1. Bayesian reasoning is about coherence (1) while diagnosis is about accuracy.
2. In Bayesian reasoning, an initial subjective belief represented by a prior probability is updated by new data to generate a final subjective belief represented by a posterior probability by employing Bayes' theorem (2)
3. An inference made from a posterior probability is considered coherent as it prevents a Dutch book, which is a series of bets that ensures betting loss, from being created against us if the inference is looked upon as a bet made with odds based on the posterior probability (3).
4. It is to be noted Bayesian inference is silent about accuracy, that is, about correspondence of the inference to presence or occurrence of an event.
5. Bayesian reasoning has been prescribed for diagnosis, it appears due to its coherence (4), while the issue of diagnostic accuracy with this prescription has not been addressed.
6. In diagnosis, as is well-known, the goal is achieving very high accuracy in diagnosis of a disease in patients with varying presentations and therefore with varying prior probabilities.
7. Whether this goal of high diagnostic accuracy will be achieved if the prescribed Bayesian reasoning is employed for diagnosis in practice is not clear as prescription of Bayesian reasoning is silent about (inferential) accuracy.
8. We shall now assess diagnostic accuracy with Bayesian reasoning by looking at it critically from the point of view of a practicing physician.
9. First of all, let us look at the role of the Bayesian notion of interpreting prior probability of a disease as prior degree of belief for or against it. It is not clear to us in what way this notion could promote diagnostic accuracy as it is well known from experience that a disease could be present in a patient regardless of whether its prior probability is high or low. In fact, we believe this notion could lead to a diagnostic error in a patient with an atypical presentation by failing to suspect or test a disease by interpreting its low prior probability as prior evidence against it.
10. The only role of a prior probability of a disease, derived from a prevalence, in our view, is by interpreting it in a non-Bayesian manner as chance of a

disease to help us prioritize testing of this disease. If the prior probability is high, we test this disease first as it has a greater chance of being present.

11. The other Bayesian notion of inferring a disease from a posterior probability generated by combining a prior probability and a likelihood ratio (LR) for a test result is also a source, in our view, of diagnostic error and confusion.
12. If the prior probability of a suspected disease is very low, 7 percent and the LR very high at 13, the generated posterior probability of 50 percent may lead to an erroneous Bayesian diagnosis as noted in a real patient in a clinical problem solving exercise (5).
13. Similarly if the prior probability is very high, say 85 percent and LR of a test result non- informative at 1, the generated posterior probability of 85 percent may lead to an erroneous Bayesian diagnosis as we have discussed recently (6).
14. Therefore, Bayesian reasoning appears to lead to diagnostic errors instead of promoting diagnostic accuracy which is why, we believe, it is not employed for diagnosis in practice as we note in all published diagnostic exercises in real patients such as in clinical-pathologic conferences (CPCs) and clinical problem solving exercises (6,7).
15. At a personal level too, we have not found discussion about diagnosis among colleagues or in morbidity-mortality conferences to be in Bayesian terms. Thus we have not found anyone to talk about his or her prior or posterior degree of belief or to infer a disease from a posterior probability or to comment about coherence of a diagnosis.
16. In conclusion, Bayesian reasoning has been prescribed for diagnosis due to its coherence and not due to its diagnostic accuracy. The goal in diagnosis, on the other hand is achieving high diagnostic accuracy, which cannot be achieved, as we have argued in this essay, by Bayesian reasoning which in fact leads to diagnostic errors. It is not surprising therefore that Bayesian reasoning is not employed for diagnosis in practice.

References

1.Lindley D. Bayesian Statistics In Harper W and Hooker C (eds). Foundations of Probability Theory, Statistical Inference and Statistical Theories of Science. Vol 2, Boston MA: D Reidel; 1976 pp 353-62.

2. Weinstein MC, Fineberg HV. Clinical Decision Analysis. Philadelphia: WB Saunders Company, 1980.

3. Edwards W, Lindman H, Savage LJ. Bayesian statistical inference for psychological research. Psych Review 1963; 70: 193-242.

4. Jain BP. History of prescription of the Bayesian method for diagnosis. Posted on Discussion Board, SIDM on July 15, 2021.

5. Pauker SG, Kopelman RI. How sure is sure enough? N Engl J Med 1992; 326: 688-91.

6. Jain BP. The consequences of employing the Bayesian method for diagnosis. Posted on Discussion Board, SIDM on June 21, 2021.

7. Jain BP. An investigation into method of diagnosis in clinical-pathologic conferences (CPCs). Diagnosis 2016; 3: 61-64.

8. Jain BP. Why is diagnosis not probabilistic in clinical-pathologic conferences (CPCs): Point. Diagnosis 2016; 3: 95-97.