

# UC San Diego

## Independent Study Projects

### **Title**

Implementation of an educational exercise to enhance clinical reasoning in third year medical students

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### **Author**

Cochran, Megan

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Megan Cochran, MS4  
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## **TITLE**

Implementation of an Educational Exercise to Enhance Clinical Reasoning in Third Year Medical Students

## **ABSTRACT**

Clinical reasoning (CR) is essential to a physician's practice of medicine. Although there have been clear efforts to incorporate CR into the pre-clinical curriculum at UCSD-SOM, there is a lack of formal CR education during rotations. Thus, the Clinical Reasoning Exercise (CRE) was designed for third year medical students on the inpatient internal medicine service. The CRE is an educational exercise that provides step-by-step guidance through the diagnostic process by utilizing three principles – problem representation, diagnostic schema, and illness scripts. Supplementary materials include narrated PowerPoint/YouTube tutorials (for both students and faculty) as well as an example completed CRE for student reference. The CRE was piloted with six students rotating the Veteran's Association (VA) in February 2019. Students were met in small groups (2-3) to review general aspects and logistics. After the one-month long inpatient rotation, students were sent the link to an anonymous survey. The overall respondent rate was 66% (N = 4/6). All four students reported completing one CRE during the 4-week block. Overall, students felt the CRE was a useful exercise that helped educate them on CR/CR principles and helped them systematically approach a clinical problem. However, there was a mixed response as to whether the CRE should be implemented in the future curriculum. The students' main concerns included increasing the number of requirements for the rotation and redundancy with a pre-existing requirement. Going forward, the CRE itself will need to be modified and its position in the curriculum closely reassessed. In addition, a larger sample size is needed to adequately obtain generalizability to the remainder of the third-year class.

## **BACKGROUND**

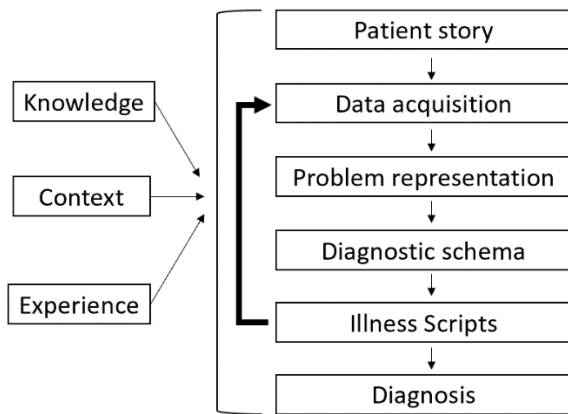
Clinical reasoning (CR) is difficult to define. Despite over four decades of research, considerable challenges continue to prevent professionals from arriving at a consensus<sup>6</sup>. First, CR investigators stem from multiple disciplines, such as psychology and sociology. This has produced a largely fragmented body of literature<sup>8</sup>. Second, CR is ambiguous by nature. For example, as the accrediting body for programs leading to an MD degree in the United States, the Liaison Committee on Medical Education (LCME) releases updated standards annually. In 2017, the LCME broadly defined CR as "the integration, organization, and interpretation of information gathered as a part of medical problem-solving".<sup>3</sup> In 2018, however, "clinical reasoning" was replaced altogether with a rather lengthy description of "critical judgement."<sup>4</sup>

Although our understanding is constantly evolving, it is widely accepted that CR is essential to the health care professional's practice of medicine.<sup>7</sup> It is a central component to competence and the ability to make diagnoses and decisions. Thus, CR education is of the utmost importance in teaching medical students. There has been a recent focus on CR enhancement on a national level as well. In 2014, the Association of American Medical Colleges (AAMC) established thirteen core "Entrustable Professional Activities" (EPAs) in response to growing evidence illustrating a "performance gap" in students transitioning from medical school to residency.<sup>5</sup> Lyss-Lerman et al. found that lack of medical knowledge

and self-reflection/improvement were common struggles among interns. In addition, program directors rated “advanced clinical reasoning” as the most common competency that fourth-year medical students should possess prior to residency.<sup>7</sup>

Medical school curricula has traditionally taught basic science and CR in the pre-clinical and clinical years, respectively. A study in 2017, however, found that a majority of internal medicine (IM) clerkship directors at US medical schools believed that CR should be taught during all four years of study with the greatest emphasis during rotations.<sup>8</sup> At the University of California, San Diego School of Medicine (UCSD-SOM), students are first introduced to CR through problem based learning, ambulatory care apprenticeships, and the UCSD Free Clinic. An hour-long lecture on CR was also added to the second-year didactics several years ago. During core clerkships, students are then evaluated by a variety of methods including clinical evaluation exercises (CEX) and patient note scoring rubrics. Thus, while CR has been integrated into the pre-clinical curriculum and there are robust assessments on CR during rotations, there remains a lack of formal CR *instruction* during clerkships.

The clinical reasoning exercise (CRE) was designed for third year medical students to address this issue. By adopting a modern paradigm of diagnostic reasoning (see figure below)<sup>1</sup>, the CRE provides 1) education on CR and CR concepts, 2) step-by-step guidance through the diagnostic reasoning process, 3) an opportunity to discuss CR with and receive feedback from attending physicians. By identifying personal goals regarding clinical problems, utilizing CR principles, and completing a self-reflection exercise, students will be encouraged to store information in a clinically relevant manner.



Bowen, Judith L. “Educational strategies to promote clinical diagnostic reasoning.” *New England Journal of Medicine* 355. (2006): 2217-25.

## METHODS

### Clinical reasoning exercise (CRE) Development:

1. The CRE was developed with the guidance/input of my ISP committee.
2. The CRE is an educational modality consisting of instructional PowerPoint/YouTube presentations and word documents that were designed for third year UCSD-SOM medical students and faculty.

### CRE Materials:

1. Student Materials:

- a. Blank CRE:
    - i. Description: an incomplete CRE comprised of six sections
    - ii. Modality: word document (two pages)
    - iii. Process: after students fill out identifying information, they are prompted to designate a “clinical problem” (CP) relevant to one of their patients. A CP can range from a symptom to an exam characteristic to an abnormal lab/imaging finding. (Example: acute onset of knee pain.) Students then state a goal regarding that CP. (Example: to generate a differential diagnosis for acute onset of monoarticular arthritis in adults.) Students work through three CP principles:
      - 1. Problem representation
      - 2. Diagnostic schema
      - 3. Illness Scripts
 Students conclude the exercise by discussing their assessment of the CP and complete a self-reflection exercise.
    - iv. Example: refer to Appendix A
  - b. A Review of Clinical reasoning:
    - i. Description: provides education on CR (definition, brief background), reviews a CR paradigm, defines CR concept, provides novice vs expert examples.
    - ii. Modalities:
      - 1. PowerPoint presentation (17 slides)
      - 2. Narrated YouTube Video (20 minutes, 16 seconds)
        - a. Link: [https://www.youtube.com/watch?v=v-h\\_3Fy6Z-U](https://www.youtube.com/watch?v=v-h_3Fy6Z-U)
  - c. CRE Student Guide:
    - i. Description: provides instructions on how to complete the CRE, highlights key features of the Example CRE document (see below)
    - ii. Modalities:
      - 1. PowerPoint presentation (19 slides)
      - 2. Narrated YouTube Video (13 minutes, 43 seconds)
        - a. Link: <https://www.youtube.com/watch?v=fUxDriDQjC0>
  - d. CRE example:
    - i. Description: provides students with a completed (example) CRE for guidance
    - ii. Modality: word document (three pages)
    - iii. Example: refer to Appendix B
2. Faculty Materials:
- a. A Review of Clinical Reasoning: refer to section 1b above
  - b. CRE Faculty Guide:
    - i. Description: reviewed CRE development/rationale/goals, provided example of student CRE and feedback topics
    - ii. Modalities:
      - 1. PowerPoint presentation (36 slides)
      - 2. Narrated YouTube Video (16 minutes, 29 seconds)
        - a. Link: <https://www.youtube.com/watch?v=5qVX3axLYKE>
3. Summary:
- a. Students materials: blank CRE, example CRE, A Review of Clinical Reasoning, CRE Student guide
  - b. Faculty materials: A Review on Clinical Reasoning, CRE Faculty Guide
  - c. Examples: refer to Appendix C for thumbnails of example PowerPoint/YouTube slides

**CRE implementation:**

1. Population: third year medical students on the inpatient internal medicine clerkship (Medicine 401)
2. Pilot implementation:
  - a. Timing: February 2019 (Winter quarter)
  - b. Student requirements: complete of two CREs during the one-month long inpatient medicine rotation at the VA, review with an attending and acquire signature
  - c. Process:
    - i. Students: students were met in small groups (2-3 students) to go over the CRE logistics and give a brief overview of CR topics. Students were asked to complete two CREs in conjunction with any of the four required H/P (history/physical) notes which necessitate an attending signature. Each student was asked to complete the H/P and CRE within 24 hours of the patient admission and give to attending physician for assessment and feedback. Students were provided a blank CRE, example CRE, and PowerPoint/links to YouTube video tutorials in individual emails.
    - ii. Faculty: faculty were sent individual emails that introduced the CRE and contained links to all resources (PowerPoint, YouTube, example CRE). The CRE was also discussed in a Hospitalist meeting at the VA.

