Preventing Chronic Pain through Multidisciplinary Approaches: An Overview

Katrina Maluf, PT, PhD

It takes a team to do anything of lasting value
John C Maxwell
Overview

• Evolution of multidimensional models of pain
• Challenges and opportunities in multidisciplinary prevention of chronic pain
Pain Defined

Aristotle

Pleasure and pain are ‘passions of the soul’. Pain is not regarded as a sensation but is thought of as an emotion.
Pain Defined

International Association for the Study of Pain

An unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage
Evolution of Pain Theories

19thC: Von Frey’s specificity theory: large and small fibres transmit touch and pain specifically, to specific touch or pain centres in the brain.

19thC: Goldscheider’s Summation theory: small fibres converge onto a dorsal horn cell, and touch is carried on large fibres.


1959: Noordenbos’ sensory interaction theory: large fibres inhibit, small ones excite central transmission neurons; comprises multi-synaptic afferent system.
Contemporary Pain Models: Neuromatrix Theory

- **Inputs to Body-Self Neuromatrix from:**
  - Cognitive-related brain areas: Memories of past experience, attention, meaning, and anxiety
  - Sensory signalling systems: Cutaneous, visceral, and musculoskeletal inputs
  - Emotion-related brain areas: Limbic system and associated homeostatic/stress mechanisms

- **Outputs to Brain Areas that Produce:**
  - Pain perception: Sensory, affective, and cognitive dimensions
  - Action programs: Involuntary and voluntary action patterns
  - Stress-regulation programs: Cortisol, noradrenalin, and endorphin levels, immune system activity

- **Diagram Elements:**
  - Spinal dorsal horn
  - DRG
  - Descending inhibitory and facilitatory influences
  - Various brain regions (motor cortex, prefrontal cortex, insula, etc.)


Denk et al., *Nat Neurosci* 2014
Biopsychosocial Model of Pain

Adapted from Engel, Science (1977)
Social & Environmental

Home & Community
- Social support
- Interpersonal relationships
- Family roles
- Community roles

Work
- Financial resources
- Supervisor/Co-worker support
- Job satisfaction
- Job control
- Physical strain
- Psychological strain

Healthcare System
- Access
- Delivery/coordination
- Stigma
- Patient-provider therapeutic alliance

Kristman, J Occup Rehabil (2016)
Feelings
- Depressed mood
- Anxiety
- Fear
- Anger

Thoughts
- Catastrophizing
- Rumination
- Pain beliefs
- Expectations
- Locus of control/Self-efficacy

Behaviors
- Coping strategies
- Pain behaviors
- Acceptance/Avoidance
- Adherence
Physiological

Innate
• Sensorimotor processing
• Cognitive-Affective
• Musculoskeletal
• Cardiorespiratory
• Immunologic
• Metabolic/Endocrine

Acquired
• Sensorimotor processing
• Cognitive-Affective
• Musculoskeletal
• Cardiorespiratory
• Immunologic
• Metabolic/Endocrine

Risk for chronic pain

Hardware at birth
- Gender, genotype and epigenetic profile

Environmental influences
- Acute injury or disease at critical developmental periods
- Stressful life events

Gene x environment interactions
- Personality and psychology (for example, pessimism, neuroticism, anxiety, catastrophizing, reward bias)

Denk et al. Nat Neurosci 2014

Innate mechanisms
Acquired mechanisms
Brain vulnerable networks
Priming
Adverse event(s) affect

Epigenetics
- Example: Depression
  - Persistent alterations in histone methylation at the BDNF promoter

Cell biology
- Example: Repeated challenge with inflammatory mediator
  - Changes to cellular processes

Systems and neural networks
- Example: Neonatal skin incision
  - Altered innervation of skin and spinal cord; altered glial responses

Long-term molecular memory:
- Risk factor for recurring depression or other conditions like chronic pain?

