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# Decision-Making in Medicine: A Kuhnian Approach

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RESUMEN

En este artículo exploro el debate entre los defensores de la EBM y los de una perspectiva que no se rinde ante la principal exigencia metodológica de aquella, a saber, que la decisión en medicina debe plegarse al *ranking* epistémico que figura en las llamadas "jerarquías de evidencia". Aquí defiendo una concepción más robusta de la evidencia que no descansa en ningún *ranking* y también una imagen kuhniana de la toma de decisiones en la que los procedimientos (o reglas) de decisión rígidas y únicas son excluidos.

PALABRAS CLAVE: EBM, RCT, *Tesis Russo-Williamson, Kuhn, robustez, toma de decisiones, elección de teorías.*

ABSTRACT

In this paper, I explore the debate between evidence-based medicine (EBM) and the supporters of a perspective that does not accept EBM's main methodological demand, namely, that decision-making must conform to the epistemic ranking included in the so-called "evidence hierarchies." I argue for a more robust conception of evidence, which does not rely on any ranking, and for a Kuhnian depiction of decision-making, in which rigid and exclusive decision-making procedures (or rules) are excluded.

KEYWORDS: *EBM, RCT, Russo-Williamson Thesis, Kuhn, Robustness, Decision-Making, Theory Choice.*

## I. INTRODUCTION

In his philosophy of science, Thomas Kuhn argues against the idea of an algorithm-based decision for the whole of a scientific community [see Kuhn (1977), (2012)]. So, every scientist makes individual considerations on a given hypothesis on the basis of his or her distinctive training in the field, the evidence he or she gathers (which updates her prior beliefs) and other individual factors. Each scientist acts, as it were, like a cell that is not completely identical to his or her surrounding peers; or, using a better analogy by Richard Grandy (2000), "scientists" would be

"imperfect detectors" of whom we can expect to opt for the more correct alternative between the available theories while they remain "independent of one another" [Grandy (2000), p. 69].

In Kuhn's vision, the scientist's practice depends on a paradigm that is not a series of rules and gives some scope for individuality [see Rouse (2003)]. From this point of view, a hypothesis that gains acceptance and allegiance within a community is the one that emerges as more often employed (applied) by a number of community members. So, the majority's practice acts as a sort of warrant for the accepted hypothesis [see again Grandy (2000), p. 69]. As Samuel Schindler [(2017), pp. 32-33] claims, such a hypothesis gains strength because different *individuals* within the community opt for the same option on the basis of their somewhat diverse backgrounds, theoretical options and evidence gained during their particular professional lifetimes. We can understand this proposal as saying that because of that varied support, the hypothesis becomes more "robust."[1]

I see this sketch as applicable to decision-making in medicine, too. I shall mainly consider decision-making in those contexts in which the physician must make up his or her mind concerning an appropriate cure or therapy for a given patient or group of patients.[2] Arguing for that thesis is a main goal of this paper. However, I shall also consider another idea. According to the evidence-based medicine (EBM) point of view, once debiasing methods are applied to the design of randomized controlled trials (RCTs) and meta-analyses are properly conducted, a general rule is obtained that can be applied to decision-making regarding therapy for a given patient. There are, on the other hand, good arguments [see, e.g., Stegenga (2012), pp. 218-219] that support the idea that, if the result – the hypothesis in question – is obtained by virtue of a number of individually differentiated experimental and observational methods, the conclusion is better supported thanks to the robustness that this procedure grants (see section II.2, below). Both approaches are not altogether compatible, and I would like to explore the second one and its relation to the former.

In short, in this paper I shall consider (1) the application of robustness procedures in medicine, (2) the application of a Kuhnian framework (originally devised for theory choice) as a convenient framework for interpreting decision-making in that field and (3) their conflict with the spirit of EBM.[3] In the second section, I shall briefly examine EBM as well as a competitor – the so-called "Russo-Williamson Thesis" (RWT) – and then shall consider robustness and its application to medicine. In the third

section, I shall give a brief account of Kuhn's perspective on theory choice within scientific communities so as to argue that decision-making in medicine would benefit from that view, though perhaps at the expense of EBM. A last section is devoted to drawing some conclusions from this line of thought.

