International Journal of General Medicine

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PERSPECTIVES

DECLARE: A Comprehensive, Multifaceted Cognitive Forcing Strategy to Confront Complex Cases

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Abstract: Diagnostic excellence is an important goal in medicine. The enhancement of clinical reasoning skills of physicians, which is at the core of this concept, is a significant challenge. To achieve this improvement, it is necessary to enhance the ability to collect patient history information and to integrate the information. Additionally, the complexity of diagnosis is confounded by biases, noise, uncertainty, and contextual factors, and the impact of these factors is particularly prominent in complex cases. In such cases, the dual process theory, which is a classical reasoning measure, alone is insufficient to cope with these challenges, and a multifaceted and comprehensive approach is required to supplement its limitations. Therefore, the author presents six concrete steps, represented by the acronym DECLARE (Decomposition, Extraction, Causation Link, Assessing Accountability, Recomposition, Explanation and Exploration), that implement the concept of cognitive forcing strategy that has been shown to be effective in bias control, and include reflection, meta-cognition, and the recently popularized decision hygiene procedure. DECLARE is a strategy that should be deployed when faced with more complex diagnostic scenarios. By examining each of the six steps that comprise DECLARE individually, cognitive load can be reduced. Furthermore, by verifying causation and accountability when constructing diagnostic hypotheses, biases can be mitigated, which can also help to address noise and uncertainty, leading to an improvement in the quality of diagnosis and effectiveness in medical education.

Keywords: diagnostic excellence, diagnostic strategy, meta-cognition, reflection, causal inference, decision hygiene

Introduction

Diagnostic excellence is an important goal in healthcare.[1] A multifaceted approach is warranted for its excellence because of complex conditions involving cognitive biases, noise (randomness in decision-making), uncertainty, and situational factors (called as situativity) that have been addressed in recent years.[2] Diagnostic errors have a significant impact on the quality of healthcare,[3] and errors in information gathering and cognitive factors are known to account for a large proportion of these errors.[4,5] Addressing these causes is crucial to reducing diagnostic errors and achieving diagnostic excellence. On the other hand, the development of strategies that can improve these causes is expected to contribute to the quality of future diagnosis. The author currently works in a department responsible for diagnostic consultations and also teaches diagnostic reasoning to young doctors and medical students, showing a strong interest and motivation in developing strategies to improve diagnostic accuracy. Surprisingly, however, there has been little discussion of specific thinking measures by physicians on how to analyze problems in diagnosis, which are a complex interplay of factors.

Hence, I endeavor to propose a new model of diagnostic thinking strategy. The contribution of this article is expected to be as follows:

Received: 23 February 2023
Accepted: 12 April 2023
Published: 25 April 2023

Proposes a new strategy for improving diagnostic accuracy from the perspectives of information gathering and cognitive science.

Proposes a comprehensive strategy that incorporates not only the dual process theory but also other concepts such as decision hygiene procedures and causal inference.

This new model is expected to be an effective method not only for clinical practice but for medical education.

Materials and Methods

The prevailing diagnostic thinking model among physicians until recently was the dual process theory (DPT), which posits that diagnostic accuracy can be improved by complementarily using two types of thinking, intuitive (non-analytic: System 1) and analytical (analytic: System 2), depending on the case at hand. However, in order to overcome the confounding effects of various elements that influence physicians' thinking, various thinking models beyond DPT have been proposed. These include cognitive forcing strategies that have been shown to be effective against cognitive biases,[6] as well as techniques such as "decision hygiene", which is said to reduce noise.[2] The decision hygiene template incorporates a range of diverse approaches, including the concept of "isolate assessment items", which involves breaking down complex problems into individual components for analysis and is considered effective to solve problems involving noise.[2] Methods of isolating elements comprising complex problems and tracking down their relationships to form a hypothesis for problem-solving have been widely discussed as problem-solving methods in many fields.[7] The information thus obtained may be selected according to its importance, and precise causal inference may clarify the overall story,[8] or further reflection on this conclusion may lead to a more valid diagnosis.[6] By combining methods that are known to be effective, it is expected that highly accurate problem-solving strategies will be generated. In other words, the complex work of decomposing a complicated problem into its elements (isolation), finding causality (causality) in the selected information, verifying its validity based on reflection (reflection), and then analyzing it with a clear awareness (cognitive forcing) of these series of tasks is expected to be an effective method for dealing with complex problems. Therefore, I propose the development of a framework, summarized by the acronym DECLARE, which incorporates a decision hygiene template, causal inference, and reflection, to enhance cognitive strategies.

