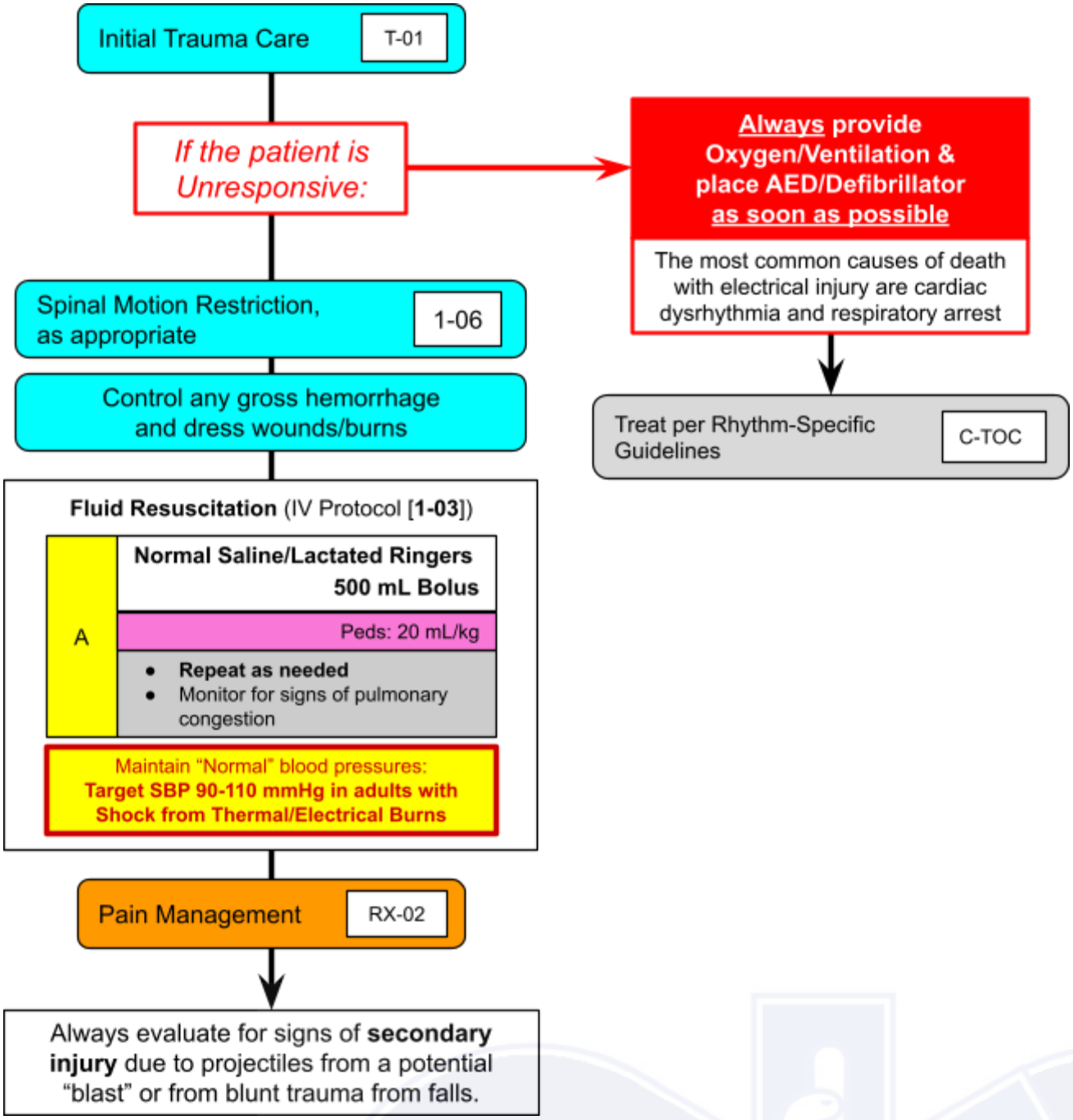


T-06 ELECTROCUTION/ LIGHTNING INJURY		First Responder EMT AEMT Paramedic

INJURY MECHANISMS

- Current through high resistance → creates **HEAT!** **= tissue damage**
  - Bone has the highest resistance → deep burns not visible on the surface
  - Dry skin has a high resistance → prevents conduction
  - More water content (e.g. blood, muscle, wet skin) = low resistance → low heat production/damage
- Current can also cause **electrical depolarization** → neurologic dysfunction and <u>interference with cardiac conduction</u>
  - Low voltage (household, <600V) alternating current → V-fib
  - Direct Current (DC) or high-voltage AC (>1000V) → Asystole
    - **Generally transient with spontaneous ROSC**
    - **Also associated with paralysis of the respiratory center in the brain = <u>respiratory arrest despite cardiac ROSC</u>**
- Secondary/tertiary injuries can be caused by
  - **Muscle contractions** →
    - Fractures (e.g. spine) or dislocations due to uninhibited muscle activation.
    - Cause the body to be “thrown” away from the source, causing any type of blunt force trauma
  - Some electrical exposures may be associated with **blast injury**, leading to barotrauma, thermal burns and penetrating injury from projectiles.

TREATMENT APPROACH

- Always start with the ABC’s!!! → Defibrillate, Oxygenate & Ventilate - paralysis of the respiratory center is an easily reversible cause of preventable death with electrocution.
