

The two faces of medical evidence

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Summary

The dictionary definition of “evidence” is given. The meaning of evidence in the history of science is described. Clinical examples are presented to illustrate different aspects of evidence, i.e. the mechanistic versus the semiotic points of view. Evidence is explained in the light of con-

structivism, and suggestions are presented as to how evidence can be applied in a biopsychosocial model of medicine.

Key words: evidence-based medicine; theoretical models of medicine; constructivism; semiotics

The term “evidence” is defined in the dictionary as follows: “the available facts, circumstances, etc. supporting or otherwise a belief, proposition, etc. or indicating whether or not a thing is true or valid; clearness, obviousness.” The word “evident” is defined as “plain or obvious; manifest”. These terms imply that truth and reality are in plain view and merely need describing. Sackett [1] defined evidence-based medicine as “the conscientious, explicit and judicious use of current best evidence in making decisions about the case of individual patients”.

Descartes (1596–1650) [2] defined evidence as “clara et distincta perceptio”. His separation of subjectivity, or “res cogitans”, from objectivity, or “res extensa”, places evidence next to the latter, making it something exterior, tangible and usable. Locke (1632–1704) [3] considered reason to be a “tabula rasa”, or white sheet of paper, on which perception, an equivalent of “experience”, is depicted. In his “Essay Concerning Human Understanding” he writes: “All the materials of reason and knowledge come from one word, ‘experience’, which can be equated with ‘perception’. Let us then suppose the mind to be, as we say, white paper, void of all characters, without any ideas.” Hume (1711–1776) [4] added the idea that the “regularity of nature’s processes” evokes the habit of perception. We may add the thought that the accuracy of perception of nature’s processes, that is, of reality, can only be guaranteed by repetition.

Clinical evidence can therefore be defined as the comprehension of those symptoms which prove themselves to be included criteria for the suitability of a certain kind of treatment using controlled observations. This is the essence of evi-

dence-based medicine. The evidence-based medicine-oriented physician merely needs to recognise those symptoms and signs which have proved themselves suitable for certain treatments. This appeals to physicians eager to intervene, as their patients, freed from subjective and social aspects, become objects open to intervention by the doctor’s hand, instrument or medication. Patients can be seen as systems comparable to a watch which can be opened and repaired. Using this model, medicine has yielded significant successes in the last 200 years.

The human being, seen as an open system, can be catalogued, closely defined, its diseases equated to faults in the running of a machine, and its treatment standardised. Lawmakers and economists can now control physicians and their treatments and decide on treatment costs and length of hospital stay. The model of the organism as an open system suggests that a certain type of stimulus always provokes the same response, according to the linear principle of cause and effect.

Observation of living organisms, however, teaches us the shortcomings of this model. Richter [5] exposed wild rats in a tank to a stream of water. The rats, whose whiskers had been trimmed for this experiment, swam for about two minutes, then sank to the bottom of the tank while their pulse frequency kept decreasing until they died in asystole. Where the animals were lifted out of the water before they began to sink and the experiment was repeated, the animals swam for many hours. What they experienced while being rescued in the first trial remains their secret; the living organism is a closed system.

An inherent governing body deals with the

stimulus before deciding on a response. The same applies to humans, as illustrated in the example of Tom, the laboratory assistant of Wolf and Wolff [6], who as a nine-year-old had scalded his oesophagus so severely with hot soup that the result was stenotic scars necessitating an epigastric fistula. During the operation, the large curvature of the stomach was attached to the abdominal wall. The gastric mucosa grew into the opening, which had a diameter of 3 cm. As a result, the mucosa was visible to the naked eye. Tom's stomach was instilled with prostigmin via the fistula. He responded with cramps and diarrhoea. Later a placebo substance resulted in the same symptoms. Even atropine, which is known to produce atony of the stomach, resulted in cramps and diarrhoea. The governing body within Tom had transferred the experience with prostigmin to the placebo and the atropine. Tom had attributed to atropine a meaning overruling the chemical effect of that substance. Semiotically interpreted, atropine merely acted as a vehicle for meaning, a sign of a working principle. This meaning had been imprinted on the vehicle by a governing body which Peirce (1839–1914) called the "interpretant" [7]. The two links of the cause-effect chain of the mechanistic model, or open system, now become three. The vehicle, as the first link, has the task of stimulating the receptors. The interpretant, as the second link, imprints this stimulus with a meaning. This meaning, according to von Uexküll (1864–1944) [8], the "Merk-Mal" (imprinted mark), prompts the organism to impregnate his environment with a "Wirk-Mal" (effect mark), thus concluding the chain of events as a third link.