Results

The strategy consists of the six steps represented by the acronym DECLARE (Figure 1). Suppose that the patient's problem consists of complex elements obtained from structured history,[9] physical examination, etc. Decomposing these elements to the extent possible to "tag" them with semantic qualifiers (D: decomposition). Elements that are considered necessary are extracted (E: extraction), and elements that are considered less critical are set aside. Next, the mutual influence of the extracted elements is examined, to detect a causal link among them (CL: causation link). Then the relationship is assessed if that represents a pathophysiologically explainable story for the patient (A: assessing accountability). And the elements are recomposed into a clinical representation (R: recomposition). If there are inconsistencies in the causality or if the hypothesis explanation does not sound plausible through reflection by clinicians, the patient's information is actively explored to see if there is a hidden or ignored element or hidden relationship in the existing elements (E: Explanation and Exploration). Here are some examples:

Case 1

A man in his 60s with dyslipidemia presented with intractable vomiting for two years. The vomiting increased within 30 minutes of starting to eat. His appetite was also reduced, and his weight had decreased by more than 15% in one year. Pain in the pericardial to peri-umbilical area and back pain appeared with nausea. After an upper gastrointestinal endoscopy and contrast-enhanced CTs at three hospitals failed to reveal the cause, the patient was referred to the author's department. After the Decomposition, the essential elements were "refractory vomiting", "intensification within 30 minutes of starting to eat", "tenderness over the artery at the level of the transpyloric plane on abdominal palpation", and "an arterial murmur at the same site" elicited by examination (DE). Based on the association of the respective elements, I suspected a functional upper gastrointestinal tract obstruction associated with arterial bowel ischemia (CLA), specifically celiac artery compression

