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**Supplementary Data**

## Appendix 1: Creation of training videos and expert answer keys

First we iteratively created a matrix of important behaviors for history taking and counseling using evidence-based recommendations.[23-28] The group discussed how to characterize residents whose history taking and counseling skills were aspirational compared to residents who require direct or indirect supervision.[29] The group worked to reach consensus about which observable behaviors and combinations of behaviors would be necessary for different resident skill levels.[29] Multiple resident phenotypes or exemplars were created for each learner level and these exemplars were then assigned to different clinical conditions (e.g. chest pain, diabetes management). The group created a robust matrix to ensure that all relevant behaviors were included in the videos and that the exemplars covered a breadth of different learner phenotypes for history taking and counseling. Using this matrix, one investigator (JK) wrote stimulus video scripts with careful attention to subtle differences in performance and with a focus on observable behaviors and skills.[29] Scripts were developed from highest to lowest performance levels. [29] The six experts and study investigators (ES, LC) reviewed and edited the scripts to ensure they accurately represented the resident phenotype, designated performance level and specified behaviors and skills. Videos, with actors trained to portray both the resident and patient, were filmed with real-time oversight (JK, EH, MS) to ensure actor performance accurately represented each script.[29] To ensure the video represented the exemplar and that the behaviors/skills were accurately represented, all videos were reviewed by an expert who had reviewed the script before filming plus two experts who had not seen the script and who were blinded by the scripted performance level.[29] All feedback on the assessment videos was combined by a study author (JK) to create an answer key for each case that had the expert informed consensus entrustment rating and narrative assessment.

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**Appendix 2: Components of Rater Training Faculty Development**

- Rationale for and the importance of direct observation (Day 1)
- Performance Dimension Training: History Taking (Day 1); Counseling (Day 2)[a]
    - Participants watched a stimulus video of a resident taking a history from or counseling a patient and completed a rater assessment form. The resident was scripted as requiring indirect supervision.
    - Participants shared their ratings and rationale for their ratings including the standard they used to select their rating.
    - Participants worked in small groups of 4-6 to develop a list of behaviors that constituted aspirational history taking or counseling.
    - Groups were given an evidence-based framework of behaviors associated with effective history taking or counseling and were asked to compare the framework to the list of behaviors they had identified.
    - Groups were then asked to apply their framework back to the video.
- Frame of Reference Training: History Taking (Day 1), Counseling (Day 2)
    - Participants discussed what framework items were necessary for a patient to receive safe effective patient centered care.
    - Participants were asked to make a prospective entrustment decision using their framework.
    - Participants watched a video of the same case with the resident performing at a level requiring direct supervision.
    - Participants then watched a video of the same case with the resident not needing supervision.
- Asynchronous Online Spaced Learning (SL) (3 sessions)[b-d]
    - Participants watched a video of a resident taking a history, rated the resident and compared their assessment to the expert. They then watched a second video of the same scenario at a different level, rated the resident and compared their assessment to the expert. The third video in the series was optional.
    - Participants posted to a discussion board similarities and differences between their assessment and that of the expert.
    - The identical sequence described above was also done for a counseling video.
    - A similar sequence was repeated for Spaced Learning 2 and 3

[a] In-Person Workshops: Resident taking a history from a 58-year-old (yo) man with chest pain who recently lost his job (indirect supervision->direct supervision-> aspirational). Resident counseling a 54 yo woman with hypertension, hyperlipidemia, obesity, and tobacco use who meets criteria to start lipid lowering therapy (indirect supervision->direct supervision-> aspirational).

[b-d] Spaced Learning 1: Resident taking a history from a 40 yo woman with a history of migraines presenting with worsening chronic daily headaches in the setting of stress managing work, school, and caring for an ill parent (indirect supervision->aspirational-> direct supervision). Resident counseling a 70 yo with hypertension and coronary artery disease who presents with progressive lower edema, shortness of breath for 4 weeks, and volume overload on exam (indirect supervision-> direct supervision-> aspirational).

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Spaced Learning 2: Resident taking a history from a 60 yo woman with hypertension, poorly controlled diabetes, obesity, chronic low back pain who presents with progressive bilateral lower extremity edema, frustrated with the number of medications she needs to take and inability to lose weight (direct supervision->indirect supervision->aspirational). Resident counseling a 49 yo healthy woman with worsening constipation for three months, episodic hematochezia, paternal grandfather with late onset colon cancer and a hemorrhoid on rectal exam (indirect supervision->aspirational->direct supervision).

Spaced Learning 3: Resident counseling a 68 yo woman with uncontrolled diabetes (HgA1c 8.4%) and hypothyroidism (last TSH 10) presenting for a routine follow-up visit who is non-adherent to medication secondary to social stressors (direct supervision->aspirational->indirect supervision). Resident taking a history from a 75 yo woman with hypertension with a recent onset of falls in the setting of a medication change (indirect supervision->aspirational->direct supervision).

