Using PubMed Search Strings for Efficient Retrieval of Manual Therapy Research Literature

Paolo Pillastrini, PT, MSc,[a] Carla Vanti, PT, OMPT, MSc,[b] Stefania Curti, MStat, PhD,[c] Stefano Mattioli, MD,[d] Silvano Ferrari, MD,[e] Francesco Saverio Violante, MD,[f] and Andrew Guccione, PT, PhD, FAPTA[g]

Abstract

Objective: The aim of this study was to construct PubMed search strings that could efficiently retrieve studies on manual therapy (MT), especially for time-constrained clinicians.

Methods: Our experts chose 11 Medical Subject Heading terms describing MT along with 84 additional potential terms. For each term that was able to retrieve more than 100 abstracts, we systematically extracted a sample of abstracts from which we estimated the proportion of studies potentially relevant to MT. We then constructed 2 search strings: 1 narrow (threshold of pertinent articles ≥ 40%) and 1 expanded (including all terms for which a proportion had been calculated). We tested these search strings against articles on 2 conditions relevant to MT (thoracic and temporomandibular pain). We calculated the number of abstracts needed to read (NNR) to identify 1 potentially pertinent article in the context of these conditions. Finally, we evaluated the efficiency of the proposed PubMed search strings to identify relevant articles included in a systematic review on spinal manipulative therapy for chronic low back pain.

Results: Fifty-five search terms were able to extract more than 100 citations. The NNR to find 1 potentially pertinent article using the narrow string was 1.2 for thoracic pain and 1.3 for temporomandibular pain, and the NNR for the expanded string was 1.9 and 1.6, respectively. The narrow search strategy retrieved all the randomized controlled trials included in the systematic review selected for comparison.

Conclusion: The proposed PubMed search strings may help health care professionals locate potentially pertinent articles and review a large number of MT studies efficiently to better implement evidence-based practice.

(J Manipulative Physiol Ther 2015;38:159-166)

Key Indexing Terms: *Manual Therapy; PubMed, Utilization; Evidence-Based Practice*

Evidence-based practice is a pressing concern for all health care professionals,[1] which begins with the formulation of a clinical question that can be answered using existing evidence. Like other forms of research, the key to successful research using the current literature depends on a robust methodological strategy. Once the question is formulated, clinicians must carefully plan their search strategy including identification of search terms and databases.

Literature databases are widely available through the Internet, although none of these databases is totally comprehensive.[2] Bibliographic searches on a topic related to manual therapy (MT) are often needed in contemporary practice, but they are often a challenge because practitioners are compelled to search multiple databases.[3,4] However, the sheer magnitude of articles retrieved does not necessarily equate to quality. Indeed, each article retrieved must be carefully and critically read, a time-consuming endeavor for clinicians. Evidence-based search strategies have been shown to positively influence the effectiveness of literature searching.[5] Although such strategies have been developed in clinical medicine,[6] they are difficult to transpose to MT. The literature on MT is drawn from professionals of different disciplines that may use different words to describe the same concepts, a situation that requires an explicit approach to resolve.[7]

Rollin et al[8] reported that 90% of high-quality intervention studies included in Cochrane reviews could be retrieved searching PubMed, the database managed by the US National

[a] Associate Professor, Department of Biomedical and Neuromotor Sciences, University of Bologna, Italy.
[b] Adjunct Professor Manual Therapy, Department of Biomedical and Neuromotor Sciences, University of Bologna, Italy.
[c] Research Fellow, Department of Medical and Surgical Sciences, University of Bologna, Italy.
[d] Associate Professor, Department of Medical and Surgical Sciences, University of Bologna, Italy.
[e] Adjunct Professor Manual Therapy, Department of Biomedical Sciences, University of Padova, Italy.
[f] Professor, Department of Medical and Surgical Sciences, University of Bologna, Italy.
[g] Professor and Chair, Department of Rehabilitation Science, College of Health and Human Services, George Mason University, Fairfax, VA.
Submit requests for reprints to: Paolo Pillastrini, PT, MSc, Associate Professor, Via P. Palagi, 9-40138 Bologna, Italy. (e-mail: *paolo.pillastrini@unibo.it*).

