

# The Causation Method for Evaluation of a Claim

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The Hand Center

ORTHOPAEDICS OF THE HAND & UPPER EXTREMITY



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IAIME

International Academy of Independent Medical Evaluators  
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# Declare

- The Hand Center
- MAP Managers, owner of CtdMAP
- PHI = Physical Health Index – Health Assessment
- Books: Physician's Guide to Return To Work, Guides to the Evaluation of Disease and Injury Causation, etc
- Professional Organizations: ABA, AMA, AADEP, AAOS, ACOEM, ASSH, AAHS, IAIABC, SDPM, etc
- Organizations: MDA, ODG, SEAK, etc
- Speaker: multiple national and state level organizations
- Reviewer: multiple journals and books
- **Any other task or job that will improve outcomes for injured workers**

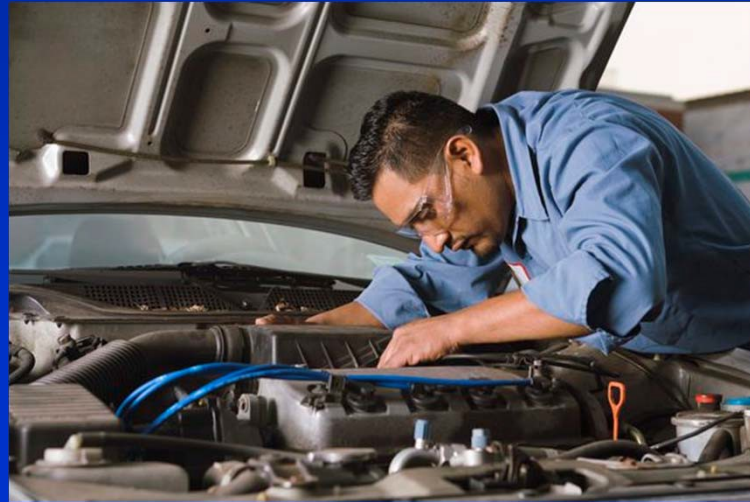


# Why We Are Here Today



# Why We Are Here Today

If your car develops a mechanical problem, you have the option of repairing it, or, should the repair be prohibitively expensive, getting another car.



# Why We Are Here Today

If the repair is more costly than replacing the car, the only people who would repair it, are those with an attachment of some sort to that particular vehicle. Most people would trade in the vehicle.



# Why We Are Here Today

The cost of repairing many humans exceeds the value which that employee brings to the employer, using conventional accounting.

This is particularly the case with unskilled jobs in a high un-employment market.

# Why We Are Here Today

Cars themselves don't care if one of their kind is repaired or junked.





# Why We Are Here Today

However, in the case of humans, the remaining workforce is significantly impacted by the treatment one of their own receives at the hands of the employer or its agents.

The emotional response to the workplace incident impacts the whole organization in a multitude of ways, which may be difficult to put a dollar value on

# Why We Are Here Today

It impacts the worker's immediate family, his friends and acquaintances, the reputation of the company as a place to work, and ultimately its products or services.



# Today's Thought

Simply put:

Medicine is practiced to help our patients live happier, healthier, and longer lives.

- JMM

# Perspective

What do disabled people call those who are not?"

"TABs"

"TABs" ... "Temporarily Able Bodied"

Yes, we will all likely be disabled some day, unless we go out in a flash.

# 2018



AAOS Annual Workers' Compensation CME  
Oct 26, 27, 28 Rosemont, IL

AAOS Expert Witness  
Oct 25





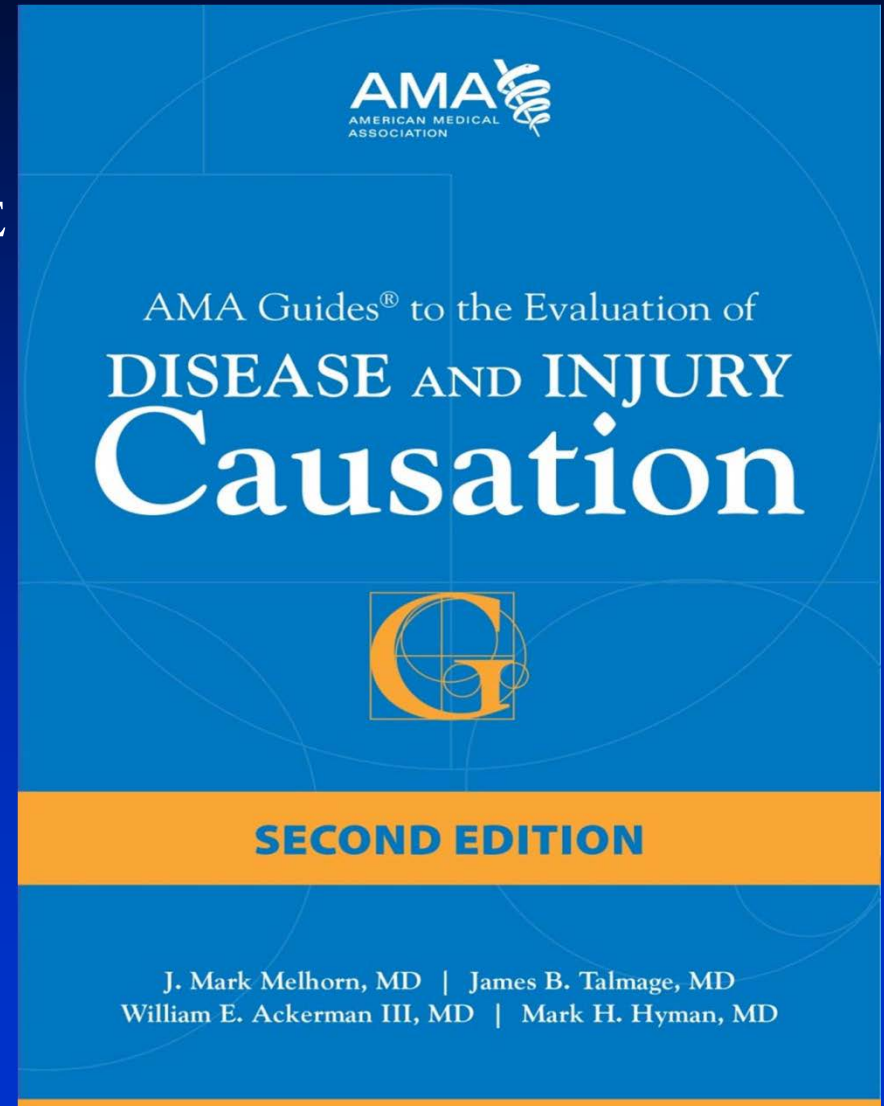
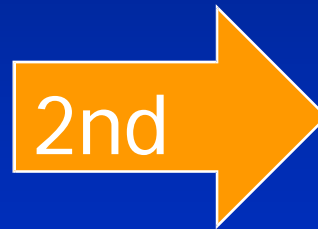
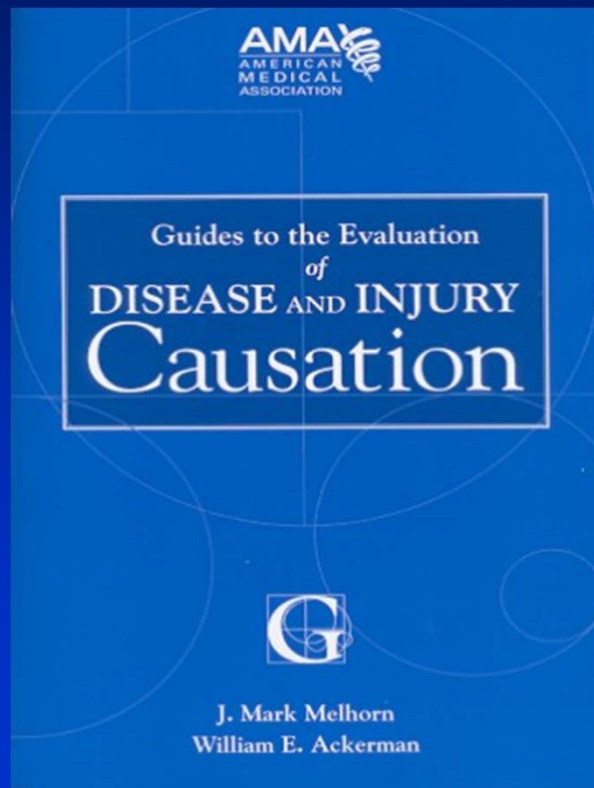
# Occupational Health

## 5 Primary Issues

1. **Dx** – what we do best
2. **Causation** – who is responsible for costs
3. **Treatment** – cost of care & outcomes
4. **Return to Work** – disability duration
5. **Impairment & Disability** – final costs

