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# Military Acute Concussion Evaluation 2 (MACE 2) Training

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*Student Workbook*



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Defense and Veterans Brain Injury Center

Military Acute Concussion Evaluation  
2 (MACE 2):  
Revision Update and Tutorial

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Red Flags previously appeared in the Concussion Management Algorithm (CMA); now in the assessment tool (MACE 2). Observable signs came from the Concussion Recognition Tool (CRT) that was released when the SCAT 5 (sports concussion assessment tool) was released. Observable signs came from video taping on the playing field of those who sustained a concussion. These visual cues may suggest a concussion occurred.

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Learning Objectives

- At the conclusion of this training, participants will be able to:
  - Distinguish high level changes in the Military Acute Concussion Evaluation 2 (MACE 2) including specific updates and evidence to support:
    - Red flags
      - Brain injury detection device
    - History questions
      - Expanded assessment by the addition of the Vestibular Ocular Motor Screening (VOMS), cervicogenic symptoms and enhanced balance assessment
  - Show how MACE 2 improves the current standard of care for Traumatic Brain Injury (TBI) management.

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Neuro exam broken out to provide more clarity; also balance sequelae is emerging as a significant domain affected that needs to be evaluated

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## Key Changes

**Concussion screening:**

- Red flags added indicating when to stop the MACE 2 and immediately consult higher level of care and consider urgent evacuation
- New observable signs checklist added
- Symptoms checklist moved to screening section
- More detailed history and follow-up instructions

**Neurologic exam:** expanded speech and balance testing

- **Vestibular/Ocular-Motor Screening (VOMS):** added

**Updated diagnostic codes**

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VOMS: recent literature shows that the visual system uses 30 areas of the brain and seven of the 12 cranial nerves, and the system can be affected by brain injury. There are also shared anatomic pathways between eye movements, attention/concentration, spatial abilities and vestibular system  
The exam summary page has been updated to better capture history and VOMS data.

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## Card Features

- MACE 2 card design easier to use:
  - **Black text → action**
  - **Gray text → Key questions** (helpful hints & assessment tips - typically appear on the right side of the card)
  - **Italics text → Cue to read instructions exactly as written**
  - Check boxes 
    - New check boxes replaced bullets to ensure attention and action

**A. Record the event as described by the service member or witness.**  
Use open-ended questions to get as much detail as possible.

Key questions:  
 → Can you tell me what you remember?  
 → What happened?  
 → Who were you last with?

**B. Observable Signs**  
 At the time of injury were any of these observable signs witnessed?  
 Visual clues that suggest a possible concussion include:

→ Lying motionless on the ground	→ Balance difficulties
→ Slow to get up after a direct or indirect blow to the head	→ Stumbling, or slow labored movements
→ Disorientation, confusion	→ Facial injury after head trauma
→ An inability to respond appropriately to questions	→ Negative for all observable signs
→ Blank or vacant look	

**Trial 1 script:** Read the script exactly as written.  
 • "I am going to test your memory. I will read you a list of words and when I am done, repeat back to me as many words as you can remember, in any order."  
**Trial 2 and 3 script:** Read the script exactly as written.  
 • "I am going to repeat that list again. Repeat back to me as many words as you can remember, in any order, even if you said them before."

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### How to Administer the MACE 2

- MACE 2 is most effective when used as close to the time of injury as possible. The MACE 2 may be repeated to evaluate recovery
- Administer in sequence
- Use scripts when provided
- Use in conjunction with clinical judgment, the Concussion Management Tool (CMT) and clinical recommendations
- Factors such as sleep deprivation, medications, or pain may affect MACE 2 results

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Sequence: except for ruling out Red Flags ASAP (continuing to look for them throughout the evaluation), the rest of the MACE 2 should be conducted in sequence.

Here is foundational information for administering the MACE 2:

Providers and trained nurses or corpsmen/medics should administer the MACE 2. It is important to administer the MACE 2 in the sequence in which the questions are presented. Follow the provided script exactly and do not provide the patient with hints or answers.

Do not make up word lists or number strings for the patient: the cognitive test is standardized and depends on the verbatim statements.

Additional factors to consider when weighing MACE 2 results include, deployment related stress such as difficulty tracking day/time, chronic stress, high adrenaline sustained over time, sleep deprivation, medications, additional co-morbidities etc.

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### CONDUCTING CONCUSSION SCREENING



**MACE 2 is to be used as close to time of injury as possible.**

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### Concussion Screening

- Red Flags
- Concussion Screening
  - Description of incident (includes new observable signs list)
  - Alteration of conscious
  - Symptoms
  - History
- Screening Results
  - Service Member (SM) Instructions

Unclassified    **"Medically Ready Force...Ready Medical Force"**    2

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### Identify Red Flags

**RED FLAGS**

Evaluate for red flags in patients with Glasgow Coma Scale (GCS) 13-15.

<ul style="list-style-type: none"> <li>❑ Deteriorating level of consciousness</li> <li>❑ Double vision</li> <li>❑ Increased restlessness, combative or agitated behavior</li> <li>❑ Repeat vomiting</li> </ul>	<ul style="list-style-type: none"> <li>❑ Results from a structural brain injury detection device (if available)</li> <li>❑ Seizures</li> <li>❑ Weakness or tingling in arms or legs</li> <li>❑ Severe or worsening headache</li> </ul>
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Defer MACE 2 if any red flags are present. Immediately consult higher level of care and consider urgent evacuation according to evacuation precedence/Tactical Combat Casualty Care (TCCC).

- ❑ **Negative for all red flags**  
Continue MACE 2, and observe for red flags throughout evaluation.

- New Red Flag: Abnormal result from brain injury detection device (if available)

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## Identifying Concussion

- Concussion screening should determine:
  - If emergent care should be provided to the SM
  - If the SM meets Department of Defense (DoD) concussion criteria



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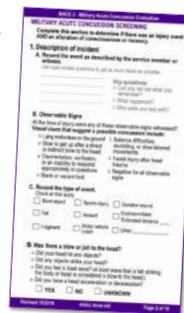
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## Concussion Screening - 1. Description of Incident

- Complete this section to determine if there was both an injury event and an alteration of consciousness (AOC)
- Establish details of the latest incident, including:
  - A. Record the event as described by the SM or witness.
  - B. Record observable signs.
  - C. Record the type of event.
  - D. Was there a blow or jolt to the head?
- Use “Key Questions” to get as much detail as possible



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## Concussion Screening 2. Alteration of Consciousness or Memory

- A. Was there alteration of consciousness (AOC)?\*
- B. Was there loss of consciousness (LOC)?\*
- C. Was there post-traumatic amnesia (PTA)?\*
- D. Was an AOC/LOC/PTA witnessed or observed?

Reminder: Use the key questions to ensure the SM provides yes or no answers.

**\* If the SM responds "yes" ask how long they were affected (seconds, minutes)**

**2. Alteration of Consciousness or Memory**

**A. Was there alteration of consciousness (AOC)?**  
AOC is temporary confusion or "seeing your feet wrong."  
 YES  NO  
If yes, for how long? \_\_\_\_\_ seconds  
 UNKNOWN \_\_\_\_\_ minutes

**B. Was there loss of consciousness (LOC)?**  
LOC is temporary passing out or "blacking out."  
 YES  NO  
If yes, for how long? \_\_\_\_\_ seconds  
 UNKNOWN \_\_\_\_\_ minutes

**C. Was there any post-traumatic amnesia (PTA)?**  
PTA is a problem remembering part or all of the injury events.  
 YES  NO  
If yes, for how long? \_\_\_\_\_ seconds  
 UNKNOWN \_\_\_\_\_ minutes

**D. Was the AOC, LOC or PTA witnessed?**  
 YES  NO  
If yes, for how long? \_\_\_\_\_ seconds  
 UNKNOWN \_\_\_\_\_ minutes

**Key questions:**  
 a. Were you dazed, confused, or did you "see stars" immediately after the event?  
 b. Did you feel like you were in a fog, slowed down, or something was not right?  
 c. Did you pass out or block out?  
 d. Is there a period of time you cannot account for?  
 e. Is there a period of time you cannot account for?  
 f. What is the last thing you remember before the event?  
 g. What is the first thing you remember after the event?

