

Best practice to identify and prevent cognitive bias in clinical decision-making

Citation Garrubba M, Joseph C. & Melder A. 2019. Best practice to identify and prevent cognitive bias in clinical decision-making: Scoping review. Centre for Clinical Effectiveness, Monash Innovation and Quality, Monash Health, Melbourne, Australia.

Summary about evidence of best practice

This review reports that there is limited evidence to inform best practice to manage cognitive bias. The review included information about the different types of cognition bias that exist and how this might impact clinical decision making. Literature explained the influence and impact of cognitive bias on diagnostic accuracy, management errors and patient outcomes. Findings suggest that cognitive biases may be associated with diagnostic inaccuracies and, some evidence suggest a potential influence of cognitive biases on management or therapeutic errors. In terms of best practice around strategies to reduce, manage and prevent cognitive bias, the evidence body is also limited. The only intervention shown to be successful was *reflection on diagnostic hypothesis*. Reflection on the initial formulated diagnosis was induced by means of instructions, either at test or during training or both. The instructions were either non-specific (unguided) prompting a need to relook or re-evaluate the initial diagnostic hypothesis, or specific structured instructions - guiding subjects on deliberate stepwise evaluation of the initial diagnostic hypothesis and alternate hypotheses. Evidence also explains that many attempts to develop specific strategies to counter particular biases have led to a considerable fragmentation of the research field, leaving doubts about the worth and necessity of *de-biasing*. Overall, the literature about *de-biasing interventions* in the health context appears to work better than their reputation might present: more than two-thirds of the reviewed interventions were at least partially effective. Results should however, still be interpreted with caution due to heterogeneity between included studies, and other methodological limitations. The most recent randomised controlled trial tested a de-biasing strategy during clinical cases by clinicians. The intervention was delivered via an online application and found that the use of the tool overall did not have any measurable effect on cognitive bias. Qualitative assessment showed that 'thinking aloud' interviews, using a cognitive forcing strategy improved the subjective quality of thought and problem solving.

Abstract

Background. The Centre for Clinical Effectiveness was requested to identify best practice to effectively prevent and or manage cognitive bias.

Objective. The objective of this review was to identify best practice to effectively prevent, reduce, manage, cognitive bias in clinical decision making? Related questions included: What is cognitive bias? What is the influence/impact of cognitive bias on diagnostic accuracy, management errors and patient outcomes? What strategies have been evaluated to reduce, manage and prevent cognitive bias?

Method. Literature was included from studies that involved any patient group and any clinician type (doctors, nurses, allied health) involved in making decisions about clinical care were included. The premise of an included study needed to focus on the concept of cognitive bias or cognitive errors in the hospital setting. Peer reviewed and grey literature were included if published in English from 2014 to present. A search of Google and Medline was undertaken using a combination of relevant search terms including cognitive bias, management, reduction and prevention. Search results were screened by one reviewer in consultation with colleagues as necessary.

Results. This literature review identified three systematic reviews [1-3] and one RCT [4]. An additional four narrative reviews were included to provide background theory and discussions points [5-8].

Defining Cognitive Bias. Cognitive bias describes a variety of unconscious influences, short cuts and behaviours which influence our decision making [2, 4]. These "cognitive shortcuts" are useful tools for "fast and frugal" decision making as they "employ a minimum of time, knowledge, and computation to make adaptive choices in real environments" [2].

Increasingly recognised as an important cause of medical errors, cognitive factors are estimated to contribute to up to 75% of errors in internal medicine and errors in cognition have been identified in all steps of the diagnostic process including information gathering, association triggering, context formulation, processing and verification [2, 4].

Examples of common cognitive biases that were found to effect clinical decision making include: See Table 1 in 'Full Review', for the full list.

- Outcome bias
- Information bias
- Risk Aversion
- Ambiguity tolerance
- Overconfidence
- Availability bias
- Reflective reasoning
- Framing effect
- Anchoring
- Premature closure
- Feedback bias
- Blind obedience

Framing effects and overconfidence were the most commonly reported biases however, due to methodological limitations of the included studies an accurate estimation of the true prevalence cannot be made [3].

