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"Evaluating normative epistemic frameworks in medicine: EBM and casuistic medicine"

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Abstract

Since its inception in the early 1990s, evidence-based medicine (EBM) has become the dominant epistemic framework for Western medical practice. However, in light of powerful criticisms against EBM, alternatives such as casuistic medicine have been gaining support in both the medical and philosophical community. In the absence of empirical evidence in support of the claim that EBM improves patient outcomes, and in light of considerations that it is unlikely that such evidence will be forthcoming, another standard is needed to assess EBM against its alternatives. In this paper, I propose a set of criteria for this purpose based on Helen Longino's criteria for assessing the objectivity of a knowledge productive community. I then apply these criteria to assess EBM against a casuistic framework for medical knowledge. I argue that EBM's strict adherence to a hierarchical organization of knowledge can reasonably be expected to block it from fulfilling a high level of objectivity. A casuistic framework, on the other hand, because it emphasizes critical evaluation in conjunction with the flexibility of a case-based approach, could be expected to better facilitate a more optimal epistemic community.

Since its inception in the early 1990s, evidence-based medicine (EBM) has become the dominant epistemic framework for Western medical practice. However, in light of powerful criticisms against EBM, alternatives such as casuistic medicine [1] have been gaining support in both the medical and philosophical community. In the absence of empirical evidence in support of the claim that EBM improves patient outcomes (2, p199), and in light of considerations that it is unlikely that such evidence will be forthcoming (3, p2424; 4), another standard is needed to assess EBM against its alternatives.

In this paper, I propose a set of criteria for this purpose based on Helen Longino's criteria for assessing the objectivity of a knowledge productive community [5]. I then apply these criteria to assess EBM against a casuistic framework for medical knowledge. I argue that EBM's strict adherence to a hierarchical organization of knowledge can reasonably be expected to block it from fulfilling a high level of objectivity. A casuistic framework, on the other hand, because it emphasizes critical evaluation in conjunction with the flexibility of a case-based approach, could be expected to better facilitate a more optimal epistemic community.

Longino's account of objectivity

Longino's view of objectivity developed as a response to the debate over what demarcates science from pseudoscience. Over the past century, many demarcation criteria have been proposed and rejected, but almost everyone agrees that what makes scientific practice distinctive from other knowledge productive practices is that it is 'objective' in some way.

From the 1920s through the 1960s, the logical empiricist view dominated both scientific and philosophical discourse on scientific objectivity. Karl Popper, a prominent proponent of this view, argued that scientific inquiry produces objective knowledge because, even though the subjective features of the individual scientist might influence scientific practice in the context of discovery, the context of justification is completely deductive and therefore objective [6].

In 1962, Thomas Kuhn radically challenged this picture of science in his *The Structure of Scientific Revolutions* [7]. Kuhn took a historicist approach to understanding scientific knowledge by examining the way that justification of scientific theories actually occurred in the history of science. Contrary to Popper, Kuhn argued that theory choice and acceptance is in fact influenced by numerous psychological and social factors [7].

Longino's project can be understood as an attempt to marry our Popperian intuition that science is somehow distinctively objective, with the historical evidence presented by Kuhn and his followers that demonstrates the infiltration of values and social forces in science. She begins by setting aside the question of scientific realism, that is, whether or not our theories represent the world as it is, and rather focuses on the methodological objectivity of science, arguing that our view of the objectivity of the former is justified by our trust in the latter (5, p171). In particular, Longino focuses on the objectivity of the *methods* by which scientists evaluate hypotheses/theories. She argues that both the Popperian and

Kuhnian views of science are highly individualistic, locating the rationality of science in the application of methods by an individual practitioner or in the isolated communities of scientific paradigms. Longino argues that in order to hold on to the objectivity of science while still accounting for the historical evidence of the role of social factors in science, we must move away from individualistic accounts of scientific practice towards an account of science as a practice of communities (5, p174–6).

Longino argues that the inclusion of social influence in the practice of science does not have to take away from the objectivity of science, but rather that social factors are necessary for objectivity. Science is not done in isolation, but in a community of scientists who assess, confirm and critique each other's work continuously. Longino argues that it is this process of public critique and responding to critique that gives the scientific method a high level of objectivity – hypotheses become knowledge when they are checked by other scientists, when experiments are successfully reproduced and when the wider scientific community accepts the finding as sufficiently confirmed. Without this community, she argues, there could be no objectivity to the methods of science, because there would be no way to block the subjective preferences and values of individual scientists (5, p179–180).