# AMA Press

Editors  
WILL RECEIVE  
Royalties



I have gifted all of my royalties to charity

# Request for Help

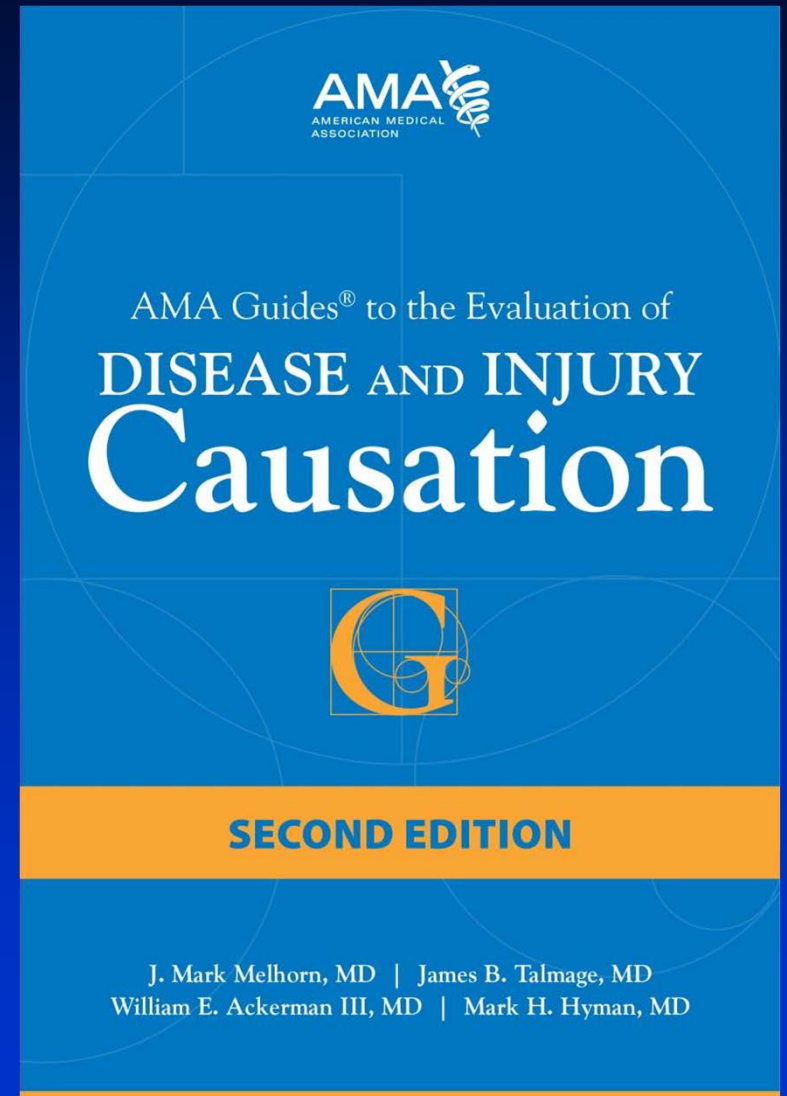
Make the 3<sup>rd</sup> edition better – email all info, data, and suggestions to Mark Melhorn at

[melhorn@onemain.com](mailto:melhorn@onemain.com)

Target date is 2020

All discussions are 2<sup>nd</sup> edition unless otherwise indicated

**The Blue Book**



**Dx & Tx**



**Impairment  
Disability**

**Causation**

**Return  
to Work  
Disability  
Duration**



# Misconceptions

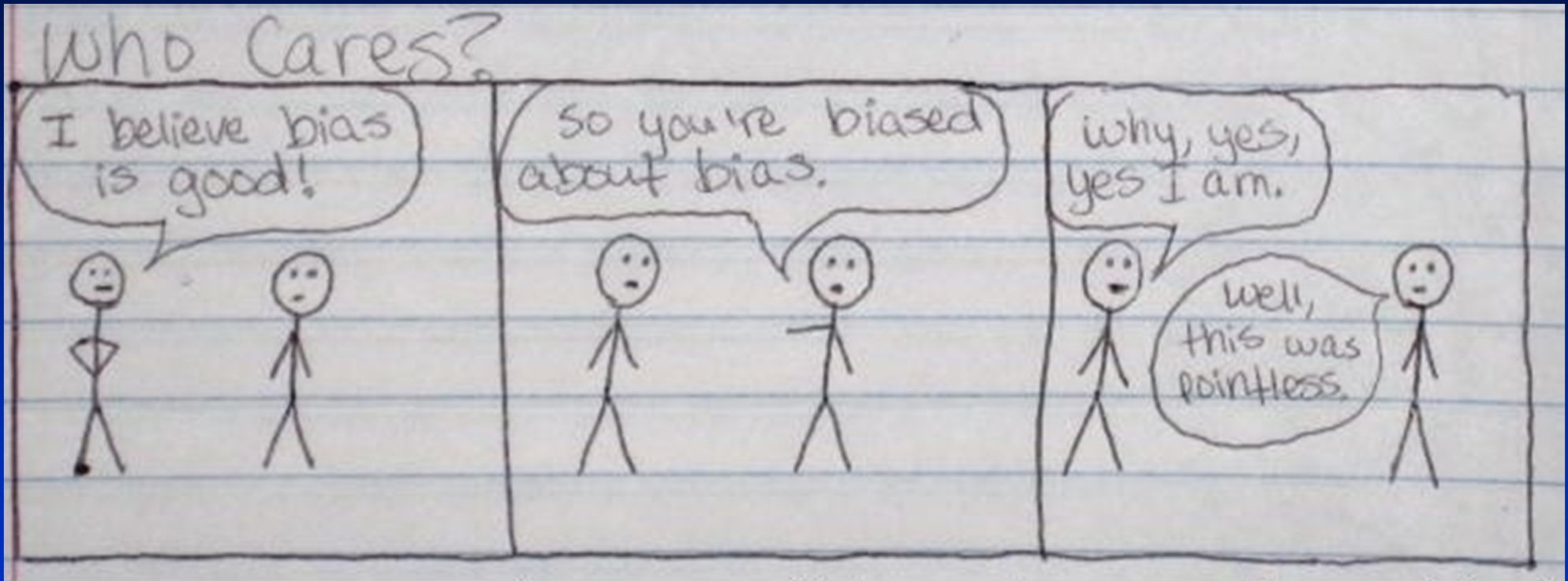
Heart attacks more deadly in winter

True

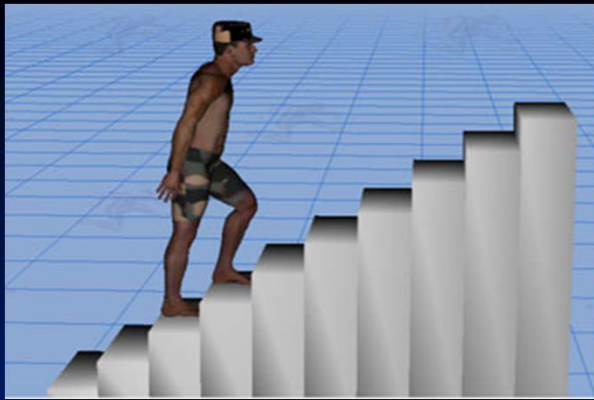
False



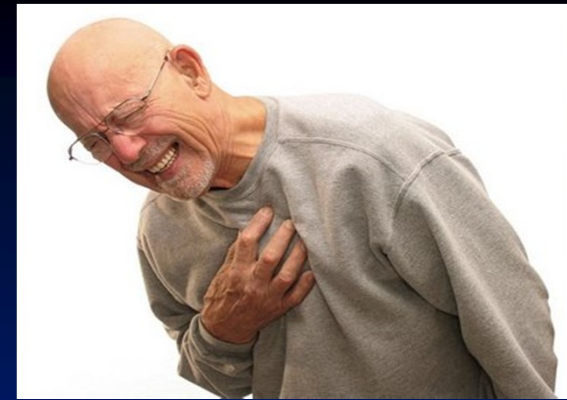
# Causation Example



Bias?



# Example



- When the first ever episode of angina occurs when Joe walks up stairs at work, we recognize that this was when, but not why he had angina.
  - Not a worker' comp claim
- Yet, in the past, when the first episode of \_\_\_\_\_ (back pain, shoulder pain, knee pain, etc.) occurs with normal activity at work or minimal trauma at work, doctors have assumed this was intended to be "work compensable" even if they understood it was not actually **CAUSED BY** the work exposure.







**Trust Me, I'm a Doctor**



# Fun with the word "Repetitive"

- "Repetitive" is a word misused repetitively by physicians.
- A dictionary definition would state repetition is the "act of doing a thing a SECOND time, or again and again".

# Fun with the word “Repetitive”

- Therefore, punching a time clock at the start of work each day is done “repetitively”.
- What is the purpose of the definition?
  - Research
  - Medical
  - Legal

# Fun with the word “Repetitive”

- From a **legal** point of view – there are no validated (scientifically proven) numbers for defining repetitive.
- In other words, there is no cutoff threshold that says – if you do more than x/hour you get this Dx.

# Fun with the word “Repetitive”

- From a **medical** point of view –

Silverstein and Armstrong are generally credited with (or blamed for) the current obsession with linking symptoms to work activity based on their paper (“Occupational Factors and Carpal Tunnel Syndrome” AM J Ind Med 1987; 11:343-358) which . . .

