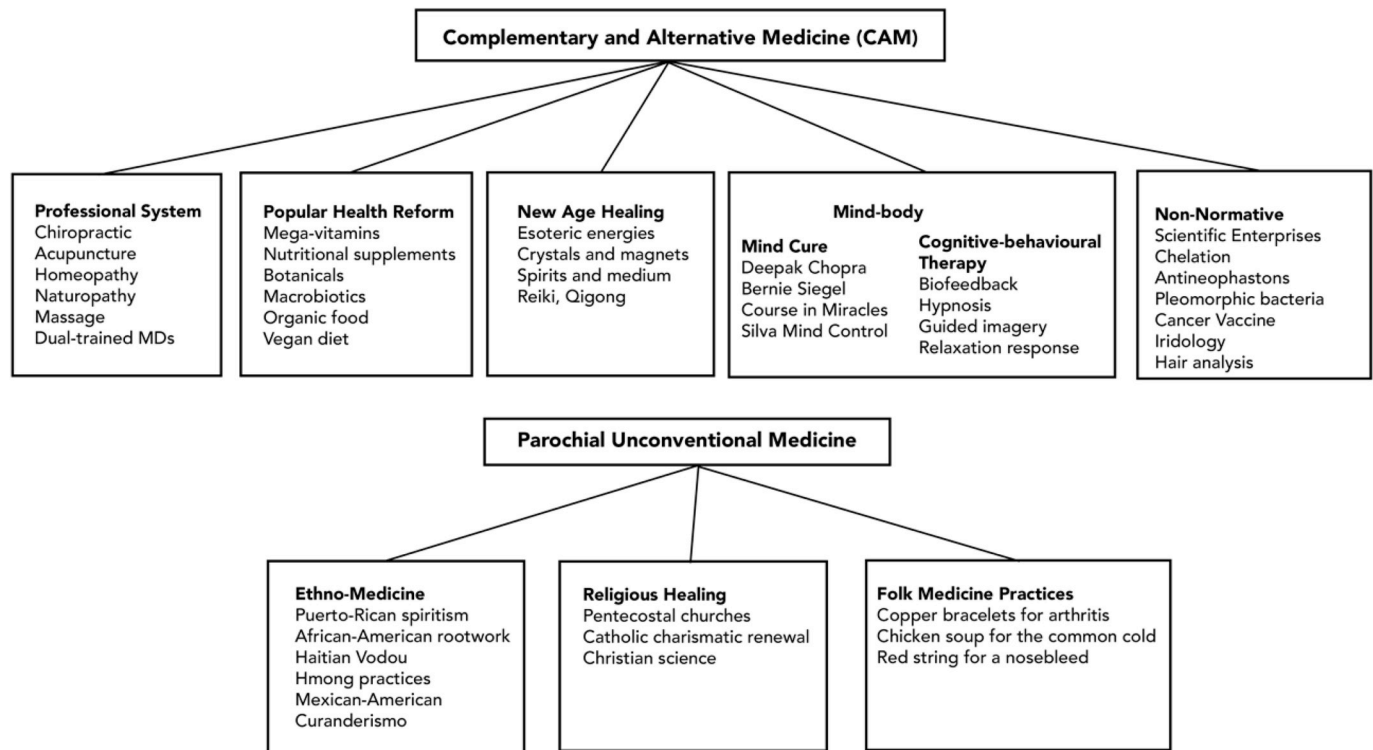


Fig. 1. Reproduced from Kaptchuk and Eisenberg (2001, p.197).

university versus private hospital affiliations, and among laypeople versus experts. Echoing the call to recognise diversity while being precise about the nuances of various medicines' ongoing trajectories, Cassidy (2008) recommends paying attention to specialisation trends within non-biomedical practices, minding the differences in scale that separates modalities from therapies, and referring to specific modalities by their names. Most of these individual names are indicative of the therapeutic cultures in which they are embedded (Ayurveda, *Unani*, *curanderismo*) and their geo-political identities (Traditional Chinese medicine, Southern Vietnamese medicine, Tibetan medicines). This call for viewing non-biomedical modalities as 'things in themselves' highlights the significance of semantics in this domain. The naming and classification of practices are value-ridden activities; their semantic shifts create opportunities for new beneficiaries of these interpretations to emerge.

A decade has passed since Cassidy (2008)'s recommendations on streamlining terminology use were proposed, yet the landscape of scholarly discourse about non-biomedical modalities remains conceptually ambiguous. Templeman, Robinson and McKenna (2015) conducted a study into medical students' conceptualisation of 'complementary medicine' and 'complementary and alternative medicine' within their discourse community only to find that what these terms mean vary depending on context, and once again called for a revisit of terminology use. Concluding that terminology use for complementary medicine is not definitive and that there might never be universal agreement on the meanings of different terms used to describe non-biomedical modalities, they predict, however, that a progression towards the term 'integrative medicine' is inevitable in order to facilitate legitimacy and acceptance of complementary medicines by the medical community (Templeman et al., 2015). However, it remains unclear whether this supposedly inclusive term will be embraced by the scholarly community, how long it will take for this to happen, and what implications this semantic shift will have on knowledge in this area.

The discourse of integration is not without problem; it remains elusive what should be integrated, how this integration should take place, whether the integration has indeed happened, and who should decide the course of this integration.

Our discussion so far has demonstrated a multiplicity of terms that permeates the articulation of non-biomedical modalities in scholarly literature. This multiplicity is fundamentally different from the systematic growth in vocabulary that orders the language of biomedical literature. Foucault (1966) distinguishes between horizontal and vertical articulation in the general grammar of naming. The naming of scientific biomedicine is being articulated horizontally: this is achieved both through the grouping together of common individual specialties and modalities and their sequential generalisation, as well as the infinite subdivision of these groups through evolving distinctions. The articulation of non-biomedical modalities and specialties, on the other hand, is vertical: it is through descriptions of modifications, features, accidents, and characteristics that naming proliferates within this domain. This articulation is formalised through the predominant 'adjective + medicine' convention that seems to have been taken for granted. While horizontal articulation lends itself to taxonomy and nomenclature through increasing generalities and specificities, vertical articulation is substantive: it creates names that subsist by themselves in discourse. Structuring and ordering the vertical articulation of non-biomedical modalities are not straightforward tasks; they are important tasks nevertheless, as a discourse overburdened by a multiplicity of terms is also one riddled with confusion.

