



# 'Cognitive biases plus': covert subverters of healthcare evidence

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## Abstract

The evidence-based medicine (EBM) paradigm has been associated with many benefits, but there have also been 'some negative consequences'. In part, the consequences may be attributable to: (1) limitations in some of the tenets of EBM, and (2) flawed or unethical decisions in healthcare related organisations. We hypothesise that at the core of both is a cascade of predominantly unconscious cognitive processes we have syndromically termed 'cognitive biases plus', with conflicts of interest (CoIs) as crucial elements. CoIs (financial, and non-financial including intellectual) catalyse self-serving bias and a cascade of other 'cognitive biases plus' with several reinforcing loops. Authority bias, herd effect, scientific inbreeding, replication publication biases, and ethical violations (especially subtle statistical), are key contributors to the cascade; automation biases through uncritical use of statistical software and applications (apps) of preappraised sources of evidence at point of care, may be other increasingly important factors. The 'cognitive biases plus' cascade which involves several intricately connected healthcare-related organisations has the potential to facilitate, compound and entrench flaws in the paradigm, evidence and decisions that converge to inform person-centered healthcare. Our reasoning is based on observational data and opinion. However, the susceptibility of all humans to 'cognitive biases plus' makes our hypothesis plausible. Individual and collective fallibility may be minimised and the quality of healthcare decisions (including those related to improving EBM) enhanced by being conscious of our vulnerability and open-minded to the 'outside view'.

Sir Francis Bacon (1620): "The human understanding when it has once adopted an opinion (either as being the received opinion or as being agreeable to itself) draws all things else to support and agree with it..." (Novum Organum: XLVI)

## Introduction

Evidence-based medicine (EBM) was introduced in 1992 as a 'new approach to teaching the practice of Medicine'.<sup>1</sup> EBM's tenets were rapidly incorporated into all aspects and disciplines of healthcare, and its benefits and influence have been widely recognised.<sup>2</sup> In 2014, Greenhalgh *et al*<sup>3</sup> referred to the numerous successes of EBM but also drew attention to 'some unintended consequences,' and proposed open debate to help improve EBM. Our 'perspective' contributes to the dialogue.

## Hypothesis

The 'unintended consequences' may be explained by: (1) limitations in the tenets of EBM, and (2) flawed or unethical decisions and actions ('misuses of EBM'<sup>2</sup>) by

several distinct yet interconnected healthcare-related organisations.<sup>4,5</sup> At the core of both is the covert cognitive syndrome we have termed 'cognitive biases plus'.<sup>4</sup> Qualitative information is summarised and up-dated from a more detailed review,<sup>4,5</sup> to support the hypothesis.

## Definitions and concepts

### Cognitive biases plus

Decisions are considered to be cognitively driven by two interconnected neurophysiological systems. System 1 ('thinking fast') is primarily mediated by the phylogenetically older limbic system, and involves cognitive processes that are predominantly automatic and unconscious; system 2 ('thinking slow') is more deliberate and conscious, with networks in the phylogenetically newer parts of the brain, especially frontal, being principally implicated.<sup>6</sup> Most decisions occur primarily at system 1 level.<sup>6</sup> Cognition and decisions are inextricably linked with emotion, and may be compromised by factors such as uncertainty, stress, high work load and complexity, sleep deprivation and social or organisational pressures, all common in healthcare.

There is considerable literature on conflicts of interest (CoIs), biases, fallacies and ethical violations (table 1); generally, these have been discussed in a silo fashion.<sup>4</sup> We have suggested grouping them syndromically as 'cognitive biases plus' for the following reasons: (1) the four entities frequently co-occur in various combinations, (2) they share neurobiological processes (especially related to system 1), (3) many have evolutionary roots and (4) all are potentially influenced by prevailing organisational and sociocultural values. Individually and collectively, they undermine rational thinking, decisions and discourses.

### Organisations that influence healthcare

In the current context, 'organisation' is a functional concept rather than a structural one, and refers to a body of people with common goals, vision and/or mission, often with a hierarchy of authority. The term 'organisations' incorporates the individuals in them; these individuals may or may not be employees but typically share or are governed by a common culture including values, beliefs and behaviour.

