STFM Conference on
Medical Student Education




Aquifer Family Medicine Exam Update and Future Directions with Test-Enhanced Learning

February 1, 2019

Jason Chao, David Anthony, Elizabeth Brown, Martha Seagrave, John Waits, Shou Ling Leong, Bridie Napier, Nancy Weigle, Tomoko Sairenji, Jordan White, Katie Margo, Stephen Scott, Leslie Fall

Disclosures

- Jason Chao, David Anthony, Elizabeth Brown, Martha Seagrave, John Waits, Shou Ling Leong, Nancy Weigle, Tomoko Sairenji, Jordan White, Katie Margo, and Stephen Scott received an annual honorarium for their work from Aquifer.
- Bridie Napier and Leslie Fall are employees of Aquifer.
- Aquifer is a 501 (c)(3) non-profit, and as such is not a commercial entity as defined by the ACCME.
- We would like to acknowledge Aquifer's support, including staff time in preparation for this presentation.

Overview

- Current Aquifer Assessment Tools
- Summary of Aquifer Exam Surveys
- Review of Test-Enhanced Learning
- Aquifer – Future Directions
- Group Discussion

Demonstration of Aquifer Assessment Tools

Two Current Resources

- Self-Assessment Questions – SAQs
- Final Exam Questions - FEQs

Self Assessment Questions

- Grass roots development
  - Student outcry for study tools
- Development
  - Mentored student authors
  - 5 questions per case
  - Proofreading and editing by Editorial Board
- Five questions per case
  - Single Correct Answer
  - Answer Comment

Self-Assessment Questions

- Challenges
  - Maintenance
    - Reviewed with each substantive content review
    - Case Reviewers, Associated Editors, Assessment Lead
  - Standardization
    - Many authors
    - Limited training

Internal Medicine 02: 60-year-old

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RELEASE NOTES

RELEASE NOTES

LEARNING OBJECTIVES

LEARNING OBJECTIVES

QUESTION 1

SAQ

Question

A 58-year-old woman presents to the clinic complaining of chest pain over the past three months. She describes the pain as sharp and stabbing, in the mid-sternal region, lasting for one to two minutes, occurring a few times a day. The pain can come on at rest or with exertion and resolves on its own. It has not become worse since it began. There is no associated diaphoresis, shortness of breath, nausea, jaw pain, or pain with movement, eating, or laying supine. She has a 10-year history of obesity and hypertension for which she takes chlorthalidone. She was recently diagnosed with diabetes, but does not require medication for treatment. Physical examination shows her pulse is 86 beats/minute, respiration rate is 16 breaths/minute, and blood pressure is 135/85 mmHg. Her lungs are clear, heart sounds are normal, and there is no chest wall tenderness to palpation or abdominal tenderness. There is no peripheral edema. How would you best characterize her chest pain?

- [ ] A. Atypical angina
- [ ] B. Gastroesophageal reflux
- [ ] C. Musculoskeletal
- [ ] D. Stable angina
- [ ] E. Unstable angina

SUBMIT

Answer Comment

DIAGNOSES | FINDINGS | NOTES | BOOKMARKS

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SUBMIT

DIAGNOSES | FINDINGS | NOTES | BOOKMARKS

Answer Comment

The correct answer is A.

This woman is experiencing atypical angina. She does not meet the criteria for angina which includes substernal chest discomfort with characteristic duration and features, is exertional in nature and relieved with rest or nitroglycerin. This is considered atypical angina because the pain does not follow the classic pattern of angina; however, it is still possible that the pain is cardiac in origin, especially since atypical features are more common in women and patients with diabetes.

Gastroesophageal reflux typically occurs after meals or while laying flat and is often described as having a burning quality.

Musculoskeletal pain is typically worse with certain movements and associated with chest wall tenderness.

Stable angina would meet the criteria and follow a predictable pattern with exertion.

Unstable angina is characterized by chest pain at rest or with progressively less exertion. Angina with worsening features or new within the past four to six weeks is also considered unstable.

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Family Medicine 05: 30-year-old

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QUESTION 4

SAQ

Question

A 35-year-old woman has been diagnosed with Graves disease and has decided to go for treatment with radioactive iodine (RAI). She has had good relief from taking propranolol for her palpitations. What is the best way to counsel this patient about what to do after her treatment?

The best option is indicated below. Your selections are indicated by the shaded boxes.

- [ ] A. Tell her to stop her propranolol a week after she gets the RAI.
- [ ] B. Check her TSH level two weeks after her treatment with RAI.
- [ ] C. Describe the symptoms of hypothyroidism to her and tell her to expect to become symptomatic within one month.
- [x] D. Check her TSH levels two to three months after her treatment and treat as necessary.

SUBMIT

Answer Comment

The correct answer is D.

The correct answer is (D). The RAI takes several months to destroy the overactive thyroid cells. There is no point in checking the TSH after only two weeks and since she may still be symptomatic from her hyperthyroidism for several months there is no reason to stop her propranolol until she becomes euthyroid. It generally takes a number of months to notice symptoms of hypothyroidism, so while it is important to let her know what to expect in the future you do not want her to have unrealistic expectations.

QUESTION 5

SAQ

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SAQ Evidence

- Seagrave, et al. 2019 (in preparation)
  - 1,738 students at 21 schools
  - SAQ engagement and performance compared to Final Exam
  - 89% of students complete *some* SAQs
  - Performance on SAQs = 76%
    - Average on Aquifer Final Exam is 75.5%
  - Multivariable modeling
    - Number of cases completed predicts exam performance ($\beta = 0.11$, $p < .05$)

BUT

    - Performance on SAQs predicts even better ($\beta = 0.17$, $p < .0001$)

Aquifer Family Medicine Final Exam

- Development
  - From the birth of the fmCASES
  - Trained item writers
  - Rigorous validation over first year, and ongoing
- Maintenance
  - New batches of questions written periodically
  - Face-to-Face review of questions happening at this meeting
  - Ongoing continuous writing, vetting, and validating of more questions
  - Review of FEQs every time content is updated in a case
    - Is the question now out of date?