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**Appendix 3: Focus Group Interview Guide**

We are going to ask you some questions about the rater training workshops that you did. We are going to start with some broad questions about your overall thoughts about the rater training workshops. Then we are going to focus on some more specific questions about some of the particular components of the training, if you thought it was effective, and why it was or was not effective. We would like to start by having you take 5 minutes to write down on your 3x5 card which components of the workshop yesterday and today were most useful to you and why. It is the mechanism question we are really interested in. That is, for whatever you thought was useful, we would like to know what made it useful. [Allow up to 5 minutes of writing time. Can move on if participants look like they have finished writing]. Now that you have each written down a few things, let's talk about it.

**1. What do you think were the most useful components and what about it was useful?**

[Allow individuals to share their responses. Write answers on flip chart. Probe if others feel similarly or different. Probe to elucidate what the mechanism is of why it was effective or how it will change what they do when working with residents. If there are components that are ineffective, probe why it was ineffective and what might make it more effective. Allow all ideas to come forth]. We have discussed many components of the workshop that individuals found useful. Just to summarize, we talked about (INSERT LIST FROM FLIP CHART). Just to get a quick sense of what was most effective, I would like you, by show of hands, to indicate which of these components you think was most helpful. [READ LIST AND MAKE NOTE OF HOW MANY INDIVIDUALS RAISE THEIR HAND FOR EACH ITEM]

So that was really helpful. Now we are going to dive deeper into the particular components of the workshops and talk about them in more detail. There were several parts to the workshops you did. You talked about why direct observation is important and factors that influence the variability of ratings. You did performance dimension training. That was when you created the lists of behaviors that compromise outstanding history taking and outstanding counseling. You also did frame of reference training. That was when you watched three videos of the same scenario at three different resident skill levels. You also brainstormed ways to increase observation and you had a mini-workshop on feedback. If we have time we will talk about each of these components, but we would like to start by talking more specifically about the frame of reference training which is the newest addition to the faculty development workshop.

**2. What are your thoughts about usefulness of watching the multiple videos of the same encounter performed at different resident skill levels and what exactly made it useful or not?**

a. What would you change about this to make it more effective?

**3. What are your thoughts about usefulness of doing performance dimension training where you created behavioral lists of skills needed for history taking and counseling? What made that useful, or not?**

a. What would you change about this to make it more effective?

**4. What are your thoughts about usefulness of the feedback workshop? What made that useful, or not?**

a. What would you change about this to make it more effective?

**5. So, let's look at the big picture of the rater training workshops again. Thinking about everything we have discussed, how would you change the faculty development to make it more effective?**

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a. What, if anything, should be added to the faculty development to make it more effective? Why would this addition make it more effective?

b. What, if anything, should be eliminated from the faculty development approach to make it more effective?

c. We are almost done here- what final thought – good or bad – do you have for us that would lead to a better session in the future?

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**Appendix 4: Follow-up Survey of Frame of Reference Training**

Thank you for participating in this study! Data will only be analyzed in aggregate; individual responses will not be reported. Click NEXT at the center/bottom of each screen to move to the next question and to save your responses. Click DONE to submit the completed survey.

Enter your study ID (free text)

SPACED LEARNING

Thinking about the SPACED LEARNING modules you worked on in Canvas, please indicate your level of agreement with each of the following statements:

| | **Strongly Disagree** | **Disagree** | **Neutral** | **Agree** | **Strongly Agree** | **NA** |
|---|---|---|---|---|---|---|
| Spaced learning was a valuable addition to the in-person rater training. | | | | | | |
| Spaced learning helped me to increase how often I do **direct observation**. | | | | | | |
| Spaced learning improved my skills in direct observation of **history taking**. | | | | | | |
| Spaced learning improved my skills in direct observation of **counseling** | | | | | | |
| Spaced learning helped to improve my **feedback** to learners | | | | | | |
| Spaced learning improved my skills in selecting an assessment/entrustment rating. | | | | | | |
| The expert answer keys were a valuable resource | | | | | | |
| The in-person workshop was important to have before doing spaced learning | | | | | | |

In what way, if at all, did the in-person workshop prepare you for spaced learning? (free text)

The **number** of spaced learning modules was

- □ Not enough
- □ Just right
- □ Too many

The **time between** each of the three spaced learning modules was

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□ Too short
□ Just right
□ Too long

The **amount of time I was given to complete each** spaced learning module was

□ Too little
□ Just right
□ Too much

The **amount of work** in each spaced learning module was

□ Not enough
□ Just right
□ Too much

Please describe strengths, if any, of the spaced learning for improving your skills in direct observation (free text).

Please describe ways, if any, in which the spaced learning could be improved to improve your skills in direct observation (free text).

What, if anything, kept you from participating spaced learning? (free text)

OVERALL

Please indicate your level of agreement:

| | **Strongly Disagree** | **Disagree** | **Neutral** | **Agree** | **Strongly Agree** | **NA** |
|---|---|---|---|---|---|---|
| The in-person workshop helped to improve my feedback to learners | | | | | | |

Thinking about **all** of faculty development training you had during this study (in-person training, spaced learning) and materials you received as a part of this study (frameworks, observation tip sheets, videos, expert answers)...

...what, if anything, was most effective in helping you to improve your skills in direct observation? (free text)

…what, if anything, would need to be improved or added to help you to improve your skills in direct observation? (free text)