Fraser Health Department of Emergency Medicine

A Guide to Enhancing Morbidity and Mortality Rounds

Goals of Morbidity and Mortality Rounds

- Discuss cases of actual or potential adverse outcomes
- Forum for discussion of patient safety incidents
- Improve patient care by sharing, examining and learning from collective experiences
- Identify where improvements are possible (identify gaps in quality contributing to patient safety incident)
- Create an action plan for recommendations where applicable
- Progress towards a culture which values patient safety and continuous quality improvement

Sources of cases for rounds

- Cases brought forward by group members
- PSLS events
- Trigger tools
    - 72 hour returns
    - Deaths in ED
    - Deaths in hospital within 30 days of admission

Guidelines for completing rounds

- Four cases should be completed every quarter at each site
- Rounds are a learning opportunity, no blame should be placed on individuals
- Protect patient privacy – no initials, or dates in presentation
- Protect staff privacy – no names, do not show a copy of the chart as others may recognize the writing
- Consider having a rotating schedule of responsibility for presenting rounds – each group member should have the opportunity to present
- It is appropriate to invite other parties to rounds including residents, consultants and nurses
- Ensure that physicians involved in the case are notified confidentially in advance of rounds
- Morbidity and Mortality Rounds are confidential and protected by Section 51 of the Evidence Act which protects opinions expressed during patient safety rounds from being subpoenaed

Criteria for case selection

Cases should have **all three** of the following

1. Adverse outcome
    a) death, disability, harm or injury
    b) near miss (potential harm avoided)
2. Preventable
3. Lessons to be learned about cognitive biases or system issues (see Appendix 1 for a list of potential cognitive biases and system issues)

Making recommendations

- The ultimate goal of patient safety rounds is to implement concrete recommendations to prevent similar events from occurring. Consider the following options when making recommendations
    a) Potential cognitive debiasing strategies (see Appendix 3 for relevant BMJ articles)
    b) Education
    c) Changes to the system – these will have the greatest impact

What to do After Rounds

- Complete the Morbidity and Mortality Rounds Template (see Appendix 2 or fillable PDF document "DEM Morbidity and Mortality Template) and submit to the Regional Medical Director of Emergency Medicine (Neil.Barclay@fraserhealth.ca) or their administrative assistant and Quality Consultant (Shauna.Scotland@fraserhealth.ca)
- Site M&M will be presented at the Regional Department of Emergency Medicine Quality meeting which affords local rounds Section 51

APPENDIX 1 – CONTRIBUTORS TO PATIENT SAFETY EVENTS

COGNITIVE BIASES POTENTIALLY PRESENT IN PATIENT SAFETY EVENTS

Error of overattachment to a particular diagnosis	
Anchoring	The tendency to fixate on specific features of a presentation too early in the diagnostic process and subsequent failure to adjust
Confirmation bias	The tendency to look for confirming evidence to support the hypothesis, rather than to look for disconfirming evidence to refute it
Premature closure	Accepting a diagnosis before it has been fully verified
Error due to failure to consider alternative diagnoses	
Multiple alternatives bias	Irrational inertia against optimizing choice among competing alternatives
Representativeness restraint	Restraint from considering a particular diagnosis for a patient because the presentation is not sufficiently representative of the class
Search satisficing	The tendency to call off a search once something is found and not considering additional findings or diagnoses
Sutton's slip	Fixation on the most obvious answer or interpretation
Unpacking principle	Being influenced by the way in which the facts are presented
Diagnosis momentum	The tendency for a particular diagnosis to become established in spite of other evidence
Framing effect	A decision being influenced by the way in which the scenario is presented or ''framed''
Ascertainment effect	When thinking is preshaped by expectations
Errors in prevalence perception or estimation	
Availability bias	The tendency for things to be judged more frequently if they come readily to mind
Base-rate neglect	Failing to adequately take into account the prevalence of a particular disease
Gambler's fallacy	The belief that a sequence of similar diagnoses will reverse (belief that the same thing won't happen again)
Hindsight bias	Once the outcome is known, an underestimation (illusion of failure) or overestimation (illusion of control) of the calibration of the original decision
Playing the odds	Deciding that a patient does not have a particular disease on the basis of a likelihood judgment (frequency gambling)

Posterior probability error	Having a judgment unduly influenced by what is known to have been the case before
Order effects	Focusing on information given at the beginning or end of a history, to the neglect of the ‘‘stuff in the middle’’
Errors involving patient characteristics or presentation context	
Fundamental attribution error	Attributing the blame for a circumstance or event to the patient’s personal qualities rather than the situation
Gender bias	When the decision made is influenced unduly by the patient’s gender or the gender of the decision maker
Psych out error	A variety of biases associated with the health care provider’s perception of the psychiatric patient
Yin-yang out	Presumption that extensive prior investigation has ruled out any serious diagnosis
Errors associated with physician affect or personality	
Commission bias	Tendency toward action rather than inaction
Omission bias	Tendency toward inaction rather than action
Outcome bias	Choosing a course of action according to a desired outcome; avoiding possibilities that would suggest an undesired outcome
Visceral bias	Making decisions influenced by personal (positive or negative) feelings toward patients (affective bias)
Overconfidence, underconfidence bias	Being overconfident in (more likely) or underconfident in the efficacy of decisions that we make
Belief bias	The tendency to accept only things that fit in with our belief systems
Ego bias	In this context, a systematic overestimation of the prognosis for one’s own patients
Sunk costs	Unwillingness to give up a diagnosis in which we have invested considerable effort
Zebra retreat	Reticence to pursue a rare diagnosis for a variety of reasons

From: Campbell SG, Croskerry P, Bond WF. Profiles in patient safety: a “perfect storm” in the emergency department. AcadEmerg Med. 2007; 14:743-749.

System issues potentially present in patient safety events

System issue	Examples
Patient factors	Communication barriers (due to critical illness, intoxication, language), behaviors eliciting bias
Skill set factors	Procedural complications or errors in interpretation
Task based errors	Failure of routine behaviours – may be reflective of work overload
Personal impairment	Fatigue, illness, emotional distress
Teamwork failure	Communication breakdown
Local environment contributors	Staffing, equipment, lack of guidelines
Hospital wide contributors	Consultants, lack of access to inpatient beds
Hospital administration contributors	Budget constraints, policies and guidelines
External contributors	Public health campaigns

fraserhealth Better health. Best in health care.

APPENDIX 2 – DEPARTMENT OF EMERGENCY MEDICINE M&M TEMPLATE

Date of rounds____

Site____

Potential sources of cases for review are

- **Patient Care and Quality Office (PCQO)**
- **Patient Safety Learning System (PSLS)**
- **Trigger tools (72 hour returns, Deaths in ED and hospital)**
- **Other**

Cases with important learnings or potential for regional recommendations should be presented at the Regional Department of Emergency Medicine Quality Meeting

Not all cases discussed at patient safety rounds will result in recommendations

See Appendix for examples of cognitive biases and system issues

A minimum of 4 cases should be reviewed by each site quarterly

Return completed In Camera Minutes to Department of Emergency Medicine Administrative assistant or Dr. Neil Barclay (neil.barclay@fraserhealth.ca)

Example	**Source of Case** PCQO complaint
	Case / Event Example: 87 year old male presented to ED after fall. Workup including plain x-rays of cervical spine was negative. Patient returned the next day with persistent neck pain. CT of the neck revealed C5 fracture
	Cognitive biases or system issues identified Example: Local environment system issue - CT scan has limited hours of availability overnight
	Recommendations Example: Consider CT scan of the cervical spine instead of plain x-ray in high risk patient populations
	Present at Regional Department of Emergency Medicine Quality Meeting (Yes or No) Yes

1	**Source of Case**
	Case / Event
	Cognitive biases or system issues identified
	Recommendations
	Present at Regional Department of Emergency Medicine Quality Meeting (Yes or No)

2	**Source of Case**
	Case / Event
	Cognitive biases or system issues identified
	Recommendations
	Present at Regional Department of Emergency Medicine Quality Meeting (Yes or No)

3	**Source of Case**
	Case / Event
	Cognitive biases or system issues identified
	Recommendations
	Present at Regional Department of Emergency Medicine Quality Meeting (Yes or No)

4	**Source of Case**
	Case / Event
	Cognitive biases or system issues identified
	Recommendations
	Present at Regional Department of Emergency Medicine Quality Meeting (Yes or No)

5	**Source of Case**
	Case / Event
	Cognitive biases or system issues identified
	Recommendations
	Present at Regional Department of Emergency Medicine Quality Meeting (Yes or No)

6	**Source of Case**
	Case / Event
	Cognitive biases or system issues identified
	Recommendations
	Present at Regional Department of Emergency Medicine Quality Meeting (Yes or No)

fraserhealth Better health. Best in health care.

OPEN ACCESS

Cognitive debiasing 1: origins of bias and theory of debiasing

Pat Croskerry,[1] Geeta Singhal,[2] Sílvia Mamede[3]

[1]Department of Pediatrics, Division of Medical Education, Dalhousie University, Halifax, Nova Scotia, Canada
[2]Baylor College of Medicine Texas Children's Hospital, Houston, Texas, USA
[3]Institute of Medical Education Research, Rotterdam, Erasmus University Medical Center, Rotterdam

Correspondence to
Professor Pat Croskerry, Division of Medical Education, Dalhousie University, Clinical Research Centre, 5849 University Avenue, PO Box 15000, Halifax, NS, Canada B3H 4R2; croskerry@eastlink.ca

Received 23 November 2012
Revised 1 May 2013
Accepted 9 June 2013
Published Online First
23 July 2013

Open Access
Scan to access more free content

Linked

▶ http://dx.doi.org/10.1136/bmjqs-2013-002387

To cite: Croskerry P, Singhal G, Mamede S. *BMJ Qual Saf* 2013;**22**:ii58–ii64.

