

Management of Stroke and Cerebrovascular Emergencies in the Deployed Setting, 03 July 2024

Guidelines and recommendations for treatment and management of non-traumatic, cerebrovascular diseases and strokes in an environment where personnel, resources, and follow-on care are limited.

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Background

According to the data from the Centers for Disease Control and Prevention published in 2024, stroke prevalence has significantly increased by 7.8% across the United States, rising from 2.7% in the period of 2011-2013 to 2.9% in the period of 2020 -2022. While the prevalence was highest among adults older than 64 years, the increased incidence was more pronounced among young adults with a 14.6% increase in stroke prevalence in adults aged 18-44, and 15.7% in adults aged 45-64.¹ The populations at increased risks for stroke correspond to the majority of active-duty service members, 90% of whom are under age 40,² and military contractors employed by DoD, many of whom are between ages 30-50's. In contrast, while hemorrhagic stroke, aneurysmal and non-aneurysmal subarachnoid hemorrhage affect mostly people older than 55-year-old,³ when service members develop non-traumatic intracranial hemorrhage, the limited resources in a deployed setting present unique challenges in diagnosing and caring for service members in these environments.

Outcomes in ischemic stroke have significantly improved with the increased availability of intervention therapy across the United States. Systemic thrombolytics as well as the increased availability of endovascular intervention for large vessel occlusion (LVO) and neurosurgical interventions have significantly improved outcomes and significantly decreased stroke related mortality.⁴ Regarding non traumatic subarachnoid hemorrhage, while the incidence has been stable over the past three decades, mortality has significantly decreased due to the advancements in endovascular interventions and medical management in specialized centers.

Purpose

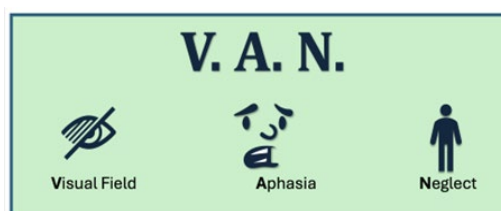
The following is guidance for management of patients suffering with cerebrovascular accidents in the deployed settings. This applies to patients with:

- Ischemic Stroke.
- Hemorrhagic Stroke.
- Nontraumatic Aneurysmal or non-aneurysmal subarachnoid hemorrhage.

Seek expert consultation, when possible, utilize the [JTS Telemedicine in the Deployed Setting, 19 Sep 2023 CPG](#) for guidance if no subject matter expert is available at your location.⁴ Capabilities and management would depend significantly on the area of responsibility (AOR) and capabilities of the medical facility and the availability of emergent CT imaging and reporting. In certain circumstances coordination with host nation facilities if available might be needed for emergency life-saving interventions or while aeromedical evacuation is being arranged.

Presentation with Suspected Stroke Symptoms

- BE-FAST⁶
 - Balance loss, Eyesight changes, Facial droop, Arm weakness, Speech difficulty, Time of onset.
- VAN Assessment (can indicate large vessel involvement)⁷
 - Vision (deviation and/or loss of right or left gaze), Aphasia (naming difficulties), Neglect (ignoring one side of the body)
 - **Other symptoms:** Altered mentation, dizziness/vertigo, dysphagia.



Triage 4,5

- Airway, Breathing, Circulation (**ABC**)
- Obtain **vital signs**, check blood **glucose** level.
- **Quick triage exam**: pupils, **Glascow Coma Score (GCS)** , motor strength.
- **Determine Last Known Well (LKW), not** time of onset.
- **STAT Non contrast CT of head**
- **LABS**: CBC, BMP, INR, PTT
- If VAN positive, consider CT-Angiogram (CTA) of head and neck

Normal CT Head 4,5,7

- Full Neuro exam (See [Appendix A](#) for detailed neurological exam.)
- Determine National Institute of Health Stroke Scale (**NIHSS**).⁸
<https://www.ninds.nih.gov/health-information/stroke/assess-and-treat/nih-stroke-scale>
([Appendix B](#))
- If LKW within 4.5 hours: consider tissue plasminogen activator (TPA)
 - See indications and contraindications as detailed below.
- Seek expert consultation. See [Telemedicine in the Deployed Setting, 19 Sep 2023 CPG](#).
- Consider CTA for LVO.
VAN screening for LVO:
 - **Vision**: visual field cut
 - **Aphasia**: speech impairment
 - **Neglect**: sensory or motor neglect
- **Criteria for endo-vascular intervention (Mechanical Thrombectomy) at neuro-intervention capable facility** (Likely will require emergent transfer or host nation coordination)
 - LVO within **6 hours of Last Known well**.
 - LVO within **24 hours of Last known well with mismatch seen on perfusion imaging (CT Perfusion, or MR perfusion)**
- DO NOT give aspirin or anticoagulants until the patient is determined to not be a candidate for TPA and intracranial hemorrhage has been ruled out.
- Blood Pressure control
 - IF Not a TPA candidate: Less than 220/110
 - IF TPA candidate: Less than 180/105