**Tips for assessment:**  
 a. Ask witness to verify AOC, LOC or PTA, and estimate duration.

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## Concussion Screening 3. Symptoms

- Screens for common concussion symptoms:
  - Read list of symptoms to the SM
  - Check the box if they answer "yes" (symptoms are either present or not)
  - Check "Negative for all symptoms" if no symptoms are present

**3. Symptoms**  
Common symptoms after a concussion are listed below. For this event, check all that apply.

<input type="checkbox"/> Headache	<input type="checkbox"/> Difficulty concentrating
<input type="checkbox"/> Dizziness	<input type="checkbox"/> Irritability
<input type="checkbox"/> Memory problems	<input type="checkbox"/> Visual disturbances
<input type="checkbox"/> Balance problems	<input type="checkbox"/> Ringing in the ears
<input type="checkbox"/> Nausea/vomiting	<input type="checkbox"/> Other _____
<input type="checkbox"/> Negative for all symptoms	

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## Concussion Screening 4. History

- Ask the SM if they had a concussion during the last 12 months, had headaches prior to the injury and if they have been diagnosed with depression, anxiety or another behavior disorder.
  - The answer to question 4.A impacts rest (recovery) times

**4. History**

**A. During the past 12 months, were you diagnosed with a concussion, not counting this event?**  
 YES  NO  
 If yes, how many? \_\_\_\_  
 UNKNOWN

**B. History of diagnosed/treated headache disorder or migraine.**  
 YES  NO

**C. History of depression, anxiety, or other behavioral health concerns.**  
 YES  NO

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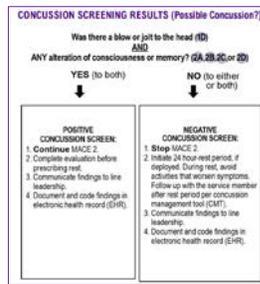
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## Concussion Screening Results

- Positive concussion criteria:
  - A blow or jolt to the head **1D** *and*
  - If the patient experienced any *one* of these conditions: (answered Yes)
    - An alteration of consciousness (AOC) **2A**
    - A loss of consciousness (LOC) **2B**
    - Post traumatic amnesia (PTA) **2C**
    - The patient's AOC/LOC/PTA was observed by someone at the scene of the injury event or during the screen **2D**



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# Clinical Case Scenario #1:

## When to Use the MACE 2

### Directions

The following activities provide an opportunity to practice applying the MACE 2 to a clinical case scenario. Read the assessment activity, then turn and discuss with a partner how to best answer the activity questions. *Use the MACE 2 to answer the questions in the “Practice Activities” sections, and write answers on the MACE 2 pocket guide where appropriate.*



A 26-year old, service member (SM) was leading his platoon on foot patrol. An improvised explosive device (IED) detonated about 15 feet behind him. The blast impact caused the SM to fall, dislodge his protective head gear and hit his head on the ground.



The SM remembered a flash of light and awakening to the corpsman shaking him. He took a while to get up, and had trouble walking and keeping his balance. His face showed no expression, as if he didn't care about, or understand, what was happening. He remained "out of it" for several more minutes, and then was able to complete the MACE 2 exam. The corpsman determined there were no Red Flags, but continued monitoring for Red Flags throughout the exam. The SM remembered all of the events surrounding his injury. Witnesses state he was "out" for about 30 seconds or so.



### *Practice Activity 1 Red Flags and Concussion Screening*

After completing Practice Activity 1, you will understand how to:

1. Complete the initial concussion screening from the MACE 2 exam.
2. Recognize Red Flags and need for immediate evacuation to higher level of care.

#### **Activity 1 Question: Red Flags**

Based on the clinical case scenario, please complete the MACE 2 Concussion Screening to determine if there were any Red Flags. Defer MACE 2 if any red flags are present. Immediately consult higher level of care and consider urgent evacuation according to evacuation precedence/Tactical Combat Casualty Care (TCCC).

Are there any Red Flags present? \_\_\_\_\_

#### **Activity 1 Questions: Concussion Screening**

Based on the clinical case scenario, please complete the MACE 2 Concussion Screening to determine if there was both an injury event AND an alteration of consciousness.

## **1. Description of the incident**

A: Record the event as described by the service member or witness.

B. Observable signs- were there any visual clues of concussion?

C. Record the type of event: \_\_\_\_\_

D. Blow or jolt to the head? \_\_\_\_\_

## **2. Alteration of Consciousness or Memory (AOC/LOC/PTA)**

A. Was there alteration of consciousness (AOC)? \_\_\_\_\_

If yes, for how long? \_\_\_\_\_ minutes \_\_\_\_\_ seconds

B. Was there a loss of consciousness (LOC)? \_\_\_\_\_

If yes, for how long? \_\_\_\_\_

C. Was there post traumatic amnesia (PTA)? \_\_\_\_\_

If yes, for how long? \_\_\_\_\_

D. Was the AOC, LOC or PTA witnessed? \_\_\_\_\_

If yes, for how long? \_\_\_\_\_ minutes \_\_\_\_\_ seconds

### ***Activity 1 Questions: Symptoms***

## **3. Symptoms**

Record the screening exam on the MACE 2 pocket guide using the following information.

**Findings:**

The SM complains of headache and ringing in the ears; no other complaints noted.

What are the symptom MACE 2 results?

- a. No symptoms
- b. 1 or more symptoms

**3. Symptoms**  
 Common symptoms after a concussion are listed below. For this event, check all that apply.

<input type="checkbox"/> Headache	<input type="checkbox"/> Difficulty concentrating
<input type="checkbox"/> Dizziness	<input type="checkbox"/> Irritability
<input type="checkbox"/> Memory problems	<input type="checkbox"/> Visual disturbances
<input type="checkbox"/> Balance problems	<input type="checkbox"/> Ringing in the ears
<input type="checkbox"/> Nausea/vomiting	<input type="checkbox"/> Other _____
	<input type="checkbox"/> <b>Negative for all symptoms</b>

**Record results (see page 13 of MACE 2 pocket guide under SYMPTOM RESULTS).**

**Activity 1 Questions: Concussion History**

**4. History**

During your MACE 2 examination, you ask the SM about prior concussions in the past 12 months, headache or migraine disorders, and about any previous behavioral health concerns.

**Findings:**

SM reveals being diagnosed with one other concussion in the past 12 months. Denies history of headaches, migraines or any behavioral health issues.

**Record concussion history on MACE 2 pocket guide and then take appropriate action.**

- A. During the past 12 months have you been diagnosed with a concussion, not counting this event?
  - a. Yes
  - b. No
  - c. Unknown
 If, yes, how many? \_\_\_\_\_
  
- B. History of diagnosed/treated headache disorder or migraine
  - a. Yes
  - b. No
  
- C. History of depression, anxiety or other behavioral health concerns?
  - a. Yes
  - b. No

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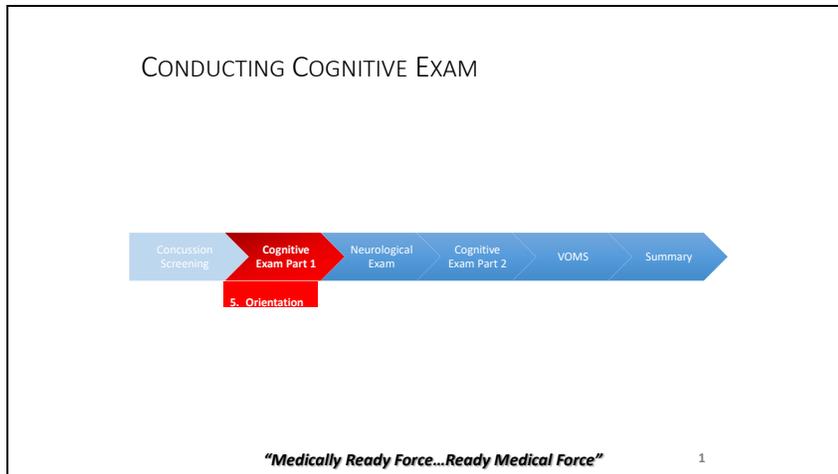
***Activity 1 Question: Concussion Screening Results***

Do you **continue** or **stop** the MACE 2? \_\_\_\_\_

Why? \_\_\_\_\_

**\*STOP, REFER TO LECTURE SLIDES AND CONTINUE PRESENTATION**

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Cognitive Exam  
5. Orientation

- The first part of the cognitive exam assesses orientation (i.e. how aware the SM is of the time, where they are, and who they are)
- Words in *italics* are said exactly as written
- Score a point for each correct answer; maximum score is 5
- This cognitive exam is most reliable within 12 hours of injury

**5. Orientation**  
Score one point for each correct response.

Ask This Question	Incorrect	Correct
"What month is this?"	0	1
"What is the date or day of the month?"	0	1
"What day of the week is it?"	0	1
"What year is it?"	0	1
"What time do you think it is?"	0	1

Correct response must be within one hour of actual time.