**CRE evaluation and assessment:**

1. Immediate assistance: students and faculty were provided my email and cell-phone number for any immediate concerns, questions, or feedback.
2. Student assessment:
  - a. Delivery: students were sent the link to an anonymous survey powered by Survey Monkey. Students were both individually emailed and text-messaged to encourage participation and maximize responses.
  - b. Timing: students were asked to complete this survey after finishing the one-month rotation at the VA.
  - c. Design: the following were considered for the survey design<sup>2</sup>
    - i. Pose the most important questions earlier in the survey
    - ii. Two questions required a response to move forward in the survey
    - iii. Use of “verb-only labels” (vs purely numbered rankings, which tend to be more inconsistent).
    - iv. Use of positive language (vs negative wording, such as un-, im). which can prove challenging for respondents for a multiple of reasons)
    - v. Format response options into only one row or one column
    - vi. Bolding important words (e.g. those with negative prefixes)
  - d. Format: 4 sections, 19 items total
  - e. Example: see Appendix D for a blank survey

**RESULTS****Student Survey Data:**

- Overall respondent rate: 66%% (N = 4/6)
- Selected graphs are highlighted below. Please refer to Appendix E for all data.

**CRE Implementation and Materials:**

- The first section of the survey consisted of evaluating the CRE completion rate and use of supplementary materials.
- Response rate for the first page was 100% (N = 4/4).
- Of the four students that responded, all reported that they completed one CRE during their 4-week inpatient rotation at the VA. (Figure 1)

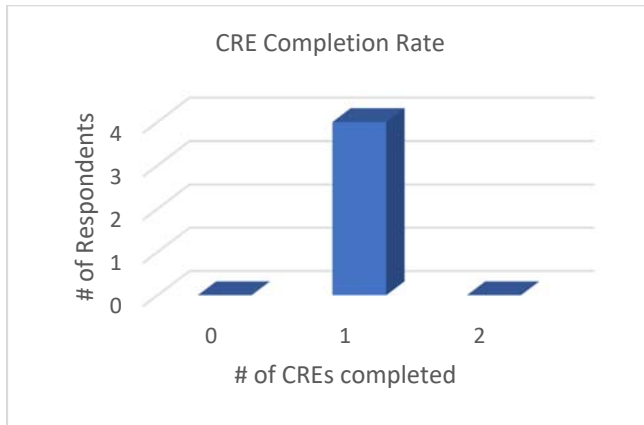


Figure 1

- There was a variation in the average time reported to complete a CRE, ranging from 15 to >45 minutes (Figure 2).

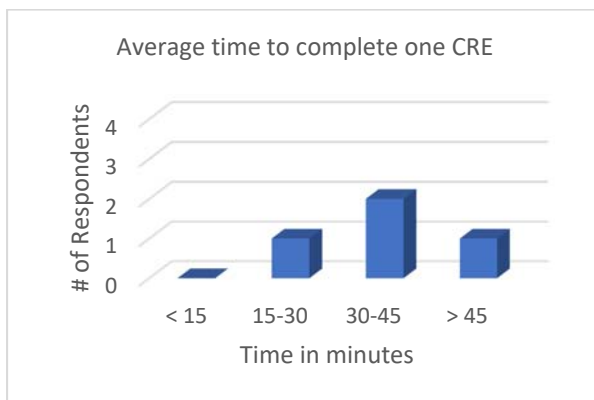


Figure 2

- 50% of students (N = 2/4) stated that they watched the “Review of Clinical Reasoning” and “CRE Student Guide” YouTube tutorial videos. Of note, there were 2 views for the “CRE Student Guide” and 2 views for the “Review of Clinical Reasoning” which was consisted with the reported student data, assuming that no faculty viewed the videos.

### Clinical Reasoning Skills

- The second page of the survey consisted of evaluating students’ CR knowledge as well as their confidence at employing CR concepts.
- Unfortunately, the second page was missing one response per item (likely a single student who skipped the entire page), giving a respondent rate of 75% (N = 3/4).
- Two students felt that they could provide a definition for clinical reasoning (responded “yes”) while one reported “maybe.” (Figure 3)

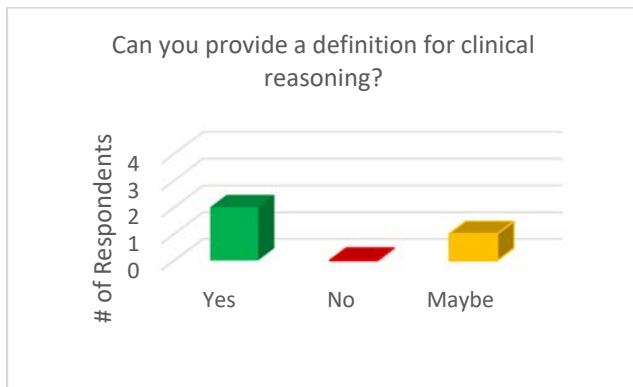


Figure 3

- There was as similar distribution in students' ability to define the core CR concepts. (Figure 4)

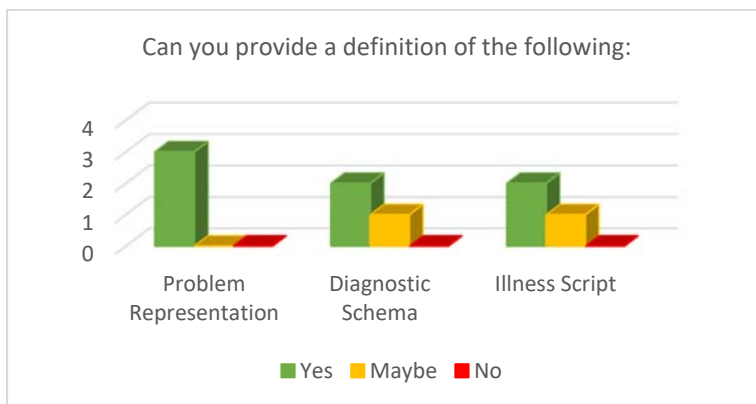


Figure 4

- Students were also asked to rate their confidence at executing clinical reasoning skills. The majority of responses were "moderate confidence," with only one response for "extreme confidence" for discussing diagnoses from most to least likely during a patient note (Figure 5).

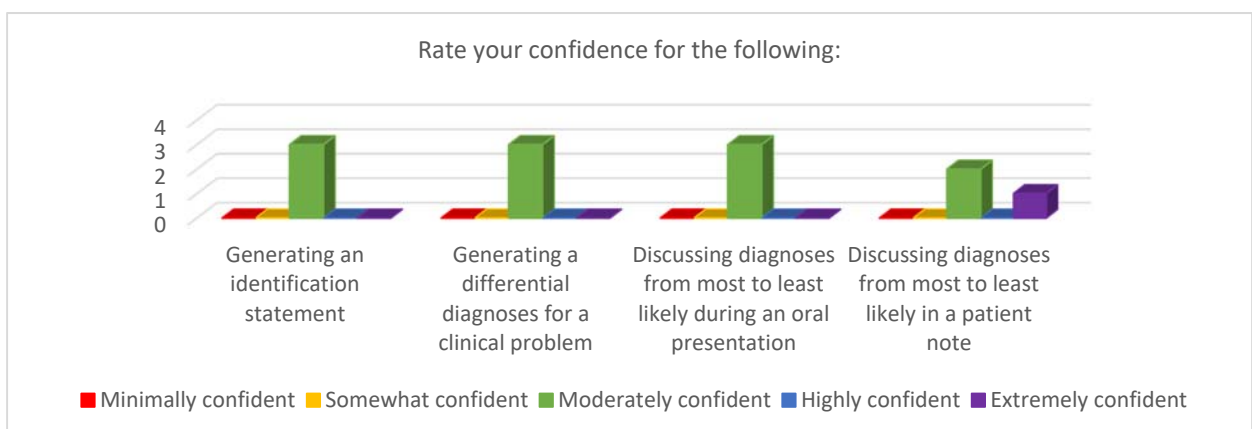


Figure 5

### CRE Assessment

- The third page of the survey assessed the utility of the CRE.