Now a fundamental problem facing medicine becomes evident. Ginzburg [9] expressed it as follows: "At this point two possibilities present themselves. Either the recognition of the individual element (the interpretant) gets sacrificed in favour of a more or less strictly mathematically expressible generalization, or one tries to work out a different paradigm, one that is founded on the scientific recognition of the individual. The first path was chosen by the scientists and much later by the so-called humanists. The reason for this is obvious. The tendency to devalue the individual aspects is directly proportional to the emotional distance of the observer. Medicine has to decide whether the randomized patient represents its benchmark, or whether every patient contact requires that the patient can also be defined as a closed system. This also means being concerned with the evidence experiences carry for the patient".

The decision to introduce two kinds of evidence is a consequence of the understanding that we must cast a critical eye on the definition of experience adopted from Locke and Hume which lives on in the model of the organism as an "open system". If one closely examines the term "experience", which Locke equates with the term "perception", it appears that experience represents

nothing but a "white sheet of paper void of all characters, without any ideas". Let us illustrate this with an experimental ischaemic pain test, the "sub-maximal effort tourniquet technique" [10]. When healthy male trial subjects are put through this test, their pain-intensity time curve increases with exposure, reaching the intensity level "unbearable" after an average of 15–20 minutes. Some subjects reach the "unbearable" level after only three to four minutes, others do not reach it at all and describe their pain as moderate even after 60 minutes, when the test is terminated for safety reasons. If the trial subjects are viewed according to the model of the organism as an open system, responding mechanically to external influences, their placebo, empty trial run, known analgesic, and trial substance curves show no differences. After each trial the subjects were interviewed with regard to fear, will to persevere in the test situation and subdue pain, and attitude to the experimenter. When they were separated into calm and interested subjects on the one hand, and fearful, heroic, pain-denying subjects on the other, it appeared that the first group was able to differentiate significantly between the four trials, i.e. the placebo and the analgesics. The perception of the different subjects was anything but "white paper void of all characters, without ideas". On the contrary, it was heavily influenced by their specific personal history. A subject who reached the level "unbearable" after three to four minutes had been a professional pianist before studying medicine and feared damage to this ischaemic arm, whereas the subject who reached the 60-minute mark feeling only moderate pain had been raised in a family where the word "unbearable" was frowned on. There is a neurophysiological explanation: the comparably mild, peripherally active analgesics which were used can only be centrally identified by the sensory-discriminative system (lateral thalamus) if the motivating-affective system (limbic), which contributes the hurting quality to the experience of pain, and the central control system (grey cortex), which contributes the life-long experience of pain, do not overrule the analysis of the centripetal impulses in the sensory-discriminative system. It therefore depends on the self-observer and his attitude towards the experiment and the theory of the experimenter as to what results the experiment produces. This insight was gained by physicists at the beginning of the 20th century [11, 12], and was called the "observer problem". Our experiment makes it clear that modern science can no longer cling to the notion of reality as a depiction on a "tabula rasa" of the mind. Instead, it must investigate how an organism constructs its environment in order to satisfy its needs.