**ORIENTATION TOTAL SCORE**

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### Cognitive Exam 6. Immediate Memory

- The second part of the cognitive exam tests immediate memory: The ability to remember a small amount of information over a few seconds/minutes

- Example:
  - Select a word list
  - Use the same word list (matching color and letter) for the remainder of the MACE 2

List A

Jacket  
Arrow  
Pepper  
Cotton  
Movie

**Immediate Memory Alternate Word Lists**

<b>LIST B</b>	<b>LIST C</b>	<b>LIST D</b>	<b>LIST E</b>	<b>LIST F</b>
Collar	Finger	Shoe	Cardie	Elbow
Honey	Penny	Monkey	Paper	Apple
Mince	Blanket	Parlour	Sugar	Carrot
Saddle	Lemon	Garment	Sandwich	Saddle
Anchor	Insect	Iron	Wagon	Subtle

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### Cognitive Exam 6. Immediate Memory (continued)

- Read the script as written in immediate memory section
- Three trials are required, even if all answers are correct in Trial 1 and 2
- Score a point for each correct word recalled; the maximum score is **15**
- Read the words at a rate of one word per second

**6. Immediate Memory**  
 Choose one list (A-F below) and use that list for the remainder of the MACE 2.  
 Read the script for each trial and then read all five words. Circle the response for each word for each trial. Repeat the trial three times, even if the service member scores perfectly on any of the trials.

**Trial 1 script:** Read the script exactly as written.  
 • Train going to test your memory, I will read you a list of words and when I am done, repeat back to me as many words as you can remember in any order.

**Trial 2 and 3 script:** Read the script exactly as written.  
 • Train going to repeat that list again. Repeat back to me as many words as you can remember, in any order, even if you said them before.

		Trial 1	Trial 2	Trial 3
<b>LIST A</b>	Incorrect	Correct	Incorrect	Correct
Jacket	0	1	0	1
Arrow	0	1	0	1
Pepper	0	1	0	1
Cotton	0	0	1	0
Movie	0	1	0	1

**IMMEDIATE MEMORY TOTAL SCORE** 15

**Immediate Memory Alternate Word Lists**

<b>LIST B</b>	<b>LIST C</b>	<b>LIST D</b>	<b>LIST E</b>	<b>LIST F</b>
Collar	Finger	Shoe	Cardie	Elbow
Honey	Penny	Monkey	Paper	Apple
Mince	Blanket	Parlour	Sugar	Carrot
Saddle	Lemon	Garment	Sandwich	Saddle
Anchor	Insect	Iron	Wagon	Subtle

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## Practice Activity 2 Cognitive Exam - Part 1

After completing Practice Activity 2, based upon the previous clinical case scenario and findings, you will understand how to:

1. Complete the Cognitive Exam – Part 1
2. Score each section of the Part 1 exam: Orientation and Immediate Memory

### 5. Orientation

Score 1 point for each correct answer.

#### Activity 2 Question 1

Record the orientation total score using the information below. Correct response must be within one hour of actual time.

Examiner (from MACE 2 script):  
 “What month is this?”  
 “What is the date or day of the month?”  
 ‘What day of the week is it?’  
 “What year is it?”  
 “What time do you think it is?”



#### Findings:

The SM was able to state the correct month, day of month, year, day of the week, but wasn't sure of the time of day.

What is the orientation total score? \_\_\_\_\_

### 6. Immediate Memory

Choose one list (A-F) and use that list for the remainder of the MACE 2. Use the Trial 1, 2 and 3 scripts provided on MACE 2 in the “Immediate Memory” section.

- Read all five words to the patient.
- Allow time for the patient to respond.
- Circle the response for each word for each trial.

Repeat two more times (*three times total*), even if the service member scores perfectly on any trials.

**Activity 2 Question 2: Immediate Memory**

Record immediate memory total score using the information below.

Examiner (from MACE 2 Script):

Trial 1 Script:

"I am going to test your memory. I will read you a list of words and when I am done, repeat back to me as many words as you can remember, in any order."

Elbow, Apple, Carpet, Saddle, Bubble

Trial 2 and 3 Scripts:

"I am going to repeat that list again. Repeat back to me as many words as you can remember, in any order, even if you said them before."

Elbow, Apple, Carpet, Saddle, Bubble

**Findings**

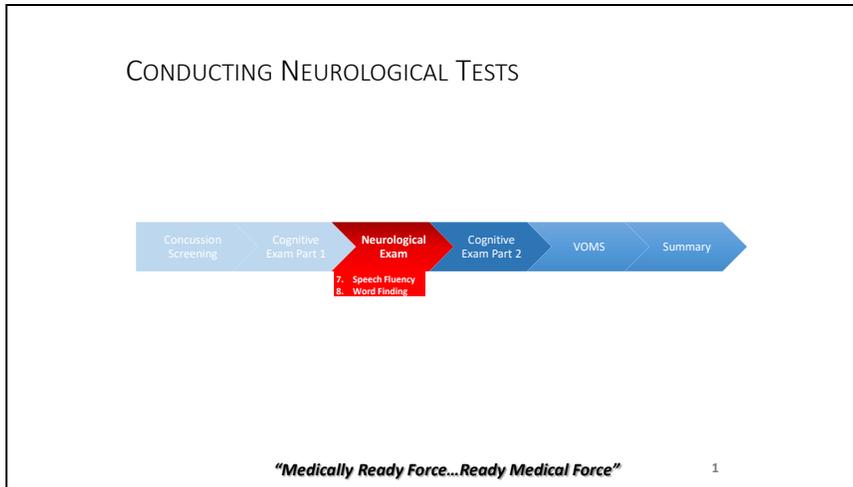
The SM was able to repeat the below using list F:

- Trial 1 - Elbow, Apple, Carpet, Saddle, Bubble
- Trial 2 - Elbow, Apple, Carpet, Saddle, Bubble
- Trial 3 - Elbow, Apple, Saddle, Bubble

What is the immediate memory total score? \_\_\_\_\_

**\*STOP, REFER TO LECTURE SLIDES AND CONTINUE PRESENTATION**

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### Neurological Exam

- The neurological exam tests overall sensory and motor functions. It is placed in the middle of the cognitive exam to allow time to pass to test delayed recall accurately. The exam consists of:
  - **Speech Fluency**
  - **Word Finding**
  - **Grip Strength**
  - **Pronator Drift**
  - **Single Leg Stance**
  - **Tandem Gait**
  - **Pupil Response**
  - **Eye Tracking**

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### Neurological Exam - 7. Speech Fluency

- Note abnormal speech during conversation
- During open-ended questions, listen for pauses or unnatural breaks in speech
- Stuttering or struggling to speak is abnormal



DVBIC image by Kori Zick

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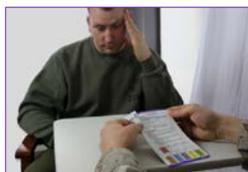
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### Neurological Exam - 8. Word Finding

- Assess word finding difficulties:
  - Does service member have trouble coming up with the name of a common object?
  - Ask the SM to repeat a sentence or name an object in view.  
Example:  
“I got a haircut today and they did it way too short.”



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### Neurological Exam - 9. Grip Strength

- Assess grip strength
  - Grip strength should be strong and equal on both sides
  - Unequal or weak limb strength is abnormal



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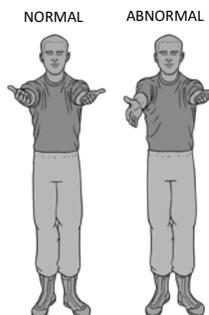
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### Neurological Exam - 10. Pronator Drift

- Direct patient to stand with eyes closed and arms extended forward, parallel to the ground with palms up. Assess for **five to 10** seconds:
  - Does either palm turn inward?
  - Does either arm drift down?
  - Any arm or palm drift is abnormal.



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### Neurological Exam - 11. Single Leg Stance

- Have service member remove shoes if possible and have them stand on one leg with arms across chest and hands touching shoulders, eyes open initially.
- Once patient is balanced, have them close their eyes and time for 15 seconds how long they can maintain their balance. Repeat test with opposite leg.
- If they lose their balance before **8** seconds, it is abnormal.



DVBIC image by Kori Zick

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### Neurological Exam - 12. Tandem Gait

- Have service member remove shoes if possible and take six steps one foot in front of the other, heel-to-toe, with arms at side
- Stumbling or shifting feet is abnormal



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**Neurological Exam**  
13. Pupil Response

- Pupils should be equal size, normal is **2-6** mm
- Pupils should be round
- Pupils should get smaller with bright light & become larger in dim light or darkness
- Pupils should quickly respond to changes in light
- Unequal pupil size, dilation or constriction delay is abnormal

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Slide  
30

**Neurological Exam**  
14. Eye Tracking

- Extra-ocular eye movement
- Check movement to all vision field areas in both “H” and “X” test patterns
- Check that both eyes move together
- Note if the head tilts or any abnormal eye movements such as repetitive, uncontrolled movements or nystagmus

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Slide  
32

Neurological Exam -  
Results

- If all sections are normal, check the **All Normal** box
- If any section is abnormal, check the **Any Abnormal** box

3

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## ***Practice Activity 3 Neurological Exam***

Following Practice Activity 3, you will be able to:

1. Complete the Neurological Exam from the MACE 2 pocket guide
2. Score and record the Neurological exam based upon presented findings

### ***Practice Activity 3 Questions***

#### ***Activity 3 Questions***

**Practice the neurological exam on a partner if directed by the instructor. Based upon the findings below, record the neurological assessment as “Normal” or “Abnormal.”**

#### ***Findings:***

Throughout the exam the SM’s speech is fluid and he has no difficulty naming objects.