Influence/impact on cognitive bias. One systematic review looked at the influence and impact of cognitive bias on diagnostic accuracy, management errors and patient outcomes [3]. Findings suggest that cognitive biases may be associated with diagnostic inaccuracies and, evidence from five out of seven studies suggest a potential influence of cognitive biases on management or therapeutic errors. Furthermore the review attempted to determine the impact of cognitive biases on patient outcomes (e.g. avoidable hospitalizations, complications related to a procedure or medication, exposure to unnecessary invasive tests, etc). The review found only two studies that provided information to answer this question, both evaluating physicians' tolerance to uncertainty. It was concluded that there is too little evidence to make definitive conclusions on the influence of physicians' personality traits or cognitive biases on patient outcomes.

Strategies to reduce, manage and prevent cognitive bias. Given the implications of diagnosis and misdiagnosis for subsequent management decisions and errors, optimising a clinician's diagnostic decision making is critical for patient outcomes [1]. Prakash et al (2019) undertook a systematic review and meta-analysis to identify cognitive interventions that improve diagnostic decision making amongst medical professionals [1]. The results were considered "clear and likely to be true" in only 11% of studies (5/44) [1]. The interventions and their effectiveness are outlined in table 2. The only intervention shown to be successful was reflection on diagnostic hypothesis [1]. Reflection on the initial formulated diagnosis was induced by means of instructions, either at test or during training or both. The instructions were either non-specific (unguided) prompting a need to relook or re-evaluate the initial diagnostic hypothesis, or specific structured instructions - guiding subjects on deliberate stepwise evaluation of the initial diagnostic hypothesis and alternate hypotheses [1].

A systematic review conducted by Ludolph et al (2017) explains that many attempts to develop specific strategies to counter particular biases have led to a considerable fragmentation of the research field, leaving doubts about the worth and necessity of de-biasing [2]. Overall, the systematic review found that de-biasing interventions in the health context appear to work better than their reputation might present: more than two-thirds of the reviewed interventions were at least partially effective [2]. Results should however, still be interpreted with caution due to heterogeneity between included studies, and other methodological limitations [2].

Another review found that further studies were needed to identify the most effective strategies to overcome their potential influence on medical task and errors [3] and too little evidence was available to make a definitive conclusion of the impact on patient outcomes [3].

Of all the strategies studied to identify and prevent cognitive bias impacting clinical decision making and diagnostic errors, reflection on the initial diagnosis was the only strategy found to be effective in improving diagnostic decision making [1]. This result should be interpreted with caution as the results were achieved in cohorts that were primarily 3rd and 4th year medical students [1].

A randomised controlled trial tested a de-biasing strategy during clinical cases by clinicians [4]. The intervention was delivered via an online application [4] and found that the use of the tool overall did not have any measurable effect on cognitive bias [4]. A qualitative assessment was also undertaken which showed that using 'thinking aloud' interviews, using a cognitive forcing strategy improved the subjective quality of thought and problem solving [4].

For a full list of strategies evaluated and the effectiveness on outcomes, see Table 2 in 'Full Review'.

Conclusion. In conclusion there is a lack of evidence evaluating strategies that mitigate the effects of cognitive bias on decision making, diagnostic errors and patient outcomes. Further, the evidence that does exist is not of high quality.

The only strategy that indicated a significant difference on the effects of cognitive bias was 'reflection on the initial diagnosis', introduced by means of instructions, either at test or during training or both [1].

The clinical narrative on cognitive bias suggests that clinicians, leaders and hospitals look to making small changes in culture and communication to help establish safer environments for admitting uncertainty in diagnosis and acknowledging errors. One suggestion is to simply change the language of "diagnostic errors" to "missed opportunities in diagnosis". Destigmatising and depersonalising errors through techniques that employ and promote safe and open communication should be employed, such as routinely incorporating diagnostic time-outs for difficult cases [8].