Positive CT Head⁴

Ischemic stroke seen: Confirm last known well, seek expert consultation before giving TPA, consider CTA to evaluate for large vessel occlusion as detailed above; if no LVO, start stroke secondary prevention and supportive management when resources permit.

Hemorrhagic stroke or Subarachnoid hemorrhage, See below.

Hemorrhagic Stroke (Intracerebral Hemorrhage)^{4,5}

- Full neuro exam, reassess ABC
- Evaluate for signs of elevated ICP or mass effect that would require emergency hyperosmolar therapy and Neurosurgery intervention.
- If Intraventricular hemorrhage (IVH) is present with or without hydrocephalus, Neurosurgery care consultation and evaluation is required.
- Maintain blood pressure control, blood pressure goal: **SBP < 160mmHg**.
- Correction of coagulopathy, reversal of antithrombotic/anticoagulation (See [Appendix C.](#))

Subarachnoid Hemorrhage (Non-Traumatic)^{4,5,9}

- Full neuro exam, reassess ABCs
- Evaluate for signs of elevated intracranial pressure (ICP) or mass effect that would require emergency hyperosmolar therapy and Neurosurgery intervention.
- Emergent Neurosurgery care consultation and evaluation is required in all cases.
- Maintain blood pressure control, blood pressure goal: SBP < 140 mm hg
- Correction of coagulopathy, reversal of antithrombotic/anticoagulation ([Appendix C.](#))

Medications recommended for blood pressure control:

- Labetalol 10 mg IV PRN
- Nicardipine infusion 5-15 mg/hr

Indications for Neurosurgery Consultation^{4,5,9}

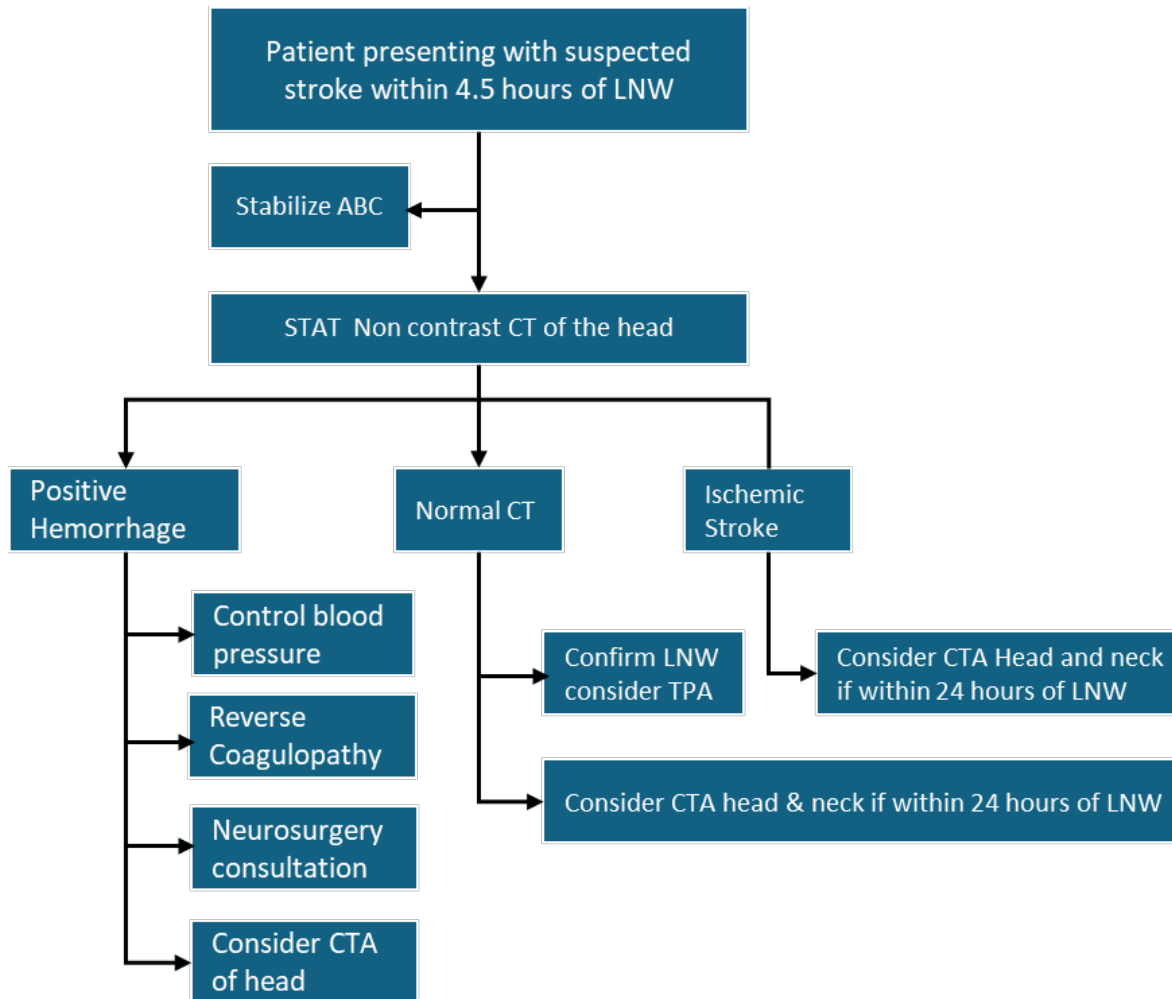
Consultation with Neurosurgery is required for all patients with the following:

- Non-traumatic Intracranial Hemorrhage (emergently if IVH or hydrocephalus is present)
- Non-Traumatic Subarachnoid hemorrhage even non aneurysmal
- Ventricular obstruction without hydrocephalus
- Large ischemic strokes (More than 33% of hemisphere, or multi-lobe involvement)
- Moderate and large cerebellar strokes
- Any cerebellar stroke with 4th ventricular obstruction, hydrocephalus, or brain stem compression

Management of Symptomatic Cerebral Edema¹⁰

Start hyperosmolar therapy with hypertonic saline (preferred) or Mannitol for any symptomatic cerebral edema, any worsening of neurological exam with associated cerebral edema on imaging, mass effect or midline shift with or without brain stem compression. (Refer to [Appendix D](#) for the hypertonic saline protocol, which mirrors the protocol in [Joint Trauma System CPG, Traumatic Brain Injury Management and Basic Neurosurgery in Deployed Environment, 15 Sep 2023](#)).

23.4 % saline or 1 gram per kilogram body weight of Mannitol can be used for rescue intervention to abort or treat herniation. This can present with acute neurological decline, pupillary size change, or loss of pupillary reactivity, irregular breathing or apnea episodes. In severe situations a Cushing reflex picture can be seen with marked hypertension and associated bradycardia (this is usually a very late sign). If treatment is administered or considered, patient needs emergent neurosurgery evaluation.

Algorithm for patient presenting with suspected stroke withing 4.5 hours of LNW**Systemic TPA for Stroke Dosing and Administration⁴**

The recommended treatment dose of alteplase (Activase®) is 0.9 mg/kg (not to exceed 90 mg total treatment dose) infused over 60 minutes.

- 10% of the total treatment dose should be administered as an initial bolus over 1 min.
- The remaining treatment dose should be infused intravenously over 60 min.

Contraindications of systemic thrombolytics in acute ischemic stroke^{4,9}

- All Patients more than 4.5 hours from last known well.
- Patients within 0-4.5-hour window who have:
 - Mild non-disabling symptoms, NIHSS less than or equal to 5.
 - Any Intracranial **hemorrhage on CT**.
 - Severe hypoattenuation or clear **hypodensity on CT**.
 - Patients with a history of ischemic stroke in the last **3 months**.
 - Severe head trauma within the last **3 months**.
 - Acute head trauma associated with presentation.
 - History of Neurosurgery (brain or spine) within the last 3 months

- Any history of intracranial hemorrhage
- Any history of subarachnoid hemorrhage
- Interaxial Intracranial neoplasm
- GI malignancy or GI bleeding within the last 21 days
- Patients presenting with coagulopathy.
 - Platelet count less than 100,000
 - INR > 1.7, aPTT > 40s, PT > 15s
- Patients with systemic anticoagulant use
- Patients on systemic therapeutic dose LMWH
 - Patient on Warfarin with INR > 1.7
 - Patient on direct oral anticoagulants (Rivaroxaban, Dabigatran, Apixaban)
 - Patients on Intravenous antiplatelet agents
- Patients with Infective endocarditis
- Patient with aortic dissection.

