

SIMULATION

Guillain-Barré

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ABSTRACT:

Audience: This scenario was developed to educate emergency medicine residents on the diagnosis and management of Guillain-Barré syndrome in the emergency department. The case is also appropriate for senior medical students and advanced practice providers. The principles of crisis resource management, teamwork, and communication are also incorporated into the case.

Introduction: Patients presenting with suspected Guillain-Barré syndrome require a thorough neurologic exam and likely a lumbar puncture. Due to the ascending weakness that may involve the diaphragm, providers must continually reassess the patient's respiratory and hemodynamic status. If a patient demonstrates respiratory function weakness or has subjective worsening dyspnea, they should be evaluated for intubation.

Objectives: At the conclusion of the simulation session, learners will be able to:

1. Recognize the clinical signs and symptoms associated with Guillain-Barré syndrome, including muscle weakness and hyporeflexia.
2. Identify abnormal vital signs secondary to dysautonomia
3. Discuss evaluation for impending respiratory failure, including bedside pulmonary function testing
4. Discuss the management of Guillain-Barré, including management of dysautonomia and respiratory failure, as well as definitive management with plasmapheresis versus intravenous immunoglobulin
5. Appropriately disposition the patient to the intensive care unit
6. Effectively communicate with team members and nursing staff during resuscitation of a critically ill patient

Method: This session was conducted using high-fidelity simulation, followed by a debriefing session and lecture on the diagnosis and management of Guillain-Barré syndrome. Debriefing methods may be left to the discretion of participants, but the authors have utilized advocacy-inquiry techniques.

Topics: Medical simulation, Guillain-Barré syndrome, emergency medicine, neurology



USER GUIDE

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Learner Audience:

Medical students, interns, junior residents, senior residents

Time Required for Implementation:

Instructor Preparation: 30 minutes

Time for case: 20 minutes

Time for debriefing: 40 minutes

Recommended Number of Learners per Instructor:

4

Topics:

Medical simulation, Guillain-Barré syndrome, emergency medicine, neurology.

Objectives:

By the end of this simulation session, the learner will be able to:

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often from an antecedent illness.² There has also been a documented increase in GBS associated with influenza infections and immunizations.¹ Demyelination affects both motor and sensory nerves.³ Patients may exhibit signs of dysautonomia, lower extremity pain, and paresthesias. If the patient is not managed attentively, the patient may develop insidious respiratory failure. This simulation scenario allows learners to reinforce their Guillain-Barré management skills in a safe learning environment, then receive formative feedback on their performance.

Results and tips for successful implementation:

This simulation was written to be performed as a high-fidelity simulation scenario, but also may be used as a mock oral board case. The scenario was based on an actual patient case. The case was written for emergency medicine residents in a freestanding, community-based, or academic emergency department.

References:

1. Vellozzi C, Iqbal S, Broder K. Guillain-Barré syndrome, influenza, and influenza vaccination: the epidemiologic evidence. *Clin Infect Dis*. 2014;58(8):1149-1155. doi: 10.1093/cid/ciu005
2. Andrus P, Guthrie JM. Acute peripheral neurologic disorders. In: Tintinalli JE, Stapczynski J, Ma O, Yealy DM, Meckler GD, Cline DM. eds. *Tintinalli's Emergency Medicine: A Comprehensive Study Guide*, 8th ed. New York, NY: McGraw-Hill; 2016:1178-1184.
3. Button KC, Mannix R. Neurologic disorders In: Walls RM, Hockberger RS, Gausche-Hill M eds. *Rosen's Emergency Medicine: Concepts and Clinical Practice*. 9th ed. Philadelphia, PA: Elsevier Mosby; 2017:2182-2200.

Suggestions for further reading:

1. Willison HJ, Jacobs BC, van Doorn PA. Guillain-Barré syndrome. *Lancet*. 2016;388(10045):717-27. doi: 10.1016/S0140-6736(16)00339-1
2. Yuki N, Hartung, H-P. Guillain-Barré syndrome. *NEJM*. 2012;366(24):2294-2304. doi: 10.1056/NEJMra1114525

Linked objectives and methods:

Guillain-Barré syndrome (GBS) is an uncommon condition that classically presents with ascending lower extremity weakness and hyporeflexia, with a mortality rate of approximately 5%.¹ It is believed that antibodies are formed against peripheral nerves' axons and myelin sheaths due to an immune response,



