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A trans-theoretical approach for teaching clinical diagnostic decision-making in real life contexts

Abstract

Making an accurate clinical diagnosis is an essential skill for all medical students and doctors, with important implications for patient safety. Current approaches to teaching how to make a clinical diagnosis tend to lack the complexity that faces clinicians in real –life contexts. In this Guide, we propose a new trans-theoretical model for teaching how to make an appropriate clinical diagnosis that can be used by teachers as an additional technique to their current approach. This educational model integrates situativity theory, dual-information processing theory and socio-cognitive theory. Mapping and microanalysis help the teacher to identify the main processes involved in making an accurate clinical diagnosis so that feedback can be provided that is focused on improving key aspects of the skill. An essential aspect of using the new educational model is the role of the experienced clinical teacher in making judgments about the appropriateness of the learner's attempts to make clinical diagnosis.

Practice Points

- Making an accurate clinical diagnosis is an essential skill for all medical students and doctors, with important implications for patient safety.
- Current approaches to teaching how to make a clinical diagnosis tend to lack the complexity that faces clinicians in real–life contexts.

- A new trans-theoretical model for teaching how to make an appropriate clinical diagnosis integrates situativity theory, dual-information processing theory and socio-cognitive theory.

- Mapping and microanalysis help the teacher to identify the main processes involved in making an accurate clinical diagnosis so that feedback can be provided that is focused on the key processes.

- An essential aspect of using the new educational model is the role of the experienced clinical teacher in making judgments about the appropriateness of the learner's attempts to make clinical diagnosis.

Introduction

The importance of making a timely and accurate diagnosis is fundamental for safe clinical practice. The task involves doctors integrating key information from across all the stages of the clinical enquiry (including history-taking, physical examination and investigations) in order to make a diagnosis.

Making an appropriate clinical diagnosis is complex with several important factors affecting success on the task. The clinical environment has various distractors (such as time pressure and patient expectations) that may deflect the attention of clinicians. Clinical presentations also change with the passage of time and diagnoses made in the early stages of the patient's presentation may be inaccurate and require refining as more information comes to light. Finally, patients suffering from multiple medical conditions present diagnostic challenge since differentiating a 'true' new problem from their existing burden of chronic disease is complicated.

It is not surprising that the process of making a clinical diagnosis is a frequent cause of error in both primary and secondary care. Nevertheless, making an appropriate clinical diagnosis remains fundamentally important for the patient since the outcome initiates a cascade of subsequent actions, such as prescribing a drug or performing an operation, with real world consequences.

The challenge for all medical educators is how to develop the fundamental competence of making an appropriate clinical diagnosis in the context of real-life clinical practice among undergraduates and doctors in training so that they can avoid making an error (Wahner-Roedler et al., 2007). We consider that current educational methods for developing this ability rely on approaches that usually lack the actual complexity of making a diagnosis in the authentic clinical environment. In this Guide we present a practical approach for teaching how to make a clinical diagnosis in the complex context of practice. Our approach has been informed by the integration of several theories.

Current approaches for teaching how to make an appropriate clinical diagnosis

The traditional approach for teaching novices how to make an appropriate diagnosis is to develop analytical reasoning skills. There is widespread recognition that the development of expertise in clinical reasoning consists of refining a series of mental rules that become more and more attuned to reality as they become frequently applied over time (Eva, 2005). At the heart of this approach is the fundamental belief that there are mental rules, which comprise of causal links between features of the clinical presentation (e.g. signs and symptoms) to categories (e.g. diagnoses) and that identifying or teaching novices these links is important. Therefore, the educator's task is to increase the capability of novices to apply mental rules when making a diagnosis for a clinical problem (Elieson & Papa, 1994). Other methods used by teachers for develop analytical reasoning among learners include using 'think aloud' or 'concept mapping' protocols (Torre, Durning, & Daley, 2013) to make the processes of deduction when applying mental rules more explicit.

Novices are also taught to formulate sieves or mnemonics to remain 'objective' and 'carefully consider all the evidence available before generating

diagnostic hypotheses' in the early stages of learning how to make a diagnosis. These tools are intended to trigger the recall of knowledge from clinical memory and minimise the likelihood of novices overlooking potential diagnoses for important clinical problems. Learners recall the mnemonic and apply the corresponding taxonomy of organized information to the problem facing them. An example is the 'I GET SMASHED' mnemonic for the causes of pancreatitis (see Figure 1).

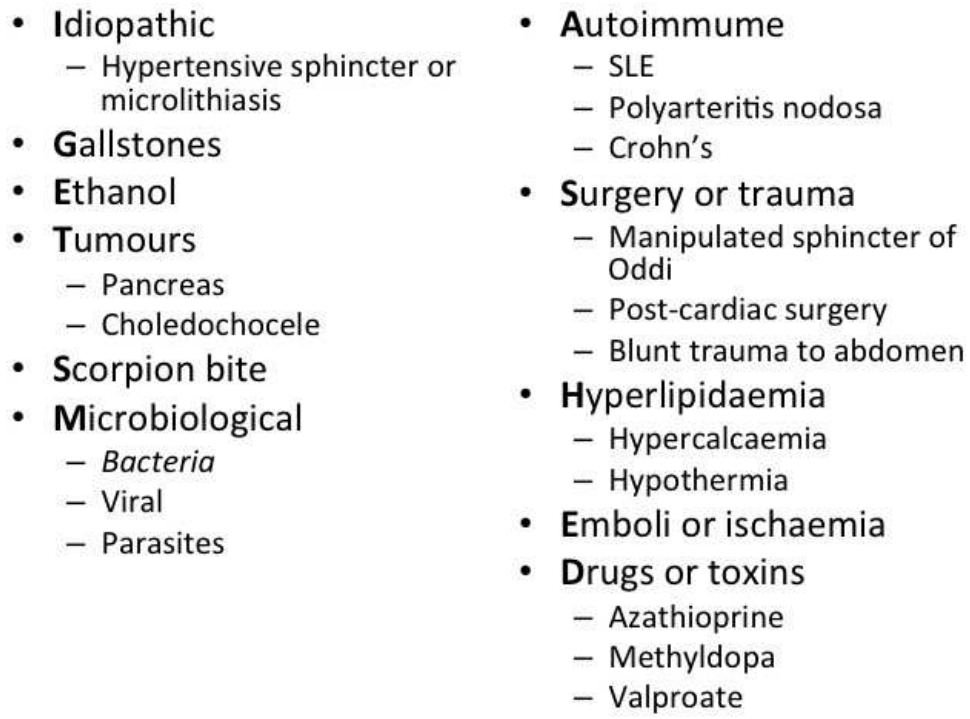


Figure 1 'I GET SMASHED' mnemonic for a few causes of pancreatitis

Although developing analytical skills has been the mainstay of teaching approaches for making a diagnosis, dual information processing (DIP) theory suggests that teachers should also develop non-analytical reasoning skills among novices (Norman & Eva, 2010; Pretz, 2008). DIP theory recognizes the role of two separate, but complimentary processes (analytical and non-analytical), for information processing when making a diagnosis (Croskerry, 2009). Neither pathway is mutually exclusive from the other and both are required for safe-decision making (Norman & Eva, 2010). Although novices use analytical processes in the early stages of learning how to make a diagnosis, they begin to use rapid non-analytical processes more frequently as they accumulate clinical experience.

> *Contrast the approach of a medical student in their year of undergraduate training and another in their final year taking a history*

from a patient with central crushing chest pain. The naïve student is likely to use a structured approach for eliciting more organ-specific features about the chest pain as well as general information about the patient, whereas the more advanced student is likely to recognize the association of crushing central pain with ischaemic heart disease and lean towards an approach more focused around pathology affecting the cardiovascular system.

Helping learners to make a diagnosis using non-analytical processing pathways involves teaching methods that encourage the use of heuristics (such as left-sided chest pain and ST-segment elevation on electrocardiography is suggestive of myocardial infarction). Non-analytical processing pathways include the use of intuition (such as "*although the tests are normal there is something wrong with the patient but I don't know exactly what*") and can be very efficient for formulating a working diagnosis during uncertainty or ambiguity (Stolper et al., 2009). Non-analytical processing is often the exclusive pathway for making a diagnosis where information is limited and the situation is constantly changing (Van den Bruel, Thompson, Buntinx, & Mant, 2012).

However, the non-analytical form of reasoning is particular prone to error (Brieger et al., 2004; Croskerry, 2009; Gilovich, Griffin, & Kahneman, 2002). Non-analytical processing is particularly influenced by cognitive biases, which further increases the potential for inaccuracy during the reasoning process. For example, 'search satisficing' occurs when clinicians avoid fully exploring a presenting complaint after ruling out a particular diagnosis, in most cases, the "worst case scenario" (Ambady & Rosenthal, 1992; Graber, Franklin, & Gordon, 2005). Cognitive forcing strategies are educational interventions for reducing the impact of biases on clinical decision-making and involve promoting mindfulness in the thinking of the clinician (Croskerry, 2003; Croskerry, 2013) for mitigating the potential adverse outcomes.

