INTRODUCTION

- **Texas State Alumni**
  - Bachelors in 2009
  - DPT in 2013

- **Clinical Rotations**
  - Quentin Mease Hospital-Harris Health System
    - Outpatient Clinic
    - Immersed in chronic pain for 7 months
OBJECTIVES

- Define Chronic Pain
- Discuss the Evolution of Pain
- Pain Science: the experience of pain
- Understand the Role of the Nervous System in the Processing of Pain
PAIN: OVERVIEW
PAIN

- **Acute**
  - Normal physiologic and time-limited response to an adverse stimulus.

- **Chronic**
  - Pain that persists for 3-6 months or longer.
### PREVALENCE OF CHRONIC PAIN

<table>
<thead>
<tr>
<th>Condition</th>
<th>Number of Sufferers</th>
<th>Source</th>
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</thead>
<tbody>
<tr>
<td>Chronic Pain</td>
<td><strong>100 MILLION</strong></td>
<td>Institute of Medicine of The National Academies</td>
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<tr>
<td>Diabetes</td>
<td>25.8 million Americans (diagnosed and estimated undiagnosed)</td>
<td>American Diabetes Association</td>
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<tr>
<td>Coronary Heart Disease</td>
<td>16.3 million Americans</td>
<td>American Heart Association</td>
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<tr>
<td>Stroke</td>
<td>7.0 million Americans</td>
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<tr>
<td>Cancer</td>
<td>11.9 million Americans</td>
<td>American Cancer Society</td>
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(Institute of Medicine Report from the Committee on Advancing Pain Research, 2011)

Chronic Pain affects more Americans than Diabetes, Heart Disease, and Cancer COMBINED.
Current Interventions

- **Drugs:** Pain Relievers, Antidepressants, Anticonvulsants, Opioids
- **Surgery:** Nerve Block, Spinal Stimulators, Various Ectomies, Rhizzotony, Spinal Fusions
- **Alternative Treatments:** Acupuncture, Natural Remedies
- **Cognitive-Behavioral Therapy:** Coping Skills and Relaxation Techniques, Stress Relief
- **Physical Therapy:** Standard Practice?
- **Electro Stimulation:** TENS TENS TENS

GOLD STANDARD??
No common, logical, structured strategy for progressing an individual out of a pain state

<table>
<thead>
<tr>
<th>Week</th>
<th>Program Details</th>
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<tbody>
<tr>
<td>Week 1</td>
<td>4 min walk, 1 min run x 4 (20 min total)</td>
</tr>
<tr>
<td>Week 2</td>
<td>3 min walk, 2 min run x 4 (20 min total)</td>
</tr>
<tr>
<td>Week 3</td>
<td>2 min walk, 3 min run x 4 (20 min total)</td>
</tr>
<tr>
<td>Week 4</td>
<td>2 min walk, 3 min run x 5 (25 min total)</td>
</tr>
<tr>
<td>Week 5</td>
<td>1 min walk, 4 min run x 5 (25 min total)</td>
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<tr>
<td>Week 6</td>
<td>1 min walk, 4 min run x 6 (30 min total)</td>
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<tr>
<td>Week 7</td>
<td>30 min continuous running</td>
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</tbody>
</table>
“Doctors are so undertrained in treating chronic pain.”

“That we just have not done as well in quality of life as we’ve done in quantity of life.”

-Scott Fishman M.D.
Chief of Pain Medicine at the University of California, Davis
Are PT’s any more prepared??
Do we prioritize pain as a profession?

APTA Sections
- Acute Care
- Aquatic Physical Therapy
- Cardiovascular & Pulmonary
- Clinical Electrophysiology & Wound Management
- Education
- Federal Physical Therapy
- Geriatrics
- Hand Rehabilitation
- Health Policy & Administration
- Home Health
- Neurology
- Oncology
- Orthopaedic
- Pediatrics
- Private Practice
- Research
- Sports Physical Therapy
- Women’s Health

PAIN SECTION?
EVOLUTION OF PAIN
Theory of pain first originated in the 17th century by Descartes. Philosopher who proposed that humans have a soul (or mind), but the human body is nevertheless a machine like an animal’s body.

(Melzack R, 1993)
Descartes coined the *Specificity* Theory.

Proposed that an injury to the periphery activated *specific* pain receptors that projected pain signals to a *specific* pain center in the brain via a *specific* pain pathway.

(Melzack R, 1993)
During the revolution of the Specificity Theory, attempts of treating chronic pain led to a laundry list of neurosurgical techniques.

- cordotomies, rhizotomies, cortical ablations, etc.

- Isolate the *specific* pain center and pathway, **CUT IT OUT**.

- Endless search for the magic excision of the so-called pain receptors, pain pathways, and pain center of the brain......
Following the specificity theory, several attempts to find a new theory were which led to the Gate Control Theory.

**Gate Control Theory**
- Developed in the 1960’s
- Ronald Melzack
- Charles Patrick Wall
  (Melzack R, 1993)
Proposed that there is a “gate” within spinal cord that modulates the transmission of sensory information from the primary afferent neurons to transmission cells within the spinal cord.

Controlled by the activity in the large and small fibers. Large-fiber activity inhibited (or closed) the gate, whereas small-fiber activity facilitated (or opened) the gate.
The Gate Control Theory was incorporated into almost every major textbook in the biological and medical sciences and was heavily researched leading to modulation techniques such as the TENS Unit and acupuncture.
SHORTCOMINGS
SHORTCOMINGS OF PAST BELIEFS

Created assumptions that the experience of pain was equated with peripheral injury.
Created assumptions that the pain experience was proportional to the amount of tissue damage.