INSTRUCTOR MATERIALS

Case Title: Guillane-Barrè Case Scenario

Case Description & Diagnosis (short synopsis): A 60-year-old male presents with one week of bilateral leg weakness and tingling. He also has back pain and mild dyspnea. He is having trouble walking, and states it feels “as if I’m drunk.” Participants should perform a thorough neurologic exam, obtain a computer tomography of the head (head CT), and perform a lumbar puncture. Cerebrospinal fluid will show albuminocytologic dissociation. The patient will be diagnosed with Guillain-Barré syndrome, and plasmapheresis or intravenous immunoglobulin (IVIG) should be discussed with neurology. The patient’s respiratory status will continue to decline prompting respiratory testing, and the patient will require intubation with admission to the intensive care unit.

Equipment or Props Needed:

High fidelity simulation mannequin

Optional: lumbar puncture task trainer

Lumbar puncture kit with 18-20 gauge 3.5-inch spinal needle and stylet

Optional: negative inspiratory force meter

Angiocaths for peripheral intravenous access = 18g, 20g, 22g

Oxygen sources = Nasal cannula, face mask, non-rebreather mask

Cardiac monitor

Pulse oximetry

Bag-valve mask

Intravenous (IV) pole

Normal saline (1L x2)

Medications: succinylcholine, rocuronium, etomidate, propofol, ketamine

Confederates needed:

Primary nurse

Stimulus Inventory:

- #1 Complete blood count (CBC)
- #2 Basic metabolic panel (BMP)
- #3 Liver function tests
- #4 Arterial blood gas (ABG)
- #5 Lumbar puncture results (gram stain, glucose, protein, cell count)
- #6 Ethanol level



INSTRUCTOR MATERIALS

- #7 Toxicology screen
- #8 Respiratory measurements
- #9 Computed tomography (CT) head
- #10 Electrocardiogram (ECG)—sinus tachycardia
- #11 Chest X-ray (CXR)
- #12 Lumbar plain film
- #13 Lumbar magnetic resonance imaging (MRI)

Background and brief information: Wife brings patient into the emergency department from home.

Initial presentation: 60-year-old male presents with one week of bilateral leg weakness and tingling. He also has back pain and mild dyspnea. He's having trouble walking, and feels "as if I'm drunk." He is otherwise alert, oriented x4, and does not have any obvious dysarthria or facial droop.

If asked, he received the flu shot about a week and a half ago. Denies history of back injections, trauma, falls, saddle anesthesia, fever, IV drug use, sick contacts, recent surgeries, recent travel, outdoor swimming, or history of cancer. Denies diarrhea or drinking outside water. Last alcoholic drink was this morning, and he had one beer.

- Past medical history: hypertension, anxiety, alcohol dependency
- Past surgical history: none
- Medications: Amlodipine, citalopram, multivitamins
- Allergies: none
- Family history: noncontributory
- Vital signs:
 - Heart rate (HR) – 110
 - Respiratory rate (RR) – 16
 - Temperature (T) – 98F
 - Blood pressure (BP) – 150/90
 - Oxygen saturation (O₂sat) – 98% on room air (RA)
- Weight: 100 kg

Assessment: Lying supine



INSTRUCTOR MATERIALS

How the scenario unfolds: 60-year-old male presents with one week of bilateral leg weakness and tingling. He also has back pain and mild dyspnea. He's having trouble walking, "as if I'm drunk." Participants should obtain a head CT and perform a lumbar puncture. Patient's respiratory status will continue to decline, and the patient will require intubation and admission to the intensive care unit.

Critical Actions:

1. IV access
2. Perform thorough neurologic exam
3. Perform head CT
4. Perform lumbar puncture
5. Obtain respiratory parameters (forced vital capacity, maximum inspiratory pressure, maximum expiratory pressure)
6. Re-evaluate for respiratory fatigue with 2 out of the 3 following modalities: patient symptoms, vital sign abnormalities, and/or repeat respiratory parameters
7. Intubate for respiratory failure without using succinylcholine
8. Admit to the intensive care unit



INSTRUCTOR MATERIALS

Case Title: Guillain-Barré Case Scenario

Chief Complaint: 60-year-old male presents with one week of bilateral leg weakness and tingling.

