

# Neuromuscular Electrical Stimulation after Total Knee Arthroplasty

TKA Program | Clinician Education



# Welcome and Contact Info

Questions?

Please talk to your Site Champion and/or contact us here:

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# Overview

Welcome to NMES Training for the TKA Program.

Topics we will cover:

1. Introduction to NMES for TKA Recovery
2. Contraindications and Safety Monitoring
3. TKA Program Parameters
4. Patient Protocol and Education
5. Tips and Troubleshooting
6. Clinic Testing and Documentation

# Module 1

Introduction to NMES for TKA Recovery

# Why NMES after TKA?

Recovering range of motion and strength are essential after TKA, but quadriceps weakness has a more significant impact on long-term function

Quad strength deficits can be profound after TKA

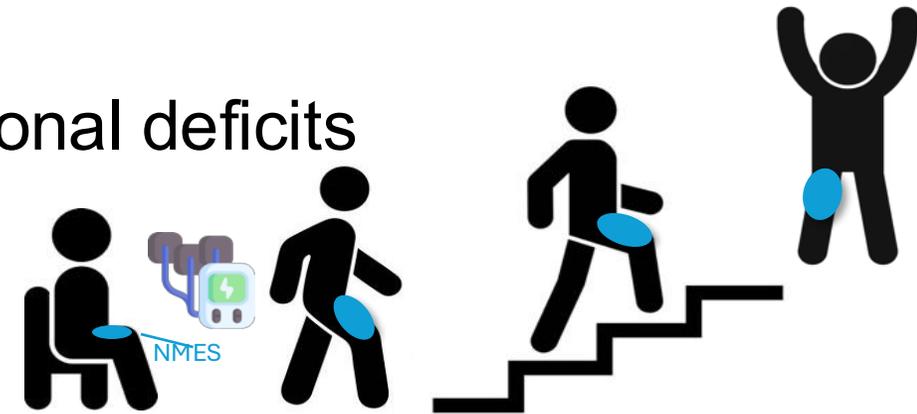
- 60% in quad strength following surgery and
- 17% decrease in muscle activation
- Recovery can take months or even years