A more systematic approach to analysing the conceptual landscape of literature on non-biomedical terminologies is due. In a space where universal consensus seems unattainable and terminology proliferation is the norm, it is useful to map out how these terminologies and their associated conceptual networks emerge and relate to each other using quantitative methods. By visualising the problematic socio-cognitive networks of these contested terminologies, dormant domains of

meaning and conceptual spaces are excavated and brought to life. This mapping exercise also helps substantiate and clarify the separation that exists between biomedicine and non-biomedicine within scholarly literature: the degrees of their separation, their boundaries, features within their territories, and any bridges that link them together.

A systematic mapping exercise of this nature requires systematic literature retrieval. Our thematic discussion so far has provided us with 18 common terminologies used in literature. These terminologies are alternative medicine, traditional medicine, herbal medicine, complementary medicine, *materia medica*, integrative medicine, ethnobotany, ethnomedicine, natural medicine, faith healing, popular medicine, indigenous medicine, national medicine, plant-based medicine, religious healing, unconventional medicine, nonbiomedical modalities, and unorthodox medicine. These terms relate to each other on a systemic level: they are referred to either in the same document, or in documents citing one another. These terms therefore could be used as search terms for a systematic retrieval of literature. The corpus generated from this systematic retrieval can in turn be analysed quantitatively, allowing us to operationalise discursive structures underpinning the production of knowledge in this field.

2. Methods

This paper conducts systematic mapping of the extant literature referencing non-biomedical therapeutic modalities by adopting a network approach. A structured search of document keywords, titles, and abstracts from 1987 to 2017 was conducted on Scopus using 18 search terms. Scopus is the largest citation and abstract database of peer-reviewed literature. The strings entered for this search are “alternative medicine”, “traditional medicine”, “herbal medicine”, “complementary medicine”, “*materia medica*”, “integrative medicine”, “ethnomedicine”, “natural medicine”, “faith healing”, “popular medicine”, “indigenous medicine”, “national medicine”, “plant-based medicine”, “religious healing”, “unconventional medicine”, “nonbiomedical*” “unorthodox medicine”. It is estimated that Scopus covers around 69 million records of literature spanning the life sciences, social sciences, physical sciences, and health sciences (Elsevier, 2017).

From the structured search, a dataset of 17,613 bibliographic records was generated. The dataset was retrieved on September 31, 2018. These records represent the contemporaneous scientific corpus produced by the most recent generation of researchers over the past 30 years. The dataset contains the following elements: author name, author affiliation, publication title, year of publication, journal title, abstract, keywords provided by publication authors, keywords indexed by Scopus, and citation count. Only the most cited 2000 records for each search term were exported due to restrictions imposed by Scopus. There are seven search terms that returned more than 2000 records. Table 1 provides an overview of the dataset. Duplicate records from these separate queries were removed; there were 1472 duplications. This corpus is made up of the most cited scientific publications in the field that is commonly known as traditional, complementary and alternative medicine (TM/CAM). A variety of bibliometric analyses can be conducted on such a dataset, including word frequency analysis, citation analysis, co-word analysis, simple document counting (Thelwall, 2008), and semantic title-abstract-keyword content analysis (Meyer and Schroeder, 2009). Fig. 2 plots the number of publications for each search term over time.

The researcher conducted a co-word analysis (Callon et al., 1983, 1986, 1991) on the keywords collected from the dataset. Co-word analysis, whose theoretical roots trace back to actor-network theory, is a method widely used in bibliometric and scientometric studies (He, 1999; Börner et al., 2003; Yang et al., 2012; Igami et al., 2014). Co-word analysis was developed partly in response to the limitations of co-citation analysis, which tends to overemphasise highly focused ‘specialty areas’ in scientific research where knowledge transformations are sudden and radical (Callon et al., 1983). Co-word analysis has been

used for a variety of research purposes, including knowledge discovery (He, 1999; Ronda-Pupo and Guerras-Martin, 2012; Lv et al., 2018), hypothesis generation (Stegmann and Grohmann, 2003), and mapping intellectual structures of scientific disciplines (Ravikumar et al., 2015; Flis and van Eck, 2018; Corrales-Garay et al., 2018). Co-word analysis is an effective quantitative method to account for the heterogeneity of actors and concepts involved in problematic networks of knowledge. In carrying out co-word analysis we can identify certain patterns of clustering among and between the scientific papers recorded in the current corpus; by subsequently performing a semantic content analysis we can see which thematics appear as prevalent in each of these clusters. Within the corpus, certain forms of clustering around particularly dominant keywords can be observed; within those clusters, we can also observe some semantic affinities (see Fig. 3).

There are two types of keywords in this dataset: keywords provided by publication authors (author keywords), and keywords provided by Scopus (index keywords, or subject headings). Scopus assigns subject headings to both individual publications and the journals in which they are published (Elsevier, 2017). Scopus claims to manually index 80 per cent of the publications it stores, using seven separate controlled vocabularies/thesauri (Elsevier, 2017). Inclusion of all subject headings provides an added layer of translation imposed upon relevant modalities, which is suitable to the purpose at hand. Indexing as a socio-cognitive practice does not generally aim at summarising document content; the objective is to identify interests relevant to different specialists (Callon et al., 1983, 1991). Both types of keyword therefore act as active translation operators that define conceptual domains while establishing their relationships with a series of other domains. As a result, networks constructed from these translation operators provide a map of inscriptions, and a map of chosen inscriptions in turn provides an insight into the ontologies so inscribed. These ontologies are important in the construction of the socio-cognitive foundations of diverse scientific communities.