Vitals: *Heart Rate (HR)* 110 *Blood Pressure (BP)* 150/90 *Respiratory Rate (RR)* 16
Temperature (T) 98.0 *Oxygen Saturation (O₂Sat)* 98% on room air

General Appearance: lying supine in bed

Primary Survey:

- **Airway:** intact
- **Breathing:** mildly dyspneic with conversation, weak cough
- **Circulation:** tachycardic. 2+ symmetric pulses

History:

- **History of present illness:** 60-year-old male presents with one week of bilateral leg weakness and tingling. He also has back pain and mild dyspnea. He's having trouble walking, "as if I'm drunk." He is otherwise alert, oriented x4, and does not have any obvious dysarthria or facial droop.
- If asked, he received the flu shot about a week and a half ago. Denies history of back injections, trauma, falls, saddle anesthesia, fever, IV drug use, sick contacts, recent surgeries, recent travel, outdoor swimming, or history of cancer. Denies diarrhea or drinking outside water. Last alcoholic drink was this morning, when he had one beer.
- **Past medical history:** hypertension, anxiety, alcohol dependency
- **Past surgical history:** none
- **Patients medications:** Norvasc, Celexa, multivitamins
- **Allergies:** No known drug allergies
- **Social history:** drinks 4 beers per day, denies smoking or illicit drugs
- **Family history:** noncontributory

Secondary Survey/Physical Examination:

- **General appearance:** lying in bed, alert and oriented, mildly dyspneic
- **Head, ears, eyes, nose and throat (HEENT):** within normal limits
- **Heart:** tachycardic, otherwise within normal limits



INSTRUCTOR MATERIALS

- **Lungs:** + conversational dyspnea. No wheezing, rhonchi, wheezes or rales. Weak occasional cough
- **Abdominal/GI:** hypoactive bowel sounds with mild suprapubic fullness, otherwise within normal limits
- **Genitourinary:** mild suprapubic fullness, otherwise within normal limits
- **Rectal:** rectal tone slightly decreased, otherwise within normal limits
- **Extremities:** 3/5 lower extremity strength bilaterally. 4/5 upper extremity strength bilaterally. Absent patellar/Achilles reflexes. 2+ symmetric peripheral pulses. Vague paresthesias to palpation around circumferential lower extremities which are not dermatomal.
- **Back:** within normal limits
- **Neuro:** No cranial nerve deficits. Unable to ambulate secondary to lower extremity weakness.
- **Skin:** within normal limits
- **Lymph:** within normal limits
- **Psych:** within normal limits



INSTRUCTOR MATERIALS

Results:

Complete blood count (CBC)

White blood count (WBC)	12.0 x1000/mm ³ (H)
Hemoglobin (Hgb)	13.1 g/dL
Hematocrit (HCT)	34.0%
Platelet (Plt)	160 x1000/mm ³

Basic metabolic panel (BMP)

Sodium	132 mEq/L
Chloride	98 mEq/L
Potassium	4.2 mEq/L
Bicarbonate (HCO ₃)	22 mEq/L (L)
Blood Urea Nitrogen (BUN)	36 mg/dL (H)
Creatine (Cr)	1.4 mg/dL (H)
Glucose	140 mg/dL
Calcium	8.0 mg/dL

Liver Function Tests (LFTs)

Total bilirubin	1.2 mg/dL
Direct bilirubin	0.4 mg/dL
Albumin	3.0 g/dL
Alkaline Phosphate	100 U/L
Total Protein	7.0 g/dL
Aspartate Aminotransferase (AST)	22 u/L
Alanine Aminotransferase (ALT)	40 u/L

Arterial Blood Gas (ABG)

pH	7.3
pCO ₂	50 mmHg
PO ₂	88 mmHg
HCO ₃	23 mEq/L
O ₂ saturation	94%

Lumbar Puncture Results

Appearance:	Clear, colorless
Gram stain:	No organisms



INSTRUCTOR MATERIALS

Cerebral spinal fluid (CSF) protein	120 mg/dL (H)
CSF glucose	100 mg/dL
Cell count	<5 cells/mm ³

Ethanol level

<0.003 g/dL

Urine Toxicology Screen

Opiates	negative
Cocaine	negative
Marijuana	negative
PCP	negative
Amphetamines	negative
Benzodiazepines	negative
Barbiturates	negative
Methadone	negative
Propoxyphene	negative
MDMA	negative

Respiratory measurements

Forced vital capacity	18 mL/kg
Maximum inspiratory pressure	25 cmH ₂ O
Maximum expiratory pressure	35 cmH ₂ O