ABSTRACT

Numerous studies have shown that diagnostic failure depends upon a variety of factors. Psychological factors are fundamental in influencing the cognitive performance of the decision maker. In this first of two papers, we discuss the basics of reasoning and the Dual Process Theory (DPT) of decision making. The general properties of the DPT model, as it applies to diagnostic reasoning, are reviewed. A variety of cognitive and affective biases are known to compromise the decision-making process. They mostly appear to originate in the fast intuitive processes of Type 1 that dominate (or drive) decision making. Type 1 processes work well most of the time but they may open the door for biases. Removing or at least mitigating these biases would appear to be an important goal. We will also review the origins of biases. The consensus is that there are two major sources: innate, hard-wired biases that developed in our evolutionary past, and acquired biases established in the course of development and within our working environments. Both are associated with abbreviated decision making in the form of heuristics. Other work suggests that ambient and contextual factors may create high risk situations that dispose decision makers to particular biases. Fatigue, sleep deprivation and cognitive overload appear to be important determinants. The theoretical basis of several approaches towards debiasing is then discussed. All share a common feature that involves a deliberate decoupling from Type 1 intuitive processing and moving to Type 2 analytical processing so that eventually unexamined intuitive judgments can be submitted to verification. This decoupling step appears to be the critical feature of cognitive and affective debiasing.

INTRODUCTION

Clinical decision making is a complex process. Clinical decisions about patient's diagnoses are made in one of two modes: either intuitive or analytical, also referred to, respectively as Type 1 and Type 2 processes. The former are more commonly used. They are fast, usually effective, but also more likely to fail. As they are largely unconscious, mistakes—when they occur—are seldom corrected.[1–3] In contrast, Type 2 processes are fairly reliable, safe and effective, but slow and resource intensive. The intuitive mode of decision making is characterised by heuristics—short-cuts, abbreviated ways of thinking, maxims, 'seen this many times before', ways of thinking. Heuristics represent an adaptive mechanism that saves us time and effort while making daily decisions. Indeed, it is a rule of thumb among cognitive psychologists that we spend about 95% of our time in the intuitive mode.[4] We perform many of our daily activities through serial associations—one event automatically triggers the next with few events of deliberate, focused, analytical thinking. We have a prevailing disposition to use heuristics, and while they work well most of the time, they are vulnerable to error. Our systematic errors are termed biases,[3] and there are many of them—over a hundred cognitive biases[5] and approximately one dozen or so affective biases (ways in which our feelings influence our judgment).[6] Bias is inherent in human judgment, and physicians are, of course, also subject to them.

Indeed, one of the principal factors underlying diagnostic error is bias.[7–9] Post hoc analyses of diagnostic errors[10 11] have in fact suggested that flaws in clinical reasoning rather than lack of knowledge underlie cognitive diagnostic errors, and there is some experimental evidence that, at least when problems are complex, errors were associated with intuitive judgments and could be repaired by analytical reasoning.[12–14] Moreover, a few experimental studies have supported the claim that bias may misdirect diagnostic reasoning, thus leading to errors.[15 16] While the evidence for the role of bias in medical diagnostic error is still scarce, research findings in other domains[1 3] is sufficient

BMJ Qual Saf: first published as 10.1136/bmjqs-2012-001712 on 23 July 2013. Downloaded from http://qualitysafety.bmj.com/ on 24 April 2018 by guest. Protected by copyright.

to justify concerns with the potential adverse influence of bias on diagnostic reasoning. Two clinical examples of biased decision making leading to diagnostic failure are given in Case 1 and Case 2, displayed, respectively, in boxes 1 and 2. From the case descriptions, the mode of decision making the physician was relying upon cannot be determined. This is indeed a limitation of studies on diagnostic reasoning, which only have indirect evidence or post hoc inference of reasoning processes, at least until other tools such as functional MRI (fMRI) can be experimentally employed.

In this first paper, we discuss how biases are generated, and situations that make physicians more vulnerable to bias. Building upon dual process theories (DPTs) of reasoning,[1 3] we discuss the origins of

Box 1 Example of biased decision making leading to diagnostic failure: case 1

A 55-year-old man presents to a walk-in clinic towards the end of the evening. It has been a busy day for the clinic and they are about to close. His chief complaint is constipation. He has not had a bowel movement in 4 days, which is unusual for him. He complains of pain in his lower back and lower abdomen and also some tingling in his legs. He thinks that he will feel better with a laxative because what he has tried so far has not worked. He was briefly examined by the physician who did not find anything remarkable on his abdominal examination. There was some mild suprapubic tenderness, which was attributed to the patient's need to urinate. Bowel sounds were good, his abdomen was soft and there were no masses or organomegaly. The physician prescribed a stronger laxative and advised the patient to contact his family doctor for further follow-up.

During the night, the patient was unable to urinate and went to the emergency department. On examination, his lower abdomen appeared distended and he was found to have a residual volume of 1200cc on catheterisation. His rectum was markedly distended with soft stool that required disimpaction. He recalled straining his lower back lifting about 4 days earlier. The emergency physician suspected cauda equina syndrome and this was confirmed on MRI. He was taken immediately to the operating room for surgical decompression. He did well postoperatively and regained full bladder control.

Comment: The patient was initially misdiagnosed and might have suffered permanent loss of bladder function requiring lifelong catheterisation. The principle biases for the physician who saw him in the clinic were *framing, search satisficing* and *premature diagnostic closure*. These may have led to the incomplete history-taking, an incomplete physical exam, failure to consider symptoms that appeared discordant with constipation (back pain, leg paresthesias) and to consider other diagnoses. Fatigue may have been a contributing factor; it is known to increase the likelihood of defaulting to System 1 and vulnerability to bias (for a description of particular cognitive biases, see ref. 7 17 18).

Box 2 Example of biased decision making leading to diagnostic failure: case 2

A mildly obese, 19-year-old woman is admitted to a psychiatric hospital for stabilisation and investigation. She has suffered depressive symptoms accompanied by marked anxiety. Over the last week she has had bouts of rapid breathing which have been attributed to her anxiety. However, she has also exhibited mild symptoms of a respiratory infection and the psychiatry resident transfers her to a nearby emergency department (ED) of a tertiary care hospital to 'rule out pneumonia'. She is on no medications other than birth control pills. At triage, she is noted to have an elevated heart rate and respiratory rate. She is uncomfortable, anxious and impatient, and does not want to be in the ED. She is noted to be 'difficult' with the nurses.

After several hours she is seen by an emergency medicine resident who finds her very irritable but notes nothing remarkable on her chest or cardiac examination. However, to ensure that pneumonia is ruled out he orders a chest X-ray. He reviews the patient with his attending noting that the patient is anxious to return to the psychiatric facility and is only at the ED 'because she was told to come'. He expresses his view that her symptoms are attributable to her anxiety and that she does not have pneumonia. Nevertheless, he asks the attending to review the chest X-ray to ensure he has not missing something. The attending confirmed that there was no evidence of pneumonia and agreed with the resident that the patient could be returned to the psychiatric hospital.

While awaiting transfer back to the psychiatric hospital the patient requests permission on several occasions to go outside for a cigarette and is allowed to do so. Later, on the sidewalk outside the ED, the patient has a cardiac arrest. She is immediately brought back into the ED but could not be resuscitated. At autopsy, massive pulmonary saddle emboli are found as well as multiple small emboli scattered throughout both lungs.

Comment: The patient died following a diagnostic failure. Various cognitive and affective biases are evident. The principle ones are *framing*, *diagnostic momentum, premature diagnostic closure* and *psych-out error*[7] (see ref. 7 for a description of the biases). The patient's demeanour towards staff and the resident may have engendered some negative antipathy which may have further compromised decision making.

BMJ Qual Saf: first published as 10.1136/bmjqs-2012-001712 on 23 July 2013. Downloaded from http://qualitysafety.bmj.com/ on 24 April 2018 by guest. Protected by copyright.

biases, and the theoretical basis of how cognitive debiasing actually works. In the second paper, we summarise the known strategies for cognitive debiasing that have been proposed to counteract different types of biases.

Biases are 'predictable deviations from rationality'.[19] Many biases that diagnosticians have can possibly be recognised and corrected. Essentially, this is the process that underlies learning and refining of clinical behaviour. We may have acquired an inappropriate response to a particular situation that, in turn, leads to a maladaptive habit. Through feedback, however, or other processes, some insight or revelation occurs and we are able to change our thinking to achieve a more successful outcome. The basic premise is that if we can effectively debias our thinking, from innate and learned biases, we will be better thinkers and more accurate diagnosticians.

Clinical decision making is a complex process. Besides the overall vulnerability of the human mind towards biases in decision making, it is generally appreciated that the quality of decision making is also influenced by ambient conditions: prevailing conditions in the immediate environment—context, team factors, patient factors, resource limitations, physical plant design and ergonomic factors. Individual factors such as affective state, general fatigue, cognitive load, decision fatigue, interruptions and distractions, sleep deprivation and sleep-debt, are influential too. Other individual factors such as personality, intelligence, rationality, gender and other variables also impact decision making. Since our judgments are so vulnerable to biases and so many different factors affect decision making, the challenge of developing clinical decision makers who consistently make optimal and reliable decisions appears daunting. Two questions need to be answered: can we improve our performance by using cognitive debiasing to repair incorrect judgments made under the influence of bias? This means appropriately alerting the analytical mode to situations in which a bias might arise so that it can be detected and a debiasing intervention applied. Second, can we mitigate the impact of adverse ambient conditions, either by improving conditions in the decision making environment, or by changing the threshold for detection of bias and initiating debiasing strategies?