Background

An organisation-wide program is to be considered to reduce cognitive bias at Monash Health. Currently, Monash Health utilise the NSW TWED checklist which is a simple checklist for recognising and reducing bias.

The Centre for Clinical Effectiveness was asked to identify best practice in effectively preventing, reducing and managing cognitive bias in clinical decision making.

Objectives

What is best practice to effectively prevent, reduce, manage, cognitive bias in clinical decision making?

1. What is cognitive bias?
2. What is the influence/impact of cognitive bias on diagnostic accuracy, management errors and patient outcomes?
3. What strategies have been evaluated to reduce, manage and prevent cognitive bias?

Inclusion Criteria

Types of participants: Any patient group and any clinician type (doctors, nurses, allied health) – anyone involved in making decisions about clinical care.

Concept: Cognitive bias or cognitive error

Context: Hospital, clinical setting

Types of information: Peer reviewed literature, grey literature – published 2014 to present

Search strategy

A search of Google and Medline was undertaken using a combination of relevant search terms including “cognitive bias, management, reduction and prevention” for peer reviewed and grey literature published from 2014 onwards. Reference chaining was also used to identify relevant papers.

Search results were screened by one reviewer in consultation with colleagues as necessary. Literature was included based on the inclusion criteria above.

Results

This systematic review of the evidence identified three systematic reviews [1-3] and one RCT [4]. An additional four narrative reviews were included to provide background theory and discussions points [5-8].

What is Cognitive Bias?

Cognitive bias describes a variety of unconscious influences, short cuts and behaviours which influence our decision making [2, 4]. These “cognitive shortcuts” are useful tools for “fast and frugal” decision making as they “employ a minimum of time, knowledge, and computation to make adaptive choices in real environments” [2]. Increasingly recognised as an important cause of medical errors, cognitive factors are estimated to contribute to up to 75% of errors in internal medicine and errors in cognition have been identified in all steps of the diagnostic process including information gathering, association triggering, context formulation, processing and verification [2, 4].

It is likely that most, if not all, clinical decision-makers are at risk of error due to bias – it seems to be a ubiquitous phenomenon and does not correlate with intelligence nor any other measure of cognitive ability [5]. The causes of bias are varied and include learned or innate biases, social and cultural biases, a lack of appreciation for statistics and mathematical rationality, and even simply environmental stimuli competing for clinicians attention [5].

A recent systematic review evaluating the most common cognitive biases affecting physicians’ decisions, identified 19 different biases [3] (Table 1). Framing effects and overconfidence were the most commonly reported biases however, due to methodological limitations of the included studies, an accurate estimation of the true prevalence cannot be made [3].

Table 1. Types of cognitive bias identified [3]

<ul style="list-style-type: none">• Multiple alternative/Decoy bias• Outcome bias• Information bias• Risk Aversion• Ambiguity tolerance/aversion• Overconfidence	<ul style="list-style-type: none">• representativeness bias• confirmation bias• omission• Omissions and naturalness bias• Availability bias• Gambler's and Conjunction fallacy	<ul style="list-style-type: none">• Reflective reasoning• Deliberation without attention• Framing effect• Anchoring• Premature closure• Feedback bias• Blind obedience
---	---	--

What is the influence/impact of cognitive bias on diagnostic accuracy, management errors and patient outcomes?

In their review of the evidence, Saposnik et al (2016) assessed the influence of cognitive bias on diagnostic, medical management or therapeutic tasks [3]. Their findings suggest that cognitive biases may be associated with diagnostic inaccuracies and evidence from five out of seven studies suggest a potential influence of cognitive biases on management or therapeutic errors. Physicians who exhibited information bias, anchoring effects and representativeness bias, were more likely to make diagnostic errors [3]. It was noted in the review that further studies were needed to identify what the most common cognitive biases and the most effective strategies to overcome their potential influence of medical task and errors were [3].