Aquifer Family Medicine Final Exam

- Nuts and Bolts
  - 100 items
    - (90 validated)
  - Three hours
  - Administered online
  - Different software from NBME
  - Scores returned within 48 business hours
- Exam challenges
  - Cost
  - Limited use as high-stakes assessment
  - Challenges with content updates

Aquifer Final Exam Evidence

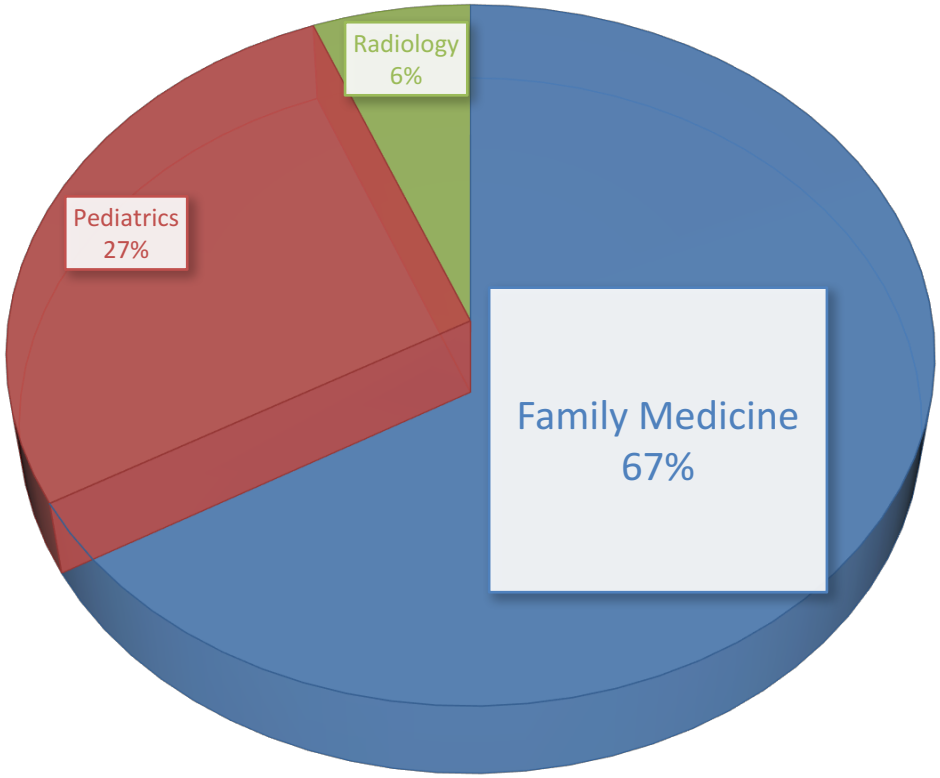
- Sussman, 2012
  - Good correlation with NBME FM exam
- Chessman, et al. 2013
  - 8 schools
  - Best predictor of exam performance was number of cases completed
- Nguyen, et al. 2018
  - NBME exam alone (historical control)
  - Aquifer exam as pretest with NBME as high stakes exam (intervention)
  - Lower failure rate with Aquifer Pretest (8.1% vs 17.5%)
  - Moderate to strong correlation between scores ($\rho = 0.55$, $p<0.001$)

Summary of Aquifer Exam Surveys

- Two different surveys:
  - #1: Current Aquifer Multiple-Choice Exam Users
    - Pediatrics, Family Medicine, Radiology
    - How they are using the exam
    - Gauge reaction to change in exam
  - #2: Schools that don't use Aquifer Multiple-Choice Exams
    - Would they use formative assessment tools if available?
    - What features would be most valuable?
    - Are the formative assessment tools valuable enough to pay for them?

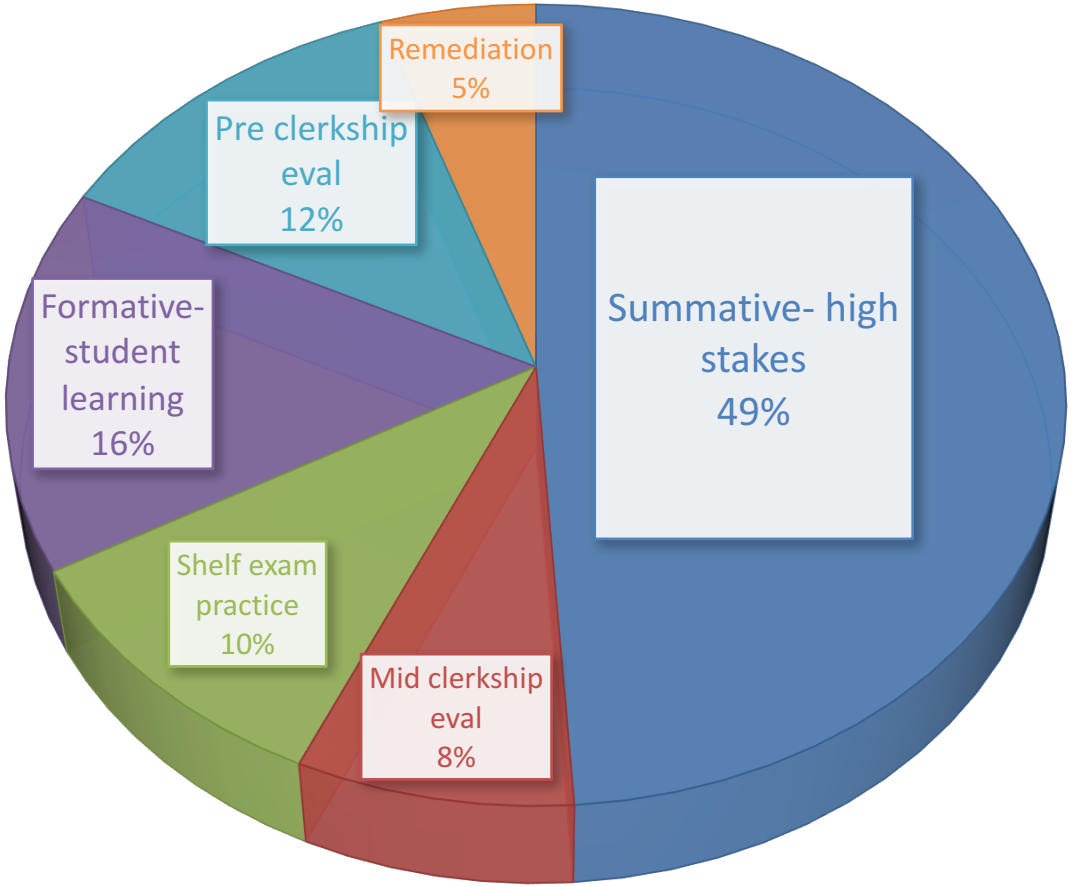
Survey results of those who use exam

Respondents



Survey results of those who use exam

Exam Use



Exam is keystone for 78% users: either for summative feedback / national exam practice