Aeromedical Evacuation Consideration

Coordination with the sending and receiving teams is critical. Communication of critical information to triage and coordinate care is paramount in order to facilitate the appropriate facility and timing of transportation. Reporting of the Last known well (LNW) time as well the NIHSS accurately is very important when coordinating emergent care and evacuation for stroke patients who may need intervention.

Patients in need of neurosurgical and/or endovascular intervention would need emergent transport and may need to be considered for unregulated patient movement to the nearest capable facility.

Where available, patients may be able to receive care at host nation facilities. Coordination with the treatment teams at those facilities is of critical importance to assure adherence to standards of care and coordination of ideal timing for evacuation to higher echelons of care.

Patients at risk for elevated intracranial pressure, especially with intracranial hemorrhage, subarachnoid hemorrhage or if the nature of the neurological injury is not known due to the lack of cranial imaging. It would be prudent to load patients head-first and with head elevated to avoid worsening intracranial pressure during transport.

Close neurological monitoring is critical during transportation.

Performance and Outcome Metrics

- Immediate neurological assessment of all patients presenting with stroke symptoms and achieving the following timelines:
 - Ischemic stroke in Role 2 facility with brain imaging and thrombolytic capability
- Patients presenting with stroke symptoms within 4.5 hours of last known well.
 - Time to non-contrast Head CT, documentation for reason for delay
 - Time to intravenous thrombolytic therapy if indicated.
 - Neurological exam monitoring and documentation
 - Dysphagia screening
 - DVT prophylaxis or reason for not starting DVT prophylaxis documentation.

- Ischemic Stroke patient with suspected large vessel occlusion (VAN positive):
 - Vascular imaging or transportation to vascular imaging capable facility
- Hemorrhagic stroke and subarachnoid hemorrhage patients presenting to Role 2 facilities with brain imaging capability:
 - Neurological exam monitoring and documentation.
 - Blood pressure control to target range as detailed above.
 - Reversal of coagulopathy if present and pharmaceutical capabilities available.
 - If external ventricular drain is present, hourly documentation of ICP and output.
 - Avoidance of corticosteroids.

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Appendix A: Neurological Examination

- Mental Status:
 - Wakefulness
 - Alertness
 - Orientation
- Cranial nerves: pupil exam, facial droop, palate elevation asymmetry, tongue deviation.
- Speech evaluation: expression, reception, dysarthria.
- Visual fields
- Motor strength: 5 grades for extremities

Full strength	5/5
Can overcome resistance	4/5
Can overcome gravity	3/5
Movement only when gravity eliminated	2/5
Only muscle activation without movement	1/5
No movement	0/5

- Sensory exam: light touch and pain perception
- Deep tendon reflexes:

No response	0/4
Reduced response (compare sides)	1/4
Normal response	2/4
Hyperactive response	3/4
Clonus	4/4

- Coordination: Ataxia (finger to finger and finger to nose tests, heel to shin test)
- Gait if applicable (usually can be omitted for fall risk)

Appendix B: National Institute of Health Stroke Scale (NIHSS)⁸

Category	Test scale	Score
1a. Level of consciousness (LOC) Alertness	0 Alert 1 Not alert, but arousable with minor stimulation 2 Not alert, requires repeated stimulation. 3 unresponsive, or only reflex movements	
1b. Level of consciousness (LOC) Questions (Month, and age)	0 Answers both correct 1 Answers one correct 2 neither correct, or no answer at all (also aphasic)	
1c. Level of consciousness (LOC) Commands (2 tasks)	0 Performs both tasks correctly. 1 one task correctly 2 neither task correctly	
2. Best Gaze: Test only horizontal eye movements	0 Normal 1 Partial gaze palsy 2 forced deviation	
3. Visual fields	0 No visual Loss 1 Partial hemianopia 2 complete hemianopia 3 bilateral hemianopia	
4. Facial Palsy	0 normal 1 minor paralysis 2 partial paralysis 3 complete paralysis	
5.a Motor Arm (Right): Extend arm (palms down) 90 degrees or 45 if supine	0 No drift for 10 seconds 1 Drifts down before 10 sec, does not hit bed. 2 Some effort against gravity, hits bed 3 No effort against gravity 4 No movement UN Amputation	
5b. Motor Arm (Left): Extend arm (palms down) 90 degrees or 45 if supine	0 No drift for 10 seconds 1 Drifts down before 10 sec, does not hit bed. 2 Some effort against gravity, hits bed 3 No effort against gravity 4 No movement UN Amputation	
6a . Motor Leg (Right): Hold Leg 30 degrees when supine	0 No drift for 5 seconds 1 Drifts down before 5 sec, does not hit bed. 2 Some effort against gravity, hits bed 3 No effort against gravity 4 No movement UN Amputation	
6b. Motor Leg (Left): Hold Leg 30 degrees when supine	0 No drift for 5 seconds 1 Drifts down before 5 sec, does not hit bed. 2 Some effort against gravity, hits bed 3 No effort against gravity	