## II. EBM, MECHANISMS AND ROBUSTNESS

In this section I shall compare the program of EBM – a methodological program – with the possibilities of looking to robustness as a desideratum. In his nuanced examination of robustness, Stegenga (2012) has shown that, in effect, finding supporting evidence from different sources for a given causal hypothesis – as those handled in medicine, which connect a therapeutic action with its effects on the patient [see Worrall (2002), pp. S317-S319; La Caze (2011), p. 81] – is a positive value [see Stegenga (2012), pp. 210-211]. EBM primarily promotes a specific kind of source, the one that eventually comes from RCTs and their assessment. So, from that point of view, EBM severely (and perhaps artificially) constrains decision-making. That is my main conclusion in this second section. The third section shall show the convenience of an alternative point of view more compatible with the robustness perspective expounded here.

### II.1. *Evidence Hierarchies and Mechanisms*

EBM has distinguished ancestors in the controlled experiments that started to be practiced in the seventeenth century and even before. Teira (2016) has shown that the eighteenth century saw early instances of the experimental control [Teira (2016), p. 734] that is sought for in current RCTs in the practice of James Jurin and his tabulation of experimental results, and of Antoine-Laurent Lavoisier and his blinding of patients in experiments testing mesmerism. As a rule, the current use of statistics in observational (case-control) studies is traced back to A. Bradford Hill and his attempts to settle a causal relation between smoking and the suffering of lung cancer, while his appeal to RCTs in testing the use of streptomycin for treating tuberculosis is also considered the origin of the current experimental practice.[4]

As promoted in a well-known and oft-quoted paper by the so-called Evidence-Based Medicine Working Group (1992), EBM tries to base clinical practice, as La Caze says, on "the best available evidence"

[La Caze (2011), p. 83] or, "the best available external clinical evidence," according to Sackett *et al.* (1996), pp. 71-72 [as quoted by La Caze (2011), p. 86; see also Worrall (2002)], thus trying to avoid biases and confounding factors, and arriving at causal relations that make decision-making much easier to achieve. It is well known that, in order to obtain those results, defenders of EBM find support in a sort of "pyramidal" arrangement of the different sources of evidence available, which is usually known as "evidence hierarchies" [La Caze (2011), pp. 83-84; Solomon (2011), pp. 454 ff.].[5] At its basis, there is clinical expertise and observation as much as evidence from mechanical models of diseases and their treatments. While there is still some room left in the hierarchy for case-control studies halfway up, a higher place over them is filled by RCTs, whose excellence in terms of debiased evidence is only overcome by systematic reviews of series of them and by meta-analyses.[6] Clearly, this latter step in the scaling up to pure objective evidence, and, therefore, to the basis of well-supported causal relations, is also an improvement in the elimination of most subjective bias involved in the establishment of those causal relations. In order to overcome the limitations of traditional medicine, EBM recommends applying that hierarchy in decision-making [see La Caze (2011), pp. 83-84]. Note that judgment is not excluded from the process. As Solomon (2011), pp. 453-457, recalls, individual judgment and consensus are not, and cannot be, avoided in any part of the process — from devising trials to applying their conclusions. Yet, as she says, "An evidence hierarchy is typically used to structure the judgments of quality and strength of evidence" [Solomon (2011), p. 453]. Judgment thus depends on a previously hierarchized ranking. I shall argue for the convenience of an alternative viewpoint from a Kuhnian approach.

The resource of mechanistic models and the evidence that comes from them are, as noted, limited in EBM.[7] In recent times, a position against the neglect of mechanisms in medical practice has been put forward. The position is well known in terms of the so-called Russo-Williamson Thesis (RWT).[8] This thesis was suggested by philosophers of science Federica Russo and Jon Williamson in an also oft-quoted paper [Russo and Williamson (2007)]. RWT defends the combination of several types of source for establishing causal hypotheses: mechanistic and probabilistic [Russo and Williamson (2007), p. 159]. RWT does not argue for a pluralistic theory of causality. In medicine, they say, there are not diverse kinds of causal connection depending on the source of evidence they are based on [see Russo and Williamson (2007), pp. 158, 164-168]. Sources are therefore diverse and they do not seem either eliminable or