# Fun with the word "Repetitive"

- From a **medical** point of view –
  - . . . which defined "HIGH repetitions" as jobs with a cycle time of less than 30 seconds, or more than 50% of the cycle time involved in performing fundamentally the same cycle or activity

# Fun with the word “Repetitive”

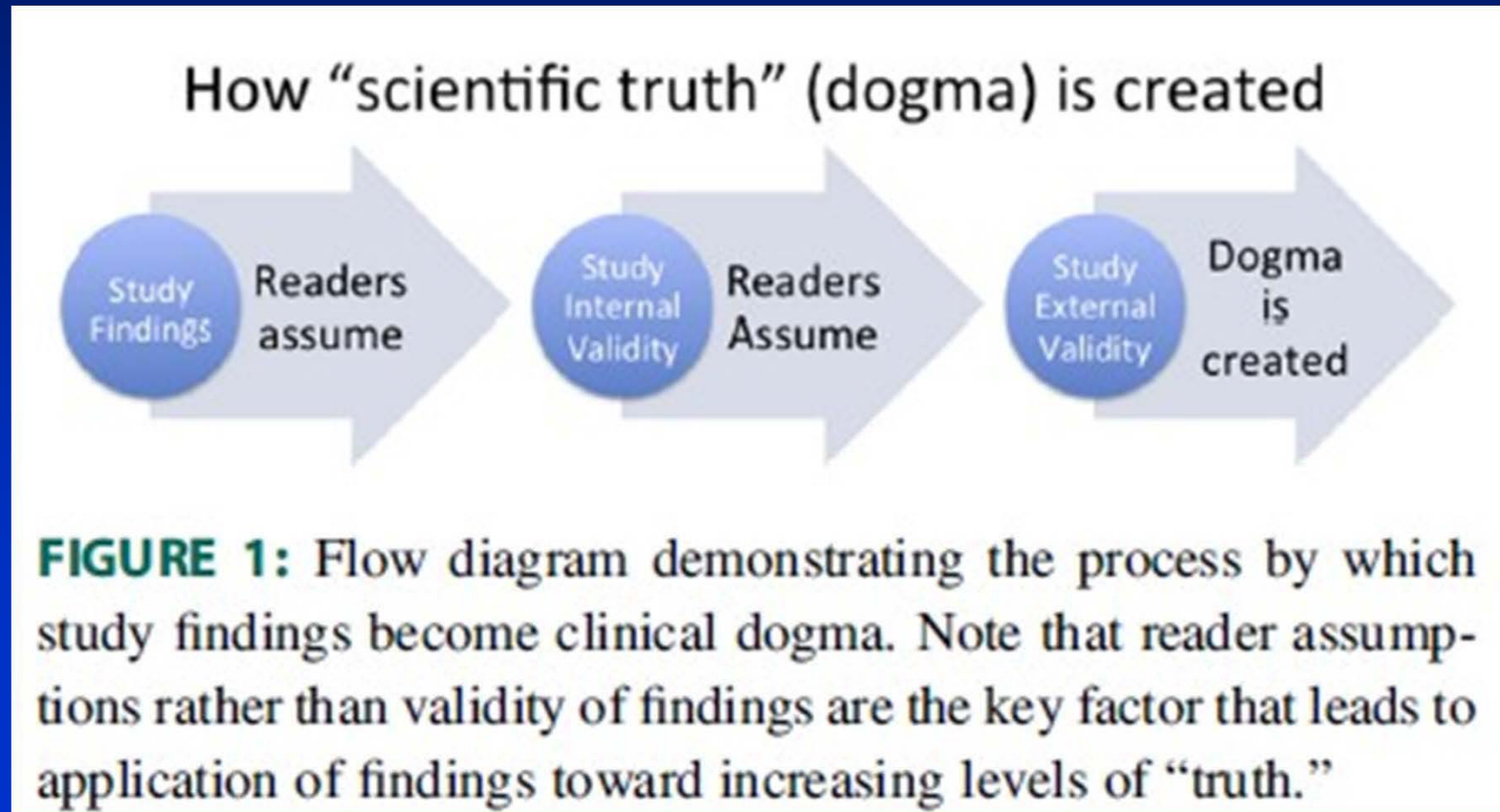
- From a **medical** point of view –

Many ergonomists and many subsequent papers have adopted this definition.

But have we ever been wrong?

# Fun with the word “Repetitive”

- From a **medical** point of view –





# Fun with the word “Repetitive”

- From a **medical** point of view –

“Numerous examples can be found in the medical literature in which prospective RCTs have found vastly disparate results compared with the observational epidemiologic studies preceding them that had been accepted as the final answer.”

# Fun with the word “Repetitive”

- From a **medical** point of view –

## Examples of “Been Wrong”

- JAMA 2001; 286: 821-830. Comparison of evidence of treatment effects in randomized and nonrandomized studies.
- JAMA 294 (2):218-228, 2005. Contradicted and initially stronger effects in highly cited clinical research.
- JAMA 298(21):2517-2526, 2007. Persistence of Contradicted Claims in the Literature

# Fun with the word “Repetitive”

- From a **medical** point of view –

Unfortunately, these were retrospective epidemiological studies exploring data end points and were based on inclusion criteria by subjective symptoms for Dx. This data is also only applicable to automotive industry.

# Fun with the word “Repetitive”

- From a **medical** point of view -

Therefore, at best these studies are hypothesis generating but not confirming.

Furthermore, this works out to about 1000 repetitions per 8 hour work shift (actually a minimum of 960 reps).

# Fun with the word “Repetitive”

- From a **medical** point of view –
- For companies who routinely work 12 hour shifts, this would permit almost 1500 repetitions per work day before the **possible threshold** is crossed and does not take into account the object to which task is being applied.



# Fun with the word "Repetitive"

Are job tasks in 1987 applicable to same job title today?



# Fun with the word "Repetitive"

Are job tasks in 1987 applicable to same job title today?



# Fun with the word "Repetitive"

Can you move the concept of repetitive in job to repetitive in a different job?





# Fun with the word “Repetitive”

- From a **research** point of view

current studies suggest that the best assessment instrument for **CTS** is the Strain Index

(J. S. Moore and A. Garg. The Strain Index: a proposed method to analyze jobs for risk of distal upper extremity disorders. American Industrial Hygiene Association Journal 56 (5):443-458, 1995. and A. Garg, J. Kapellusch, K. Hegmann, J. Wertsch, A. Merryweather, G. Deckow-Schaefer, and E. J. Malloy. The Strain Index (SI) and Threshold Limit Value (TLV) for Hand Activity Level (HAL): risk of carpal tunnel syndrome (CTS) in a prospective cohort. Ergonomics 55 (4):396-414, 2012.)

# Fun with the word "Repetitive"

- From a **research** point of view

Moore - Garg Strain Index		Strain Index	4.5
Description of task.			Uncertain
Intensity of Exertion	Somewhat Hard: Noticeable or definite effort (BS: 3)	▼	3.0
Duration of Exertion (% of Cycle)	30-49%	▼	1.5
Efforts Per Minute	4 - 8	▼	1.0
Hand/Wrist Posture	Good: Near Neutral	▼	1.0
Speed of Work	Fair: Normal speed of motion	▼	1.0
Duration of Task Per Day (hours)	4 - 8	▼	1.0



# Fun with the word “Repetitive”

- From a **research** point of view

What is the best assessment instrument for all of the other DxS that currently are commonly related to work activities?

# Causation In A Nut Shell

- **Physician** - determination of causation leads to amelioration of the causative agent and restorative treatment
- **Legal** - the primary effect of the determination of causation is cost-shifting, e.g., from the individual or health insurance to liability or WC insurance.

# Causation, Etiopathogenesis and Biostatistics

Case Studies = Clinical Examples

# Morton's Neuroma

- The injured worker is a 40 year old male warehouse workers whose job required him to be on his feet for most of the work day. While working in the warehouse he would be required to lift and move heavy mining equipment that weighed over 100 lbs.

# Morton's Neuroma

- The claimant filed a workers' compensation claim alleging these work activities caused a Morton's neuroma in his right foot that required surgical treatment. The applicant's Doctor opined that prolonged pressure on the foot, repetitive trauma resulting from standing and heavy lifting contributed to the gradual development of the Neuroma.



# Morton's Neuroma

- The defense expert believed the condition was idiopathic in cause and not related to the repetitive work activities of the employee.
- Is this a compensable injury?

# Morton's Neuroma

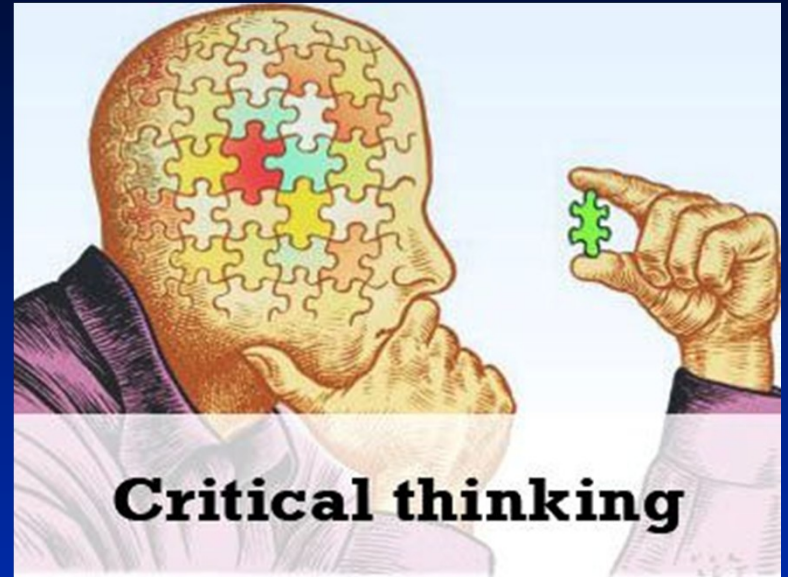
## The Original Question

Is this a compensable injury?