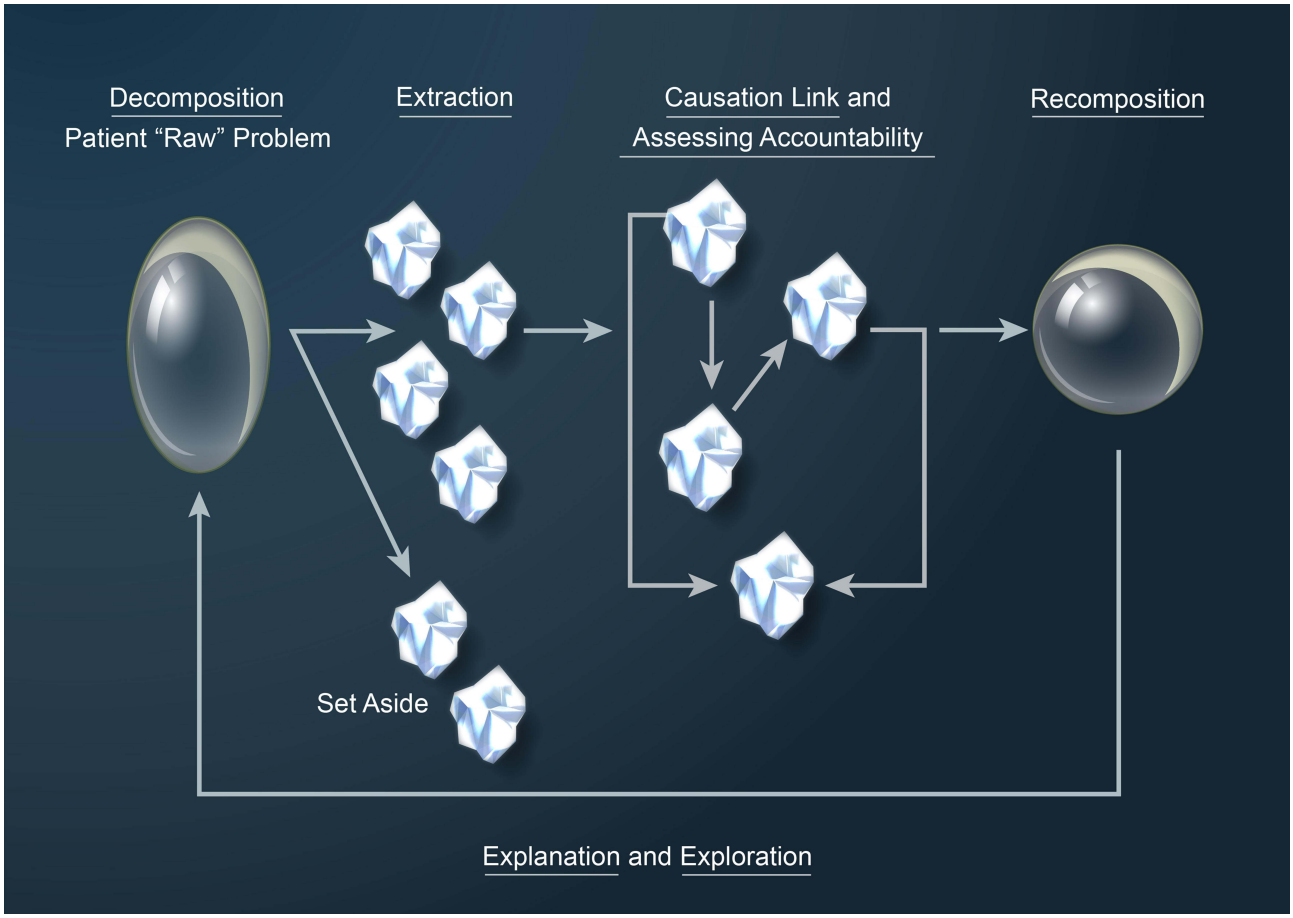

Figure 1 The illustrative diagram of the DECLARE model.

syndrome (R). Previous abdominal contrast-enhanced CTs showed no stenosis at the celiac artery root. However, as celiac artery pathology was still suspected, an ultrasound in the sitting position for the eating posture was performed. The patient had a strong kyphosis in the sitting position, and the end-expiratory ultrasound showed a celiac artery root compression. Meanwhile, as there was no explanation for why this symptom appeared two years earlier (A), the physician asked the patient regarding the possibility of a spinal problem (E). He admitted he had a lumbar compression fracture episode at work three years earlier, which might have triggered an abnormal position of the celiac artery in relation to the median arcuate ligament. The patient confirmed this and replied that this made sense in terms of the timeline.

Case 2

A woman in her 70s with hypertension was brought to the emergency department because she "suddenly started talking funny". Her vital signs included 130/80 mmHg of blood pressure, and her pulse was in the 40s. Her consciousness appeared clear, but she closed her eyes as if she would fall asleep on the spot if not spoken to and woke up immediately when called. According to her accompanying husband, there was no history of bradycardia. The element breakdown at this point was "sudden onset", "altered consciousness (speech)", "reduced level of consciousness", and "sinus bradycardia" (DE). Through the analytical thinking process, the physician thought that the elements of altered consciousness and reduced level of consciousness suggested a widespread disturbance of the ascending reticular activating system and cortex. Still, the causal link connecting the element of bradycardia was unclear (CLAR failure). Reviewing the history again (E), the elements of "vascular risk (age, hypertension)" and "recurrent symptoms with momentary changes" recalled vascular pathology. Considering the anatomy connecting the cerebrum-brainstem (impaired consciousness) to the sinus node (bradycardia) in the context of vascular pathology recalled Type A acute aortic dissection (CLARE).

Further exploring the patient's medical history revealed that minimal but sudden-onset neck pain preceded the onset of other symptoms. A contrast-enhanced CT scan was immediately ordered, and an acute aortic dissection was diagnosed.

Case 3

A thirty-year-old man with severe atopic dermatitis presented to the clinic with fever and a chest pain that had started four days prior. His body temperature was 38.0°C, pulse rate was 130/min, blood pressure was 100/95mmHg, respiratory rate was 26 breaths/min, and SpO_2 was 96% on room air. Physical examination revealed decreased breath sounds in the right upper and left lower lung fields, and chest X-ray showed infiltrates in the same area. The resident physician in charge prescribed antibiotics after a blood culture and advised the patient that he could go home as he suspected acute bacterial pneumonia and pleuritis, not requiring hospitalization, based on the acute onset of fever, chest pain, and lung infiltrations. However, the senior physician, reviewing the resident physician's clinical reasoning presentation in light of DECLARE, felt uneasy about the relationship between the information of tachycardia (CLA failure) and the fact that scattered infiltrates were present in a young patient (CLA failure). She, the senior physician, suspected that the relative tachycardia was due to cardiac damage or involvement of systemic toxins (revised CLA) and that the scattered infiltrates were more likely to be related to embolic conditions rather than to pneumonia (revised CLA). Through a careful examination, she detected micro-hemorrhagic spots in the conjunctiva, purple dot-like spots on the fourth fingertip of the right hand, and a trace diastolic murmur in the aortic area. Consequently, she considered the possibility of infective endocarditis due to entry from the skin caused by atopic dermatitis (Extract) rather than pneumonia and advised the patient to be hospitalized urgently. After hospitalization, blood culture at the time of the visit revealed *Staphylococcus aureus* in all four bottles drawn, and an echocardiogram showed small vegetation on the aortic valve. The patient was diagnosed with *Staphylococcus aureus* infective endocarditis.