reducible to a statistical basis for decision-making alone, as some defenders of EBM claim. So, according to RWT, causal claims in medicine must find their ground in different kinds of sources, from the statistical background that RCTs provide to the kind of understanding idealized models of physiological and pathological mechanisms contribute. Evidence arises from all these kinds of sources, and so all of them (mechanisms included) must be considered for achieving the goals that are present in medicine — from diagnosis to therapy [see La Caze (2011), pp. 82-83 (and ff.)]. For Russo and Williamson, "the mechanistic aspect is required because mechanisms explain the dependencies, and in the health sciences causal relationships are also meant to be explanatory" [Russo and Williamson (2007), p. 159].

It is difficult to decide between both positions — EBM and RWT. For one, EBM supporters claim that decision-making in clinical practice must be based on RCTs and meta-analyses of their systematic reviews. There is no better resource to avoid all kinds of biases—though many critics counter that biases are not definitely eliminated (see references in footnote 6). For another, RWT supporters claim that purely statistical evidence for a causal claim is insufficient and that the kind of understanding and theoretical systematization of knowledge that mechanical models provide is basic for designing RCTs and implementing meta-analysis [see La Caze (2011), pp. 83, 95-96]. Mechanical models often end up being false, though, so they remain a source of bias and false causal attributions [see Howick (2011), p. 931].

Although it is indeed difficult to decide between these positions, a Kuhnian point of view tilts the balance in favor of RWT. The Kuhnian view emphasizes the importance of the *agent's* intentional attitude toward the scientific world he or she lives in as inextricably linked to his or her activity in it. So, it seems necessary for him or her to display his or her cognitive and practical activities as fully as they are available — even more so as decisions depend on those activities. If, for Russo and Williamson, medicine pursues both a "cognitive goal" and an "action-oriented goal," the first of which assumes an explanatory function among many others [Russo and Williamson (2007), p. 157], it seems that RWT is compatible with the Kuhnian point of view.

I shall pursue this point in the third section. However, there is a common attitude toward evidence in recent philosophy of science that may serve as a critical counterpart of the EBM attitude. The key concept here is robustness, and I shall devote the rest of this section (II.2) to examining the shift in attitude it involves as compared to EBM's.

II.2. *Robustness and Medicine*

In Stegenga's (2012) paper on "evidential diversity" – "multimodal evidence," in his terms – robustness is described as increasing the confirmatory virtues of a hypothesis as soon as evidence supporting it, which comes from different sources, is, he says, "concordant." Stegenga qualifies this point by arguing that evidence is often "discordant," so that an "amalgamating function" that concentrates it is necessary.[9] Functions of that sort are exemplified by, say, Bayesian conditionalization (among others) or, in the case of EBM, by hierarchy schemes and meta-analyses — where the former provides a qualitative result and the latter a quantitative one [Stegenga (2012), p. 222].[10] However, in case of concordant evidential diversity in favor of a hypothesis, we are talking about the previously noted concept — *robustness*. "A hypothesis is robust," Stegenga says, "if and only if it is supported by concordant multimodal evidence" [(2012), p. 210].

Robustness has a lively recent history among philosophers of science, but also a well-earned prestige in science itself. The term was used and emphasized by the biologist Richard Levins in a now classic paper [Levins (1966), p. 423] and further examined and improved by the philosopher William C. Wimsatt [see esp. Wimsatt (1981)]. During the second half of the last century, the concept has been examined in depth.[11] Its significance may be appreciated by contrasting with the more selective view that we see in EBM. Whereas EBM considers that decision-making in clinical contexts should be based on the best evidence, it is evidence, whether the best or not, which is often all many scientists can count on in their respective fields. Evidence frequently comes from a number of different sources. That's why Stegenga and others talk about evidential *diversity* or *multimodal* evidence. There are many sources from which evidence on behalf of a given hypothesis can be obtained. The amount of evidence thus gathered increases our confidence in that hypothesis. As Wimsatt recalls, "Adding alternatives (or redundancy, as it is often called) always increases reliability" [Wimsatt (1981), p. 50, as quoted by Schupbach (2018), p. 282].