His grip strength is equal bilaterally and he is able to stand with his eyes closed and no drifting of either arm.

With eyes closed using his right leg, he *can* stand on one leg for 10 seconds, but is *unable* to stand on only his left leg with his eyes closed. The SM is also unable to walk a straight line, heel-to-toe with his arms at his side.



**12. Tandem Gait**

The SM is unable to walk a straight line, heel-to-toe with arms at side.

This response is: \_\_\_\_\_

**13. Pupil Response**

The eyes are equal and reactive to light and tracking.

This response is: \_\_\_\_\_

**14. Eye Tracking**

Eyes track smoothly and equally.

This response is: \_\_\_\_\_

**Neurological MACE 2 Score**

Based upon the above results, what is the MACE 2 neurological exam result?

All Normal (+)    Any Abnormal (-)

**Note:** If all the sections are normal, check the normal box. If any one of the sections is abnormal, check the abnormal box.

MACE 2 - Military Acute Concussion Evaluation

**NEUROLOGICAL EXAM - Continued**

**12. Tandem Gait**

Normal                       Remove shoes if possible. Have service member take six steps one foot in front of the other, heel-to-toe, with arms at side  
 Abnormal                      - Stumbling or shifting feet is abnormal.

**13. Pupil Response**

Normal                       Pupils should be round, equal in size and briskly constrict to a direct, bright light.  
 Abnormal                      - Unequal pupil size, dilation or constriction delay is abnormal.

**14. Eye Tracking**

Normal                       Both eyes should smoothly track your finger side-to-side and up and down.  
 Abnormal                      - Unequal, irregular or delayed eye tracking is abnormal.

**NEUROLOGICAL EXAM RESULTS (Questions 7-14)**

All Normal

Any Abnormal

**COGNITIVE EXAM**

**15. Concentration**

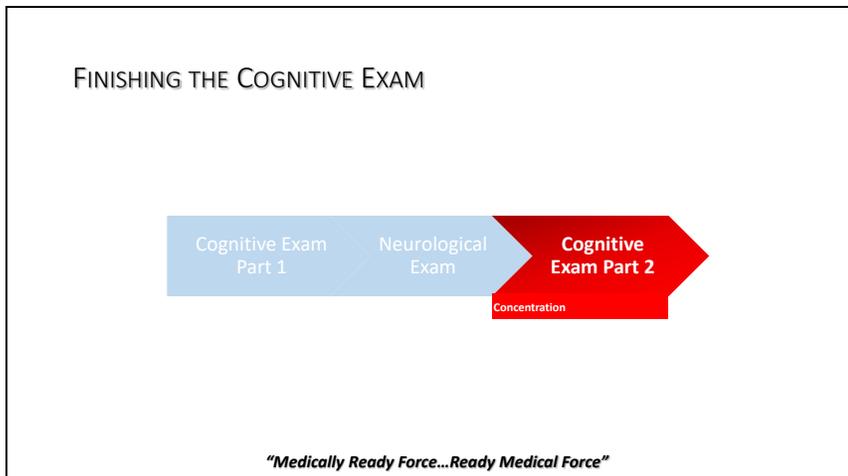
**A. Reverse Digits**  
 Read the script and begin the trial by reading the first string of numbers in Trial 1.  
**Circle the response for each string.**

- If correct on string length of Trial 1, proceed to the next longer string length in the same column.
- If incorrect on string length of Trial 1, move to the same string length of Trial 2.
- If incorrect on both string lengths in Trials 1 and 2, **STOP** and record score as zero for that string length. Record total score as sum of previous correct trials.

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**\*STOP, REFER TO SLIDES AND CONTINUE PRESENTATION**

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Cognitive Exam  
15. Concentration- Reverse Digits

**A. Reverse Digits**  
Tests concentration by having the SM repeat back a string of numbers in reverse order:

- Use the color number list (A-F) that matches the word list color you used before in the memory section (Question # 6).
- Read the script on the card word-for-word.
- Read the digits at a rate of one-per-second.
- **Do NOT group the digits in any way.**
- Allow the SM two attempts at repeating each digit string (trials 1 and trial 2).

List A	
Trial 1	Trial 2 (if Trial 1 is incorrect)
4-9-3	6-2-9
3-8-1-4	3-2-7-9
6-2-9-7-1	1-5-2-8-5
7-1-8-4-6-3	5-3-9-1-4-8

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### Cognitive Exam

Concentration- Reverse Digits Correct Results

- If **correct** on 1st or 2nd attempts at that string length:
  - Score one point for that string length
  - Move to Trial 1 of the next string length, in this case: "3-8-1-4"
- If both attempts at a string length are incorrect, **STOP** and record a zero for that string length **AND** all the remaining string lengths

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Slide  
37

### Cognitive Exam -

16. Delayed Recall

- Use the same five-word-list as in earlier immediate memory test from page 5 of the MACE 2.
- Do **NOT** repeat the word list this time or indicate how many words are on the list.
- Ask the SM to recall as many words as they can in any order.
- Allow only **one** trial.
- Score **1** point for each word remembered correctly for a maximum score of **5**.

List A	Incorrect	Correct
Jacket	0	1
Arrow	0	1
Pepper	0	1
Cotton	0	1
Movie	0	1

DELAYED RECALL TOTAL SCORE 5

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Cognitive Exam  
15. Concentration- Months in Reverse Order

**B. Months in Reverse Order**

- Instruct the SM to state the months of the year in reverse order.
  - Score 1 for correctly reciting the entire sequence.
  - Score 0 (zero) if 1 or more months is out of sequence or omitted.

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Cognitive Exam -  
Concentration Scoring

- **Total scores for 15.A and 15.B:**
  - A. Reverse Digits: Maximum score 4 points
  - B. Months in Reverse Order: Entire sequence correct maximum score 1 point
    - Recite the entire sequence correctly for a maximum score of 5 points

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Slide  
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### Cognitive Exam -

#### 16. Delayed Recall

- Use the same five-word-list as in earlier immediate memory test from page 5 of the MACE 2.
- Do **NOT** repeat the word list this time or indicate how many words are on the list.
- Ask the SM to recall as many words as they can in any order.
- Allow only **one** trial.
- Score **1** point for each word remembered correctly for a maximum score of **5**.

List A	Incorrect	Correct
Jacket	0	1
Arrow	0	1
Pepper	0	1
Cotton	0	1
Movie	0	1

DELAYED RECALL TOTAL SCORE

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## Practice Activity 4 Cognitive Exam - Part 2

Following Practice Activity 4, participants will be able to:

1. Complete the Cognitive Exam Part 2 from the MACE 2 pocket guide.
2. Score and record the Cognitive Exam Part 2 based upon presented findings.

### Activity 4 Questions: Concentration

Record the reverse digits score using the information below.

#### 15. Concentration

##### (15A) Reverse Digits

Examiner (from MACE 2 script):

“I am going to read you a string of numbers. When I am finished, repeat them back to me backward. That is, in reverse order of how I read them to you. For example, if I said 7-1-9, then you would say 9-1-7.”

##### Findings:

Using List A, the SM answered:

- 3-digit string: 3-9-4
- 4-digit string: 4-1-8-3
- 5-digit string: 1-7-9-2-6
- 6-digit string : 3-6-5-3-7-1;  
Trial 2: 8-4-2-7-5-6

List A		Incorrect	Correct
Trial 1	Trial 2 (if Trial 1 is incorrect)		
4-9-3	6-2-9	0	1
3-8-1-4	3-2-7-9	0	1
6-2-9-7-1	1-5-2-8-5	0	1
7-1-8-4-6-3	5-3-9-1-4-8	0	1
<b>REVERSE DIGITS SCORE (16A)</b>			
			4

As you can see from above, the SM answered the 3, 4 and 5-digit strings correctly in Trial 1, but was unable to recall the 6-digit string correctly. When the SM tried the 6-digit string again in Trial 2, he could not recall it accurately either

What is the reverse digits score? \_\_\_\_\_

Record months-in-reverse-order score on the MACE 2 pocket guide using the following information:

### **(15B) Months in Reverse Order**

**Record months-in-reverse-order score using the following information:**

Examiner (from MACE 2 script): “Now tell me the months of the year in reverse order. Start with the last month and go backward. So you’ll say: December, November....Go ahead”

***Findings:***

The SM stated, “December, November, October, September, August, July, June, May, April, March, February, January”

What is the months-in-reverse-order score? \_\_\_\_\_

### ***Concentration Total Score***

What is the Concentration Total Score? \_\_\_\_\_

## **16. Delayed Recall**

The SM was able to remember all the words in list F (we used list F in the Immediate Memory section earlier).

