Optimal Search Strategies for Evolutionary Medicine

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Evolutionary Medicine - Fall 2010

Introduction

Evolutionary medicine is the application of principles of evolutionary biology to human health and disease. This is a new field, introduced with the 1994 book “Why we get sick, The New Science of Darwinian Medicine” (1), co-authored by Randolph Nesse MD, a psychiatrist and George Williams, an evolutionary biologist. The last decade has seen an increase in publications relating to evolutionary medicine (2-4). Three recently published textbooks (5-7) have been authored by an anthropologist, evolutionary biologist, and geneticist, respectively. Despite interest from workers in a variety of specialized fields, no single journal is devoted to the topic of evolutionary medicine. Publications on evolutionary medicine topics can be found in the journals in many disciplines, including evolutionary biology (8), general medicine (9), general biology (10,11), epidemiology (12), anthropology (13), and many specialized medical fields (14-16). The absence of a specialized journal in evolutionary medicine and the multidisciplinary nature of this work make it hard to identify publications in evolutionary medicine. This fragmentation hinders scholarly work in this topic. To find an optimal search strategy, searches in the ISI Web of Science and PubMed were evaluated for their ability to identify relevant publications that include works by leaders in the field.

Criteria for Search Success

Searches were rated on their ability to identify publications by the following authors on their respective topics: Randolph Nesse (1), an evolutionary psychiatrist; Stephen Stearns, (4) an evolutionary geneticist; Michael Rose (17) and Caleb Finch (18), both researchers on the evolution of senescence; Paul Ewald (19), who studies the evolution of infectious diseases; David Haig (14) and Bernard Crespi (20) who both study genomic imprinting and genetic conflict; Chris Kuzawa (21) and Wenda Trevathan (5) both anthropologists who study evolution, life history and disease. This benchmark list includes well-known researchers and theorists who have been extensively cited in textbooks on Evolutionary Medicine and are well represented at national meetings in evolutionary medicine. The second benchmark was relevance to the field of evolutionary medicine, determined by the following criteria:

1) Presents an evolutionary hypothesis that relates to a disease of humans.

2) Makes a clear distinction between proximate and ultimate levels of causation. Most medical literature presents disease and physiology in proximate terms: mechanisms, biochemical processes, and molecular pathways. The ultimate or evolutionary level of causation is concerned with population changes in gene frequencies and the effects of traits on an individual’s ability to survive and reproduce.

3) Explains how evolutionary history (phylogeny) explains a disease or health-related trait. Phylogenetic effects include physiologic constraints as well as population genetic effects, such as the founder effect and population bottlenecks. Or, alternatively, explains a disease in terms of a trait’s effect on natural selection, including its effects on an organism’s survival and reproduction.

4) Articles on history of evolutionary medicine, proceedings of national meetings, applicability of evolutionary medicine to medical school education, and the clinical utility of evolutionary medicine were also included.

Results

PubMed Search 1. "evolutionary medicine" or "Darwinian medicine"

This search yields 91 results. While more than 90% of the results are relevant, this search returns only 3 of the 9 authors. This approach misses many important results. Searching the term “evolutionary medicine” without quotation marks yields 4680 results, an excessive number unless another search term is added.

PubMed Search 2. (natural selection or aging) and (evolutionary or Darwinian) and (health or disease or medicine) Limits: Humans, English
This yields 871 results, and gives results with 8 of 9 authors. This search has about 80% relevance. This strategy is effective in returning relevant articles.

PubMed Search 3. (natural selection or adaptation or aging) and (evolutionary or Darwinian) and cardiovascular disease

Adding the term “adaptation” increases the yield of a search. When adaptation is added, as above, and a specific topic in medicine or a diagnosis is substituted for (health or disease or medicine) in search 4, with limits removed, the search produces a reasonable number of results, (106) for cardiovascular disease in this case, with 90% relevance. For example, this strategy was repeated using the terms hypertension, cardiac disease, fever, obesity, diabetes, and stroke. In each case, between 20 and 110 relevant results were returned. This is a very effective strategy if a narrow topic of medicine is the area of interest.

Searching ISI Web of Knowledge can be a very effective means of finding literature in certain fields. When searches were performed in the ISI Web of Knowledge database, they generally yield more results than PubMed, with an increased number of both relevant and irrelevant results. ISI Web of Knowledge searches often performed better than PubMed in returning leading authors’ most cited works. In the Web of Knowledge, the searching with the terms (natural selection or adaptation or aging) AND (evolutionary or Darwinian) AND (health or disease or medicine) yielded most of the most influential works by all the leading authors. The downside is that this search yields more than 2000 results. To be effective, the terms “health or disease or medicine” must be replaced with a narrower search term (table 1). Two search strategies can work well for ISI Web of Science and for PubMed, and it is advisable to try both.

The most effective strategy using the ISI Web of Knowledge, like PubMed, is to pair the search term “(natural selection or adaptation or aging) AND (evolutionary or Darwinian) AND” with a topic in medicine. Pairing those terms with “Neurology”, for instance, yields 175 results in ISI Web of Knowledge, mostly relevant. The same search in PubMed yields only 20 results. The search “evolutionary medicine AND Neurology” in ISI Web of Knowledge yields 525 results. The same search in PubMed yields 20 results.

Discussion

No single search in either database was able to yield results to include both all the leading authors and a high proportion of relevant results (greater than 90) with a reasonable number of results (less than 500). These findings reflect compartmentalization of work by researchers in diverse fields. The inconsistency about terminology and keywords also adds to search difficulty. These search findings reflect the absence of a Mesh term for evolutionary medicine, as well as some confusion in the literature regarding the preferred term: "evolutionary medicine" versus "Darwinian medicine." Without a dedicated journal and the advocacy of a professional organization, the utility of searchable databases may remain limited. Those studying evolutionary medicine should work toward consensus on terminology and should advocate for new Mesh terms. For the Evolutionary Medicine course in the UNM Biology Department, students will survey the existing literature as background for a final project. Student searches that maximize the relevance of articles rather than comprehensiveness may be more successful in navigating the literature. I recommend that students apply the search strategy displayed in Table 1.

Table 1. Recommended Strategy:

Search using the following terms in both PubMed and ISI Web of Knowledge: Enter the following into the search box:

1. (natural selection OR adaptation OR aging) AND (evolutionary or Darwinian) AND

Then insert your area of interest, e.g. “obstetrics” or “diabetes”, and press “search”

As a second search repeat the process using the following term:

2. evolutionary medicine AND
Literature