Current exam users

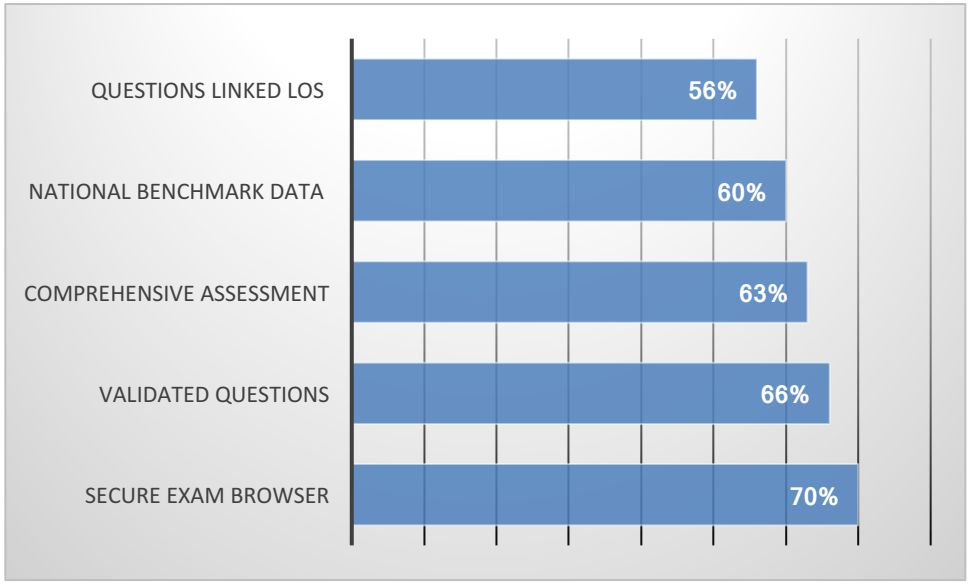
Change in strategy would likely decrease subscriptions as hard to justify paying for Aquifer and the NBME exam

Of those who use the exam

Most important features

- Expert written, validated questions
- Comprehensive assessment
- Exam questions linked to learning objectives
- National benchmark data

Highly satisfied with



Formative assessments

- Mix response on customizable quizzes or progress testing
- Most would use it 1-2 times during their clerkship
- Desire there to be granular feedback and believe it would help improve their performance on testing and care of patient
- 50% strongly agreed that they would require formative assessments if of high quality
- 25% strongly agreed that they would ask their institution to dedicate resources for formative assessments

Most valuable

- Immediate granular feedback to student and faculty linked to curricular objectives
- Customizability
- Comprehensive testing
- Comparison of student's performance to national benchmarks less important but not by a significant amount, only 17%willing to standardize

Aquifer Announcement regarding Final Exam

- 2018 Decision to transition the Aquifer Final Exam to Formative Assessment Design
  - Response to common use of the exam by current Clerkship Directors
  - At end of 2019 / 2020 academic year
  - Change to focus on formative assessment

Test-Enhanced Learning

What is Test Enhanced Learning?

- Test Enhanced Learning in medicine is a pedagogy in which students are assessed as a formative process
- Evolution from assessment OF learning to assessment FOR learning (Schuwirth and Van der Vleuten 2011)

How is it being used?

- Informally
  - Students have been utilizing test enhanced learning for years
    - On-line prep question banks
    - Question bank books
    - Review groups
    - Creating their own practice exams
- Formally
  - Case reviews
  - SP/SIM experiences
  - On-line cases with incorporated questions
  - Self-assessment questions
  - TBL IRAT and GRAT
  - Quizzes or tests

Benefits of Test Enhanced Learning

Research has shown that “retrieval practice” enhances ability to recall, retain and apply information over traditional study methodology

- Effects are consistent for multiple health professions, learner levels, formats and learning outcomes (Green et al. 2018)
- Also found to improve student study behaviors
- Aids in metacognition, identifying areas for further study

Brief Review of the Literature

2009 --Larsen DP, et al. Med Educ. 43:1174–1181.

- Randomized controlled trial pediatric and emergency residents.
- "Repeated testing with feedback appears to result in significantly greater long-term retention of information…"

2014 – Cook, et al. Acad Med, 89: 169–175.

- Crossover trial in 1 IM and 1 FM residency
- "Increasing the number of self-assessment questions improves learning until a plateau beyond which additional questions do not add value."
- "10 questions may be ideal"

2018 – Green, et al. , BEME Guide No. 48, Medical Teacher, 40:4, 337-350.

- 19 studies winnowed down from rigorous exclusion criteria of 6000+ articles
- "TEL demonstrates robust effects across health professions, learners, TEL formats, and learning outcomes. The effectiveness of TEL extends beyond knowledge assessed by examinations to clinical applications. Educators should include TEL in health professions curricula to enhance recall, retention, and transfer."

2018 – Nguyen, et al. Fam Med, 50(2):142-5.

- "fmCASES National Examination is helpful as a formative assessment tool for students beginning their family medicine clerkship. This tool introduces students to course learning objectives, assists them in identifying content areas most in need of study, and can be used to help students design individualized study plans."

2018 – McConnell, et al. CMEJ, 9(3):e83-e88.

- Randomized TEL vs. non-TEL for CME showed no benefit.