- Unfortunately, like the second page, each item was missing exactly one response. Again, this is likely a single student that skipped each question. The response rate was 75% (N = 3/4).
- Overall, the CRE was helpful in teaching students about CR and CR concepts. (Figures 6 and 7)

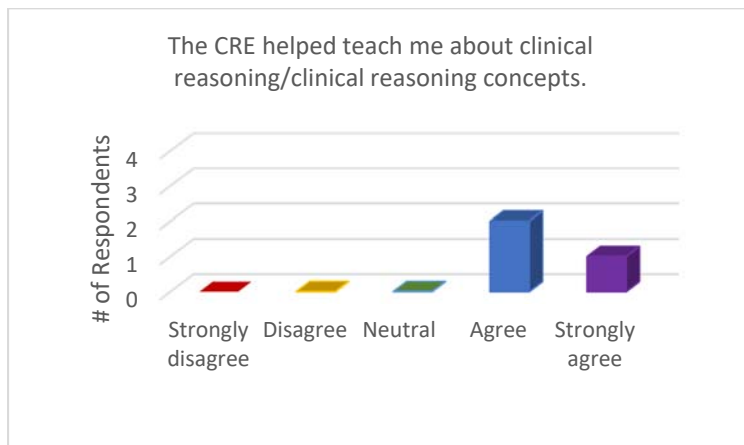


Figure 6

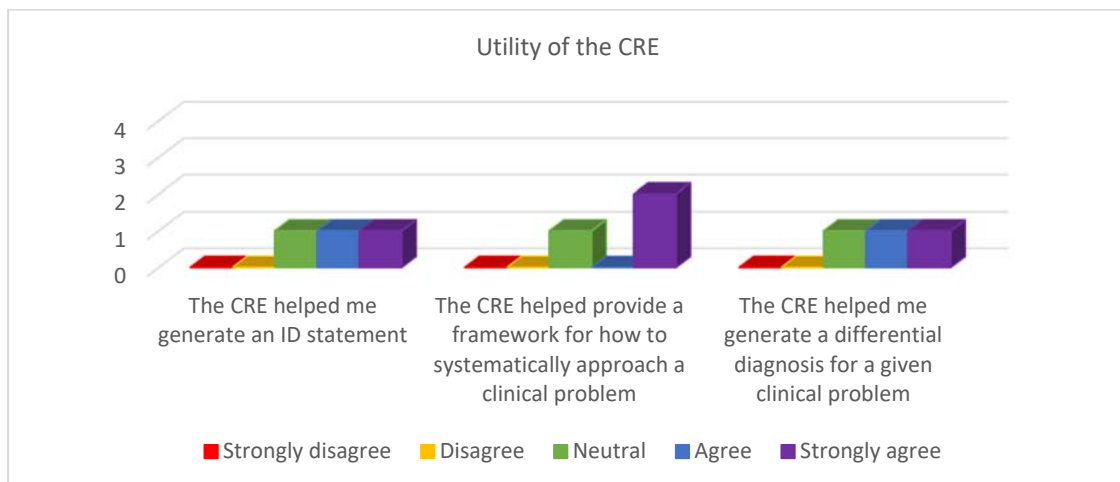


Figure 7

### Clinical Reasoning Education

- The fourth and final page of the survey assessed the overall CR education at UCSD, as well as final conclusions regarding the CRE.
- Unfortunately, several questions were skipped on this page. The response rate ranged from 75-100%.
- All three students that responded reported that they were “moderately satisfied” with the CR education that they have received at UCSD-SOM. However, when asked how much time should be devoted to CR instruction in the curriculum, responses varied (Figure 8).



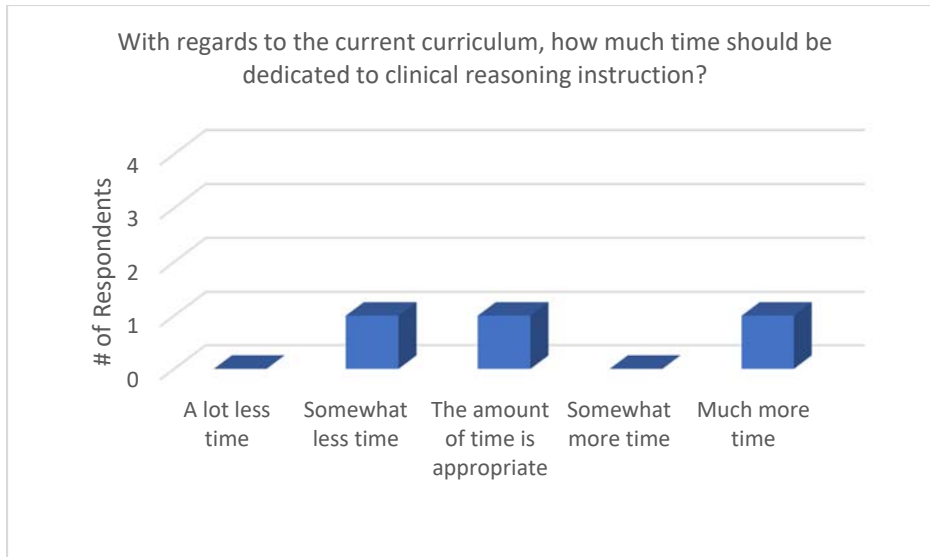


Figure 8

- Although it appeared that students found the CRE to be a useful experience (Figure 9), there were varied responses if the CRE should be implemented in the future Medicine-401 curriculum; one student responded “yes,” “no,” and “maybe.”

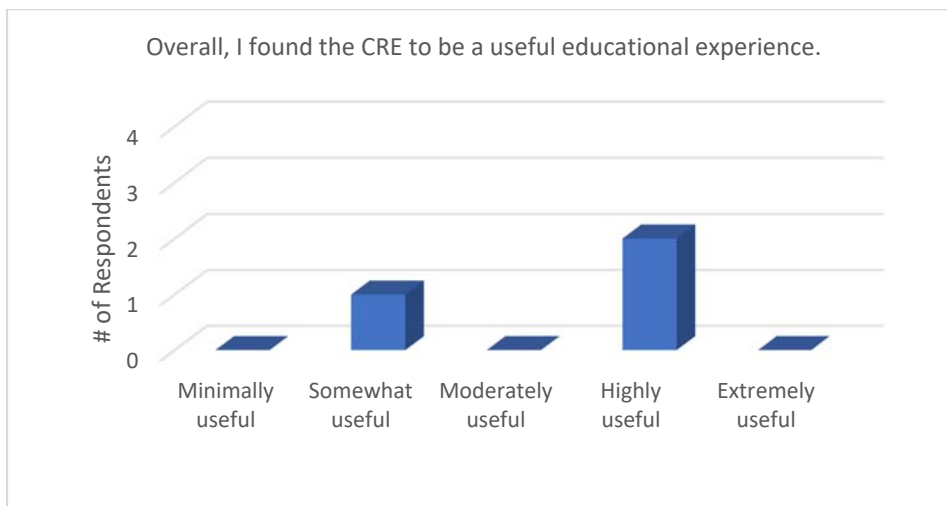


Figure 9

- Two free-text response boxes inquiring about 1) the strengths and 2) weaknesses/ways to improve the CRE are as follows:
  - Respondent rate: 50% (N = 2/4)
  - Strengths of the CRE:
    - It was helpful to systematically go through a clinical problem
    - It helped form/frame a differential diagnosis
    - “Illness script” was an unfamiliar term which tended to re-surface during the inpatient month.
    - Constructing an illness script helped summarize the most important characteristics of different diseases.
  - Weaknesses and ways to improve the of the CRE:

- There are many pre-existing requirements for the inpatient medicine rotation, so adding the CRE was another thing to the checklist
- Certain portions of the CRE, such as the assessment of the clinical problem, were redundant with the H/P
- Performing the CRE in conjunction with the H/P was time consuming and stressful

## DISCUSSION

It is universally accepted that clinical reasoning (CR) is fundamental to daily decision-making in which physicians care for each and every patient. It is a complex process that is cultivated over years of training and practice. At UCSD-SOM, CR is first introduced in the pre-clinical curriculum. During core clinical rotations, however, there is a lack of formal CR *instruction* despite long-standing methods of CR *evaluation*. Thus, the CRE was designed to help educate students on the internal medicine inpatient service about explicit CR/CR principles.