Co-word analysis of 890 keywords which co-occurred at least 40 times across 17,613 bibliographic entries results in four conceptual clusters, as shown in Fig. 3. While depth is lost when working with such a large data set, there are gains in terms of mapping the topography and patterns of publication in this field. The semantic topography produced as a result of this co-word analysis (Fig. 3) was generated using VOS-Viewer (van Eck & Waltman, 2009a, 2017). VOSViewer is an application widely used in scientometric. VOSViewer generates two-dimensional maps by combining two techniques: mapping and clustering. The mapping technique employed in this program is called VOS, which is closely related to multidimensional scaling (van Eck et al., 2010). The clustering technique employed in this program is closely related to modularity-based clustering (Waltman et al., 2010; van Eck and Waltman, 2017). The result is a map that illustrates the relatedness of keywords as translation operators in two dimensions: distance (mapping) and colour (clustering). Keywords that share the same colour (belonging to the same cluster) appear more frequently together than keywords that have a different colour. The distance between keywords is constructed based on the software's built-in attraction and repulsion parameters; the closer two keywords are on the map, the more closely related they are to each other.

3. Research findings

3.1. Descriptive results

An overview of the dataset is presented in Table 1, sorted by number of results. From the table, we can see that traditional medicine, alternative medicine, and herbal medicine are the most used terms in literature. Additionally, they share the same most cited paper; this paper is also the most cited paper in the dataset. This triple popularity signals the dominant narrative in scholarly discourse on non-biomedical therapeutic modalities. This narrative presents non-biomedical modalities

Table 1
Overview of results.

Strings entered	Results	Most cited paper	Citations
“Alternative medicine”	38833	Trends in alternative medicine use in the United States, 1990–1997: Results of a follow-up national survey Eisenberg, D.M., Davis, R.B., Ettner, S.L., (...), Van Rompay, M., Kessler, R.C. 1998 Journal of the American Medical Association 280(18), pp. 1569–1575	5368
“Traditional medicine”	33444	Trends in alternative medicine use in the United States, 1990–1997: Results of a follow-up national survey Eisenberg, D.M., Davis, R.B., Ettner, S.L., (...), Van Rompay, M., Kessler, R.C. 1998 Journal of the American Medical Association 280(18), pp. 1569–1575	5368
“Herbal medicine”	29234	Trends in alternative medicine use in the United States, 1990–1997: Results of a follow-up national survey Eisenberg, D.M., Davis, R.B., Ettner, S.L., (...), Van Rompay, M., Kessler, R.C. 1998 Journal of the American Medical Association 280(18), pp. 1569–1575	5368
“Complementary medicine”	4886	Use of complementary and alternative medicine in cancer patients: A European survey Molassiotis, A., Fernandez-Ortega, P., Pud, D., (...), Kearney, N., Patiraki, E. 2005 Annals of Oncology 16(4), pp. 655–663	564
“Ethnobotany”	4788	Medicinal plants: Traditions of yesterday and drugs of tomorrow Gurib-Fakim A. 2006 Molecular Aspects of Medicine, 27(1) pp.1–93	739
“Materia medica”	4470	Lead, mercury, and arsenic in US- and Indian-manufactured Ayurvedic medicines sold via the internet Saper, R.B., Phillips, R.S., Sehgal, A., (...), Thuppil, V., Kales, S.N. 2008 JAMA - Journal of the American Medical Association 300(8), pp. 915–923.	261
“Integrative medicine”	3781	Effectiveness of acupuncture as adjunctive therapy in osteoarthritis of the knee. A randomised, controlled trial Berman, B.M., Lao, L., Langenberg, P., (...), Gilpin, A.M.K., Hochberg, M.C. 2004 Annals of Internal Medicine 141(12), pp. 901–910 + I-20	404
“Ethnomedicine”	1546	Phytochemical constituents of some Nigerian medicinal plants Edeoga, H.O., Okwu, D.E., Mbaebie, B.O. 2005 African Journal of Biotechnology 4(7), pp. 685–688	828
“Natural medicine”	1163	Natural medicines used in the traditional Chinese medical system for therapy of diabetes mellitus Li, W.L., Zheng, H.C., Bukuru, J., De Kimpe, N. 2004 Journal of Ethnopharmacology 92(1), pp. 1–21	524
“Faith healing”	702	Complementary and alternative medicine use among adults: United States, 2002. Barnes, P.M., Powell-Griner, E., McFann, K., Nahin, R.L. 2004 Advance data (343), pp. 1–19	1195
“Popular medicine”	627	Antioxidant properties of natural compounds used in popular medicine for gastric ulcers Repetto, M.G., Llesuy, S.F. 2002 Brazilian Journal of Medical and Biological Research 35(5), pp. 523–534	335
“Indigenous medicine”	342	Sesquiterpene lactones specifically inhibit activation of NF- κ B by preventing the degradation of I κ B- α and I κ B- β Hehner, S.P., Heinrich, M., Bork, P.M., (...), Dröge, W., Schmitz, M.L. 1998 Journal of Biological Chemistry 273(3), pp. 1288–1297	323
“National medicine”	201	Poor-quality antimalarial drugs in southeast Asia and sub-Saharan Africa Nayyar, G.M.L., Breman, J.G., Newton, P.N., Herrington, J. 2012 The Lancet Infectious Diseases 12(6), pp. 488–496	172
“Plant-based medicine”	172	Natural products as α -Amylase and α -Glucosidase inhibitors and their hypoglycaemic potential in the treatment of diabetes: An update Tundis, R., Loizzo, M.R., Menichini, F. 2010 Mini-Reviews in Medicinal Chemistry 10(4), pp. 315–331	194
“Religious healing”	140	Varieties of healing. 2: A taxonomy of unconventional healing practices Kaptchuk, T.J., Eisenberg, D.M. 2001 Annals of Internal Medicine 135(3), pp. 196–204	115
“Unconventional medicine”	127	Unconventional Medicine in the United States – Prevalence, Costs, and Patterns of Use Eisenberg, D.M., Kessler, R.C., Foster, C., (...), Calkins, D.R., Delbanco, T.L. 1993 New England Journal of Medicine 328(4), pp. 246–252 3273	3275
Nonbiomedical*	49	Do illness perceptions predict health outcomes in primary care patients? A 2-year follow-up study Frostholt, L., Oernboel, E., Christensen, K.S., (...), Weinman, J., Fink, P. 2007 Journal of Psychosomatic Research 62(2), pp. 129–138	82
“Unorthodox medicine”	17	Screening of crude extracts of six medicinal plants used in South-West Nigerian unorthodox medicine for anti-methicillin resistant <i>Staphylococcus aureus</i> activity Akinyemi, K.O., Oladapo, O., Okwara, C.E., Ibe, C.C., Fasure, K.A. 2005 BMC Complementary and Alternative Medicine 5,6	171