Analytical and non-analytical information processing are often presented as separate linear two-dimensional processes, but the reality is that both occur simultaneously and vary in their influence on the individual's approach to making a diagnosis across a range of clinical problems. The tendency for using one system over the other is likely to be specific to the individual's knowledge, skill and clinical experience as well as the context of the patient encounter. Intuition about the seriousness of illness in children is an instinctive response by clinicians to the concerns of the parents and the appearance of the children, triggering a search for a second opinion or further investigations (Van den Bruel et al., 2012).

Limitations of current approaches to teaching how to make an appropriate diagnosis

Teaching approaches for developing how to make an appropriate clinical diagnosis usually overlook important aspects of the authentic 'real-world' process.

Firstly, teaching activities within the early years are often delivered using paper-based methods or computer-assisted instruction. The complexity of making a diagnosis through problem-solving or decision-making with 'real-life situations' is invariably lost. The authenticity of the challenge cannot be adequately re-created, especially the management of contextual factors such as managing uncertainty or information overload, as well as the anxiety and stress generated by patient concerns or expectations. These simplistic approaches also prevent learners from experiencing the 'real-world consequences' of their actions, reducing to a "sterile" academic exercise, rather than feeling responsible for any morbidity or mortality experienced by the patient as a consequence of making an inappropriate diagnosis.

Secondly, strategies for teaching making a diagnosis in the early years may concentrate on scaffolding analytical problem-solving skills at the expense of giving sufficient attention towards the role of non-analytical processing and managing intuition when making a diagnosis. This is an important consideration for teachers when giving feedback since novices will use a combination of both information-processing pathways as they develop clinical memory and intermediate expertise (Verkoeijen, Rikers, Schmidt, van de Wiel, & Kooman, 2004). The skill of the teacher is to untangle these processes and to give appropriate feedback about the balance of intuition or deduction used when making the diagnosis. Although skilled teachers may be able to deconstruct how they make an appropriate clinical diagnosis for use in their teaching, this is not possible across every context since some processes are unconscious and cannot be easily made explicit. This presents a significant problem for learners since they may choose to inadvertently learn from the observable (role-modeling) behaviours of expert clinicians, which may be inappropriate in the context of poor clinical competence or personal qualities (Coderre, Mandin, Harasym, & Fick, 2003; Cruess, Cruess, & Steinert, 2008).

Thirdly, existing methods for teaching how to make a diagnosis give minimal attention to developing metacognition as a core skill. Metacognition is the active response by the individual to "thinking about their thinking" process. An essential feature of metacognition is self-regulation, which involves active planning, monitoring and adapting around a given task (Zimmerman, 2000). Self-regulation is required for making an appropriate diagnosis, especially within a complex clinical context. The planning, monitoring and adaption of multiple tasks, such as history-taking or reducing anxiety, that occur at the same time make up the challenge of clinical diagnostic decision-making and require appropriate coordination for achieving a satisfactory outcome (Artino, Cleary, Dong, Hemmer, & Durning, 2014). The adaptation of the individual to the environment, as well as management of an evolving clinical problem, relies on metacognition and self-regulation, specifically the appropriate switching from non-analytical to analytical processing, when one begins experiencing uncertainty or when the diagnosis appears to be inconsistent with the evolving clinical situation.

Finally, current methods for giving feedback following teaching activities have limited evidence for their effectiveness in improving skill and changing behaviour in making a clinical diagnosis. Although feedback is an essential component of any learning process, feedback following teaching around

making a clinical diagnosis can over-emphasise whether learners achieve particular tasks or not (such as whether they have asked specific questions in the history), but under-report the demonstration of self-regulatory processes such as strategy selection or self-monitoring that are necessary for successful outcomes. There is a tendency to only provide learners with feedback comprising a list of behaviours that were observed during the task (such as the use of basic knowledge or the use of checklists) (Butler & Winne, 1995; Hattie & Timperley, 2007). However this feedback alone when the task is making a diagnosis is insufficient for improving diagnostic performance. Effective feedback requires essential information about the self-regulatory processes demonstrated around the making of a diagnosis as well as an appraisal of 'self-factors' (such as self-efficacy beliefs) that are associated with the actual performance of the task (Durning et al., 2011; Langendyk, 2006).

In summary, medical educators require a practical model for teaching students or doctors how to make a clinical diagnosis which recognises the complexity of the authentic 'real-world' task as well as providing a framework for gathering information about performance on the task and generating effective feedback for learners.

The foundations of a new trans-theoretical educational model for teaching how to make an appropriate clinical diagnosis

We propose a new trans-theoretical educational model for teaching how to make an appropriate diagnosis in an authentic clinical context. The aim of this new model is to provide a pragmatic approach that draws on different, but complementary theories, and provides a richer understanding of making an appropriate clinical diagnosis in the "real world" workplace. This new trans-theoretical model integrates key insights from situativity theory, dual-information processing theory and social-cognitive theories.

A new definition of clinical diagnostic decision-making (CDDM) is proposed which highlights how making a clinical diagnosis is a delineated task with a clearly defined performance outcome. This outcome is the first step in the management of a patient such as requesting further investigations or observing the patient as part of a 'watch and wait' strategy. In all of the possible outcomes to making a diagnosis, formulating a working diagnosis initiates a management cascade underpinned by the doctor's reasoning processes. Therefore, observing individuals perform CDDM provides an opportunity for teachers to understand what reasoning processes are being used, or not being used, by the learner when making the clinical working diagnosis in an authentic context, such as when there is uncertainty or numerous distractors. These observations can also identify how essential self-regulation processes are being used to ensure that individual and environmental factors are appropriately modified to achieve the clinical working diagnosis. Insights from these observations form the basis of the feedback given to individuals in the form of instructions for improving future performance.

The CDDM definition recognises that making a working diagnosis for the clinical presentation is iterative and likely to change as new information becomes available or the clinical problems evolves with the passage of time. The changing nature and temporal aspect of CDDM leads to further iterative cycles of the process, but each cycle remains a defined task providing opportunities for giving feedback.

The assessment of outcomes from the CDDM process require a teacher to use expert opinion and decide whether the novice (undergraduate or postgraduate) has appropriate judgment during the reasoning process as well as whether they have reached a satisfactory outcome. Applying judgment and reaching an appropriate outcome for and with the patient are essential for complex real-life CDDM.

The theories integrated in the model are now described in greater detail:

(a) Situativity theory

Situativity theory is an amalgam of three complementary perspectives (situated cognition, ecological psychology and distributed cognition) that recognise the importance of knowledge, thinking and learning occurring from "real world" experience. There is a need to locate teaching and learning of CDDM in the real world from a situated perspective since the complexity of the evolving problem and uncertainty within the task cannot be replicated outside of this context. Environmental factors (such as loud noises, time pressures or other distractions) as well as individual factors (such as anxiety or self-efficacy beliefs) affect real-world CDDM, therefore teaching and learning activities need to also provide opportunities for novices to experience these challenges. Error frequently occurs when affective changes and cognitive overload effect the CDDM process (Croskerry, 2009; R. Mayer, 2005; R. E. Mayer, 2010), therefore practicing CDDM in the 'real world' within an authentic context for making a clinical diagnosis that influences patient management is an important part of training.

(b) Dual information processing

Dual-information processing theory suggests that two cognitive processing pathways are used for CDDM and that these are separate, but complementary, for making a clinical diagnosis.

One pathway involves non-analytical reasoning and this strategy results in rapid CDDM based on fast access to illness scripts located in memory (Schmidt & Rikers, 2007). These illness scripts are refined over time as the individual comes into contact with the disease in daily life and their quick retrieval is trigger by intuitive or inductive reasoning. This pathway requires little cognitive effort and is therefore the pathway of choice for experts performing CDDM, such as acutely unwell children in the community presenting for medical attention(Van den Bruel et al., 2012).

The other pathway involves analytical reasoning and this approach results in slower CDDM since it is reliant on an integration and subsequent appraisal of information from a range of different sources. This processing is logical, relying on deductive reasoning and critical thinking. This pathway requires

cognitive effort and is therefore the pathway of choice in situations of uncertainty or difficulty.

Non-analytical processing is instinctively triggered in both novices and experts after the presentation of a clinical problem(Balla, Heneghan, Glasziou, Thompson, & Balla, 2009), however experts are more likely to be sensitive to its limitations and change strategy when required during the process of clinical enquiry. Novices are less aware of the tendency for this strategy to error and its limitations due to cognitive biases. Therefore managing the risk associated this powerful and effective but error-prone form of CDDM is an important skill to teach novices.