To briefly review, the CRE is an educational modality in which students choose a clinical problem (CP) for their patient. The CP can range from a symptom to an abnormal lab value. After choosing a CP, the student designates a “goal” regarding that CP and subsequently works through three CR concepts: problem representation, diagnostic schema, and illness scripts. For example, one student chose the “symptom” of “painful excoriations” for his lookup. For his “goal,” he stated, “to develop a differential diagnosis for acute onset of painful excoriations.” The student proceeded to utilize the “VITAMIN DEC” construct for his diagnostic schema, and compared/contrasted scabies, bed bugs, Skin Picking Disorder, and Grover’s Disease for his illness script. After constructing an identification statement using problem representation to help generate his assessment of the CP, he ultimately concluded his patient likely had Grover’s Disease.

Overall, the third-year medical students found the CRE to be a useful exercise. All students strongly agreed or agreed that the CRE helped provide education on CR and CR concepts. After the CRE, most students could provide a definition of CR, problem representation, diagnostic schema, and illness scripts. Another strength included helping students systematically approach a clinical problem. Two students also wrote specifically regarding the utility of learning about illness scripts. One stated, “I thought presenting the idea of an illness script was also helpful as I had not really heard that term, and it ended up coming up a lot during the inpatient month.”

Despite the predominantly aspects regarding the CRE, there was a range of responses when asked if the CRE should be implemented in the future Medicine-401 curriculum. Students chose “yes,” “no,” and “maybe.” In the free-text response assessing CRE weaknesses, two students touched on common themes. The first was an additional requirement to course. The Medicine-401 course has a number of time sensitive requirements (such as the 4 H/Ps, online learning modules, CEX, etc.) in addition to the CRE. One student wrote, “I like the idea of the CRE, but I feel like we already have a lot of requirements during our inpatient months, so adding another one seems like a lot.” Another wrote, “When I did do the CRE, I did it with my H&P on a long call day ... it took me about an hour or more as well as complete my H&P after getting home.” The second concern was redundancy of discussing their assessment and differential diagnosis. One student wrote, “it seemed like we were sort of doing the same thing in a different format for the CRE.”

There are several noteworthy limitations concerning this project. Perhaps the most prominent is the small sample size as the pilot implementation included six students. Furthermore, of those six students, only four replied to the anonymous survey despite individualized emails and text-message reminders. This small sample size, in conjunction with the fact that all students rotated at the same hospital, clearly limits generalizability to the remainder of the third-year class and rotation sites. Although this was largely a “proof of concept” project, a larger collaboration either extending to the additional sites and/or consecutive cohorts of students at the VA should be undertaken to further assess the utility of the CRE. In addition to expanding the intervention group, in the future, *all* students taking Medicine-401 should be surveyed at 1) the beginning of the rotation, and 2) upon completing the rotation. The intervention (CRE) and non-intervention (non-CRE) groups can be compared with regards to their CR skills and confidence.

There are also many other ways to improve the CRE. First and foremost, the CRE itself needs to be tailored. The main issue is that the “assessment” portion of the CRE was redundant with the “assessment and plan” section of the H/P. (Of note, student did not raise any issues with regards to utilizing illness scripts, problem representation, or diagnostic schema.) Going forward, the “assessment” portion of the CRE can simply be deleted and the attending physician can refer to the H/P to evaluate the student’s diagnostic reasoning more thoroughly. Alternatively, the H/P and CRE can be melded into a single, streamlined exercise. Secondly, the overall role of the CRE in the medicine-401 curriculum must be taken into consideration. Students expressed concern over the time/effort required to complete the CRE in the context of other outstanding course requirements. If the CRE is successfully implemented into the curriculum down the road, it will likely replace a pre-existing requirement to avoid overloading students with too much additional work.

Another major consideration is on-site vs remote communication with students. During the pilot implementation, this author personally met with students and most faculty to discuss the CRE. Students were shown an example CRE and “A Review of Clinical Reasoning” PowerPoint over the course of 15-20 minutes. However, despite this in-person review of the project, no student completed the desired two CREs during the inpatient month. Other factors could also be coming into play, such as less motivation due to no official grade or general fatigue from being on wards. Perhaps the CRE “requirement” can be lowered to one per inpatient month. Although this would ideally help ensure maximum participation, it is unclear if this would replace the need to personally meet with students to discuss the CRE logistics.

In summary, the CRE is a novel exercise designed for third-year medical students on the internal medicine rotation. It appears that the CRE was a worthwhile exercise that was moderately effective in educating students on CR and CR principles. After some alteration in the CRE itself, barriers to implementation are largely logistical with the main concern being too much added time/requirements to the course. Furthermore, a larger sample size is needed to obtain generalizability to the third-year medical students and other Medicine-401 sites.

#### References:

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8. Rencic, Joseph, et al. "Clinical Reasoning Education at US Medical Schools: Results from a National Survey of Internal Medicine Clerkship Directors." *Journal of General Internal Medicine* 32.11. (2017): 1242-46.
9. Young, M, et al. "Drawing boundaries: the difficulty in defining clinical reasoning." *Academic Medicine*. (2018).

**Introduction:**

Welcome to the CRE! The CRE was designed to guide M3s through the complex clinical reasoning process. In this exercise, you will identify a "clinical problem" (CP) that your patient faces. This can range from a symptom to an exam finding to a lab/imaging abnormality. Regardless of the CP that you choose, the goals are as follows:

- 1) Provide a succinct patient identification statement using the principles of "**problem representation**"
- 2) Generate of a framework for approaching the CP using "**diagnostic schema**"
- 3) Compare and contrast pertinent diseases/diagnoses by utilizing "**illness scripts**"

**Tips for success:**

- Try to choose a CP that is neither too broad (chest pain in adults) nor too focused (sudden onset of chest pain in an elderly patient with known diagnosis of CAD and ST segment changes on EKG).
- Ideally, the chosen problem will be the chief complaint (e.g. sudden onset of right knee pain) or reason for hospitalization (e.g. upper GI bleed).
- If the chosen CP is **NOT** the chief complaint or main reason for admission, this is okay. In these cases, please note that the CP does not necessarily need to be highlighted or even included in the ID statement. For example, if your patient is admitted for sepsis due to a UTI, but the clinical problem that you would like to investigate is AKI, you should still highlight "sepsis secondary to UTI" in the ID statement.
- Don't stress too much. View this as a learning activity – it is **not** graded!

**Step 1:** Identifying information

- **Student name:** Enter text here.
- **Date:** Chose a date.
- **Attending:** Enter text here.

**Step 2:** Designation of a clinical problem and a goal

- **Clinical problem:** Select an type of clinical problem.
  - **Please specify:** Example symptom: "sudden onset of right knee pain"
- **Goal:** State your goal for this CRE. Example: "develop a differential diagnosis for acute monoarticular arthritis"

**Step 3:** Application of clinical reasoning concepts

- A. Problem Representation:**  
*Enter a 1-2 sentence patient ID statement using the principles of problem representation. Please note this should provide the "who, what, why" and the "big picture." (e.g. Mr. Jones is a 64 year old Caucasian man with...)* Depending on your chosen clinical problem, it may or may not be included in this statement.
- B. Diagnostic schema:** Select a schema.

*Insert completed "Diagnostic Schema" here.*

*Please see the CRE Student Guide PowerPoint for example diagnostic schema*

- C. Illness Script:** is a compare and contrast table applicable? Choose an item.
  - If not applicable, please designate another approach. Example: flowsheet

*Insert an "Illness script compare/contrast table" or alternative approach.  
Please see the CRE Student Guide PowerPoint for an example of an illness script framework*

**Step 4:** Summary of case and diagnostic reasoning

**Assessment:**

Provide your assessment of the patient's clinical problem. Please note it is okay if your chosen problem is not the chief complaint or main reason for hospitalization; patients can have any number of issues. However, for the purposes of this exercise, this assessment should largely focus on the chosen clinical problem. (Example: your patient is admitted for sepsis secondary to a UTI, but you chose "AKI" as the clinical problem. Therefore, your assessment on be centered on their AKI.) Demonstrate your reasoning by including a differential diagnosis. Diagnoses should be discussed from most to least likely. Support (and refute) diagnoses by citing pertinent history/exam/diagnostic data. Finally, include any "can't miss diagnoses" (example: PE in an immobilized patient with SOB).