### ***Activity 4 Question: Delayed Recall***

What is the delayed recall total score so far? \_\_\_\_\_



## Practice Activity 5 Vestibular/Ocular-Motor Screening-

### Smooth Pursuits

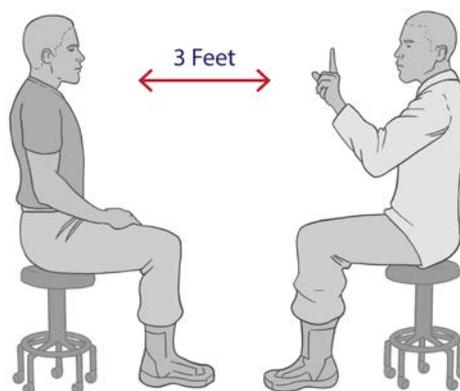
Assuming the patient has no contraindication, find a partner to practice performing these VOMS tests.

#### 17A) Baseline symptoms

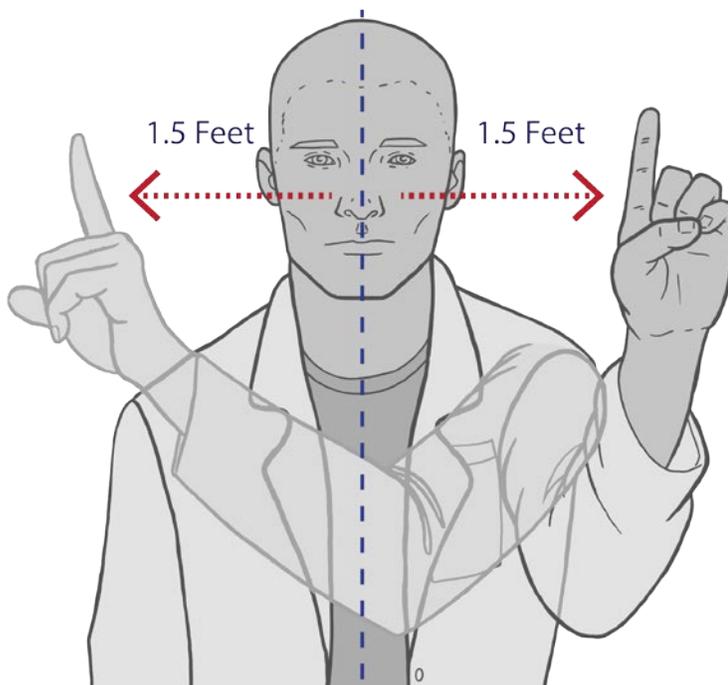
First, ask the patient to rate their headache, dizziness, nausea and fogginess (HDNF) on a scale of 0 to 10 to establish a baseline. Record in VOMS Scoring Chart (page 12 of 14 in pocket guide).

#### 17B) Smooth Pursuits

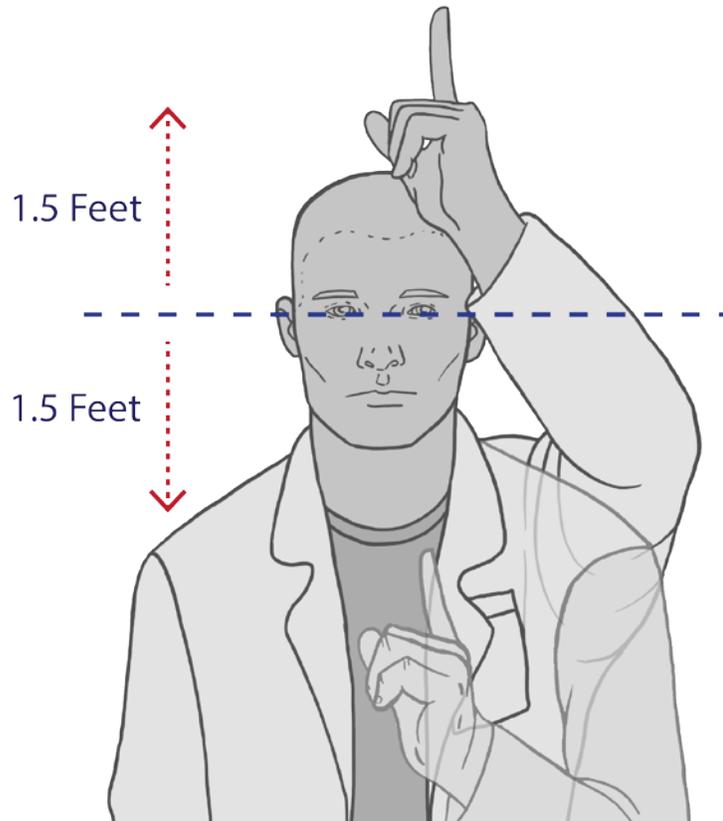
- Sit facing the patient.
- Hold your finger tip 3 feet from the patient.



- With the patient focused on your finger tip, smoothly move your finger left 1.5 feet. Then move your finger to the right 1.5 feet (it should take about 2 seconds to move 3 feet). Perform twice.



- With the patient focused on your finger tip, smoothly raise your finger 1.5 feet from the horizontal midline, and then lower your finger 1.5 feet from the midline (it should take about 2 seconds to move 3 feet). Perform twice.
- Have the patient rate headache, dizziness, nausea and fogginess on a scale of 0 to 10. Record the results.

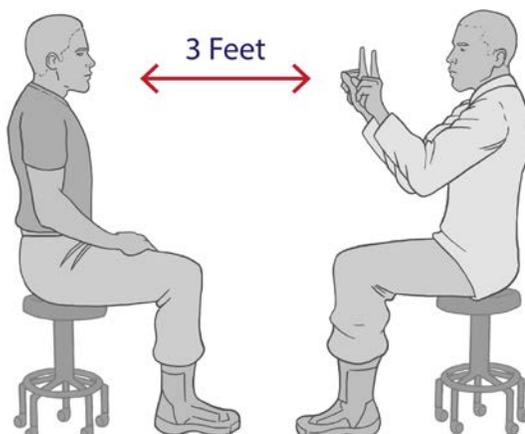




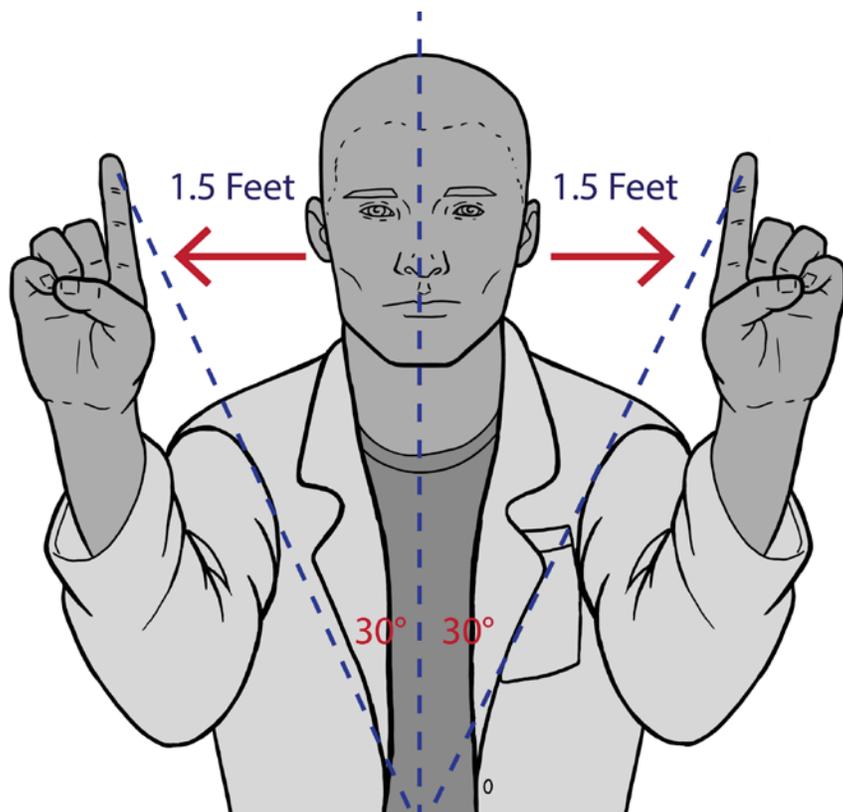
## Practice Activity 6 Vestibular/Ocular-Motor Screening- Saccades

### 17C1) Saccades– Horizontal

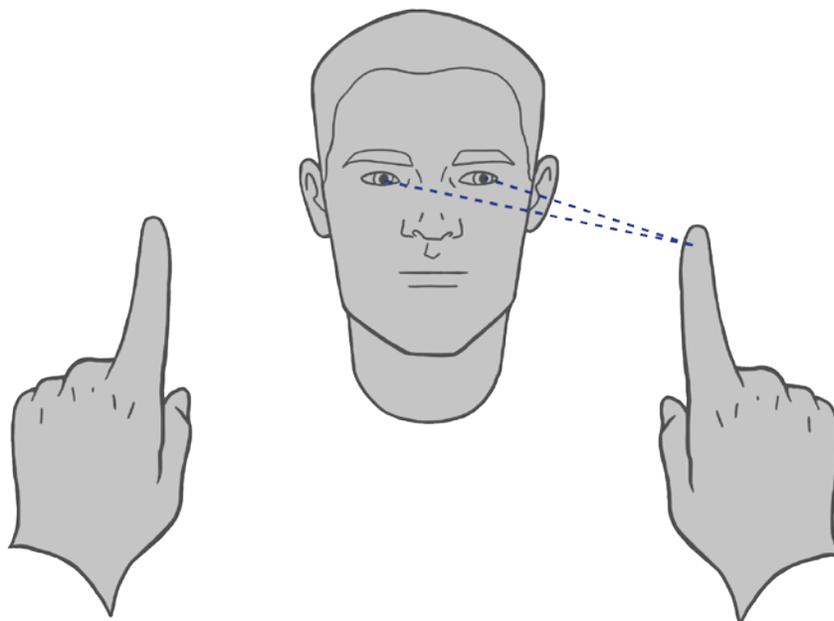
- Sit facing the patient about 3 feet away.