Quad weakness can result in significant functional deficits

- Difficulty with daily activities
- Increased fall risk

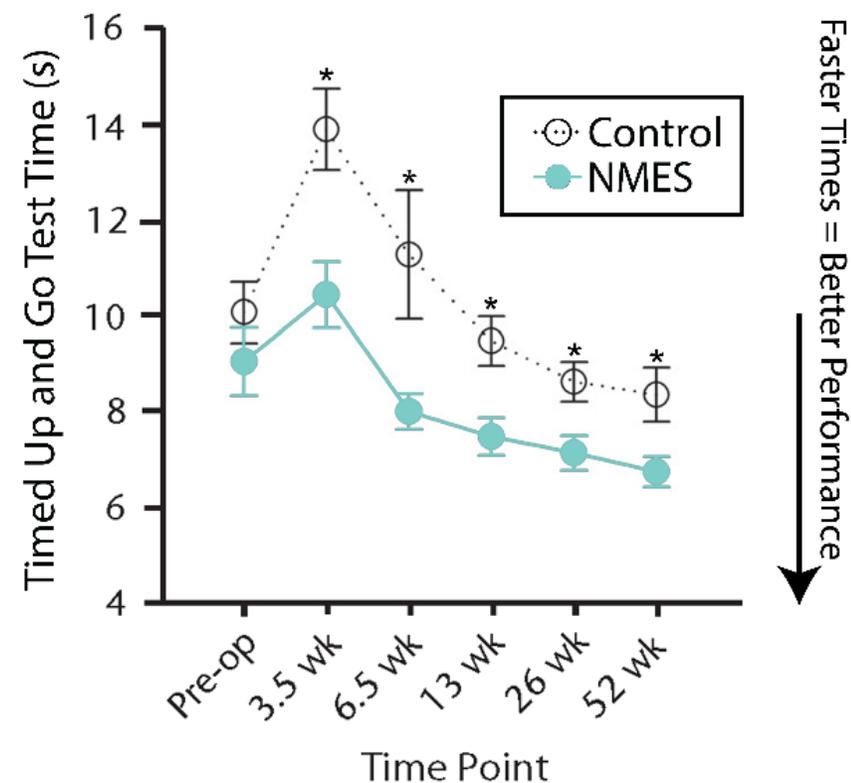
Benefits of NMES

- Activates all size motor units simultaneously
- Activates muscle fibers that patients may be reluctant or unable to activate
  - Particularly important early after surgery
  - Can stimulate Type II fibers which atrophy after TKA
- Analgesic effect

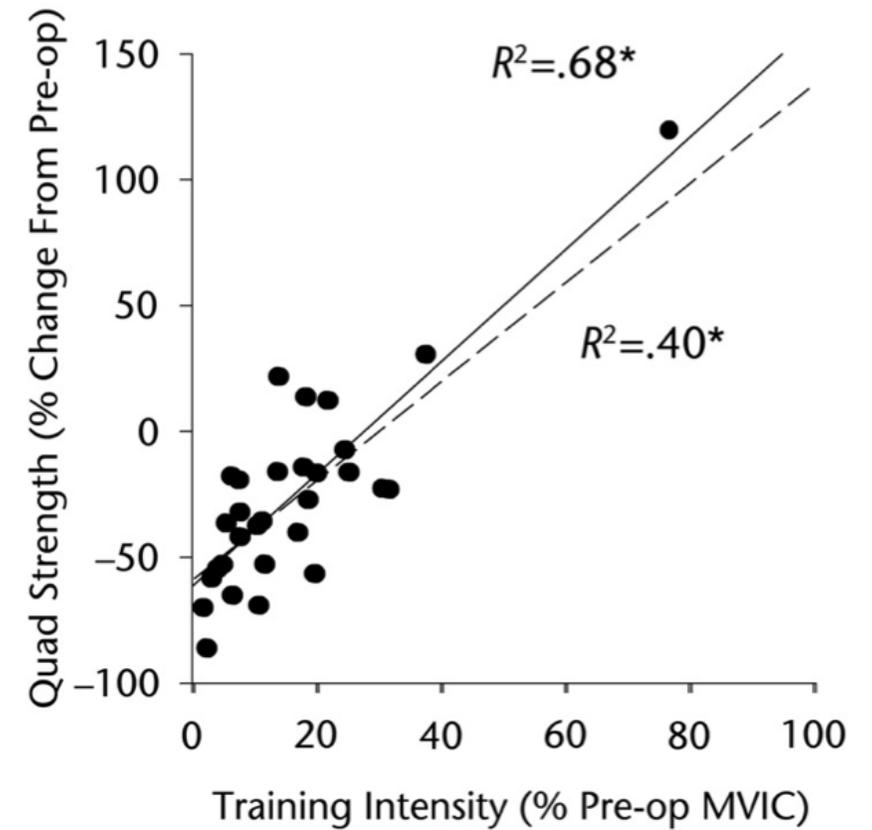


# NMES is standard of care after TKA

- NMES after TKA improves functional recovery (TUG) in the short and long term, through one year
  - 2x rate of recovery compared to controls
- NMES after TKA is a part of PT clinical practice guidelines