**Step 5:** Reflection

1. Please summarize key learning points that you will take away from this exercise.  
Enter text here.
2. Briefly list which resources you utilized. (UpToDate, Pathoma, Step up to Medicine, etc.)  
Enter text here.
3. Do you believe that this approach/framework will be useful when evaluating patients in the future?  
Enter text here.
4. Please list any challenges that you faced in this clinical reasoning exercise.  
Enter text here.

**Step 6:** Attending feedback

**Checklist:**

- Reviewed the chosen "clinical problem" and student self-stated goal
- Reviewed the ID statement (problem representation)
- Reviewed the selected diagnostic schema (approach to the clinical problem)
- Reviewed the illness script (summary of disease knowledge)
- Reviewed the overall assessment of the clinical problem

**Comments:**

Attending Signature: \_\_\_\_\_

## APPENDIX

### Appendix A. Blank CRE Document

Appendix B. Example CRE Document

Clinical Reasoning Exercise (CRE) - Example  
Internal Medicine Clerkship

**Step 1: Identifying information**

- **Student name:** Megan Cochran
- **Date:** 9/3/2018
- **Attending:** Dr. Goldberg

**Step 2: Designation of a clinical problem and a goal**

- **Clinical problem:** Symptom
- **Goal:** develop a differential diagnosis for acute onset of monoarticular arthritis in adults

**Step 3: Application of clinical reasoning concepts**

**A. Problem Representation:**

*Instructions:* Enter a 1-2 sentence patient ID statement using the principles of problem representation (e.g. semantic qualifiers). Please note this should provide the "who, what, why" and the "big picture." Depending on your chosen clinical problem, it may or may not be included in this statement.

**Novice example:**

Mr. Jones is a 54 year old Caucasian man with PMHx of poorly controlled DM2 and alcohol dependence who presents with right knee pain starting suddenly last night in the setting of previously similar self-resolving episodes, with joint fluid aspiration results of crystals, 20K WBCs, and 60% PMNs.

**Advanced example:**

Mr. Jones is a 54 year old Caucasian man with PMHx of recurrent gout, poorly controlled DM2, and alcohol dependence who presents with acute monoarticular arthritis with joint fluid aspiration consistent with acute gout.

**B. Diagnostic schema: VITAMIN DEC**

VITAMIN DEC Approach (Diagnostic Schema)	
Vascular	
Infectious	Septic arthritis Bacterial (gonococcal, non-gonococcal bacteria, Lyme, mycobacteria)
Trauma	Trauma to the knee Crystal induced
Autimmune, Inflammatory	Gout Pseudogout (CPPD) Systemic disease RA Seronegative Spondyloarthritis (Reactive Arthritis, Psoriatic Arthritis, IBD)
Metabolic	
Iatrogenic	
Neoplastic	Soft tissue or synovial mass
Degenerative	Osteoarthritis flare
Episodic	Crystal induced (see above)
Congenital	

Clinical Reasoning Exercise (CRE) - Example  
Internal Medicine Clerkship

**C. Illness Script:** is a compare and contrast table applicable? Yes, an illness script is applicable

- If not applicable, please designate another approach: N/A

**DDX for Acute Monoarticular Arthritis (Illness Script)**

Epidemiology	Gout	Pseudogout	Septic arthritis
Pathophys	Males, obesity, postmenopausal women, binge drinking Monosodium urate crystals Hyperurcemia (↑ production can be idiopathic, TLS, myeloproliferative or lymphoproliferative d/o, ↓ excretion via CKD, TZ/LDs)	Common in elderly with DID Associated with HC and hyperparathyroidism Calcium pyrophosphate crystals	Risk factors include prior joint damage (e.g. RA), joint prosthesis, DM2, IVDU Hematogenous spread (MC) Contiguous spread Other causes are trauma, iatrogenic (e.g. arthroscopy) GN: N. gonorrhoea GP: staph aureus Other: Lyme, mycobacteria
Time course	Sudden onset, discrete episodes, may have h/o similar	Sudden onset, discrete episodes, may have h/o	Sudden onset, discrete episodes
Clinical presentation	Location commonly MTP of large toe (podagra) Sx: pain that starts at night (classic), tophi or polyarticular attacks with severe disease - Physical exam - Tests/Labs - Treatment	Location commonly knee and wrists Aspiration: rhomboid shaped with positive birefringent crystals, WBC 15-30K, PMNs often >50% XR: chondrocalcinosis Tx: similar to gout	Sx: fever, chills, malaise common, painful joint Exam: swollen, warm, painful passive and active ROM, ± effusion Aspiration: WBC >50-80K, >80% PMNs, + gram stain, + fluid culture Tx: antibiotics, selection depends on culture data

\*Recall: the goal of an illness script is to highlight the defining features of a diagnosis/disease, not necessarily to list every fact and detail

**Step 4: Summary of case and diagnostic reasoning**

**Assessment:**

*Instructions:* Provide your assessment of the patient's clinical problem. Please note it is okay if your chosen problem is not the chief complaint or main reason for hospitalization; patients can have any number of issues. However, for the purposes of this exercise, **this assessment should largely focus on the chosen clinical problem.** (Example: your patient is admitted for sepsis secondary to a UTI, but you chose "AKI" as the clinical problem. Therefore, your assessment on be centered on their AKI.) Demonstrate your reasoning by including a differential diagnosis. Diagnoses should be discussed from most to least likely. Support (and refute) diagnoses by citing pertinent history/event/diagnostic data. Finally, include any "can't miss diagnoses" (example: PE in an immobilized patient with SOB).

**Novice example:**

Patient does not report any trauma. On exam, his vital signs are normal. His knee is swollen, red, and tender to touch. It hurts him a lot when I test his ROM. He's had this problem twice before. It could be an infection, but he doesn't have a fever. It could be new onset of RA or Lyme disease. Since he doesn't recall falling, I doubt it's an injury. I don't know whether OA ever presents like this, but he does have a history of chronic knee pain.

**Advanced example:**

The patient likely has acute gout; he has had multiple discrete discrete episodes with abrupt onset of extremely severe pain involving a single joint with evidence of inflammation on exam. Before all of his episodes, he is asymptomatic. Furthermore, his joint fluid aspiration is consistent with acute gout given the presence of needle-shaped and negatively birefringent crystals. I would have expected gout to affect the first MTP joint as it did in his previous episodes, but it can present in the knee. Nothing suggests any chronic problem of the knee. I don't suspect infectious arthritis since patient is afebrile, is without leukocytosis, and has no portal of entry nor prostatic joint. Given that his other joints are normal on exam, I doubt that he has a flare-up of OA with pseudogout or a systemic, inflammatory arthritis such as RA.

**Step 5: Reflection**

1. **Please summarize key learning points that you will take away from this exercise.**  
By contrasting my top 3 diagnoses, I have a better understanding of the "classic" presentation of gout vs CPPD vs septic arthritis. I also have a framework for approaching monoarticular arthritis in an adult.
2. **What resources did you utilize? (e.g. UpToDate, Pathoma, Step up to Medicine, etc.)**  
Step up to Medicine, UpToDate, lecture notes
3. **Do you believe that this approach/framework will be useful when evaluating patients in the future?**  
Yes, the VITAMIN DEC approach allowed me to generate a broad differential diagnosis
4. **Please list any challenges that you faced in this clinical reasoning exercise.**  
With regards to the joint aspiration findings, there was variation between resources (some sources say WBC >50K for septic arthritis while others say WBC >50K). I also had some trouble coming up with an ID statement because I have little prior experience and this is my first rotation.

**Step 6: Attending feedback**

- Checklist:
- Reviewed the chosen "clinical problem" and student self-stated goal
  - Reviewed the ID statement (problem representation)
  - Reviewed the selected diagnostic schema (approach to the clinical problem)
  - Reviewed the illness script (summary of disease knowledge)
  - Reviewed the overall assessment of the clinical problem

Comments (optional, verbal feedback is also welcome!)