Category	Test scale	Score
	4 No movement UN Amputation	
7 Limb Ataxia with eyes open perform finger to nose and heel to shin tests	0 absent 1 present in 1 limb 2 presents in 2 limbs UN amputation	
8 Sensory Sensation or grimace to pin prick or withdrawal from noxious stimuli	0 normal (no sensory loss) 1 Mild to moderate 2 Severe or total sensory loss	
9 Language: use attached picture, ask patient to describe the picture, name objects and read	0 No Aphasia (Normal) 1 Mild to moderate aphasia 2 Severe aphasia 3 Mute or global aphasia	
10 Dysarthria	0 No dysarthria 1 Mild to moderate dysarthria 2 Severe dysarthria UN – intubated	
11 Extinction and inattention	0 No abnormality 1 Visual, tactile, auditory, special, or personal inattention 2 Profound hemi-inattention or extinction to more than one modality	

Words and Phrases for Language Testing		
<ul style="list-style-type: none"> You know how. Down to earth. I got home from work. Near the table in the dining room. 	<ul style="list-style-type: none"> Tip – Top Fifty – Fifty They heard him speak on the radio last night. 	<ul style="list-style-type: none"> Mama Thanks Huckleberry Baseball Player Caterpillar

Diagram for Object Naming and Description



Appendix C: Recommended Agents for Reversal of Coagulopathy ¹¹⁻¹³

Warfarin with elevated INR: 4 factor Prothrombin Complex Concentrate (PCC) (Kcentra[®]) + IV vitamin K

- INR 2-4: 25 units/kg IV + 10 mg of Vitamin K IV
- INR 4-6: 35 units/kg IV + 10 mg of Vitamin K IV
- INR >6: 50 units/kg IV + 10 mg of Vitamin K IV
- ***If 4 factor PCC is not available, fresh frozen plasma (FFP) should be used for INR correction with IV vitamin K***

Unfractionated Heparin (UFH)

- For prophylaxis dose subcutaneous heparin, no reversal is routinely recommended.
- Protamine sulfate is recommended according to the dose of the infusion over the preceding 2-3 hours.
- 1 mg of Protamine sulfate for every 100 units given over the past 2 hours (maximum dose is 50 mg)
- If aPTT remains elevated, repeat dose of 0.5mg per 100 units of heparin may be considered

Low Molecular Weight Heparin (LMWH) (Enoxaparin) (Lovenox[®])

- If enoxaparin was given within 8 hours, protamine sulfate should be administered at a dose of 1 mg per 1 mg of enoxaparin (max: 50 mg)
- If enoxaparin was given within 8-12 hours, protamine sulfate should be administered at a dose of 1 mg per 0.5 mg of enoxaparin (max: 50 mg)
- If enoxaparin was given more than 3-5 half-lives, pharmacological reversal is likely not needed

Dabigatran (Pradaxa[®]) Praxbind[®]

Direct factor Xa inhibitors (rivaroxaban, apixaban and edoxaban):

- If available Andexanet alfa can be used for reversal, if not available 4 factor PCC should be used.
- 4 factor PCC (Kcentra[®]), 25-50 units per kg IV
- If 4 factor PCC is not available, no other reversal agents are recommended.
- TXA can be considered but the benefit remains unclear.

Antiplatelet agents (Aspirin, Clopidogrel. Prasugrel)

- Consider DDAVP 0.04 units /kg IV once.
- Avoid platelet transfusion until surgical intervention is planned.

Reversal of Tissue plasminogen activator (TPA) in the event of hemorrhagic conversion

- Immediately stop infusion if not complete
- 10 units of Cryoprecipitate if available (Fibrinogen goal \geq 200)
- Tranexamic acid (10-15 mg /kg over 20 min)
- Platelet transfusion is of unclear utility.

