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Epistemological Beliefs and Knowledge among Physicians: A Questionnaire Survey

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Abstract: **Background:** All sciences share a common underlying epistemological domain, which gives grounds to and characterizes their nature and actions. Insofar as physicians depend on scientific knowledge, it would be helpful to assess their knowledge regarding some theoretical foundations of science.
Objectives: 1.To assess resident physicians' knowledge of concepts and principles underlying all sciences. 2. To determine, to what extent physicians' epistemological beliefs and attitudes are compatible with the scientific paradigm.
Design: A questionnaire was administered to 161 resident physicians at three hospitals in Lima, Peru.
Results: 237 resident physicians were selected, 161 (68%) of whom agreed to answer the survey. 67% of respondents indicated they did not know what epistemology is, 21% were able to correctly define epistemology; 24% of the residents knew the appropriate definition of scientific theory. No respondents knew the philosophical presumptions of science; and 48% took a relativistic stand towards knowledge.
Conclusions: There appear to be deficiencies in the knowledge of scientific theoretical foundations among physicians.

Keywords: Epistemological beliefs, medical education, scientific knowledge.

Science differs from other forms of knowledge because of properties and content peculiar to it. Its formal background, objectives, concerns and methodology constitute a unique conceptual system, which shows and owns a distinctive epistemology whereby truthful, dynamic, contrastable and rectifiable knowledge may be obtained.[1-2] Science is a complex system with many of its bases being of philosophical and logical nature, rather than a mere aggregate of data, a set of rules or statistical conditions.[2-3]

The everyday practice of medicine thrives within a nexus of individual clinical expertise, "art", social values, and science. Without minimizing the other aspects; the concepts and data taken of basic and clinic sciences lend meaning to and explain clinical medicine,[4] thus biochemistry, physiology, pathology and pharmacology provide knowledge dealing with health, disease, and modes of therapy. Evidence is available that physicians require and utilize basic science principles and facts to explain, diagnose, and manage complex medical problems.[5] Nevertheless, data and facts are not the only knowledge lent by sciences. Scientific knowledge subsumes a set of epistemological, logical and ethical foundations.[2-3] Therefore identifying and integrating these principles should be necessary for improved application, teaching and learning of medical practice.[6]

On the other hand, considerable evidence supports the fact that epistemological beliefs, i.e., the set of individual premises and presuppositions about knowledge and learning, play an influential and conditioning role on the cognitive process.[7-11] Psychological studies regarding personal epistemological development seek to understand what individuals believe about the certainty, origin, and justification of knowledge.[10] Their results provide evidence that students possess some erroneous beliefs, "misbeliefs," (e.g. "knowledge is certain") that differ from expert beliefs (e.g. "knowledge is tentative.")[11] In addition, the study of beliefs about how learning occurs also provides convenient information. For example some physics students may think learning consists of memorizing formulas provided by the teacher, while others may believe it entails applying and modifying their own insights; awareness of these beliefs may improve teachers' understanding of students' behavior.[11]

Research on "epistemological beliefs" may also contribute to medical education, fundamentally by knowing students' biases and ideas about their attitudes, namely how they perceive scientific knowl-

edge, how they justify their own inferences, how they plan their study strategies and how they should practice medicine trusting their experience rather than scientific publications, for example. All the above may provide us with further understanding of the professional behavior of medical students and physicians.

J. D. Miller has found in over two decades of research that both laymen and professions lack an adequate understanding of concepts related to the nature of scientific knowledge.[12-14] His works, which are published by the US National Science Board, reveal that only 10% of graduate-professionals understand science in terms of theory construction and its corresponding verification.[14] Although it is not clear whether it is appropriate to extrapolated his findings to the medical community, given the lack of similar studies among physicians, Miller's results are at least disturbing and provocative. Disturbing because they reveal that the core of science is not part of the professional culture, and provocative because they show that even in the most developed country, the educational system has not been able to ingrain the guidelines of scientific culture into their students. Such evidence should lead us to reflect and research on whether physicians have managed to overcome such "scientific illiteracy."