*I like that you included the pertinent past medical history in your ID statement. This is an important component of problem representation. Don't forget to update the problem representation on a daily basis – a lot changes when patients are admitted to the hospital. Sometimes new problems arise, or complications result from existing problems. The ID statement should reflect this.*

*I think VITAMIN-DEC is a great way to approach acute monoarticular arthritis.*

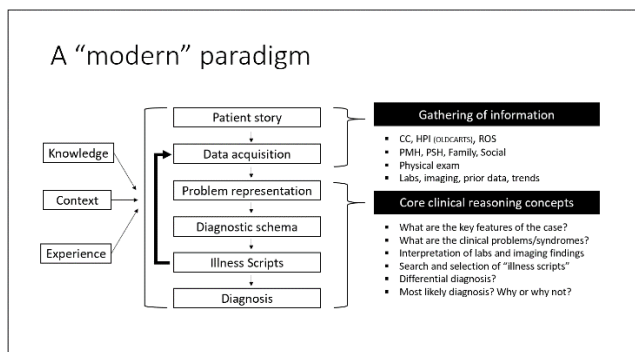
*During the assessment, be sure to list most likely diagnosis first, and then discuss other diagnoses. Good job in providing supporting/refuting evidence for the differential. I also like how you included the can't miss diagnosis of septic arthritis – we wouldn't want to treat a patient who has an infected joint with steroids!*

Attending Signature: Dr. Charles Goldring

Appendix C. CRE Instructional PowerPoints and YouTube Videos

# A Review of Clinical Reasoning

Internal Medicine 401 Clerkship  
Megan Cochran, MS4



## Problem Representation – examples

### Novice

Mr. Jones is a 54 year old man with PMHx of DM2 and alcohol dependence who presents with right knee pain starting suddenly last night in the setting of previously similar self-resolving episodes, with joint fluid aspiration results of crystals, 20K WBCs, and 60% PMNs.

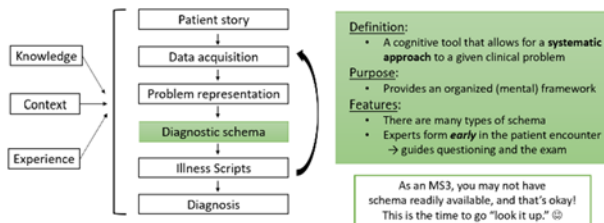
Semantic qualifiers less utilized  
Does not give a sense of why the patient is admitted

### Expert

Mr. Jones is a 54 year old Caucasian man with PMHx of recurrent gout, poorly controlled DM2, and alcohol dependence who presents with acute monoarticular arthritis with joint fluid aspiration concerning for acute gout.

Appropriate use of semantic qualifiers  
Interprets aspiration fluid results

## Diagnostic Schema



## Example of (simple) gout illness script

<b>Risk Factors</b>	<ul style="list-style-type: none"> <li>Male, age &gt;50, alcohol use, prior gout, loop diuretics, high purine foods, CKD</li> </ul>	<b>Defining feature</b>	Features that are typical of a disease or diagnosis
<b>Pathophys</b>	<ul style="list-style-type: none"> <li>Precipitation of urate crystals in the joint space</li> </ul>		
<b>Symptoms</b>	<ul style="list-style-type: none"> <li>Acute onset of severe joint pain, usually monoarticular, 1st MTP most common</li> <li>± Low-grade fevers, systemic symptoms usually absent (vs. septic joint)</li> </ul>	<b>Discriminating feature</b>	Descriptors that help distinguish diagnosis from one another
<b>Physical Exam</b>	<ul style="list-style-type: none"> <li>Generally well appearing</li> <li>Swelling and erythema of the joint, pain w/touch or movement</li> </ul>		
<b>Workup</b>	<ul style="list-style-type: none"> <li>Joint aspiration: WBCs + crystals (monosodium urate, negative birefringence)</li> <li>Labs: serum uric acid typically &gt;6</li> </ul>	<b>Pathognomonic feature</b>	Sign/symptom that is indicative of a particular diagnosis
<b>Treatment</b>	<ul style="list-style-type: none"> <li>Acute: NSAIDs, steroids, colchicine</li> <li>Prophylactic (after flare): allopurinol</li> </ul>		

Note that illness scripts can range from short summary of a rare diseases, to elaborate descriptions of common diseases

## Appendix D. Student Assessment (Survey Monkey generated survey)



Clinical reasoning skills

**Clinical Reasoning Exercise (CRE)**

CRE implementation and materials

- \* 1. How many CREs did you complete during your 4-week inpatient rotation at the VA?
  - None
  - 1
  - 2
- 2. On average, how long did it take you to complete a CRE?
  - <15 minutes
  - 15-30 minutes
  - 30-45 minutes
  - >45 minutes
- 3. Did you watch the "Review of Clinical Reasoning" YouTube tutorial?
  - Yes
  - No
- 4. Did you watch the "CRE Student Guide" YouTube tutorial?
  - Yes
  - No

- 5. Can you provide a definition for "clinical reasoning"?
  - Yes
  - No
  - Maybe
- 6. Can you provide a definition for "problem representation"?
  - Yes
  - No
  - Maybe

7. Can you provide a definition for "diagnostic schema"?

- Yes
- No
- Maybe

8. Can you provide a definition for "illness script"?

- Yes
- No
- Maybe

9. Please rate how confident you are at the following activities:

	Minimally confident	Somewhat confident	Moderately confident	Highly confident	Extremely confident
Generating an "identification statement" for a patient.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Generating a differential diagnosis for a clinical problem.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Discussing diagnosis from most to least likely during an oral presentation.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Discussing diagnosis from most to least likely in a patient note.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

### Clinical reasoning education

#### CRE assessment

10. The CRE helped teach me about clinical reasoning/clinical reasoning concepts.
- Strongly agree  
 Agree  
 Neutral  
 Disagree  
 Strongly disagree
11. The CRE helped teach me how to generate a quality "identification (ID) statement."
- Strongly agree  
 Agree  
 Neutral  
 Disagree  
 Strongly disagree
12. The CRE helped provide a framework for how to systematically approach a clinical problem.
- Strongly agree  
 Agree  
 Neutral  
 Disagree  
 Strongly disagree
13. The CRE helped me generate a differential diagnosis for a given clinical problem.
- Strongly agree  
 Agree  
 Neutral  
 Disagree  
 Strongly disagree

14. How satisfied are you with the quality of clinical reasoning education that you have received at UCSD?

- Minimally satisfied  
 Somewhat satisfied  
 Moderately satisfied  
 Highly satisfied  
 Extremely satisfied

15. With regards to the current curriculum, how much time should be dedicated to clinical reasoning instruction?

- A lot less time  
 Somewhat less time  
 The amount of time is appropriate  
 Somewhat more time  
 Much more time

\* 16. Overall, I found the CRE to be a useful educational experience.

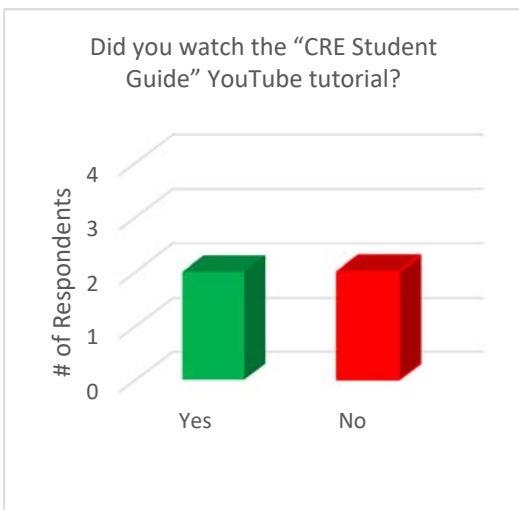
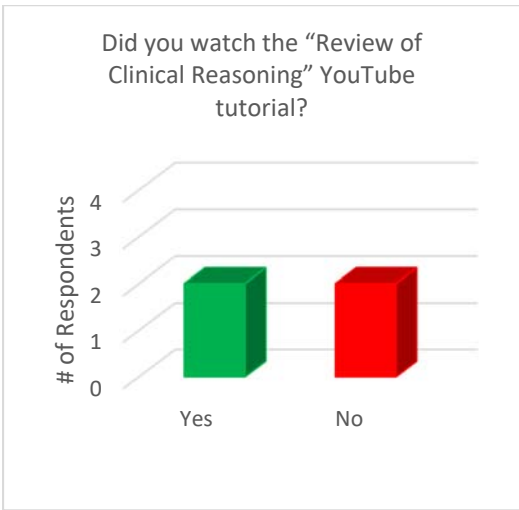
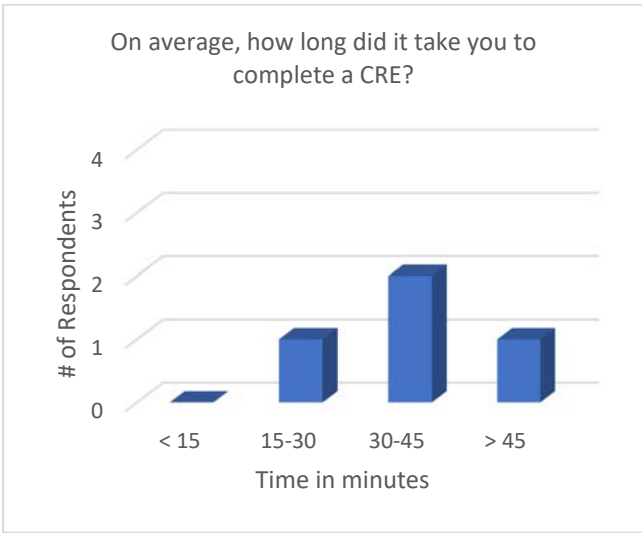
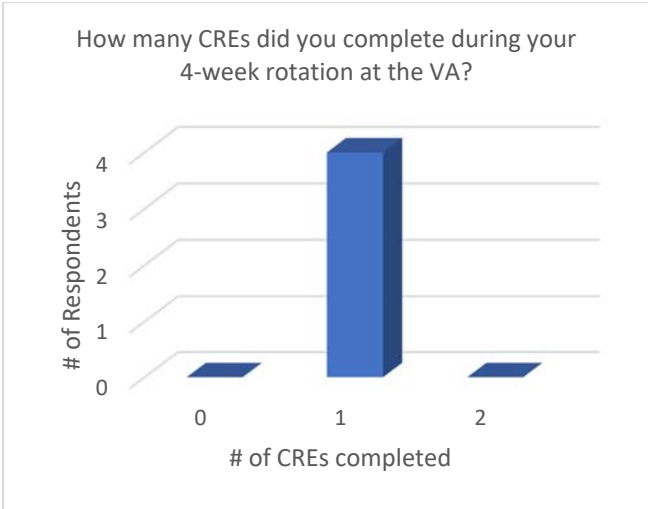
- Minimally useful  
 Somewhat useful  
 Moderately useful  
 Highly useful  
 Extremely useful

