

Charles Sanders Peirce, 1839-1914, is considered to be the greatest American philosopher of all time (1) due to his highly original contributions in a number of different fields which include founding the pragmatism school of philosophy, founding semiotics (study of signs), contributions in logic, mathematics and philosophy of science to name some of them. In this paper, we shall argue that his characterization of scientific investigation as consisting of abduction, deduction and induction (2) describes precisely the method employed for diagnosis in practice by experienced physicians.

He states that when we encounter an unexpected or surprising situation, we think of a cause to explain it, based on our knowledge and experience. This thinking is usually no more than guessing as there is no evidence initially to support the thought of cause. Therefore the status of this cause is that of a hypothesis, that is, an assumption which may or may not be correct. Peirce calls this process of guessing and formulating a hypothesis, abduction. He considers abduction the most important step in an investigation as it leads to a plausible cause which we then proceed to verify as being correct. Without this step, we do not have a plausible cause and thus the investigation cannot proceed.

Let us now look at the process of diagnosis in practice. We encounter a patient with a symptom for example with chest pain, which is unexpected. We guess, based on our knowledge and experience, that acute myocardial infarction (MI) is a plausible cause of this presentation and formulate it as a hypothesis. That is, we perform abduction as described above.

It is to be noted that a prior probability is not attached to a hypothesis developed by abduction in Peirce's account (2), which is in sharp contrast to what was done by the "conceptualists" (term for followers of the subjective Bayesian method of inference) at that time. This is not done because Peirce believed in the objective interpretation of a probability as a frequency and a prior probability could only be derived objectively, he famously commented, if "universes were as plenty as blackberries" (3).

We find that we follow Peirce in not attaching a prior probability to a disease hypothesis during diagnosis in practice, as we pointed out recently (4), even

though attaching a prior probability to a hypothesis is a key feature of the Bayesian method which has been prescribed for diagnosis in theory (5). A prior probability is not attached to a hypothesis in practice because, as we have discussed, it is likely to cause diagnostic errors (4).

The second step in Peirce's account of the method of investigation is deduction, in which one or more key features of a cause, which is formulated as a hypothesis, are deduced, so that they can be searched for by appropriate tests. This is done in diagnosis in practice, for example, by deducing acute myocardial injury as a key feature of acute MI, which is formulated as a hypothesis in a patient with chest pain. A test, an EKG is performed to search for this key feature in this patient.

Let us suppose, the highly informative test result, acute ST elevation EKG changes, is observed on performing an EKG in this patient. According to Peirce, the third step in his method of investigation, induction (2), now comes into play in inferring acute MI from this test result. He says that we employ a procedure, which has a high probability in the form of a high frequency of accurate inference of acute MI given this test result, in inferring acute MI in this patient.

It will be noted that the method of inference in Peirce's third step of induction is identical to the frequentist confidence method developed by Neyman in first half of twentieth century (6), that we have described in detail elsewhere (4). Peirce is now recognized as a precursor of Neyman (7) in development of the frequentist confidence method of inference.

It is of interest that Peirce had a deep interest in medicine including diagnosis, even though he was not a physician. His last attending physician G Alto Pobe claimed (8) that "Peirce knew more medicine than I did....He would often tell me all his symptoms and diagnose his illness...He was never wrong". We wonder if his interest and excellence in diagnosis is related in some way to his studies on the scientific method of investigation.

We mention here a few interesting facts about Peirce's life and career (9). He was born in an illustrious family; Sanders Theater in Harvard is named after one of his

ancestors and his father, Benjamin Peirce, a professor at Harvard, was the leading mathematician in America at that time. Unfortunately, due to most of his ideas being far ahead of his time and due to his difficult personality, he did not hold an academic position except for a few years as Lecturer in Logic at Johns Hopkins from 1879-1884 and lived in poverty for the last 30 years of his life. His output was enormous, his published work constitutes 12,000 printed pages and his known unpublished manuscripts run to about 80,000 handwritten pages (2).

References

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