Number of publications across different terminologies, 1987 - 2017

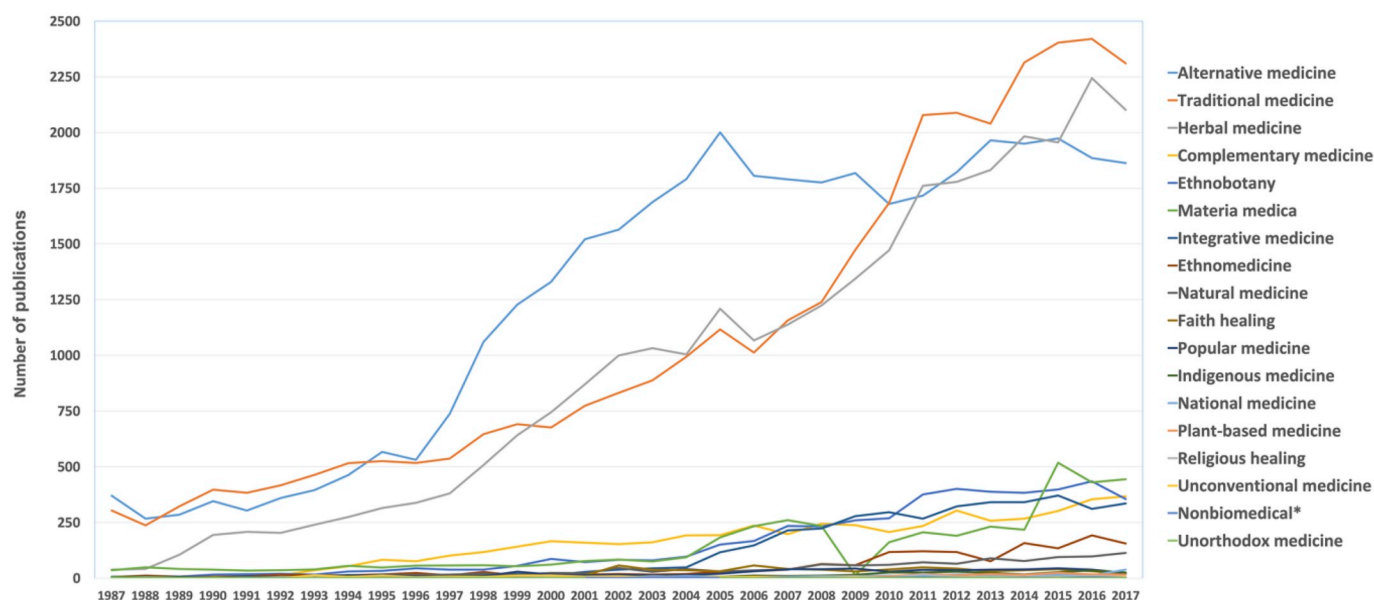


Fig. 2. Number of publications across different terminologies, 1987–2017.

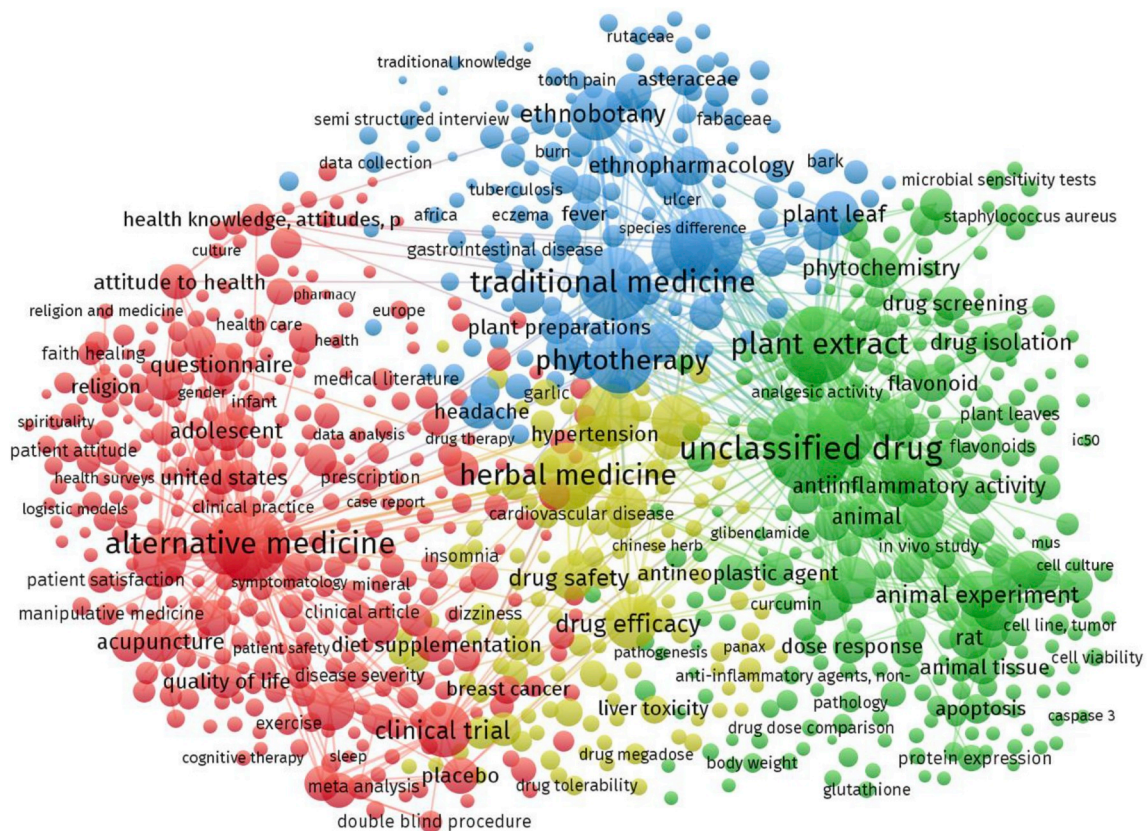


Fig. 3. Semantic topography of non-biomedical modalities.

in ideological terms (“alternative” – circumscribing an undefined ‘otherness’), against teleological scientific progress (“traditional” – reminiscing of a pre-modern cultural past), and against systematic scientific experimentation (“herbal” – evoking a kind of crudeness that diametrically opposes synthetic pharmaceutical biomedicine).