What are the characteristics that work

Items that require “production” or recall that requires a student to construct an answer rather than “recognition”, selecting a correct answer from a list e.g. short answer and essay rather than MCQ/T-F

Feedback immediate vs. delayed

Clearly distinguish right and wrong answers and why

Repeated testing

Spacing testing

Equal spacing intervals

Max 10 questions

There may be some enhancement related to the stress of a “test” where there is a consequence—new research on IRATs that count and those that don’t. No research yet on whether IRATs that count have a stronger impact on final exam testing.

Different TEL

- SAQs
- Simulated experiences
- NBME Self-Assessment exams
- AAFP Board Review Questions
- Sloane's Family Medicine Essentials CD
- FM Pretest Self Assessment and Review

Test your knowledge

What is Test Enhanced Learning?

Name 2 benefits of test enhanced learning?

List 3 characteristics of effective test enhanced learning.

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Aquifer Family Medicine Exam – Future Directions with Test-Enhanced Learning

Key Concepts

The most effective study strategies are rarely preferred by students.

	Effectiveness	Students' #1 Strategy
Recall Practice (Self-testing)	High	7%
Self Explanation	Medium	N/A
Summarizing	Low-Medium	4%
Rewriting	Low	12%
Rereading	Low	55%
Highlighting	Low	2%

Dunlosky, John, et al. "Improving students' learning with effective learning techniques promising directions from cognitive and educational psychology."Psychological Science in the Public Interest 14.1 (2013): 4-58. Retrieved at http://psi.sagepub.com/content/14/1/4/T4.expansion.html
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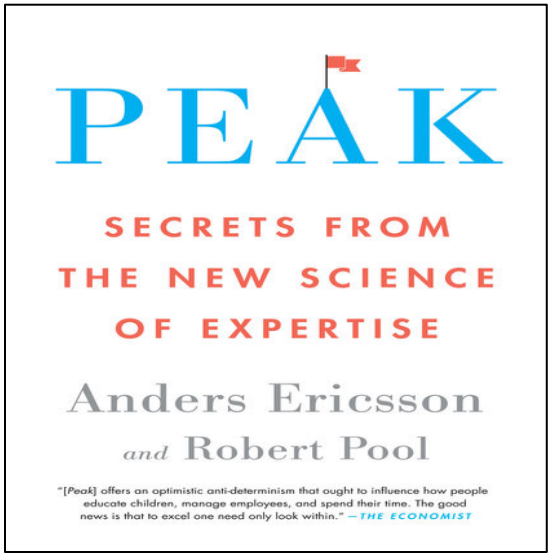
SLIDE Courtesy of Jeff Karpicke

>2/3 of students report using a low utility strategy as their #1 study habit.

Deliberate Practice

- Motivation/attention
- Clear goals
- Focused repetitive practice
- Immediate, informative feedback



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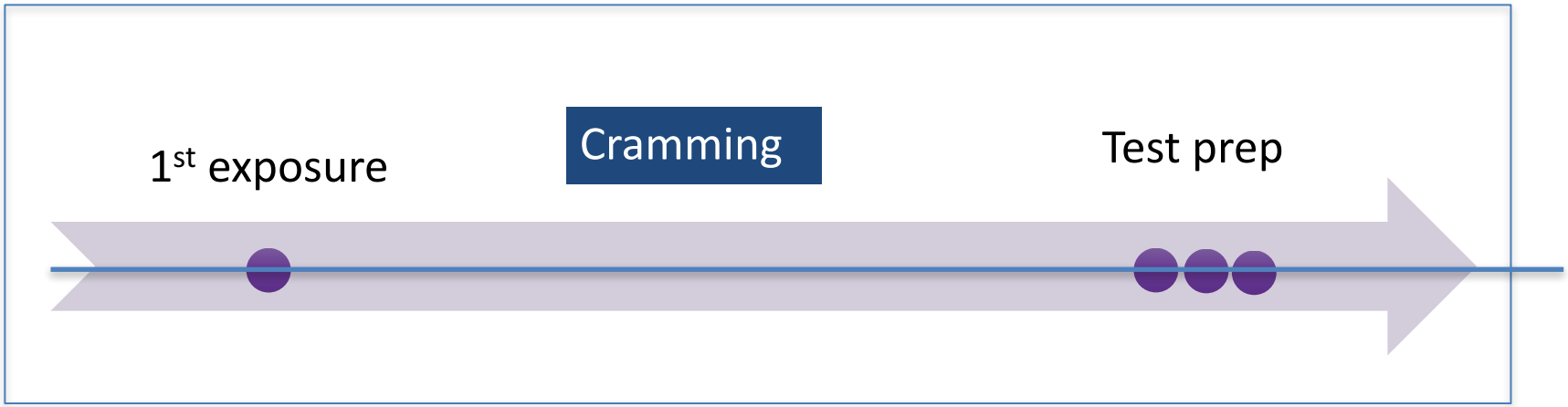
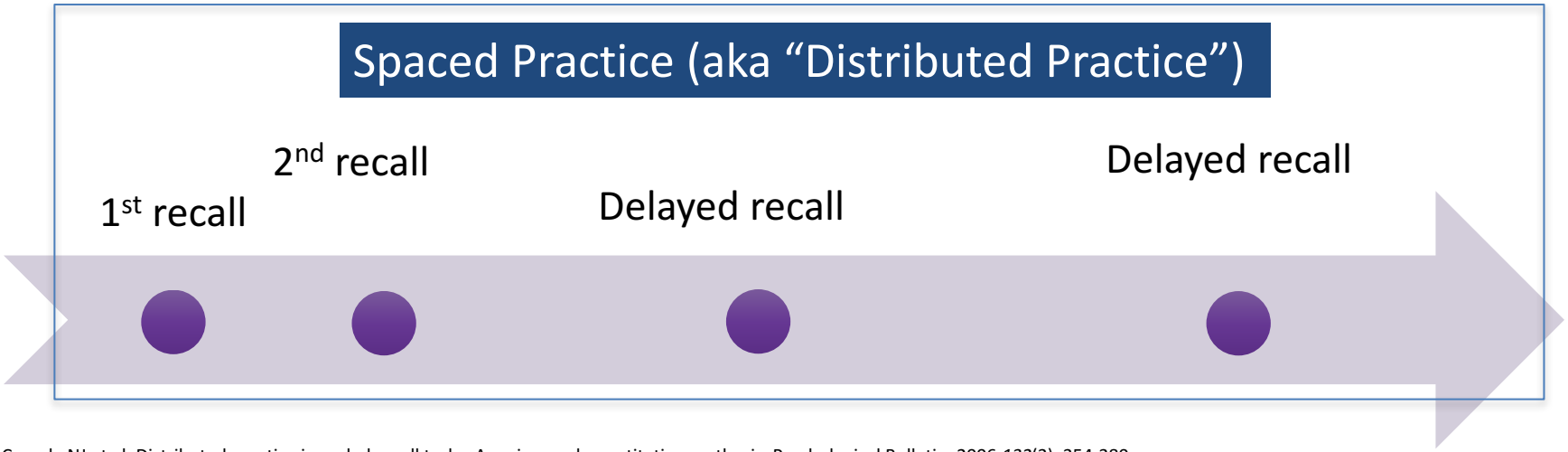
Focused, repetitive practice