### EBM expert groups

EBM expert groups can be collectively considered to be an organisation; included are not only the founding group at McMaster University (Canada) and the Centre for Evidence-based medicine in Oxford (UK), the late Dr David Sackett being the pioneering influence for both, but also EBM centres established elsewhere by trainees. The achievements of EBM testify to the contributions made by EBM expert groups to evidence-informed



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**Table 1** 'Cognitive Biases Plus' and healthcare evidence

	Description
Conflicts of interest (Cols)	
Financial, non-financial and intellectual Cols (often co-occur)	Circumstances in which a self-serving factor (gain) has the potential to prejudice views and decisions. Non-financial Cols include desire for promotion, prestige, etc. Intellectual Col is driven by a strong personal belief and likely confounds all discourses. Potential for succumbing to Col is intrinsic to all humans. Cols are necessary catalysts for the cascade (see <a href="#">figure 1</a> )
Individual or group cognitive biases	
Self-serving bias (incentive bias)	The most important of all biases. Judgment influenced by personal or organisational (self-serving) motives
Confirmation bias (interpretive bias)	Favouring evidence supporting one's preconception and ignoring evidence that does not support it. Often associated with anchoring and consistency
In-group conformity (social proof)	Increasing confidence in a decision when it is in agreement with others
Authority bias and halo effect	Uncritical acceptance, even without coercion, of the views of authority, including expert groups and high-impact publications
Reductionism	Reducing complex or uncertain scenarios into simpler ideas or concepts. The resulting evidence risks being flawed for the often complex clinical situations seen in clinical practice
Automation	Uncritical use of automated technology, including statistical software, apps with preappraised sources of evidence, decision support systems and the like. An increasingly important bias
Group or organisational cognitive biases	
Scientific inbreeding	The practice of those trained in the same school of thought/or by the same experts, working together in the same field. High risk for groupthink and replication publication biases. Similar to academic or intellectual inbreeding
Groupthink (inside view)	The views of close-knit/inbred decision-making groups risk becoming homogeneous; opposing views are discouraged or disregarded
Herd effect (lemming effect, emperor's new clothes effect)	Alignment of thoughts or behaviours in a group/organisation, often catalysed by authority. Decisions or opinions of authority are accepted/obeyed unquestioningly. Social media are becoming important catalysts ('the viral effect')
Fallacies (logical errors in reasoning)	
Two examples (individual, group or organisational level)	Planning fallacy: Incorrectly estimating the benefits of policies or actions, and/or unrealistically discounting costs and consequences Sunk cost fallacy: Reluctance or inability to change course when too much has been invested
Ethical violations	
A spectrum	Range of behaviours including subtle statistical manipulations, selective publication and outright fabrication. Associated with rationalisation and self-deception. In healthcare, no ethical violation is minor: all can harm

Elements of 'cognitive biases plus'. Only some of the many (frequently co-occurring) cognitive biases and fallacies are listed. The table and figure supplement each other. The contents are substantially condensed and revised from (1) table 1 in Seshia *et al.*<sup>4</sup> and (2) table 1 in Seshia *et al.*<sup>5</sup> Publisher: John Wiley & Sons Ltd. Please refer to the references for details and primary references.

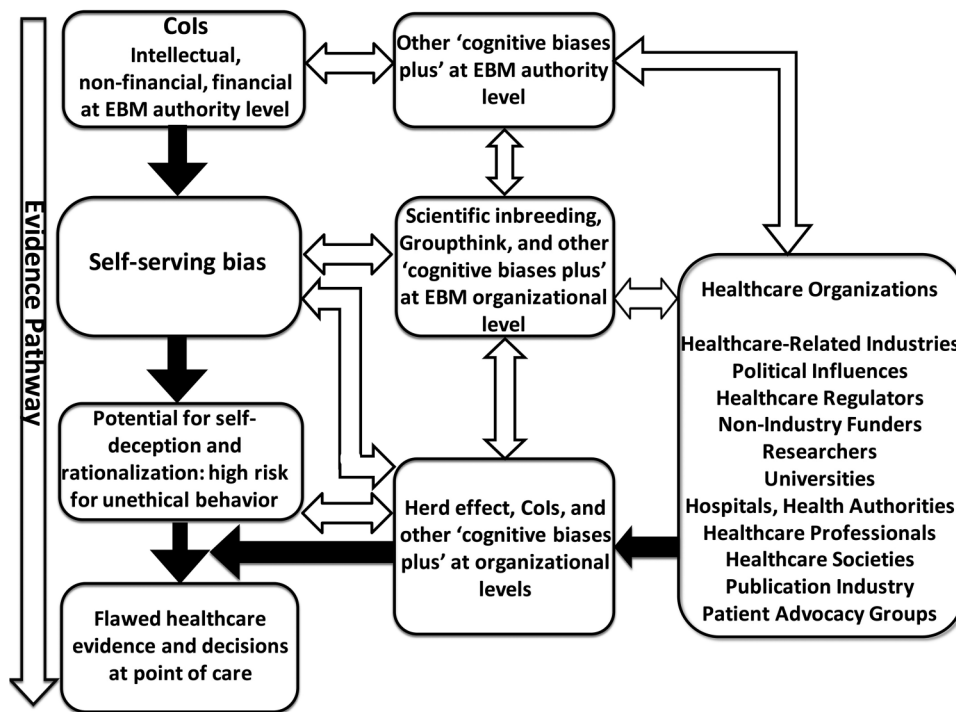
healthcare. At the same time, the potential for scientific inbreeding and groupthink increases the risk of shared intellectual CoIs and replication biases.<sup>4 5 7</sup>