Glaserfeld [13] expresses this understanding when he states ".that reality doesn't exist but is constructed by us and that the notion of a 'congruence' of our construction of reality with reality is replaced by the notion of 'matching'". "Knowledge", he writes, "is useful if it matches the limit-

ing conditions of (the unknown) reality and doesn't collide with them". Or, phrased in another way: "... if it doesn't contain any discrepancies with the functioning of the black box which for us signifies reality. For between our experience and what the philosophers call ontologic reality there exist merely hypothetical connections". This epistemological view is called "constructivism". It needs to be complemented by the insight that we receive only signs from our environment the meaning of which we must interpret ourselves in the light of our needs and experiences. We can therefore say: signs are indices for something, the meaning of which the sign-receiver interprets himself and for which he needs an interpretant. Using Tom's example, we demonstrated how his interpretant gave the stimulations of his sensory receptors a meaning and constructed his environment. The material of our constructions, according to Peirce, is therefore signs which fill the universe. This insight subjects our idea of science to a radical change. No longer is its task (or capability) to depict a reality before and beyond our knowledge, for such reality is not accessible to us. We can only construct realities according to our theories and investigate whether the processes as comprehended contradict our theory. Today, science no longer means "discovery of a given reality pre-dating all experiences" but, much more modestly, the interpretation of observed phenomena according to defined principles of order. This leads us back to Ginzburg's conclusion that historically two principles of order can be identified which in turn lead to different forms of science.

Ginzburg calls one form the "science of indices", which he classifies as the hunter cultures which had learned to recognise clues as the "not directly perceptible reality" of prey or enemies, based on footprints in the mud and broken branches. The other form he calls the "Galilean sciences", which are based on the notion of empiric experience which has dominated the development of science over the last 200 years to such an extent that the science of indices has been lost. The evidence of experimental proof is based on the possibility of repeating the events in question. This stands in contrast to an individuating science which excludes repeatability by definition because an organism's history changes it with every event and only allows quantification as an auxiliary function. For the science of indices, evidence means the appearance of the future based on the signs of the present. In this way, the hidden prey becomes apparent to the hunter thanks to the traces he saw in the mud. For the constructivist view, according to which everyone constructs his or her own reality, evidence means the certainty that signs are indices for something imprinted with a meaning. It is certainly not yet widely known that in the meantime the "Essay Concerning Human Understanding" has been rewritten by Jean Piaget [14], not as philosophical speculation but as the consequence

of empirical tests on the origin of intelligence in children. According to this, our mind constructs our reality within the framework of sensomotor circular reactions. These consist of space-time and linear-causal elements used to check the sensory constructions of our needs and wishes. We have torn apart this ongoing interaction between the two components of our construction of reality, thus creating the two incompatible worlds of physics and psychology. For the science of indices, the term "evidence" is devised from the Latin verb "videre". Perception implies the ability to see whether the signs we receive match the designated ones which comprise our reality.

Whether medicine acts in a Galilean or indices-scientific way depends on the theoretical viewpoint of the observer, his formulation of a question and, significantly, the situation the problem itself presents. The paradigm for a Galilean procedure and the application of the empirical term "evidence" represents a situation where a patient's vital function fails, e.g. cardiac failure due to ventricular fibrillation. Personality, social circumstances and personal history are irrelevant in the critical period. The patient is prepared for the intervention of the hand, i.e. cardiac massage, the instruments, the defibrillator and the antiarrhythmic drugs. We know, however, from animal models, that experiences and situations in dogs [15, 16] and pigs [17] influence the occurrence of arrhythmias. In humans it is proven that depression, hopelessness and "vital exhaustion" [18-20], increase the risk of ischaemic heart disease in healthy individuals, and the risk of reinfarction and sudden cardiac death in individuals with a past history of myocardial infarction [21]. This makes it obvious that medical interventions in emergencies are best based on empirical evidence. In any other situation it is necessary to estimate how far the evidence of the machine model or the model of indices should be used.

The question whether evidence can and should form the basis of medicine can now be answered. There is the evidence of the linear cause-effect causality and the evidence of the meaning-cause-effect chain. Which should be the chosen evidence under the given circumstances depends on the situation and the way the physician formulates the question. He must always be aware of the fact that reality does not just exist, but that it represents a construct formulated in accordance with the machine model or the indices model, which consists of three links and is also called the biopsychosocial model.

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