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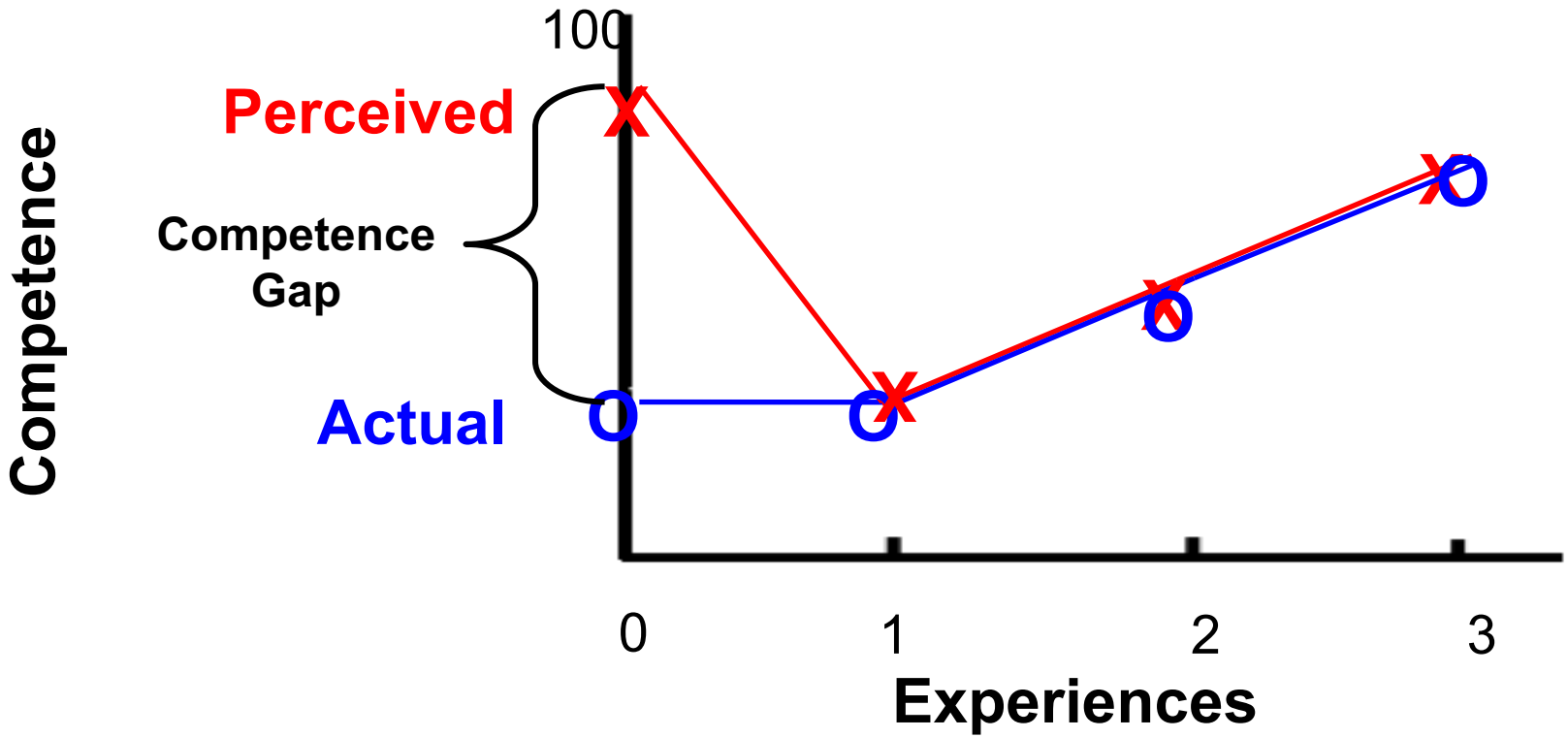
Immediate, informative feedback



Transfer

Application of Key Concepts

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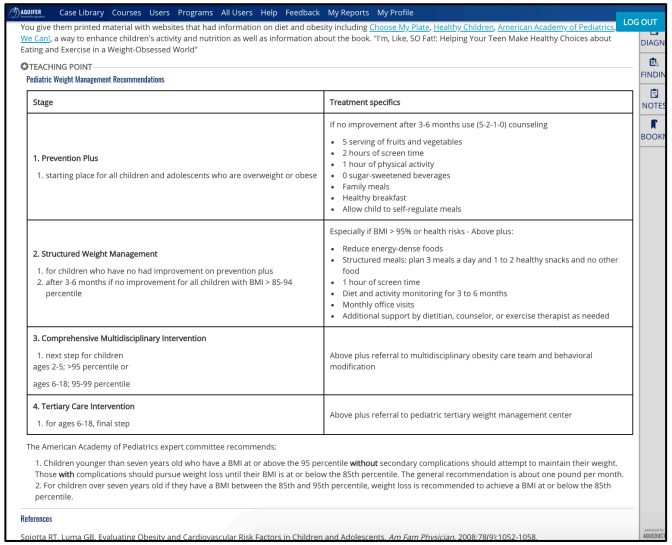
Specific Case Content Feedback



