

Key Concepts in Pretest Probability Estimation

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In general terms, probability is a mathematical calculation that determines the likelihood of something happening. In the context of healthcare medicine, this term is commonly used to describe the possibility that a clinical event (usually the occurrence of a particular disease) may occur in a population or, more often, in an individual patient.

The process of arriving at the diagnosis of a given disease consists of several steps: it begins with the collection of initial clinical data and the formulation of

one or more diagnostic hypotheses.¹ To navigate this complex diagnostic pathway, physicians often use a variety of diagnostic tests.

Two concepts should be emphasized: pretest probability and posttest probability. In the first case, it is the probability that a patient has of having a disease before undergoing a particular diagnostic test. In the second case, it is the probability that the same patient has of having the disease once the results of the diagnostic test in question are available. This posttest probability depends on the characteristics of the test itself (sensitivity and specificity), the test result (positive or negative), and the probability of having the disease before the test, i.e. the pretest probability.²⁻³

Consequently, the first key concept is that knowing the pretest probability is fundamental to interpreting and contextualizing the result of a diagnostic test, and thus, the final probability that our patient has or does not have a certain disease. Similarly, a given posttest probability automatically becomes a pretest probability the moment we decide to perform a second diagnostic test.

How can we estimate the pretest probability of a given disease in our patients? Several aspects converge here, some more subjective, related to the "experience" or "clinical judgement" of the physician, and others more objective, such as those related to data on the

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"real" prevalence of the disease in the population to which the patient belongs, or the use of clinical prediction rules.

Thus, the second key concept is that pretest probability is constructed with multiple subjective and objective elements.

Intuition is defined as the ability to understand things immediately, without the need for reasoning. Very often, when faced with a patient, the physician "intuitively" estimates the probability of being ill before performing any diagnostic test. In doing so, we mentally establish a spectrum ranging from "very unlikely" (close to 0%) to "extremely likely" (close to 100%). This estimate is based on the data collected from the clinical history, including anamnesis and physical examination, and is strongly influenced by other factors such as the clinical setting where the patient is seen or the clinician's own experience. Although there is a considerable variability, previous data suggest that experienced clinicians tend to have more accurate estimates of pretest probability.^{1,3} However, we must be cautious when considering this type of approach. Clinical judgement based on intuition, while refined with medical training and experience, is not without limitations, such as the presence of cognitive and heuristic biases.⁴⁻⁵ Heuristic biases are cognitive strategies that simplify decision making (mental shortcuts), while cognitive biases can distort the perception of information and influence the way in which the patient's presenting symptoms and signs are evaluated. In fact, there is evidence that physicians tend to overestimate the pretest probability of being ill or the potential benefit of diagnostic tests and treatments.⁶ *A third key concept, then, is that estimating pretest probability based on clinical judgement alone has limitations.*

But then, what other tools can help us to more accurately estimate a given pretest probability? One is to investigate data on the "real" population prevalence of the patient's disease in the relevant population. Data on disease prevalence usually come from large epidemiological studies, which are not always available due to cost and logistical issues. The latter is particularly evident in developing countries such as ours. Moreover, the usefulness of this tool has been questioned for two reasons:⁷ 1) for pragmatic reasons, since it is almost impossible to know the true prevalence for each type of disease for each individual patient; 2) we usually estimate prevalence by considering the wrong denominator. When assessing population prevalence, it is

common to consider both healthy and sick individuals, whereas when we want to estimate pretest probability in the clinic, we do so only with symptomatic patients. Also, clinical applicability will be given by the degree of similarity between the patient and the population being studied. In other words, the more similar the patient is to the population included in the studies, the more accurate the prevalence-based pretest probability estimate will be.

Clinical prediction rules are mathematical equations that calculate the probability that an individual will present the event of interest in a given time interval, depending on the level of exposure to different risk factors.⁸ Research that quantifies the contribution of specific components of the clinical history, physical examination and some results of previous diagnostic tests can assist the clinician in constructing the pretest probability. However, these functions have major limitations in terms of calibration and discrimination, as many clinical prediction rules are applied in populations other than those from which they were derived.⁹

Considering the above, a fourth concept would be that knowing the "real" prevalence in the population or using clinical prediction rules when they exist could help the clinician when estimating pretest probability.

In conclusion, while physicians are usually more interested in finding one or more diagnostic tests, and usually place a great deal of interest in the outcome of such a diagnostic test, we must understand that estimating a pretest probability as accurate as possible is at least equally important. We have no foolproof method for this estimation, and any attempt is likely to be inaccurate. Considering different approaches, some more subjective, based on experience and clinical judgement, and others more objective, based on evidence or additional tools such as clinical prediction rules, reduces error and increases the accuracy of the process. It may be more appropriate to mentally work with "probability ranges" rather than "fixed" values. Inaccurate pretest probability estimates will inevitably lead to inaccurate posttest probability estimates (and thus diagnostic errors or inappropriate treatment), even if the diagnostic method used is correct. Therefore, an effort to estimate the pretest probability with all available resources will lead to a substantial improvement in decision making with our patients.

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