The conscious switch between non-analytical and analytical processing in the setting of uncertainty or potential error is reliant on metacognitive processes, as is the regulation of the external influences on CDDM, such stress, hunger or tiredness(Pottier et al., 2013). Experts become more aware for the need to switch processing pathways through their development of metacognitive awareness, that is “thinking about their thinking” process. Moving from non-analytical reasoning towards a more analytical approach is essential for CDDM in situations which are error-prone or situations of uncertainty so that harm to patients can be avoided.

The driver for focusing attention or switching strategy from non-analytical reasoning towards a more analytical approach is often instinctive (often called “intuition”) and is triggered by an awareness of a feeling or emotion, such as uncertainty (‘*this presentation is not making sense*’). These emotions are crucial for experts since they safeguard them from acting in unfamiliar situations or exposing themselves and their patients to danger. The development of intuition in experts is achieved by clinical experience in which there are repeated clinical encounters and continuous refinement of illness scripts, enabling experts to very quickly become aware that the clinical presentation does not fit with their mental store of previous encounters . Opportunities to teach or learn these switch points are an important part of training and for the development of expertise in CDDM since discussing these points in the clinical enquiry may help novices understand how experts cope with external influences, such as pressure or uncertainty during CDDM.

However, teaching analytical methods or templates for CDDM still remains important to develop the knowledge structures of novices and to provide a safe means for learners to engage in clinical problem-solving or decision-making in the absence of clinical experience. Inevitably novices move towards developing expertise with every clinical contact, therefore the recognition by educators that novices make the transition from exclusively using analytical reasoning to a blend of both non-analytical and analytical approaches soon after starting their training is important for formulating appropriate feedback. For these individuals, feedback should include information about their performance in relation to the presenting clinical problem but also include sufficient information about how and when they make a switch between non-analytical to analytical reasoning. Useful approaches to help learners become more aware of when to switch include developing a self-awareness of their emotions, such as through mindfulness training, and making conscious steps to check whether they are on the right track during the CDDM process.

(c) Socio-cognitive

Socio-cognitive theories recognise that knowledge acquisition and learning occurs as a consequence of the constant interplay between people, the environment and their behaviours. An essential aspect of socio-cognitive theory is the role of self-regulation, which is when individuals dynamically adjust their behaviours in response to changes in the environment or when there is a change in the way that they think and feel about the task.

Socio-cognitive theorists argue that effective self-regulation around a task involves planning beforehand, monitoring during and adaption for the next attempt afterwards. Although Zimmerman (2001) presents a model for self-regulation derived from educational theory, this model also helps to make explicit the thinking experts naturally do around a clinical task (Zimmerman & Schunk, 2001). The self-regulation model allows experts to communicate with novices exactly what their rationale may be for approaching a given clinical problem and this is especially important when experts may struggle to make their thinking or reasoning explicit. For example, effective self-regulation when managing a cardiac-arrest involves clear goal-setting (such as securing a definitive airway or ensuring safe-defibrillation) and strategic planning (such as following the Advanced Life Support (ALS) algorithm when the patient is in cardiac arrest) before the task begins. In addition, the ability to think through and correct reversible causes of cardiac arrest whilst cardiopulmonary resuscitation is ongoing is also dependent on accurate self-monitoring during the task, which is a metacognitive process. Finally, the integration of external feedback from the cardiac arrest team and internal self-generated feedback is essential for self-reflection after an arrest.

Self-regulation models are widely used in education for understanding and providing feedback on performance during a given task. Interviewing methods (e.g. microanalysis) based on the model obtain additional useful information about self-efficacy and attributional beliefs. Self-efficacy beliefs are highly specific judgements about one's capabilities to perform specific acts in a particular situation (Cleary & Zimmerman, 2001; Cleary, Zimmerman, & Keating, 2006; Wigfield & Eccles, 2000). Attributional beliefs relate to the reasons given by individuals for success or failure on a task. Researchers have shown that when students struggle to succeed or when they encounter challenges during learning, those who make internal and controllable attributions, such as effort and strategy use, tend to be high achieving and adaptive in their persistence and use of strategies in response to the task (Cleary & Zimmerman, 2001; Cleary et al., 2006). Information for teachers obtained from microanalysis about perceived self-belief or causal attributions before and after a given task can be used to enhance the quality of feedback given to learners.

Using the new trans-theoretical educational model for teaching how to make an appropriate clinical diagnosis

The new trans-theoretical model for CDDM that we propose draws together the aspects of making a clinical diagnosis in a way, which preserves the key considerations for teachers wanting to develop this competence among learners. The model is presented in Figure 2.

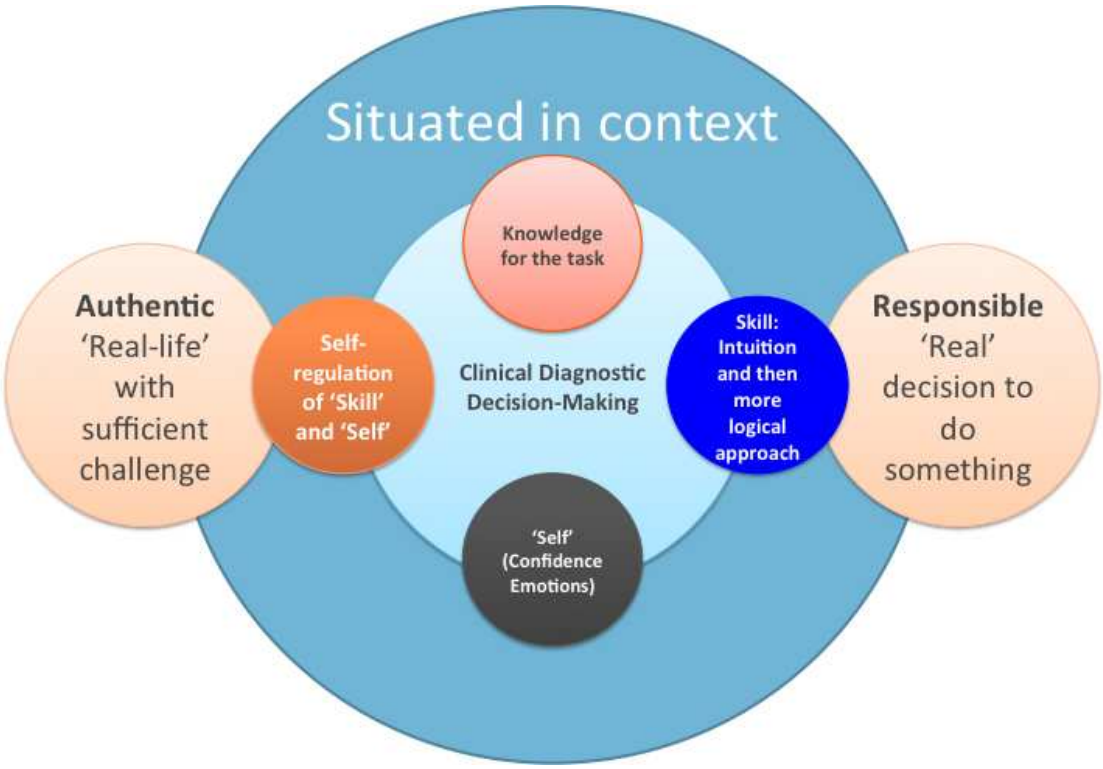


Figure 2 A trans-theoretical model for clinical diagnostic decision-making

The main components of the model are now described:

Situated in a context that is authentic, with sufficient real –life challenge, and in which there is a responsibility to make a decision

The context provides an "envelope" within which all of the other components occur. An essential aspect of making a diagnosis is that there is a real diagnostic task (as opposed to a paper-based exercise) and it is situated in a "real-world" context, with all the complexity that can influence appropriate decision-making. Furthermore, the task has some form of responsibility for their actions (as opposed to a paper-based exercise).

Four key factors that influence the outcome of CDDM

In the proposed new model, the outcome of CDDM is affected by four factors in particular: (1) knowledge for the task, (2) the "skill" of using both non-analytical and analytical processes (3) the role of "self", such as self-efficacy beliefs and emotions created by the environment, and (4) the self-regulation of both the "skill" and "self" to achieve the task.

We will illustrate the influence of these four factors in Figure 3 using the clinical presentation of shortness of breath associated with cough, fatigue, anorexia and weight loss in a 75-year-old man.