Goal of NMES:  
Produce the **maximum tolerable tetanic contraction**

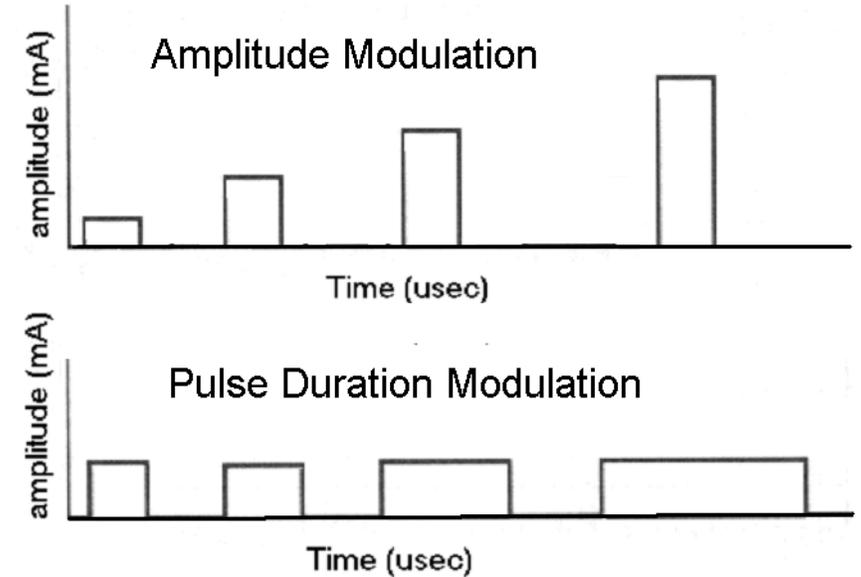


**Higher intensity contractions are associated with increased quad strength.**

**↑ Higher tolerated intensity = ↑ Greater strength gains**

# Increasing Intensity of Muscle Contraction

- Increase amplitude
- Increase distance between electrodes to recruit more of the muscle
- Maximizing electrode conductivity
- Increase pulse width



# Module 2

Contraindications and Safety Monitoring

# Safety considerations

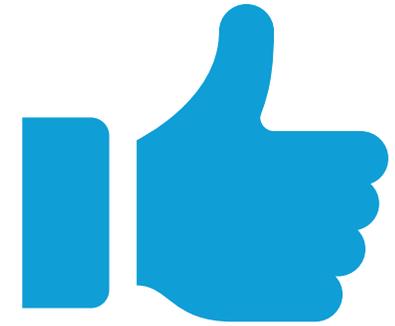


Contraindications/Exclusion criteria:

- An implanted cardioverter defibrillator (ICD) or pacemaker
- Active cancer
- Post-operative diagnosed deep vein thrombosis (DVT) in the leg with TKA

# Appropriate responses

- Muscle soreness or fatigue
- Minor skin redness
- Minor discomfort
- Strong but tolerable sensation



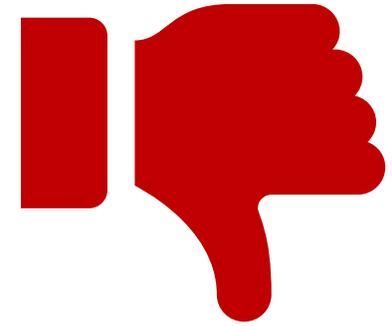
**Intensity should be high enough that the patient pauses conversation or is distracted each time the stimulation kicks in.**

Appropriate muscle discomfort or soreness is a generalized, dull sensation that is within the muscle.

Discomfort is expected at first and improved tolerance with stronger contractions will soon follow.

# Inappropriate responses

- Burns (electrical)
- Pain
- Excessive muscle fatigue



Inappropriate pain is sharp and localized, rather than generalized and dull and deep muscle soreness.

These symptoms are rare but can be caused if electrodes are not placed properly or are left on too long. They are indicators to stop and adjust usage and parameters.

# Module 3

TKA Program Parameters

# Inclusion Criteria

## **Inclusion Criteria**

- Primary, unilateral TKA
- Attend outpatient PT within 10 days after surgery
- Attend at least 3 total outpatient PT visits

# TKA Program and Patient Communication

**NMES after TKA is standard of care as shown in Physical Therapy Clinical Practice Guidelines (Jette et al., 2020), and we are implementing NMES after TKA on a **system** level.**

**We use standardized and evidence-based parameters and instructions for NMES in the TKA program.**

Therefore, this is not a research protocol that requires individual consent from patients. It is a systems-level implementation study, and not a study on the safety of an individual treatment. The treatment (NMES after TKA) is already a part of Physical Therapy Clinical Practice Guidelines. IRB has approved this study design.

“Research” language should be avoided to prevent patient confusion. The NMES protocol can be referred to as the TKA Program.