Another objective from the Saposnik et al (2016) review was to determine the impact of cognitive biases on patient outcomes (e.g. avoidable hospitalizations, complications related to a procedure or medication, exposure to unnecessary invasive tests, etc) [3]. The review found only two studies that provided information to answer this question, both evaluating physicians' tolerance to uncertainty. It was concluded that there is too little evidence to make definitive conclusions on the influence of physicians' personality traits or cognitive biases on patient outcomes [3].

What strategies have been evaluated to reduce, manage and prevent cognitive bias?

Technological strategies and Cognitive strategies [2]

A systematic review conducted by Ludolph et al (2017) explains that many attempts to develop specific strategies to counter particular biases have led to a considerable fragmentation of the research field, leaving doubts about the worth and necessity of debiasing [2]. Their review aimed to systematically synthesise, categorise and analyse the existing debiasing research in the health domain, allowing for the identification of actual effectiveness of health-related debiasing and lead to the identification of opportunities and challenges for the development of future debiasing interventions targeting both the general population and health professionals [2].

Cognitive strategies, which primarily aim at improving people's critical thinking skills, were used in 36 of 87 studies (41.1%) included in Ludolph et al (2017) review. These strategies often comprised training to raise awareness of and acquire techniques for avoiding cognitive biases [2].

Thirty-three studies (37.9%) applied a technological debiasing strategy (e.g., by providing graphical in addition to statistical information to eliminate framing effects or base rate neglects) [2].

Two studies (2.3%) employed a motivational debiasing strategy by holding people accountable for their decisions [2].

Thirteen studies (14.9%) applied an affective strategy aiming at overcoming biases (e.g., by using in-group v. out-group framing or inducing feelings) [2].

Three studies applied a mixed intervention, twice consisting of a cognitive and a technological strategy and one time of a combination between an affective and a technological strategy [2].

A slight advantage for overcoming the framing effect and denominator neglect emerged. In 90% of the cases (n = 9), it was at least partially possible to debias the denominator neglect. Similarly, 85.7% (n= 12) of anti-framing effects strategies led to a positive outcome. The optimistic bias appears to be more robust: 64.0% (n = 16) of interventions achieved a debiasing effect, whereas 36.0% (n=9) did not.

Overall, the systematic review found that debiasing interventions in the health context appear to work better than their reputation might present: more than two-thirds of the reviewed interventions were at least partially effective (n = 60) [2]. With regard to debiasing strategies' effectiveness across different categories, 87.9% (n = 29) of technological interventions were partially or completely successful. In turn, cognitive strategies were in 50.0% (n = 18) of cases effective [2]. Although positive, these results should still be interpreted with caution due to heterogeneity between included studies, and other methodological limitations [2].

Reflection on diagnostic hypothesis - Improving diagnostic decision making [1]

Given the implications of diagnosis and misdiagnosis for subsequent management decisions and errors, optimising a clinician's diagnostic decision making is critical for patient outcomes [1]. Prakash et al (2019) undertook a systematic review and meta-analysis to identify cognitive interventions that improve diagnostic decision making amongst medical professionals [1]. Included were a total of 44 studies, mostly involving medical students only. The results were considered "clear and likely to be true" in only 11% of studies (5/44) [1]. The interventions and their effectiveness are outlined in table 2. The only intervention shown to be successful was reflection on diagnostic hypothesis [1]. Reflection on the initial formulated diagnosis was induced by means of instructions, either at test or during training or both. The instructions were either non-specific (unguided) prompting to relook or re-evaluate the initial diagnostic hypothesis, or specific structured instructions - guiding subjects on deliberate stepwise evaluation of the initial diagnostic hypothesis and alternate hypotheses [1].

SLOW [4]

A randomised controlled trial tested a de-biasing strategy during clinical cases by clinicians [4]. The Mnemonic SLOW was presented to both students and doctors to address the following biases in decision-making:

- S = Overconfidence, hindsight
- L = Multiple biases
- O = Anchoring
- W = Search satisfying

The intervention was delivered via an online application [4] and found that the use of the tool overall did not have any measurable effect on cognitive bias [4]. A qualitative assessment was also undertaken which showed that using 'thinking aloud' interviews, using a cognitive forcing strategy improved the subjective quality of thought and problem solving [4]. The authors state that issues surrounding engagement with the intervention (not meeting number needed to show a difference 78/300) make it difficult to conclusively say whether this was a truly negative trial, or rather an unsuccessful trial design/delivery.