Pain intensity
- Primed state, leading to increased and longer lasting pain in animal models

Altered pain sensitivity in adulthood

EP-R → PGE2 → PKC → CPEP → Primed → Naive

Time
PAIN

Physiological

Psychological

Social/Environmental

Adapted from Engel, *Science* (1977)
Multidisciplinary Models of Care for the Prevention of Chronic Pain

- **Pain Collaboration and Exchange Initiative**
  South Hampton UK

- **British Columbia Pain Initiative**
  Canada

- **Chronic Pain Collaborative Care Network**
  Nova Scotia, Canada

- **Chronic Pain Scotland Service**

- **Hunter Integrated Pain Service**
  New South Wales, Australia

- **STEPS model**
  Perth, Western Australia

- Risk stratification and targeted referral systems
- Interdisciplinary pain education for health care providers
- Minimum datasets for cost-benefit analyses
- Inter-professional collaboration using a biopsychosocial approach
- Virtual interdisciplinary networks and communities
- Community-based education programs with evidence based resources for prevention and self-management
- Telehealth and electronic technologies to promote access

Multidisciplinary Prevention and Management of Pain

- **Multidisciplinary** – professionals from different disciplines work with the same patient, but practice within their own professional boundaries and often with limited knowledge about each other’s practice

- **Interdisciplinary** – professionals from different disciplines share skills and knowledge while working together toward shared goals for the same patient

- **Transdisciplinary** – professionals from a given discipline cross professional boundaries to implement skills and knowledge from another team member’s discipline
Opportunities for Multidisciplinary Prevention

- **Primary Prevention**: Pain Free
- **Secondary Prevention**: Acute Pain
- **Tertiary Prevention**: Chronic Pain
- **Chronic Disability**
Tertiary Prevention
### Primary outcome

<table>
<thead>
<tr>
<th>Group</th>
<th>Pretraining&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Posttraining&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Follow-up&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Time effect&lt;sup&gt;b&lt;/sup&gt;</th>
<th>Group effect&lt;sup&gt;b&lt;/sup&gt;</th>
<th>Interaction effect&lt;sup&gt;b&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neck Disability Index (0–100)</td>
<td>Multidisciplinary</td>
<td>41.9 (40.7; 43.2)</td>
<td>24.3 (22.4; 26.2)</td>
<td>21.7 (19.7; 23.6)</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>General exercise</td>
<td>41.1 (39.8; 42.3)</td>
<td>36.7 (34.8; 38.6)</td>
<td>37.3 (35.4; 39.3)</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
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</tbody>
</table>

### Secondary outcomes

<table>
<thead>
<tr>
<th>Group</th>
<th>Pretraining&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Posttraining&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Follow-up&lt;sup&gt;a&lt;/sup&gt;</th>
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<th>Interaction effect&lt;sup&gt;b&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tampa Scale for Kinesiophobia (13–52)</td>
<td>Multidisciplinary</td>
<td>28.0 (26.2; 29.7)</td>
<td>18.2 (16.6; 19.8)</td>
<td>16.8 (15.3; 18.2)</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>General exercise</td>
<td>28.2 (26.5; 30.0)</td>
<td>28.3 (26.7; 29.8)</td>
<td>29.1 (27.7; 30.6)</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Pain Catastrophizing Scale (0–52)</td>
<td>Multidisciplinary</td>
<td>20.4 (19.0; 21.9)</td>
<td>13.4 (12.9; 14.8)</td>
<td>12.2 (10.9; 13.5)</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>General exercise</td>
<td>20.8 (19.4; 22.2)</td>
<td>20.2 (18.8; 21.6)</td>
<td>21.2 (19.9; 22.5)</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Numerical Rating Scale (0–10)</td>
<td>Multidisciplinary</td>
<td>6.0 (5.7; 6.2)</td>
<td>2.1 (1.8; 2.3)</td>
<td>2.1 (1.8; 2.3)</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>General exercise</td>
<td>6.1 (5.9; 6.3)</td>
<td>5.3 (5.1; 5.6)</td>
<td>5.6 (5.3; 5.8)</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>
Secondary Prevention

- Acute Pain
- Secondary Prevention
- Chronic Pain
- Tertiary Prevention
- Chronic Disability
Transition from acute to chronic pain

Table 1: Examples of studies examining the emergence or incidence of chronic pain