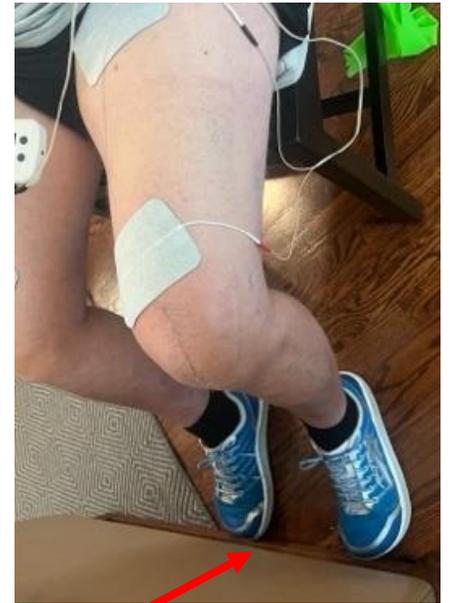
# TKA Program Protocol

## Schedule:

- 15 minutes, 2x per day, for 6 weeks

## Set Up:

- Parameters pre-set and locked by PT; patient only controls intensity (amplitude)
- Seated, knee in a comfortable flexion position for isometric quad contraction
- Sturdy piece of furniture or wall blocking foot from kicking out during stimulation
  - **Note.** Straps can be used to block kicking in clinic if needed, but furniture or wall should be used to block at home
- Patients do not have to voluntarily activate their quad while NMES is on, unless it improves patient comfort/tolerance



# Electrode Placement

**Goal:** Largest distance between electrodes while avoiding contact with incision and dressings, to recruit as much of the quadriceps as possible

## Proximal electrode

- As proximal as possible
- Slightly **lateral** and angled

## Distal electrode

- As distal as possible
- Slightly **medial** and angled (as permitted with dressing and incision)



Work around incision and dressings to find a position that produces a tetanic contraction



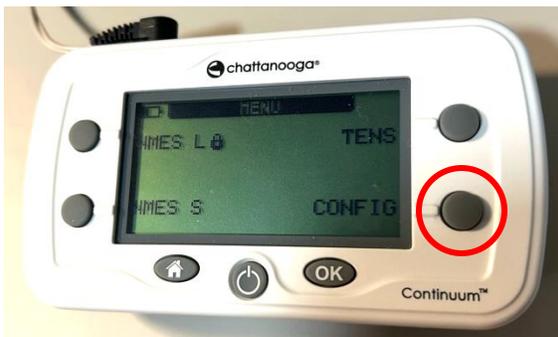
**Tip:** When you find a good electrode placements for your patient, outline the electrodes using a Sharpie marker, and have them take a photo on their phone, so they can easily use the same place at home.

# Standardized NMES Parameters for TKA Program

Component	Setting
Time	15 minutes
Rate	50 Hz
Width	400 $\mu s$
Waveform	Symmetrical
Off Time	10 seconds
Cycling	1 channel
Ramp + (CH1 & CH2)	2 seconds
On Time (CH1 & CH2)	10 seconds
Ramp - (CH1 & CH2)	0 seconds
Lag (CH1 & CH2)	0 seconds

# Locking and Unlocking Parameter Settings

On Home screen,  
Press **CONFIG**

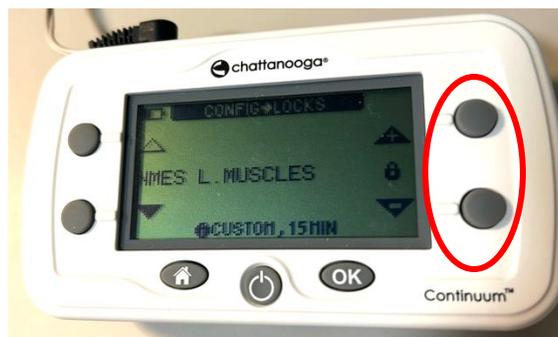


Make sure the screen says  
NMES L.MUSCLES.  
If it doesn't, scroll using arrows  
on left side until you see this



TO LOCK: 

Press right side arrows UP  
or DOWN until the closed  
lock appears



When *locked*, settings cannot  
be modified

More information can be found in your clinic  
resource binder and in the TKA Program Teams  
page.

