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Diagnostic probability function for acute coronary heart disease garnered from experts' tacit knowledge

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Abstract

Objectives: Knowing about a diagnostic probability requires general knowledge about the way in which the probability depends on the diagnostic indicators involved in the specification of the case at issue. Diagnostic probability functions (DPFs) are generally unavailable at present. Our objective was to illustrate how diagnostic experts' case-specific tacit knowledge about diagnostic probabilities could be garnered in the form of DPFs.

Study Design and Setting: Focusing on diagnosis of acute coronary heart disease (ACHD), we presented doctors with extensive experience in hospitals' emergency departments a set of hypothetical cases specified in terms of an inclusive set of diagnostic indicators. We translated the medians of these experts' case-specific probabilities into a logistic DPF for ACHD.

Results: The principal result was the experts' typical diagnostic probability for ACHD as a joint function of the set of diagnostic indicators. A related result of note was the finding that the experts' probabilities in any given case had a surprising degree of variability.

Conclusion: Garnering diagnostic experts' case-specific tacit knowledge about diagnostic probabilities in the form of DPFs is feasible to accomplish. Thus, once the methodology of this type of work has been "perfected," practice-guiding diagnostic expert systems can be developed.

Keywords: Chest pain; Diagnosis; Acute coronary heart disease; Diagnostic probability function; Tacit knowledge; Experts

1. Introduction

Diagnosis can be thought of as knowing about the presence/absence of a particular illness in a patient at a particular time. That knowing can only be probabilistic whenever the available facts on the case do not fully determine the nature of the underlying illness. Thus, the diagnostic challenge is to know about the probability that the illness in question is actually present, that is, about the proportion of instances at the set of facts—the diagnostic profile—in general such that the illness is present.

Despite the central role of diagnosis in medicine, the requisite knowledge base for setting diagnostic probabilities remains practically nonexistent for today's medicine. For example, textbooks of cardiology give no diagnostic probabilities for myocardial infarction specific to particular clinical profiles of the case, nor are these probabilities codified anywhere else.

This is not altogether surprising, given how challenging the form of the requisite knowledge base and the development of knowledge of that form are. Given a patient from a particular demographic category (e.g., an adult male) with a particular chief complaint (e.g., chest pain), the relevant further particulars (e.g., age, type of pain, location of pain, history of coronary heart disease …) of the case imply an enormous number of possible diagnostic profiles in the context of the presentation at issue. The development and codification of knowledge about the diagnostic probability separately for each of the multitude of possible diagnostic profiles is unrealistic as a goal.

Thus, the need is to address diagnostic probability as a joint function of the diagnostic indicators involved, but research directed to such functions, in turn, commonly involves major challenges, especially from the need to

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What is new?

This project produced a diagnostic probability function for acute coronary heart disease on the basis of experts' tacit, case-specific knowledge about these probabilities; and it also shows great inter-expert variability in those probabilities. Both of these results are unprecedented. Production of such DPFs was shown to be feasible but in need for further methodologic development; and even more important turns out to be development of greater expertise among emergency-rooms doctors in the diagnosis about ACHD.

determine, for each of the study subjects, the truth about the presence/absence of the illness in question.

These major challenges in the development of the requisite knowledge base for diagnosis raise the question of whether it would be feasible to garner the tacit knowledge about diagnostic probabilities possessed by diagnostic experts in the requisite form of diagnostic probability functions (DPFs). The work reported here represents our attempt at answering this question, focusing on the diagnosis of acute coronary heart disease (ACHD; i.e., unstable angina pectoris or myocardial infarction) in the context of chest pain and/or dyspnea as the chief complaint of an adult.

2. Methods

Focusing on diagnosis of ACHD, we took the prompting complaint to be that of acute chest pain and/or dyspnea in a person at least 18 years of age. The main components in developing the function for experts' typical probability of ACHD in that domain were the development of a questionnaire with a view to specification of the diagnostic profile of any given case, specification of a set of hypothetical cases in terms of filled-out versions of this questionnaire, formation of a panel of experts on the diagnosis and having them set the diagnostic probability for each of the cases, and translation of these probabilities into the DPF.

2.1. Development of the questionnaire

In the development of the questionnaire, the initial step was a review of all published "prediction rules" for ACHD diagnosis [1] as the basis for the formation of a first draft of a comprehensive set of the diagnostic indicators to consider. We included all these in the first draft of the questionnaire. We consulted senior internists and cardiologists in Zurich about this draft questionnaire, asking for their suggestions for further diagnostic indicators and the scales of these. This led to the next draft of the questionnaire, which the senior internists/cardiologists again critically examined. Two further iterations led to the questionnaire's final form given in Appendix A.

2.2. Specification of hypothetical cases

Based on the questionnaire and concerned to keep the number to a bare minimum necessary for a demonstration project, we specified 80 hypothetical cases, all different.

Two considerations governed the case specifications. One of these was the concern to minimize the number of cases with ST changes or elevated cardiac enzymes, so as to enhance the discernment of the relevance of less-discriminating diagnostic indicators. The other consideration was the concern to minimize the correlatedness of the diagnostic indicators in the database.

2.3. Garnering experts' diagnoses

We contacted 24 directors of departments of internal medicine in 3 university hospitals and 21 affiliated teaching hospitals in Switzerland, asking them to nominate from their hospital one or two physicians with a high degree of diagnostic expertise on cases of acute chest pain and/or acute dyspnea. Of the 24 directors, 23 nominated one or two experts, for a total of 37. All 37 agreed to serve on the panel, but actually, only 32 of them addressed all the cases presented to them. These 32 experts are specified in Appendix B.

We divided the 80 cases into five subsets of 16 cases each. Each expert received four of these five subsets, in a random order, with the cases within the subsets also randomly ordered. The subsets were submitted sequentially, the second through fourth submission some time after the work on the previous subset.

The case specifications were available online on the Internet, accessible only with a personalized password. The task of the panel members was to set, independently of the other members of the panel, the diagnostic probability for ACHD for each of the 64 hypothetical cases. They were instructed to think, after reading the case description, about 100 cases like the one described in the vignette and estimate how many of them are cases of "acute coronary syndrome (unstable angina pectoris or myocardial infarction)." The experts' probability estimates were stored in the project's database, accessible only to the principal investigator.

For the development of the DPF, we excluded data from some of the 32 members of the panel, based on two considerations. We first examined the distribution of the expert-specific means of the 64 probabilities associated with the cases they addressed. The highest mean was 74%, followed by 53%, and the lowest mean was 21%, followed by 23%. On this basis, we excluded the data from the panel member with the highest mean. The second consideration was the pattern of variation of the expert-specific probabilities. On this basis, we excluded from the remaining 31 sets of probabilities those with a coefficient of correlation of less than 0.50 with the means of the others. Five sets of probabilities