If, as noted, evidence sources in medicine are diverse, we had better consider the possibilities of increasing the robustness of its causal inferences on the basis of an inquiry into its variety and diverse force: a "robustness analysis," as it is often termed [see, e.g., Wimsatt (1981), pp. 44 ff., Schupbach (2018)]. In order to briefly describe it, let us consider, for example, Woodward's (2006) classification of robustness into four different modes: "inferential," "derivational," "measurement" and "causal" ro-

bustness [see Woodward (2006), pp. 219, 231, 233, 235]. In the spirit of robustness, a certain procedure is varied according to a given assumption or method in order to figure out if the result is stable or not. The corresponding stability – or "invariance," as Wimsatt (1981), p. 44, says – indicates that the result is reliable. Available variations are diverse, depending on the kind of robustness we are trying to analyze. For Woodward, it is not the same to find out if a certain model allows for deriving some facts while some assumptions are varied as it is to find out if a quantity is measured by means of different measurement procedures and instruments. In his terminology, the former kind of robustness is "derivational" while the latter is "measurement robustness" [see Woodward (2006), pp. 231, 233-234]. In any case, the differences involved do not affect the expected outcome and so some inductive support for this latter is obtained.[12] As Stegenga (2012), pp. 218-220, shows, we can think of cases in medicine in which – despite the difficulties involved in defining diversity – robustness would be obtained on the basis of a similar procedure.

Robustness is a more complicated goal of science than is reflected here and it is worth a more careful analysis — as many philosophers have done (see, e.g., footnote 11). I simply wish to compare the methodological recommendation of practicing a robustness analysis (whenever possible) to a certain hypothesis, as Stegenga's characterization of the concept permits, with the EBM's expectations that applying a hierachy of evidence might make decision-making complete. If practicable in medicine, as Stegenga shows it is, a robustness analysis looks advisable for causal hypothesis of the kind (*CH*) "drug *A* causes a cure of disease *B* in $x$ per cent of cases" — particularly if, as noted, biases and confounding factors might not have been suppressed from RCTs, systematic reviews and meta-analyses [see Solomon (2011), Stegenga (2011) and Worrall (2002)]. As soon as a variety of evidential sources is available for a hypothesis along the lines of *CH*, a robustness analysis allows the researcher to check out if the expected result is inductively supported, despite biases and in a domain of likely limited evidence available. Clearly, this proposal counters EBM's defense of a methodological guideline based on evidence hierarchies, which might push some evidential sources aside.[13] So, robustness analysis presents a first line of criticism of EBM from a methodological point of view.

I shall pursue a second critical point in the next half of this paper. In the next section, I approach medicine from a Kuhnian point of view, in which decision-making in scientific communities does not rely on the existence of general methodological rules dictating the outcome but ra-

ther on each member's weighing up the virtues of the alternatives involved. This characteristic of Kuhnian theory choice in scientific communities complements the nonhierarchical stance toward evidence I have just examined.

## III. Kuhn, Theory Choice and the Health Sciences

In his reflections on the role of value judgments in theory choice, Kuhn is mainly talking about revolutionary contexts. At first glance, therefore, theory choice between paradigms might have in historical terms a greater scope than opting for a given diagnosis and intervention in a particular medical case. However, Kuhn (1993) is clear that those "criteria" (or values) that govern science in "periods of lexical stability" are those also used in "speciation and lexical change" [Kuhn (1993), p. 338]. In the former periods, science is mainly an activity of puzzle solving, and these values, he says, "must [be] weigh[ed] in deciding whether or not a given puzzle about the match between phenomena and belief has been solved" [Kuhn (1993), p. 338]. So, beyond the grand historical context in which revolutions are studied, there is a context of normal theory choice that Kuhn also includes in his account. If this context is considered in the abstract – leaving aside its historical consequences of normal or revolutionary science – it seems to work well for decision-making in medicine, in which the best intervention, given a certain patient and the particular context involved, is the problem at issue. In the end, we are talking about a context of hypothesis selection on an individual, rather than a social, basis.