Discussion

Case 1: The initial reasoning was that the patient may have had celiac artery compression syndrome, however, the negative diagnostic test pointed against the suspected diagnosis. Then the physician actively gathered potential information to elucidate the unexplained onset of symptoms that occurred two years earlier for the potential diagnostic clue. This led to the acquisition of information that was logically relevant and resulted in a successful diagnosis.

Case 2: The physician attempted to relate extracted information to each other, but failed to explain the pathophysiology of the hypothesis in the suspected diagnosis. Therefore, the physician analyzed the obtained information from a different angle and drew a correct diagnosis from a more explicable inference.

Case 3: The junior physician ignored the history of atopic dermatitis and downplayed the history of relative tachycardia, resulting in the failure to extract necessary information. Furthermore, the junior physician short-circuited the association of fever and chest pain with multiple scattered lung infiltration due to pneumonia and pleuritis. The senior physician carefully analyzed the problem again using the DECLARE model, which allowed for inference from diverse angles, such as reflection, and precise examination of causal relationships. Consequently, the senior physician detected flaws in the young physician's reasoning and finally generated a correct hypothesis.

It is critical for clinicians to decompose complex diagnostic problems into elements to extract the essential elements properly (D and E= isolate assessment items in the decision hygiene template) and then to sequentially explore the similarities and differences in the differential diagnoses derived from these elements.[10] Meanwhile, the additional distinctive features of DECLARE lie in the R and CL parts. A valid problem-solving hypothesis is formed by not merely dividing complex problems but by clearly considering causal relationships between clinical information (CL= Causal inference), assessing the relationship in order to satisfy accountabilities to the patient (A), and by reconstructing them appropriately (R). A pathophysiology hypothesis with understandable coherence can be established by clarifying the causal relationships between the elements and creating a storyline. Then the patient explanations accompanying the subsequent examination become reasonable (A). This has important implications in light of patient-centeredness and diagnostic excellence. On the other hand, excessive coherent reconstructions should be avoided in cases of potential causal flaws. The treatment of missing data in clinical reasoning differs from the approaches used in epidemiology and statistics.[11] A careful and thorough search for unresolved "puzzle pieces" of information obtained from the patient (E)

derived from reflection by colleagues and patients (E=Reflection) may allow for more robust hypothesis formation. Moreover, engaging team consensus of the reflection will enhance the quality to cope the complex cases in the uncertain situation (E= meta-cognition).[12] Isolating assessment items, causal inference, reflection, meta-cognition, and cognitive forcing are various essential cognitive science items underpinning this strategy (Figure 2).

When should DECLARE be used? DECLARE is not a case that can be easily diagnosed under the general dual process theory operation, but rather a strategy that should be consciously deployed when confronting more complex phenomena. By examining each of the six steps that make up DECLARE individually, issues can be identified at which stages of the thinking flow are problematic. Concentrating on the problematic step will speed up the overall problem-solving process. The advantages of DECLARE are threefold. One is cognitive load reduction. Dividing the diagnostic thinking process into six steps reduces the cognitive load of physicians and allows them to focus on the specific part of the problematic process.[13] Second, there is a strength that in the second half of the whole process, the CLARE, the hypothesis is double-checked within the process. The cognitive forcing embedded in the entire process serves as surveillance and feedback, if any, to reinforce the causality and completeness of the thinking process, contributing to the quality of the diagnosis.[6] Another advantage is the educational benefit. DECLARE framework will have a positive effect on the education of novices. The DE part would be relatively easy, but the CLAR and E parts are more complex. Knowing at which stage learners fail would be an indicator for teaching on the diagnostic process. Incorporating the DECLARE model into clinical reasoning classes for medical students would be beneficial. In complex case discussions, small groups of students can be directed to employ the DECLARE model to generate diagrams, as shown in Figure 1. Subsequently, the instructor can then evaluate and reflect on their diagrams and present the teacher's own DECLARE model to the students, resulting in effective educational feedback. As for clinical reasoning education for physicians, senior and junior physicians could engage in one-on-one mentoring sessions that concern the DECLARE model during actual complicated diagnostic cases to promote reflective thinking from a DECLARE perspective.