- Hold your left-hand finger 1.5 feet from the vertical midline and your right-hand finger 1.5 feet from mid-line (so that the patient must gaze 30° left and 30° right).

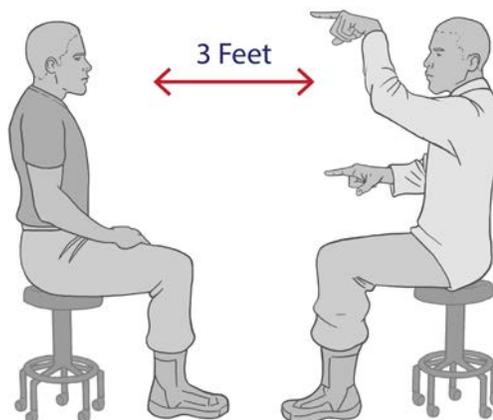


- Ask the patient to move their eyes from point to point as quickly as possible. Perform 10 times.
- Have the patient rate headache, dizziness, nausea and foginess on a scale of 0 to 10. Record the results.

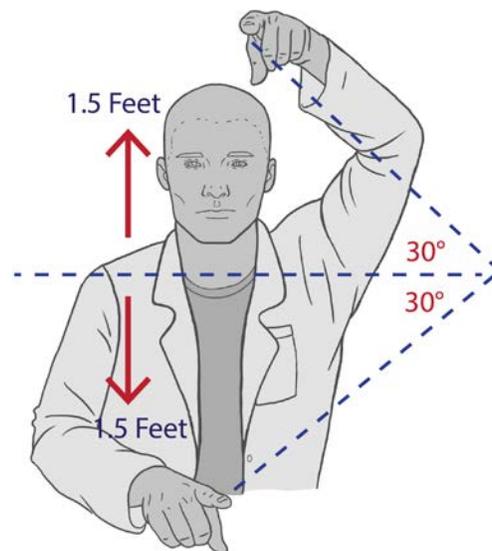


**17C2) Saccades– Vertical**

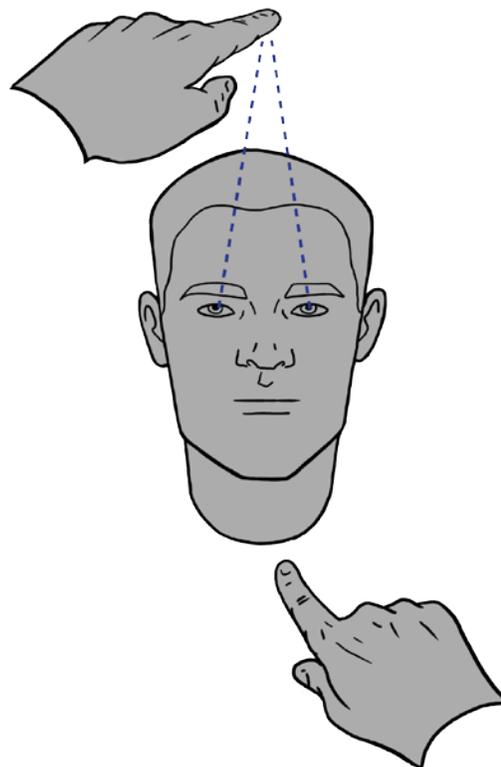
- Face the patient, sitting about 3 feet away.



- Hold one finger 3 feet below the other, so that the patient gazes 30° up and 30° down.



- Ask the patient to move their eyes from point to point as quickly as possible. Perform 10 times in each direction.
- Have the patient rate headache, dizziness, nausea and fogginess on a scale of 0 to 10. Record the results.

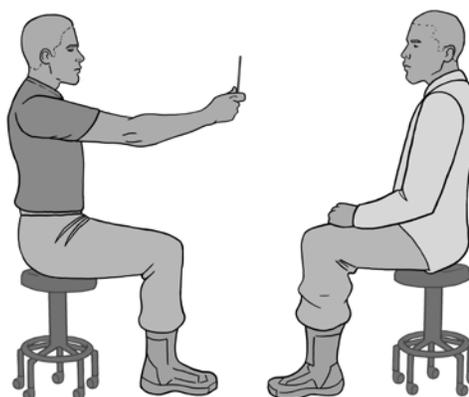




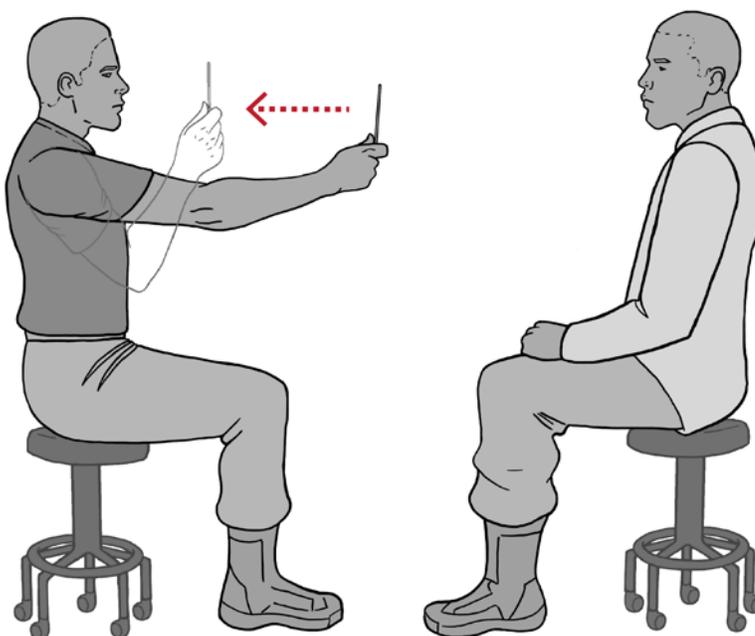
## Practice Activity 7 Vestibular/Ocular-Motor Screening- Convergence

### 17D) Convergence (near point)

- Sit down facing the patient.
- Ask the patient to focus on the target holding it about an arm's length from their nose.



- Ask the patient to slowly move the target toward the tip of their nose and stop when they see two distinct images, or stop them if you notice an outward deviation of the eye.
- Measure the distance between the nose and the target, and record it in centimeters. Repeat two more times.
- Have the patient rate headache, dizziness, nausea and foginess on a scale of 0 to 10. Record the results.



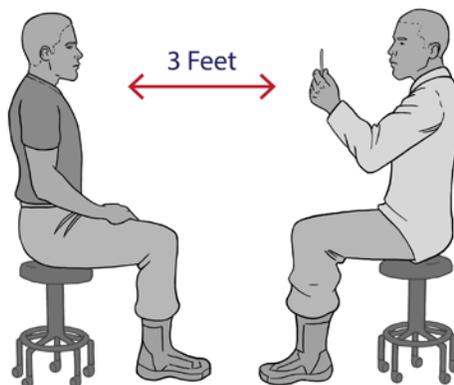
Convergence points greater than or equal to 5 centimeters are considered abnormal.