Paper submitted September 4, 2013; in revised form March 4, 2014; accepted May 2, 2014.
0161-4754

http://dx.doi.org/10.1016/j.jmpt.2014.11.005

Library of Medicine (NLM). They concluded that searching PubMed only is more cost-effective than previously thought, which is a highly relevant consideration, given that this database is freely accessible. As a consequence, an MT practitioner could efficiently retrieve most part of literature on a topic using PubMed database.

Search strategy in a database can be conducted by a clinician using MeSH terms (Medical Subjects Heading terms—NLM-controlled vocabulary thesaurus used for indexing articles), not-MeSH terms, or a combination of these terms. For example, members of our research team developed and tested PubMed search strings to explore the occupational determinants of diseases.[9] Rational use of MeSH terms is becoming increasingly important, also considering terminological overlaps in the MeSH vocabulary and their different possible use during manual indexing at the NLM. A clinician, searching PubMed, may omit relevant terms (MeSH or not) or may repeat several times similar searches with the result of wasting time by reading abstracts that are not pertinent or not finding articles that are relevant to the clinical question.

Tailored PubMed search strategies need to be developed for areas of investigation, such as for MTs. The aim of this study was to identify efficient PubMed search strategies to retrieve articles regarding the MT to help simplify searching for evidence by ensuring an acceptable yield of pertinent articles in a short amount of time.

Methods

Overview

Our research team was composed of different professionals including physicians, physical therapists, epidemiologists, and statisticians. Using the study design and methodological approach developed by Mattioli et al,[9] we compiled a list of search terms that we deemed particularly pertinent to MT.

Then, we explored the yield of each search term in PubMed considering the number of articles identified by the individual term. For each search term, we then determined the proportion of retrievable articles that could be considered potentially pertinent to MT. We then designed 2 search strings (1 narrowly focused, 1 expanded), to be used in different contexts.

Subsequently, we measured the search strings efficiency through the "number needed to read" (NNR), which quantifies the number of abstracts that might have to be read to locate 1 pertinent manuscript (NNR = number of retrieved abstracts/number of potentially pertinent abstracts, which is equal to 1/precision).[10] Finally, we tested their capability in retrieving relevant articles using a systematic review on MT and chronic low back pain (CLBP) for comparison.[11]

Selection of Terms

Using the PubMed MeSH database, which is the NLM-controlled vocabulary thesaurus used for indexing articles, the research team considered MeSH terms along with their various subheadings related to MT. The field tag [MH] or the field tag [MeSH] may be added to a term to restrict a search to MeSH terms only. We selected 11 MeSH terms as likely pertinent to MT: *Chiropractic[MH]*; *Exercise Movement Techniques[MH]*; *Exercise Therapy[MH]*; *Manipulation, Orthopedic[MH]*; *Manipulation, Osteopathic [MH]*; *Massage[MH]*; *Muscle Relaxation[MH]*; *Muscle Stretching Exercises[MH]*; *Musculoskeletal Manipulations [MH]*; *Osteopathic Medicine[MH]*; *Traction[MH]*.

Based on the authors' combined clinical expertise, group discussion, and culling other terms from preliminary PubMed searches, we further identified 84 non-MeSH terms.

Estimating Proportions of Pertinent Articles

In November 2011, we tested all the identified search terms on PubMed by introducing them one by one in the database to obtain the number of citations retrieved by each term. Limits were set for articles added to PubMed before November 1, 2011, and with available abstract. Furthermore, we added the words *NOT* (*animals [MH] NOT humans [MH]*) at each query.

To decide the pertinence of each abstract to MT, we referred to the definition of MT adopted by the International Federation of Orthopaedic Manipulative Physical Therapists.[12] As a consequence, abstracts on both passive manual techniques (massage, traction, translation, mobilization, manipulation, etc) and abstracts on active exercises (strengthening exercises, proprioceptive neuromuscular facilitation, active stabilization, etc) were included. Abstracts dealing exclusively with physical modalities, medications, splints, acupuncture, or nonconventional treatments were excluded.

The proportion of pertinent articles was calculated based on a sample of 100 articles. Based on the total number of retrieved abstracts, we systematically extracted abstracts by setting the PubMed "show" function to a number per page that allowed us to select the study at the top of the page for inclusion. This methodology assured that our sample would be chronologically representative.