Yes vs No = you vote

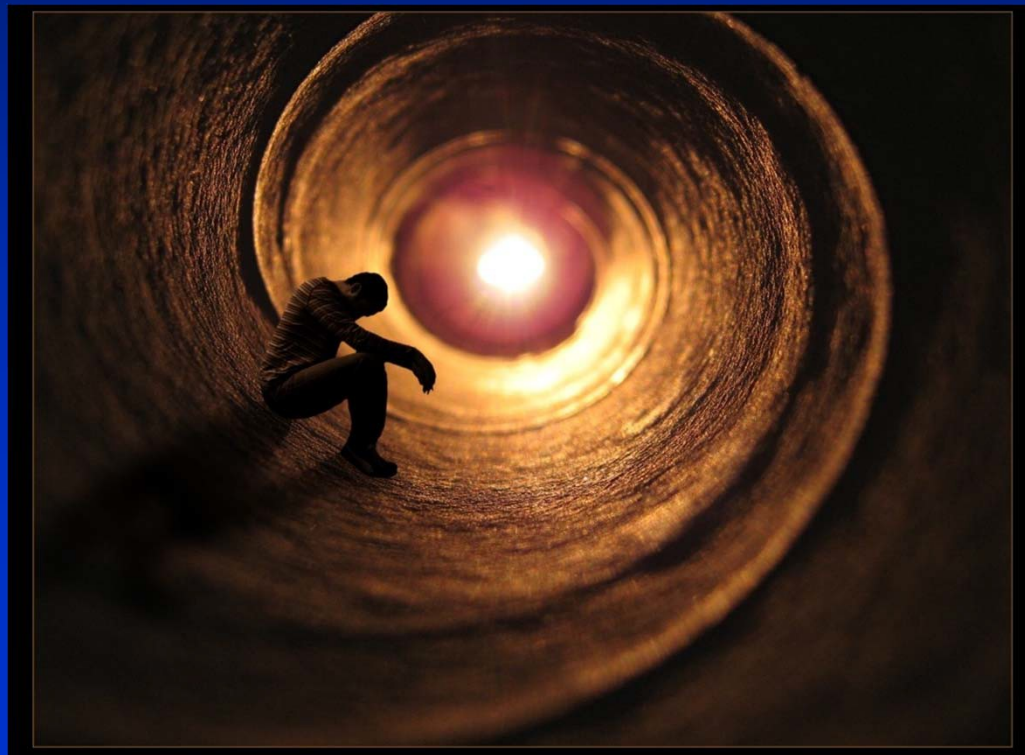
# Causation

- Medical = Science
- Legal = Social Justice



# Medical Causation

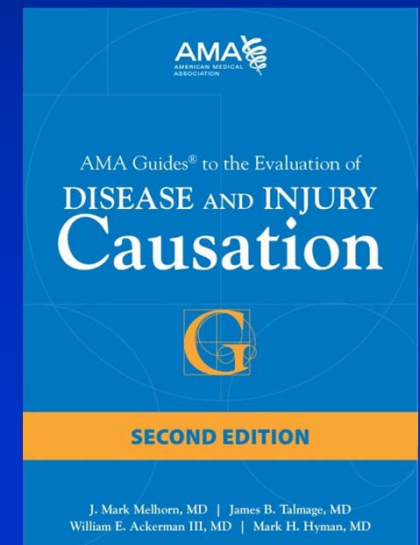
How do I make a decision or provide an opinion on causation?

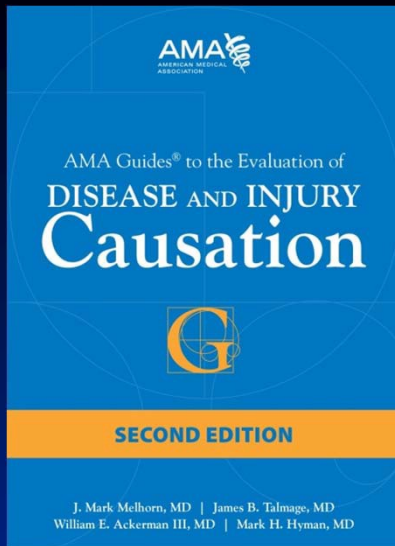


# Medical Causation

## Two Approaches

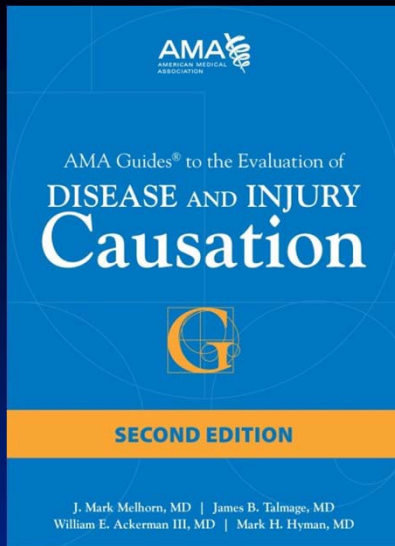
- Due it on your own
- Use the Blue Book





- Chapter 1 Introduction
- Chapter 2 Understanding Work-Relatedness
- Chapter 3 Causal Associations and Determination of Work-Relatedness





- Chapter 4 Methodology
- Chapter 5 Apportionment
- Chapter 6 The Causality Examination
- Chapter 7 Report Writing

# Use the Causation Book

- Only six easy steps to complete your opinion after you have read chapters 1 to 7.
- What are the six steps?

# Causation Table 3-2

1. Identify evidence of disease
2. Review and assess the available epidemiologic evidence for a causal relationship
3. Obtain and assess the evidence of exposure
4. Consider other relevant factors
5. Judge the validity
6. Form conclusions about the work-relatedness of the disease in the person undergoing evaluation

# Use the Causation Book

- Use the Dx to find the correct Chapter

## Chapter 10

---

# Lower Limb

Naomi N. Shields, MD,  
David A. Fetter, MD,  
Matthew J. Dietz, MD, and Hany Bedair, MD\*

**Foot and Ankle Disorders/Dysfunction**

**The Knee**

**Hip Osteoarthritis**

**Avascular Necrosis of the Femoral Head**

**Acetabular Labral Tears**

# Use the Causation Book

- Confirm your Dx and review the data
- Locate the risk factors
- Unfortunately, our Dx is not in the Book

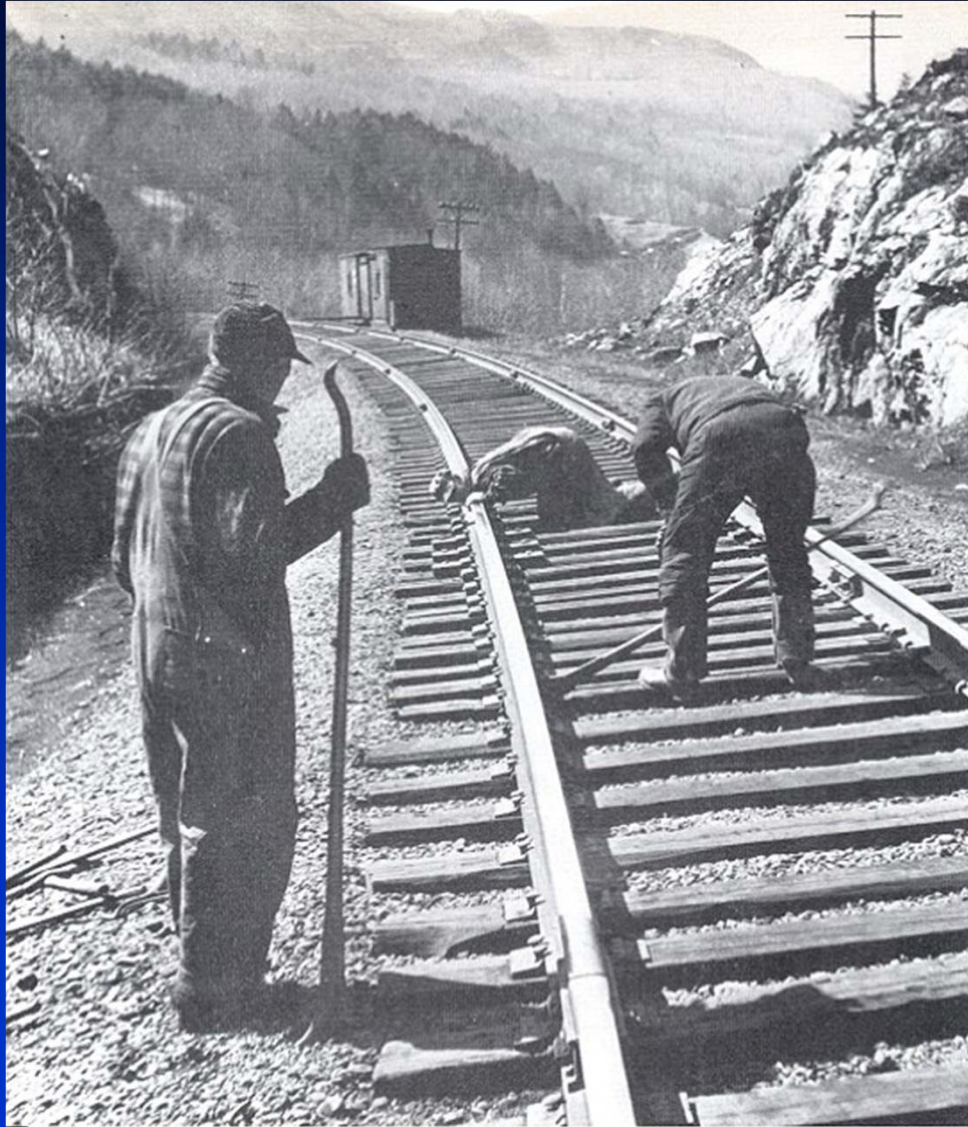
## **Plantar Fasciitis and Heel Pain**

Chronic plantar heel pain is 1 of the most common foot disorders and has been estimated to account for 15% of all adult foot complaints requiring medical care.<sup>3</sup> Approximately 2 million people are affected in the United States each year and approximately 10% of the population during a lifetime, usually adults older than 40 years. It is important that a correct diagnosis of plantar fasciitis be made supported by morning pain, pain after resting, and pain over the medial tubercle of the calcaneus. Differential diagnosis includes central heel pain, heel pad atrophy, and tarsal tunnel syndrome. Central heel pain and heel pad atrophy are much more common in the older age group. Although many risk factors have been proposed in the literature, there is limited conclusive evidence on plantar fasciitis.