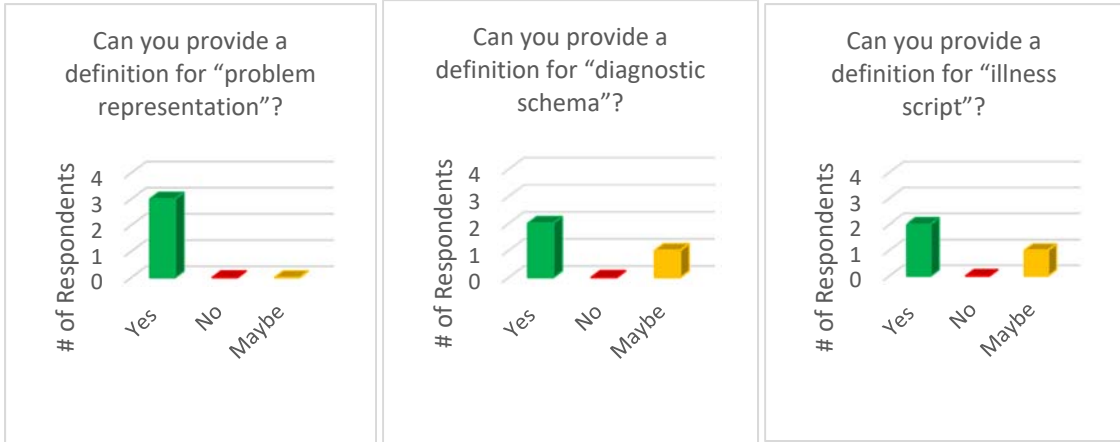
\* 17. The CRE should be implemented in the future medicine-401 curriculum.

- Yes  
 No  
 Maybe

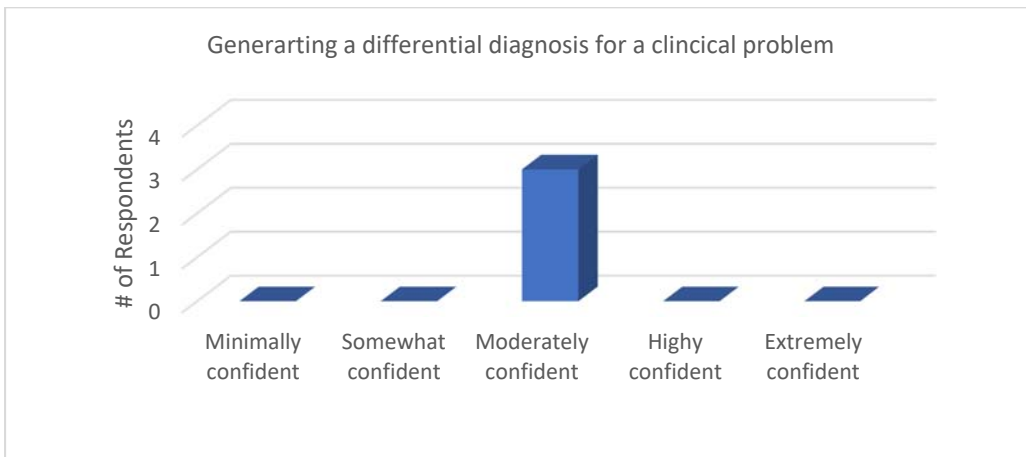
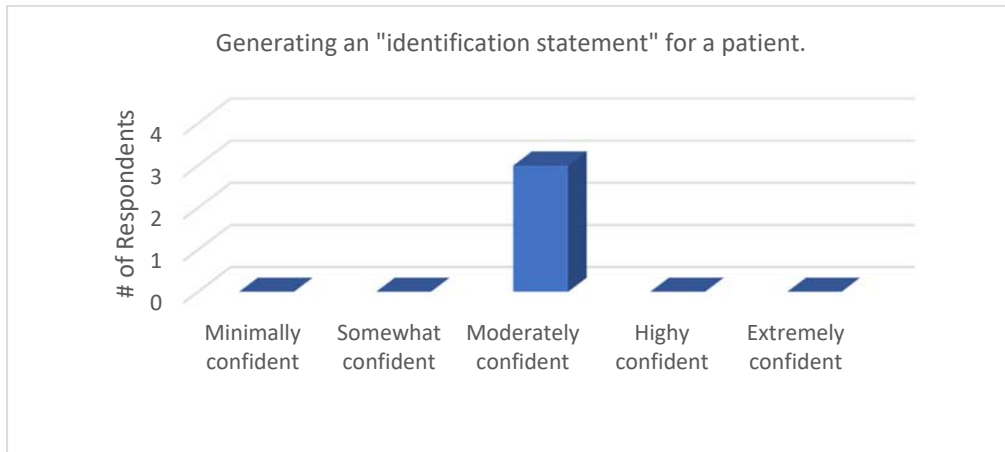
18. Please comment on any **strengths** of the CRE

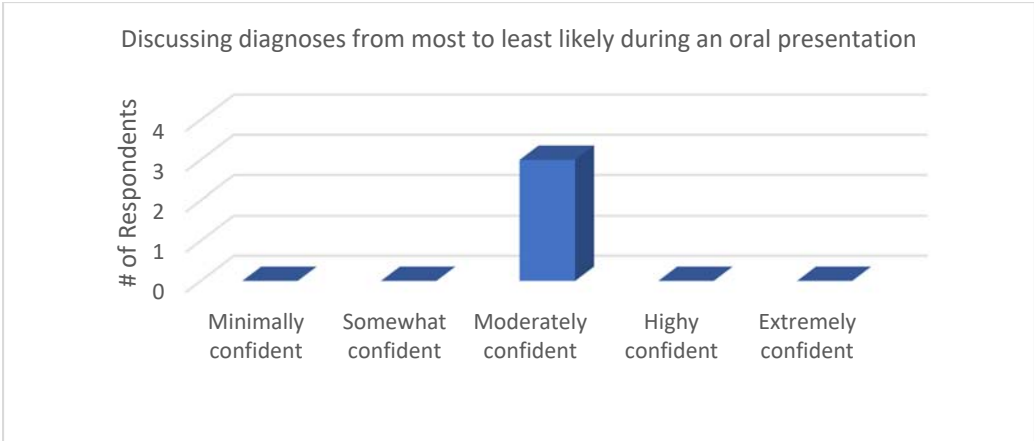
19. Please comment on any **weaknesses** or **ways to improve** the CRE.