The pertinence of each article was assessed manually by 4 pairs of physical therapists (MB and SB, GD and IG, SM and JP, and FD and AC) who independently examined each abstract and determined whether the abstract contained information relevant to the topic of MT. Regarding interobserver variability, these 4 pairs achieved a κ value of 0.67, 0.90, 0.98, and 0.90, respectively, corresponding to "good/very-good" agreement in a preliminary assessment of 100 abstracts.[13] In case of disagreement, pertinence was adjudicated by 3 physical therapists (PP, CV, and SF). In case the term under study extracted less than 100 abstracts, we did not calculate the proportion of pertinent articles.

Formulation of Search Strings

Based on the proportions of pertinent articles, we devised 2 distinct search strategies. For the narrowly focused search string, we arbitrarily set an inclusion threshold of 40% of the overall yield of a term that would be pertinent to MT. This cutoff was selected so that the NNR would not exceed 2.5 (ie, precision ≥40%). The expanded search string comprised all the terms (included or not included in the narrow search string) for which a proportion of pertinent articles had been calculated.

Testing the Efficiency of Search Strings

The 2 search strategies were tested for retrieving pertinent abstracts on 2 different and well-known clinical conditions: thoracic pain and temporomandibular pain. Two members of our team (PP and CV) determined relevance to MT of all the abstracts retrieved from PubMed, with limits set for articles published before February 20, 2013. We then calculated, for the 2 search strings, the NNR to find a pertinent article regarding MT on those clinical conditions.

We then constructed a "benchmark" database of studies on MT by gathering the 16 randomized controlled trials (RCTs), which were retrievable from PubMed and included in a systematic review on spinal manipulative therapy for CLBP, a very common clinical condition.[11]

To determine if the proposed PubMed search strings were able to identify these 16 RCTs, we further tested the narrow search string plus the first author's name of each RCT (eg, *Goldby LJ [1 AU]*), conjoined with "AND". If this string with the author's name returned only the exact RCT, then the utility of the search string would be confirmed.

Results

Numbers of Identified Citations and Proportion of Pertinent Abstracts

Fifty-five search items (11 MeSH terms and 44 non-MeSH terms) were able to extract more than 100 citations. The other 40 non-MeSH terms under study extracted less than 100 abstracts (Appendix), and therefore, we did not calculate their proportion of pertinent articles produced by these terms. Conversely, based on the evaluated pertinence of each article, we estimated the proportions of potentially pertinent abstracts retrieved by each of the 55 search items. Three MeSH terms and other 12 terms were suitable for the narrow search string (proportions of pertinent abstracts ≥40%); their data are reported in Table 1. Data on 8 MeSH and 32 non-MeSH terms, which did not meet the inclusion threshold for the narrow search string, are reported in Table 2.

Formulation of Search Strings

The narrow search string is presented in Figure 1 and includes those search terms that retrieved an estimated proportion of pertinent articles greater than or equal to 40% (Table 1). The expanded search string is also included in Figure 1 and includes all the terms for which the proportion of pertinent articles was calculated (Tables 1 and 2).

Table 1. *Numbers of Abstracts Identified by MeSH and Non-MeSH Terms of the Narrow String and Estimates of Numbers Potentially Pertinent to MT*

PubMed Query	Total No. of Abstracts Retrieved [a]	Estimated Proportion of Potentially Pertinent Abstracts (%) [b]	Estimated Absolute Nos. of Potentially Pertinent Abstracts [c]
Chiropractic[MH]	1338	82	1097
Manipulation, Osteopathic[MH]	170	54	92
Musculoskeletal Manipulations[MH]	5796	41	2376
Chiropractic	1956	58	1134
Joint Mobilization*	173	68	118
Manipulative	3554	42	1493
Manual Therap*	1376	94	1293
"Muscle Strengthening"	404	45	182
"Muscle Stretching"	588	77	453
Myofascial*	1963	48	942
Osteopathic Manipulation*	195	68	133
"Proprioceptive Neuromuscular Facilitation"	118	79	93
Spinal Manipulation*	1031	97	1000
"Static Stretching"	227	95	216
Trigger Point*	1016	40	406

MH or *MeSH*, medical subject heading.
Note: The asterisk represents the PubMed truncation symbol. The PubMed searches were performed in November 2011.
[a] PubMed limits were set for abstract available and publication date to November 1, 2011. Furthermore, we added the words "NOT (animals [MH] NOT humans [MH])" to each query.
[b] Estimates were based on reviews of 100 systematically sampled abstracts.
[c] Calculated by multiplying the number of abstracts identified by the estimated proportion of potentially pertinent abstracts.