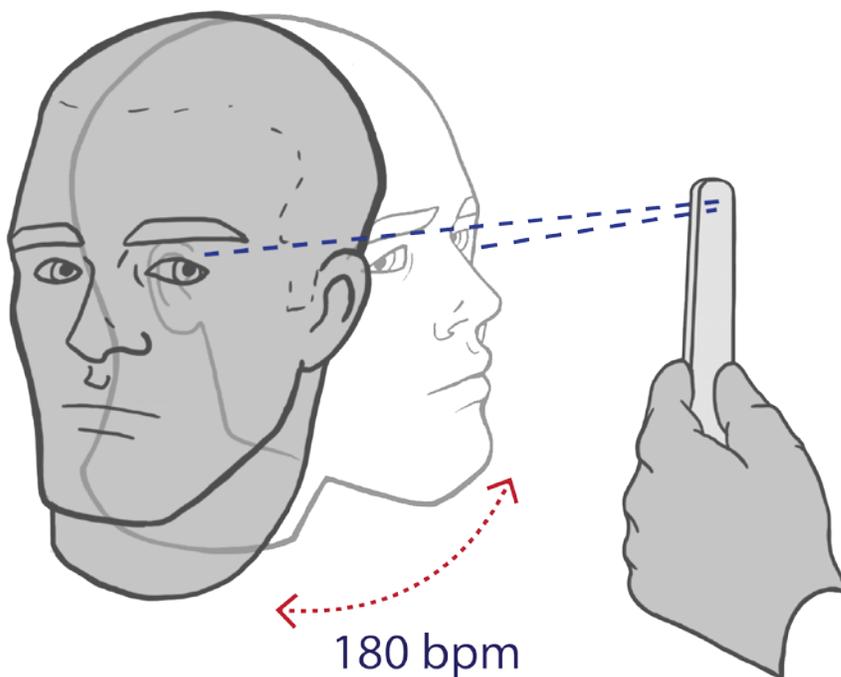
## **Practice Activity 8** Vestibular/Ocular-Motor Screening- Vestibular-Ocular Reflex (VOR)

### **17E1) Vestibular/Ocular Reflex- Horizontal**

- Sit facing the patient.
- Set the metronome to 180 beats per minute (bpm).
- Hold the target 3 feet from the patient.



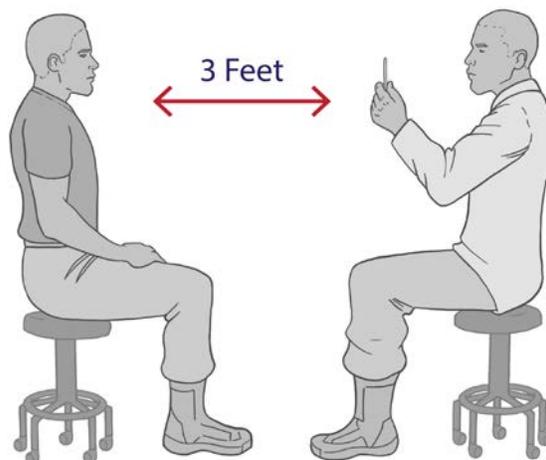
- While focusing on the target, ask the patient to turn their head from 20° left to 20° right 10 times, in time to the metronome beat.



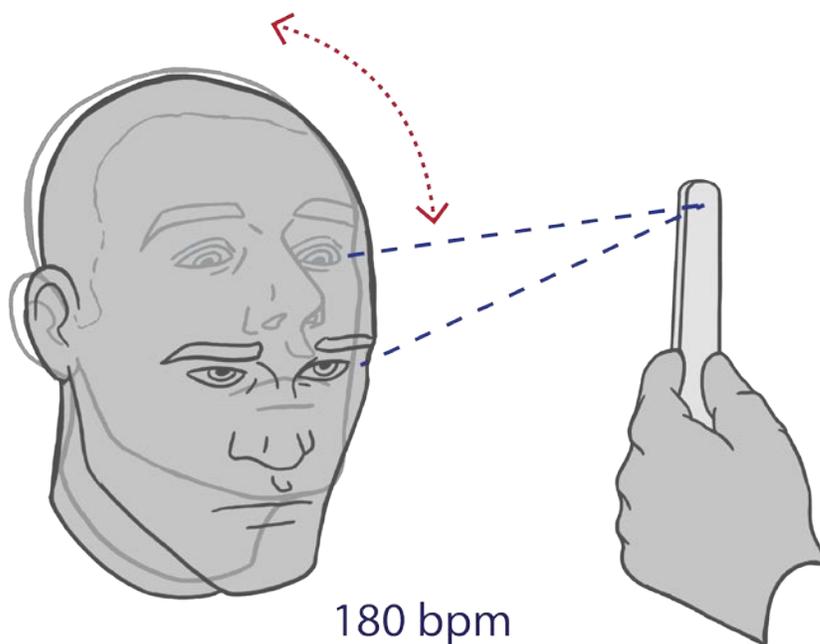
- Wait 10 seconds then have the patient rate headache, dizziness, nausea and foginess on a scale of 0 to 10. Record the results.

**17E2) Vestibular-Ocular Reflex- Vertical**

- Sit facing the patient.
- Set the metronome to 180 bpm.
- Hold the target 3 feet from the patient.



- While focusing on the target, ask the patient to nod their head from 20° down to 20° up 10 times, in time to the metronome beat.
- Wait 10 seconds then have the patient rate headache, dizziness, nausea and foginess on a scale of 0 to 10. Record the results.





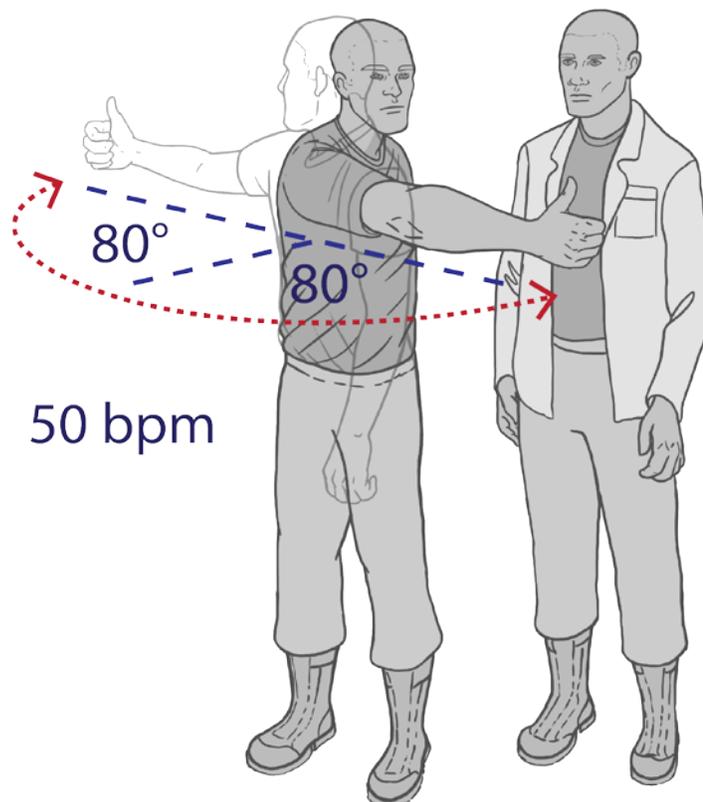
## *Practice Activity 9 Vestibular/Ocular-Motor Screening- Visual Motor Sensitivity (VMS)*

### **17F) Visual Motion Sensitivity (VMS) Test**

- Ask the patient to stand with their feet shoulder width apart, facing a busy area.
- Stand next to the patient, slightly behind them.
- Set the metronome to 50 bpm.
- Have the patient stretch out their arm in front of them and focus on their thumb.



- Ask the patient to twist their head and trunk as a unit from 80° right to 80° left in time to the metronome beat. Perform five times.
- Have the patient rate headache, dizziness, nausea and foginess on a scale of 0 to 10. Record the results.



**\*STOP, REFER TO LECTURE SLIDES AND CONTINUE PRESENTATION**

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## Final MACE 2 Scoring

- **Exam Summary**  
Guides provider through scoring
- **Cognitive Results**  
Scoring and results = \_\_\_/30
- **Neurological Results**  
Check + (Abnormal) or - (Normal)
- **Symptom Results**  
Check + (1 or more symptoms) or - (No symptoms)
- **History Results**  
Check + (Positive) or - (Negative)
- **VOMS Results**  
Check + (Positive) or - (Negative) or (Deferred)
- **MACE 2 RESULTS**  
Check + (Positive) or - (Negative)

The screenshot shows a form titled 'EXAM SUMMARY' for 'MACE 2 (Brainmaster)'. It includes sections for 'Cognitive Summary' with scores for Orientation, Immediate Memory, Concentration, and Delayed Recall. Below that are sections for 'COGNITIVE RESULTS', 'NEUROLOGICAL RESULTS', 'SYMPTOM RESULTS', 'HISTORY RESULTS', 'VOMS RESULTS', and 'MACE 2 RESULTS', each with checkboxes for 'Abnormal', 'Normal', 'Positive', 'Negative', or 'Deferred'.

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## TBI Coding

- TBI screening code\*: Z13.850  
**Primary TBI diagnostic code: S06.ELSE\*\***
- 1. **Primary symptom code**, if applicable: (e.g., H53.2 diplopia)
- 2. **Deployment status code**, if applicable\*\*\*  
(e.g., Z56.82 history of deployment)
- 4. **TBI external cause of morbidity code**: (e.g., Y36.290A)
- [A- initial visit] **operations involving explosions and fragments, military personnel, initial encounter**
- 5. **Place of occurrence**, if applicable
- 6. **Activity code**, if applicable
- 7. **Personal TBI history**: if applicable Z87.820

\* MACE 2  
\*\* Etiology, Location, Severity, Encounter  
\*\*\* Deployment code must fall within the first four codes when applicable  
For more information, see DVVIC ICD-10 Coding Guidance Tool.