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You give them printed material with websites that had information on diet and obesity including Choose My Plate, Healthy Children, American Academy of Pediatrics, We Can!, a way to enhance children's activity and nutrition as well as information about the book. "I'm, Like, SO Fat!: Helping Your Teen Make Healthy Choices about Eating and Exercise in a Weight-Obsessed World"

TEACHING POINT

Pediatric Weight Management Recommendations

Stage	Treatment specifics
1. Prevention Plus 1. starting place for all children and adolescents who are overweight or obese	If no improvement after 3-6 months use (5-2-1-0) counseling • 5 serving of fruits and vegetables • 2 hours of screen time • 1 hour of physical activity • 0 sugar-sweetened beverages • Family meals • Healthy breakfast • Allow child to self-regulate meals
2. Structured Weight Management 1. for children who have no had improvement on prevention plus 2. after 3-6 months if no improvement for all children with BMI > 85-94 percentile	Especially if BMI > 95% or health risks - Above plus: • Reduce energy-dense foods • Structured meals: plan 3 meals a day and 1 to 2 healthy snacks and no other food • 1 hour of screen time • Diet and activity monitoring for 3 to 6 months • Monthly office visits • Additional support by dietitian, counselor, or exercise therapist as needed
3. Comprehensive Multidisciplinary Intervention 1. next step for children ages 2-5; >95 percentile or ages 6-18; 95-99 percentile	Above plus referral to multidisciplinary obesity care team and behavioral modification
4. Tertiary Care Intervention 1. for ages 6-18, final step	Above plus referral to pediatric tertiary weight management center

The American Academy of Pediatrics expert committee recommends:

1. Children younger than seven years old who have a BMI at or above the 95 percentile **without** secondary complications should attempt to maintain their weight. Those **with** complications should pursue weight loss until their BMI is at or below the 85th percentile. The general recommendation is about one pound per month.
2. For children over seven years old if they have a BMI between the 85th and 95th percentile, weight loss is recommended to achieve a BMI at or below the 85th percentile.

References

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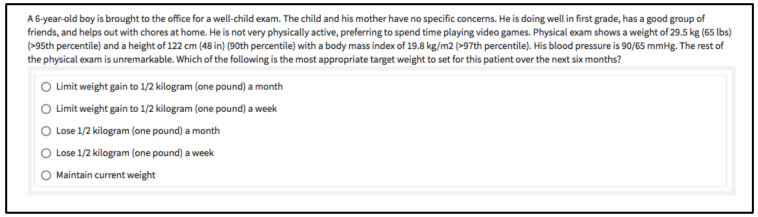
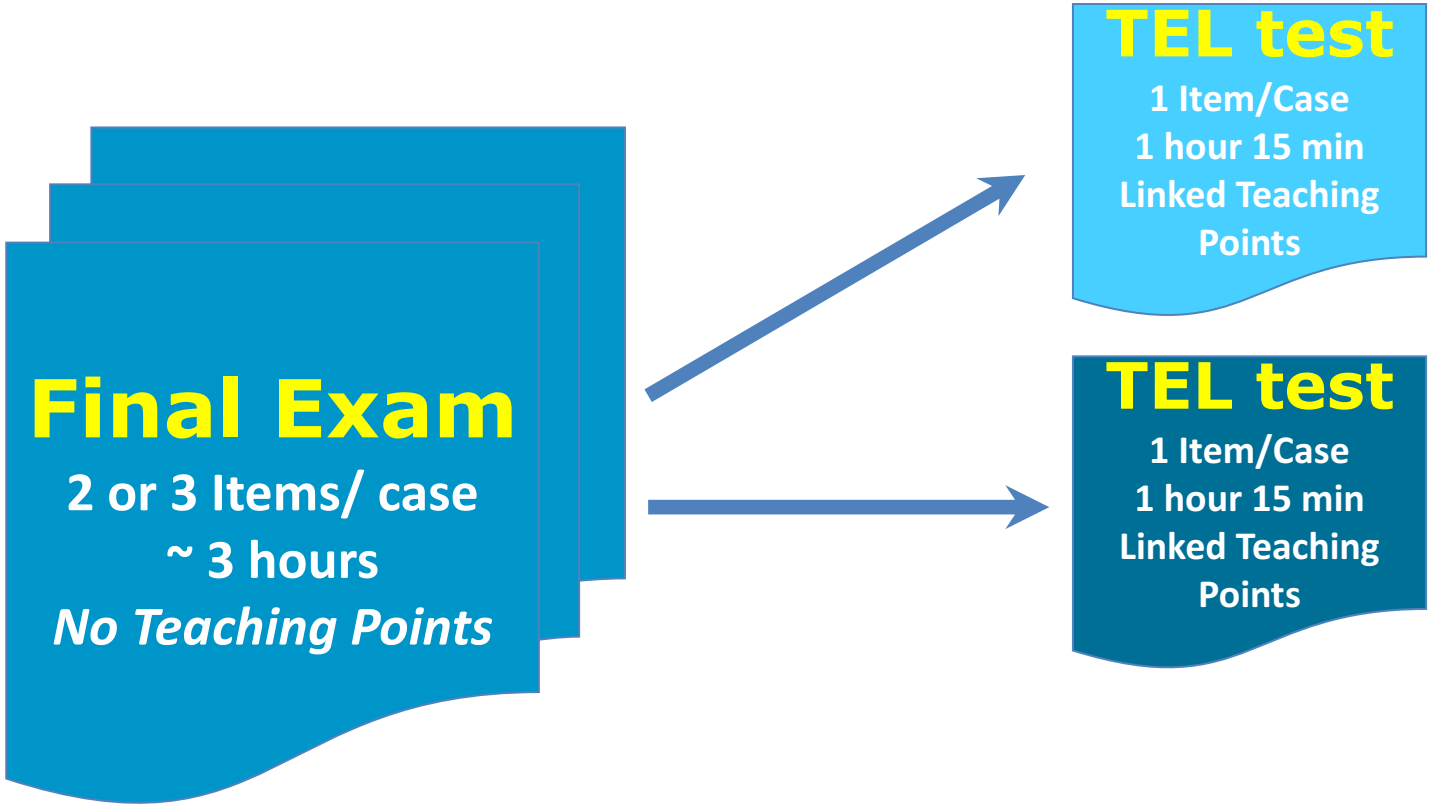
High-Quality Assessment