The next trio in Table 1, namely complementary medicine, ethnobotany, and *materia medica*, return significantly fewer records. These terms signal the ‘scientisation’ of non-biomedical modalities that are common to both Western and non-Western contexts. This ‘scientisation’ is manifested through acknowledging uses of natural resources prior to the advent of science (“*materia medica*”) while giving them legitimacy only within the confinement of scientific medical discourse (“complementary” and “integrative”).

In terms of citation count, the three most cited papers in the table, pertaining to five different keywords and outperforming the rest by a large margin, are written about the United States. This could be indicative of what Graham et al. (2011) characterised as the dominance of the Anglosphere, particularly the United States, in scholarly publishing.

As can be seen from Fig. 2, the overall trend for all 18 terms are upward. This means that all existing terms, regardless of their prevalence in literature, are expanding their territories. While it might be the case that recent publications are better recorded than those published 30 years ago, all existing terms nevertheless continue to be used across disparate literature. Finally, the uniform downward trend across all terms in 2017 might be a result of Scopus's latency in indexing latest data at the point of retrieval in September 2018. Scopus does not include newest unindexed materials from PubMed, which might also explain these results (Elsevier, 2017).

3.1.1. Co-word analysis results

Fig. 3 presents the semantic topography of non-biomedical modalities as a result of co-word analysis. The weight of each concept –

visualised by the size of each corresponding node – represents its total link strength. Total link strength is defined as the sum of the number of links a node shares with all other nodes in the network. Clusters are determined by the association strength method (van Eck and Waltman, 2009b), a probabilistic measure which normalises co-occurrence data to calculate direct similarity. Concepts that belong to the same cluster are represented in the same colour; they co-occur more frequently than those outside their cluster. The most densely populated cluster is marked in red (344 nodes), followed by green (275 nodes), blue (149 nodes), and finally yellow (122 nodes). These clusters are numbered from 1 to 4, respectively. Not all nodes are visible in Fig. 3 due to the limits of two-dimensional visualisation.

Concepts with the highest number of links are considered the most central/influential within their respective clusters. These nodal modalities are: alternative medicine (cluster 1), unclassified drug (cluster 2), herbal medicine (cluster 3), and traditional medicine (cluster 4). ‘Unclassified drug’ was not included in the original search strings; however, our analysis indicates that it is one of the most used terms in literature. For our purpose, clusters 1–4 are hereafter named after their nodal modalities – their most influential concepts.

The clustering techniques employed were such that cluster membership of each node is probabilistic rather than categorical (soft clustering), with no subcluster partitioning (flat clustering). The following analysis complements these techniques by interpreting each cluster and its associated concepts qualitatively.

3.1.1.1. Alternative medicine. Alternative medicine is the most influential concept both within its cluster and within the overall network. It is also the concept with the most associated non-biomedical modalities, namely complementary medicine, complementary therapies, complementary and alternative medicine, integrated medicine, faith healing, holistic care, manipulative medicine, and religious healing. These modalities can be understood

as belonging to the same conceptual level; they are umbrella terms that designate therapeutic modalities existing outside of mainstream biomedicine.

This cluster also features terms that describe more specific modalities. These terms include acupuncture, acupressure, allopathy, aromatherapy, Ayurveda, chiropractic, diet therapy, homeopathy, hypnosis, kinesiotherapy, naturopathy, osteopathy, and tai chi. The countries and continents featured in this cluster are Australia, Canada, China, Israel, Japan, the UK, the USA, Europe, and Asia. As we shall see later on, this is in stark contrast with the geopolitics associated with unclassified drug and traditional medicine clusters.

Also featured in this cluster are names of disease and condition. These include breast cancer, breast neoplasms, chronic diseases, chronic pain, depression/depressive disorder, fibromyalgia (muscle pain)/low back pain, HIV infections, mental disease & disorders, mood disorder, musculoskeletal disease, and osteoarthritis. It can be seen that some of these diseases and conditions are gendered and aged; some, such as HIV and depression, are more politicised than others.

Alternative medicine research also appears to be very patient-oriented. This is reflected through the presence of keywords such as attitudes, patient satisfaction, surveys, questionnaires, and quality of life in this cluster. This character distinguishes alternative medicine as a conceptual cluster from clusters such as traditional medicine and herbal medicine, which are more disease-oriented and plant constituent oriented.

3.1.1.2. Unclassified drug. Unclassified drug as a term is in itself a novel finding; it was not included in the original search strings. Unclassified drug encapsulates a distinctly biomedical approach to studying non-biomedical modalities, as it signifies an untamed ‘other’ that evades the task of scientific ordering. A majority of terms associated with unclassified drug are biochemical, such as acetic acid ethyl ester, antibacterial agent, antidiabetic activity, antifungal agent, artemisinin (antimalarial agent), and hyperglycemia. As such, unclassified drug represents the interests of pharmacology in non-biomedical modalities. This cluster also features the complete scientific process in its set of terms, namely targeting, identifying, evaluating, isolating, screening, and synthesising drugs for pharmaceutical use. There is no occurrence of terms denoting geographical location anywhere in this cluster; it is as if the workings of biomedical scientific discovery are independent of the geopolitical structure which haunts those who escape laboratories and randomised controlled trials. Two non-biomedical modalities featured in this cluster are natural medicine and Ayurvedic medicine. Natural medicine as a term is emblematic of the nature vs. science dichotomy; this is consistent with the overall narrative of the term unclassified drug. The presence of Ayurvedic medicine in this cluster signifies its unique credence in pharmacology. This will be further explored in the Discussion section. The absence of geography descriptors in this cluster suggests that this credence, however, seems to be detached from the larger socio-cultural and political discourse surrounding the legitimacy of medical traditions.