TO UNLOCK: 

Press right side arrows  
DOWN until a closed clock  
appears

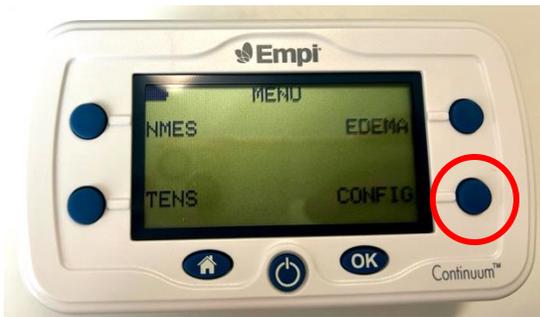


When *unlocked*, you can  
modify settings

**Be sure to LOCK after you  
are done modifying**

# Locking and Unlocking Parameter Settings Empis Version 1.7

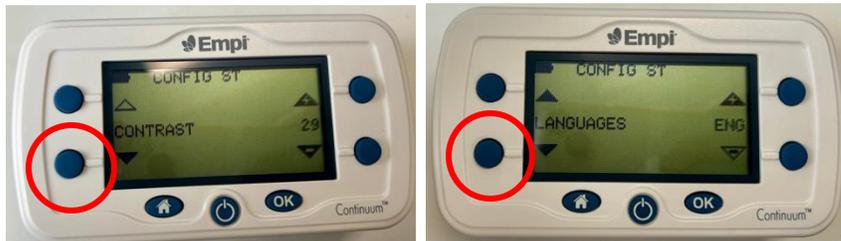
1. On Home screen,  
Press **CONFIG**



2. Press **SET**

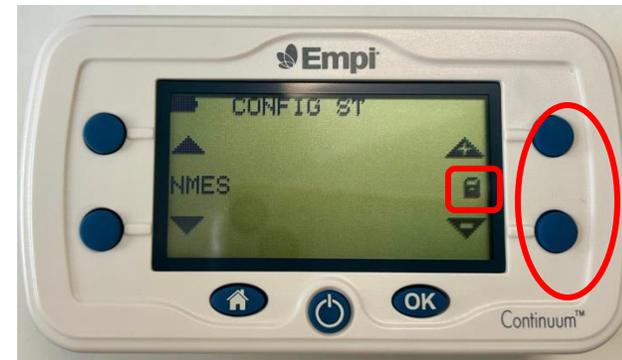


3. Press DOWN twice until screen displays NMES.



TO LOCK: 

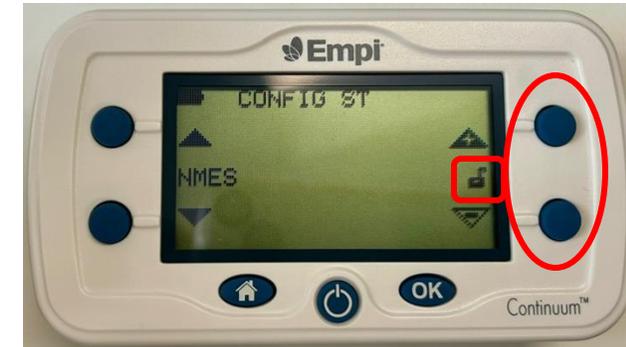
Press right side arrows UP  
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Press right side arrows  
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# Module 4

Patient Protocol and Education



# Module 5

Tips and Troubleshooting

# Tips: Psychological Considerations Associated with Discomfort

- Patient's coping strategy (encourage relaxation)
- Whether the stim caused a contraction
  - A light kick with stimulation may help if it improves tolerance
  - Whether the patient was judging the intensity or unpleasantness