In the rest of this section, I explore Kuhn's view of theory choice – how it fits in with some previous perspectives on the nature of the medical community and on the elements involved in decision-making within that kind of community – and show how that view disagrees with EBM on some of those points. Section III.1 is mainly devoted to exploring Kuhn's general view on theory choice and section III.2 compares that approach with previous views. In both sections, the contrasts with EBM are discussed.

### III.1. *Kuhn's Theory Choice*

In Kuhn's work, the resistance of scientists to change was explainable. Many cases of resistance were, from a more traditional (empiricist) point of view, accounted for as dogmatic attitudes against the advance-

ment of knowledge. Kuhn insisted that that kind of fidelity to what was soon going to be an outdated paradigm was an attitude as reasonable or unreasonable as allegiance to a fresh, untested paradigm was. Acceptance of and allegiance to a new or an old paradigm was not an attitude *imposed* by a dogma acting in the minds of practicing scientists.

Dogma, if at all preserved by Kuhn, meant something different in his hands as compared to Popper's and his followers' version [see Kuhn (1963)]. Rather than dogma, however, we should refer to paradigms. These latter do not impose on the scientists' mind. For Kuhn, it was more important to see the allegiance to an older paradigm or the confidence in a newer one as a matter of *individual decision*, whose methodological significance (e.g., that many decisions bring about a revolution) can only be grasped when approaching its result historically and from the *group* perspective [see Kuhn (1977), (2012), pp. 199-200, Rouse (2003)]. For Kuhn, it made as little sense to understand theory choice as the outcome of the activity of a rigid set of rules in the scientist's mind as it was to consider the same effect from a different, perhaps more dogmatic, but identically *impersonal* source. When reemphasizing the methodological messages that could be seen in *Structure*, Kuhn not only claimed that theory choice was a decision in whose analysis Carnapian unique algorithms should be replaced by *personally* measured value judgments but also that it was a *social result* — which, as noted, sometimes involves *resistance*. [See Kuhn (2012), pp. 184-186, (1977), (1993).]

In applying this point of view to decision-making in medicine, it is important to consider some specific aspects of the work that the physician carries out. For example, that kind of context involves time limits that influence decision-making. This is an important difference as compared with the more theoretical context Kuhn usually bears in mind. La Caze (2011) and Goldenberg (2015), for instance, recall that there is often no time available to examine the huge amount of available evidence before proceeding to decide on a diagnosis and an intervention. So, time limits need to be considered and – as authors like these also recall – EBM provide a rule that reduces the physician's burden. EBM's guideline is to opt for evidence sources closer to the top of the justificatory pyramid (the evidence hierarchy), because good (maybe the best) evidence is thus gained while saving time [see La Caze (2011), p. 84, Goldenberg (2015), p. 18, and sec. II.1, above].

Time limitations are indeed important. Yet, the solution involved is imposed on a practice that usually relies on a high variety of sources, not only on RCTs and systematic reviews. If EBM's guideline were admitted

as a general solution, the basis for decision-making would be severely restricted in a way that is not supported by other methodological considerations. We saw in the previous section that, for Wimsatt, increasing the number of diverging sources increases a hypothesis' trustworthiness. Accordingly, diminishing their number surely produces the contrary effect. Moreover, according to Kuhn, there is no general rule that fixes what factors are at work in theory choice for each individual within a community – and to what degree – and what are not. So, the clinical context imposes time limits that must be considered in obtaining a general perspective for decision-making in medicine, but, despite its noble intention, a general, rigid rule is not perhaps the best solution.

Kuhn's view shifts the focus from the assistance of external rules to appropriate training in the field – which may be more time-saving rather than less – and it seems applicable to the medical case as well. Before exploring how it fits in with previous perspectives in philosophy of medicine in the next section (III.2), I shall examine how Kuhn introduces his own perspective as compared with previous approaches to scientific methodology.