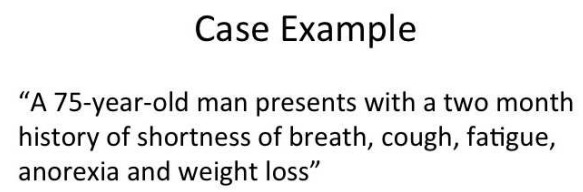


Figure 3 Case Example

1) Knowledge for the task

Knowledge required for the task refers to the content or subject-matter required for successful completion of the CDDM task, that is making an appropriate clinical diagnosis. To make an appropriate clinical diagnosis for the presentation described in Figure 3, knowledge is required about the normal structure and function of major organ systems as well as the pathological processes which present with shortness of breath, cough, fatigue, anorexia and weight loss. Knowledge about the technique for history-taking, physical examination and the rest of the clinical enquiry is also needed to proceed with managing the clinical problem.

2) Skill: Intuition and then a more logical approach

The skill required to successfully complete a CDDM task requires the clinician to correctly apply subject-matter knowledge to a presenting problem. CDDM requires the clinician to use non-analytic and analytic approaches appropriately so that a non-analytic approach (intuition) is used when there is familiarity with the presentation and an analytic approach is used when there is unfamiliarity or a lack of experience with the clinical problem.

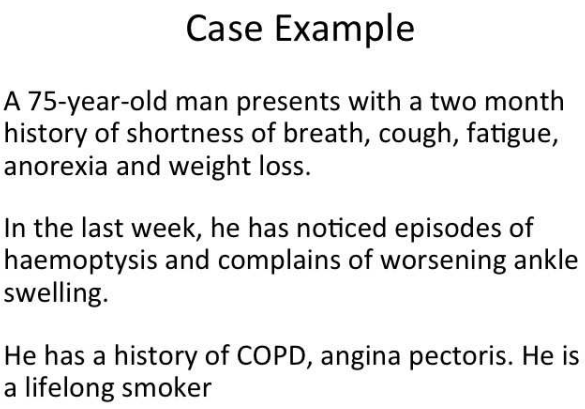


Figure 4 Case Example

The information in Figure 4 presented to experts triggers an intuitive approach guided by an illness script retrieved from clinical memory. The specific illness script contains schema for managing diseases causing shortness of breath and cough as well as weight loss and anorexia. A possible diagnosis may be

lung cancer, hence the approach to clinical enquiry will involve confirming or refuting this hypothesis.

Experts will continue using intuition as long as the actual clinical course correlates with the expected one as suggested by the illness script, however may need to "switch" strategy and use an analytic approach in the event "something doesn't fit".

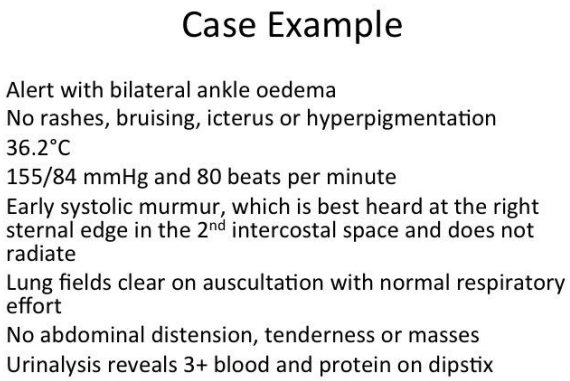


Figure 5 Case Example

The examination findings in Figure 5 are consistent with a diagnosis of lung cancer except the presence of blood and protein on dipstix suggest this may not be the case. Any deviation from an exemplar illness script represents an opportunity to 'switch' strategies and prompt a decision as to whether continuing down an 'intuitive' path remains appropriate.

Although intuition may suggest a diagnosis of lung cancer in this case example, the urinalysis finding is inconsistent and introduces the differential of small-vessel vasculitis as a possible alternative.

Unfamiliarity with presentation, or difficulty interpreting information emerging from the clinical enquiry, also represents opportunities to switch strategy to a more analytical approach for verifying or refuting alternative possibilities.

3) Self (Confidence and emotion)

"Self" refers to individual factors that influence performance on a given CDDM task. Self-efficacy beliefs are particular important since self-confidence on the task is associated with successful outcome. The evolving presentation in Figure 4 may cause self-efficacy levels to fall in novices but this may occur in some "experts" who are unfamiliar with how to interpret the information in light of their working hypotheses. A drop in self-efficacy can affect outcome on the CDDM task since individuals are more likely to use intuition(Croskerry, Abbass, & Wu, 2008) in response to the increase in cognitive demand and the perceived threat to their psychological well-being.

The influence of emotions created by the environment can also influence performance on the CDDM task. For example, the sight of people coughing up blood may evoke emotions such as anxiety or panic. This may cause

greater reliance on intuition, with the consequence that it can impair judgment around when to switch to a more appropriate analytic approach to CDDM.

4) Self-regulation of Skill and Self

The self-regulation of both 'skill' and 'self' is essential to maintain clinical vigilance and safeguard patient safety. Self-regulation of "skill" during the CDDM task involves monitoring the anticipated and actual clinical problem for anything that does not "fit the clinical picture", since at these times it is essential to ensure that the most appropriate approach (non-analytic or analytic) for that particular point in the clinical enquiry is being used.

Depending on whether the clinician considered lung cancer to be the most likely diagnosis, appropriate self-regulation would involve recognition of the inconsistency with emergent clinical findings and this should provoke a switch to a more careful search for other plausible diagnoses. Equally, appropriate self-regulation would involve actively seeking the urinalysis result to confirm the appropriateness to proceed with intuition in the event the clinician considered the presentation to be small vessel vasculitis from the outset.

Self-regulation of "self" would also be required to monitor and control the potential impact of environmental factors on CDDM, such as the anxiety provoked by the sight of coughing up blood.

In summary, the outcome of CDDM in the example case of the 75-year-old man who presents with shortness of breath, cough, fatigue, anorexia and weight loss is affected by four factors: (1) the clinician's knowledge in the clinical domain of the presenting complaint (2) the clinician's ability to appropriately use non-analytical and analytical processes for making a diagnosis (3) the clinician's self-efficacy beliefs and management of 'self' in the working environment and (4) the self-regulation of both the CDDM process and self before, during and after the task. Feedback for learners attempting to learn how to make a diagnosis for this case presentation require information in all four areas for improving their performance on future cases.

Teaching clinical diagnostic decision-making process using the trans-theoretical model

In this section, we will describe how to practically teach CDDM by using the trans-theoretical model. The first phase is to identify the four key factors and the second phase is to provide feedback to the learner about the extent to which they use, or do not use, the processes in each of the four factors. A discussion of the principles of feedback is beyond the remit of this Guide and readers are referred to appropriate literature(Ramani & Krackov, 2012).

(a) Initial conditions for teaching CDDM

Before medical educators begin to identify the four factors used by students in the process of CDDM, it is essential to consider some important aspects that can influence the interpretation of the performance demonstrated by learners during CDDM. Using the model described in Figure 2, medical educators need to ensure that the CDDM task is appropriately situated in a context that has a 'real-world' task such as real clinical practice instead of paper-based or computer-assisted approaches with linear case presentations. Also, medical educators should have some awareness beforehand about the learner's level of expertise in CDDM and the clinical problems since the task needs to be of sufficient challenge in order for CDDM processes to be demonstrable or amenable to identification. Lastly, medical educators need to create activities that require the learner to be responsible for doing something otherwise there are no consequences for the learner on task and the 'real-world' challenge of CDDM is lost. This can be achieved by asking learners to take responsibility for making a clinical decision (such as by asking "how would you manage this patient?") instead of a paper-based case in which making a diagnosis has a more "sterile" end point, such as "what are the differential diagnoses?".

(b) Identification and feedback of the four key factors used in CDDM

We propose that Mapping and SRL-Microanalysis (Durning et al., 2011) are particularly effective teaching approaches to identify information and provide feedback about the use of the four key factors that are essential for CDDM – (1) knowledge for the task, (2) the "skill" of using both intuition and analytical processes (3) the role of "self", such as self-efficacy beliefs and emotions created by the environment, and (4) the self-regulation of both the "skill" and "self". Using a combination of information from mapping, microanalysis and the observations from experts whilst the learner performs an authentic CDDM task provides a "rich" interpretation of a learner's CDDM ability compared with self-reported clinical reasoning questionnaires (Bordage, Grant, & Marsden, 1990) or retrospective case reviews (Graber et al., 2005) alone.

Mapping

In the absence of a method that detects real time information-processing(Norman & Eva, 2010), various 'think-aloud' protocols can yield some useful information about the likely cognitive approach taken during a stage of the clinical enquiry (Boshuizen & Schmidt, 1992; Patel & Groen, 1986; Patel, Evans, & Groen, 1989; van de Wiel, Boshuizen, Schmidt, & Schaper, 1999) that can be used for giving feedback to learners.