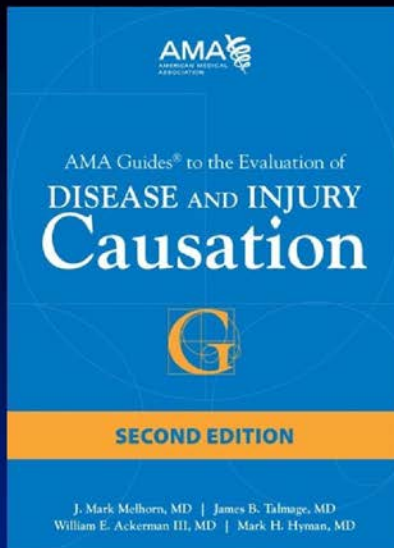
# Causation Table 3-2

1. Identify evidence of disease
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3. Obtain and assess the evidence of exposure
4. Consider other relevant factors
5. Judge the validity
6. Form conclusions about the work-relatedness of the disease in the person undergoing evaluation

# Methodology







## Chapter 4

# Methodology

J. Mark Melhorn, MD,  
Kurt T. Hegmann, MD, MPH,  
James B. Talmage MD,  
Mark H. Hyman MD, and William E. Ackerman III, MD\*

### **Methods for Determining Work-Relatedness**

#### **Study Design**

#### **Outcomes from Literature Search and Causations Analysis**

#### **Causation: Strength of Evidence Definitions**

#### **Quality Scoring Method for Epidemiologic Studies**

#### **Limitations and Other Considerations**

#### **Summary**

#### **Appendix A: Study Design Definitions**

#### **Appendix B: Techniques for Reading the Medical Literature**

# Methodology

**Table 3-2** National Institute for Occupational Safety and Health/American College of Occupational and Environmental Medicine Steps for the Determination of Work-Relatedness of a Disease

1. Identify evidence of disease
2. Review and assess the available epidemiologic evidence for a causal relationship
3. Obtain and assess the evidence of exposure
4. Consider other relevant factors
5. Judge the validity of testimony
6. Form conclusions about the work-relatedness of the disease in the person undergoing evaluation

Source: Adapted from Kusnetz and Hutchison, Eds. DHEW, CDC, NIOSH, Pub. No. PB298-561; 1979 and Occupational Medicine Practice Guidelines, 2nd and 3rd Eds. ACOEM OEM Press, 2004, 2008, 2011.

K. T. Hegmann, M. S. Thiese, S. J. Oostema, and J. M. Melhorn. Causal Associations and Determination of Work-Relatedness. In: Guides to the Evaluation of Disease and Injury Causation, edited by J. M. Melhorn, J. B. Talmage, W. E. Ackerman, and M. H. Hyman, Chicago, IL: American Medical Association, 2013, p. 105-114. {10680}

# Causation Table 3-1

1. Collect all epidemiologic literature on the disorder = see Methodology page 121

## Five Steps

1. Literature search = Table 4-3
2. Article reviewed by panel = Table 4-5
3. Quality score = Table 4-4
4. Quality score x weight factor = Table 4-5
5. All relative articles are summed = Table 4-7

# Methodology

## Literature Search

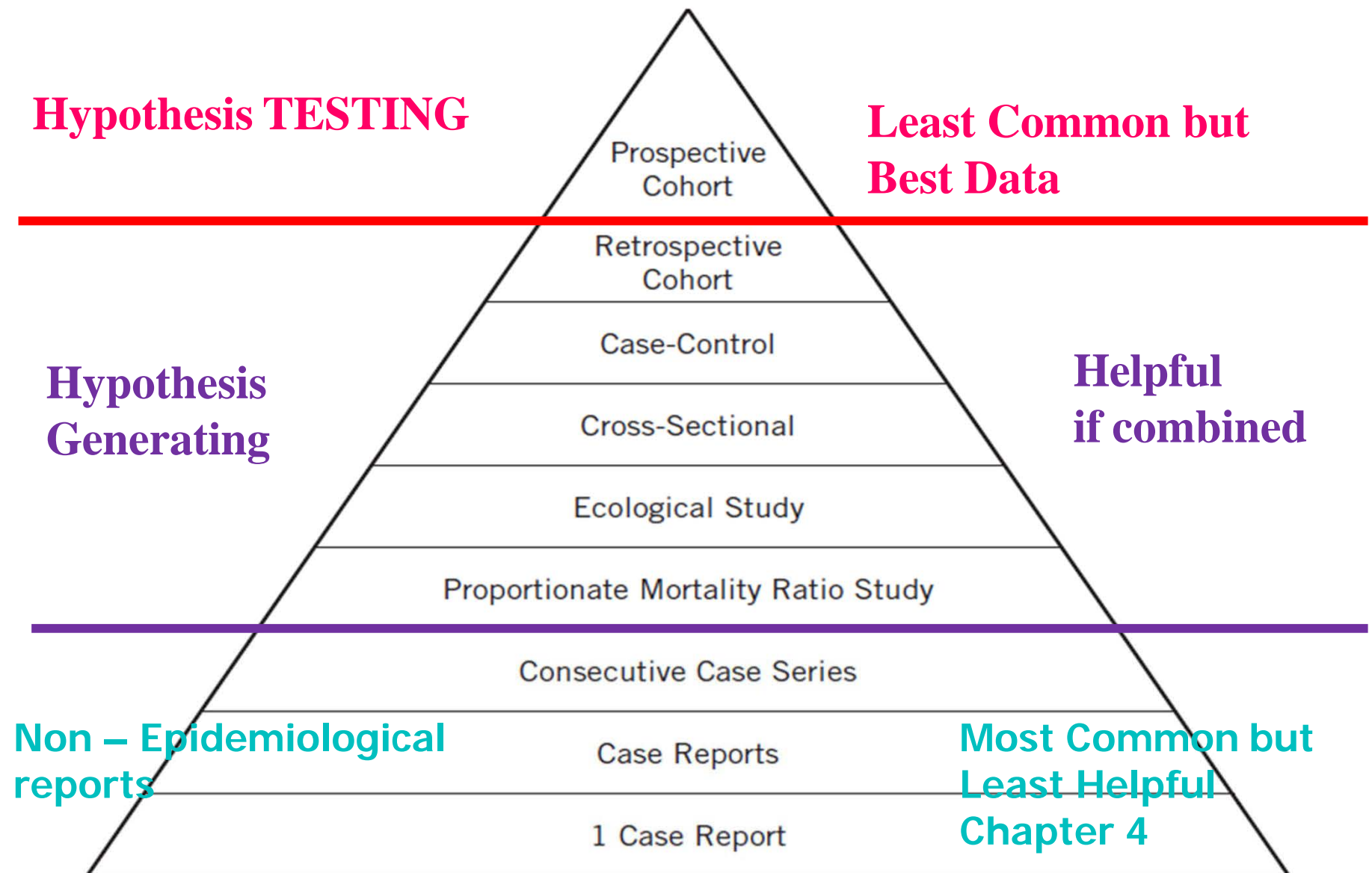
- Morton's, Neuroma, risk, factor = 0
- Morton's, Neuroma, risk = 6 = 1 =  
or14773
- Morton's, neuroma = 292 = 11 and 1  
duplicate
- Morton's, neuroma, trauma = 27 = 27  
duplicates

# Causation Table 3-1

2. Identify the design of each study giving stronger consideration to superior study designs, provided each study has sound methodology

2. In Blue Book reviewed by panel = to determine the study design and score the article

**Figure 3-1** Study Design Pyramid (2<sup>nd</sup> edition Causation pg 107)



# Ecological Study

- Ecological studies are studies of risk-modifying factors on health or other outcomes based on populations defined either geographically or temporally.
- Both risk-modifying factors and outcomes are averaged for the populations in each geographical or temporal unit and then compared using standard statistical methods.



# Ecological Fallacy

- Findings for the groups may not apply to individuals in the group.
- All epidemiological studies include some people who have health outcomes related to the risk-modifying factors studied and some who do not.

# Ecological Fallacy

- Thus, concern about the ecological fallacy should not be used to disparage ecological studies.
- The more important consideration is that ecological studies should include as many known risk-modifying factors for any outcome as possible, adding others if warranted.

# Ecological Fallacy

- Then the results should be evaluated by other methods, using, for example, Hill's criteria for causality in a biological system.
- This is how we developed the Scoring System used in Chapter 4 Methodology

# Methodology

## 3. Quality Score

Strength of association

Psychosocial factors

Range of 0 to 140

# Epidemiologic Evidence

- 11 articles {or14773-14784} Summarized
- The etiology and pathogenesis of Morton's Neuroma remains controversial.
- It is not a true neuroma and therefore, it is better referred to as Morton's metatarsalgia.

# Epidemiologic Evidence

- Incorrect terminology suggests that the underlying pathological process is a nerve tumor, although histological examination reveals the presence of inflammatory tissue that is a perineural fibrosis. The common digital nerve and its branches in the third planter webspace are most commonly affected.