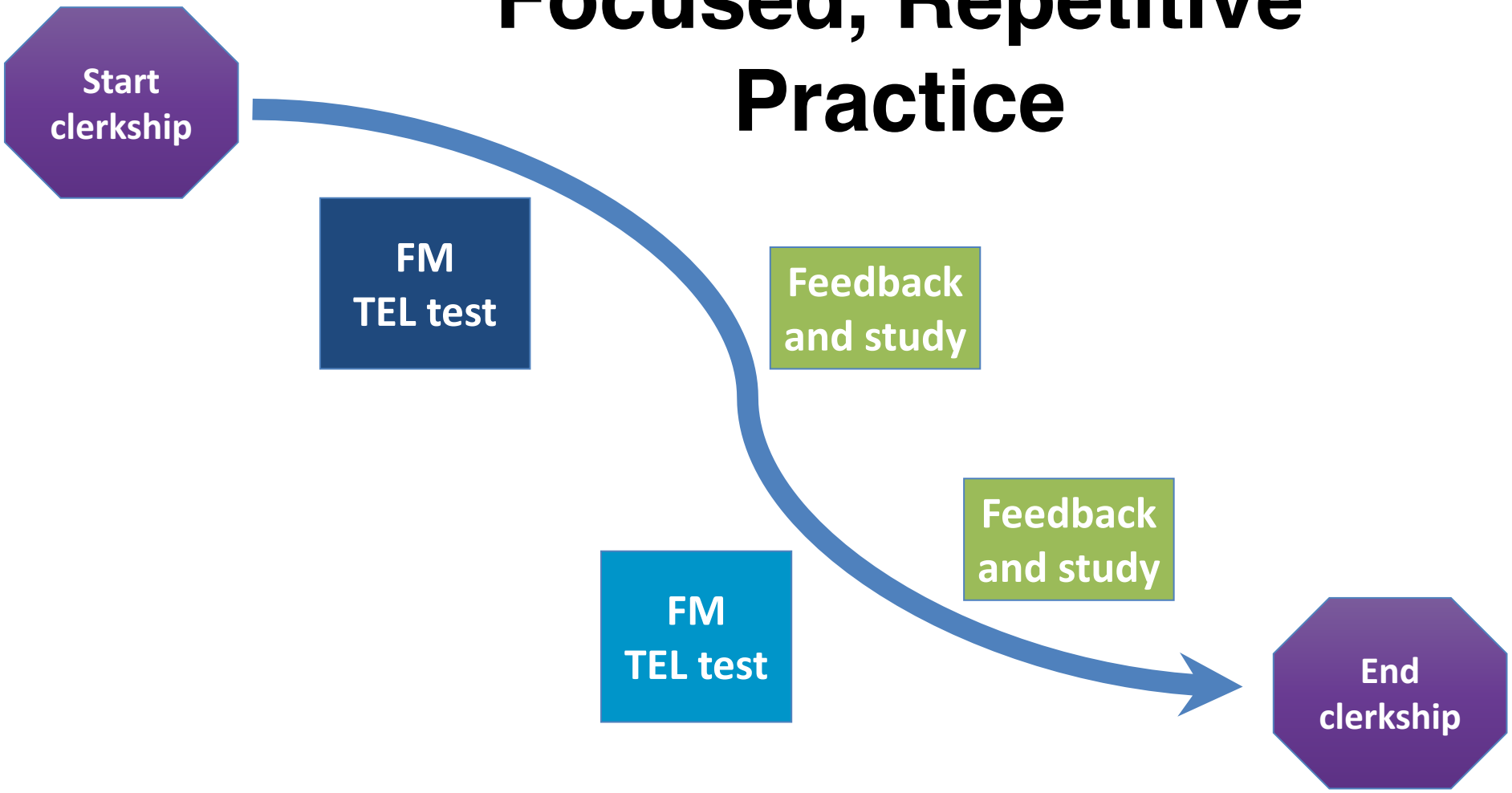
A 6-year-old boy is brought to the office for a well-child exam. The child and his mother have no specific concerns. He is doing well in first grade, has a good group of friends, and helps out with chores at home. He is not very physically active, preferring to spend time playing video games. Physical exam shows a weight of 29.5 kg (65 lbs) (>95th percentile) and a height of 122 cm (48 in) (90th percentile) with a body mass index of 19.8 kg/m2 (>97th percentile). His blood pressure is 90/65 mmHg. The rest of the physical exam is unremarkable. Which of the following is the most appropriate target weight to set for this patient over the next six months?

- Limit weight gain to 1/2 kilogram (one pound) a month
- Limit weight gain to 1/2 kilogram (one pound) a week
- Lose 1/2 kilogram (one pound) a month
- Lose 1/2 kilogram (one pound) a week
- Maintain current weight

Based on STFM Curriculum


Final Exam
2 or 3 Items/ case
~ 3 hours
No Teaching Points
TEL test
1 Item/Case
1 hour 15 min
Linked Teaching Points
TEL test
1 Item/Case
1 hour 15 min
Linked Teaching Points

Focused, Repetitive Practice



Informative Feedback

Answered Correctly			
Case	**Learning Objective**	**Teaching Point**	**Case Completion**
Family Medicine 01: 45-year-old woman wellness visit	Identify risk factors for osteoporosis and appropriate preventative measures.	Risk factors for osteoporosis are mainly due to low estrogen states. Low estrogen states may be caused by early menopause (i.e., before age 45 years), prolonged premenopausal amenorrhea, and low weight and body mass index. Lack of physical activity and inadequate calcium intake (which could be attributable to poor nutrition or alcoholism) are also associated with osteoporosis.	✓
Family Medicine 04: 19-year-old woman with sports injury	Apply evidence-based medicine indications for radiologic evaluation of ankle injury.	**Ottawa Ankle Rules.** The Ottawa ankle rules are a clinical decision tool designed to help in evaluation of adults (age 18 and up) with acute ankle and midfoot injuries. These have been reported to have a sensitivity of 97% to 100%. Recently the rules have also been used to exclude fractures in children greater than five years of age presenting with ankle and midfoot injuries. The rules suggest that radiographs of the ankle are needed if: There is pain in the malleolar zone AND either bony tenderness along the distal 6 cm of the posterior edge of either malleolus OR inability to bear weight 4 steps both immediately after the injury and in the emergency department. Radiographs of the foot are needed if: There is pain in the midfoot region AND one of the following: (a) bony tenderness at either the navicular bone or base of the fifth metatarsal OR (b) inability to bear weight four steps immediately after the injury and in the emergency department.	●

