# Online Search for Logically-Related Noninteractive Medical Literatures: A Systematic Trial-and-Error Strategy

**Don R. Swanson**
*Graduate Library School, University of Chicago; 1100 East 57th Street, Chicago, IL 60637*

An online search strategy to help find pairs of medical literatures that are logically (scientifically) related but noninteractive is described and exemplified. "Noninteractive" means that the two pairs have no articles in common, do not cite each other, and are not co-cited—thus implying that any logical relationship between them may be unintended and perhaps unnoticed.

In earlier papers I analyzed two noninteractive sets of medical articles ("literatures") that together contain implications that cannot be seen within either of the two sets separately (Swanson, 1986; Swanson, 1987). My purpose was to show that unintended and unnoticed connections exist between pairs of literatures, and can be revealed by bringing the two sets together. Since then I have developed a more systematic process for identifying such sets of literatures; this note describes that process.

The proposed strategy consists of two parts. The first part is an exploratory process intended to stimulate human creativity in perceiving connections that identify logically-related pairs of literatures. Second, and more prescriptive, is a method for eliminating all pairs except those that are noninteractive.

This dual "explore/exclude", or trial-and-error, search strategy will be applied here to the pair of literatures already studied and reported (Swanson, 1986; Swanson, 1987). That reported example entails a syllogism with premises split between two noninteractive sets of articles, but the strategy itself is not limited to syllogisms. In principle, any chain of reasoning that can be constructed from links scattered among noninteractive sets can become the basis for new connections.

The problem prototype for which the strategy seems best suited is the search for an unknown drug or dietary factor that might cure a specified disease—in this example, Raynaud's disease, a peripheral circulatory disorder. I shall illustrate one plausible route from the Raynaud literature to the literature on a possible cure, a route that is taken without knowing the specific destination in advance.

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The search strategy is divided into four stages. Stages 1 and 2 implement the exploratory process and stages 3 and 4, the exclusion process.

## Stage 1

This stage is based on an assumption that article titles, especially in medical literature, often signal logical connections treated within the article. The first step is to browse in a list of titles of articles about Raynaud's disease, selected in a Medline search according to criteria intended to enhance the density and patterns of connections that might be seen. There are two such criteria in this case; first, the title must contain the word "Raynaud" and, second, the descriptor for Raynaud's disease must contain some specified subheading. The purpose of introducing subheadings is to exploit their logical relationships with the main descriptors to which they are attached. The subheadings should be tried one at a time, in order to increase the chance of seeing useful patterns. There are not many subheadings to explore—only 42 are applicable to diseases at all, and many of these 42 would not be reasonable choices for this exploratory search for a cure.

One successful subheading in this example was "Blood", used to indicate changes in the blood in disease states. A search constructed according to that criterion, and "Raynaud" in the title, led to a set of about 60 articles, the titles of which were then displayed for browsing. There were various potentially interesting recurring terms among these titles, including terms related to blood viscosity and to red cell deformability. These two factors together are of interest in that they suggest the possibility of ameliorating Raynaud attacks, for there is a close relationship between red cell deformability and the flow properties of blood in small blood vessels.

## Stage 2

The second stage of the search process explores additional titles related in this case to blood viscosity and red cell deformability, among other things; the point of the search is to find ways to influence these factors. A search

based on the combination of viscosity and deformability terms occurring in titles led to a set of 32 articles among which were two articles on fish oil. These two articles indicated that dietary fish oil tends to increase the deformability of red blood cells and to decrease blood viscosity, factors that seemed sufficiently suggestive of potential benefit to patients with Raynaud's disease to justify further exploration.

In the Venn diagram of Figure 1, the rectangles represent sets of articles. The search process proceeds from left to right. The intersection between the left and center rectangles is the scene of creative guesswork about red cell deformability and other blood factors. These guesses then define the center rectangle, which itself becomes the arena for the second stage search. The intersection of the center and right rectangles is the locale of the conjectural leap to the hypothesis that fish oil might benefit Raynaud patients.*

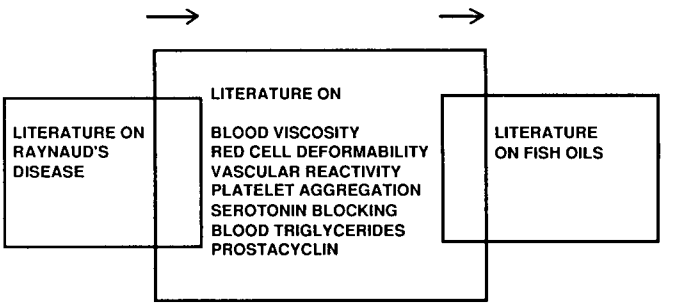


FIG. 1. Venn diagram illustrating Stages 1 and 2 of search process.