With this view in place, Longino proposes four criteria by which a scientific community can be assessed for its potential for objective practice. Objectivity, on this account, is a matter of degrees; a scientific community can be more or less objective depending on how well it meets the four criteria that she identifies.[1] This means that when making an assessment with these criteria, the goal is not to find the one correct normative epistemic framework for medical practice, but rather the one that can be expected to achieve the highest standard of objectivity. In other words, no epistemic community will be perfectly objective, but some will be better than others.

Criterion 1: flexible shared standards

Critical discourse, the key to objective practice on Longino's account, requires shared standards that can be drawn on to critique ideas presented to the community (5, p182). However, Longino argues that these standards must be flexible and not dogmatically held. No one standard should be committed to irrevocably, because any given standard must be open to critical scrutiny in order to maintain objectivity.

It is not just the presence of shared standards that is important, but also the ability of outside voices to appeal to them and a willingness to amend, and when appropriate, reject these shared standards. Kirstin Borgerson [8] argues that it is important that the requirement of shared standards not be too demanding so that we can ensure inclusion of diverse perspectives that will challenge entrenched background assumptions (more on this below). She therefore proposes that critics need only to share one standard with the community they intend to critique and suggests that in the case of scientific practice this will most likely be something like empirical adequacy (8, p442).

[1]Longino does not propose these four criteria as a set of necessary and sufficient conditions. Rather, they are meant to be general guidelines, open to revision and addition. In my characterization below I use some of Kirstin Borgerson's [8] emendations to supplement Longino's original account.

Criterion 2: equality of intellectual authority

Longino argues that in order to ensure that one group or perspective does not dominate the scientific discourse, and thereby disrupt the possibility of valid critique, it is vital for objectivity that there be an equality of intellectual authority among all community members ([5], p183–4).

Borgerson proposes that this criterion should be revised to explicitly reflect a commitment to diversity in the community (8, p442). She argues that diverse perspectives can offer strong dissent to the orthodox theories of the community because they are more likely to call attention to the problematic background assumptions of these theories. I would further note, in a similar vein, that active recruitment of outside perspectives encourages the possibility of shedding light on the background assumptions that are held at the most macroscopic level of the community. Ensuring a diversity of voices is important not just for providing perspectives that dissent from dominant theories but also perspectives that dissent from those shared standards that the community requires and cultivates.

Criterion 3: recognized avenues for criticism

Community members should be required to present their ideas publicly and in a timely and transparent manner in recognized avenues for criticism such as journals and conferences (5, p181). Longino argues that it is important that critical work and negative results receive as much attention as 'original work' (positive results). This criterion is meant to ensure the transparency needed for critical discourse to function properly and for the positive valuation of critical work.

This criterion can also be used to prevent members of the community from skewing scientific results for personal or corporate gain. If negative results and critical work are not valued by the community, then it may not be to the advantage of one's career to publish this kind of work. Monetary interests can also disrupt scientific discourse. Borgerson provides an example of this kind of disruption:

> In recent years researchers (usually those working for pharmaceutical companies, but not in all cases) have been employing a number of tactics designed to suppress negative results from clinical trials. Tactics include delaying publication (sometimes for years), publishing in little-known journals or in other languages, and most notably by refusing to publish trial results at all (8, p439).

Ensuring that an epistemic community is able to meet this third criteria would provide safeguards against these kind of abuses.

Criterion 4: concrete response to criticism

It is not enough that criticism happens and that people are open to it. Criticism must also be taken up by the community in concrete ways (5, p182–3). This means that members of an epistemic community must be sensitive to promptly updating their project goals, educational literature and funding opportunities in line with valid criticisms. This criterion calls not just for recognition of criticism, but appropriate action based on that recognition.

In summary, an epistemic framework that promotes objectivity should be conducive to facilitating a community that (1) has

flexible shared standards; (2) ensures equality of intellectual authority among its members and actively seeks out diverse perspectives; (3) provides and mandates the use of recognized avenues for criticism; and (4) ensures concrete uptake to criticism in a timely and effective manner.