EBM should be viewed as a 'continuously evolving heuristic structure for optimising clinical practice'.<sup>8</sup> In essence, the tenets are improved as limitations are recognised; GRADE (*Grading of Recommendations, Assessment, Development and Evaluation*) replacing the original EBM hierarchy being one example.<sup>9</sup> Several limitations, including those within the original hierarchy were foreseen from the outset by many outside the core EBM groups,<sup>10-14</sup> for example, Feinstein and Horwitz<sup>12</sup> predicted all the problems listed by Greenhalgh *et al.*<sup>3</sup> Reservations about systematic reviews,<sup>10 12</sup> including Cochrane, have also been justified.<sup>15-17</sup> We suggest that intellectual CoI, scientific inbreeding and other cognitive biases ([table 1](#)) resulted in the inability of EBM experts to anticipate the limitations or accept the 'outside view.' Planning and sunk cost fallacies may help explain the delay in rectifying oversights.

### Healthcare-related organisations

EBM influences healthcare evidence indirectly through several organisations; those we studied are listed in the bottom extreme right panel of the [figure 1](#), and are likely representative of organisations in most countries.

CoIs and ethical violations have been well documented in industry and among researchers,<sup>4</sup> as have cognitive biases at the practicing physician-patient interface.<sup>18</sup> Industry is the epicentre of financial CoIs, and its influence pervasive.<sup>3 4</sup> Decisions by regulatory agencies for drugs and devices can be flawed and oversights inadequate.<sup>19 20</sup> Cognitive biases of health authorities, especially anchoring bias and groupthink can lead to the imposition of inflexible rules and guidelines.<sup>3</sup> CoIs and cognitive biases of reviewers, editors and editorial boards risk publication biases that can consolidate flawed or even fraudulent data,<sup>4 5 7</sup> non-conforming views may be rejected or overridden.<sup>15</sup> In addition, patients and their families often introduce cognitive biases into shared decision-making.<sup>21</sup>



**Figure 1** The putative ‘cognitive biases plus’ cascade and evidence pathway. Cols, conflicts of interest; EBM, evidence-based medicine. Double-headed arrows reflect bi-directional reinforcing influences. This figure has been substantially revised from figure 3 in Seshia *et al.*<sup>5</sup> Publisher: John Wiley & Sons Ltd.

Thus, clinical evidence can be compromised by ‘cognitive biases plus’ at several inter-related organisational levels.

**The ‘cognitive biases plus’ cascade**

The cascade is a simplified visual summary of several putative inter-linked complex sets of reinforcing primarily unconscious cognitive processes involving several organisations (figure 1). These processes have the potential to create, compound and entrench flawed opinions and evidence that converge to inform healthcare.

The authority bias of EBM can have a herd effect in healthcare-related organisations, reinforcing and entrenching not only the strengths but also the limitations associated with the paradigm. In addition, elements of ‘cognitive biases plus’ within each organisation at individual and group levels, can also subvert evidence and decisions. Collectively, these risk inappropriate healthcare practices at the point of care, examples of which Greenhalgh *et al.*<sup>3</sup> have provided.