THE ORIGINS OF COGNITIVE BIASES

There appear to be a prevailing assumption that biases are all created equal, that all are difficult to overcome and that some common debiasing strategy might work. However, as Larrick points out, many biases have multiple determinants, and it is unlikely that there is a 'one-to-one mapping of causes to bias or of bias to cure'[20]; neither is it likely that one-shot debiasing interventions will be effective.[21] From DPT and other work of cognitive psychologists we know that, although biases can occur in both types of processes, most biases are associated with heuristics and typically are Type 1 (intuitive) processes. Other theories of reasoning exist, but DPT has become prevalent, gaining increasing support including from functional MRI studies.[22] DPT has been used as a template for the diagnostic process (figure 1).[23]

In the figure, the intuitive system is schematised as Type 1 processes and the analytic system by Type 2 processes. There are eight major features of the model:

1. Type 1 processing is fast, autonomous, and where we spend most of our time. It usually works well, but as it occurs largely unconsciously and uses heuristics heavily, unexamined decision making in the intuitive mode is more prone to biases.
2. Type 2 processing is slower, deliberate, rule-based and takes places under conscious control, which may prevent mistakes.
3. The predictable deviations from rationality that eventually lead to errors tend to occur more frequently in the Type 1 processes, in line with findings of dual-process researchers in other domains.[24–26]
4. Repetitive processing using Type 2 processes may allow processing in Type 1. This is the basis of skill acquisition.
5. Biases that negatively affect judgments, often unconsciously, can be overridden by an explicit effort at

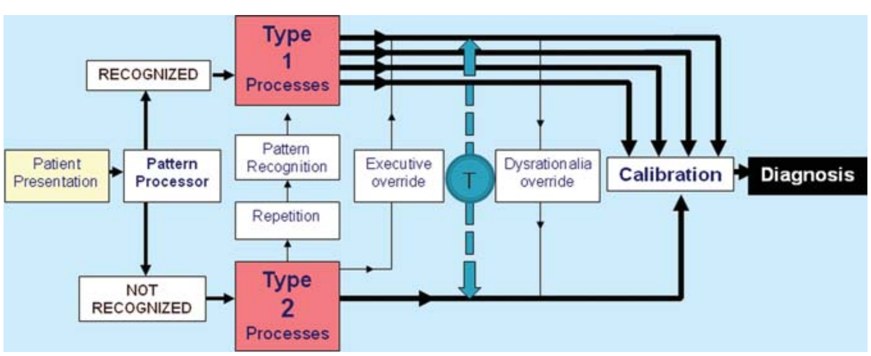

Figure 1 Dual process model for decision making. From: Croskerry[23] (T is the toggle function, which means that the decision maker is able to move forth and back between Type 1 and Type 2 processes).

 Croskerry P, et al. BMJ Qual Saf 2013;22:ii58–ii64. doi:10.1136/bmjqs-2012-001712

BMJ Qual Saf: first published as 10.1136/bmjqs-2012-001712 on 23 July 2013. Downloaded from http://qualitysafety.bmj.com/ on 24 April 2018 by guest. Protected by copyright.

reasoning. Type 2 processes can perform an executive override function—which is key to debiasing.
6. Excessive reliance on Type 1 processes can override Type 2, preventing reflection and leading to unexamined decisions—this works against debiasing.
7. The decision maker can toggle (T) back and forth between the two systems—shown as broken line in figure 1.
8. The brain generally tries to default to Type 1 processing whenever possible

These operating characteristics have been described in more detail elsewhere.[22 23 27] The model does not imply that one single reasoning mode accounts for a diagnostic decision or that a particular mode is always preferable over the other one. Current thinking is that making diagnoses usually involves some interactive combination of intuitive and analytical processing in different degrees.[28] And whereas in some circumstances a high degree of System 1 processing may work well or be even lifesaving, such as in imminent life-threatening conditions, in others a high degree of reflection (System 2) may be required. Optimal diagnostic reasoning would appear to be a blend of the two reasoning modes in appropriate doses.[22] Further, not all biases originate in Type 1 processing, but when a bias does occur it can only be dealt with by activating Type 2 processing. Thus, a good balance of Type 1 and Type 2 processes is required for a well-calibrated performance.

Importantly, the intuitive processes are multiple and varied. Stanovich[29] has recently categorised these 'autonomous' Type 1 processes according to their origins, and describes four main groups (figure 2).

1. *Processes that are hard-wired*. These were naturally selected (in the Darwinian sense) in our evolutionary past for their adaptation value. Examples of such 'innate' heuristics that may induce biases are: the metaheuristics (anchoring and adjustment, representativeness, availability), search satisficing, overconfidence and others.
2. *Processes that are regulated by our emotions*. These too may be evolved adaptations (hard-wired) and are grouped into six major categories: happiness, sadness, fear, surprise, anger and disgust.[30] Fear of snakes, for example, is universally present in all cultures. Or they may be socially constructed (acquired, learned), or combinations of the two—hard-wired modified by learning for example, visceral reactions against particular types of patients.[31]
3. *Processes that become firmly embedded in our cognitive and behavioural repertoires through overlearning*. These might include explicit cultural and social habits, but also those associated with specific knowledge domains. An example of a bias acquired through repetitive exposures might be a 'frequent flyer' in a family doctor's office or in the emergency department where the bias may be the expectation that no significant new diagnosis will be found.
4. *Processes that have developed through implicit learning*. It is well recognised that we learn in two fundamental ways. First, through deliberate explicit learning such as occurs in school and in formal training, and second, through implicit learning which is without intent or conscious awareness. Such learning plays an important role in our skills, perceptions, attitudes and overall behaviour. Implicit learning allows us to detect and appreciate incidental covariance and complex relationships between things in the environment without necessarily being able to articulate that understanding. Thus, some biases may be acquired unconsciously. Medical students and residents might subtly acquire particular biases by simply spending time in environments where others have these biases, even though the bias is never deliberately articulated or overtly expressed to them that is, the hidden curriculum. Examples might be the acquisition of biases towards age, socioeconomic status, gender, race, patients with psychiatric comorbidity, obesity and others.

Although Type 1 processes appear the most vulnerable to bias and suboptimal decision making, they are not the only source of impaired judgment. Cognitive error may also arise through biases that have become established through inferior strategies or imperfect decision rules. Arkes points out that error due to biases also occurs with Type 2 processes,[32] that is, even though the decision maker may be deliberately

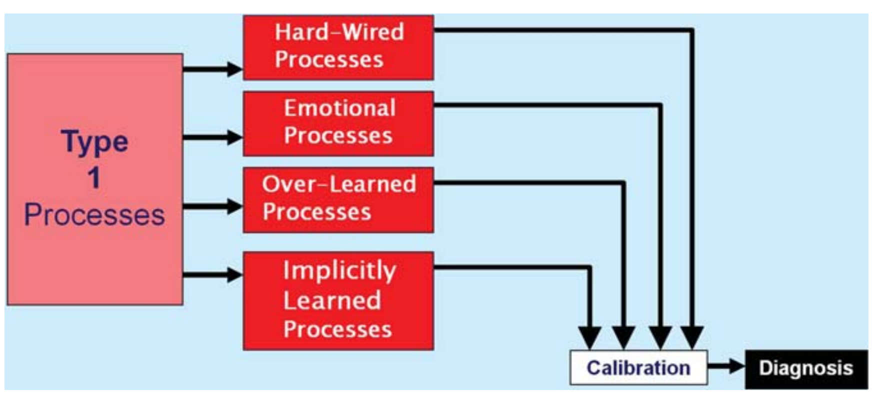

Figure 2 Origins of biases in Type I processes. This is a modified section of the dual process model of diagnosis expanding upon the origins of Type 1 processes (based on Stanovich).[27]

BMJ Qual Saf: first published as 10.1136/bmjqs-2012-001712 on 23 July 2013. Downloaded from http://qualitysafety.bmj.com/ on 24 April 2018 by guest. Protected by copyright.

and analytically applying accepted strategies or rules, they may be flawed. Thus, there may have been a problem in the initial selection of a strategy which may then underestimate or overestimate a diagnosis. Of the two, it would seem preferable to always overestimate (as in the forcing strategy 'rule out worst case scenario') so that important diagnoses do not get missed; however this can sometimes be wasteful of resources. Generally, suboptimal strategies get selected when the stakes are not high.

Situation-dependent biases: An important question is: are there situations in which biases are more likely? Evidence suggests that certain conditions such as fatigue, sleep deprivation and cognitive overload, predispose decision makers to using Type 1 processes.[33] In addition, specific clinical situations might increase vulnerability to specific biases. Some will set the physician up for exposure to particular biases whereas others will produce exposure to a wide range of biases. Some common situations are described in table 1.