This study intends to assess physicians' knowledge about some concepts and grounds ubiquitous in all sciences. As a second objective, this study intends to be an initial step to know, compare, and eventually determine, to what extent physicians' beliefs and attitudes are compatible with the paradigm of scientific knowledge.

Methods

We selected a random sample of 237 individuals via a random number table from a pool of 310 resident physicians registered as healthcare personnel of three urban teaching hospitals in Lima, Peru. The sample included 87 residents from Daniel A. Carrión Public Hospital, 38 residents from the Peruvian Air Force Central Hospital and 112 residents from Guillermo Almenara Social Security Hospital. In addition to names, the Healthcare Personnel Department of each hospital provided information on gender, age, years of labor experience, and the medical school from which residents graduated.

From August to November 2000 each resident who had agreed to participate was personally given a one-page questionnaire with eight items. Completion of the questionnaire took about 10 minutes. The participants were previously informed about the nature of the survey, as well as of their voluntary and confidential participation.

The questionnaire, which had previously been validated by two pilot surveys (the results whereof are not included in this paper), was structured as follows:

Four questions were intended to assess respondents' knowledge of a minimal set of concepts commonly used in any scientific dissertation. One open-ended question asked for the definition of *scientific hypothesis*. Two related questions, a structured YES/NO question and an open-ended question asked for the definition of *epistemology*, provided the answer to the previous question *"Do you know what epistemology is?"* had been positive.

One closed question asked respondents to choose the assertion they think correctly defines scientific theory: (a) Speculation or assumption with no or insufficient evidence; (b) A scientific hypothesis which may be proven, but there is a lack of evidence verifying it; (c) A set of scientific knowledge on a given topic or area; and (d) A system of hypothesis logically related to one another, with common background, some of them verified.

In order to know participants' beliefs, they were presented four statements: (i) Knowledge is possible, reality does exist, but nobody is the owner of truth, each has his or her own opinion and nobody can impose it to others; (ii) Knowledge is possible, it is a fact and it only takes human reason to attain it; (iii) Knowledge is possible, reality exists independently from us, it is possible the existence of universal truths and people's accepting them as such; (iv) Knowledge is not possible, nature is ideal, a product of our thinking activity. Each enunciation falls within a particular, mutually excluding epistemological category in relation to the knowledge of reality: (i) Relativistic. (ii) Rationalistic–Naïve. (iii) Realistic–Authoritarian. (iv) Idealistic. Each respondent was asked to choose only one, so as to determine with which one he/she identifies himself/herself most, or at least which he/she perceives as the most adequate or plausible.

Additionally, respondents were asked to: a) Name the presumptions or philosophical hypotheses common to all sciences. b) State their beliefs regarding the purpose of science. c) Report whether they had ever pursued any philosophy and/or epistemology course in their under- or postgraduate studies.

Responses to the open ended questions were categorized as follows. Definitions of scientific hypothesis were categorized into: 1. - Proposition or enunciation. 2. - Answer or solution to a question or problem. 3. - Capacity of verification or empirical demonstration (proof.) The responses to the concept of epistemology were initially broken into six distinct categories, which were later grouped into three broader categories.

All data were stored electronically in Microsoft Excel 5.0.

as the set of scientific knowledge about a given topic or field; and 29 % (44/153) considered it as unproven hypothesis [Fig. 1].

None of the respondents mentioned philosophical pre-assumptions, principles, or grounds of all sciences. In relation to their epistemological beliefs: 48% (73/151) agreed with the relativistic enunciation; 27% chose the rationalist-naïve assertion; 20% (30/151) selected the realistic – authoritarian view, and only 5% (8/151) felt the idealistic affirmation was valid.