## Stage 3

The next question to ask is whether the proposed hypothesis is or is not well known. An immediate preliminary test of that question can be made by searching online for all articles on both fish oil and Raynaud's disease. One quickly discovers that there are none—the left and right rectangles do not intersect—thus elevating the tentative conjecture to a matter of greater interest, for the possibility now arises that this connection might be both unintended and previously undiscovered.

The majority of the logical connections noticed or constructed or conjectured during the process of title browsing tend to be well-known relationships that need not be further considered; only novel relationships are sought. This third stage of the search process is intended to eliminate these known connections expeditiously. An appropriate online search usually can confirm immediately whether a connection is a candidate for being considered novel. For instance, had many articles been found that deal with both Raynaud's disease and fish oils, then the presumed connection would be dropped from further consideration, on the ground that it is probably well known.

The rest of the process is described in the two earlier papers; that process leads to the identification of two literatures that are studied in depth—34 articles on Raynaud's disease and blood changes, and 25 articles on fish oil and the same blood changes (Swanson, 1986; Swanson 1987).

## Stage 4

If anyone had previously examined the possible benefits of fish oil for Raynaud patients, and published the findings, it is reasonable to suppose that they would have cited at least one or more articles from each of the two sets identified. I have reported a co-citation study of these two sets of articles, and found that almost no members of either set were co-cited with any member of the other set (Swanson, 1986). So it was plausible to assume that fish oil articles and Raynaud articles had never before been brought together and analyzed, thus supporting the idea that the connection has gone unnoticed.

The final task was to carefully study the two literatures in question in order to determine whether the apparent logical connections hypothesized were medically and physiologically plausible and defensible (Swanson, 1987).

The search strategy described has been applied also to three other pairs of literatures, with initially favorable results.

It is far easier to describe an ideal process of identifying and bringing together two literatures than it is to state what actually goes on, for there are always many false leads for every one that seems fruitful—and for each lead a large amount of medical literature must be read and understood. This process entails as much interaction with the literature itself as with the online databases. Nonetheless, even allowing for such thrashing about, the prospect for taking any step at all toward a repeatable process for extracting new scientific knowledge from the published literature is not without interest.

*The logic of the process illustrated in Figure 1 is similar to that of Soergel's method of subsearches [1985; pp. 356-357]. Soergel's method is applicable provided the chain of reasoning is obvious or well-known, whereas I have assumed that the chain, if it exists at all, was unknown at the outset and must therefore be discovered through trial-and-error exploration. Six years ago, physiologist A.R. Gardner-Medwin seemed to be on the same track. His paper began as follows, but did not otherwise discuss search strategy:

> In these days of library computers it is possible to search the literature for papers linking two or more keywords. If one were to pick out the following associations: *neuroglia—potassium; potassium—spreading depression; spreading depression—migraine,* one would make quite an impressive collection. Try to link *neuroglia* with *migraine,* however, and there would be little to show. The aim of this paper is to explore the three associations set out above—. [1981; p. 111].

Gardner-Medwin implies that a *neuroglia—migraine* connection is presently unknown, but may become of interest if and when the above chain of connections is more clearly established [1981; p. 125].

Note added in proof: Two years after the above Raynaud/fish oil hypothesis was first proposed by the author, it was independently corroborated by a clinical test conducted at the Albany Medical College; see Swanson (1989) Letter to the Editor, *JASIS 40*, 143.

## References


Gardner-Medwin, A. R. (1981). Possible roles of vertebrate neuroglia in potassium dynamics, spreading depression and migraine. *Journal of Experimental Biology, 95*, 111–127.

Soergel, D. (1985). *Organizing information. Principles of database and retrieval systems*. New York: Academic Press.

Swanson, D. R. (1986). Fish oil, Raynaud's Syndrome, and undiscovered public knowledge. *Perspectives in Biology and Medicine, 30*, 7–18.

Swanson D. R. (1987). Two medical literatures that are logically but not bibliographically connected. *Journal of the American Society for Information Science, 38*, 228–233.