Testing the Efficiency of Search Strings

The efficiency of the 2 search strings was tested on thoracic pain and temporomandibular pain. The numbers of abstracts retrieved in PubMed by each search string, the proportion of abstracts likely to be pertinent, and the corresponding estimate of NNR are shown in Table 3. Overall, the NNR of the narrow string was lower (more efficient) than the expanded string. The narrow search string strategy produced 38 articles of the 856 articles indexed under "thoracic pain" and "temporomandibular pain" in PubMed. Of these 38 articles, our 2 reviewers determined that 31 articles (82%) were pertinent, corresponding to an NNR of 1.2. We retrieved 86 articles with the expanded search string. Of these, 49 (57%) were deemed pertinent, corresponding to an NNR of 1.8. Finally, the narrow search strategy was able to retrieve all the 16 RCTs that were cited in a systematic review

Table 2. *Numbers of Abstracts Identified by MeSH and Non-MeSH Terms Added to the Narrow String to Identify the Expanded String and Estimates of Numbers Potentially Pertinent to MT*

PubMed Query	Total No. of Abstracts Retrieved [a]	Estimated Proportion of Potentially Pertinent Abstracts (%) [b]	Estimated Absolute Nos. of Potentially Pertinent Abstracts [c]
Exercise Movement Techniques[MH]	2527	4	101
Exercise Therapy[MH]	14 894	34	5064
Manipulation, Orthopedic[MH]	1525	38	580
Massage[MH]	1951	15	293
Muscle Relaxation[MH]	12 308	1	123
Muscle Stretching Exercises[MH]	474	39	185
Osteopathic Medicine[MH]	573	14	80
Traction[MH]	2271	26	590
"Clinical Reasoning"	902	12	108
"Exercise Therapy"	454	36	163
"Joint Range of Motion"	472	25	118
Joint Stabilization*	102	17	17
Manipulation*	46 214	8	3697
Manual Intervention*	194	5	10
"Massage"	3312	11	364
Mobilization*	23 373	5	1168
Motor Control*	5626	27	1519
"Motor Learning"	1581	28	443
"Muscle Relaxation"	2094	5	105
"Muscle Strength Training"	108	25	27
Neurodynamic*	391	17	66
"Orthopedic Manipulation"	1564	39	610
Osteopathic*	3028	22	666
"Osteopathic Medicine"	1838	7	129
"Passive Range of Motion"	511	28	143
"Passive Stretching"	180	28	50
"Physical Therapy"	126 151	25	31 538
Physiotherapy	66 062	32	21 140
PNF	385	19	73
Postural	19 776	18	3560
Postural Adjustment*	530	6	32
"Postural Balance"	8488	19	1613
"Postural Control"	2188	20	438
"Postural Stability"	1203	19	229
"Range of Motion"	32 908	28	9214
"Reflexology"	187	5	9
Stabilization*	44 653	2	893
Stretching	10 197	17	1733
Thrust*	2190	14	306
Traction	7547	4	302

MH or *MeSH*, medical subject heading, *MT* manual therapy; *PNF*, proprioceptive neuromuscular facilitation.
Note: The asterisk represents the PubMed truncation symbol. The PubMed searches were performed in November 2011.
[a] PubMed limits were set for abstract available and publication date to November 1, 2011. Furthermore, we added the words "NOT (animals [MH] NOT humans [MH])" to each query.
[b] Estimates were based on reviews of 100 systematically sampled abstracts.
[c] Calculated by multiplying the number of abstracts identified by the estimated proportion of potentially pertinent abstracts.

on spinal manipulative therapy for CLBP.[11] The expanded search string was not tested as we had confirmed that the narrow one was able to retrieve all the selected references.

Discussion

This study identified evidence-based PubMed search strings on MT for use by health care professionals. A narrow and an expanded search strategy was developed and tested. We implemented our search string strategies to locate studies relevant to MT for 2 clinical conditions and calculated the NNR as a measure of efficiency. The very low NNR (1.2) estimated for the narrow string gives some indication of its efficiency. In comparison, although the overall number of potentially pertinent articles greatly increased when using the expanded strategy, there appears to be a concomitant loss of efficiency (NNR, 1.8).