# Epidemiologic Evidence

- Symptom complex should not be given the diagnosis of nerve compression.
- Incidence interdigital neuroma between two elderly human populations by age 80  
25% Japanese and 33% Finnish
- Prevalence in US 33% with + MRI findings or 54% + by sonogram who were asymptomatic



# Epidemiologic Evidence

- Left-handed people were less likely to have foot pain or any foot disorders ipsilateral but were more likely to have hallux valgus

# Epidemiologic Evidence

- Right-handed people have statistically significant increased odds of having an ipsilateral versus contralateral Morton's neuroma by 30%, 18% for hammer toes, 21% for lesser toe deformity, and a twofold increased odds of any foot disorder; there was a 17% decreased odds for Tailor's bunion and an 11% decreased odds for pes cavus

# Epidemiologic Evidence

**Non-occupational Risk Factors** - all trending positive but insufficient evidence by Methodology

- Age: increased risk with age
- Gender: Female (mainly affecting middle aged women)

# Epidemiologic Evidence

- Increase with Specific Risk Factors:
- second metatarsophalangeal joint instability and increased second metatarsal length
- ankle equinus
- moderate or severe hallux valgus 70% of Japanese 0% Finnish
- wearing pointed and high-heeled shoes
- Diabetes
- Rheumatoid arthritis

# Epidemiologic Evidence

## Occupational Risk Factors:

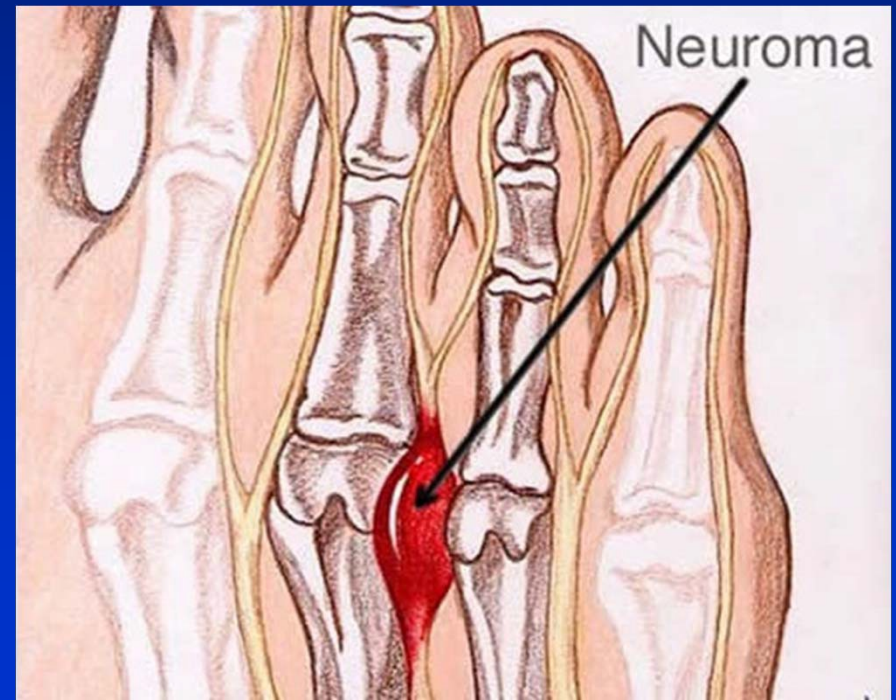
- force, standing, trauma were all insufficient evidence

# Methodology Table 4-7

**Table 4-7** Strength of Evidence of Causation in Epidemiologic Studies

<b>Evidence</b>	<b>Point Value</b>
Very strong	> 500
Strong	300-500
Some	100-299
Insufficient	< 100
Conflicted	See conflicted evidence
Insufficient risk	See insufficient risk

# Morton's Neuroma





# Causation Table 3-2

## 1. Identify evidence of disease

- Make the correct Diagnosis
- Pain in foot is not the same as a Morton's neuroma



# Causation Table 3-2

2. Review and assess the available epidemiologic evidence for a causal relationship
  - See Table 3-1 Steps for Concluding a Causal Association Exits
  - See the word “association” above not cause

# Causation Table 3-2

1. Identify evidence of disease
2. Review and assess the available epidemiologic evidence for a causal relationship
3. Obtain and assess the evidence of exposure
4. Consider other relevant factors
5. Judge the validity
6. Form conclusions about the work-relatedness of the disease in the person undergoing evaluation

# Causation Table 3-2

## 3. Obtain and assess the evidence of exposure

**Table 3-3** Hierarchy of Exposure Data

Type of Data	Estimation of Actual Exposure
1. Quantified personal or individualized measurement	
2. Quantified surrogate of exposure (another worker used to infer all workers' exposures doing same job)	
3. Quantified pseudosurrogates of exposure (another worker used to infer all workers' exposures doing similar jobs)	
4. Employment in a defined job category	
5. Employment in a defined job trade	
6. Employment in a plant or obtained from the employer	

Source: Adapted from Nieuwenhuijsen MJ, ed. *Exposure Assessment in Occupational and Environmental Epidemiology*. Oxford University Press; 2003.

# Causation Table 3-2

## 3. Obtain and assess the evidence of exposure





# 3. Obtain and assess the evidence of exposure

Standard forms can be helpful



## Ergo Activities Form

Date:	Page 1 of 1
Job:	
Dept:	
Group:	
Area:	

Circle the appropriate box for Hours of Exposure							Circle the appropriate box for Hours of Exposure								
<b>Fingers/Hand</b>							<b>Neck</b>								
Repetition:	Intermittent	0	2	4	6	8	10	Repetition:	4 - 10 motions/min	0	2	4	6	8	10
	Intensive	0	2	4	6	8	10		> 10 motions/min	0	2	4	6	8	10
Force:	Pinch > 2 lbs	0	2	4	6	8	10	Posture:	Forward >20°	0	2	4	6	8	10
	Power > 10 lbs	0	2	4	6	8	10		backward >5°, rotate >20°	0	2	4	6	8	10
Posture:	Flexed (holding)	0	2	4	6	8	10	<b>Activities</b>							
	Extended (straight)	0	2	4	6	8	10	Environmental:	Cold <60°F for	0	2	4	6	8	10
Contact Stress:	punch points	0	2	4	6	8	10		sedentary or <40°F light or						
<b>Wrist</b>															
Repetition:	4 - 20 motions/min	0	2	4	6	8	10		<20°F med heavy work						
	20 or more motions/min	0	2	4	6	8	10	Vibration:	localized	0	2	4	6	8	10
Force:	Flex or extend > 10 lbs	0	2	4	6	8	10		whole body	0	2	4	6	8	10
	Radial or Ulnar > 5lbs	0	2	4	6	8	10	Keyboard,	typing, data entry	0	2	4	6	8	10
Posture:	Flexed >20°	0	2	4	6	8	10	Mouse or push screen		0	2	4	6	8	10
	or extended >30°	0	2	4	6	8	10	TrackBall or Digital Device		0	2	4	6	8	10
	Radial or Ulnar noticeable	0	2	4	6	8	10	<b>Other</b>							
Contact Stress:	ie hammer in palm; utility knife in palm	0	2	4	6	8	10		yes	no					
<b>Forearm/Elbow</b>															
Repetition:	4 - 20 motions/min	0	2	4	6	8	10	Machine paced work?	yes	no					
	20 or more motions/min	0	2	4	6	8	10	Incentive pay or piece rate work?	yes	no					
Force:	Flex or extend > 10 lbs	0	2	4	6	8	10	Job rotation occurs?	yes	no					
	Rotation > 10 lbs	0	2	4	6	8	10	Task rotation occurs?	yes	no					
Posture:	Flexion >135° or Extension <15°	0	2	4	6	8	10	Constant job monitoring or direct management oversight?	yes	no					
	Rotation > 45°	0	2	4	6	8	10	Is there constant pressure to keep working?	yes	no					
Contact Stress:	ie lean on edge	0	2	4	6	8	10	Does there seem to be a rush or urgency about everything at work?	yes	no					
<b>Shoulder</b>															
Repetition:	4 - 20 motions/min	0	2	4	6	8	10	Unpleasant physical conditions like noise, dust, fumes, etc.	yes	no					
	20 or more motions/min	0	2	4	6	8	10	Poor lighting: bright or dark or glare computer	yes	no					
Force:	>45° from side or >10lbs	0	2	4	6	8	10	<b>Intervention</b>							
	90° from side >10 lbs	0	2	4	6	8	10	Work Station evaluation performed?	yes	no					
Posture:	45° side or unsupported	0	2	4	6	8	10	Job redesigned for ergonomic tasks?	yes	no					
	90° from side	0	2	4	6	8	10	MotionRisk Assessment completed?	yes	no					
Contact Stress:	ie lean on edge	0	2	4	6	8	10	Ergo Intervention completed?	yes	no					
<b>Instructions:</b>							<b>Definitions:</b>								
The CtdMAP uses three primary job assessment instruments labeled as Job Activities, Ergo Activities, and Essential Functions. Ergo Activities is a follow-up to Job Activities and is designed to convert the postural targeting method (qualitative) for estimating the job risk with objective numbers (quantitative).							Repetition: Intermittent if < 33% of work period or intensive if > 33% of work period or by the number of motions per minute								
Start by reviewing the essential functions of the job. Observe the use of the finger/hand, wrist, forearm/elbow, shoulder, and neck. Record sample times to estimate total hours of exposure for a typical work day for each anatomical area by activity type. Activity type is defined as repetition, force, posture, and contact stresses as defined below.							Force: in pounds (lbs) for pinch and power and mass; include a posture for angle requirement								
Review the job and ask employee or employer for insight into the section "Other" and "Intervention" and select the appropriate "yes" or "no".							Posture: flexion, flexed means to bend or move down; extension, extend means to bend or move up; radial is thumb side; ulnar is little finger side; forearm rotation is supination/pronation (palm up/palm down)								
Remember, these are approximate hours of exposure. If you are unsure or can not decide between two numbers, select the larger number. For example between 4 or 6 select 6 hours. If unsure for "Other" select "yes" and for unsure for "Intervention" select "no" for this form.							Contact Stress: body; part leans against or rests on a sharp or narrow edge, tool held put pressure on finger/strand								
							Environmental: sedentary; work is <10lbs, light <20, med heavy; >75 lbs								
							Vibration: localized = holding onto part or tool, whole body = auto or plane								