Kuhn sets himself against the defenders of an abstract perspective on the context of theory choice or decision-making. He refers us to the idealized situation on which that kind of perspective is based. This criticism is already discerned in his 1977 paper, but a text he wrote seven years later, his "Scientific Development and Lexical Change" [see Kuhn (1984), (2017)], is perhaps a bit clearer about it. I shall omit the details of the long text and even of the model involved, but, in essence, Kuhn criticizes what, for him, is the kind of idealized situation empiricist philosophers usually propound, in which a given number of propositions is assessed on an evidential basis, which is also another list of propositions. As Kuhn says, that methodological and highly idealized model lacks the down-to-earth attitude that empirical situations provide. The model, he says, is epistemologically foundationalist, methodologically solipsistic, deductivist and propositionalist, and even its holistic nature is less a virtue than a problem [see Kuhn (1984), I, pp. 9-10]. By contrast, he defends a point of view about philosophy of science that, in order for it to be *developmental*, is based on contrary positions to those listed above [see Kuhn (1984), I]. Ironically, Kuhn attacks the idealization involved in the empiricist methodological model on the basis of a highly idealized – though, of course, non-formalized – social model.

I would like to stress Kuhn's disagreement with *methodological solipsism*, which he takes to be the thesis that as individuals that follow abso-

lute rules (whatever our idiosyncrasies), we acquiesce to their impositions and so we are, as it were, interchangeable — just *any* individual shall make a given theory choice as *any* other. It involves a diminished role (to say the least) for *judgment* in theory choice [see Kuhn (1984), I, pp. 9, 19]. No wonder, then, that Kuhn takes sides against the idea of rules not only in paradigm-learning contexts, but also in theory-choice settings. Throughout his career, Kuhn says that *any* two practicing scientists may disagree on their respective theory-choice options in spite of their likely agreement about the set of values they consider epistemically significant because of the different weight they lend to each value; even if they agree, those weights may be different [see Kuhn (2012), p. 184, (1977), (1984), p. 19].

Despite that criticism against the idea of algorithmic rules and on behalf of a role for judgment on the basis of appropriately and individually weighted criteria of theory choice, Kuhn considers that, "If science can justifiably be described as a puzzle-solving enterprise, such arguments suffice to prove the rationality of the observed norms" [Kuhn (1983), p. 209]. In short, there is no challenge in his perspective for the rationality of science — only for the idea that the scientist responds to an idealized methodological model.

Does that perspective fit in with theory choice – or decision-making – in medicine? A full answer would require a detailed empirical exploration of the field, something I shall not attempt in the limited scope of this article. Instead, in the next section, I shall show how Kuhn's view agrees with some current philosophical perspectives on medicine and, at the same time, the kind of alternative to EBM's guidelines it amounts to.

### III.2. *Kuhnian Decision-Making in Medicine*

In this paper, I have implicitly argued for a perspective in medicine in which the medical community is as heterogenous as Kuhn's perspective made scientific communities at large. The Kuhnian paradigm brings several approaches together under the common feature of considering a given solution to a problem as the main focus of training and research work. Whatever the central concept medicine requires to explain how a high variety of individuals converge to a similar common practice (a central concept that does not need to be the Kuhnian "paradigm"), a Kuhnian default approach seems to be applicable to the medical community. Solomon, for example, has emphasized the diversity of individual educational background in that community and the "limitations of particular health-care providers"; as she also says, "Physicians and nurses are particular individuals who have some particular kinds of training and

lack some others" [Solomon (2008), p. 416]. Solomon's picture resembles Grandy's perspective of the heterogeneous scientific (in Solomon's case, medical) community, which we saw in the introduction to this paper. They talk about its virtues and, accordingly, they both suggest a view that, to my mind, approaches the limit Kuhn also suggests.

If the medical community could be approached in Kuhnian terms, then his account of theory choice could be applied as well. In that case, we would also be talking about decision-making about a particular therapy for a specific patient — something that, as noted in the introduction to this section III, seems reasonable. Now, if the Kuhnian perspective is applied, its basis is individual judgment. The question that remains to be answered is, what *elements of judgment* are at play? That is, on what grounds must decisions be based? From a Kuhnian point of view, individual judgment includes a weighing of some characteristics to be found in the theories in competition [see Kuhn (2012), pp. 184-186, (1977)]. The individual should have resource to a comprehensive view of the problem and the hypothetical explanations involved before he or she decides among available alternatives. In the case of medical decisions (as in the larger context of scientific theory choice), it seems therefore that no available aspect of a causal hypothesis should be suppressed (or its relevance diminished) beforehand. So, RWT [and similar positions, like La Caze's (2011)] would be vindicated on the Kuhnian account. Russo and Williamson mentioned a "cognitive goal" together with an "action-oriented goal" and their relevance in medicine [Russo and Williamson (2007), p. 157]. Even a sympathetic though critical exposition of the role of mechanisms in medicine such as Howick's (2011) emphasize their utility once some desiderata (as their completeness) are satisfied [see Howick (2011), pp. 937-939]. If mechanisms partake in medical training and research, they should be included in the practice of decision-making as well.