Answered Incorrectly			
Case	**Learning Objective**	**Teaching Point**	**Case Completion**
Family Medicine 06: 57-year-old woman diabetes care visit	Apply evidence-based standards of care to the diagnosis, monitoring, and management of a patient with Type 2 diabetes mellitus.	**Vaccines Recommended for Patients with Diabetes.** Influenza vaccine should be provided to patients with diabetes annually. Pneumococcal 23-valent polysaccharide (Pneumovax) should be provided to all patients with diabetes over 2 years of age. A one-time revaccination is recommended for patients over 64 years of age if the vaccine was first received greater than five years ago. Hepatitis B vaccine should be administered to all unvaccinated adults with diabetes, HIV, other immunocompromising conditions, or liver disease. There is evidence that patients with diabetes are at increased risk for developing hepatitis B, perhaps due to the frequent use of needles for injectable medications and glucometers. http://www.cdc.gov/vaccines/schedules/downloads/adult/adult-schedule.pdf	✓

Frequently Asked Questions

Can we continue to use this as our final exam?

- As of July 2020, these assessment tools are designed for formative assessment.
- You may choose to combine two test-enhanced learning forms and provide them as a summative assessment.
- We will provide the overall score to you for each student.
- Proctoring is required.
- The same questions will be used for formative assessment.
- No national benchmarking will be provided.

Will proctoring be required?

- If using two test-enhanced learning forms combined for summative purposes, yes.

- If using individual test-enhanced learning for formative assessment, we are still investigating the options.

Discussion Topics

Discussion Topic #1

Dashboards & Reporting

Discussion Topic #2

Confidence Rating

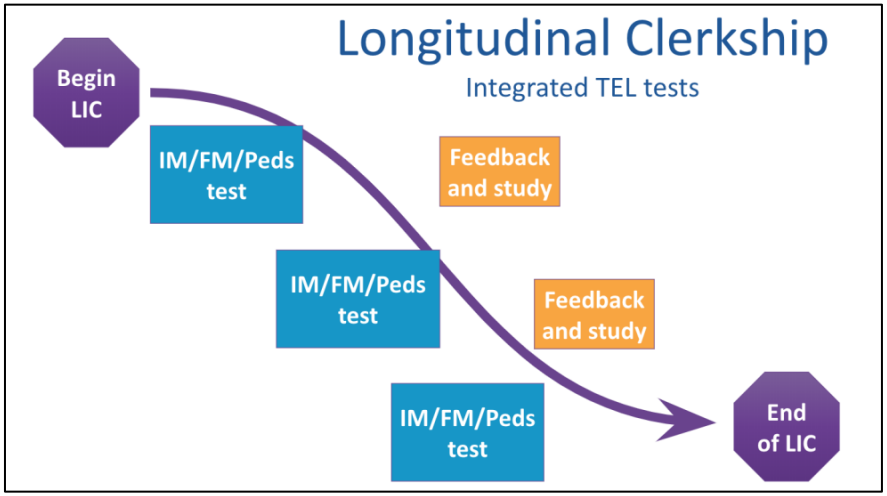
&

Coaching

Teaching Points	Case Completed	Aquifer Coach Recommends
Answered correctly, and you were fairly certain you got it right		
Beta blockers should be used as first line therapy for hypertension in patients with coronary artery disease.	✓	Well done! Doing your cases really paid off. It's helpful to review these teaching points so you don't forget, but you will want to prioritize other material for more intense study.
Viral meningitis cannot be distinguished from bacterial meningitis without analysis of the CSF.	●	Well done! There are lots of other important concepts in the cases, too. We suggest that you review cases 2 and 10, but only after you review the other cases below.
Answered correctly, but you were pretty uncertain you knew it		
C difficile should be considered in the differential diagnosis of diarrhea in a patient who was recently on antibiotics.	✓	Well done! Doing your cases really paid off. We recommend you review the teaching points and ask yourself what you weren't sure about. Consider bringing these teaching points to one of your faculty to help understand why you're still uncertain. Then focus more of your studying on other cases below.
Screening tests should take into account the patient's age and goals. The USPSTF guidelines should be used to guide your recommendations.	●	You may have felt uncertain because you haven't done the cases yet. We recommend working through cases 7 and 17.
Answered incorrectly, and you were pretty uncertain you knew it		
Urinalysis should not be routinely checked in geriatric patients with delirium, unless there are other signs or symptoms of UTI.	✓	Even though you did the cases, you appropriately recognized you didn't master the material. Consider bringing these teaching points to one of your faculty to help understand where you're having difficulty.
Septic arthritis should be considered in the differential diagnosis of acute monoarticular arthritis.	●	This material may look unfamiliar to you, and you appropriately recognized that! Accurately recognizing areas of uncertainty is very important in medicine, and we'd like to help you fill in the gaps. We recommend doing case 22.
Answered incorrectly, though you were pretty certain you knew it		
In patients with hyponatremia, it is important to correct the serum sodium slowly, preferably less than 10 mEq/24 hours, to avoid osmotic demyelination.	✓	We recommend resetting cases 5, 14, and 28, and working through them again. Make sure you limit distractions so you can focus. Also, be sure to answer the questions in the case and after the case (SAQs). Consider bringing these teaching points to one of your faculty to help understand where you're having difficulty.

Discussion Topic #3

- Family Medicine
- Internal Medicine
- Pediatrics
- Radiology



Discussion Topic #4

How can we best meet your formative assessment needs?

Please evaluate this presentation using the conference mobile app! Simply click on the "clipboard" icon on the presentation page.