# Causation Table 3-2

## 3. Obtain and assess the evidence of exposure

### ESSENTIAL JOB FUNCTIONS

- Must be available to work weekday afternoons.
- Knowledge of and strict adherence to high journalistic standards.
- Knowledge of all facets of online news production, including writing for the web, editing, graphic design, photography, and audio/visual production.
- Excellent writing, grammar, and proofreading skills. Knowledge of AP style.
- Achieve and maintain knowledge of Wisconsin current events and issues.
- Knowledge of ways to use social media to develop stories and interact with audience.
- Ability to work independently and with a team of news staff throughout Wisconsin.
- Ability to work on multiple projects simultaneously on deadline.
- Aural and visual acuity to capture and edit sound and pictures/video for non-broadcast news platforms.
- Ability to work for sustained periods at computer work station.





# Causation Table 3-2

1. Identify evidence of disease
2. Review and assess the available epidemiologic evidence for a causal relationship
3. Obtain and assess the evidence of exposure
4. Consider other relevant factors
5. Judge the validity
6. Form conclusions about the work-relatedness of the disease in the person undergoing evaluation

# Use the Causation Book

## 4. Consider other relevant factors

- Individual risk factors
- Two jobs
- Hobbies
- Previous conditions



# Use the Causation Book

## 5. Judge the validity

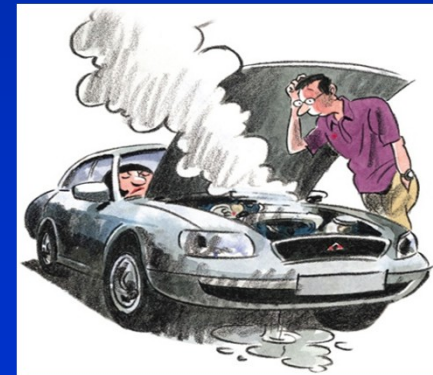
5. Assess the studies using the Updated Hill Criteria; apply the criteria to individual studies (especially 5a–5c) and to the studies as a whole (5a–5l)
  - a. Temporality
  - b. Strength of association
  - c. Dose-response relationship
  - d. Consistency
  - e. Coherence
  - f. Specificity
  - g. Plausibility
  - h. Reversibility
  - i. Prevention/elimination
  - j. Experiment
  - k. Analogy
  - l. Predictive performance

Temporal Correlation  
does NOT prove Causation

# Temporality



- Post hoc ergo propter hoc
- The rooster crows, then the sun rises.
  - Perfect temporal correlation
  - Therefore, the rooster crowing **CAUSES** the sun to rise.
  - **ERROR: "When" does not equal "Why"**
  - "As I turned into the discount store parking lot, a part broke on my 6 year old car; therefore, the store is liable for injuring my car.



# Plausibility

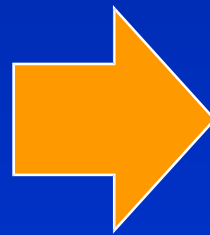
Gray Hair Correlates With

- Type 2 Diabetes Mellitus
- Myocardial Infarction
- Cervical Spondylosis
- Lumbar Spinal Stenosis



# Cannot Replace the Physician

6. Form conclusions about the work-relatedness of the disease in the person undergoing evaluation = convert data from the whole to data for the individual?

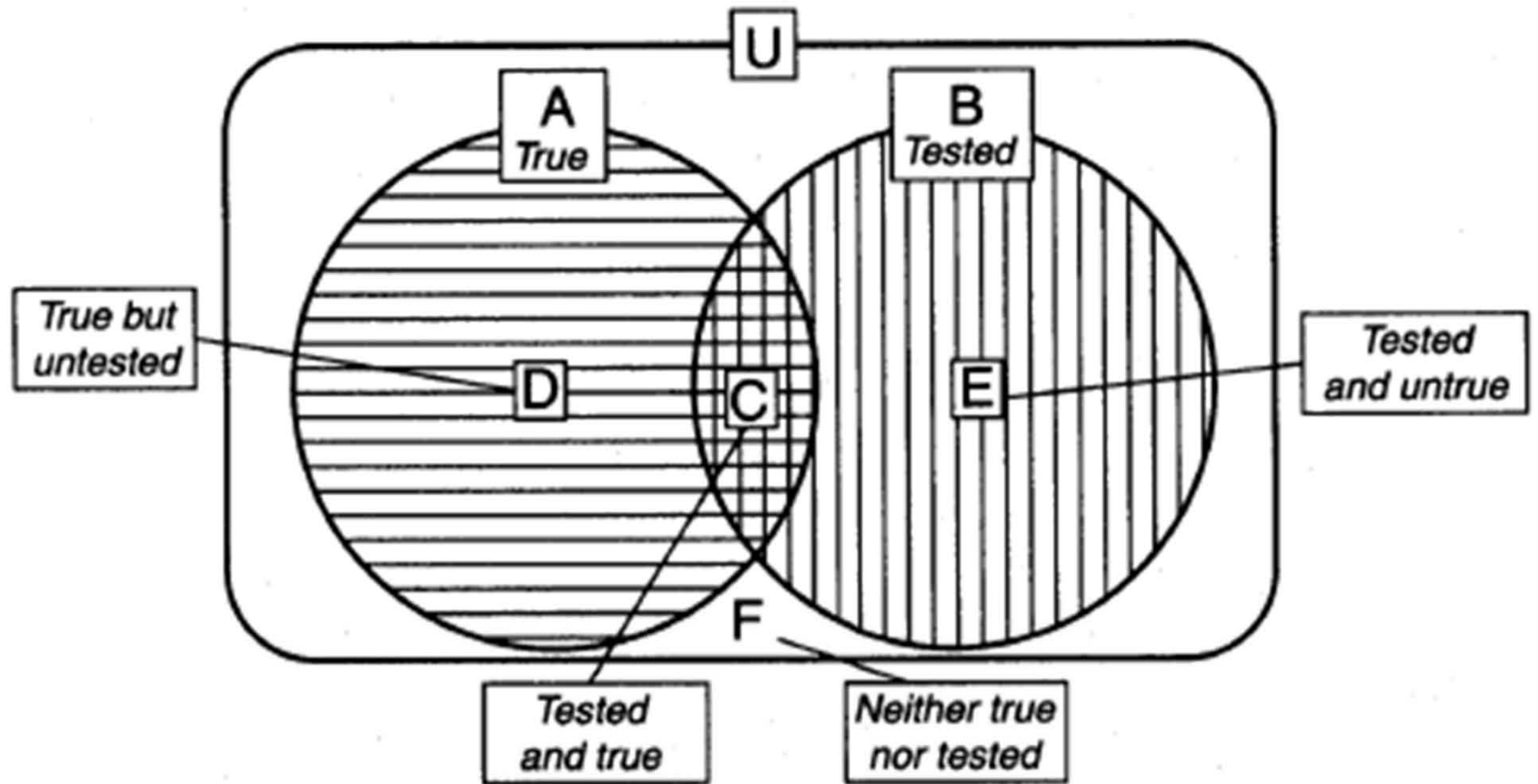




# Limitations of Epidemiology

- Like Science in general,  
Epidemiology can NOT prove a theory.
- Epidemiology can disprove a theory.
  - Can establish that proposed explanation or association is due to chance.
  - Can disprove a theory's predictions.
  - Hadler N M, *Occupational Musculoskeletal Disorders, 2<sup>nd</sup> Edition*, Lippincott, Williams, and Wilkins, Philadelphia, 1999

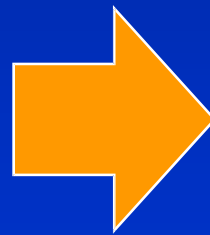
# What We Know



Source: © 2004 American Academy of Orthopaedic Surgeons. Reprinted from the *Journal of the American Academy of Orthopaedic Surgeons*, Volume 12(2), pp. 80-88, with permission.

# Cause

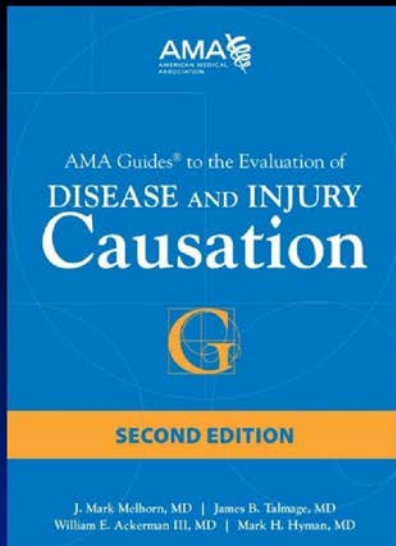
- Limited Prospective Studies
- Many Epidemiological Studies
- How do we convert data from the whole to data for the individual?