**Discussion**

CoIs, self-serving bias, tendency to cheat, authority bias (the  $\alpha$  animal), groupthink, social proof and the herd/lemming effect, are among the most fundamental of our evolutionary traits. In humans, intellectual CoI is a strong driver of beliefs and argumentations, potentially introducing subjectivity and fallacies into all discourses.<sup>4 5 22</sup> ‘Cognitive biases plus’ are ‘human universals:’ that is, attributes to which all humans (and therefore organisations), including those involved in

healthcare-related decisions, are potentially susceptible. The ‘multi-system failure’ related to anti-influenza drugs<sup>19</sup> and the problems in the current approaches to drug safety<sup>20</sup> can be explained by the concepts underlying the cascade, several organisations and elements of ‘cognitive biases plus’ (figure 1 and table 1) likely being responsible. The ramifications are multidisciplinary and global.<sup>19 20 23</sup>

On this background, suggestions for debate are outlined:

I ‘Cognitive biases plus’

Decision-making, especially under uncertainty, is rarely rational, and experts are as prone to error as laypersons; however, some individuals may be more rational than others (Stanovich).<sup>6</sup> Hence, experts, professionals and organisations must be constantly mindful of being in a perpetual ‘cognitive minefield,’ and welcome the ‘outside view.’<sup>6</sup> Cognitive debiasing may help to minimise some biases.<sup>18 21</sup> The concept of ‘cognitive biases plus’ needs to be validated. The role and management of ‘cognitive biases plus’ in medical decision-making require well-designed prospective studies; these studies should involve all professionals, including biostatistical experts and administrators, who contribute to or influence healthcare evidence, decisions and care.

II EBM

Any attempt to improve the evidence that informs current healthcare should also include a critical

reappraisal of the tenets of EBM.<sup>5</sup> Space does not permit the discussion this topic deserves.

### III Organisations

- 1 The apparent increase of CoIs in the culture of healthcare-related organisations may mirror the erosion of ethics in society.<sup>24</sup> An editorial in the *BMJ* in response to publications in the *NEJM* reflects both sides of the debate on how to address financial CoIs;<sup>23</sup> non-financial and intellectual CoIs may be equally important catalysts of the 'cognitive biases plus' cascade, and also need discussion. Potential remedies to address and minimise CoIs and ethical violations should be brainstormed with experts in ethics, law and behaviour research; patients should have a say. Anecdotally, altruistic ethical leaders and role models can catalyse positive change in organisations, an example of the beneficial effects that authority bias and the consequent herd effect can have.
- 2 The publication industry (print, electronic and preappraised sources of evidence) is the gatekeeper of analysing and disseminating healthcare evidence; high-impact publications have a halo effect and exert authority bias on those responsible for funding, directing, managing and performing research, patient care and teaching.<sup>4</sup> Greenhalgh *et al's*<sup>3</sup> call for publishers to raise the bar is justified. For example, safety information in clinical trials is often under-reported in RCTs,<sup>9 20</sup> even in those published in high-impact journals and formal warning of toxicity or withdrawal of drugs associated with death are often delayed.<sup>20</sup> One hundred and two drug studies were retracted from the biomedical literature for the period 2000–2011, the median time to retraction being 31 months (range: 1–130 months);<sup>25</sup> frequently, flawed evidence lingers. The responsibility of editors to lead the drive to improve the reliability of information has been acknowledged.<sup>23</sup> The open data movement should improve the quality of published evidence.<sup>23</sup>  
All preappraised sources of evidence are not equally trustworthy, and users are advised to always critically appraise the information.<sup>9</sup> The use of preappraised sources of evidence through applications (apps) at point of care risks automation bias: consequently, 'rules' based, that is, cookbook medicine.<sup>3 12 14</sup> Regulation and quality control are urgently needed for medical apps, as are well-designed studies to better assess risks and benefits.<sup>26</sup>
- 3 Healthcare regulatory agencies for drugs and devices across the world must be autonomous and standards global. Resources, including the services of unbiased methodological experts should be pooled. These experts must be capable of (1) setting standards for trials of efficacy and effectiveness with meaningful clinical end points, (2) establishing robust pharmacovigilance systems and (3) detecting the increasingly subtle and harder to detect statistical and methodological

manipulations.<sup>4 20</sup> Benefits and risks should be assessed consistently, comprehensively and continuously throughout the market life of a drug.<sup>27</sup>

### Conclusion

Like all arguments, ours are likely coloured by intellectual CoI and cognitive biases. In addition, the best supportive evidence is qualitative, observational and expert opinion. Nevertheless, there is tenable evidence to support the occurrence of a complex cascade of 'cognitive biases plus' that has the potential to undermine evidence and decisions, which inform the EBM paradigm and person-centered healthcare.

The landscape of healthcare problems is ever-changing. Hence, the principles of evidence-informed practice will have to be improved continuously;<sup>8</sup> an appreciation of 'cognitive biases plus' may help in this endeavour. Evidence alone should never drive clinical decisions;<sup>9</sup> critical thinking and appraisal at individual and organisational levels must remain the core of EBM and evidence-informed practice.<sup>3 5 9 28</sup>

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