Computers can accurately diagnose primary headache disorders as well as most physicians

Yes: **Robert Cowan,** USA

2500 years ago, patients would queue in the town square and await their turn to see the traveling physician, hoping he would have the right diagnosis and treatment in his head. We have come a long way since then. Today, patients sit in waiting rooms, awaiting their turn to see the physician, hoping he or she would have the right diagnosis and treatment in his head. 2500 years ago, according to the best medical science, there were four diseases, corresponding to black bile, yellow bile, phlegm and blood. And there were four treatments: bleeding, vomiting, diarrhea, and expectoration. Most physicians could keep the diagnoses and treatments straight. But today, approximately 100,000 distinct disease states have been described, and most have multiple treatment options. To expect "most physicians" which means primary care doctors, to retain enough information to diagnose and properly treat 100,000 different diseases is a tall order.

The challenge to a primary care doctor confronted with a patient presenting with headache is only slightly less daunting. Bearing in mind that headache makes up only a small percentage of the patient complaints seen in a typical primary care clinic, the primary care physician would need to know the diagnostic criteria for more than 150 primary headache disorders identified in the ICHD 3 (beta). And this number does not even include the many secondary headache disorders that could present in the out-patient setting.

Admittedly, many of the 150 headache disorders identified in ICHD 3 (beta) are relatively uncommon, but even among the common primary headaches: Migraine with aura, Migraine without aura, Cluster, Tension-type headache, and chronic the chronic forms of each, the diagnostic criteria are quite specific, and it is the rare Neurologist, much less primary care physician that can accurately characterize each of these clinical entities. Indeed, even among headache specialists, careful review of documentation does not always support the clinical impression if one adheres strictly to ICHD 3 (beta) criteria.

Thus, there is little evidence to suggest that primary care doctors do an adequate job of diagnosing the primary headaches. In fact, there is considerable evidence to the contrary. Is a computer any better?

A computer program is only as good as the programmer makes it. If the program does not ask the right questions, the correct conclusions cannot be drawn. If the rule engine does not extract the correct data points or the correct data points are not available, then the program fails. Fortunately, when there are established criteria for diagnostic categories, as there are in the ICHD 3 (beta) it is a simple matter of reverse engineering to create questions that will identify data points to meet or exclude those criteria. Thus, a computer program cannot, by definition, draw a conclusion that is not supported by data. The variable, of course, is the quality of the data obtained.

There is a variety of techniques to help ensure the reliability of the query. For example, the same data point can be approached several ways with different

questions, or even the same question phrased several different ways. The consistency of the responses can then be valued with respect to reliability. For example: if we want to identify the migrainous feature of light sensitivity, the question could be "are you sensitive to light?" This question, standing alone could have several interpretations that may or may not be related to a diagnosis of migraine. The patient could have photophobia due to a concurrent condition such as retinitis pigmentosa, or light sensitivity of long-standing, not correlated with other migrainous features resulting from light eye color or even central sensitization due to another chronic primary headache condition. However, if the response to that question is combined with a question about light avoidance during a headache, and association with sound sensitivity (ICHD 3 (beta) requires BOTH photophobia and phonophobia), the reliability of the data point [+ photophobia] becomes more reliable.

It is also possible to use decision-tree analysis (in which the response to one question prompts the next question), and machine learning to improve the quality of the data. These techniques when combined with clinical expertise from a panel of experts can reliably tie historical elements obtained in a web or app-based history to specific sets of diagnostic criteria. One might even argue, that a well-designed computer program is MORE reliable than an unstructured or semi-structured interview for reaching a diagnosis that meets specific criteria because it is not prey to the vagueries of memory or interviewer bias.

Where then is the role of the clinician in the diagnosis of primary headache? The diagnostic algorithms of a computer-based tool is only as good as the data that is entered. There is no physical examination, no diagnostic testing. At best, the computer can make a diagnosis based on historical elements provided by the patient and the physician. If the physician can also enter findings on examination and testing, the diagnostic accuracy can be improved in so far as findings on examination and testing are requisite to the diagnosis.

In the case of a patient presenting with a primary headache disorder, the consensus among headache specialists is that the vast majority of these headaches can be diagnosed based on history alone. This is not to say that examination and testing are irrelevant, only that these components of the medical encounter rarely change the diagnosis generated from the history in patients with primary headache. Given that the gold standard, at present, is a clearly articulated set of criteria for a large number of entities, the computer is ideally suited to correlate data points in the history with elements of diagnostic criteria, not prone to interviewer bias or knowledge deficits.