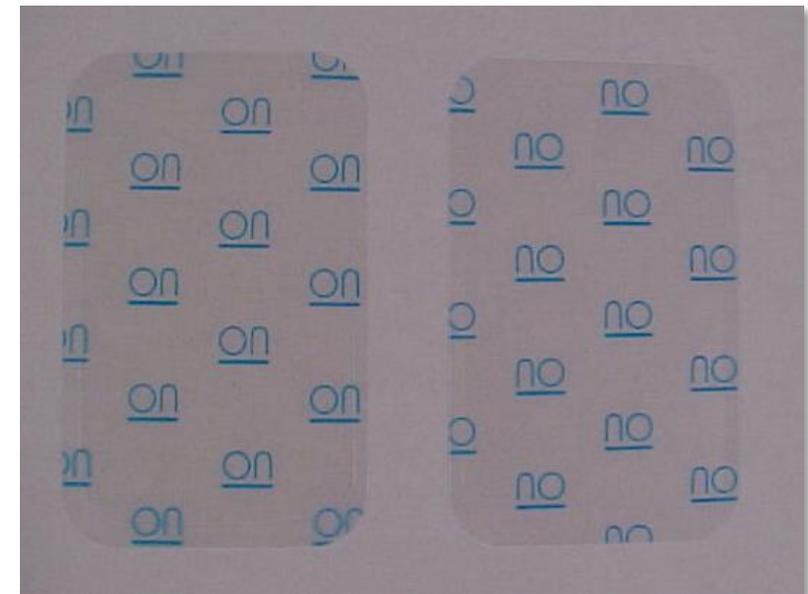
## Give the Patient Control

- Self-adjust intensity
- Therapist manually resuming stim
- Count down to the stim
- Explain to the patient the value of the modality
- **Have patient clasp fingers in front of them and pull apart**



# Tips: Electrodes

- We are providing large electrodes, which help to improve comfort
- How to improve lifespan of electrodes
  - Proper storage
  - Keep them moist (apply water)
  - Place properly on plastic
- Remind patients to replace electrodes every 1-2 weeks, or more often if the electrode has lost adherence to the skin
  - They will be given 4 pairs with their unit and will request more from PT as needed
- If electrode edges lose their grip, use tape to secure them down
- Modify electrode placement
  - Do not place distal electrode too medially on adductors
  - Can move proximal electrode slightly closer to the distal electrode if helps with tolerance



# Tips: Stimulation Parameters

## **Use the standardized parameters for the TKA Project.**

However, if the strategies above (psychological and electrodes) are not effective and a patient is still not tolerating and at risk of not using NMES, parameters may be modified slightly in attempt to increase comfort.

What can we modify?

- **For pain despite pad placement adjustment:** Modify Pulse Width – can try 300  $\mu s$   
Can also try moving proximal electrode slightly closer to the distal electrode.  
If they tolerate well, move back to more proximal later on to engage more of the quad.
- **If contraction comes on too strong:** Increase ramp + time to 3 seconds
- **For excessive muscle soreness/fatigue:** Can try off time (time between contractions) of 20 seconds

**If a patient is at the highest intensity on the NMES unit (100mA), encourage active isometric contraction with the stimulation.**

# Other FAQ/Tips

## **Their skin is becoming irritated.**

Strategies:

1. Clean and dry skin
2. Check the condition of the electrodes
3. Rotate electrode placement slightly each session
4. Avoid placing electrodes on irritated skin
5. Hold off for a few days as a last resort

## **Their unit turns off in the middle of a session (e.g., batteries died)**

1. Unplug the cord to the device
2. Replace batteries
3. Start stimulation again
  - Set a timer to complete NMES for approximately the time you had remaining in your session
  - Turn device off

# Other FAQ/Tips

**They attribute bruising and swelling to NMES use.**

Strategies:

1. Listen to their concerns
2. Educate on body recovering from surgery
3. Educate on mechanisms of NMES and studies that support these are likely not caused by NMES

Example bruising photos:



**Your patient has very hairy legs.**

Strategies:

1. Do NMES first over hair and taping or wrapping (coband or elastic wrapping)
2. If they are open to it, suggest they cut or shave on their own. Mark the area with a Sharpie (as you may anyway for pad placement at home) so they know where to remove hair