"It was one of those things where I couldn't believe it. I honestly didn't feel the pain. It was more a shock," Ware said.
SHORTCOMINGS OF PAST BELIEFS

- Did not account for social context such as the experience of pain being influenced by who else is around.

(Gijsbers K, Nicholson F., 2005)
Did not account for psychological contributions to pain such as sensory cues to a noxious stimulus.

(Moseley GL, 2007)
SHORTCOMINGS OF PAST BELIEFS

- **Phantom Limb Pain**
  - Experience of pain in a body part that does not exist

- **Specificity Theory**
  - No “pain pathway” to send signals to the “pain center” in the brain!

- **Gate Control Theory**
  - How does the pain signal arrive at the “gate” without a limb or peripheral tissue travel on??
The past models are focused on acute pain and do not address mechanisms of persistent pain.

It was assumed in the past that the nervous system was hard wired and that the brain's only role was a passive receiver of messages.
WHERE DO WE GO FROM HERE
“We tend to endorse the complexity of the brain and its fundamental role in what we experience. Unless, of course, we are talking about pain.”

-Lorimer Moseley
The sensation of pain is our body’s danger alarm system.
- This system has evolved for thousands of years to tell the brain about changes that occur in our body’s tissues.
- Its primary purpose is to warn the brain when we are in danger. Just like thirst and hunger, the sensation of pain is created by our brain in order for us to survive.

Pain protects Us!

(Butler D, Moseley GL., 2003)
AN EXAMPLE OF PAIN PROTECTING US
Hansen's Disease
- “Leprosy”
- Chronic infectious disease that attacks the peripheral nervous system causing your body's natural alarm system to fail.

The brain no longer receives danger messages from the periphery about actual or potential tissue damage leaving the individual unable to produce the experience of pain when necessary.

What can a faulty danger alarm system lead to?
OUR BODIES ALARM SYSTEM
The command center for this alarm system is the brain, and this is where the future of pain science lies.

It becomes obvious the importance of this command center as it is housed within the bony protection of the skull, suspended in the hydraulically-cushioned environment of the CSF.

Its subcommand centers housed within the spinal cord located within the bony protection of our vertebrae stacked together creating our spine.

(Butler D, Moseley GL., 2003)
The human body consists of millions of sensors that are constantly surveying the area for activity and relaying information to the command center (Brain).
These sensors are made up of proteins and are housed in your neurons.

Sensors are specialized to respond to specific inputs.

- Mechanical forces, pinch or pressure.
- Temperature, both hot and cold.
- Chemical changes, from outside the body (allergens) or inside the body (lactic acid).

(Butler D, Moseley GL., 2003)
Some of these neurons are specialized to respond to all types of stimuli, if they find that the stimuli are sufficient to be dangerous to the tissue.

Activation of these special neurons sends a prioritized alarm signal to your spinal cord, which may be sent to the brain.

Activity of this type of neuron is called “nociception” translating to “danger reception”. We all have nociception happening nearly all the time, only sometimes does it end in pain.

(Butler D, Moseley GL., 2003)
Neurons communicate through electrical impulses that are sent when a specific threshold is crossed creating an action potential.

(Butler D, Moseley GL., 2003)
**NOCICEPTION, THE DANGER SIGNAL**

- **Noxious stimulus to the periphery**
  - Activate a neuron to send a danger message to the SC, once the message reaches the SC chemicals are dumped into a synapse of the second order neuron, once this action potential threshold is crossed a danger message is transmitted from the spinal cord to the brain.

- So what happens when the danger message makes it to the brain?
  - The brain has to construct as sensible a story as possible, based on all of the information that is arriving at the time the danger message is received. Use other senses to gather information such as sight, taste, touch, smell, emotions and even past memories.

  (Butler D, Moseley GL., 2003)

The brain has to decide if this danger signal is truly a threat!!
However, not a one way street as the brain can influence what is going on with the danger messages arriving at the spinal cord.

- The brain contains hormones that can descend to the SC and dampen down the alarm signals.

- The hormones make the sensors less excited, which in turn makes it less likely to send a danger message to the brain.

(Butler D, Moseley GL., 2003)

The brain plays an active role in pain modulation!!
PAIN STORIES
The experience of pain is meant to protect us, therefore it is purposeful.

The pain experience is driven by an alarm system that is housed within our nervous system.

Nociceptors send danger signals from the periphery to the spinal cord, which may then be sent to the brain where it is to be determined a threat or not. “Nociception”

The brain plays an active role in dampening these signals at the spinal cord with endogenous hormones.

PAIN IS AN OUTPUT OF THE BRAIN, IT CAN PLAY AN ACTIVE ROLE IN MODULATING OUR PATIENTS PAIN IF THEY ARE EDUCATED PROPERLY.
Resources
3.) http://www.somasimple.com/
4.) http://www.bodyinmind.org/
5.) http://www.ted.com/talks

References
7.) American Cancer Society, Prevalence of Cancer: http://www.cancer.org/docroot/CRI/content/CRI_2_6x_Cancer_Prevalence_How_Many_People_Have_Cancer.asp
8.) Bach SN. Phantom limb pain in amputees during the first 12 months following limb amputation, after preoperative lumbar epidural blockade. Pain. 1988;33:297-301


16.) Institute of Medicine Report from the Committee on Advancing Pain Research, Care, and Education: Relieving Pain in America, A Blueprint for Transforming Prevention, Care, Education and Research. The National Academies Press, 2011.