Table 2. Effectiveness of interventions

Strategy	Description	Effectiveness
Reflection on diagnostic hypothesis [1]	These studies evaluated the impact of either: (i) nonspecific (unguided) instructions to reexamine or reevaluate the initial diagnostic hypothesis (n=4), or, (ii) specific instructions (guided) on deliberate stepwise evaluation of initial diagnostic hypothesis and alternate hypotheses (n=14).	Statistically significant impact on diagnostic accuracy for both non-specific and specific instructions
De-biasing workshops [1]	These studies evaluated predominantly the impact of teaching cognitive forcing strategies (CFS). These strategies are defined as forms of self-monitoring during decision making, in which an individual acknowledges the risk of error, identifies potential biases influencing decision making, and actively employs a cognitive process to counter a potential bias.	No clear conclusions could be drawn to where the results were clear and likely to be true
Checklists [1]	These studies evaluated the impact of using checklists, which were either a list of generic prompts to work through the reasoning process [e.g. SNAPPS checklist] or prompts to avoid common biases in reasoning process [e.g. TWED checklist]	
Instructions to induce primary analytical approach [1]	Participants were instructed to approach a particular clinical problem using a stepwise analytical approach.	
Feedback [1]	These studies evaluated impact of providing different forms of feedback to trainees. Feedback is defined as 'specific information about the comparison between a trainee's observed performance and a standard, given with the intent to improve the trainee's performance'.	
Mixed approaches [1]	Teaching clinical reasoning approaches using short workshops or curriculum, incorporating a mix of various methods.	
Mnemonic SLOW [4]	<ul style="list-style-type: none"> • The word "slow" itself is an important reminder to slow down, a known method of improving diagnostic accuracy • Each letter is a prompt which is chosen to counteract a specific bias • Each specific prompt is designed to act as a metacognitive trigger, drawing from existing evidence of individually successful interventions and combining these into a single tool <ul style="list-style-type: none"> ➢ S – Sure about that? Why? ➢ L – Look at the data, What is Lacking, does it all Link together? ➢ O – Opposite – What if the Opposite is true? ➢ W – Worst case scenario, What else could this be? 	No measurable effect on cognitive bias

Discussion

This review of evidence has highlighted that despite a growing recognition of cognitive bias/error, it is a challenging area to research for a variety of reasons. These reasons include a lack of high quality data on the prevalence of cognitive biases and the difficulty recording or observing a sometimes nebulous and intangible internal process [3, 4]. Methodological limitations including drawing conclusions from a mix of clinicians and students [1-3], conclusions drawn from student populations only [2], and the majority of studies undertaken using narrative case vignettes and not real life measures on actual patient encounters [3], rendering results difficult to interpret [2, 4].

In their narrative review, Norman et al (2017) reflect that “however attractive the assumption is that diagnostic errors originate in cognitive biases, and the implication that relatively simple and quick strategies directed at identifying and eliminating biases can reduce errors, the evidence is consistent in demonstrating that such strategies have no or limited effectiveness. Knowledge matters. Even if some proportion of errors arise from cognitive biases, the resolution of errors also involves the application of clinical knowledge, which may underlie the initial mistake. If there is a science of error reduction, it is in its infancy, and we have far to go [6].”

Similar thoughts are echoed by O’Sullivan and Schofield (2018). They suggest that with a lack of longer-term studies with follow up data to suggest that any intervention to prevent cognitive bias has had a lasting effect, a pragmatic approach should be taken [5]. It is worthwhile to use the rules for good decision making as a reminder to slow down, be aware of base rates for differentials, consider what data is truly relevant, actively seek alternative diagnoses, ask questions to disprove hypotheses, remember that errors are often made and it is important to consider the immediate implications of this [5].

