Even though the importance of experience in diagnosis has been emphasized (1), its precise role remains far from clear. In this paper, we shall analyze this important issue.

Experience has been described as knowledge or skill in a particular job or activity which is gained from doing that job or activity for a long time (2). Based on this description, we shall consider a physician to be experienced in diagnosing a particular disease, acute myocardial infarction (MI), for example, if he has diagnosed this disease in a large number of patients over a long period of time in the past. There are two important facts, we suggest, he would learn from this experience which are (a) acute MI occurs with varying presentations and therefore with varying prior probabilities, which range from being high to low, in different patients, (b) if a highly informative test result, such as acute ST elevation EKG changes with likelihood ratio (LR) of 13 (3) is observed in a patient in whom acute MI is suspected, this disease is diagnosed accurately in 8 to 9 out of 10 (in 86 percent) such patients, regardless of prior probability of acute MI (4).

Based on this experience, we suggest, this physician is likely to suspect acute MI in a patient with a typical or an atypical presentation that he encounters now and formulate it as a hypothesis which he will test by performing an EKG. And if acute ST elevation EKG changes are observed in this patient, he will infer this hypothesis to be correct and diagnose acute MI with a high degree of accuracy, regardless of its prior probability. This is seen in a real patient discussed in a clinical problem solving exercise (5), the patient being a healthy 40 year old woman with no cardiac risk factor who presents with highly uncharacteristic chest pain. The prior probability of acute MI is estimated to be 7 percent in this patient from its prevalence. An EKG reveals acute ST elevation EKG changes from which alone the discussing physician diagnoses acute MI accurately with a high degree of confidence in this patient who has a very low prior probability of acute MI.

We note the diagnosis of acute MI in the above patient is not made by the Bayesian method (6), in which the very low prior probability of 7 percent would be interpreted as very strong prior degree of belief against acute MI and it would be inferred to be indeterminate from a posterior probability of 50 percent

(Appendix) generated by combining prior probability of 7 percent and LR of 13. These Bayesian steps are not taken by the discussing physician, we suggest, because they are inconsistent with his experience. Thus the low prior probability of 7 percent interpreted as very strong prior degree of belief against acute MI may encourage him to rule it without testing, but this is not done as he is likely to have encountered a similar patient with a low prior probability in the past who was found to have acute MI. Similarly, in his experience the test result, acute ST elevation EKG changes leads to an accurate diagnosis of acute MI in practically every patient in whom it is suspected (in 86 percent patients). He could only have had experience corresponding to the Bayesian diagnosis of acute MI being indeterminate from the posterior probability of 50 percent if he had observed a frequency of 50 percent corresponding to this posterior probability. This would be possible, we suggest, only if he lived in a universe in which all patients in whom acute ST elevation EKG changes are observed have the same prior probability as in the given 40 year old woman. The comment about the Bayesian method (or the conceptualist method as he called it) made by the eminent philosopher of science, Charles Sanders Peirce (7), that Bayesian inference would be valid only if 'universes were as plenty as blackberries', is relevant in this context.

The real life fact is that all physicians live and practice in this one universe, in which they gain their experience in diagnosing any given disease from patients with varying presentations and thus with varying prior probabilities. And it is this experience which is employed by a highly reliable method for diagnosis of a disease in a given, individual patient. This method consists of suspecting a disease from a presentation and formulating it as a hypothesis without attaching any prior probability to it so that it does not have any prior degree of belief for or against it. The hypothesis is then tested and inferred to be correct if a highly informative test result with LR greater than 10 (8) is observed, with a high degree of confidence in the high accuracy of this inference. This highly reliable method is identical, as we have discussed elsewhere (9), to the frequentist confidence method which is the other major method of statistical inference (other than the Bayesian method) (10). Therefore, we shall call the highly reliable, experienced based method employed for diagnosis in practice as the confidence method.

We find that in addition to acute MI, any disease which has a test capable of generating a highly informative result with LR greater than 10 (8) is diagnosed in practice by the confidence method. For example, pulmonary embolism is diagnosed from positive chest CT angiogram, LR 20 (11); deep vein thrombosis from positive venous ultrasound study, LR 16 (12); and covid-19 disease from positive covid-19 PCR test, LR 14 (13) in any patient regardless of prior probability of respective disease. A disease which does not have such a test is diagnosed, we suggest, from a combination of two or three test results whose combined LR is greater than 10, but this, we believe, needs to be studied further.