Generally speaking, decisions in medicine, if approached from a Kuhnian point of view, seem to find in EBM procedures a barrier to overcome rather than a guideline to make practice more accurate. Certainly, the Kuhnian perspective is not defending the downplaying of the kind of resources that appear at the top of evidence hierarchies. On the contrary, their importance cannot be understated. Yet, it is more coherent from a Kuhnian point of view to avoid hierarchies and to leave for individual critical examination and judgment to decide how evidential sources should be considered. As seen in this way, useful methodological procedures such as the robustness analysis of evidence would be easily practicable. In addition, considerations regarding, for example, the con-

sistency of statistical and mechanistic grounds for a given hypothesis would also be more easily made. In short, a rigid rule that makes evidence hierarchies in EBM the primary resource in decision-making looks like a shortcoming for a healthy evaluation of the available evidence — at least if that evaluation is approached from a Kuhnian point of view. From this latter approach, minimizing its activity would be perhaps advisable. To conclude, the possibility that a Kuhnian framework is more flexible and potentially productive for the special case of decision-making in medicine is at least worth exploring.

## IV. Concluding Remarks

In this paper, in its third section in particular, I have tried to argue for the convenience of a Kuhnian approach to philosophy of medicine in decision-making contexts. In the second section, I have shown how EBM defends a healthy critical approach to decision-making in which debiasing methods of key evidence are put forward and defended. Yet, I have also argued that the constraints its hierarchical methodological model imposes on the practice of the biomedical models are counterproductive. Recent philosophers such as Russo and Williamson have opposed that perspective; I have commented on their alternative. Then, I have also supported a critical point of view on the basis of a plea for robustness in scientific decision-making, which seems apt in this context too. Then, in the third section, I have shown that a Kuhnian model is particularly timely in medicine, that it would be compatible with RWT and the perspective of robustness analysis, but also that it would oppose rigid hierarchical models of decision-making like that visible in EBM. In the end, Kuhn's perspective of theory choice is, I claim, fruitfully applicable to decision-making in medicine.

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NOTES

[1] I am twisting the meaning of "robustness" a little as usually employed in philosophy of science since Richard Levins and William Wimsatt (see section II.2 for further details). I use it here only metaphorically. Concerning Schindler's thesis, in which he denominates "no-virtue-coincidence argument" [Schindler (2017), p. 32], it is aimed at supporting scientific realism. I do not claim that consequence here.

[2] In other words, theory-choice contexts in which two hypotheses are at stake with a mainly theoretical goal shall be secondary. In that case, the kind of Kuhnian framework that I support is applicable in the biomedical sciences without much additional discussion. I am grateful to an anonymous referee for suggesting to make this point more explicit.

[3] I shall differentiate, for convenience only and temporarily, theory-choice contexts as explored by Kuhn from decision-making contexts in medicine as referred to in this Introduction (see also fn. 2). My main aim is to show that the Kuhnian framework for theory choice is applicable to that kind of decision-making, but that some commentary is nevertheless required (see section III for further details). In some works, however, "theory choice" and "decision making" are used as synonymous [see, e.g., Goldenberg (2015), esp. p. 21]. I do not disagree with such usage.

[4] On the history of RCTs, and these facts in particular, see Gillies (2011), pp. 110-111 and Solomon (2011), pp. 453, 455. On the differences between observational (case-control or cohort) and experimental studies (RCTs), see Broadbent [(2011), pp. 136-138].