A limitation of DECLARE is that it might be a cumbersome strategy when used for simple diagnostic cases. As a complex and exhaustive structure, comprising six sequential steps, DECLARE is primarily an analytical thinking model from a DPT perspective. Evidence has suggested that the utilization of analytical thinking in straightforward cases may result in less precision than intuitive thinking,[14] implying that DECLARE may not be the optimal strategy for simple cases. Conversely, it is anticipated that DECLARE could be beneficial in intricate cases.

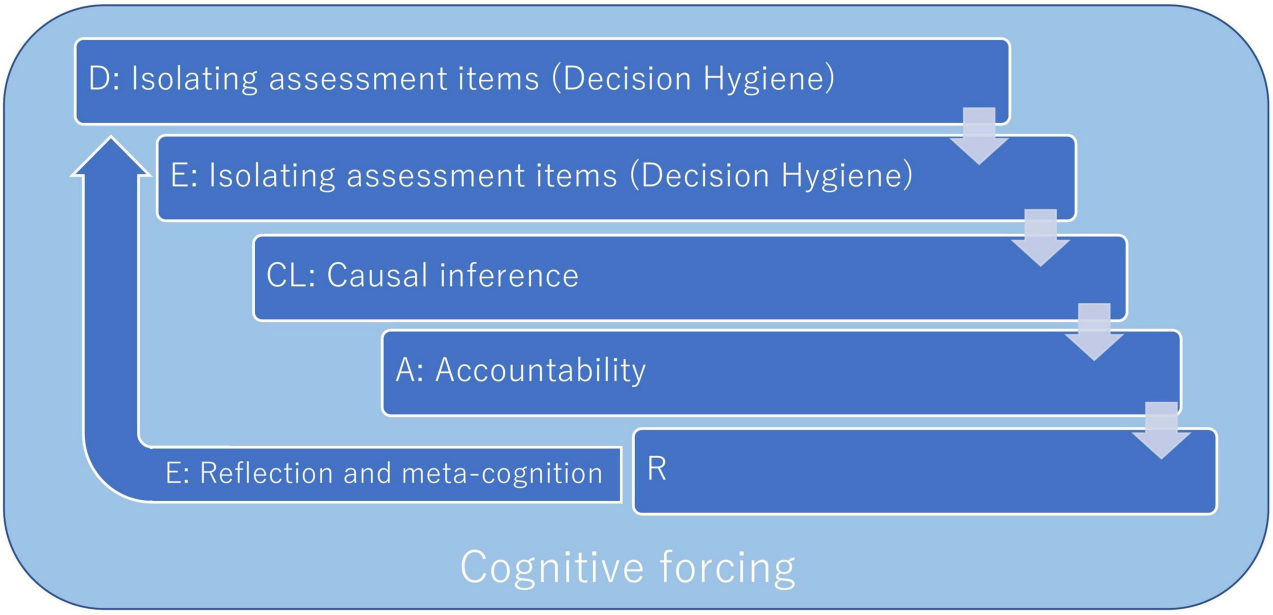

Figure 2 The block diagram of the DECLARE model, showing the relationship with background theories.

Future perspectives of DECLARE are as follows: The evaluation of effectiveness using statistical analysis and metrics for evaluation in DECLARE will be presented as future research topics. Additionally, to validate this diagnostic process analysis, a double check based on the concept of ethnography of the physician population would be necessary.[15] Also, established evidence-based training measures for each stage will be needed. Upcoming research is expected in order to clarify these points.

Conclusion

In the context of promoting diagnostic excellence, the expertise of physicians' clinical reasoning plays a pivotal role. As pillars of this expertise, relying solely on DPT may render controlling biases, noise, and uncertainty challenging, thus requiring a flexible and comprehensive approach that integrates diverse perspectives. DECLARE is a novel and powerful diagnostic strategy that can be applied to complex diagnostic cases by harmonizing currently useful theories rooted in cognitive science, such as reanalysis, retrospection, and precise examination of causal relationships, rather than merely using the analytic methods of the DPT, and will be expected to be more diagnostically effective than previous methods. When confronted with perplexing diagnostic situations, scrutinizing each aspect of DECLARE may facilitate a breakthrough, enhancing cognitive forcing and increasing the probability that physicians can advance to the next diagnostic step under such circumstances.

Case Information

Please note that the cases presented in this manuscript are entirely fictional and were created solely for illustrative purposes. They do not represent any real individuals or situations, and any resemblance to actual persons or events is purely coincidental.

Funding

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Disclosure

There is no competing interest to declare.

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