The diseases and conditions associated with unclassified drugs include cancer, diabetes, liver injury, and diseases related to metabolism. Within this cluster, these diseases and conditions are mentioned not only in relation to treatment, but also prevention and protection – particularly with regards to cancer and liver conditions.

3.1.1.3. Herbal medicine. Herbal medicine, contrary to unclassified drugs, is firmly grounded in the geopolitics of medical traditions. *Materia medica*, an old-fashioned term that designates the branch of academic study which precedes modern pharmacology (Whyte et al., 2002), is featured in this cluster. Other terms include Ayurvedic drug, Chinese drug/herb/medicine, and traditional Chinese medicine. These terms refer to two medical traditions whose development date back to antiquity and the medieval period, and as such comparable to European medical systems.

The diseases and traditions associated with herbal medicine include anxiety disorder, cancer (particularly colorectal, lung, and prostate cancer), dementia, fatigue, heart infarction, hypercholesterolemia, hyperlipidemia, insomnia, irritable colon, liver cirrhosis, liver toxicity, malignant neoplastic disease, menopause, obesity, Parkinson disease, rheumatoid arthritis, sleep disorder, and xerostomia (dry mouth syndrome). There seems to be a more pronounced intersection between age and gender in the diseases within this cluster.

3.1.1.4. Traditional medicine. Traditional medicine as a cluster features the highest number of diseases and conditions. These include abdominal pain, allergy, anemia, arthritis, asthma, backache, bronchitis, influenza/the common cold, constipation, diabetes, diarrhea, dysentery, dyspepsia (indigestion), eczema (rash), epilepsy, fever, flatulence, gastrointestinal disease, headache, heart disease, haemorrhoid, hepatitis, malaria, migraine, neurologic disease, pneumonia, pruritus (skin itch), respiratory tract disease, tooth pain, and tuberculosis. This is a diverse set of diseases and conditions, which may reflect the semantic malleability of the word “traditional” within the ‘traditional vs. modern’ dichotomy. This is the only cluster that does not feature cancer in its midst.

Other non-biomedical modalities in this cluster include ethnobotany, ethnomedicine, ethnopharmacology, folk medicine, indigenous knowledge, medicinal plants, and traditional knowledge, and African medicine. There is also a diverse set of countries and continents featured in this cluster, including Brazil, India, Iran, Italy, Mexico, Nigeria, Pakistan, Spain, Turkey, Africa, and South America. There is no English-speaking country featured in this collection of geographic descriptors; this is in contrast with those featured in the alternative medicine cluster. Alternative medicine might be a construct more popular to the Anglosphere, where non-biomedical modalities are primarily studied under the framework of integration and/or isolation. By contrast, ‘traditional medicine’ seems to be used in contexts where integration and isolation are not the sole strategies of meaning-making. In countries where non-biomedical modalities enjoy a less subjugated status, ‘traditional’ as a substantiator is invoked both as an ode to historical discontinuities and as a political gesture – particularly in the case of postcolonial states and continents, such as India, Pakistan, and Africa.

4. Discussion

Five main themes of discussion emerge from our analysis of the main semantic map and its complementary chart of publications over time (Figs. 2 and 3). These themes are (i) the overall expanding territories of all four knowledge domains, (ii) boundary and proximity of each domain in relation to each other, (iii) the geography of knowledge production in this area, (iv) methodological pitfalls encoded in terms used, and (v) the disconnection of cancer from traditional medicine as a domain. These themes substantiate the original definition of non-biomedical modalities as existing in separation but not isolation from biomedicine – a term much better equipped to reflect the state of literature on medical practices and knowledge at the margin of scientific medical knowledge.

The first theme concerns the overall upward trend of all existing terms used to describe non-biomedical modalities in the corpus; despite widespread recognition of the problematic nature of these terms, they continue to be used and referenced across different disciplines. While terms such as alternative medicine, traditional medicine, and herbal medicine have seen their popularity fluctuate over time, they remain the most influential nodes around which knowledge within this domain is organised. This finding resonates with what Daston and Gallison (2007) observe to be the surprising longevity of scientific epistemic virtues, in which concepts and methods do not usually replace each other like “succession of kings” (p.111). They instead accumulate into a repertoire of possible forms of knowing. As long as there are urgent

conceptual challenges to the acquisition and securing of knowledge that can be addressed through existing forms of knowing, concepts and methods would not become extinct; they would emerge and evolve. In this sense, knowledge production about non-biomedical modalities within scholarly literature written in the English language resembles problematic networks that span ‘webs of interest’, which stabilise over time while constantly expanding and adjusting for the sake of their own survival. This process is vital to acquiring knowledge in scientific practices. The biases encoded in these terminologies will most likely carry themselves well into the future; their meanings and connotations, however, will also shift with time as emerging concepts become connected to their networks of meaning.

Foucault (1966) noted in his discussion on naming and representation that when a discourse seizes upon the adjective to designate not only modifications to meanings but also the very substance of its main propositions, as is the case with the nature of scholarly discourse on non-biomedical modalities, the adjective becomes substantial rather than qualifying. The noun, which would otherwise be articulating substance, behaves like an accident within this discourse; it has become adjectival. Be it traditional, alternative, complementary, herbal, natural, integrative, or indigenous – the adjectives used to describe therapeutic modalities within this knowledge domain seem to overshadow the modalities themselves. One way to disrupt this discourse is to discard the ‘adjective + medicine’ formula altogether by coopting the horizontal articulation that has defined the scientific discourse of biomedicine, in favour of the term non-biomedical modalities.