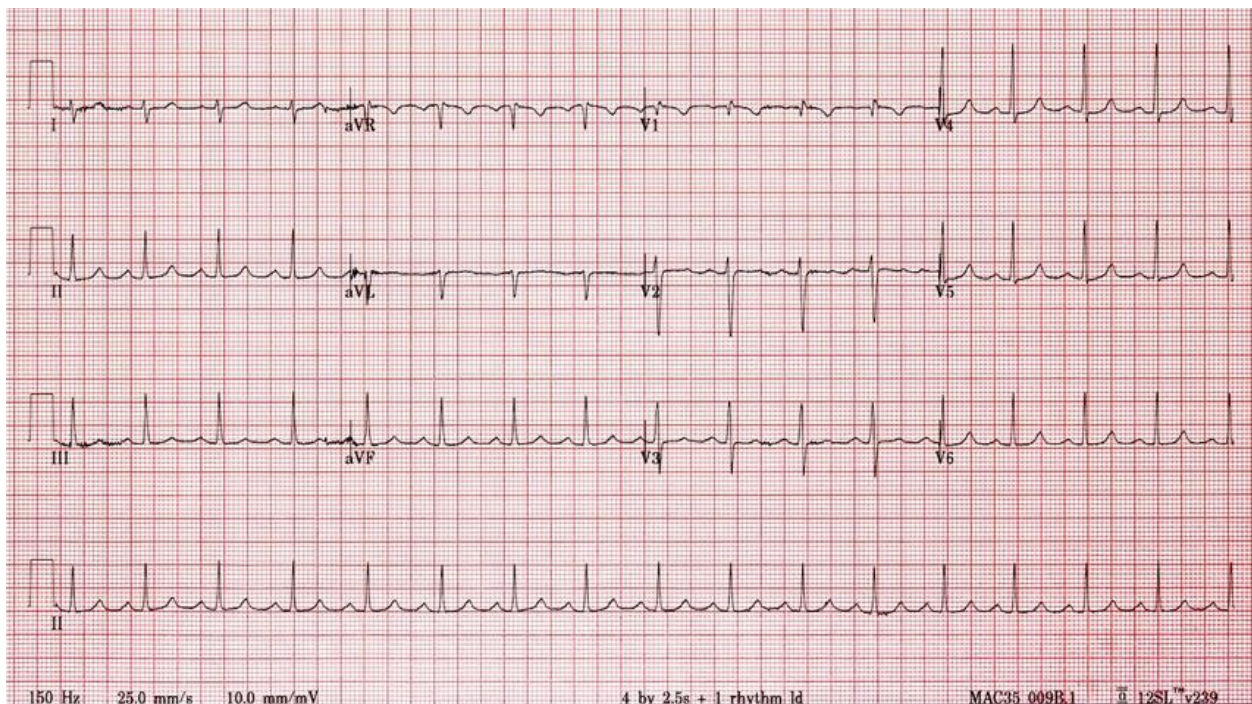


INSTRUCTOR MATERIALS

Head CT: Normal (author's own image)



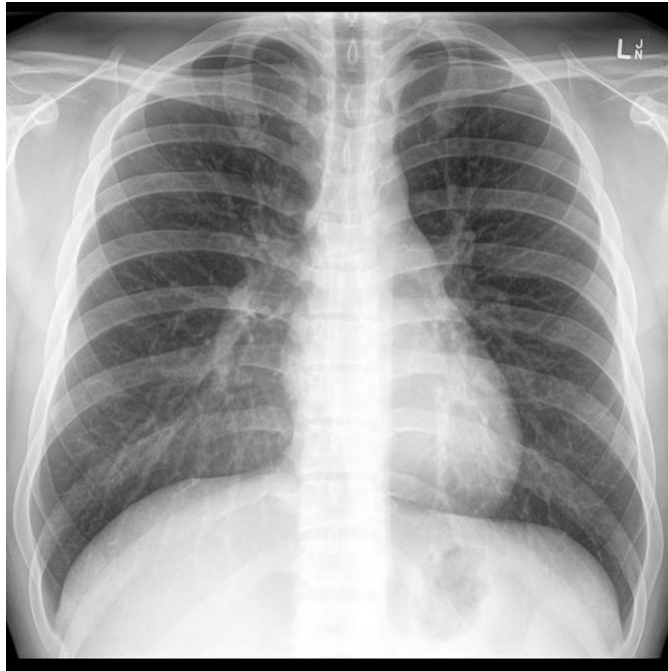
ECG: Sinus tachycardia (author's own image)