A commentary noted in the narrative reviews looks to see how hospitals and department leaders can do better to prevent diagnostic errors from cognitive bias [7]. The following suggestions are made:

- Seek out and analyse the causes of diagnostic errors that are occurring locally in their institution and learn from their diagnostic errors [7]
- Promote a culture of open communication and questioning around diagnosis. Trainees, physicians, and nurses should be comfortable questioning each other, including those higher up in the hierarchy, by saying, “I’m not sure” or “What else could this be?” to help reduce cognitive bias and expand the diagnostic possibilities [7, 8].
- Developing strategies to promote feedback on diagnosis among physicians will allow us all to learn from our diagnostic mistakes [7, 8].
- Use of the electronic medical record to assist in follow-up of pending diagnostic studies and patient return visits is yet another strategy [7].
- Healthcare organisations can adopt strategies to promote patient involvement in diagnosis, such as providing patients with copies of their test results and discharge summaries, encouraging the use of electronic patient communication portals, and empowering patients to ask questions related to their diagnosis. Prioritising potential solutions to reduce diagnostic errors may be helpful in situations, depending on the context and environment, in which all proposed interventions may not be possible [7].

Conclusions

Eight papers [1-8], consisting of systematic reviews, an RCT and narrative reviews provided evidence for the effects of cognitive bias on diagnostic errors and best practice strategies to for prevention.

The papers are consistent in their conclusions that there is a lack of evidence interrogating strategies that mitigate the effects of cognitive bias on decision making, diagnostic errors and patient outcomes. Further, the evidence that does exist is not high quality evidence.

The only strategy shown to make a significant difference on the effects of cognitive bias was reflection on the initial diagnosis, introduced by means of instructions, either at test or during training or both. Diagnostic accuracy was the outcome evaluated making quantitative assessment feasible.

Strategies to identify and eliminate biases in clinical decision making have limited or no effectiveness to support them. In this case the clinical narrative suggests that clinicians, leaders and hospitals look to making small changes in culture and communication to help establish safer environments for admitting uncertainty in diagnosis and acknowledging errors. Destigmatising and depersonalising errors through techniques that employ and promote safe and open communication such as routinely incorporating diagnostic time-out for difficult cases or at patient handovers.

References

1. Prakash S, Sladek RM, and Schuwirth L, *Interventions to improve diagnostic decision making: A systematic review and meta-analysis on reflective strategies*. Medical Teacher, 2019. **41**(5): p. 517-524.
2. Ludolph R and Schulz PJ, *Debiasing Health-Related Judgements and Decision Making: A systematic review*. Medical Decision Making, 2017. **38**(1): p. 3-13.
3. Saposnik, G., et al., *Cognitive biases associated with medical decisions: a systematic review*. BMC Medical Informatics & Decision Making, 2016. **16**(1): p. 138.
4. O'Sullivan ED and Schofield SJ, *A cognitive forcing tool to mitigate cognitive bias – a randomised control trial*. BMC Medical Education, 2019. **19**(12).
5. O'Sullivan ED and Schofield SJ, *Cognitive bias in clinical medicine*. J R Coll Physicians Edinb, 2018. **48**: p. 225-232.
6. Norman GR, et al., *The Causes of Errors in Clinical Reasoning: Cognitive Biases, Knowledge Deficits, and Dual Process Thinking*. Acad Med, 2017. **92**: p. 23-30.
7. Mull N, Reilly JB, and Myers JS, *An elderly woman with 'heart failure': Cognitive biases and diagnostic error*. CLEVELAND CLINIC JOURNAL OF MEDICINE, 2015. **82**(11): p. 745-753.
8. Royce CS, Hayes MM, and Schwartzstein RM, *Teaching Critical Thinking: A Case for Instruction in Cognitive Biases to Reduce Diagnostic Errors and Improve Patient Safety*. Acad Med, 2019. **94**: p. 187-194.