[5] Broadbent (2019) already calls that arrangement a "pyramid" [Broadbent (2019), pp. 135 ff.]. My description of EBM in the rest of this paragraph agrees with his in those pages — as well as with other authors' like Solomon (2011) or La Caze (2011).

[6] For criticism of EBM's debiasing methods, see Broadbent (2019), pp. 143-147 and Worrall (2002). For a specific criticism of meta-analyses, see Stegenga (2011).

[7] The current literature on mechanisms is rich. See the classic paper by Machamer, Darden and Craver (2000), among others.

[8] Other authors as La Caze (2011) have made a similar statement [see La Caze (2011), pp. 83 ff.]. My arguments on behalf of a Kuhnian understanding of deci-

sion-making in medicine support RWT as well as positions like La Caze's — though, of course, all of them require a more careful analysis.

[9] Terms in quotation marks are all Stegenga's (2012), pp. 210 ff.. "Evidential diversity" can be found in other authors, Stegenga says (2012), p. 208; a good recent example is Schupbach (2018), pp. 280 ff.

[10] Stegenga says that, in case robustness is explored on the basis of such functions, "there would be a systematic way to guide credence when presented with multimodal evidence" [Stegenga (2012, p. 222)]. Prima facie, EBM methods would then be helpful in such kinds of study. However, the restrictions imposed by EBM's hierarchical methods are actually contrary to the spirit of robustness, as Stegenga shows elsewhere [see Stegenga (2011), pp. 498, 500 ff.] and as I also argue below.

[11] See Stegenga (2012), p. 208, fn. 2, for a list of past philosophers that have used the concept. See also Soler *et al.* (eds.) (2012) for a recent collection of contributions to the analysis of robustness, and also Schupbach (2018).

[12] A good example is Weisberg and Reisman's (2008) robustness analysis of the Volterra Principle.

[13] Again, Stegenga (2011) has studied in detail this critical attitude toward EBM (especially toward meta-analysis) from the point of view of evidential diversity; see in particular his contrast with Bradford Hill's position [Stegenga (2011), pp. 504-506].

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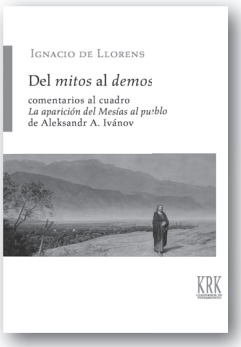


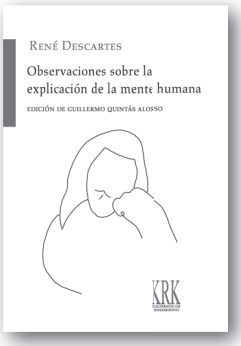




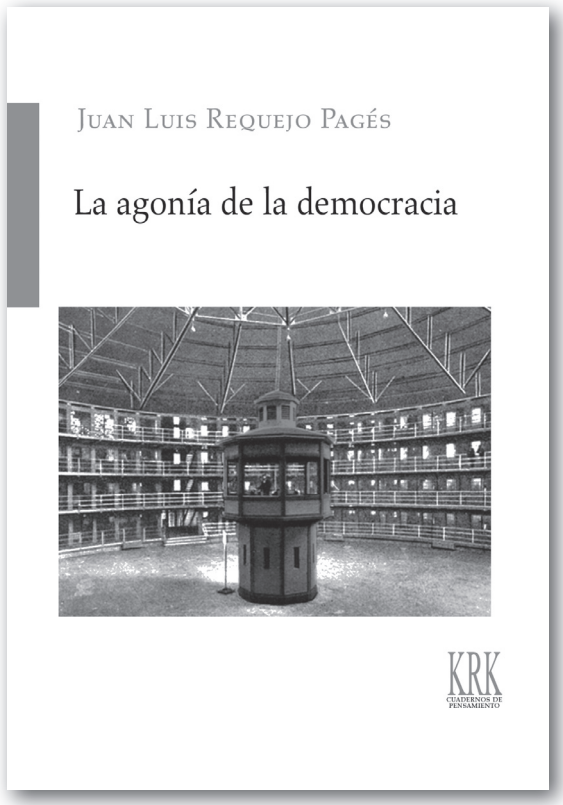


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