# Module 6

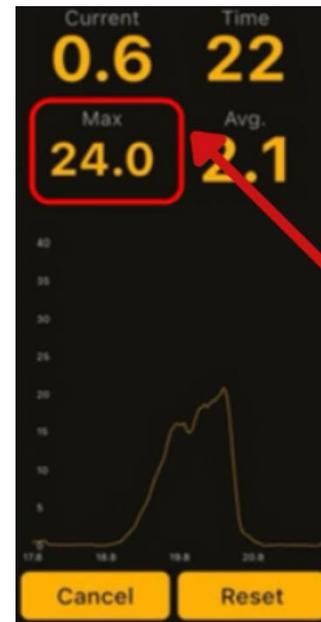
Clinic Testing and Documentation

# NMES Dose Testing



*At post-op eval & weekly measure maximal contraction evoked during NMES and document.*

1. Set up NMES on quad while patient is in position for Tindeq quad strength testing (same set up as quad strength outcome measure).
  - Can use their home unit if they bring it or a clinic unit.
2. Administer NMES following parameters patients use at home.
3. Have patient increase intensity to the level of contraction they get to at home.
4. **Document highest load attained (from Tindeq app), in pounds.**
5. **Also document highest contraction that you observed using the 0, 1, 2 scale (on next page)**
6. If unable to use Tindeq, follow steps 2, 3, and 5 without it



# NMES Intensity Rating Scale

<i>Choose the category that best fits. If in between two, choose the lower one.</i>	<b>0</b> <b>No contraction</b>	<b>1</b> <b>Weak contraction</b>	<b>2</b> <b>Strong tetanic contraction</b>
<i>Muscle appearance</i>	Relaxed, soft, no visible tension	Gentle tightening	Defined, rigid, pronounced
<i>Contraction quality</i>	No visible contraction, twitching possible	Smooth, sustained contraction**	Smooth, sustained contraction
<i>Palpation of muscle</i>	Squishy, relaxed	Soft but active, slight resistance	Tense, solid, rope-like
<i>Movement example</i>	Relaxed leg	Slow and controlled leg extension	Quick and forceful leg extension

\*\* Muscle contraction may appear jumpy or rolling at times because different motor units are being recruited during a sustained contraction.

# Check on NMES Home Usage

During PT visits, check in on patients' home NMES use. Ask how frequently they've been using NMES and how it has been going. Be sure to emphasize the importance of increasing stimulation intensity to maximum tolerated.

**Check off in EMR that you provided NMES education**

When patients discharge, they will return their NMES unit and paper log. Remind them of this to boost accountability.

- If patients bring their NMES unit and/or paper log to other PT visits, check usage data and document in EMR.** (Instructions below)
- **Encourage patients to bring in at least their paper log regularly.**

**IMPORTANT: DO NOT CLEAR DATA ON NMES DEVICE. DATA SHOULD ONLY BE CLEARED BY THE SITE CHAMPION AFTER THEY DOCUMENT DATA, AFTER A PATIENT'S DISCHARGE.**