INSTRUCTOR MATERIALS

Chest X-ray: Normal (author's own image)





INSTRUCTOR MATERIALS

Lumbar plain X-ray: Normal

Jmarchn. Lumbar hyperlordosis. In: Wikimedia Commons [free media repository].
https://commons.wikimedia.org/wiki/File:Hyperlordosis_XRay_lat.jpg. The Wikimedia Foundation; 2014. CC BY-SA 3.0

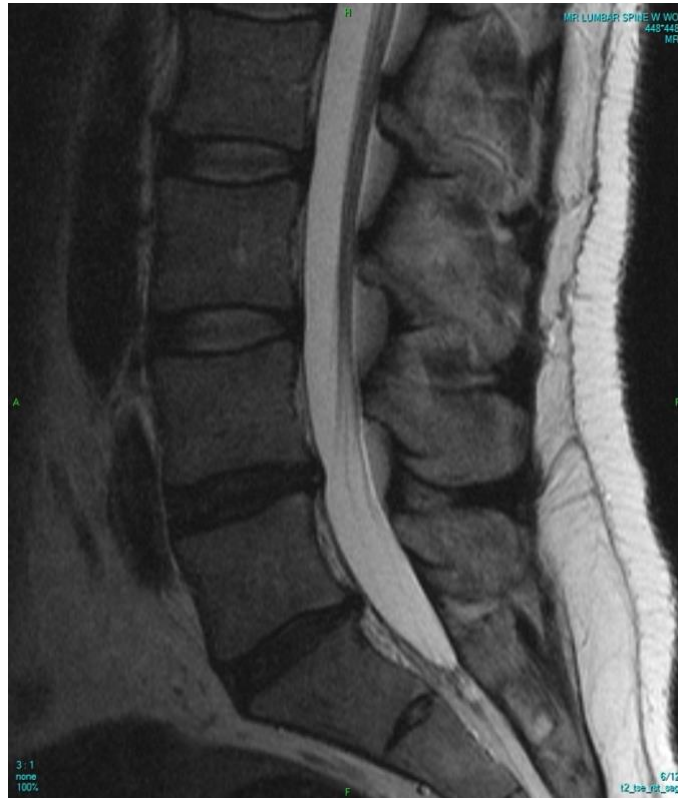




INSTRUCTOR MATERIALS

Lumbar MRI: Normal

Stillwaterising. MRI of lumbar spine T2 weighted. Part of series of 12. In: Wikimedia Commons [free media repository]. https://commons.wikimedia.org/wiki/File:Lumbar_MRI_t2-tse-rst-sagittal_06.jpg. The Wikimedia Foundation; 2014. Public Domain.





OPERATOR MATERIALS

SIMULATION EVENTS TABLE:

Minute (state)	Participant action/ trigger	Patient status (simulator response) & operator prompts	Monitor display (vital signs)
0:00 (Baseline)	Patient moved into bed in the emergency department.	Participants should begin by placing the patient on a monitor, obtaining a history and physical exam.	T: 98F HR: 110 BP: 150/90 RR: 16 O2: 98% RA
04:00	IV placed, labs drawn. Participant should perform a thorough neurologic exam	Appropriate management: obtain CT head and lumbar puncture (may be verbalized or a task trainer may be used). Clear CSF is obtained. If not performed, patient states he is feeling shorter of breath and is having trouble speaking in full sentences. <i>Note: consider providing clues such as “does this have anything to do with the flu shot I had last week? Or “Why do my legs feel weak?” if learners are off track.</i>	T: 98F HR: 110 BP: 150/90 RR: 16 O2: 98% RA
10:00	Regardless of actions, patient will become more dyspneic with shallow respirations.	Appropriate management: obtain negative inspiratory force, forced vital capacity, and maximum expiratory pressure measurements. Participants should recognize respiratory fatigue and prepare to intubate. If performed incorrectly (not intubated): patient will become unresponsive and become more bradycardic until the patient goes into ventricular fibrillation arrest (Vfib). Remain in vfib until 2 cycles of advanced cardiac life support (ACLS) are performed correctly.	T: 98F HR: 140 BP: 170/100 RR: 30 O2: 98% RA
15:00	Patient should be intubated. Neurology should be called for definitive management.	If performed correctly: team should tell neurology their presumptive diagnosis and communicate the patient’s need for plasmapheresis/intravenous immunoglobulin. If their presentation is not succinct or direct: Neurologist will ask them why they are calling and what they want from him/her.	T: 98F HR: 110 BP: 120/80 RR: set by team O2: 98% FiO2 100%