A cognitive map is a physical representation of the thought process recalled by the learner that may help teachers make better sense of the CDDM process or errors made the learners (All & Havens, 1997; Clayton, 2006). It is a useful technique for gathering information about (1) knowledge for the task, and (2) the "skill" of using both intuition and analytical processes. Whereas checklists identify whether a completed task was observed or not, maps can

highlight the intended and actual actions made by learners, enabling more accurate feedback to be given to learner about their CDDM.

Mapping involves tracing the pathway taken by a learner during a task using information collected at defined stages of the clinical enquiry, such as the questions asked during history-taking or the clinical techniques performed by the learner during physical examination. The information may be represented visually as a series of themes on a concept map or causal links on a cognitive map if structured questioning about the cause and consequence of CDDM actions are explored by the observer (Eden, 1988).

The order in which learners say things aloud may not represent the order in which they think through or reflect on their actions, therefore annotating statements verbatim on the map in real-time is important. The placement of causal links between concepts in collaboration with learners is essential for validating maps and ensuring the chain of thought is faithfully represented on the map. The output is a co-constructed cognitive map detailing the learner's abstraction of the clinical problem at that point in the clinical enquiry.

Mapping CDDM is useful for demonstrating deviation from experts as well as peers and also helps learners calibrate their self-perceived performance with their actual performance compared to others. Mapping provides valuable information about situations that provoke uncertainty and dilemmas among learners. The maps enable a conversation between teacher and learner about the choice of strategy used by the learner, either non-analytical or analytical, especially where the approach was associated with error. The maps also provide an opportunity for learners to reflect over possible switch points in the clinical enquiry where alternative approaches for CDDM may have been appropriate.

Mapping can take place prior to a stage of the clinical enquiry as well as during the stage as shown in **Error! Reference source not found.**. Prior to a given stage in the clinical enquiry, mapping is essentially an active dialogue between teacher and learner to explore assumptions and clarify intentions prior to embarking on the CDDM task.

SRL Microanalysis

Microanalysis identifies the key self-regulated learning (SRL) processes that are used by a learner as they approach an authentic task (Cleary & Sandars, 2011). A series of targeted questions before, during and after a CDDM task is used to identify information from the learner about their planning, monitoring and adaption following performance on the CDDM task (Durning et al., 2011). Microanalysis is undertaken in real-time and in situations where the learner would authentically undertake the task. Microanalysis also involves observing the individual to see what CDDM processes are being demonstrated and whether these lead to appropriate performance outcomes.

SRL Microanalysis during CDDM can be very useful for evaluating the appropriateness of self-regulation around potential switch points, such as a change in the complexity of a clinical problem in which there is presentation of new clinical information or a change in the expected clinical course. Important information about CDDM can also be obtained from microanalysis about the appropriate changes that are required in the strategies that the learner is

using to make a diagnosis, such as a change in the focus of history or clinical examination, a switch from intuition to analytical or an alteration in the level of self-efficacy.

The main components of microanalysis are:

Before the task

Questions prior to the learner embarking on the CDDM task can identify:

- information about perceived self-efficacy in dealing with the CDDM task
- recognition of the existence and possible impact of environmental or self- factors that may affect their CDDM performance
- information about the choice of goals and strategies to achieve an appropriate diagnosis, including both the use of non-analytic and analytic approaches and the focus of history taking and examination skills

During the task

Questions asked during the CDDM task can identify:

- use of clinical knowledge by the learner
- appropriateness of strategies (including intuition or analytical and history or examination skills) for the CDDM task.

These responses can be used to interpret the appropriateness of the chosen strategy selection and the extent of self-monitoring whilst performing the task and the impact of distractors on the whether the outcomes of the CDDM are appropriate for the clinical presentation, as observed by the experienced teacher.

After the task

Questions asked after the CDDM task can identify:

- self-awareness of individuals about correct outcomes
- changes in self-efficacy as a result of undertaking the CDDM task.
- attributional beliefs of the learner, giving teachers an important insight into the appropriate calibration between the confidence and competence of the learner. This information about calibration is essential when providing feedback since learners may be over-confident about their performance (Kruger & Dunning, 1999).

This post-task information can also be used for predicting performance on future tasks and offers an opportunity for discussing any requirements for improvement if necessary.

The relative merits of Mapping and SRL Microanalysis

The merits of mapping and SRL microanalysis rest on the strength of both methods to identify information about the clinical knowledge demonstrated by the learner during the CDDM task as well as information about the skill or approach for CDDM during a stage in clinical enquiry.

Mapping has the potential to explore the breadth and depth of clinical knowledge possessed by the learner in greater detail since there is opportunity to do this during each stage of the clinical enquiry. Despite this opportunity, mapping may be subject to hindsight bias, which may be overcome by the use of microanalysis.

Microanalysis has the potential to explore self-regulation around particular points of sufficient challenge and has the advantage that it is used during the actual CDDM task. Although the microanalytic approach may not be appropriate for real world clinical practice, this may have significant utility for novices in the learning environment.

The use of mapping and SRL microanalysis allows medical educators to triangulate information about performance more accurately and present the learner with a list of processes were or were not demonstrated during their CDDM. Both approaches offer useful and practical methods for identifying key processes undertaken during CDDM in authentic situations and may better understand the probable reasons for success or failure on the task by helping to provide better feedback on performance to the learner.

Applying Mapping and SRL Microanalysis to CDDM within a clinical enquiry

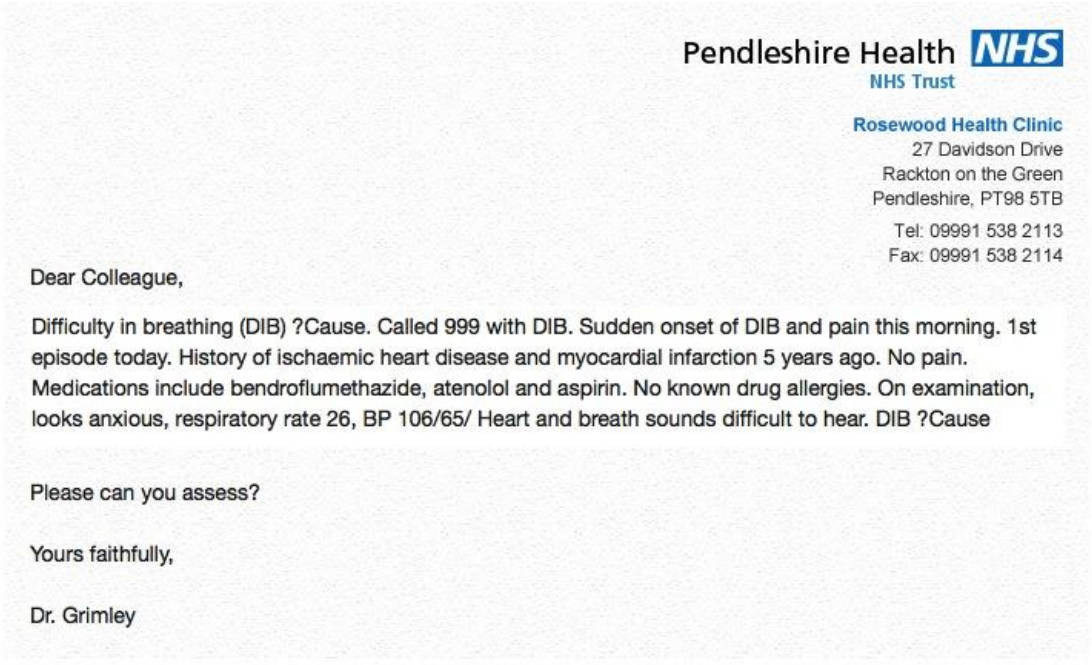
Mapping and SRL microanalysis can be undertaken around CDDM tasks within an authentic clinical enquiry on real patients but they can also be used in sophisticated simulated situations, including some virtual patients generated using software allowing global navigation to represent the complexity of real-life CDDM (such as www.le.ac.uk/badger). Natural points within the clinical enquiry for conducting mapping and SRL microanalysis are shown in Figure 6.

Mapping during a given stage of the clinical enquiry should be a passive process whereby the teacher allows the learner to proceed through the stage of the clinical enquiry without interruption. Certain stages of the clinical enquiry such as history-taking and physical examination in an authentic context preclude teachers from interjecting since learners are interacting with patients. Tracking or tracing the sequence of events taken by a learner onto a map allow teachers to triangulate intended actions with actual actions, thereby providing more meaningful feedback.

Figure 6 demonstrates how mapping and SRL microanalysis is applied to a particular stage of the clinical enquiry such as history-taking stage.

Illustration of putting the new trans-theoretical educational model into practice to teach clinical diagnostic decision-making

A clinical problem is presented using a web-based virtual patient that facilitates an open–ended exploration and discovery of the patient's complaints (Ellaway & Masters, 2008) to demonstrate how mapping and SRL-microanalysis can be used to gather information about CDDM from the history-taking stage of the clinical enquiry. This type of computer-based approach is closer to a real life situation since learners are permitted to complete the task without any restriction or pre-determined pathway.



