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Analyzing the research in *Integrative & Complementary Medicine* by means of science mapping

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Abstract
Objectives: The research in the *Complementary and Alternative Medicine* (CAM) field is analyzed according to the journals indexed in ISI Web of Science. Science Mapping Analysis (SMA) is used to provide and overview of the conceptual evolution of the CAM field.
Methods: The software SciMAT is used to detect and visualize the hidden themes and their evolution over a consecutive span of years. It combines SMA and performance analysis. Twenty one journals related to CAM were analyzed, in four consecutive periods from 1974 to 2011.
Results: Strategic diagrams and the thematic evolution of CAM, together with performance indicators (h-index), were obtained. The results show that CAM research has focused on seven main thematic areas: MEDICINAL-PLANTS, CHIROPRACTIC-AND-LOW-BACK-PAIN, ACUPUNCTURE-AND-PAIN, CELL-PROCESSES-AND-DISEASES, LIPID-PEROXIDATION and DIABETES-AND-INSULIN.
Conclusion: The research output could be used by the scientific community to identify thematic areas on which interest is focused.

Contents

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1. Introduction

Complementary and Alternative Medicine (CAM) can be described as a group of health care systems, practices and products which are not considered a part of conventional care (such as chiropractic, ayurveda, homeopathy and naturopathy).[1] On the other hand, Integrative Medicine incorporates aspects of both CAM and conventional care through a combination of conventional medical therapies with those of CAM that have high-quality scientific evidence of safety and effectiveness. Recently, it was concluded that it is unclear whether CAM is used as a substitute for conventional care rather than a complement.[2] An increment in publications and interest related with CAM and Integrative Medicine has been observed. In fact, one of the most important bibliographic databases, the ISI Web of Science (ISIWoS), has established a subject category, *Integrative & Complementary Medicine*, to represent the set of journals that publish the main research works related to both disciplines.

A high quantity of research documents hampers the detailed analysis of any research area. Although an expert on the field could develop a detailed analysis, it would nevertheless be a daunting and tedious task. For this reason, the use of scientific support tools, such as Bibliometrics, is required to facilitate the analysis of a research area by automatically classifying the research conducted in a particular research field in different themes and topics.[3]

Science Mapping Analysis (SMA)[4] is a powerful bibliometric method for the analysis of scientific output. It provides a spatial representation of how disciplines, fields, specialties, and individual documents or authors are related to one other.[5] SMA is focused on monitoring a scientific field and delimiting research areas to determine its structure and its evolution.[6] SMA aims at displaying the structural and dynamic aspects (conceptual, intellectual and social) of scientific research.[7,8,6]

Co-word analysis has been used in SMA to study the conceptual structure of scientific fields, using the most important terms or keywords in the documents.[9] Some examples of the use of SMA in research fields are: cardiology and cardiovasology,[10] library and information science,[11] and intelligent transportation systems.[12,13]

The open-source software SciMAT[14] is a powerful science mapping analysis software tool that presents the following main characteristics[14,15]: (i) it incorporates all the modules necessary to perform an SMA, (ii) it is able to build the majority of the bibliometric networks, it can use different similarity measures to normalize them and it incorporates a variety of clustering algorithms to build the science maps, (iii) it implements a wide variety of preprocessing tools, (iv) it allows the analyst to perform an SMA in a longitudinal framework, and (v) it builds science maps enriched with bibliometric measures based on citations. Furthermore, SciMAT presents some key features that distinguish it in respect to other science mapping software tools: (a) a powerful preprocessing module to clean the raw bibliographical data, (b) the use of bibliometric measures to study the impact of each element studied, and (c) a wizard to configure the analysis.

Recently, a series of papers analyzing the bibliometric impact of the CAM research field have been published. Danell et al.[16] analyze the evolution of scientific production in academic journals from 1966 to 2007. Fu et al.[17] analyze the document types and the geographical and institutional distribution of the authorship from 1980 to 2009. Tam et al.[18] show the most frequently cited articles published in the journals indexed in the *Integrative & Complementary Medicine* ISIWoS subject category. However, a complete CAM science mapping study is yet to be undertaken. In this paper a complete longitudinal SMA is presented, in which the whole CAM research field is analyzed and its structure and conceptual evolution is demonstrated.

2. Materials and methods

SciMAT is used to develop the SMA presented in this paper. SciMAT is based on the bibliometric analysis methodology defined by Cobo et al.[15] This approach establishes four phases with which to analyze the themes and thematic evolution of a research field:

1. *Research themes detection.* A equivalence index[19] normalized bibliometric co-word network of keywords co-occurrence is built.[9] This is followed by a clustering of keywords in topics/themes using the simple centers algorithm.[20] These clusters correspond to centers of interest or to research problems that are the object of significant interest among researchers.
2. *Low dimensional space layout of research themes.* This is achieved by plotting research themes using two-dimensional strategic diagrams based on the their centrality (degree of interaction of a research theme with other research themes) and density (internal strength of a research theme) rank values.[19] Thus, with both parameters a research field can be understood to be a set of research themes, mapped in a two-dimensional space and classified into four groups[15]: (a) *Motor*: Themes in the upper-right quadrant, which are well developed and important for the structuring of a research field, (b) *Basic and Transversal*: Themes in the lower-right