The second theme concerns the boundaries among different knowledge clusters within this semantic landscape, as well as their relative proximity to each other. We can see from the map that traditional medicine, herbal medicine, and unclassified drug, together with their associated concepts, are closer to each other than they are to alternative medicine and its associated cluster. This is somewhat counterintuitive, considering how unclassified drug both as a term and as a cluster stands out from the rest of the map semantically: the publications within its population mostly reside within the biomedical domain, feature biochemical jargon, and give no mention to geographical locations. There is a kind of ‘placelessness’ that sanitises scientific practices in laboratories. This finding substantiates the original definition of non-biomedical knowledge as existing in separation, but not isolation, from scientific biomedical knowledge. While traditional medicine and herbal medicine attach themselves more closely to unclassified drug, which acts as a bridge between the biomedical domain and its non-biomedical counterpart, alternative medicine seems to have gained a more independent, though not completely secluded, position in relation to the biomedical domain.

From a semantic perspective, this has a number of implications: it is almost as if non-biomedical modalities could claim a more equal footing once they become an ‘alternative’ to mainstream biomedicine. This signifies a discourse of ‘choice’ that grants the patient at once the freedom and responsibility to manage their own state of health. This finding also resonates with the ethos of the majority of healthcare legislative bodies and subsequent legislations introduced in the West. Since the late 1970s, including the Dutch Commission on Alternative Systems of Medicine in 1977, the Swedish Minister of Health’s Alternative Medicine Committee formed in 1984, the Victorian Parliament Social Development Committee’s ‘Inquiry into alternative medicine and the health food industry’ reporting in 1986 in Australia, the United States Congressional Subcommittee, Subcommittee on Departments of Labor, Health and Human Services, Education, and Related Agencies’ hearings on ‘Alternative medicine’ in 1993; the Norwegian Ministry of Health and Social Affairs’ ‘Public Assessment of Alternative medicine’ from 1998; House of Lords Select Committee on Science and Technology report on ‘Complementary and Alternative Medicine’ in 2000, the USA’s White House Commission on Complementary and Alternative Medicine reporting in 2002, and a Ministerial Advisory Committee’s report on ‘Complementary and

Alternative Health Care in New Zealand’ for the Minister of Health in 2004. This shift in language use also coincides with what Wahlberg (2007) characterises as a shift in regulatory discourse in the UK during the closing decades of the 20th century. The battleground of good vs. bad medicine has shifted to the ethical domain of practitioner qualification and conduct; it has moved away from the epistemological domain of the late 19th and early 20th century as well as the commercial domain of miracle cures and patent medicine of the 18th and 19th century (Wahlberg, 2007). This could partially explain the significant wealth of the alternative medicine domain within our map. Alternative medicine is the domain with the most number of publications, the most number of connections, the most bridges that link it to the rest of the map, and is the furthest away from the second wealthiest domain in this landscape – unclassified drug – in an almost polarising fashion. What Wahlberg (2007) observes to be a turn to the practitioner in the discourse on non-biomedical practices might have evolved to repulse discursive themes that precede this turn. These themes are that of epistemology (with unclassified drugs being a translation operator) and commercial opportunity (with traditional medicine and herbal medicine as translation operators). This also suggests that the ethical and epistemological domains of current scholarly literature on non-biomedical practices seem to have diverged from each other.

The third theme concerns the geography of knowledge production, as evidenced in the previous section. Apart from unclassified drug, all other knowledge clusters are firmly grounded in their geographical context. This represents a kind of geographical stickiness which contextualises knowledge about non-biomedical modalities. While herbal medicine as a cluster is associated exclusively with Ayurvedic and Chinese medicines, alternative medicine is used in literature about the West and Asia. Traditional medicine, on the other hand, is used alongside a more eclectic set of geographical descriptors. Herbal medicine and *materia medica* have a unique evocation of materiality; they encapsulate therapeutic substances that possess exchange value, whose commodity careers are disrupted and displaced by commercially manufactured synthetic drugs. Foundational texts of the Ayurvedic tradition as well as Chinese Shen-nung’s scripture on *materia medica* dating from the first millennium of our era both contain hundreds of medicinal recipes and descriptions of therapeutic substances (Whyte et al., 2002, Unschuld, 1988). The spread of biomedical pharmaceuticals to India and China was rapid and far-reaching after World War II; antibiotics were imported to China during the 1950s (Dong et al., 1999), while by the 1960s antibiotics were incorporated in the *materia medica* of Ayurvedic practitioners in India (Taylor, 1976). This materiality also designates the terms and conditions for counterflows; the popularisation of Ayurveda in the West has come hand in hand with the reduction of this tradition to a mere supplier of pharmaceutical products – a process Banerjee (2008) describes as the ‘pharmaceuticalisation’ of Ayurveda. In the United States, where roughly one in five adults uses herbal medicine, the standardisation of complex Chinese herbal formulations has also been substantially linked to the discourse on regulation, efficacy, and safety (Bent, 2008). This narrative mirrors that of ‘unclassified drug’.

This narrative of therapeutic materiality does not extend to terms like ethnobotany, ethnomedicine and ethnopharmacology – which all belong to the traditional medicine cluster. This is our fourth theme of discussion – that of a methodological nature. Whyte et al. (2002) observe that ethnopharmacology as a field focuses on the biochemical properties and effects of indigenous medicines while accounting for people’s own conception about these modalities, whereas ethnomedicine as an approach places primary value on contextualisation. Studies conducted using this approach usually situate therapeutic modalities within the cosmology, ritual, and knowledge of particular ethnic groups. Whyte et al. (2002) argue that a major weakness of ethnomedicine is its presentation of context as integrated tradition; this is an analytical move that portrays culture and society as static and homogenous. It is no coincidence, then, that these terms are clustered around

‘traditional medicine’. ‘Traditional medicine’ carries a sense of fixity that stabilises pre-modern cultures of therapy as rigid and unchanging, while simultaneously being disorderly and excessively repetitive. This conceptualisation opens up the possibilities of scientific innovation and disruption. Confined to a discourse constructed on an opaque temporality, traditional medicine and its associated *ethno-x* are caught in an intricate web of contextual sense-making that seems to absolve them of their materiality.

This brings us to our last theme of discussion, which concerns the disconnection of cancer from the traditional medicine cluster. As mentioned in the previous section, traditional medicine is the only cluster in which no occurrence of ‘cancer’ or any variation thereof is included in the current map. This does not mean that there exists no publication in the dataset wherein ‘cancer’ and ‘traditional medicine’ occur together; these terms do not, however, co-occur with a frequency significant enough for their relationship to be represented on the map.