Appendix D: Hypertonic Saline Protocol

Hypertonic (3% saline) may be delivered via peripheral IV or intraosseous access:

1. Give 250cc 3% sodium chloride (NaCl) bolus IV (children 5 cc/kg) over 10-15 minutes.
2. Follow bolus with infusion of 3% NaCl at 50 cc/hour.
3. If awaiting transport; check serum Nat levels every hour:
 - a. If Na < 150 mEq/L re-bolus 150 cc over 1 hour, then resume previous rate
 - b. If Na 150-154, increase NaCl infusion 10 cc/hour.
 - c. If Na 155-160, continue infusion at current rate.
 - d. If Na >160, hold infusion, recheck in 1 hour.
4. Once Na is within the range- continue to follow the serum Nat level every 6 hours
5. After cessation of 3% NaCl infusion, and there is no further concern for cerebral edema the Na Levels should be lowered gradually back to the normal range. Recommend decreasing Na by 5mEq/L each day until normal and continuing to monitor at regular intervals for 24hrs after cessation of hypertonic saline.

A 30cc Bolus of 23.4% NaCl can also be given over 10-15 minutes. Can be given as IV piggyback or as an IV push over 10-15 minutes by an experienced provider.

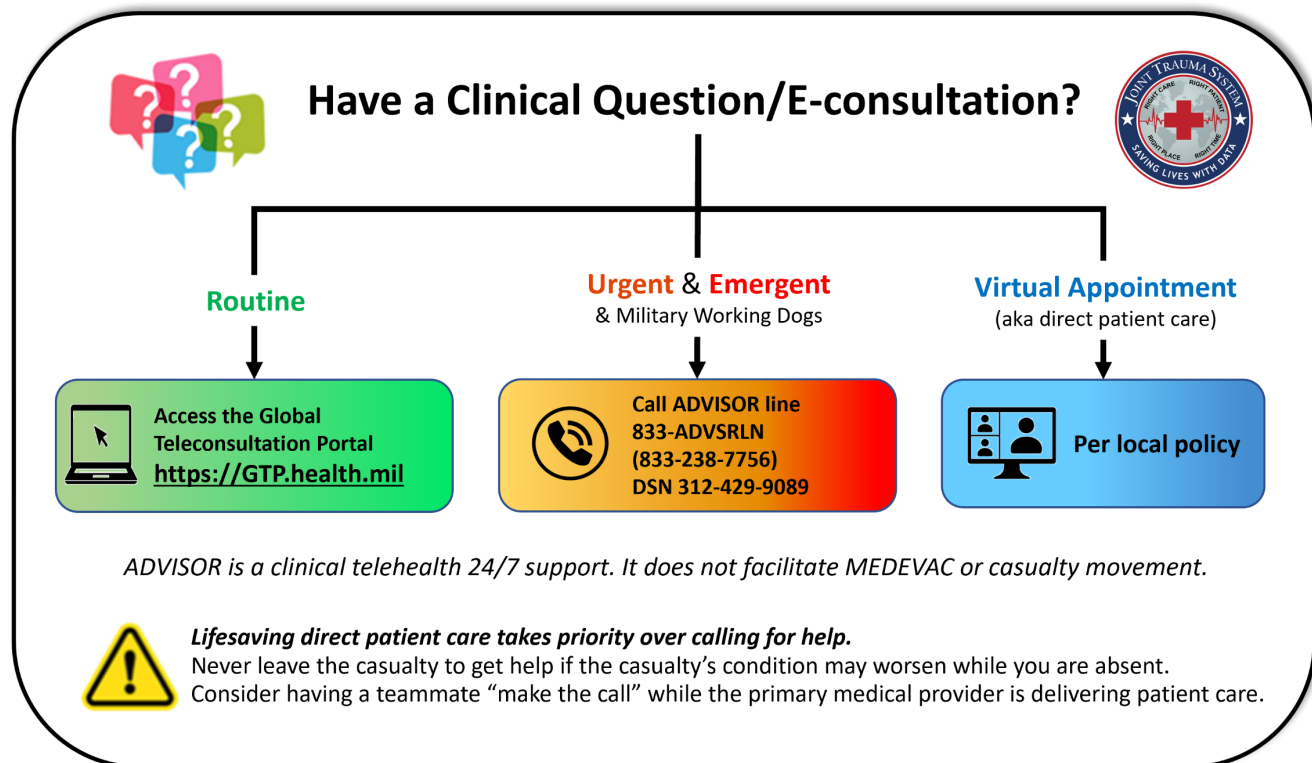


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