The narrow search string was able to locate 100% of the RCTs included in the systematic review by Rubinstein et al.[11] We believe that this narrow search string may provide a time-saving useful tool for health care professionals who need to explore MT in practice-based situations with typical time constraints. Nevertheless, we caution that our included terms

Narrow search strategy:

(Chiropractic[MH] OR Manipulation, Osteopathic[MH] OR Musculoskeletal Manipulations[MH] OR Chiropractic OR Joint Mobilization* OR Manipulative OR Manual Therap* OR "Muscle Strengthening" OR "Muscle Stretching" OR Myofascial* OR Osteopathic Manipulation* OR "Proprioceptive Neuromuscular Facilitation" OR Spinal Manipulation* OR "Static Stretching" OR Trigger Point*) NOT (animals[MH] NOT humans[MH]) AND *name(s)-of-the-disease*

Expanded search strategy:

(Chiropractic[MH] OR Manipulation, Osteopathic[MH] OR Musculoskeletal Manipulations[MH] OR Chiropractic OR Joint Mobilization* OR Manipulative OR Manual Therap* OR "Muscle Strengthening" OR "Muscle Stretching" OR Myofascial* OR Osteopathic Manipulation* OR "Proprioceptive Neuromuscular Facilitation" OR Spinal Manipulation* OR "Static Stretching" OR Trigger Point* OR Exercise Movement Techniques[MH] OR Exercise Therapy[MH] OR Manipulation, Orthopedic[MH] OR Massage[MH] OR Muscle Relaxation[MH] OR Muscle Stretching Exercises[MH] OR Osteopathic Medicine[MH] OR Traction[MH] OR "Clinical Reasoning" OR "Exercise Therapy" OR "Joint Range of Motion" OR Joint Stabilization* OR Manipulation* OR Manual Intervention* OR "Massage" OR Mobilization* OR Motor Control* OR "Motor Learning" OR "Muscle Relaxation" OR "Muscle Strength Training" OR Neurodynamic* OR "Orthopedic Manipulation" OR Osteopathic* OR "Osteopathic Medicine" OR "Passive Range of Motion" OR "Passive Stretching" OR "Physical Therapy" OR Physiotherapy OR PNF OR Postural OR Postural Adjustment* OR "Postural Balance" OR "Postural Control" OR "Postural Stability" OR "Range of Motion" OR "Reflexology" OR Stabilization* OR Stretching OR Thrust* OR Traction) NOT (animals[MH] NOT humans[MH]) AND *name(s)-of-the-disease*

Usage notes:
It is possible to "copy and paste" each of the two strings into PubMed from a .doc file.
The *name-of-the-disease* should be entered without any search tag. For diseases that have more than one name, the various "names-of-the-disease" should be entered in brackets, connected by the OR operator.

Example:
Searching for papers regarding the use of manual therapy in cases affected by knee pain where a more specific search is needed:
1) copy the narrow search string and paste it on PubMed: 24,469 citations were retrieved on January 21st, 2014;
2) add, after the narrow search string, in PubMed search window: *AND "knee pain";* 91 citations were retrieved on January 21st, 2014;
3) look at the abstracts retrieved to evaluate their potential pertinence.

Figure 1. *Proposed PubMed search strategies for identifying potentially pertinent articles on MT.*

Table 3. *Implementation of Search Strings: Articles Retrieved, Proportions of Potentially Pertinent Articles, and NNR*

	"Thoracic Pain" (n = 736)			"Temporomandibular Pain" (n = 120)			Overall (n = 856)		
	Retrieved	Pertinent		Retrieved	Pertinent		Retrieved	Pertinent	
PubMed Query	n	n (%)	NNR	n	n (%)	NNR	n	n (%)	NNR
Narrow string	23	19 (83)	1.2	15	12 (80)	1.3	38	31 (82)	1.2
Expanded string	52	28 (54)	1.9	34	21 (62)	1.6	86	49 (57)	1.8
"Expanded string" NOT "Narrow string"	29	9 (31)	3.2	19	9 (47)	2.1	48	18 (38)	2.7

NNR, number of abstracts needed to read.
Note: The PubMed searches were performed in February 2013. PubMed limits were set for abstract available and publication date to February 20, 2013.

emphasize that published research on MT is heavily biased toward manipulative techniques.