# View NMES Usage Data

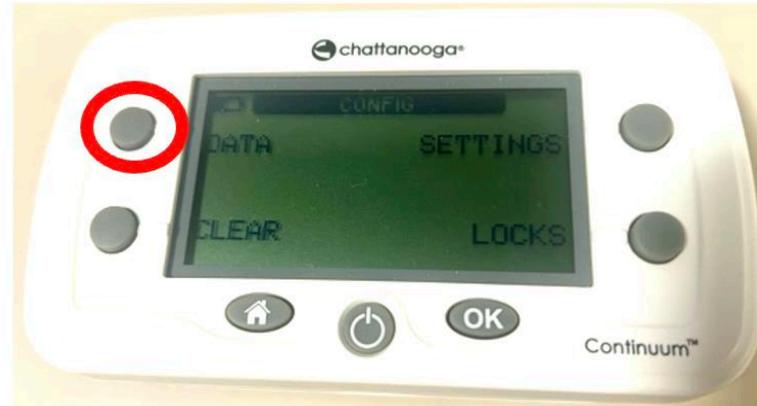
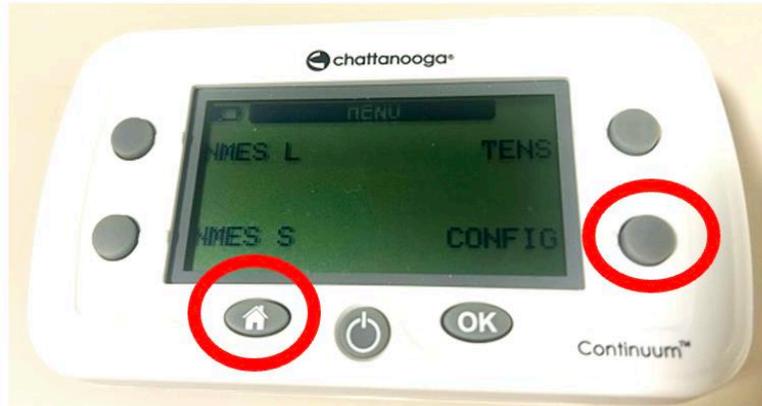
**IMPORTANT: DO NOT CLEAR USAGE DATA ON NMES DEVICE.**

View and document when patients bring their units in

Suggested every 2 weeks when collecting other outcomes

Site champions will view and document usage data for each device after discharge.

Turn on the unit and go to **HOME > CONFIG > DATA**.



Scroll through and document the following fields in the REDCap form:

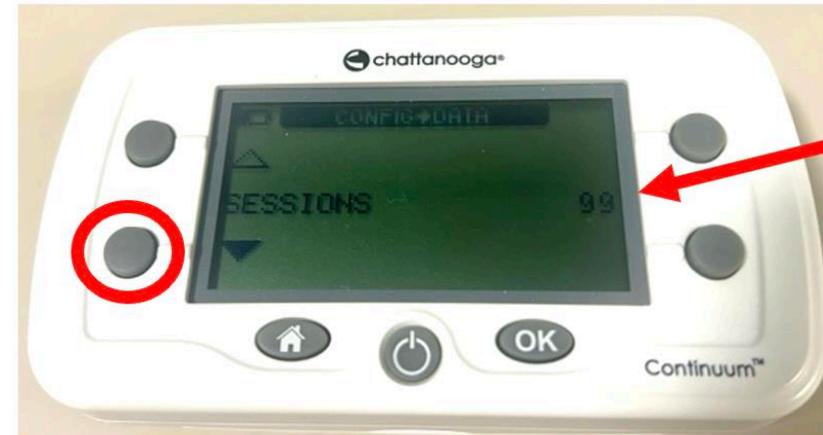
**SESSIONS**

**TOTAL HOURS**

**AVERAGE TIME**

**CH1 INTENSITY**

**CH2 INTENSITY\*** *CH2 will often not be used and will be 0*



# Interpreting NMES Usage Data

Usage data provided by the NMES unit includes:

- Total number of sessions
- Total hours
- Average time per session
- CH 1 intensity (and CH 2 intensity though may not be used)

See chart for benchmarks by week, following the TKA Program Protocol:  
(2x/day, 15 minutes, for 6 weeks)

<b>Number of Weeks</b>	<b>Total Number of Sessions</b>	<b>Total Hours</b>	<b>Average Time Per Session</b>	<b>CH 1 Intensity (and CH2 Intensity if used)</b>
1	14	3.5 hours (210 mins)	0.2 (15 mins = 0.25 hrs)	Varies; ranges from 0-100; generally the higher the better
2	28	7 hours (420 mins)		
3	42	10.5 hours (630 mins)		
4	56	14 hours (840 mins)		
5	70	17.5 hours (1050 mins)		
6	84	21 hours (1260 mins)		



# THANK YOU



University of Colorado  
Anschutz Medical Campus



*uhealth*



Intermountain  
Health