OPERATOR MATERIALS

Minute (state)	Participant action/ trigger	Patient status (simulator response) & operator prompts	Monitor display (vital signs)
		If patient is given succinylcholine, monitor should show a widened QRS. If a repeat BMP is drawn, lab should call with a panic potassium level of 7.0. QRS stays wide until calcium and another drug (albuterol, Lasix, IV insulin, kayexalate) is given.	
18:00 ICU should be called for admission	Patient is dispositioned.	Case ends.	T: 98F HR: 110 BP: 120/80 RR: set by team O2: 98% FiO2 100%

Diagnosis:

Guillain-Barré Syndrome

Disposition:

Admit to the intensive care unit



DEBRIEFING AND EVALUATION PEARLS

Guillain-Barré Syndrome

Guillain-Barré syndrome is secondary to demyelination of peripheral nerves due to molecular mimicry. The most common precipitant is *Campylobacter jejuni* infection, but cytomegalovirus, Epstein-Barr virus, Zika, influenza, and human immunodeficiency virus have also been implicated. Non-infectious etiologies have also been identified, such as surgery, immunizations, and trauma.

GBS presents with progressive symmetric muscle weakness. Weakness is typically ascending beginning with lower extremities, but may present initially in the upper extremities or with bulbar muscles. Deep tendon reflexes may be absent or depressed. Symptoms often progress over two to four weeks.

Important differential diagnoses to consider include transverse myelitis and spinal cord compression. While these typically present with hyperreflexia, this may not be present in the early stages of disease.

Patients may experience back and extremity pain from nerve root inflammation. Paresthesias of the hands/feet also may occur.

Dysautonomia may commonly occur, including tachycardia, bradycardia, hypertension, hypotension, dysrhythmias, orthostatic hypotension, ileus, urinary retention, and lack of sweating.

Cerebrospinal fluid may exhibit albuminocytologic dissociation.

Respiratory parameters indicating fatigue are a forced vital capacity <20 mL/kg, maximum inspiratory pressure <30 cmH₂O, and maximum expiratory pressure <40 cmH₂O. Providers should also evaluate patient's ability to cough, stand, lift their elbows, and lift their head.

If intubation is required, providers should avoid succinylcholine due to risk of precipitating the development of hyperkalemia.

Hypotension should be addressed with IV fluids and potentially phenylephrine, while refractory hypertension should be addressed with antihypertensive therapy. Providers should be diligent to assess for labile fluctuations in blood pressure readings.



DEBRIEFING AND EVALUATION PEARLS

Case should be discussed with neurology for plasmapheresis versus intravenous immunoglobulin therapy.

Other debriefing points:

Closed-loop communication amongst team: was it used? Why or why not? Were there any implications of this during case execution?



SIMULATION ASSESSMENT

Guillain-Barré Case Scenario

Learner: _____

Assessment Timeline

This timeline is to help observers assess their learners. It allows observer to make notes on when learners performed various tasks, which can help guide debriefing discussion.

Critical Actions

1. IV access
2. Perform thorough neurologic exam
3. Perform head CT
4. Perform lumbar puncture
5. Obtain respiratory parameters (forced vital capacity, maximum inspiratory pressure, maximum expiratory pressure)
6. Re-evaluate for respiratory fatigue with 2 out of the 3 following modalities: patient symptoms, vital sign abnormalities, and/or repeat respiratory parameters
7. Intubate for respiratory failure without using succinylcholine
8. Admit to the intensive care unit

0:00



SIMULATION ASSESSMENT

Guillain-Barré Case Scenario

Learner: _____

Critical Actions:

- ☐ IV access
- ☐ Perform thorough neurologic exam
- ☐ Perform head CT
- ☐ Perform lumbar puncture
- ☐ Obtain respiratory parameters (forced vital capacity, maximum inspiratory pressure, maximum expiratory pressure)
- ☐ Re-evaluate for respiratory fatigue with 2 out of the 3 following modalities: patient symptoms, vital sign abnormalities, and/or repeat respiratory parameters
- ☐ Intubate for respiratory failure without using succinylcholine
- ☐ Admit to the intensive care unit

