In several earlier papers (1,2,3), we have pointed out that the prescribed Bayesian method is not employed for diagnosis in practice. In this paper, we shall compare these two methods to bring out clearly why the Bayesian method is not employed for diagnosis in practice.

Let us consider two patients, a 40 year old woman and a 65 year old man, in both of whom acute myocardial infarction (MI) is suspected from the presentation.

The 40 year old woman who has been discussed in a clinical problem solving exercise (4) is healthy, without any cardiac risk factors and presents with highly uncharacteristic chest pain and is found to have acute Q wave and ST elevation EKG changes (acute EKG changes).

The 65 year old man, often seen in practice, has multiple cardiac risk factors and presents with highly characteristic chest pain and is found to have non-specific T wave EKG changes.

The prior probability of acute MI is estimated to be 7 percent in the 40 year old woman from its prevalence and combined with likelihood ratio (LR) of 13 (5) for acute EKG changes by Bayes’ theorem to generate a posterior probability of 50 percent (4).

Let us suppose the prior probability of acute MI is estimated to be 85 percent in the 65 year old man which is combined with the LR of 1 for non-specific T wave EKG changes to generate a posterior probability of 85 percent.

In the Bayesian method, acute MI would be diagnosed to be indeterminate from the posterior probability of 50 percent in the 40 year old woman while it would be diagnosed with a high degree of certainty from the posterior probability of 85 percent in the 65 year old man.

In practice however, acute MI is not diagnosed in the above manner in these two patients.

In the clinical problem solving exercise in which the 40 year old woman was discussed, the discussing physician diagnoses acute MI definitively in her from the high LR of 13 for acute EKG changes alone (4).
In the 65 year old man, acute MI would not be diagnosed with any degree of certainty in practice, we suggest due to presence of non-specific EKG changes with LR of 1.

Let us now analyze why acute MI is not diagnosed in a Bayesian manner in practice from the posterior probability in these two patients.

The reason, we suggest, is that the posterior probability does not locate evidence for acute MI in the given patient of interest, as a probability is a frequency in a population (6).

Thus the posterior probability of 50 percent only informs us that 50 percent patients in a population similar to the 40 year old woman with acute EKG changes will have acute MI.

As this information does not provide us any evidence for or against acute MI in the given 40 year old woman, it is not employed for diagnosis in this patient.

The LR of 13 for acute EKG changes, on the other hand, indicates a thirteenfold increase in odds (probability) of acute MI in this particular patient (Appendix 1) thus providing strong evidence from which acute MI is diagnosed with near certainty in her.

Similarly, the posterior probability of 85 percent merely tells us that 85 percent patients in a population similar to the 65 year old man with non-specific TR wave changes have acute MI.

Again as this information does not provide any evidence for or against acute MI in the given 65 year old man, it is not employed for diagnosis in this patient.

The LR of 1 for non-specific T wave EKG changes in this patient does not change the odds of acute MI at all in this patient and thus provides no evidence for acute MI in this patient (Appendix 2).

Therefore acute MI is not diagnosed with any degree of certainty in this patient despite a posterior probability of 85 percent.
Thus the Bayesian method is not employed for diagnosis, because the posterior probability fails to locate evidence for a disease in the given patient of interest.

Instead, the diagnosis is made from a likelihood ratio because it locates evidence in the given patient of interest.

We note that the LR of 13 for acute EKG changes represents a thirteenfold increase in odds of acute MI in every patient regardless of prior probability of acute MI.

This indicates, we suggest that acute EKG changes provide strong evidence for acute MI in every patient and this underlies the practice of diagnosing acute MI from acute EKG changes in any patient regardless of prior probability (7).

The accuracy of diagnosis of acute MI from acute EKG changes across patients with varying prior probabilities has been found to be 85 percent (5).

This high experienced diagnostic accuracy is employed, as we have discussed elsewhere, to diagnose acute MI from acute EKG changes definitively with a confidence level of 85 percent in a given patient with acute EKG changes by means of a confidence argument (8).

We note that prior probability of acute MI plays no role in diagnosis of acute MI from acute EKG changes in either of these two patients. Therefore, the function of a presentation from which a prior probability is derived is merely to make us suspect acute MI which is then formulated as a diagnostic hypothesis that is evaluated by performing an EKG.

The method of diagnosis of acute MI in practice consists therefore of hypothesis generation and hypothesis verification, which is identical, as we have pointed out, to the scientific method (9).

We find that all diseases which have tests capable of generating results with likelihood ratios greater than 10 (10) are diagnosed in practice in a manner similar to that of acute MI.
For example, pulmonary embolism is diagnosed definitively from positive chest CT angiogram. LR 20 (11) and deep vein thrombosis from positive venous ultrasound from positive venous ultrasound, LR 16 (12) in every patient regardless of prior probability.

The scientific method is employed for diagnosis in practice, we suggest, due to the goal in diagnosis of determining a disease correctly in every patient regardless of prior probability.

If the goal in a certain field is not accuracy of inference in every individual person but accuracy in a group of persons in the long run such as in life insurance business, then an inference is made from a probability in a Bayesian manner as we have discussed elsewhere (2).

The creation of a comprehensive differential diagnosis which includes diseases with high as well as with low probabilities is well known to be a key step in achieving high diagnostic accuracy (13).

However, inclusion of diseases with low prior probabilities in a differential diagnosis would be discouraged if the Bayesian method were to be employed for diagnosis as the low prior probabilities would be interpreted as evidence against these diseases in a given patient. This exclusion would obviously increase diagnostic errors.

In the scientific method of diagnosis, on the other hand, every suspected disease is a diagnostic hypothesis without any prior evidence for it. This encourages, we believe, creation of a comprehensive differential diagnosis which includes diseases with low prior probabilities.

We conclude from the above discussion that the scientific method, which is employed for diagnosis in practice is superior to the prescribed Bayesian method in every respect.

In our view, if the goal in diagnosis is diagnostic accuracy in every patient regardless of prior probability, then the continued prescription of the Bayesian method for diagnosis cannot be justified.
Appendix 1

In odds form of Bayes' theorem,

Prior odds x likelihood ratio = Posterior odds,

Thus, Posterior odds / Prior odds = Likelihood ratio = 13.

Appendix 2

Posterior odds / Prior odds = Likelihood ratio = 1.

References