Pendleshire Health NHS
NHS Trust

Rosewood Health Clinic
27 Davidson Drive
Rackton on the Green
Pendleshire, PT98 5TB
Tel: 09991 538 2113
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Dear Colleague,

Difficulty in breathing (DIB) ?Cause. Called 999 with DIB. Sudden onset of DIB and pain this morning. 1st episode today. History of ischaemic heart disease and myocardial infarction 5 years ago. No pain. Medications include bendroflumethazide, atenolol and aspirin. No known drug allergies. On examination, looks anxious, respiratory rate 26, BP 106/65/ Heart and breath sounds difficult to hear. DIB ?Cause

Please can you assess?

Yours faithfully,

Dr. Grimley

Figure 7 An ambulance sheet listing information about a patient presenting with difficulty in breathing (DIB)

The case presentation is shown to the learner before starting mapping or microanalysis to trigger CDDM processes and retrieval of relevant illness scripts from clinical memory, if present. Novices may attempt to use mnemonics or sieves in the absence of clinical experience or unfamiliarity with the case presentation.

After enough time has elapsed allowing the learner to make sense of the presented information, microanalysis can be used to gain an understanding about how the learner intends to approach the CDDM task. Specific questions are asked to identify perceived self-efficacy for successfully completing the CDDM task as well as gain information about goal-setting, strategic planning and knowledge for the CDDM task. See Figure 8 for an illustrative response

> 1. How confident are you that you can manage the case presentation? Please indicate your confidence on this rating scale
>
> 0_____10_____**40**_____70_____100
>
> 2. What are you thinking about as you prepare yourself to take a history?
>
> *I am asking myself to work out what the main points are so I will start to look for information about the case such as difficulty in breathing is the presenting complaint. From the GP letter, it looks as though this is the first episode and so I will use the information to generate an idea of what systems might be involved. I think the cardiac system may be a cause of the problem given the patient's previous history of heart*

disease. Given that difficulty in breathing is the presenting complaint, I suspect the respiratory system could also be a problem.

3. Do you have any goals in mind? If so, what are they?

To focus on the respiratory and cardiac systems in the first instance but I plan to ask open questions at the start of the history. I also want to use the patient's own words when asking questions at the start of the history. I want to cover important things which need to be covered in the history afterwards using a structure for my questions in the same way I do when asking about 'chest pain'. I noticed the patient has a high respiratory rate so I am considering that this is an acute problem that needs to be dealt with quite quickly. I'll need to get on with seeing the patient and getting a cause for the presentation.

4. What do you need to do to successfully complete your history-taking?

One of the main things is to make sure I avoid taking a history for the diagnosis that I want to find, but actually for what is there in the patient. I want to determine the areas where I need to progress things further in the later stages of the clinical enquiry as well as get on with the things which need doing for the patient sooner rather than later.

5. Do you have a particular approach you will follow?

I will ask what the problem is without putting words into the patient's mouth. I'll use the patient's own words to ask this question at the start of the history. I want to distinguish early on whether the problem is actually difficulty in breathing (DIB) or the patient can't breathe because of the chest pain. I'll also enquire that if its DIB, then when "it" started before asking how the DIB feels. I'll ask these questions in a structured way before going on to cover important things that need to be asked in the history afterwards. After asking these questions, I'll pick out features that help solve the problem and ignore the irrelevant information in order to formulate a list of differentials which might be involved in the presentation

Figure 8 Illustrative microanalysis answers to "Before the task" questions

An example of a cognitive map for a learners as they prepare to start the clinical enquiry are shown in Figure 9. This map demonstrates:

- The questions planned of the patient were intended to explore the presenting complaint and generate a mental image of the body system responsible for the patient's presentation (e.g. "*generate an idea as to what systems might be involved*")
- The history planned and posed predominantly aimed to verify or clarify aspects of the presentation so further problem-solving could take place in the history and later stages of the clinical enquiry (e.g. "*enquire if 'it' has changed since it started*" and "*evaluate whether this a long term problem with a sudden exacerbation*")

- The focus was on avoiding unconscious processing or biases that may negatively affect clinical reasoning at the start and during the clinical enquiry such as "*use patient's own words to ask this question at the start*" and "*avoid putting words in the patient's mouth"*
- There was a significant amount of attention placed on the process of problem-solving and decision-making rather than reaching the outcomes and only coming up with a diagnosis such as "*distinguish actual DIB with can't breathe due to chest pain*" and "*consider different causes from presentation depending on the time period*"

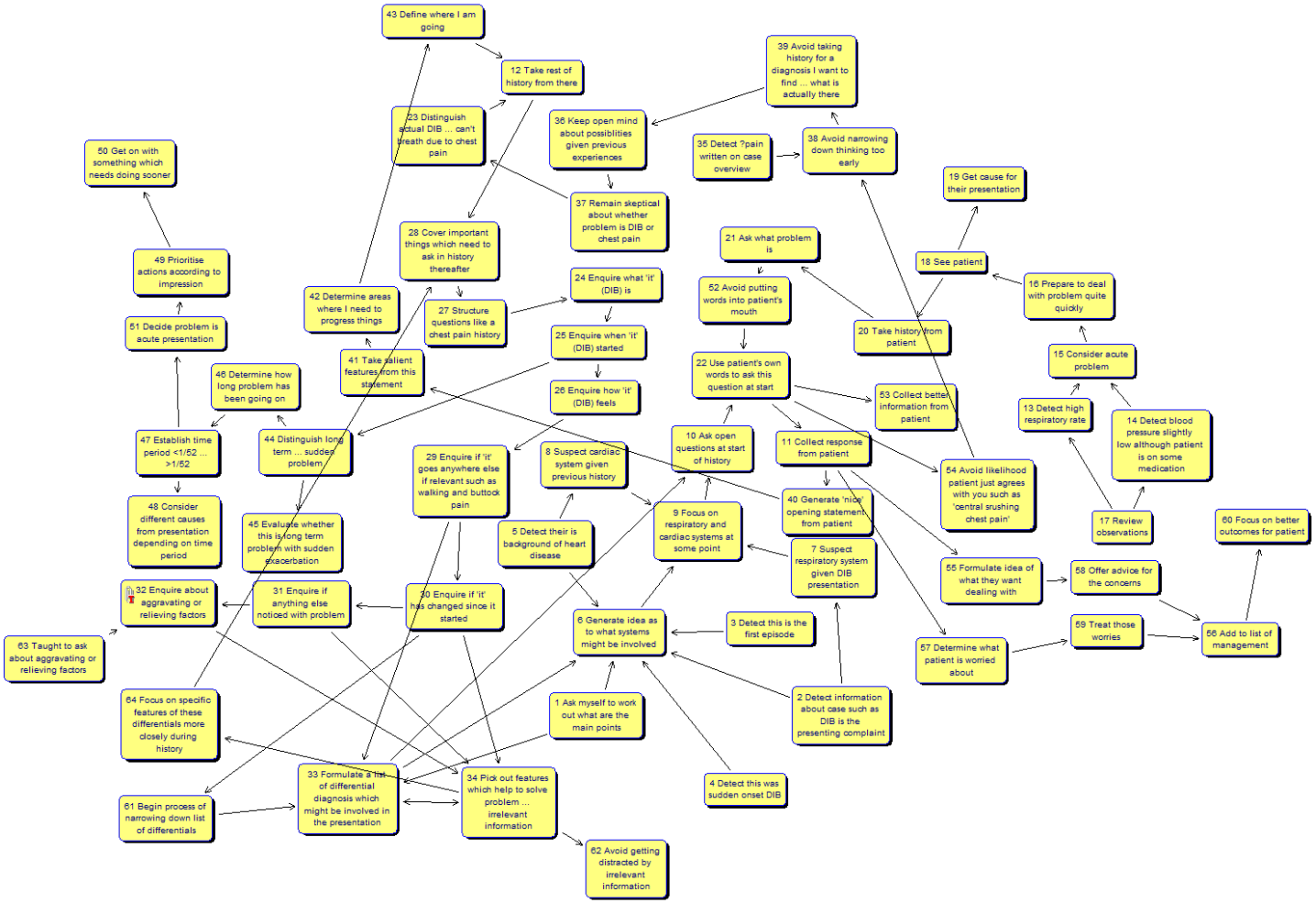

Figure 9 A map of the cause and consequence of actions at the start of the clinical enquiry for Learner 2 following cognitive mapping

The tracking of the pathway taken by the learner is presented in Figure 10.