Table 1. Characteristics of respondents and non-respondents

Personal characteristics?	Respondents (n =161)	Non-respondents (n = 76)	P value of difference
Age (SD)	28,74 (1,83)	29,26 (2,04)	NS[1]
Men	119 (74%)	52 (68%)	NS[2]
Female	42 (26%)	24 (32%)	
Years of Labor Experience (SD) *	3,38 (1,2)	4 (1,5) *	p < 0,05 [1]
Medical School *			
UNMSM	114 (71%)	41 (63%) *	NS[2]
USMP	15 (9%)	8 (12%)	
UNSLG	13 (8%)	6 (9%)	
Others	19 (12%)	10 (16%)	

? Data provided by Healthcare Personnel Department of each hospital.
* We were unable to determine this characteristics of some residents.
[1] Student's *t*-test, [2] chi-square test.

Results

Out of 237 selected residents, 161 (68%) agreed to fill out the questionnaire. There were 64 from the Daniel A. Carrión Public Hospital, 26 from the Air Force Central Hospital, and 71 from the Guillermo Almenara Hospital. Table 1 shows the characteristics of the individuals who agreed to participate as well as of those who did not.

Of the total number of individuals who answered the question, "Do you know what epistemology is?" 67% (103/154) said they did not, 28% (43/154) gave some sort of definition; 18% (28/154) answered it was the study of science or knowledge; and 3% (4/154) defined it as the philosophy of science.

Forty-two percent (68/161) defined scientific hypothesis using two of the three categorized criteria, 6% (10/161) used all three, and 49% (79/161) only one. In relation to the concept of scientific theory, 47% (72/153) chose the alternative, which defined it

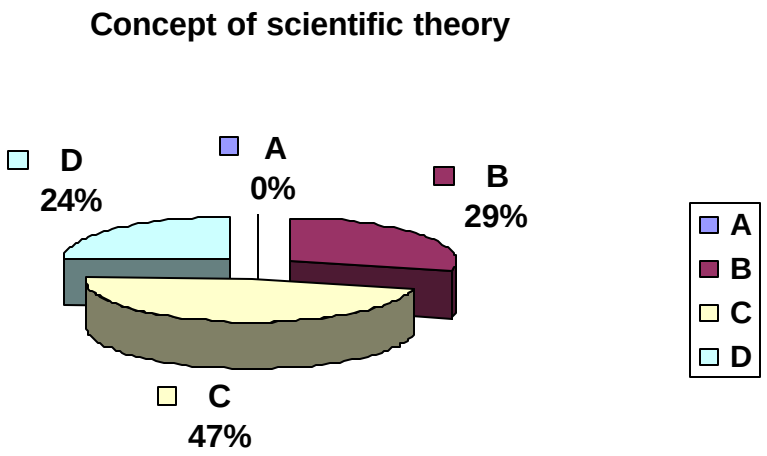
Regarding the purpose of science, 72% (114/158) thought science involves knowing or researching only what is useful, and 28% (44/158) believes science involves knowing for the sake of knowledge itself, although what is studied may not have immediate usefulness.

Finally, 74% (118/160) reported never having taken any philosophy or epistemology course during their under- and/or post-graduate studies.

Discussion

Epistemology is a branch of philosophy, which investigates the nature, and origins of human knowledge. What is knowledge? How can we (mankind) know? How can we justify what we know? From where should our knowledge originate? How many types of knowledge exist? Which should be veracity criteria? All the above are its primary issues. Scientific knowledge, particularly, is one of its main subject matters. Epistemology analyzes the general nature of scientific and technological practice[15](pp13-

Figure 1



A) Speculation or assumption with no or insufficient evidence.
B) Scientific hypothesis that may be proven, but lacking evidence for verification.
C) Set of scientific knowledge on a given topic or area.
D) System of hypotheses logically connected to one another, with common background, some of which have been verified.

27); consequently, although it may not teach how to apply specific rules, it does contribute to attaining a clearer insight of what is science.[1] In spite of such relevance, this survey may suggest that epistemology is apparently unknown by most physicians, since more than half of respondents said they did not know what it is or what it studies and only a small percentage (21%) were able to define it appropriately.