Summative and formative comments:



SIMULATION ASSESSMENT

Guillain-Barré Case Scenario

Learner: _____

Milestones assessment:

	Milestone	Did not achieve level 1	Level 1	Level 2	Level 3
1	Emergency Stabilization (PC1)	☐ Did not achieve Level 1	☐ Recognizes abnormal vital signs	☐ Recognizes an unstable patient, requiring intervention Performs primary assessment Discerns data to formulate a diagnostic impression/plan	☐ Manages and prioritizes critical actions in a critically ill patient Reassesses after implementing a stabilizing intervention
2	Performance of focused history and physical (PC2)	☐ Did not achieve Level 1	☐ Performs a reliable, comprehensive history and physical exam	☐ Performs and communicates a focused history and physical exam based on chief complaint and urgent issues	☐ Prioritizes essential components of history and physical exam given dynamic circumstances
3	Diagnostic studies (PC3)	☐ Did not achieve Level 1	☐ Determines the necessity of diagnostic studies	☐ Orders appropriate diagnostic studies. Performs appropriate bedside diagnostic studies/procedures	☐ Prioritizes essential testing Interprets results of diagnostic studies Reviews risks, benefits, contraindications, and alternatives to a diagnostic study or procedure
4	Diagnosis (PC4)	☐ Did not achieve Level 1	☐ Considers a list of potential diagnoses	☐ Considers an appropriate list of potential diagnosis May or may not make correct diagnosis	☐ Makes the appropriate diagnosis Considers other potential diagnoses, avoiding premature closure



SIMULATION ASSESSMENT

Guillain-Barré Case Scenario

Learner: _____

	Milestone	Did not achieve level 1	Level 1	Level 2	Level 3
5	Pharmacotherapy (PC5)	☐ Did not achieve Level 1	☐ Asks patient for drug allergies	☐ Selects an medication for therapeutic intervention, consider potential adverse effects	☐ Selects the most appropriate medication and understands mechanism of action, effect, and potential side effects Considers and recognizes drug-drug interactions
6	Observation and reassessment (PC6)	☐ Did not achieve Level 1	☐ Reevaluates patient at least one time during case	☐ Reevaluates patient after most therapeutic interventions	☐ Consistently evaluates the effectiveness of therapies at appropriate intervals
7	Disposition (PC7)	☐ Did not achieve Level 1	☐ Appropriately selects whether to admit or discharge the patient	☐ Appropriately selects whether to admit or discharge Involves the expertise of some of the appropriate specialists	☐ Educates the patient appropriately about their disposition Assigns patient to an appropriate level of care (ICU/Tele/Floor) Involves expertise of all appropriate specialists
9	General Approach to Procedures (PC9)	☐ Did not achieve Level 1	☐ Identifies pertinent anatomy and physiology for a procedure Uses appropriate Universal Precautions	☐ Obtains informed consent Knows indications, contraindications, anatomic landmarks, equipment, anesthetic and procedural technique, and potential complications for common ED procedures	☐ Determines a back-up strategy if initial attempts are unsuccessful Correctly interprets results of diagnostic procedure



SIMULATION ASSESSMENT

Guillain-Barré Case Scenario

Learner: _____

	Milestone	Did not achieve level 1	Level 1	Level 2	Level 3
20	Professional Values (PROF1)	☐ Did not achieve Level 1	☐ Demonstrates caring, honest behavior	☐ Exhibits compassion, respect, sensitivity and responsiveness	☐ Develops alternative care plans when patients' personal beliefs and decisions preclude standard care
22	Patient centered communication (ICS1)	☐ Did not achieve level 1	☐ Establishes rapport and demonstrates empathy to patient (and family) Listens effectively	☐ Elicits patient's reason for seeking health care	☐ Manages patient expectations in a manner that minimizes potential for stress, conflict, and misunderstanding. Effectively communicates with vulnerable populations, (at risk patients and families)
23	Team management (ICS2)	☐ Did not achieve level 1	☐ Recognizes other members of the patient care team during case (nurse, techs)	☐ Communicates pertinent information to other healthcare colleagues	☐ Communicates a clear, succinct, and appropriate handoff with specialists and other colleagues Communicates effectively with ancillary staff