Questions posed by the learner	Responses from patient
Tell me a little more about your chest pain	I haven't had any chest pain that I can recall.
Have you noticed any palpitations?	I sometimes feel as though my heart is beating fast but that doesn't happen very often.
Tell me a little more about your shortness of breath	I've felt really breathless in the past few days. It was really bad overnight. I couldn't breath. It was horrible.
What about breathlessness with exercise?	Well if I decide to try to walk anywhere that is of great distance, I have to stop along the way. I rest for about five minutes, by which time my breathing comes back to normal.
Do you every get breathless when you are not doing anything in particular?	Usually I don't get short of breath when I'm not doing anything, But this week I've noticed that I get short of breath when I'm not doing anything at all.
Are you able to complete a full sentence during conversation when you get breathless?	I'm just about able to talk to you now but it's a bit of a struggle.
Do you get breathless lying flat?	I have to sleep on three pillows. I can't lie flat. I've only had to do this for the past few years. Recently, I've preferred to rest in a chair if I'm being honest.
What makes the breathlessness better or worse?	If I do anything too strenuous, then the breathlessness comes on.
What about breathlessness if you lie flat?	I have to sleep on three pillows. I can't lie flat. I've only had to do this for the past few years. Recently, I've preferred to rest in a chair if I'm being honest.
Do you get any pain in the back of your calves when you walk?	It's the breathing that's more of a problem, not any pain in my calves or buttocks when I walk.
Do you have any ankle swelling at the moment	Oh my ankles are terrible now. They've been a lot worse in this past week. I've told my doctor but he doesn't think they are too bad. The district nurse told me to keep them up when she used to come round so I've tried to do that this week.
Do you cough regularly?	I've had a cough as well, especially at night. It's a dry cough and nothing seems to come up with it.
Have you coughed up any phlegm or blood?	I haven't coughed up any phlegm or blood. As I said, the cough is annoying and I don't seem to be bringing anything up with it.
Do you normally get wheezy?	When I get really breathless I can hear my breathing but I'm not sure if that is wheeze or not.
Have you noticed any change in your appearance?	There hasn't been a noticeable change in my appearance over the past few weeks.
What about any change in your weight?	I may have put on a little weight actually. I definitely haven't lost any unfortunately.
Have you had a fever recently?	I haven't felt a temperature. Not one that I can recall.
Have noticed any changes in your urine such as the presence of blood?	I have never seen any blood in my urine.

What can you tell me about how much urine you pass in a day or overnight?	There hasn't been any change in the amount of urine I pass at any one go I don't think. Can't say it's something I take much notice about.
What medication are you currently taking?	Aspirin 75 mg once a day, Atenolol 25 mg once a day, Bendroflumethazide 2.5 mg once a day, Felodipine 2.5mg once a day and Atorvastatin 20 mg once at night.
Tell me about any over-the-counter medication you may being taking?	Only paracetamol and occasionally some ibuprofen if the back pain starts playing up
Are you allergic to anything?	I'm not allergic to anything.
What medical problems have you had in the past and please can you tell me about any operations as well?	Well I've got cataracts and am waiting to have those done. I've got arthritis in hands, my hips and my back. I had a heart attack 5 years ago. They kept me in for five days and let me go. Other than that, I see my GP because my blood pressure is a bit high. That's about it.
Can you tell of any major illnesses or conditions that run in your family?	My brother is in his 80's and has got high blood pressure and my sister is one year younger than me and has no problems. I've got three children who have all moved away and have their kids. As far as I am aware, there isn't anything that they have that runs in families.
What was your main job or jobs when you were working?	I'm retired now. I used to work on the railways when I was younger. I also own my own shop selling bread and then finished off working in a factory.
Are you married?	I've been married nearly 40 years. My wife is on her way in.
Can you tell me a little more about where you live and the type of accommodation you have?	I live in a bungalow. Stairs were getting difficult to manage.
Do you smoke or have you ever smoked?	I used to smoke but packed it in after the heart attack. Before that a smoked about 10 a day for 30 years. I've never been a heavy smoker.
What impact has the breathlessness had on you getting in and out of bed?	I manage to get in and out of the bed without too much trouble.
Has the breathlessness affected your ability to have a wash?	I do this for myself too. I have a walk-in shower so it's not too difficult to get a decent wash.
Has the breathlessness affected your ability to cook meals?	My wife still manages to do the cooking for the both of us. She's ever so good!
What would you like to happen as a result of coming into hospital today?	If you could just make my breathing a little easier and less uncomfortable I'd be grateful for your help.

Figure 10 Mapping of the pathway taken by the during the history-taking stage of the clinical enquiry

The pathway through the case taken by the learner in Figure 10 demonstrates:

- A logical approach to questioning with probing around the shortness of breath and chest pain reported by the patient
- Specific questioning around symptoms such as shortness of breath and chest pain at the start of history-taking given the patient presented as an emergency

- Satisfactory elaboration of symptoms such as shortness of breath and chest pain to allow meaningful differentiation between possible diagnoses for the case presentation
- Attempted verification and open exploration of the presenting complaint from the outset of history-taking process
- Few omissions in the history-taking with sufficient exploration into the social circumstances of the patient given the emergency nature of the presentation.

SRL Microanalysis has flexibility for probing learners and generating information about the thinking of the individual during a task. Figure 11 shows some questions and illustrative answers that can be posed to learners to explore their self-monitoring on a task in the event they have been sufficiently challenged and are struggling or performing well on task. This questioning can be useful for clinical teachers since the responses from can be used to generate specific feedback about the observed behaviours associated with individuals struggling or performing well on a task.

1. Do you think you have done everything correctly until now or have you made any mistakes?

   I think I have done everything I needed to up until this point of the clinical enquiry. I am considering heart failure as the most likely explanation for the this presentation since the patient complains of breathlessness, ankle swelling that has got worse in the recent past, an increase in weight and needing to sleep on three pillows. He also has a history of heart disease and has smoked in the past.

   a. Why do you think you are finding this straightforward/difficult?

   Up to this point, I've tried to consider all the possibilities that could be causing the patient to come into hospital. Although the symptoms are consistent with a possible diagnosis of heart failure, I have tried to keep my list of differentials wide at this stage. I tried to clarify the circumstances of the chest pain and breathlessness as well as any other symptoms that may have been present at the time. I also asked about general symptoms to explore what else has been going on at the same time.

   b. What do you need to do when you return back to the clinical enquiry?

   I will start by doing a cardiovascular examination to ascertain a number of things. Firstly I need to look for any features that infer I need to something about things now otherwise I just need to be aware of things that I need to attend to at some point in the future. Then I need to look for features of heart failure so explore for the presence of swollen ankles or a gallop rhythm, both of which are associated heart failure. I'd also look for the present of crackle in the chest or any other abnormalities of the heart sounds which would also infer the heart wasn't pumping correctly and a column of blood was sat behind it

waiting to get into the heart. At the same time I would also consider other possibilities as differentials examining for the presence of incidental findings. I would keep renal or hepatic problems in mind as well given the combination of difficulty in breathing as well as swollen ankles.

Figure 11 Microanalysis answers from the learner to "During the task" questions

SRL Microanalysis is also performed at the end of a task to explore learner self-perceptions about success or failure on task, satisfaction with performance and self-confidence about future successful performances on task. **Error! Reference source not found.** shows some questions and illustrative answers posed to learners after a CDDM task.

1) How satisfied do you feel about your history-taking? Please indicate your confidence on this rating scale

0_____10_____**50**_____70_____100

2) What do you use to judge your level of satisfaction?

Well, the presenting complaint was about shortness of breath and chest pain. I'm fairly satisfied with the way in which I managed to work out that the chest pain was secondary to the main problem which was the shortness of breath. I'm also fairly happy with how I asked the questions to work out what's going on with the patient. I started by asking fairly open questions about the shortness of breath and chest pain to see whether the cause for the patient coming to hospital was due to a cardiorespiratory problem. I think I did that pretty well and found out that this was man who had a heart attack previously also had ankle swelling which makes me think he may have heart failure now.

3) How sure are you that you can complete history-taking from a different patient next time? Please indicate your confidence on this rating scale

*0_____10_____40_____**60**____70_____100*

4) What do you use to judge your level of confidence?

I think with a bit more practise and seeing more patients who come with shortness of breath will help. I can be quite tricky to work out whether shortness of breath is due to a lung problem or a heart problem, especially when there aren't many other symptoms such as chest pain, ankle swelling or cough. I think if I practise my history-taking and make sure I don't narrow down too quickly I should be OK. I find it tempting to come up with what I think is going on, without fully listening to what the patient is coming in for, but I am getting better at telling myself to concentrate and keep my questions nice and open

Figure 12 SRL Microanalysis "After the task" questions from the learner

After completing the history-taking stage, the clinical enquiry proceeds onto physical examination and another iteration of mapping and SRL Microanalysis

takes place with relevant “before”, “during” and “after” questions. The iterative process of mapping and microanalysis proceeds throughout the clinical enquiry with questions asked at the end of each stage as necessary, depending on the needs of learner.