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## Summative Clinical Case Scenario

Twenty-two year old SM engaged in physical fitness training when he fell from the pull up bar and hit his face on the ground. The medic conducts an initial evaluation 30 minutes after injury.

### Screen Results

**Observable signs:** 3 cm diameter bruise to left cheekbone, confusion during questioning.

**AOC or Memory:** SM does not recall how he was injured and reports “seeing stars.”

**Symptoms:** Slow speech. Unsteady gait. Complaints of headache and dizziness

**Concussion History:** Had two concussions in the last 12 months.

### Positive Screen/Exam Findings

After the positive concussion screen, the medic/corpsman proceeds with the MACE 2 exam (starting on page 5 of 14 of the pocket guide).

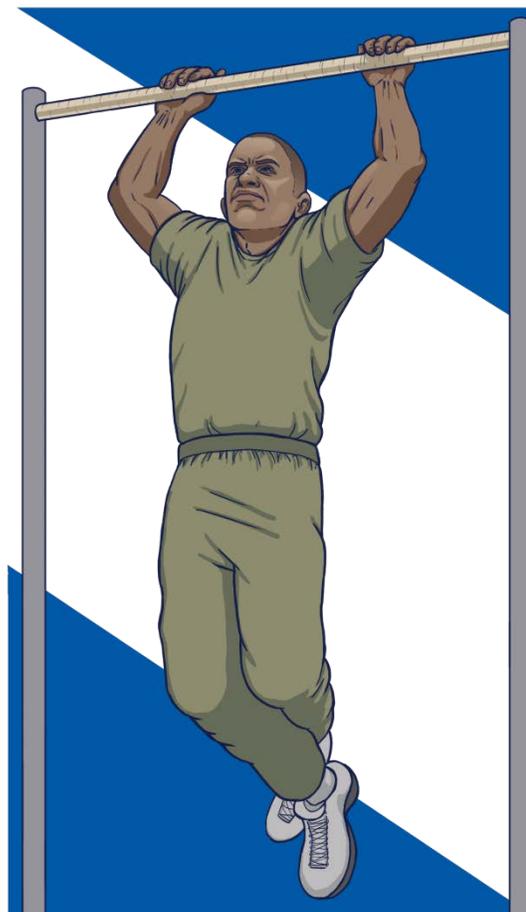
### MACE 2 Exam Findings

**Cog 1:** Missed one orientation question. Incorrectly stated two words in each immediate memory trial.

**Neuro:** Slow and delayed speech. Unsteady balance on single leg stance and tandem gait.

**Cog 2:** Unable to correctly state the months backwards. Reverse Digits: he was able to get to four digits, then failed on five digits. Could not remember three of the delayed recall words.

**VOMS:** 8 cm for convergence and sample provocation of +2 on two visual tests.



**Case Scenario Questions**

<b>EXAM SUM-</b>		
Record the data for correct MACE 2 documentation.		
<b>Cognitive Summary</b>		
Orientation Total Score - Q5	<input type="text"/>	/5
Immediate Memory Total Score (all 3 trials) - Q6	<input type="text"/>	/15
Concentration Total Score (Sections A and B) - Q15	<input type="text"/>	/5
Delayed Recall Total Score - Q16	<input type="text"/>	/5
<b>COGNITIVE RESULTS</b>	<input type="text"/>	/30
≤ 25 is abnormal		
<b>NEUROLOGICAL RESULTS (Q 7-14)</b>	<input type="checkbox"/>	<input type="checkbox"/>
	Abnormal (+)	Normal (-)
<b>SYMPTOM RESULTS (Q 3)</b>	<input type="checkbox"/>	<input type="checkbox"/>
	1 or more symptoms (+)	No symptoms (-)
<b>HISTORY RESULTS (Q 4A-4C)</b>	<input type="checkbox"/>	<input type="checkbox"/>
	Positive (+)	Negative (-)
<b>VOMS RESULTS (Q 17)</b>	<input type="checkbox"/>	<input type="checkbox"/>
	Abnormal (+)	Normal (-)
		Deferred
<b>MACE 2 RESULTS</b>	<input type="checkbox"/>	<input type="checkbox"/>
	Positive (+)	Negative (-)

**Question 1:**

What is the service member’s MACE 2 results?

**Question 2:**

What would be the next steps after completing the MACE 2 in this scenario?

**\*STOP, REFER TO LECTURE SLIDES AND CONTINUE PRESENTATION**

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### Clinical Case Scenario Exam Summary

**"Medically Ready Force...Ready Medical Force"**

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### Key Takeaways

- MACE 2 is to be used as close to time of injury as possible.
- Evaluate for red flags, including abnormal result from structural brain injury detection device (if available).
- Ask the SM if they had a concussion during the last 12 months, had headaches prior to the injury and if they have been diagnosed with depression, anxiety or another behavior disorder (impacts minimum mandatory recovery time and overall rest and recovery time).
- VOMS, Single Leg Stance, and Tandem Gait are new additions to the MACE 2 that support assessment in the vestibular and oculomotor domains.

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Distinguish high-level changes in the Military Acute Concussion Evaluation 2 (MACE 2) including specific updates and evidence to support:

- Red Flags
- Structural brain injury detection device
- History questions
- Expanded assessment by the addition of the Vestibular/Ocular-Motor Screening (VOMS), and enhanced balance assessment

# Answer Key

## Activity 1 Questions- Red Flags

**Negative** for all Red Flags

## Activity 1 Questions- Concussion Screening

1.A

Can you tell me what you remember?

What happened?

Who were you last with?

1.B

**Lying motionless on the ground**

**Slow to get up after a direct or indirect blow to the head**

**Disorientation, confusion, or inability to respond appropriately to questions**

**Blank or vacant look**

**Balance difficulties, stumbling, or slow labored movements**

1.C

**Explosion/Blast occurred approximately 5m from the SM**

1.D

**Yes**

Was there a head injury event?

2.A

**Yes**

**Several minutes**

2.B

**Yes**

**Around 30 seconds**

2.C

**No**

**N/A**

2.D

**Yes**

**(AOC) Several minutes**

**(LOC) ~30 seconds**

### Activity 1 Question: Symptoms

3.

**b. 1 or more symptoms**

### Activity 1 Questions: Concussion History

4.A

**a. Yes**

**1 event**

4.B

**b. No**

4.C.

**b. No**

### Activity 1 Questions: Concussion Screening Results

**Continue MACE 2**

**YES to 1D and 2A, 2B, 2D**

### Activity 2 Questions: Orientation

5.

**4/5**

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### Activity 2 Question: Immediate Memory

6.

**14/15**

### Activity 3 Questions: Neurological Exam

7.

a. **Normal**

8.

a. **Normal**

9.

a. **Normal**

10.

a. **Normal**

11.

b. **Abnormal**

12.

b. **Abnormal**

13.

a. **Normal**

14.

a. **Normal**

### Activity 3 Question: Neurological Score

**Any Abnormal (-)**

### Activity 4 Questions: Concentration

15.A

**3/4**

15.B

1/1

Activity 4 Question: Concentration Total Score

4/5

Activity 4 Question: Delayed Recall

16.

5/5

Case Scenario Questions

1. MACE 2 is **Positive**
2. The provider should:
  1. Document MACE 2 results in the Electronic Health Record (EHR) with coding instructions
  2. Initiate 24-hour rest
  3. Refer to CMT pocket guide for the management recommendations based upon the MACE 2 results.

After 24-hour rest period, evaluate for the initiation into the Progressive Return to Activity (PRA) following the guidance of the PRA clinical recommendation, since this is the third concussion in a 12-month period (history of two previous concussions, not counting this event).

**EXAM SUM-**  
Record the data for correct MACE 2 documentation.

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**Cognitive Summary**

Orientation Total Score - Q5 4 / 5

Immediate Memory Total Score (all 3 trials) - Q6 9 / 15

Concentration Total Score (Sections A and B) - Q15 2 / 5

Delayed Recall Total Score - Q16 2 / 5

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**COGNITIVE RESULTS** 17 / 30  
≤ 25 is abnormal

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**NEUROLOGICAL RESULTS (Q 7-14)**    
Abnormal (+) Normal (-)

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**SYMPTOM RESULTS (Q 3)**    
1 or more symptoms (+) No symptoms (-)

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**HISTORY RESULTS (Q 4A-4C)**    
Positive (+) Negative (-)

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**VOMS RESULTS (Q 17)**     
Abnormal (+) Normal (-) Deferred

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**MACE 2 RESULTS**    
Positive (+) Negative (-)