- Basic Burn/Wound Care → Similar to thermal or chemical burns.
- Other Injury Concerns
  - **<u>Rhabdomyolysis</u>** (muscle breakdown) **can lead to (1) compartment syndrome** (swelling of muscles cutting off blood supply to the extremity) **and (2) renal failure.**
    - Prehospital treatment is with bolus and (lots of) maintenance IV fluids
  - Ocular Injury = cataracts can develop over several weeks
  - Neurologic injury - *highly variable* in presentation from peripheral nerve injuries to seizures, spinal cord injury, etc.

T-06 ELECTROCUTION/ LIGHTNING INJURY		First Responder EMT AEMT Paramedic

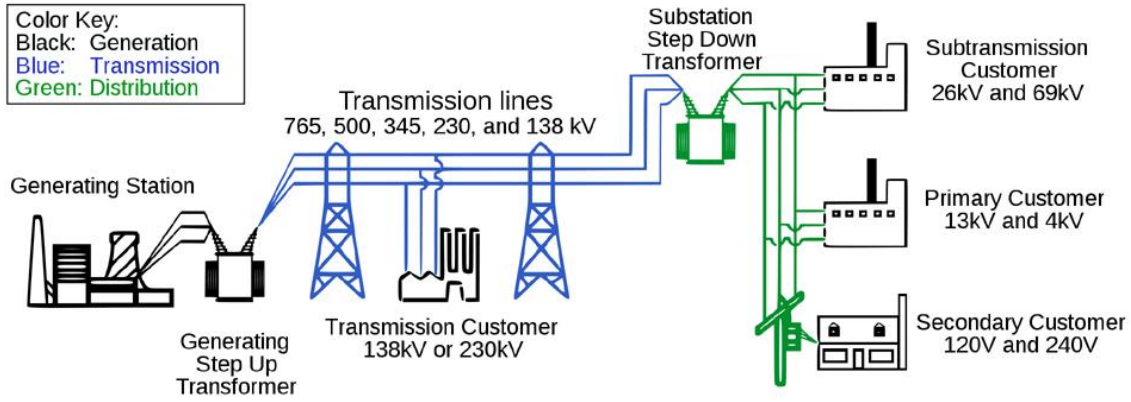
ELECTRICITY 101

- Ohm's Law: V = IR
  - Voltage (V) = "pressure" (potential) of electricity
  - Current (I) = flow (i.e. amount) of electricity, measured in amperes ("amps", A)
  - Resistance (R) = hindrance to current, measured in Ohms
- Voltage
  - High Voltage - typically >1000 volts (technically >600 V)
    - >1000 V associated with a high incidence of internal injury even with minimal external signs
    - Any exposure should be evaluated in an ED
  - Low Voltage - <600 volts
    - Generally safe at household voltages (110/220 V)
- Current Type
  - Alternating Current (AC)
    - Can cause tetanic contractions due to repeated muscle stimulation (i.e. on-then-off-then-on) leading to inability to let go of a wire/source.
  - Direct Current (DC)
    - High voltage with sudden muscle activate can cause a patient to be "thrown" from the source