Application of Longino's criteria to epistemic frameworks in medicine

In the pre-EBM era of medicine, researchers and clinicians focused on understanding the pathophysiologic causes of disease. In contrast, the modern science of epidemiology, which emerged in the 19th century, focused on understanding how treatments are effective over populations. The initial force of EBM was to shift the focus to this new and powerful science, and away from what was thought to be an authoritarian reliance on clinical experience and pathophysiological explanations, which had poor track records for predicting effective treatments [9].

The foundations of EBM, therefore, rely on the assumption that EBM will offer a non-authoritarian practice of medicine that filters out the subjective preference of individuals in the community and ensures transparency by requiring clinicians to provide evidence for any clinical care decision. It seems reasonable to describe this shift as a shift towards a more objective medical community, both in clinical practice and in the knowledge productive practices of the medical community at large. At first glance then, by their own stated overarching standards and goals, it seems that proponents of EBM should be open to, and in fact embracing of, assessment by Longino's criteria.

However, from their early to their most recent formulations, proponents of EBM consistently assert that their ultimate goal is to achieve better patient outcomes (3, p2421 and 7, p3). It is in service of this goal that they endorse providing a more rigorous and systematic guideline for attaining and assessing the best available evidence for clinical care decisions (3, p2420). An initial objection to my project might be that Longino's criteria are not suitable for assessing EBM because EBM does not provide a guideline for a knowledge-productive community, but rather provides a practical guideline for clinicians to improve patient outcomes.

It is certainly right to say that EBM has, and is intended to have, this practical function. However, EBM also clearly acts as a normative epistemic framework for the knowledge-productive practices of the wider medical community. EBM does not only prescribe what clinicians ought to do with the evidence that is presented to them. It also tells researchers what kinds of evidence they should be producing by indicating what sorts of evidence will count as 'best evidence' under the EBM paradigm. If we accept that EBM is intended to act as a framework for an epistemic community, and we accept that objectivity is a valuable goal for the medical community (as is argued by proponents of EBM), then it makes sense to evaluate EBM and other normative epistemic frameworks in medicine using Longino's criteria.

Evaluation of evidence-based medicine

As mentioned previously, the overarching goal of EBM is to produce better patient outcomes. In service of this goal, the principles of EBM are created in order to ensure that the practitioners of EBM will be using 'the current best evidence in decision making in medicine in conjunction with expertise of the decision makers and expectations and values of the patients/people' (10, p2). From this brief sketch, we can derive the following goal structure for EBM:

The end goal To improve patient outcomes.

The instrumental goal To improve patient outcomes by ensuring objectivity in the medical community through the production and use of current best evidence.

Proponents of EBM will typically admit that wanting to use the current best evidence is not unique to EBM, but rather, that what is unique to EBM is the 'difference in emphasis, explicitness, rigour and understanding. The new tools and techniques of accessing, appraising and expressing the evidence make the process (of using evidence) more systematic and rigorous'. (10, p7). This new systematicity and rigour are embodied by the creation and application of hierarchies of evidence that the clinician is required to employ in their everyday decision-making processes. Randomized control trials (RCTs), and the meta-analyses of these trials, are generally taken to represent the best form of clinical research and are placed at the top of hierarchies of evidence. These hierarchies function as the shared standards for EBM practitioners. If pathophysiological rationale and expert opinion are included in these hierarchies at all, it is typically at the bottom. This suggests a third goal of EBM:

The procedural goal To ensure the production and use of current best evidence by creating evidence hierarchies that give clear and objective guidelines to clinicians and researchers for how to use and produce best evidence.

Now that we have this brief sketch of EBM, we can assess it using Longino's criteria.

Criterion 1: flexible shared standards

A hierarchical understanding of evidence does provide shared standards of evaluation and critique within the community. This hierarchical understanding is taken by many proponents of EBM to be its first and most fundamental principle (11, p1815 and 10, p3).

These hierarchies are meant to provide a clear guide for practice that can be followed by anyone. With these rigid standards in place, a researcher or clinician wishing to make use of or contribute knowledge to the community would be at a disadvantage if, for example, their methods or practices do not lend well to being tested by an RCT.

Furthermore, an EBM community would be blocked from implementing Borgerson's suggestion that outside critics should only be required to share a minimal standard such as empirical adequacy: any outside critic would be required to buy into the hierarchical organization of knowledge in general, as well as the specific organization that places epidemiology, and in particular RCTs, at the top of that hierarchy.