How does debiasing work? While debiasing is an integral part of everyday living, some will do better than others. Those who are successful learn the consequences of their actions and take steps to avoid falling into the same thinking traps. Often this can be done using forcing strategies or deliberately suppressing impulsivity in certain situations. We can't find our car keys at a time when we are in a hurry, so many of us learn the forcing strategy of always putting them in a specific place as soon as we arrive home. In some situations, we can adopt simple, protective forcing rules whenever we are going to do something irreversible for example, by following the maxim 'measure twice, cut once'. In other domains, we have come to know that it is a good idea to suppress belief and be sceptical when we are offered deals that are too good to be true such as the email notifying us we have just won a large sum of money. Interestingly, increased intelligence does not protect against such follies.[29]

Wilson and Brekke,[35] in their extensive review, refer to cognitive bias as 'mental contamination' and debiasing as 'mental correction'. They suggest an algorithmic approach, delineating a series of steps to avoid bias (figure 3). Bazerman sees the key to debiasing is first that some disequilibrium of the decision maker needs to occur so that the individual wants to move from a previously established response and change.[36] This could come about by the individual simply being informed of a potential bias, or that their past judgment has raised the possibility they might be biased, or by developing insight into the adverse consequences of bias. This critical step may be more than simply becoming aware of the existence of biases and their causes; sometimes a vivid, perhaps emotion-laden experience needs to occur to precipitate cognitive change. The next step involves learning how the change will occur and what alternate strategies need to be learned. Finally, the last step occurs when the new approach is incorporated into the cognitive make-up of the decision maker and (with maintenance) becomes part of their regular thinking behaviour. An algorithmic approach has also been proposed by Stanovich and West,[37] in which they further delineate characteristics of the decision maker needed to inhibit bias. Importantly, the decision maker must (1) be aware of the rules, procedures and strategies (mindware)[38] needed to overcome the bias, (2) have the ability to detect the need for bias override, and (3) be cognitively capable of decoupling from the bias. Stanovich has examined the theoretical basis of

Table 1 High-risk situations for biased reasoning

High-risk situation	Potential biases
1. Was this patient handed off to me from a previous shift?	Diagnosis momentum, framing
2. Was the diagnosis suggested to me by the patient, nurse or another physician?	Premature closure, framing bias
3. Did I just accept the first diagnosis that came to mind?	Anchoring, availability, search satisficing, premature closure
4. Did I consider other organ systems besides the obvious one?	Anchoring, search satisficing, premature closure
5. Is this a patient I don't like, or like too much, for some reason?	Affective bias
6. Have I been interrupted or distracted while evaluating this patient?	All biases
7. Am I feeling fatigued right now?	All biases
8. Did I sleep poorly last night?	All biases
9. Am I cognitively overloaded or overextended right now?	All biases
10. Am I stereotyping this patient?	Representative bias, affective bias, anchoring, fundamental attribution error, psych out error
11. Have I effectively ruled out must-not-miss diagnoses?	Overconfidence, anchoring, confirmation bias

Adapted from Graber:[34] General checklist for AHRQ project.
A description of specific biases can be found in Croskerry.[7]

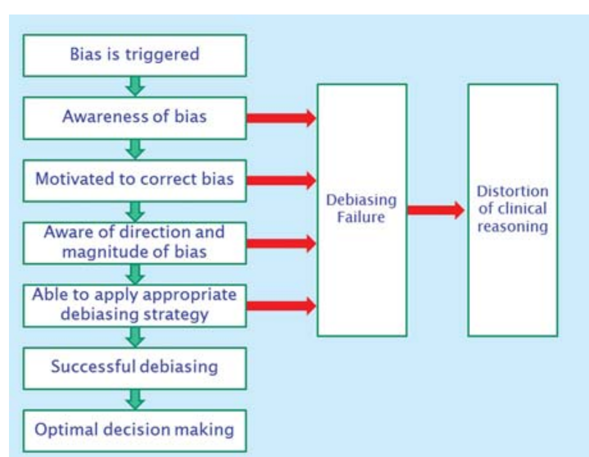

Figure 3 Successive steps in cognitive debiasing (adapted from Wilson and Brekke).[35] Green arrows=yes; Red arrows=no

BMJ Qual Saf: first published as 10.1136/bmjqs-2012-001712 on 23 July 2013. Downloaded from http://qualitysafety.bmj.com/ on 24 April 2018 by guest. Protected by copyright.

debiasing in considerable depth.[29] He proposes that a critical feature of debiasing is the ability to suppress automatic responses in the intuitive mode by decoupling from it. This is depicted in figure 1 as the executive override function. The decision maker must be able to use situational cues to detect the need to override the heuristic response and sustain the inhibition of the heuristic response while analysing alternative solutions,[37] and must have knowledge of these alternative solutions. These solutions must of course have been learned and previously stored in memory as mindware. Debiasing involves having the appropriate knowledge of solutions and strategic rules to substitute for a heuristic response as well as the thinking dispositions that are able to trigger overrides of Type 1 (heuristic) processing.

Caveats are abundant in medical training and at its completion we are probably at our most cautious due to lack of experience and high levels of uncertainty. Experience subsequently accumulates but does not guarantee expertise. However, many clinicians will develop their own debiasing strategies to avoid the predictable pitfalls that they have experienced, or have learned through the experience of others. Morbidity and mortality rounds may be a good opportunity for such vicarious learning, provided that they are carefully and thoughtfully moderated. These rounds tend to inevitably remove the presented case from its context and to make it unduly salient in attendees' minds, which may hinder rather than improve future judgment.

Although a general pessimism appears to prevail about the feasibility of cognitive debiasing,[3] clearly people can change their minds and behaviours for the better. While evidence of debiasing in medicine is lacking, shaping and otherwise modifying our behaviours, extinguishing old habits, and developing new strategies and approaches are features of everyday life. Overall, we are faced with the continual challenge of debiasing our judgments throughout our careers. In our second paper, we review a number of general and specific strategies that have been grouped under the rubric of cognitive debiasing.

Contributors The article is based on a workshop conducted by the authors during the 2011 Diagnostic Error in Medicine Annual Conference in Chicago. PC conceived the work with substantial contributions from GS and SM. PC wrote the draft of the manuscript, and GS and SM revised it critically for important intellectual content. All authors approved the final version of the manuscript.

Competing interests None.

Provenance and peer review Not commissioned; externally peer reviewed.

Open Access This is an Open Access article distributed in accordance with the Creative Commons Attribution Non Commercial (CC BY-NC 3.0) license, which permits others to distribute, remix, adapt, build upon this work non-commercially, and license their derivative works on different terms, provided the original work is properly cited and the use is non-commercial. See: http://creativecommons.org/licenses/by-nc/3.0/

REFERENCES

1 Evans JStB, Frankish K. *In two minds: dual processes and beyond*. Oxford, England: Oxford University Press, 2009.
2 Gilovic J, Griffin D, Kahneman D. *Heuristics and biases: the psychology of intuitive judgment*. Cambridge, UK: Cambridge University Press, 2002.
3 Kahneman D. *Thinking fast and slow.* Canada: Doubleday, 2011.
4 Lakoff G, Johnson M. *Philosophy in the flesh: the embodied mind and its challenge to Western thought*. New York: Basic Books, 1999.
5 Jenicek M. *Medical error and harm: understanding, prevention and control*. New York: Productivity Press, 2011.
6 Croskerry P, Abbass AA, Wu AW. How doctors feel: affective issues in patients' safety. *Lancet* 2008;372:1205–6.
7 Croskerry P. The importance of cognitive errors in diagnosis and strategies to minimize them. *Acad Med* 2003;78:775–80.
8 Klein JG. Five pitfalls in decisions about diagnosis and prescribing. *BMJ* 2005;330:781–3.
9 Redelmeier DA. Improving patient care. The cognitive psychology of missed diagnoses. *Ann Intern Med* 2005;142:115–20.
10 Graber ML, Franklin N, Gordon R. Diagnostic error in internal medicine. *Arch Intern Med* 2005;165:1493–9.
11 Singh H, Thomas E, Khan MM, *et al*. Identifying diagnostic errors in primary care using an electronic screening algorithm. *Arch Intern Med* 2007;167:302–8.
12 Mamede S, Schmidt HG, Penaforte JC. Effects of reflective practice on the accuracy of medical diagnoses. *Med Educ* 2008;42:468–75.
13 Mamede S, Schmidt HG, Rikers RM, *et al*. Conscious thought beats deliberation without attention in diagnostic decision-making: at least when you are an expert. *Psychol Res* 2010;74:586–92.
14 Coderre S, Mandin H, Harasym PH, *et al*. Diagnostic reasoning strategies and diagnostic success. *Med Educ* 2003;37:695–703.
15 Schmidt HG, Mamede S, van den BK, *et al*. Exposure to media information causes availability bias in medical diagnosis. Submitted 2013.
16 Mamede S, van Gog T, van den Berge K, *et al*. Effect of availability bias and reflective reasoning on diagnostic accuracy among internal medicine residents. *JAMA* 2010; 304:1198–203.
17 Barger LK, Ayas NT, Cade BE, *et al*. Impact of extended-duration shifts on medical errors, adverse events, and attentional failures. *PLoS Med* 2006;3:e487.
18 Landrigan CP, Rothschild JM, Cronin JW, *et al*. Effect of reducing interns' work hours on serious medical errors in intensive care units. *N Engl J Med* 2004;351:1838–48.
19 Arnott D. Cognitive biases and decision support systems development: a design science approach. *Info Systems J* 2006;16:55–78.
20 Larrick R. Debiasing. In: Koehler D, Harvey N, eds. *The blackwell handbook of judgment and decision making*. Oxford: Blackwell Publishing, 2004:316–37.
21 Lilienfeld S, Ammirati R. Giving debiasing away. Can psychological research on correcting cognitive errors promote human welfare? *Perspect Psychol Sci* 2009;4:390–8.
22 Croskerry P. Clinical cognition and diagnostic error: applications of a dual process model of reasoning. *Adv Health Sci Educ Theory Pract* 2009;14(Suppl 1):27–35.
23 Croskerry P. A universal model of diagnostic reasoning. *Acad Med* 2009;84:1022–8.

BMJ Qual Saf: first published as 10.1136/bmjqs-2012-001712 on 23 July 2013. Downloaded from http://qualitysafety.bmj.com/ on 24 April 2018 by guest. Protected by copyright.

24 Kahneman D. A perspective on judgment and choice: mapping bounded rationality. *Am Psychol* 2003;58:697–720.

25 Evans JS. Dual-processing accounts of reasoning, judgment, and social cognition. *Annu Rev Psychol* 2008;59:255–78.

26 Evans JS, Curtis-Holmes J. Rapid responding increases belief bias: evidence for the dual-process theory of reasoning. *Think Reasoning* 2005;11:382–9.

