

For last several years, I have been studying the application of Bayesian reasoning to diagnosis in which I have been most intrigued by the notion of interpreting the prior probability of a disease, suspected from a presentation, as prior degree of belief for or against this disease. It is not clear to me what useful purpose is served in terms of diagnostic accuracy by interpreting a prior probability, which is usually derived from prevalence (frequency) of a disease in a population, as prior degree of belief for a disease in a given patient, when Bayesian reasoning is employed for diagnosis as prescribed. On the contrary, this interpretation is likely to have a negative impact by encouraging failure to suspect a disease with an atypical presentation due to its low prior probability being interpreted as prior degree of belief against it leading to a diagnostic error, which has actually been reported in several studies.

We find experienced physicians in practice do not interpret a prior probability as prior degree of belief for a disease as we note in all published diagnostic exercises in real patients such as in clinical-pathologic conferences (CPCs) and clinical problem-solving exercises. In all these exercises, a suspected disease is merely a hypothesis without any prior probability attached to it so that it does not have any prior degree of belief for or against it. The great advantage of employing this strategy is that every suspected disease as a hypothesis is tested and diagnosed accurately if it is present, regardless of its presentation (prior probability) in these exercises. This is the reason, I believe, that, diseases with highly atypical presentations (low prior probabilities) are diagnosed accurately on a routine basis in these exercises. In my personal experience too, I have not found any experienced physician including myself interpret the prior probability of a disease as prior degree of belief during diagnosis. This is not done, I suggest, as it prejudices the issue and may lead to ruling out a disease with an atypical presentation without testing, as noted above.

We note that a posterior probability, from which a disease is diagnosed, is generated from a prior probability in Bayesian reasoning. In diagnosis in practice, as a suspected disease does not have a prior probability attached to it as discussed above, a posterior probability is not generated and a disease diagnosed from it. Instead, a disease is diagnosed from a test result with likelihood ratio (LR)

greater than 10, if a test capable of generating such a result is available, based on its known performance in diagnosing a disease accurately with a high frequency of 85 percent or more in patients with varying prior probabilities. As this diagnosis is made in any patient regardless of prior probability of a disease, prior probability obviously does not play any role in it.

In brief, the method of diagnosis, as we see in practice, consists of formulating a suspected disease as a hypothesis without any prior probability attached to it and inferring (diagnosing) the hypothesis to be correct (or not) from a highly informative test result with LR greater than 10, if available. This method is the frequentist confidence method, which is the other major method of statistical inference (other than the Bayesian method). The only role of prior probability in practice, in my view, is in prioritizing testing of various diseases in a differential diagnosis in a non-urgent diagnostic situation. The disease with the highest prior probability is tested first as it has the greatest chance of being present.

It seems to me, it is not widely appreciated that the Bayesian method has not been prescribed for diagnosis due to its diagnostic accuracy but due to its coherence defined in terms of not losing a bet placed on a Bayesian inference. As the goal of practicing physicians is achieving high diagnostic accuracy and not achieving coherence, it is not surprising to me that this method is not employed for diagnosis in practice.

I do not find the Bayesian method to offer any advantage in achieving high diagnostic accuracy; instead its use is likely to lead to diagnostic errors if it were to be employed for diagnosis. I suspect experienced physicians are aware of this fact and therefore do not employ it for diagnosis in practice. I have looked extensively but have not found any published case report or study of its use in diagnosis in practice. Perhaps, I have not looked hard enough; I would appreciate if a SIDM member could tell me about such a study he or she might have come across.

I find it highly unusual that a method (the Bayesian method) is prescribed for diagnosis as the normatively correct method, but does not appear to be employed at all in practice. I have not found such a wide disparity between a

prescribed method and its use in practice in any other field. I believe it is important to resolve this disparity to improve teaching of diagnosis to novice physicians and to decrease diagnostic errors. For example, in my view, there is not much point in estimating a prior probability accurately, as it does not play any significant role in diagnosis in practice as discussed above. This estimation is important only if the Bayesian method is employed for diagnosis in practice which is not actually the case.