The difficulty of alternative medicines finding their way into the EBM paradigm is a good example of this. Callahan and Tonelli [12] argue that some alternative medicines could not possibly enter

into an EBM-dominated clinical practice and research community because in some cases performing RCTs would be incompatible with the underlying metaphysical commitments of these alternative medicines. For example, there are cases where the disease cannot be considered separately from the context of the individual patient (as with Qi therapies), and so, an RCT would not be appropriate (12, p1217).

When those who do not share the hierarchical understanding of knowledge or the prioritization of epidemiology and RCTs have difficulty entering into the community's critical discourse, that community risks blocking perspectives with strong dissent that have potential to allow the community to examine and alter any problematic background assumptions.

Criterion 2: equality of intellectual authority

Borgerson and Bluhm [9] argue that the massive quantity of RCTs that are produced each year make it impossible for any individual clinician to keep up with the latest literature (9, p215–216). Consequently, new forms of authority have been created to deal with this information overload. These authorities mainly take the form of bodies that produce meta-studies and guidelines for practice, such as the Cochrane Collaboration (9, p216). Bluhm and Borgerson argue that these bodies act as the new authorities for medical practice and block the initial democratic spirit that EBM initially set out to instil (9, p216). This presents a serious challenge to ensuring equality of intellectual authority, when the power to decide what evidence counts as good evidence is distributed in an explicitly top-down way.

By placing so much authority on evidence from RCTs, EBM has also given a powerful authority to those who fund, design and carry out these RCTs. The influence of pharmaceutical companies on the focus and results of these trials is well documented (8, p439). Although this unethical behaviour cannot be blamed on the EBM framework, its top-down structural organization leaves it vulnerable to such abuses.

Criteria 3 and 4: recognized avenues and concrete response

By placing evidence from pathophysiology or experiential knowledge at the bottom of evidence hierarchies, EBM risks devaluing these kinds of knowledge and therefore risks stigmatizing knowledge produced by these methods. Rather than encouraging collaboration, the hierarchical separation of evidence risks segregating different types of knowledge producers from each other. This kind of segregation could make an EBM community prone to a breakdown of communication between knowledge producers, and thereby, these knowledge producers might lose the necessary pressure from all community members, which is needed to ensure timely and transparent use of recognized avenues of criticism and concrete uptake in response to criticism.

For example, Robyn Bluhm [13] argues that if pathophysiologists are excluded from clinical research studies through the stigmatization of pathophysiologic rationale under EBM, then clinical researchers lose a valid perspective that would be expected to improve the quality and efficacy of their work (13, p546). To illustrate this point, Bluhm gives the example of development of insulin as a treatment for diabetes:

> …insulin was saving lives long before the details of the pathophysiology were understood. It was only with further research however, that type 1 and type 2 diabetes were distinguished, with the result that non-insulin based therapies could be developed for the latter and the unpleasant consequences of long-term insulin use could be reduced through better strategies for insulin therapy (13, p545).

This example illustrates nicely the importance of communication and criticism between pathophysiologists and epidemiologists.

The above analysis suggests that EBM's hierarchical organization of evidence, and specifically its preferencing of RCTs over other sources of evidence, can reasonably be expected to block an EBM community from fulfilling a high level of objectivity in Longino's sense.

Evaluation of casuistic medicine

One of EBM's most outspoken critics over the last two decades has been Mark Tonelli. Tonelli has written several papers on EBM, at first critiquing its philosophical credentials in a variety of ways [12,14], and then eventually constructing his own casuistic alternative to EBM [1,15,16]. I will use this alternative, which I will call non-hierarchical casuistic medicine (NCM),[2] as a comparison case for EBM in terms of Longino's criteria.

In the epistemic framework that Tonelli proposes, there are five classes of knowledge that are relevant to the medical community (1, p325–6 and 16, p252)[3,4]:

1 Clinical research/epidemiology
2 Pathophysiology
3 Experiential knowledge
4 Patient goals and values
5 System features (e.g. political, economic, social and legal factors)

Tonelli's account is casuistic in the sense that the evaluation of different types of knowledge happens at the case level. Broadly speaking, we can see the clinician as passing through three stages in the case evaluation. First, the clinician gathers facts and warrants from each of the five areas of knowledge. Prior to this process, the clinician is directed to value each of these types of knowledge equally and so is motivated to seek facts and warrants from all areas (15, p384). Second, the clinician assesses the strength of all of the facts and warrants gathered. If there is a disagreement among these facts and warrants, then the clinician must decide which provides a stronger warrant for action (15, p386). It is at this level of the specific case that the valuing of different sorts of knowledge occurs. Lastly, the clinician must develop an argument for care decisions in the particular case that can be

[2]This name is not meant to imply that other forms of casuistic medicine are hierarchical, but rather to indicate that this account (Tonelli's account) emphasizes the importance of a non-hierarchical understanding of medical knowledge. This characterization is not meant to provide a model of all casuistic frameworks, but rather to present one that is specific enough to act as a contrast case for evaluation against EBM.