27 Croskerry P. Context is everything or How could I have been that stupid? *Healthcare Quarterly* 2009;12:167–73.

28 Graber ML, Kissam S, Payne VL, *et al*. Cognitive interventions to reduce diagnostic error: a narrative review. *BMJ Quality & Safety* 2012;21:535–57.

29 Stanovich KE. Rationality and the reflective mind. New York: Oxford University Press, 2011:19–22.

30 Elkman P, Friesen W, Ellsworth P. *Emotion in the human face: guidelines for research and an integration of findings*. New York: Pergamon Press, 1972.

31 Groves JE. Taking care of the hateful patient. *N Engl J Med* 1978;298:883–7.

32 Arkes HR. Costs and benefits of judgment errors: implications for de-biasing. *Psychol Bull* 1991;110:486–98.

33 Croskerry P. ED Cognition: any decision by anyone at any time. ED administration series. *CJEM* In press 2012.

34 Graber ML, Singh H, Sorensen A, *et al*. Checklists to reduce diagnostic error in emergency medicine. AHRQ ACTION 1 Contract Task Order #8 to RTI International: Develop Patient Safety Interventions to Reduce Diagnostic Error in the Ambulatory Setting. AHRQ Contract Number HHSA290200600001I, 2010.

35 Wilson TD, Brekke N. Mental contamination and mental correction: unwanted influences on judgments and evaluations. *Psychol Bull*. 1994;116:117–42.

36 Bazerman M. *Judgment in managerial decision making*. 5 edn. New York: Wiley & Sons, 2002.

37 Stanovich KE, West RF. On the relative independence of thinking biases and cognitive ability. *J Pers Soc Psychol* 2008;94:672–95.

38 Perkins D. *Outsmarting IQ: the emerging science of learnable intelligence*. New York: Free Press, 1995.

BMJ Qual Saf: first published as 10.1136/bmjqs-2012-001712 on 23 July 2013. Downloaded from http://qualitysafety.bmj.com/ on 24 April 2018 by guest. Protected by copyright.

OPEN ACCESS

Cognitive debiasing 2: impediments to and strategies for change

Pat Croskerry,[1] Geeta Singhal,[2] Sílvia Mamede[3]

[1]Division of Medical Education, Dalhousie University, Halifax, Nova Scotia, Canada
[2]Baylor College of Medicine Texas Children's Hospital, Houston, Texas, USA
[3]Department of Psychology, Erasmus University, Rotterdam, The Netherlands

Correspondence to
Professor Pat Croskerry, Division of Medical Education, Dalhousie University, Clinical Research Centre, 5849 University Avenue, PO Box 15000, Halifax, NS, Canada B3H 4R2; croskerry@eastlink.ca

Received 23 November 2012
Revised 31 July 2013
Accepted 1 August 2013
Published Online First 30 August 2013

Open Access
Scan to access more free content

Linked

► http://dx.doi.org/10.1136/bmjqs-2013-002387

To cite: Croskerry P, Singhal G, Mamede S. *BMJ Qual Saf* 2013;**22**:ii65–ii72.

ABSTRACT

In a companion paper, we proposed that cognitive debiasing is a skill essential in developing sound clinical reasoning to mitigate the incidence of diagnostic failure. We reviewed the origins of cognitive biases and some proposed mechanisms for how debiasing processes might work. In this paper, we first outline a general schema of how cognitive change occurs and the constraints that may apply. We review a variety of individual factors, many of them biases themselves, which may be impediments to change. We then examine the major strategies that have been developed in the social sciences and in medicine to achieve cognitive and affective debiasing, including the important concept of forcing functions. The abundance and rich variety of approaches that exist in the literature and in individual clinical domains illustrate the difficulties inherent in achieving cognitive change, and also the need for such interventions. Ongoing cognitive debiasing is arguably the most important feature of the critical thinker and the well-calibrated mind. We outline three groups of suggested interventions going forward: educational strategies, workplace strategies and forcing functions. We stress the importance of ambient and contextual influences on the quality of individual decision making and the need to address factors known to impair calibration of the decision maker. We also emphasise the importance of introducing these concepts and corollary development of training in critical thinking in the undergraduate level in medical education.

INTRODUCTION

In the first of these two papers, we suggested that cognitive debiasing is an essential skill in developing sound clinical reasoning. We reviewed the origins of innate and acquired cognitive biases and some proposed mechanisms for how debiasing processes might work.[1] In this paper, we first examine some barriers to debiasing and then review multiple strategies to address them.

Over the years, various strategies have been adopted to deal with shortcomings and failures in decision making. As early as 1772, Ben Johnson outlined a 'moral algebra' to improve his judgements and avoid rash decisions.[2] Proverbs, aphorisms, caveats, mnemonics, lists and many other strategies have emerged that serve a similar purpose. Investigations on their effectiveness have not been so frequent and, presently, cognitive debiasing is an inexact science. Here, we offer a variety of strategies from both behavioural sciences and medicine that have been developed in recent years, which vary from experimental studies to simple observations to opinions, with varying levels of evidentiary support. Our purpose has been to develop an inclusive collection of strategies in a framework for learners, researchers and educators that will provide a practical scaffold for the work ahead.

Cognitive debiasing involves changes that rarely come about through a discrete, single event but instead through a succession of stages—from a state of lack of awareness of bias, to awareness, to the ability to detect bias, to considering a change, to deciding to change, then initiating strategies to accomplish change, and finally, maintaining the change. These key steps are outlined in figure 1,[3] which may help our understanding of how physicians might engage in debiasing. Several caveats need to be applied to this model: first, a clinician making a biased response does not necessarily mean that the decision maker was unaware of correct approaches to make decisions[4]; second, for biases to be successfully addressed, there needs to be such awareness as well as the motivation for change; third, the clinician needs to be aware of the direction in which the bias is taking him or

BMJ Qual Saf: first published as 10.1136/bmjqs-2012-001713 on 30 August 2013. Downloaded from http://qualitysafety.bmj.com/ on 24 April 2018 by guest. Protected by copyright.

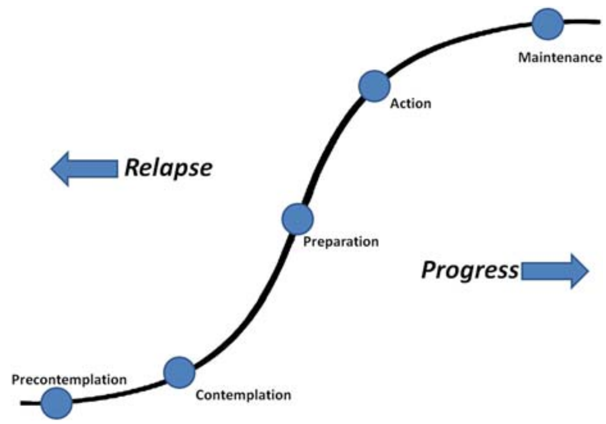

Figure 1 Transtheoretical model of change.

her and its magnitude; and finally, even if the clinician is aware of a potential for bias in a particular situation, he or she might still be unable to shake the conviction of his or her biased judgement.[5]

Many clinicians presently appear to be at the *precontemplative* level. They may be unaware of the powerful influence of unconscious factors on their reasoning, may not realise that cognitive and affective biases can affect their decision making, and therefore, see no reason to take any action to change their thinking. Introducing these ideas and raising awareness is a prerequisite for debiasing. Sometimes a sentinel event can catalyse the uptake of an important idea such as the publication of Groopman's book *How Doctors Think*.[6] Conventional forms of information exchange, such as rounds, seminars, and morbidity and mortality conferences, may provide opportunities to address cognitive pitfalls within the context of engaging case examples. At times, however, a single experience, which can be shared in such moments, can change thinking. This happens especially if the event is emotionally laden because we tend to be particularly influenced by emotionally arousing experiences.[7 8] For example, if a physician misdiagnoses a headache as benign and the patient subsequently dies from a subarachnoid haemorrhage, the powerful impact of this experience might produce long-standing changes in the physician's approach towards the diagnosis of patients presenting with headache.

Increasing physicians' awareness of the need for debiasing does not guarantee, however, that debiasing actually occurs. Indeed, since Fischoff's pioneering work,[9] a general mood of gloom and doom towards cognitive debiasing in the psychology and medical literature seems to have prevailed[5 10]; it is accepted to be a difficult but not an impossible task. A variety of factors may explain the intractability of cognitive bias and why it is so difficult to change. In addition to lack of awareness of the impact of bias in clinical reasoning, clinicians' overconfidence in their own judgements may be one of the most powerful factors preventing debiasing.[11] Even those physicians who are aware of the potential impact of biases on clinical judgement may not believe that they are vulnerable to them. Moreover, it is a human tendency to bolster existent beliefs rather than searching for new approaches, and it is easier to stay with the status quo rather than make efforts to learn new approaches and change current practice. Physicians are not immune to these tendencies. Finally, the invariably abstract, arid form of the discussions of cognitive processes contributes to these impediments: they typically lack the vividness and concrete nature of clinical disease presentations that are more appealing to clinicians.