The responses to Mapping and SRL Microanalysis from the learner can be used to synthesise accurate feedback about their CDDM ability. Both the outputs from mapping and SRL microanalysis provide rich information about (1) knowledge for the task, (2) the “skill” of using both intuition and analytical processes (3) the role of “self”, such as self-efficacy beliefs and emotions created by the environment, and (4) the self-regulation of both the “skill” and “self”.

This feedback can be presented in the form of an educational prescription for the learner. Examples of the feedback from the history-taking stage of the clinical enquiry for the learner illustrated in this section are shown in Figure 13.

Mapping and SRL-Microanalysis are intended to help educators teach novices how to develop the skills required for making a diagnosis. The information generated through both techniques provides teachers with credible evidence to challenge assumptions and manage learner expectations about developing CDDM expertise. The figures used to illustrate examples of feedback for learners is by no means prescriptive or exhaustive, however demonstrates the potential for providing learners with more meaningful feedback about CDDM. The amount of information captured through mapping or SRL Microanalysis relies on the judgment of the teacher depending on the learning needs of the novice. Mapping and SRL microanalysis provide enough substrate to give feedback about all real-life aspects of CDDM.

Figure 13 Feedback to the learner following Mapping and SRL Microanalysis

Clinical Diagnostic Decision-Making (CDDM) Feedback from History-taking for Learner 2

Knowledge

- Case presentation (Feedback from Mapping and SRL Microanalysis – Before Qs)

The patient presents with shortness of breath in association with chest pain with a background of ischaemic heart disease and myocardial infarction 5 years ago.

Although in all likelihood the cause for the patient's presentation was due to a cardiovascular problem, you kept the CDDM process open in the history-taking stage to prevent 'closing down' and continue searching for other plausible explanations for the presentation.

Your goal at the start of the clinical enquiry was to differentiate between a cardiac cause and a respiratory cause for the presentation which was entirely appropriate given the paucity of other information given and the fact the patient had a history of ischaemic heart disease

Another of your goals was to avoid "putting words into the patient's mouth" which is important for constructing an accurate presentation of the clinical problem

Similarly, you were wise to verify information presented from the patient is important for CDDM such as "distinguish actual DIB with can't breathe due to chest pain" before switching to a more non-analytical or intuitive approach to making a diagnosis

- History-taking (Feedback from Mapping)

A number of very important questions were posed to the patient such as:

Tell me a little more about your chest pain
Have you had any palpitations alongside the breathlessness?
Tell me a little more about shortness of breath
What happens to your breathing should you exert yourself?
Do you get breathless when you are not doing anything in particular?
Are you able to complete a full sentence during conversation when you get breathless?
Do you get breathless lying flat?
What sets off your breathless?
What relieves your breathlessness when it starts to get worse?
Can you describe any episodes when you have been short of breath at night? Tell me more about them.
Do you have any ankle swelling at the moment?
Do you cough regularly?
Have you coughed up any phlegm or blood?
Do you normally get wheezy?
Have you had a fever recently?
What medication are you currently taking?
Are you allergic to anything?
What medical problems have you had in the past and please can you tell me about any operations as well?
Can you tell me of any major illnesses or conditions that run in your family?
What was your main job when you were working?
Do you smoke or have you ever smoked?
What would you like to happen as a result of coming into hospital today?

A number of very important questions were also omitted posed to the patient such as:

Have you had any blackouts or lost consciousness recently?
How much alcohol are you drinking at the moment?
What impact has this problem with shortness of breath had on you?

Skill

From observations made and evidence collected during Mapping

- The challenge with CDDM is to use the right strategy for problem-solving or decision-making at the right time in the clinical enquiry.
- Whilst there is a temptation to lock onto salient features from the information such as "previous myocardial infarction" presented at the start of the case, you stuck with an analytical approach for CDDM since the information could not be safely verified until in the next stage of the clinical enquiry.
- The approach to CDDM was analytical during the history-taking stage. This was appropriate since switching to a non-analytical approach before a working diagnosis is established may encourage closing down the thinking in the clinical enquiry before it is appropriate to do so.
- Whilst you remained uncertain about the likely cause for the problem (i.e. cardiac or respiratory), sticking to a more analytical approach to history-taking was entirely appropriate. Analytical or structured questioning ensures important questions are not missed and all relevant responses are collected from patients enabling the clinical enquiry to proceed safely.
- Your approach to history-taking was organised enabling you to better appreciate the sequence of events and formulate an accurate problem abstraction
- Your organised approach suggests a sufficient level of knowledge about the case presentation and clinical problem and the analytical history-taking approach for CDDM

Self-regulated Learning

- Goal-setting (SRL Microanalysis – Before questions)

  Setting your goal to "focus on the respiratory and cardiac systems" was correct given the presenting complaint was both shortness of breath and chest pain.

  Having a goal that is to "ask open questions" is also important for safe and effective CDDM since asking too many direct questions at the start of history-taking may be a sign of closing down the problem-solving too early in the clinical enquiry

  As well as making a diagnosis, making the right management decisions for the patient is another important goal for CDDM. Noticing the patient had a raised respiratory rate from the outset was an important sign to notice and set another goal to stabilise the patient as well

- Strategic planning (SRL Microanalysis – Before questions and Mapping)

  An analytical or structured approach was appropriate for the start of this consultation given the ambiguity of the presenting complaint, i.e. shortness of breath and the chest pain.

  The decision to keep the questions open-ended and find out more about the circumstances surrounding the shortness of breath and chest pain was also important for deciphering whether the diagnosis was a cardiac or respiratory problem.

  Once a diagnosis is presumed with a high degree of suspicion, then it may be appropriate to rely on intuition and ask relatively few questions about a given symptom but until that point, it was wise to stick with open-ended exploratory questioning, i.e. an analytical approach

- Self-monitoring (SRL Microanalysis - During questions)

  It is important to monitor how well you are doing sticking with the strategy or approach to CDDM.

  You demonstrated good insight into focusing on your approach to CDDM during history-taking and gave an accurate appraisal of how well you actually performed on the task (as shown by your relatively few omissions)

  You demonstrated on a number of occasions your willingness to focus on the approach to CDDM and keep a number of differentials in your mind, rather than make one diagnosis alone. This is correct for this stage in the clinical enquiry given key discriminating information has yet to be retrieved during physical examination.

- Cognitive Biases (Observer judgment)

  There were no significant errors recurrently made during the history-taking stage that were due to a cognitive bias that may be part of a wider problem affecting your ability to accurately or safely perform CDDM

Self

SRL Microanalysis – After Qs

- The self-confidence rating at the start and self-satisfaction rating at the end of the history-taking was relatively low in comparison to the quality of performance shown in that stage

  Prior to starting the case, a confidence rating of 40 was given and this only rose to 50 when asked about satisfaction with the performance at the end of the history-taking stage. This self-rating is quite low in comparison to how well you performed so please take some encouragement from your performance on this case.

- The relative sureness of the future success on the task was relatively modest in comparison to the quality of performance shown in that stage

  At the end of the history-taking stage, the relative sureness of success on similar task in the future was 60 despite a good performance in the stage and very few omissions made at all.

- Given the relatively low self-confidence scores, there may be merit in discussing with your teacher how to increase self-belief for future tasks so your full potential is maximised and realised wherever possible.
- The reasons attributed for success or failure on the task were based on your approach to history-taking which is a marker of likely success in the future assuming you continue to focus on your technique to CDDM rather than making the diagnosis alone.

Conclusion

Making an accurate clinical diagnosis is an essential skill for all medical students and doctors, beginning a sequence of events, such as prescribing medication or implementing a treatment, with important implications for patient safety. Current approaches to teaching how to make a clinical diagnosis tend to lack the complexity that faces clinicians in real–life contexts. In response to these concerns, we propose a new trans-theoretical model for teaching how to make an appropriate clinical diagnosis that can be used by teachers as an additional technique to their current approach. This educational model integrates situativity theory (recognizing the importance of real life contexts, with the associated impact of the environment on the clinician), dual-information processing theory (recognizing the importance of both non-analytical and analytical processes in problem-solving) and socio-cognitive theory (recognizing the importance of metacognition and self-regulation in the dynamic control of self, environment and problem solving processes to achieve an appropriate clinical diagnosis). Mapping and microanalysis help the teacher to identify the main processes involved in making an accurate clinical diagnosis so that feedback can be provided that is focused on the key processes. An essential aspect of using the new educational model is the role of the experienced clinical teacher in making judgments about the appropriateness of the learner's attempts to make clinical diagnosis.

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