The expanded search string could be useful when less precision and a larger NNR might be acceptable to the user. It could be adopted either to search literature on diseases or dysfunctions, which elicit only a few articles or to explore a health condition more extensively. However, we do not know what would be the performance of our strings in less prevalent conditions where MT is also used.

A very common approach to searching the literature is the PICO model, which is used to identify the patient or population (P), intervention (I), comparison (C), and outcome(s) (O). Based on this model, a clinician can construct a relevant search string that it is aimed at a specific topic. The search strings that we proposed might help a clinician to expand the intervention (I) part of the PICO model and to avoid the omission of some procedures included in the MT field. Nevertheless, we must remember that evidence-based practice is not only consequence function of reading scientific articles, but that it requires a critical evaluation of the literature quality and the subsequent integration of the individual clinical experience with the best available external clinical evidence from systematic research. Critical thinking and appraisal in all aspects of patient management are crucial elements of evidence-based practice; thus, we hope the findings of this study will facilitate these practice behaviors.

Limitations

We restricted our searching to only articles with English-language abstracts, which may constitute an inclusion selection bias. Abstract quality varies, especially in the absence of widespread implementation of standards for more

informative abstracts,[14] which could lead to an exclusion bias. Our selection of non-MeSH search terms was to some extent arbitrary, based on the expertise of our team members. However, the ability of the narrow search string to retrieve most of the available pertinent abstracts for 2 health conditions suggests that these limitations did not greatly impact the final results. This study was restricted to PubMed, and therefore, our methodology might be altered in time by changes in how studies are cataloged by MeSH terms[15] or when databases other than PubMed are more suitable.[16] It should also be noted that manual searches may be necessary to retrieve gray literature pertinent to answer a particular clinical question. Although we tested the efficiency of the 2 search strings, a future attempt to assess their validity should explore whether they are able to identify a larger number of target articles.

Conclusions

We constructed and tested 2 search strings that could be used to locate studies on MT. A time-constrained clinician could possibly use these pretested strings to search for evidence relevant to a condition of interest with some confidence that the search would yield pertinent studies.

Practical Applications

- Search strings could assist health care professionals to detect in PubMed a large number of studies on a topic of interest.
- The proposed PubMed search strings (1 narrow and 1 expanded) are able to locate potentially pertinent articles on MT for time-constrained clinicians.
- The narrow search strategy retrieved all the RCTs included in a selected systematic review.

Acknowledgment

Silvia Borghi, Marco Boschi, Andrea Cupello, Fulvio Dal Farra, Gregorio Di Leo, Ivan Gardenghi , Sebastiano Morassi, and Jacopo Pisati.

Funding Sources and Potential Conflicts of Interest

No funding sources or conflicts of interest were reported for this study.

Contributorship Information

Concept development (provided idea for the research): P.P., C.V., S.C., S.M., F.S.V.
Design (planned the methods to generate the results): P.P., C.V., S.C., S.M., S.F.
Supervision (provided oversight, responsible for organization and implementation, writing of the manuscript): P.P., C.V., F.S.V.
Data collection/processing (responsible for experiments, patient management, organization, or reporting data): S.C., S.F.
Analysis/interpretation (responsible for statistical analysis, evaluation, and presentation of the results): A.G., S.C., S.M., F.S.V.
Literature search (performed the literature search): S.C., S.F.
Writing (responsible for writing a substantive part of the manuscript): P.P., A.G., C.V., S.C., S.M.
Critical review (revised manuscript for intellectual content, this does not relate to spelling and grammar checking): P.P., A.G., S.M., S.F., F.S.V., S.C.