This becomes even more challenging if one considers that biases tend to act unconsciously. A general problem with debiasing, as Horton notes, is that 'the same kinds of biases that distort our thinking in general also distort our thinking about the biases themselves'.[8] Indeed, many biases are applied unconsciously, and if physicians are unaware of them, they will have difficulty recognising the need for debiasing. Clinicians themselves may be just as vulnerable as their patients to a number of psychological factors that might compromise decision making.[12 13] Nevertheless, the topic has attracted considerable interest and effort, reflecting a widespread perception of the need for solutions to the vulnerability of human reasoning.[14]

STRATEGIES FOR COGNITIVE DEBIASING

In the first of these combined papers, we suggested that debiasing would require a physician to detect the need to override the initial intuitive responses to a problem in order to engage in analytical processes to restructure reasoning and find alternative solutions. The extent to which a physician tends to engage—and succeed—in debiasing depends not only on his/her prior knowledge and experiences but also on thinking dispositions. Some of the strategies described aim at making physicians aware of the risk of biases, intervening during the contemplation and preparation steps to enhance their ability to detect the need for debiasing in the future; we have grouped these under 'educational strategies' in table 1. While educational strategies aim mostly to enhance physicians' ability to debiasing *in the future*, other strategies may be implemented by the physician *at the time of problem-solving*, while reasoning about the problem at hand. These strategies have been grouped under 'workplace strategies' in table 1 and include both strategies that depend basically on physicians' cognitive processes and those that require interventions in the settings of practice. Whereas some of these strategies have been evaluated and some empirical evidence exists that supports their use, others are supported mostly by research in other domains; still others have a long-standing tradition in clinical practice but have not usually been subjected to formal investigation.

In table 2, we describe a number of strategies that are collectively referred to as 'forcing functions'. The

BMJ Qual Saf: first published as 10.1136/bmjqs-2012-001713 on 30 August 2013. Downloaded from http://qualitysafety.bmj.com/ on 24 April 2018 by guest. Protected by copyright.

Table 1 Educational and workplace strategies for cognitive debiasing

Strategy	Comment	Examples
Educational		
training on theories of reasoning and medical decision making	Achieving improved diagnostic reasoning requires an understanding of cognitive theories about decision making and the impact of cognitive biases[15–18]	▶ Educational curricula covering theories of decision making, major cognitive and affective biases and their application to diagnostic reasoning[19–21]
Bias inoculation	A key recommendation is to teach about cognitive and affective biases and develop specific tools to test for them[22–24] and for debiasing	▶ A 'consider-the-opposite' procedure marginally reduced anchoring in judgements of personality traits[25] ▶ Cognitive forcing strategies to counteract cognitive bias showed minor effects[26]
Specific educational interventions	Teaching specific skills may mitigate particular biases by providing basic knowledge leading to greater insight	▶ People trained in inferential rules committed fewer base rate errors[27 28] ▶ Combining a non-analytical with an analytical approach in reading ECGs improved diagnostic accuracy[29]
Cognitive tutoring systems	Computer-based systems can be used to construct a learner's profile of decision making and provide feedback on specific biases and strategies to mitigate them	▶ Decision monitoring software of virtual slide cases detected cognitive biases according to preset criteria[30]
Simulation training	Simulation may be a venue for teaching about, identifying and remediating cognitive errors[31]	▶ Residents experienced a simulation involving a difficult diagnosis with a cognitive error trap[32]
Workplace		
Get more information	Heuristics and biases often arise in the context of insufficient information. Diagnostic accuracy is related to thoroughness of cue acquisition[33]	▶ The greater the number of attributes of a problem that can be identified, the greater the likelihood of selecting the best alternative[34]
Structured data acquisition	Forcing deliberate data acquisition may avoid 'spot diagnoses'[35 36] by ensuring that less obvious symptoms are considered	▶ Traditionally, data acquisition has been pursued by establishing a differential diagnosis list, and more recently by employing a differential diagnosis checklist tool[37]
Affective debiasing	Virtually all decision making involves some degree of affective influence. Many affective biases are hard-wired. Decision makers often are unaware of the affective influences on decision making[38 39]	▶ Overview of affective biases and recommendations for debiasing are available[20]
Metacognition, decoupling, reflection, mindfulness	A deliberate disengagement or decoupling from intuitive judgements and engagement in analytical processes to verify initial impressions[1]	▶ Deliberately reflecting upon initial diagnoses led to better diagnoses in difficult cases[40] and counteracted availability bias[41]
Slowing down strategies	Accuracy suffers when diagnoses are made too early and improves with slowing down	▶ A planned time-out in the operating room[42 43]
Be more sceptical	A tendency in human thinking is to believe rather than disbelieve. Type 1 processing occurs by viewing something as more predictable and coherent than is really the case[10 44]	▶ No published examples
Recalibration	When the decision maker anticipates additional risks, recalibration may reduce error	▶ When bias is anticipated, (eg, medical comorbidities in psychiatric patients),[45] the decision maker may recalibrate
Group decision strategy	Seeking others' opinions in complex situations may be of value. Crowd wisdom, at times, is greater than an individual decision maker[46]	▶ Group rationality exceeded individual rationality in studies with experimental games in other domains[47]
Personal accountability	When people know their decisions will be scrutinised and they are accountable, their performance may improve	▶ Participants who knew they would be justifying their responses performed better than participants who thought that their responses were anonymous[48]

Continued

BMJ Qual Saf: first published as 10.1136/bmjqs-2012-001713 on 30 August 2013. Downloaded from http://qualitysafety.bmj.com/ on 24 April 2018 by guest. Protected by copyright.

Table 1 Continued

Strategy	Comment	Examples
Supportive environments	Friendly and supportive environments improve the quality of decision making[49]	▸ Avoid cognitive overload, fatigue and sleep deprivation.[50] Ready availability of protocols, clinical guidelines and patient care pathways reduce variance
Exposure control	Limit exposure to information that might influence judgement before an impression is formed[51]	▸ Although there are no published examples, some emergency physicians avoid reading nurse's notes until after they have assessed the patient. Similarly, clinicians can discourage patients from giving them another physician's diagnosis, or physician colleagues from giving their diagnosis, until they have formed their own impressions
Sparklines	Informational mini-graphics can be embedded in context in clinical data. Graphics have the potential to mitigate specific biases[52]	▸ A graphic outlining paediatric respiratory virus prevalence provided immediate and accurate estimates of respective base rates and trends[53]
Decision support systems	Support systems have been developed for clinical use[54 55]	▸ A reminder system reduced diagnostic errors of omission and improved diagnostic quality score[55]

degree of force can range from absolute constraints such that an erroneous response cannot be made, for example, removal of concentrated potassium solutions from hospital wards, to explicit 'if this then this' rules, to simply encouraging a desired response. Cognitive forcing functions are rules that depend on the clinician consciously applying a metacognitive step and cognitively forcing a necessary consideration of alternatives. Some of these functions can be easily recognised in clinical adages or warnings that, although rarely investigated, have long been part of clinical teaching. They do not all need to be explicit; sometimes it is possible to gently nudge people in a particular direction in order to obtain better outcomes.[68]

These three groupings show considerable overlap and are not intended to be seen as discrete but as a spectrum. We have not included here in detail the diverse initiatives in clinical research and practice that fall under Cognitive Bias Mitigation (CBM). The main purpose of CBM is to modify cognitive and affective biases that underlie psychological dysfunction, associated mostly with anxiety and depression.[69] Insofar as cognitive debiasing and CBM are both directed at changing biased cognition and behaviour, it would be expected that some CBM techniques would be effective for those interested in debiasing outside the psychiatric setting, especially for affective bias.

PRESCRIPTIVE DEBIASING: ARE THERE SPECIFIC COGNITIVE PILLS FOR COGNITIVE ILLS?

The different sources of bias might have implications for the choice of strategies that can effectively counteract them. While standard biases such as availability and representativeness likely have an evolutionary origin, that is, derive from heuristics that were adaptive in ancient environments, other biases may be acquired through individuals' particular experiences. Examples of the latter are emotional dispositions and specific biases towards particular classes of patients, for example, drug seekers, patients with psychiatric comorbidity or the 'frequent flyer'. These biases are usually acquired unconsciously through simply being in specific environments and passively taking cues from others.

Given the differing aetiologies of bias, we might ask if some are more robust, and therefore, more resistant to change than others, and should there be different approaches to debiasing them?[70] Perhaps the hard-wired 'evolutionary' biases would be the most resistant to change and may need several different debiasing strategies as well as multiple interventions. Major cultural, sociocentric and other biases that have been established through learning may be easier to change, although it would be preferable that these biases not be allowed to form in the first place. Good role modelling, good teaching programmes and optimal learning environments will help minimise them.[49] Locally acquired

BMJ Qual Saf: first published as 10.1136/bmjqs-2012-001713 on 30 August 2013. Downloaded from http://qualitysafety.bmj.com/ on 24 April 2018 by guest. Protected by copyright.

Table 2 Forcing functions

Forcing function	Comment	Examples
Statistical and clinical prediction rules (SPRs and CPRs)	Explicit SPRs and CPRs typically equal or exceed the reliability of expert 'intuitive' judgement. Easy to use, they address significant issues	▸ The superiority of SPRs and CPRs over clinical judgement has been shown.[56] Physicians demonstrate pretest probability variability in specific diagnoses[57]
Cognitive forcing strategies (CFSs)	CFSs are special cases of forcing functions that require clinicians to internalise and apply the forcing function deliberately. They represent a systematic change in clinical practice. CFSs may range from universal to generic to specific	▸ Training might be given to identify situations (cognitive overloading, fatigue, sleep deprivation, others) that promote the use of heuristics and biases leading to decision errors. Clinical scenarios can be identified in which particular biases are likely to occur [1]and explicit CFSs can be taught to mitigate them[58]
Standing rules	May be used in certain clinical settings that require a given diagnosis not be made unless other must-not-miss diagnoses have been ruled out	▸ No published examples
General diagnostic rules in clinical practice	Many diagnostic 'rules' are often passed to trainees that are intended to prevent diagnostic error	▸ Specific tips to avoid diagnostic error[59]
Rule Out Worst-Case Scenario (ROWS)	A simple but useful general strategy to avoid missing important diagnoses	▸ No published examples
Checklists	A standard in aviation and now incorporated into medicine in intensive care units, surgery and in the diagnostic process[60]	▸ Catheter-related bloodstream infections were sustainably reduced by clinicians' adopting five evidence-based procedures on a checklist and reminders such as reinforcing strategies[61] ▸ The implementation of a surgical safety checklist led to reductions in death rates and complications in non-cardiac surgery in a multicenter study[62]
Stopping rules	Stopping rules are an important form of forcing functions—they determine when enough information has been gathered to make an optimal decision[63 64]	▸ No published examples
Consider the opposite	Seeking evidence to support a decision opposite to your initial impression may be a useful way of forcing consideration of other options	▸ Experimental studies in psychological research have shown considering the opposite counteracted biases,[25 65 66] for example, a consider-the-opposite strategy led to less biased judgements of personality traits[67]
Consider the control	Causal claims are often made without an appropriate control group[67]	▸ No published examples

and individualistic biases might be expected to be the least intransigent and the most amenable to change. Regardless of their origin, affective biases may need fundamentally different approaches from cognitive biases.