Cancer is a disease as old as tradition itself; ancient Greek medical treatises of tumour formation and its therapeutic methods date back to the Hippocratic corpus and Galenic medicine (Karpouzilos and Pavlidis, 2004). The word “tumour” (瘤) in Chinese appeared in prehistoric cave carvings in North-West China as far back as 1000BC, while a more technical word for tumour (癌) appeared around 1200AD, describing ulcerative lumps and occurrences of sinuses and fistulae (Li, 1996; Bao et al., 2006; Leung et al., 2007). Ayurvedic classics developed an elaborate vocabulary to describe cancer, with *granthi* referring to minor neoplasm and *arbuda* referring major neoplasm. They also used a range of terms to refer to benign neoplasm (*vataja*, *pittaja* and *kaphaja*) and malignant tumours (*tridosaja*) (Balachandran & Govindarajan 2005). Despite its old age, cancer is an increasingly technologised disease. Since the 1970s, biomedical diagnosis of cancer has been infused with modern technologies, thanks to significant progress made in ultrasound (sonography), computed tomography (CT scans), magnetic resonance imaging (MRI scans) and positron emission tomography (PET scans). As a result, biomedical treatment of cancer has grown to include technologically sophisticated methods such as cryosurgery (the use of liquid nitrogen spray to freeze and kill cancer cells), the use of lasers to cut the tumour tissue of cervix, larynx, liver, rectum, skin and other organs, chemotherapy, hormonal therapy, radiation therapy, and immunotherapy (Sudhakar, 2009). Progress in cancer nanotechnology promises advances in early detection, diagnostics, prognostics, as well as more targeted treatment with nanovectors and more precision in the patterning of surfaces with imaging moieties (Halappanavar et al., 2018). Biomedical technologies, through magnifying the ‘visibility’ of cancer, exercise a kind of panoptic disciplinary power that fixes a space for the disease as dwelling inside the body. This is a space juxtaposed to other spaces – a body-technological space.

Tradition, deriving from the Latin word *tradere* meaning ‘to hand over’ or ‘deliver’, originally referred to the passing on of knowledge or doctrine. The word therefore had an original emphasis on the process of distribution; this meaning, however, was slipped into a more static focus on what was being distributed as tradition became associated with issues of right, duty, authority, and respect (Scheid, 2007). Traditions have the ability to assert historical continuity as a sense of connection with the past through repetition of norms, values, and behaviours. The invention of tradition, however, is an activity that persists well into modernity. The products of this invention are “responses to novel situations which take the form of reference to old situations, or which establish their own past by quasi-obligatory repetition” (Hobsbawm and Ranger, 2012, p.2). One might argue that cancer leaves little space for traditions, invented or genuine, since the disease as an experiential entity has become at once familiar and alienated.

4.1. Limitations

There are three main limitations with the semantic mapping of literature conducted in this paper. Firstly, the mapping was conducted on

a corpus of the most cited scientific publications in the field of TM/CAM indexed by Scopus, generated through the use of 18 search terms collected from a qualitative review of literature. The corpus is an artefact constructed from these systematic analytical choices, and as such operationalises a discourse found in the specific literature retrieved. Although containing a substantial number of records (over 17,000 articles), the corpus is not exhaustive. Secondly, the current corpus only includes English-language scholarly articles. English-language literature is by far the most systematically recorded body of literature through large databases, which enable the structured querying, retrieval, and processing necessary for co-word analysis. However, there is space for future research to incorporate non-English literature into a similar semantic analysis. Finally, there might be merit in conducting systematic mapping of literature using multiple databases for comparative and complementary purposes. In addition to Scopus, future research might incorporate literature retrieved from other indexing services, such as Web of Science and Google Scholar (GS). It is worth noting that even though GS is the only ‘big data’ academic literature system to date with highly extensive coverage, it is also the most limited in its capacity to export bibliometric data, and also the most opaque in indexing mechanism. GS’s strict query rate limits, proprietary ranking algorithm, and lack of a master list of sources are major barriers to sustainable data mining using this service.

5. Conclusion

By employing a network approach, this paper has mapped the various terms in the literature on non-biomedical modalities into four clusters: alternative medicine, unclassified drugs, herbal medicine, and traditional medicine. The map produced here is original in that it is data-driven; it is different from existing, qualitatively constructed classifications and taxonomies in that it relies very little on interpretation. As such, the current approach does not leave a lot of room for nuance. Instead, it is a precursor to interpretation; counting and probabilistic modelling are useful insofar as a large amount of data is handled efficiently, and whose themes can be shown with high reliability and replicability. The clustering presented in this paper claims to neither be definitive nor exhaustive. It is, however, a rigorous map with which to navigate the highly complex and interdisciplinary literature on non-biomedical traditions and practices.

Terminologies are not value-free conventions of speech; their utterance spins webs of meanings that presuppose the act of saying itself, whose convergence and intersection reflect and reshape academic discourse as it produces its subject. This paper suggests that non-biomedical modalities, defined as therapeutic modalities that exist in separation but not isolation from biomedicine, is a term much better equipped to reflect the current state of literature on therapeutic modalities that exist at the margin of scientific medicine. While the term itself does not resolve issues of power imbalance that exist between the scientific and the non-scientific, it helps bring these issues to the fore. The term also better captures the historical disruption that biomedicine both as a scientific discipline and as a mechanism of body surveillance came to solidify modernity around the world. The term therefore highlights the interaction between ‘bio’ and ‘medicine’ through the invisible hyphen that no longer seems to separate the two; it serves to remind us that biomedicine and its technologies are a very specific, and rather recent, episode in the history of medicine. Through its visible hyphen, however, the term highlights the continuity of medical practices that persist at the margin of the scientific enterprise as they continue to evolve and transform themselves through their interaction with biomedicine. It is through this duality that the term non-biomedical invites a critical mode of engagement that might otherwise be easily overlooked – one that allows science to further its commitment to fidelity to the nature of its subject.

Declarations of interest

None.

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