A core aspect of any science is theory and hypothesis construction. For that reason, knowing these concepts is necessary to adequately understand the scientific paradigm.[14-16] Scientific theories are hypothetical-deductive systems, where many of their hypotheses (but not all) have already been empirically verified, and are therefore valid explanations and descriptions about nature rather than just mere unproved speculations or hypotheses.[15] (pp51-61), [16] The explanations of much of what we know are elaborated through them. Examples include the theory of evolution, quantum mechanics, and decision theory. Therefore, their presence is ubiquitous in the scientific culture. Nevertheless, the results of this study show at least a lack of rigorousness on the part of respondents, since almost half of them seem to identify scientific theory with what laymen call theory (a set of scientific data or knowledge about a given topic) and one third with scientific speculation (unproven hypothesis.) In addition, only half of the respondents were able to define scientific hypothesis by using two key requirements of its correct definitions[15] (pp30-34): A proposed answer to a question or problem, and capacity of empirical proof. It should be noted that not all conjectures or assumptions are scientific hypotheses, but only those decidable to be true or false.

All sciences are grounded on and conditioned by their pre-assumptions, foundations, or principles. These include the ontological assumptions of reality and legality i.e. nature ruled by inflexible laws; presuppositions related to knowing i.e. the possibility of attaining truth at least partially or approximately; and ethical principles, i.e. the search of truth and refusal to use knowledge for harmful purposes.[1,17] Ever since the emergence of science, scientists have advocated and assumed these principles and worldview. Remarkably, none of the respondents to this survey mentioned them. This of course does not necessarily imply physicians do not have ideas about the foundations of science, but it is possible to infer that their ideas are at an uneducated, intuitive level and therefore not cogent. The repercussions of these findings have to do not only with vocabulary. They may well

be more important, since such ideas make up the framework of scientific culture.[1,17] Is it possible to conceive a science based on the belief that the world is completely chaotic and unpredictable? How would science work if it were assumed that the world is not cognoscible? What would the consequences be if it were assumed that knowledge should not be shared freely among all people?

Science does not admit relativistic or subjective attitudes in relation to the knowledge of reality, but rather general and universal ones. [1-3,14,17] For that reason, it is quite remarkable that almost half of respondents chose the relativistic position, e.g., knowledge is possible, reality does exist, but nobody is the owner of truth, each has its own opinion and nobody can impose it to others. Only one fifth of them chose the realistic-authoritarian enunciation, e.g., knowledge is possible, reality exists independently from us, universal truths are possible, as well as their acceptance by everyone. If the above reflects respondents' beliefs and attitudes, it reveals certain incompatibility with universality, objectivity and authority, which are characteristics of the scientific paradigm. Such disparity should be a matter of study, since it may be one of the causes of incongruence and other problems found in the clinical practice. For example, the scanty use and unreceptive attitude on the part of some physicians towards various clinic protocols and clinical practice guidelines;[18] guidelines based, precisely, on the objective and universal nature of the scientific paradigm.

Evidence-based medicine — "the conscientious, explicit, and judicious use of current best evidence in making decisions about the care of individual patients, integrating individual clinical expertise and the best available clinical evidence."[19] — is being promoted as the new paradigm.[20-21] However current data reveals that the rates of acceptation, use and change of behavior are still quite low.[18,22-23] It is possible that some of the reasons of this low rate of adherence are related to the individual epistemology underlying many physician's thoughts. If this mindset is not congruent, as the results shown here suggest, with the epistemology scientific knowledge is based upon, it will be difficult for that physician to adopt guidelines and procedures he/she considers supplementary rather than fundamental.

Medical thought and medical practice pose a number of philosophical dilemmas. These include the characterization of medicine itself as knowledge and praxis, the study epistemological, ethical, and logical problems including the analysis of rationales supporting diagnoses and prognosis, the study of logic relationships within medical theories and between them and scientific theories, the analysis of a diagnosis truth and the methodological foundations thereof. Addressing these issues from a philosophical standpoint may enhance both medical research and teaching.[15](pp234-236) Moreover, students who devote some time to philosophical questions may also obtain benefits. For example, they will be able to correct, systematize, and enrich the philosophical opinions constituting their worldview and the way they perform medicine. In addition, they will get used to systematically ordering their ideas and depurate language, seeking coherence and clarity. This way they would not confuse what is postulated with what is inferred, or verbal conventions with empirical data, the thing with its attributes, the object with the knowledge thereof, the truth with their own criteria. In other words, they will broaden their horizon as the set of logic relationships and explanations is enriched.