[3]Tonelli sometimes formulates his list of types of medical knowledge with just the first three (see 'The challenge of evidence in clinical medicine' [15].

[4]Tonelli admits that hierarchies could be formed within each of these classes, but insists that even these internal hierarchies must not be fixed, and that the clinician may decide to alter the weighting of different kinds of evidence in each of these categories depending on the case (1, p328).

transparently presented and defended to the medical community (15, p388). This means that, as in EBM, the clinician is required to have a high level of skill in critical thinking and evaluation of evidence (16, p254).

NCM is distinct from EBM in that it focuses on the importance of the non-factive components of an argument, noting that arguments cannot be made, and decisions cannot be arrived at, without what Tonelli calls 'warrants' or 'non-evidential' components. For example, I can know the fact that a certain type of drug treats heart disease very effectively in most cases, but this fact does not function as a warrant in my case until I know that my patient is willing to take medication for their condition.

It may not be immediately clear how NCM constitutes a normative epistemic framework. At first look, NCM appears to focus only on the individual clinician and their particular case arguments. However, this characterization misses the fact that, like EBM, NCM effectively sets out epistemic norms for the whole community, implying not only shared standards of evaluation for clinicians that involve constructing transparent and rigorous case arguments, but also standards of knowledge production for the wider medical community including research, corporate and other relevant members.

In terms of the characterization of the goals of EBM set out previously, we can say that NCM shares the same end goal and instrumental goal as EBM, but proposes a different procedural goal:

The NCM procedural goal To ensure the production and use of high quality medical knowledge by requiring clinicians to value all types of medical knowledge equally and to create intersubjectively available case arguments that make use of all available facts and warrants.[5]

NCM is also distinctive in not committing to the idea that there is one correct diagnosis for a given case (1, p327). There could be multiple justified conclusions about the best course of action for the case drawn from the available facts and warrants depending on how the individual clinician, in partnership with the patient, chooses to weigh them. Tonelli provides a useful example of what this kind of practice might look like:

> For instance, although the results of clinical research suggest that norepinephrine is more effective than vasopressin in sepsis, I may continue to use the latter agent when I see better end-organ perfusion and tissue oxygenation in a particular patient compared to norepinephrine. Such a decision relates to my finding a warrant (under the topic of pathophysiology) proposing that hemodynamics and end-organ profusion is beneficial for critically ill patients more compelling that a warrant (under the topic of clinical research) that states that one should provide an agent that demonstrates mortality improvement in a population study. A colleague, however, might find the latter warrant more compelling (1, p327).

Because NCM explicitly prohibits the hierarchical view of knowledge that blocked EBM from potential for achieving a high level of objectivity in Longino's sense, NCM should, at least prima facie, be expected to fare better when evaluated by Longino's criteria. A closer look at NCM is called for however.

Criterion 1: flexible shared standards

Because NCM was developed in response to the hierarchical structure of EBM, flexible shared standards are an important part of its foundation. An NCM community would share commitments to valuing the five types of medical knowledge equally (both in clinical practice and research) and to developing case arguments for clinical care in a rigorous and transparent manner. These standards should provide a framework that is robust enough to allow for criticism from within the community, but minimal enough to allow for outside critique from individuals with differing perspectives.

Criterion 2: equality of intellectual authority

The NCM framework explicitly aims at ensuring an equality of intellectual authority for all knowledge producers in the community. Outside of any particular case, facts and warrants gathered from pathophysiology, epidemiology, clinical experience, patient goals and values and system features are valued equally. As was noted previously, it is not enough to give equality of intellectual authority to existing community members. Diverse perspectives must be actively sought out in order to achieve a high level of objectivity on Longino's account. It is not clear that NCM is any better equipped to ensure a diversity of perspectives than EBM, but initiatives that would seek diversity would certainly be compatible with an NCM framework.