References

1. Delaney PM, Fernandez CE. Toward an evidence-based model for chiropractic education and practice. J Manipulative Physiol Ther 1999;22:114-8.
2. Verbeek J, Salmi J, Pasternack I, et al. A search strategy for occupational health intervention studies. Occup Environ Med 2005;62:682-7.
3. Murphy LS, Reinsch S, Najm WI, et al. Spinal palpation: the challenges of information retrieval using available databases. J Manipulative Physiol Ther 2003;26:374-82.
4. Goldstein MS, Scalzitti DA, Craik RL, et al. The revised research agenda for physical therapy. Phys Ther 2011;91:165-74.
5. Schaafsma F, Hulshof C, de Boer A, et al. Effectiveness and efficiency of a literature search strategy to answer questions on the etiology of occupational diseases: a controlled trial. Int Arch Occup Environ Health 2007;80:239-47.
6. Shariff SZ, Sontrop JM, Haynes RB, et al. Impact of PubMed search filters on the retrieval of evidence by physicians. CMAJ 2012;184:E184-90.
7. Maciejewski ML, Diehr P, Smith MA, et al. Common methodological terms in health services research and their synonyms [correction of symptoms]. Med Care 2002;40:477-84.
8. Rollin L, Darmoni S, Caillard JF, et al. Searching for high-quality articles about intervention studies in occupational health—what is really missed when using only the Medline database? Scand J Work Environ Health 2010;36:484-7.
9. Mattioli S, Zanardi F, Baldasseroni A, et al. Search strings for the study of putative occupational determinants of disease. Occup Environ Med 2010;67:436-43.
10. Bachmann LM, Coray R, Estermann P, et al. Identifying diagnostic studies in MEDLINE: reducing the number needed to read. J Am Med Inform Assoc 2002;9:653-8.
11. Rubinstein SM, van Middelkoop M, Assendelft WJ, et al. Spinal manipulative therapy for chronic low-back pain: an update of a Cochrane review. Spine (Phila Pa 1976) 2011;36:E825-46.

12. International Federation of Orthopaedic Manipulative Physical Therapists (IFOMPT). Orthopaedic Manual Therapy (OMT) Definition. [Internet]Cape Town General Meeting, March 2004; 2004. [Available from: http://www.ifompt.com/About+IFOMPT.html].
13. Some common problems in medical research. In: Altman DG, editor. Practical statistics for medical research. London: Chapman and Hall; 1991. p. 403-9.
14. Gehanno JF, Paris C, Thirion B, et al. Assessment of bibliographic databases performance in information retrieval for occupational and environmental toxicology. Occup Environ Med 1998;55:562-6.
15. Wilczynski NL, Haynes RB, Hedges Team. Developing optimal search strategies for detecting clinically sound causation studies in MEDLINE. Proc AMIA Annu Symp 2003:719-23.
16. Haynes RB, Kastner M, Wilczynski NL, Hedges Team. Developing optimal search strategies for detecting clinically sound and relevant causation studies in EMBASE. BMC Med Inform Decis Mak 2005;22:5-8.

Appendix Non-MeSH terms not included in the search strategies (ie, number of articles retrieved less than 100)

Non-MeSH Terms	No. of Abstracts Retrieved
"Active Stabilization"	61
"Bodywork"	63
"Bodyworks"	3
"Cranio-sacral"	10
"Craniosacral"	68
"Cyriax Physiotherapy"	4
"Cyriax"	91
"Elvey"	19
"End Feel"	27
"Evjenth"	8
"Exercise Therapies"	33
"High Velocity Thrust"	16
"Isometric Stretching"	1
"Joint Flexibility"	86
"Joint Play"	41
"Kaltenborn"	77
"Maitland Manual"	15
"Maitland Mobilization"	5
Manipulation Therap*	77
"Manipulation Therapies"	6
"Manipulative Therapies"	24
"McKenzie Method"	33
"McKenzie Therapy"	9
"Mennell"	70
"Muscle Stretching Exercises"	9
"Musculoskeletal Therapy"	13
"Rom Exercise"	19
"Osteopathic Manipulations"	9
"Osteopathic Manipulative Treatments"	4
"Osteopathic Manipulative"	6
"Pain Provocation Test"	31
"Passive Stabilization"	20
"Pilates"	80
"Postural Reeducation"	68
"Range of Motion Exercise"	69
"Rocabado"	23
"Rolfing"	25
"Spinal Adjustment"	17
"Spinal Adjustments"	19
"Zone Therapy"	33

Note: The asterisk represents the PubMed truncation symbol. The PubMed searches were performed in November 2011. PubMed limits were set for abstract available and publication date to November 1, 2011. Furthermore, we added the words "NOT (animals [MH] NOT humans [MH])" to each query. *MH* or *MeSH*, medical subject heading.