<table>
<thead>
<tr>
<th>Size of patient cohort</th>
<th>Condition or surgery</th>
<th>Incidence (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diabetes</td>
<td>Total incidence of neuropathy</td>
<td>48</td>
</tr>
<tr>
<td></td>
<td>Painful neuropathy</td>
<td>34</td>
</tr>
<tr>
<td>Postsurgical pain</td>
<td>Amputation</td>
<td>30–50</td>
</tr>
<tr>
<td>159,000</td>
<td>Breast surgery</td>
<td>20–30</td>
</tr>
<tr>
<td>479,000</td>
<td>Thoracotomy</td>
<td>30–40</td>
</tr>
<tr>
<td>Unknown</td>
<td>Inguinal hernia repair</td>
<td>10</td>
</tr>
<tr>
<td>609,000</td>
<td>Bypass surgery</td>
<td>30–50</td>
</tr>
<tr>
<td>598,000</td>
<td>Caesarean section</td>
<td>10</td>
</tr>
<tr>
<td>Lower back pain</td>
<td>Pain 5 years after first presentation: prospective study</td>
<td>36.9</td>
</tr>
<tr>
<td>448</td>
<td>Pain 12 months after initial consultation: prospective study</td>
<td>34</td>
</tr>
<tr>
<td>Neck pain</td>
<td>Incidence of chronic neck pain in cohort of patients reporting at least one episode of acute neck pain: prospective study</td>
<td>18</td>
</tr>
</tbody>
</table>

Denk et al. Nat Neurosci 2014
Screening Tools for Low Back Pain (LBP) Risk Assessment

The STarT Back Tool Scoring System

Total score
- 3 or less
  - Low risk
- 4 or more
  - Medium risk
  - Sub score Q5-9
    - 3 or less
    - High risk
    - 4 or more
      - Medium risk

1. My back pain has spread down my leg(s) at some time in the last 2 weeks
   - Disagree 0
   - Agree 1

2. I have had pain in the shoulder or neck at some time in the last 2 weeks
   - Disagree 0
   - Agree 1

3. I have only walked short distances because of my back pain
   - Disagree 0
   - Agree 1

4. In the last 2 weeks, I have dressed more slowly than usual because of back pain
   - Disagree 0
   - Agree 1

5. It’s not really safe for a person with a condition like mine to be physically active
   - Disagree 0
   - Agree 1

6. Worrying thoughts have been going through my mind a lot of the time
   - Disagree 0
   - Agree 1

7. I feel that my back pain is terrible and it’s never going to get any better
   - Disagree 0
   - Agree 1

8. In general I have not enjoyed all the things I used to enjoy
   - Disagree 0
   - Agree 1

9. Overall, how bothersome has your back pain been in the last 2 weeks?
   - Not at all 0
   - Slightly 0
   - Moderately 0
   - Very much 1
   - Extremely 1
Prognostic Risk Stratification for Transdisciplinary Prevention of Chronic LBP

Hill, Lancet (2011)
Transdisciplinary model of psychologically informed physical therapy practice

- Motivational Interviewing
- Cognitive Behavioral approaches
- Mindfulness
- Relaxation techniques
- Goal setting
- Graded activity

Main and George, *Phys Ther* (2011)
Risk Stratified Transdisciplinary Management for Prevention of Chronic LBP

Hill, Lancet (2011)
Prognostic Risk Stratification for Multidisciplinary Prevention of Chronic Whiplash Associated Disorders (WAD)

<table>
<thead>
<tr>
<th>Stratification</th>
<th>Treatment prescription</th>
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<tbody>
<tr>
<td>Neck Disability Index</td>
<td>Pain (VAS)</td>
</tr>
<tr>
<td>Impact of Events Scale (IES)</td>
<td>Thermal pain thresholds</td>
</tr>
<tr>
<td>Thermal pain thresholds</td>
<td>Pressure pain thresholds</td>
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<tr>
<td>Pressure pain thresholds</td>
<td>Sympathetic vasoconstrictor response</td>
</tr>
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<td></td>
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<tr>
<td></td>
<td>Cervical range of movement</td>
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<td></td>
<td>Craniocervical flexion test</td>
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<td></td>
<td>Balance</td>
</tr>
<tr>
<td></td>
<td>Cervical proprioception</td>
</tr>
<tr>
<td></td>
<td>Impact of Events Scale (IES) &gt;26</td>
</tr>
<tr>
<td></td>
<td>General Health Questionnaire (GHQ 28) &gt;30</td>
</tr>
</tbody>
</table>