The recent literature is becoming more specific about biases and their defining characteristics. Various taxonomic strategies have been proposed,[5 71–74] and future work may predict which particular types of strategies might work for certain classes of biases, as Arkes has proposed.[71] Readers interested in the process of tailoring debiasing strategies to specific biases may find a suitable starting point in the taxonomies proposed in Stanovich's work[75] or that by Wilson and Brekke.[5]

HOW DO WE GO FORWARD?

1. A major goal will be to identify the parameters of change. How might the workplace be optimised to avoid bias in the first place? Which interventions are appropriate for which biases and for which group (students, residents, practicing clinicians). What maintenance strategies will be required, and for how long?
2. While this and its companion paper were being prepared, a comprehensive narrative review listing 42 tested interventions to mitigate cognitive errors has been published.[76] The effectiveness of interventions and strategies for debiasing in clinical practice deserves most attention as studies on their use have largely been conducted in other domains.
3. Medical training has traditionally put an emphasis on declarative knowledge (knowing what, or information-based) rather than procedural knowledge (knowing how, or application-based). While clinical adages aimed at preventing cognitive pitfalls are a tradition in clinical teaching, they are addressed occasionally and without a theoretical basis. Recently, efforts have been made to increase emphasis on procedural knowledge by building critical thinking into the undergraduate curriculum.[77] Not surprisingly, the ability to avoid bias is correlated with critical thinking ability.[78 79] Many of the processes

BMJ Qual Saf: first published as 10.1136/bmjqs-2012-001713 on 30 August 2013. Downloaded from http://qualitysafety.bmj.com/ on 24 April 2018 by guest. Protected by copyright.

described above would be integral to this initiative: a knowledge and understanding of reasoning and decision-making theories, of cognitive and affective biases, of logical fallacies and of standards for clarity, precision, accuracy, relevance, logicalness, intellectual humility and other attributes.[80] The strategies described in this paper can lead to an educational curriculum that brings the traditional clinical adages into a coherent framework and that engages students and residents with real case examples in which cognitive pitfalls and debiasing are showcased and studied.

4. Many decision makers in clinical practice appear to recognise at least some of their biases and put measures in place to control them. However, the interface between patient and doctor is unique and so dynamic that even the best minds are challenged. Many contextual influences are difficult to control: the patient's characteristics and personality, the demographics and presentation (both typical and atypical) of the disease process itself, the knowledge, experience, expertise, personality and other characteristics of the physician, and the ambient conditions under which the decision will be made. Cultural and other individual differences also play a role in the effectiveness of debiasing initiatives.
5. Type 1 processing is essential to cognitive functioning and generally serves us well; in fact we could not live without it.[81 82] Given that the vast majority of our daily decisions involve Type 1 processes,[83] there is considerable ground to be made in educating intuition.[49] Better environments can be created by providing better mentoring and feedback, by having fewer insults to homeostasis (more rest, sleep and reduced cognitive overloading) and by having trainees learn their skills by making the scientific method intuitive. Strategies to avoid extraneous influences on decision making[84] would also be worthwhile.

Clinicians must be informed and recognise the need for constant vigilance and surveillance of their thinking to mitigate diagnostic and other clinical errors. There is an ongoing imperative to self-monitor for bias and especially to be mindful of faulty decision making at vulnerable times, and for the risk of excessive reliance on intuitive judgements when further reflection is required. This is captured in a current definition of critical thinking: 'the ability to engage in purposeful, self-regulatory judgment'.[85] This paper has reviewed a rich variety of cognitive debiasing initiatives from social science and clinical medicine. Given recent advances in the understanding of clinical decision making, the time appears ripe for renewed research effort and we hope these two papers will provoke such effort.

Contributors The article is based on a workshop conducted by the authors during the 2011 Diagnostic Error in Medicine Annual Conference in Chicago. PC conceived the work with substantial contributions from GS and SM. PC wrote the draft of the manuscript, and GS and SM revised it critically for important intellectual content. All authors approved the final version of the manuscript.

Competing interests None.

Provenance and peer review Not commissioned; externally peer reviewed.

Open Access This is an Open Access article distributed in accordance with the Creative Commons Attribution Non Commercial (CC BY-NC 3.0) license, which permits others to distribute, remix, adapt, build upon this work non-commercially, and license their derivative works on different terms, provided the original work is properly cited and the use is non-commercial. See: http://creativecommons.org/licenses/by-nc/3.0/

REFERENCES

1 Croskerry P, Singhal G, Mamede S. Cognitive debiasing 1: origins of bias and theory of debiasing. 2013;0:1–7. doi:10.1136/bmjqs-2012-001712
2 Newell BR, Wong KY, Cheung JCH, *et al*. Think, blink or sleep on it? The impact of modes of thought on complex decision making. *Q J Exp Psychol* 2009;62:707–32.
3 Prochaska JO, DiClemente CC, Norcross JC. In search of how people change. *Am Psychol* 1992;47:1102–4.
4 De Neys W, Moyens E, Vansteenwegen D. Feeling we're biased: autonomic arousal and reasoning conflict. *Cogn Affect Behav Neurosci* 2010;10:208–16.
5 Wilson TD, Brekke N. Mental contamination and mental correction: unwanted influences on judgments and evaluations. *Psychol Bull* 1994;116:117–42.
6 Groopman J. *How doctors think*. New York: Houghton Mifflin Co, 2007.
7 Zajonc RB. Feeling and thinking: preferences need no inferences. *Am Psychol* 1980;35:151–75.
8 Horton K. Aid and bias. *Inquiry* 2004;47:545–61.
9 Fischoff B. Debiasing. In: Kahneman D, Slovic P, Tversky A, eds. *Judgment under uncertainty; heuristics and biases*. Cambridge, England: Cambridge University Press, 1982:422–44.
10 Kahneman D. *Thinking, fast and slow.* New York: Doubleday Canada, 2011.
11 Berner ES, Graber ML. Overconfidence as a cause of diagnostic error in medicine. *Am J Med* 2008;121(5 Suppl):S2–23.
12 Beyerstein BL. Alternative medicine and common errors of reasoning. *Acad Med* 2001;76:230–7.
13 Pronin E, Gilovich T, Ross L. Objectivity in the eye of the beholder: divergent perceptions of bias in self versus others. *Psychol Rev* 2004;111:781–99.
14 Heath C, Heath D. *Decisive*. Toronto: Random House Canada, 2013.
15 Stanovich KE, West RF. Individual differences in reasoning: implications for the rationality debate? *Behav Brain Sci* 2000;23:645–65.
16 Croskerry P. A universal model for diagnostic reasoning. *Acad Med* 2009;84:1022–28.
17 Croskerry P. Clinical cognition and diagnostic error: applications of a dual process model of reasoning. *Adv Health Sci Educ Theory Pract* 2009;14(Suppl 1)27–35.
18 Croskerry P. The importance of cognitive errors in diagnosis and strategies to prevent them. *Acad Med* 2003;78:1–6.
19 Croskerry P. Cognitive and affective dispositions to respond. In: Croskerry P, Cosby KS, Schenkel S, Wears R, eds. *Patient safety in emergency medicine*. Philadelphia: Lippincott Williams & Wilkins, 2008:219–27.
20 Croskerry P, Abbass A, Wu A. Emotional issues in patient safety. *J Patient Saf* 2010;6:1–7.

BMJ Qual Saf: first published as 10.1136/bmjqs-2012-001713 on 30 August 2013. Downloaded from http://qualitysafety.bmj.com/ on 24 April 2018 by guest. Protected by copyright.