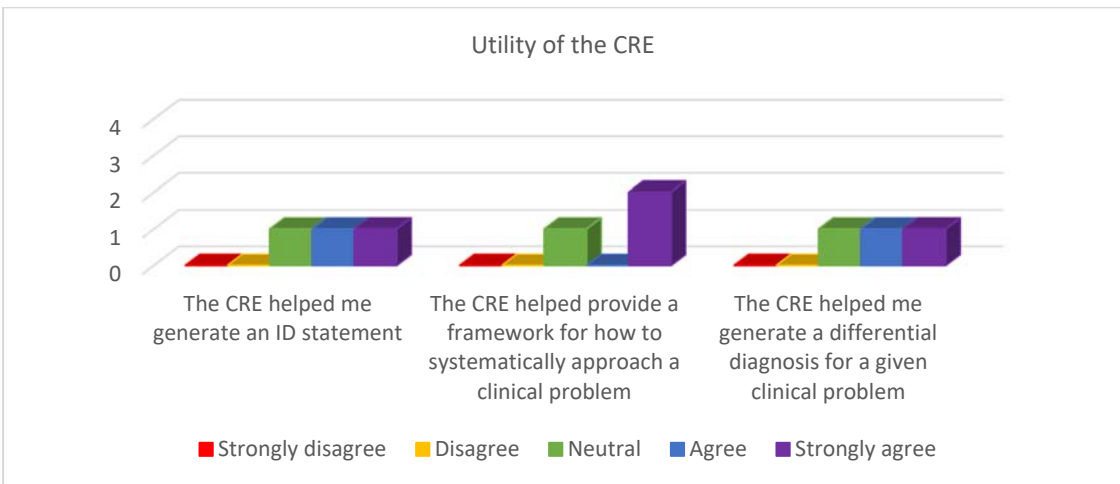
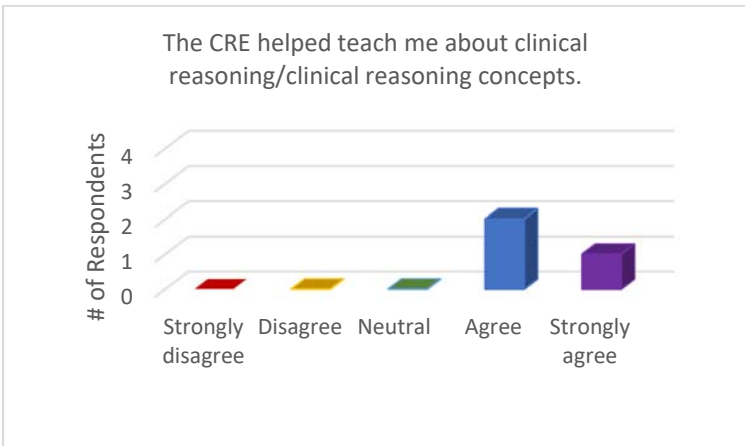


Please rate how confident you are at the following:



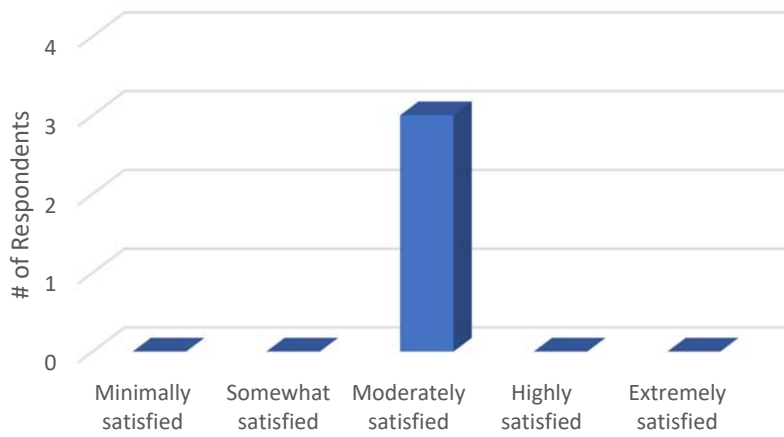


Page 3: CRE Assessment

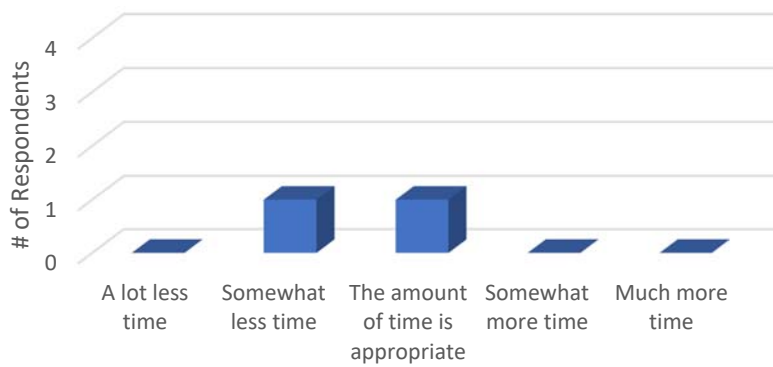


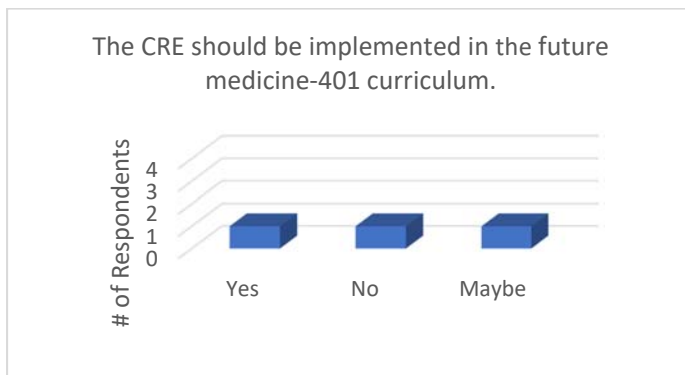
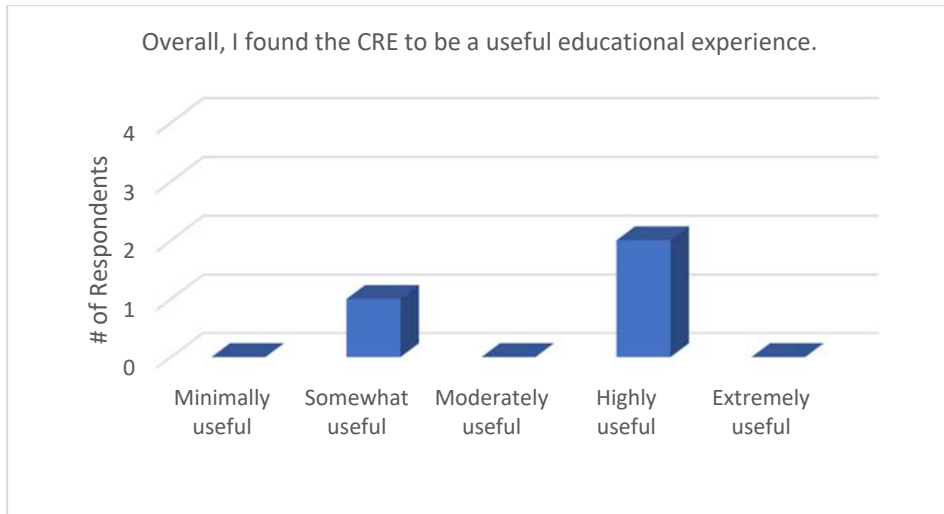
Page 4: Clinical Reasoning Education

How satisfied are you with the quality of clinical reasoning education that you have received at UCSD?



With regards to the current curriculum, how much time should be dedicated to clinical reasoning instruction?





**Please comment on any strengths of the CRE.**

I thought it was helpful to systematically go through the thought process of making a differential diagnosis. I thought presenting the idea of an illness script was also helpful as I had not really heard that term, and it ended up coming up a lot during the inpatient months on medicine.

I thought the CRE was a great tool, and I wish we had more experience with it in first and second year in POM or PBL. It helped frame a differential diagnosis for me or at least guided me in my look up for a differential diagnosis. And I learned a lot from making an illness script and helped me get better at summarizing the most important differentiating characteristics of different diseases.

**Please comment on any weaknesses or ways to improve the CRE.**

I like the idea of the CRE, but I feel like we already have a lot of requirements during our inpatient months, so adding another one seems like a lot. I also think that we go through the process of making a differential diagnosis in the assessment and plan of our H&Ps, so it seemed like we were sort of doing the same thing in a different format for the CRE.

I felt that implementing the CRE to be done on the same night as an H&P was too overwhelming. When I did do the CRE, I did it with my H&P on a long call day, and it was overwhelming working on the CRE which took me about an hour or more as well as complete my H&P after getting home after a long day. I did find the CRE helpful but would recommend not making it required for an H&P night. You could do it on a

patient you're following but not necessarily someone you admit. Or make it part of one of the EBMs rather than adding it as an additional requirement to the Medicine curriculum.