**Analgesic Meds**
- NSAIDs
- Opioids
- Anticonvulsants/Antidepressants

**Physical Therapy**

**Cognitive Behavioral Therapy**
Risk Stratified Multidisciplinary Management for Prevention of Chronic WAD
Primary Prevention

- Pain Free
- Primary Prevention
- Acute Pain
- Secondary Prevention
- Chronic Pain
- Tertiary Prevention
- Chronic Disability
Risk Factors for Incident Low Back Pain

This review provides consistent evidence that there is no “smoking gun” for LBP prevention as the identified risk factors were not replicated across different studies, weakly predictive of incidence, and many were not modifiable…

The current state of evidence suggests futility in investing significant effort into preventative care practices for LBP, and instead, these resources may be better used for effective secondary prevention approaches.'
Risk Factors for Incident Neck Pain

This review summarised the findings of 15 prospective studies from 14 independent cohorts investigating the predictive nature of around 50 physical, psychological, socio-demographic and clinical factors for the onset of non-specific neck pain.

Many of the variables have been investigated by only one study, making it impossible to be sure of their predictive nature. Many physical, psychological, socio-demographic and clinical variables have not been investigated.
Neurophysiological
- Cold pain threshold
- Cold pain tolerance
- Pressure pain threshold
- DNIC

Psychosocial
- Depressed mood
- Generalized anxiety
- Perceived stress
- Catastrophization
- Job satisfaction
- Job-related mental strain

Physical
- Forward head posture
- Cervical AROM
- Cervical strength
- Cervical endurance
- Scapular strength
- Scapular muscle length
- Physical activity
- Job-related physical strain

Shahidi, J Pain (2014)
Multivariate predictors of incident chronic neck pain

↓ physical activity
muscle fatigue
Muscle fatigue ↓ physical activity

muscle fatigue
↓ physical activity
muscle fatigue
↓ endogenous pain inhibition
↓ physical activity
muscle fatigue
↓ endogenous pain inhibition
depressed mood
Identifying biopsychosocial markers of 
**Exposure** and **Susceptibility** in pain prevention

- **Markers of exposure**
  - Sedentary lifestyle

- **Markers of health effects**
  - Poor muscle endurance

- **Exposure**
  - Internal dose
    - Biologically effective dose
      - Early biological effect
        - Altered function or structure
          - Clinical disease

- **Markers of susceptibility**
  - Reduced endogenous pain inhibition
  - Depressed mood

Jendrychovski and Goldsmith (1992)
Identifying biopsychosocial markers of Exposure and Susceptibility in pain prevention

- Reduced endogenous pain inhibition
- Depressed mood
- Female sex

Markers of exposure
- Acute musculoskeletal injury

Markers of health effects

Markers of susceptibility

Exposure
  - Internal dose
  - Biologically effective dose
    - Early biological effect
      - Altered function or structure
        - Clinical disease
Identifying biopsychosocial markers of **Exposure** and **Susceptibility** in pain prevention

- **Markers of exposure**
  - Surgical procedure

- **Markers of health effects**
  - Internal dose
  - Biologically effective dose
  - Early biological effect
  - Altered function or structure
  - Clinical disease

- **Markers of susceptibility**
  - Reduced endogenous pain inhibition

Yarnisky *Pain* (2008)
Endogenous pain modulation: A promising target for multimodal prevention of chronic pain?

- Top-down cortical regulation
- Physical activity
- Pharmaceutical analgesic responses
Conclusions

1. Multidimensional nature of pain is well recognized in contemporary pain models

2. Prognostic risk stratification has the potential to improve multidisciplinary approaches to the prevention of pain
   - Optimal timing and mode to be determined

3. Multidisciplinary approaches should consider modifiable interactions between susceptibility and exposure
Questions or Comments:
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