Notwithstanding possible benefits, medical schools do not seem to consider any philosophy courses besides bioethics. Thus, in this survey, three out of four respondents revealed they had never pursued any philosophy courses.

This paper has a number of limitations, some of them intrinsic to any survey, and other resulting from the concepts chosen, which may be considered a source of bias. On the latter factor, however, we should remark at least two extenuating considerations. First, those concepts with their definitions were based on a system of criteria rather than proposed in a sheer rhetorical way, making possible improved assessment and description. Secondly, the concepts chosen are elementary, basic, and quite common, which assumes that physicians handle them rigorously and accurately. On the other hand, the percentage of individuals who agreed to participate is always a source of bias, but 68% is not below the proportion in many published studies.[24-25] In addition, such respondents' characteristics as age, sex, graduation year, and university they graduated from were not significantly different from their non-respondent counterparts. There is always possible, of course, the existence of differences in attitude, which may not be determined.

Finally, despite its limitations, we feel that the relevance of this paper lies on its capacity of giving rise to new research paths. Its results should be taken as initial and motivating. The possibility of extrapolating them into developed countries should not be

understood solely at the light of its results, but in relation to a broader framework, on the solid evidence provided by Miller's studies.[12-14] Also on the presence of a causal factor; the absence of philosophy and/or epistemology courses in their medicine schools.[26-27] Due to all the above, it is not farfetched to assume the existence of such failures in those countries, which deserve being known and studied, since there are no published studies on this matter in universal medical literature.

Conclusion

The survey seems to reveal certain deficiencies in physicians' knowledge of basic theoretical foundations of science. Although these findings should be contrasted against other studies, their implications invite to reflect on the necessity to include philosophy courses in medical schools.

On the other hand, psychological investigation on the so-called "epistemological beliefs" may play some role in order to describe the professional behavior of physicians and students.

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Potential Conflicts of Interest: None

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APPENDIX

QUESTIONNAIRE

This questionnaire intends to determine your beliefs and knowledge about some concepts common to all sciences. We thank your participation in advance.

-Please choose only one alternative in questions exhibiting more than one.

1. Have you ever received any epistemology or philosophy courses in your under- or post-graduate college studies?

? Yes ? No

2. Do you know what epistemology is?

? Yes ? No

If your answer is "Yes," please give a definition

_____
_____
_____
_____
_____

3. Please define *scientific hypothesis* in your own words

_____
_____
_____
_____
_____

4. What is scientific theory?

? Speculation or assumption with no or insufficient evidence

? Scientific hypothesis that may be proven, but lacking evidence for verification.

? Set of scientific knowledge on a given topic or area.

? System of hypotheses logically connected to one another, with common background, some of which have been verified.

5. What are the philosophical (ontological, gnoseological and ethical) principles or presumptions of any science?

_____
_____
_____
_____
_____

6. The enunciations below refer to the knowledge of reality, please choose the one you consider to be the most appropriate.

? Knowledge is possible, reality does exist, but nobody is the owner of truth, each has its own opinion and nobody can impose it to others.

? Knowledge is possible, it is a fact, and it only takes human reason to attain it.

? Knowledge is possible, reality exists independently from us, universal truths area possible, as well as everybody's accepting them as such.

? Knowledge is not possible, nature is ideal, a product of our thinking activity.

7. In your opinion, the purpose of science is:

? To know, but only what is useful and beneficial, science is valid to the extent we get useful and beneficial knowledge through it.

? Knowing for the sake of knowledge, although what is being studied does not have immediate usefulness.