21 Jenicek M. *Medical error and harm: understanding, prevention and control*. New York: Productivity Press, 2011.
22 Hershberger PJ, Part HM, Markert RJ, *et al*. Teaching awareness of cognitive bias in medical decision making. *Acad Med* 1995;70:661.
23 Hershberger PJ, Markert RJ, Part HM, *et al*. Understanding and addressing cognitive bias in medical education. *Adv Health Sci Educ* 1997;1:221–6.
24 Turk DC, Salovey P. Clinical information processing: bias inoculation. In: Ingram RE, ed. *Information processing approaches to clinical psychology.* Orlando, FL: Academic Press, 1986:305–23.
25 Mumma GH, Wilson SB. Procedural debiasing of primacy/anchoring effects in clinical-like judgments. *J Clin Psychol* 1995;51:841–53.
26 Sherbino J, Dore KL, Siu E, *et al*. The effectiveness of cognitive forcing strategies to decrease diagnostic error: an exploratory study. *Teach Learn Med* 2011;23:78–84.
27 Fong GT, Krantz DH, Nisbett R. The effect of statistical training on thinking about everyday problems. *Cogn Psychol* 1986;18:253–92.
28 Nisbett RE, Fong GT, Lahman DR, *et al*. Teaching reasoning. *Science* 1987;238:625–31.
29 Eva KW, Hatala RM, LeBlanc VR, *et al*. Teaching from the clinical reasoning literature: combined reasoning strategies help novice diagnosticians overcome misleading information. *Med Educ* 2007;41:1152–8.
30 Crowley RS, Legowski E, Medvedeva O, *et al*. Automated detection of heuristics and biases among pathologists in a computer-based system. *Adv Health Sci Educ* 2013;18:343–63.
31 Stiegler MP, Neelankavil JP, Canales C, *et al*. Cognitive errors detected in anaesthesiology: a literature review and pilot study. *Br J Anaesth* 2012;108:229–35.
32 Bond WF, Deitrick LM, Arnold DC, *et al*. Using simulation to instruct emergency medicine residents in cognitive forcing strategies. *Acad Emerg Med* 2004;79:438–46.
33 Elstein AS, Shulman LS, Sprafka SA. *Medical problem solving: an analysis of clinical reasoning*. Cambridge, MA: Harvard University Press, 1978.
34 Umanath NS, Vessey I. Multiattribute data presentation and human judgment: a cognitive fit perspective. *Decis Sci* 1994;25:795–824.
35 Campbell WW. Augenblickdiagnose. *Semin Neurol* 1998;18:169–76.
36 Silen W. *Cope's early diagnosis of the acute abdomen*. 15th edn. New York: Oxford University Press, 1979.
37 Diagnostic Checklist. 2011. http://pie.med.utoronto.ca/dc/ (accessed 31 Mar 2013).
38 Whaley AL, Geller PA. Toward a cognitive process model of ethnic/racial biases in clinical judgment. *Rev Gen Psychol* 2007;11:75–96.
39 Vohs KD, Baumeister RF, Loewenstein G. eds. *Do emotions help or hurt decision making? A Hedgefoxian perspective*. New York: Russell Sage Foundation, 2007.
40 Mamede S, Penaforte JC, Schmidt HG. Effects of reflective practice on the accuracy of medical diagnoses. *Med Educ* 2008;42:468–5.
41 Mamede S, van Gog T, van den Berge K, *et al*. Effect of availability bias and reflective reasoning on diagnostic accuracy among internal medicine residents. *JAMA* 2010;304:1198–203.
42 Moulton CAE, Regehr G, Mylopoulos M, *et al*. Slowing down when you should: a new model of expert judgment. *Acad Med* 2007;82:S109–16.
43 Moulton CA, Regehr G, Lingard L, *et al*. Slowing down to stay out of trouble in the operating room: remaining attentive in automaticity. *Acad Med* 2010;85:1571–7.
44 Schermer M. *The believing brain*. New York: Times Books, Henry Holt and Company, 2011.
45 Daumit GL, Pronovost PJ, Anthony CB, *et al*. Adverse events during medical and surgical hospitalizations or persons with schizophrenia. *Arch Gen Psychiatry* 2006;63:267–72.
46 Surowiecki J. *The wisdom of crowds*. New York, NY: Anchor Books, 2005.
47 Bornstein G, Yaniv I. Individual and group behavior in the ultimatum game: are groups more "rational" players? *Exp Econ* 1998;1:101–8.
48 Tetlock PE, Kim JI. Accountability and judgment processes in a personality prediction task. *J Pers Soc Psychol* 1987;52: 700–9.
49 Hogarth RM. *Educating intuition*. Chicago: University of Chicago Press, 2001.
50 Croskerry P. ED cognition: any decision by anyone at any time. ED administration series. *CJEM*. doi: 10.2310/8000.2013.131053
51 Gilbert DT. The assent of man: mental representation and the control of belief. In: Wegner DM, Pennebaker JW, eds. *The handbook of mental control*. Englewood Cliffs, NJ: Prentice Hall, 1993:57–87.
52 Radecki RP, Medow MA. Cognitive debiasing through Sparkelines in clinical data displays. *AMIA Annu Symp Proc* 2007;11:1085.
53 Bauer DT, Guerlain S, Brown PJ. The design and evaluation of a graphical display for laboratory data. *J Am Med Inform Assoc* 2010;17:416–24.
54 Barnett GO, Cimino JJ, Hupp JA, *et al*. An evolving diagnostic decision-support system. *JAMA* 1987;258:67–74.
55 Ramnarayan P, Roberts GC, Coren M. *et al*., Assessment of the potential impact of a reminder system on the reduction of diagnostic errors: a quasi-experimental study. *BMC Med Inform Decis Mak* 2006;6:22.
56 Grove WM, Meehl PE. Comparative efficiency of informal (subjective, impressionistic) and formal (mechanical, algorithmic) prediction procedures: the clinical–statistical controversy. *Psychol Public Policy Law* 1996;2:293–323.
57 McGinn T, Jervis R, Wisnivesky J, *et al*. Tips for teachers of evidence-based medicine: clinical prediction rules (CPRs) and estimating pretest probability. *Gen Intern Med* 2008;23:1261–8.
58 Croskerry P. Cognitive forcing strategies in clinical decision making. *Ann Emerg Med* 2003;41:110–20.
59 Trowbridge RL. Twelve tips for teaching avoidance of diagnostic errors. *Med Teach* 2008;30:496–500.
60 Ely J, Graber M, Croskerry P. Checklists to reduce diagnostic errors. *Acad Med* 2011;86:307–13.
61 Pronovost P, Needham D, Berenholtz S, *et al*. An intervention to decrease catheter-related bloodstream infections in the ICU. *N Engl J Med* 2006;355:2725–32.
62 Haynes AB, Weiser TG, Berry WR, *et al*. A surgical safety checklist to reduce morbidity and mortality in a global population. *N Engl J Med* 2009;360:491–9.
63 Simon HA. *The sciences of the artificial*. Cambridge, MA: MIT Press, 1981.
64 Bazerman MH. *Judgment in managerial decision making*, 5th edn. New York: Wiley & Sons, 2002.
65 Lord CG, Lepper MR, Preston E. Considering the opposite: a corrective strategy for social judgment. *J Pers Soc Psychol* 1984;47:1231–43.

BMJ Qual Saf: first published as 10.1136/bmjqs-2012-001713 on 30 August 2013. Downloaded from http://qualitysafety.bmj.com/ on 24 April 2018 by guest. Protected by copyright.

66 Galinsky AD, Moskowitz GB. Counterfactuals as Behavioral Primes: priming the simulation heuristic and consideration of alternatives. *J Exp Soc Psychol* 2000;36:384–409.
67 Bishop MA, Trout JD. *Epistemology and the psychology of human judgment*. New York, NY: Oxford University Press, 2005:148–52.
68 Thaler RH, Sunstein CR. *Nudge: improving decisions about health, wealth, and happiness*. New York: Penguin Books, 2009.
69 MacLeod C, Koster EHW, Fox E. Whither cognitive bias modification research? Commentary on the Special Section Articles. *J Abnorm Psychol* 2009;118:89–99.
70 Keren G. Cognitive aids and debiasing methods: can cognitive pills cure cognitive ills? *Adv Psychol* 1990;68:523–52.
71 Arkes HR. Costs and benefits of judgment errors: implications for de-biasing. *Psychol Bul* 1991;110:486–98.
72 Arnott D. Cognitive biases and decision support systems development: a design science approach. *Info Systems J* 2006;16:55–78.
73 Campbell SA, Croskerry P, Bond W. Profiles in patient safety: a "perfect storm" in the emergency department. *Acad Emerg Med* 2007;14:743–9.
74 Lawson AE, Daniel ES. Inferences of clinical diagnostic reasoning and diagnostic error. *J Biomed Inform* 2011;44: 402–12.
75 Stanovich KE. *Rationality and the reflective mind*. New York: Oxford University Press, 2011:19.
76 Graber ML, Kissam S, Payne VL, *et al*. Cognitive interventions to reduce diagnostic error: a narrative review. *BMJ Qual Saf* 2012;21:535–57.
77 Millennium Conference 2011 on Critical Thinking. The Carl J. Shapiro Institute for Education and Research at Harvard Medical School and Beth Israel Deaconess Medical Center, Babson College, Wellesley, MA, May 19–21, 2011.
78 Elder L, Paul R. *Critical thinking development: a stage theory with implications for instruction*. Tomales, CA: Foundation for Critical Thinking, 2010.
79 West RF, Toplak ME, Stanovich KE. Heuristics and biases as measures of critical thinking: associations with cognitive ability and thinking dispositions. *J Educ Psychol* 2008;100:930–41.
80 Lilienfield SO, Ammirati R, Landfield K. Giving debiasing away: can psychological research on correcting cognitive errors promote human welfare? *Perspect Psychol Sci* 2009;4:390–8.
81 Croskerry P. Context is everything or how could I have been that stupid? *Healthc Q* 2009;12:167–73.
82 Smallberg G. Bias is the nose for the story. In: Brockman J, ed. *This will make you smarter*. New York: Harper Perennial, 2012, 43–5.
83 Lakoff G, Johnson M. *Philosophy in the flesh: the embodied mind and its challenge to Western thought*. New York: Basic Books, 1999.
84 Danzigera S, Levavb J, Avnaim-Pessoa L. Extraneous factors in judicial decisions. *Proc Nat Acad Sci* 2011;108:6889–92.
85 Facione PA. *Critical thinking: what it is and why it counts*. Millbrae, CA: Insightassessment.com, 2011.

BMJ Qual Saf: first published as 10.1136/bmjqs-2012-001713 on 30 August 2013. Downloaded from http://qualitysafety.bmj.com/ on 24 April 2018 by guest. Protected by copyright.