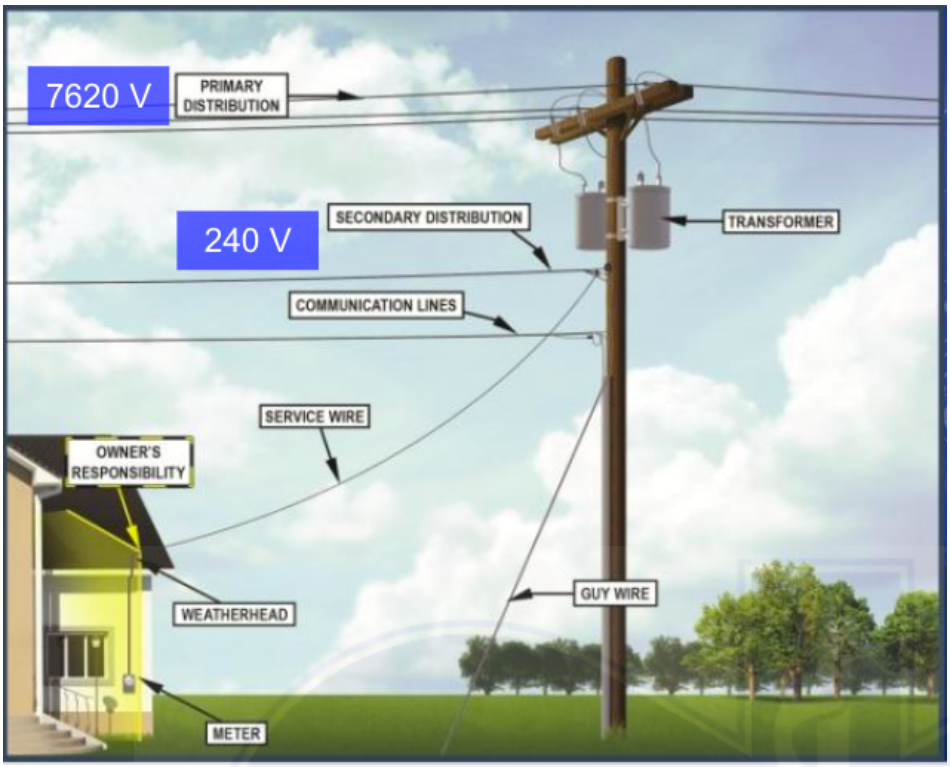
Notes:

- Power lines are almost never insulated (corrosion = dark appearance)
- Reapplication of voltage (through circuit breakers) can make the lines "jump"
- Victims and other objects (e.g. vehicles) may transmit current → never tell a patient to exit a vehicle or approach a vehicle with downed power lines nearby.
- Voltage may be transmitted through the ground via "voltage gradients" or "step voltage", discussed below.

Electrical Generation/Distribution



Household



OTHER TYPES OF ELECTRICAL INJURY/SPECIAL SITUATIONS

LIGHTNING INJURY

- VERY high voltage (~50,000 V), <u>but</u> very short duration.
    - "Flashover" → often travels over the surface of the body (especially if the skin is wet/damp), rather than entering the body (i.e. less likely to cause internal injury or burns)
    - Superheating of water on the skin can cause a rapid vaporization causing an "explosion"
    - Also creates the pathognomonic "ferning pattern" (Lichtenberg figures)
- **Injury = <u>transient asystole with persistent paralysis of the respiratory center,</u> ultimately leading to respiratory arrest in most patients who do not survive (10-30%).**
- **If the patient survives the strike they are very unlikely to have any substantial problems.**
- Electrical current from lightning can be transmitted through multiple mechanisms:
    - Directly…simple enough.
    - From other struck objects such as a nearby tree ("side flash").
    - Indirectly through a conducting medium such as a telephone line ("contact strike").
    - Through **"ground current" or "step potential"**
        - This occurs when the electrical current flows through the ground → as it gets further from the source, resistance causes the voltage to decrease.
        - If each foot is in an area of differing voltage, the potential difference between the two will create a current up one leg and down the other.

ELECTRICAL CONTROL DEVICES (e.g. TASER)

- Like lightning, high-voltage but **very low amperage** (current) = little threat of electrical injury
- Oscillates at 10 Hz (times/second), inducing brief involuntary muscle contractions, leading to temporary incapacitation.
- Barbs on the terminals should generally be removed, unless in the eye or genitals.
- Deaths due to individuals being subdued with these devices are **<u>not</u> due to electrical injury.** All altered patients should be assumed to be related to Excited Delirium syndrome [see P-01] with underlying acidosis and potential cardiovascular collapse.

T-06 ELECTROCUTION/ LIGHTNING INJURY		First Responder EMT AEMT Paramedic

QI Review Parameters:

1.