Criteria 3 and 4: recognized avenues and concrete response

Because an NCM-based community makes special effort to ensure an equality of intellectual authority for all knowledge producers, we can expect that a community embracing the NCM framework would be more likely to facilitate productive cross-discipline communication and criticism. In particular, we would hope to see a more open debate between pathophysiology and clinical research that Bluhm [13] argued would be to the benefit of both disciplines. It seems reasonable to expect that a community with a vibrant critical discourse and good cross-disciplinary communication would be better at ensuring concrete uptake of criticism among its members. Additionally, because authority is more evenly distributed among all community members, we would also reasonably expect that an NCM community would have more resources to block abuses of power that allow for the suppression of relevant medical research as discussed above.

Objections

An objection to the superiority of NCM over EBM might be that it replaces the authority of RCTs and the creators of guidelines with the authority of the clinician. The clinician has the ultimate power to decide what is the best care decision and does not have to use facts and warrants from the latest epidemiological research to justify their decision. They might decide to prioritize their experiential knowledge over all other kinds of knowledge.

[5]I should note here that the proponent of NCM would have to revise the wording of the instrumental goal to reflect their equal valuation of all kinds of medical knowledge, as opposed to the prioritization of evidence from clinical research. However, I think the spirit of the instrumental goal remains the same in both EBM and NCM despite these differences in wording.

However, this characterization does not recognize the importance of the creation of the case argument in Tonelli's account. On the NCM account, the clinician is required to identify the facts and warrants from the five different classes to construct a case argument. This argument is then available for intersubjective inspection and criticism by the community. NCM therefore places the clinicians in a position of great authority over that case, however, that authority is tempered by their responsibility to be accountable to the community and the patient through the construction of a valid and coherent argument for their decisions.

NCM requires that doctors will have a high level of critical thinking skills and an ability to compare competing facts and warrants from the five different classes. In this way NCM is very similar to EBM, which, at least in its early formulations, emphasizes the building of these kinds of skills for clinicians. The difference is that EBM focuses on applying these skills to knowledge derived from clinical research, whereas NCM advocates exercising these critical skills in the weighting and selection of all kinds of facts and warrants.

A second, and perhaps more serious, objection might be that NCM does not really provide a clear guideline for clinical decision making and therefore fails to provide the shared standards necessary for criticism. Part of the motivation to develop an epistemic framework like EBM is to provide shared standards for clinicians to appeal to and to provide a standardization of care. The strength of EBM is that it provides clear and universalizable guidelines for a clinician to follow, guidelines that should in theory lead any rational person to the same conclusion.

Although it would be ideal to be in possession of universalizable guidelines for clinical care, this might be an unrealistic demand to place on clinical practice. We cannot expect that one method of gathering facts and warrants will, when incorporated into an argument for clinical care, always lead to better outcomes. Tonelli's example of deciding when to provide norepinephrine or vasopressin and Bluhm's example of developing better therapies for diabetes provide support for this claim. In the same way that relying on pathophysiologic rationale does not always lead to better patient outcomes, we cannot assume that clinical research will either.

Research can be mistaken, and research programmes can be compromised by personal or corporate interests. It seems reasonable to think that we would want our clinicians to question purported facts when they have reason to do so, even if that reason comes from their own experience and not from epidemiological research. If a doctor consistently sees a treatment fail in many patients, a treatment that is established in the epidemiological literature to be effective, we would not think it responsible for that clinician to continue that treatment in light of the experiential evidence that is being presented to them.

However, this kind of flexibility comes at a cost. Having less-rigid guidelines means that, sometimes, incompetent clinicians will be allowed to make mistakes. But mistakes are no more avoidable at the level of clinical research than they are at the individual level.

Conclusion

I have argued that NCM is a better alternative when compared with EBM using Longino's four criteria. Specifically, I argued that it is the commitment to a hierarchy of knowledge that blocks EBM from facilitating the kind of objective epistemic community envisioned by Longino. NCM's more flexible case-based approach avoids the problems created by committing to an evidence hierarchy and could be expected to lead to a community that more optimally fulfils Longino's criteria.

This analysis does not imply that NCM is the ultimately correct epistemic framework for medical knowledge. Rather, it implies that it is the better available option between the two. Further development of NCM as a normative epistemic framework is still needed, and the development of other alternatives would be beneficial in finding an optimal epistemic framework to guide clinical practice. The aim of this paper has been to provide tools for evaluation as these alternatives become available.

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