We note that the experience based confidence method is employed in every published diagnosed exercise in a real patient such as in a clinical-pathologic conference (CPC) or a clinical problem solving exercise. (14,15) In all these exercises, a disease is suspected from a presentation, formulated as a hypothesis which is inferred to be correct if a highly informative test result is observed. Due to this method, we find diseases with atypical presentations (low prior probabilities) to be diagnosed accurately on a routine basis in these exercises.

A remarkable feature of the experience based, confidence method is that it is employed for diagnosis of a disease in a similar manner all over the world , wherever a given disease is suspected from a presentation and inferred (diagnosed) from a highly informative test result. For example, acute MI is diagnosed from acute ST elevation EKG changes with the same high degree of confidence in the high accuracy of this diagnosis in USA (16), Europe (16), India (17) and Africa (17). This similarity in diagnosis is due to the fact that experience in diagnosing a disease is gained from a random series of patients with varying prior probabilities in which a disease such as acute MI is suspected and tested, as we have discussed in detail elsewhere (19).

We have looked carefully, but have not found any published case report or study in which the prescribed Bayesian method has been employed for diagnosis in a real patient. This is consistent with the finding of the eminent clinical investigator, Alvan Feinstein (20), who noted, “I know of no clinical setting or institution in which the Bayesian diagnostic methods are being regularly used for practical

diagnostic purposes in a routine or specialized manner". We do not find the non-use of the Bayesian method for diagnosis in practice to be surprising, for this method has been prescribed due to its coherence based on a betting argument (21) and not due to its diagnostic accuracy. A leading Bayesian statistician, Dennis Lindley (22) has said about this method, "The Bayesian theory is about coherence, not about right or wrong". It seems obvious to us that a practicing physician is not going to use a method for diagnosis, which is "not about right or wrong" when his goal is achieving high diagnostic accuracy.

Due to the crucially important role of experience in diagnosis, we believe, virtual experience about diagnosis of a disease can be imparted to novice physicians as follows:

Take 50 medical records of 50 consecutive patients seen at a medical center in whom a highly informative test result such as acute ST elevation EKG changes was observed in patients in whom acute MI was suspected from a presentation. Have novice physicians review these 50 medical records under supervision of an experienced physician teacher. They would note the wide variation in presentations and thus in prior probabilities of acute MI in these patients in whom acute MI is suspected. They would also note that acute MI has been diagnosed with a high degree of confidence in every patient from acute ST elevation EKG changes alone regardless of presentation (prior probability of acute MI). They will find this diagnosis to be correct in 8 to 9 out of 10 (about 86 percent) patients based on coronary angiography which is nearly always done in these patients.

This virtual experience is identical to real experience of practicing physicians, we believe, as it has been gained from a random series of 50 patients. This virtual experience should help them, we suggest, in diagnosing acute MI accurately in the next patient, who presents to them with a typical or atypical presentation. Similarly, virtual experience can be provided about any other disease, which has a test capable of generating a highly informative result with LR greater than 10, such as pulmonary embolism and deep vein thrombosis.

In conclusion, we have discussed how experience plays a key role in diagnosing a disease accurately in practice regardless of whether its prior probability is high or low. We point out the experience based method employed for diagnosis in practice is the frequentist confidence method in which a suspected disease is formulated as a hypothesis without any prior probability attached to it so that it does not have any prior degree of belief for or against it and it is inferred to be correct from a highly informative test result (with LR greater than 10) with a high degree of accuracy. We have argued that diagnostic reasoning with the prescribed Bayesian method is not consistent with our experience, so that its use is likely to lead to diagnostic errors if it were to be employed for diagnosis in practice. We point out we are not able to find any published study or case report in which the Bayesian method has been employed for diagnosis in a real patient.

Appendix

Prior probability of 7 percent = Prior odds of 7/93

In odds form of Bayes' theorem,

Prior odds x Likelihood ratio = Posterior odds Therefore,

7/93 x 13 = 1/1 = Posterior probability of 50 percent

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