# But Wait

- You're in the deposition and the attorney or you're in the court room and the judge wants to know how you plan to support your opinion!





## Chapter 2

---

# Understanding Work-Relatedness

J. Mark Melhorn, MD,

William E. Ackerman III, MD,

Lee S. Glass, MD, JD,

David C. Deitz, MD, PhD, and Steven Babitsky, Esq., JD

### **Prevalent Perceptions of Work-Relatedness**

**Cause in Fact**

**Proximate Cause**

**Epistemology**

**Definition of Terms**

**Study Types**

**Level of Certainty Needed to Establish Causation**

**Summary**

**Appendix: Specific Statutes or Case Law Thresholds**

# Relative Risk

- Relative risks come from prospective cohort in which you know the denominators (how many are in each group you're following).
- You are dividing know risk (absolute risk) in the exposed group by the risk in the unexposed group.

# Relative Risk

Risk	Disease Status	
	Present	Absent
Exposed	a	b
Non-exposed	c	d

- 2 x 2 Table
- Relative risk (RR) for exposed relative to non-exposed
- $RR = a/(a+b) / c/(c+d)$
- $RR = 1$  = no association
- $RR < 1$  = negative association
- $RR > 1$  = positive association



# Relative Risk

Risk	Disease Status	
	Present	Absent
Smoker	a	b
Non-smoker	c	d

- 2 x 2 Table  
Lung CA 20%  
in smoker and  
1% non-smoker in study of 100 individuals
- $RR = a/(a+b) / c/(c+d)$
- $RR = 1$  = no association
- $RR < 1$  = negative association
- $RR > 1$  = positive association

# Relative Risk

- 2 x 2 Table  
Lung CA 20%  
in smoker and  
1% non-smoker in study of 100 individuals
- $RR = a/(a+b) / c/(c+d)$
- $RR = 20/(100) / 1/(100)$
- $RR = 20$

Risk	Disease Status	
	Present	Absent
Smoker	a = 20	b = 80
Non-smoker	c = 1	d = 99

# Relative Risk

- A RR of  $> 1$  means the event is more likely to occur in the exposed group than in the control (non-exposed) group.
- RR of  $>2$  sufficient to consider association for causation by legal definition
- Just how small is an RR of  $>2$

# Relative Risk

- 2 x 2 Table exposure to force

Risk	Disease Status	
	Present	Absent
Force	a = 2	b = 98
Non-force	c = 1	d = 99

resulted in 2 true positives (a) while 1 developed disease but was not exposed (c)

- $RR = a/(a+b) / c/(c+d)$
- $RR = 2/100 / 1/100 = 2$  so only need to change a to 3 and  $RR > 2$

# Relative Risk

- The concept of using the relative risk of at least 2.0 to determine "legal" causation has legal precedent (see Table 4-1), even though epidemiologists consider a relative risk of  $< 3$  as "weak" evidence, especially if the risk estimate comes from case control studies.

# Relative Risk

- The relative risk of  $> 2.0$  was selected based on several legal cases (common law). (page 118)

J. M. Melhorn, W. E. Ackerman, L. S Glass, D. C. Dietz, and S. Babitsky. Understanding Work-Relatedness. In: Guides to the Evaluation of Disease and Injury Causation, edited by J. M. Melhorn, J. B. Talmage, W. E. Ackerman, and M. H. Hyman, Chicago, IL: American Medical Association, 2013, p. 15-104.

# Relative Risk

- If in a factory with 1000 employees,
- 100 “Work related” cases
- In the general non-factory working population 100 cases/1000 people
- Relative risk is 1.0
- Incidence or prevalence (whichever the study measured) is not affected by work, but is the rate of illness in the general population.

# Relative Risk

- If in a factory with 1000 employees,
- 200 “Work related” cases [Total cases]
- In the general non-factory working population 100 cases/1000 people
- Relative risk is 2.0
- But only **half** of the cases may have occurred because of the work exposure.



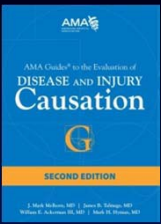
# Relative Risk

- CONSIDER THIS:  
If this illness is officially considered to be work related, work caused 100 cases, BUT, the employer will pay for all 200 cases covered by workers' comp.

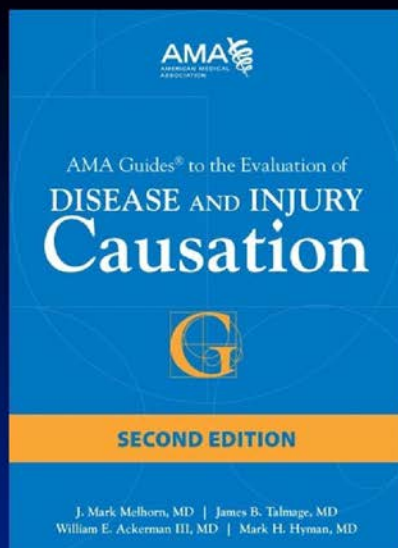
- Medical Science
- Social Justice



# Work-relatedness



- The final determination of work relatedness is established by legal definitions = jurisdictional statutes.
- Opinions regarding causation should be based the best available scientific evidence.



**Table 2-6 States' Causation Threshold Definitions for Work Relatedness**

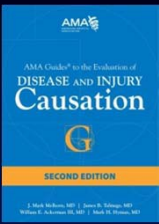
Jurisdiction	Causation Threshold
<b>Federal</b>	
Federal Black Lung Program	Medical testimony must express a "reasoned medical judgment"
Federal Employees Compensation Act	POTE/ MPTN
Federal Employers Liability Act	MPTN in federal court or applicable phrase in state court
Jones Act	POTE/ MPTN
Longshore and Harbor Workers' Compensation Act	MPTN, but if the evidence is balanced on both sides, the presumption favors the claimant
<b>State</b>	
Alabama	RDOMP
Alaska	POTE, presumption in favor of claimant (MPTN)
Arizona	RDOMP/MPTN
Arkansas	RDOMC and RDOMP
California	RDOMP
Colorado	RDOMP
Connecticut	RDOMP
Delaware	RDOMC, RDOMP, POTE, or MPTN
District of Columbia	MPTN/ POTE
Florida	RDOMC, and the work injury must be the major contributing cause of the condition (ie, > 50% contributory). There must be significant objective findings (by physical examination and diagnostic studies) causally related to the injury.
Georgia	RDOMP
Hawaii	Presumption in favor of claimant; employer must show by substantial evidence that the presumptions do not apply.
Idaho	RDOMP
Illinois	RDOMC
Indiana	RDOMC
Iowa	MPTN /POTE

# Work-relatedness

- What is prevailing factor?

**Table 2-6 (Continued)**

<b>Jurisdiction</b>	<b>Causation Threshold</b>
Kansas	RDOMP – new law May 15, 2011, prevailing factor
Kentucky	RDOMP
Louisiana	Reasonable probability



# Morton's Neuroma

The Original Question  
was

Is this a compensable injury?

Yes vs No = you vote

# Morton's Neuroma

- 40 y/o male
- Warehouse worker = flat floor, proper steel toed shoes with wide toe area
- How long on the job?
- Previous history of Dx or Tx same or similar conditions?

# Morton's Neuroma

- No epidemiological risk factor established for on feet all day or heavy lifting.
- No history of trauma, no studies to show increase with sports, running, jumping, weight lifters, etc.
- Increasing risk with age, he is 40 probably no adjustment.



# Morton's Neuroma

- 33% to 54% of US populations has nerve changes by MRI / sonogram.
- Does he have co-morbidities such as RA, diabetes, ankle equinus, second metatarsophalangeal conditions?

# Morton's Neuroma



- What is the legal threshold?
- No

in my opinion based on the current information available. However, I reserve the right to change my opinion if additional information is provided.

(\*jmm)

# Morton's Neuroma

- So do you always get this level of analysis?
- Dx was not in Blue book, so, I had to do all the steps.
- 8 hours at "Special Reports" usually limited to \$100 if paid at all.
- Please do the math!!

# But Wait - Causation Fallacies

## Post hoc ergo propter hoc

- After this, therefore because of this
- Occurs when a causal relationship is asserted based on this false reasoning.
- It is a fallacy to conclude that one event followed by a second necessarily demonstrates a causal relationship between the events.

# Causation Fallacies

## Non-Causal Relationship - example

People with gray hair may have a higher incidence of infection after tendon laceration than people with black hair.

Gray hair does not, by itself or with other factors, provide a biologically plausible explanation for the occurrence of a infection.

Therefore, there is a non-causal relationship between hair color and infection because the presence of gray hair and the incidence of infection both increase with age, for unrelated reasons.

# Carpal Tunnel Syndrome

- The injured worker is a 30 year old, right handed female legal secretary in the law office of a sole practitioner in the field of Workers' Compensation. The employee works full time in the law office and spends 5 to 6 hours per day at the keyboard preparing documents.

# Carpal Tunnel Syndrome

- Her work station does not include an ergonomically designed keyboard, however, the height of the keyboard may be adjusted by the employee. The claimant developed numbness and tingling that radiates from the right wrist into the palm and was diagnosed with median nerve entrapment, right worse than left.



# Carpal Tunnel Syndrome

- The applicant filed a gradual injury claim using the date of diagnosis as her date of injury. The employee continues to work but is requesting the right wrist surgery be paid for as compensable medical treatment for her industrial injury claim.
- Is this a compensable injury?

# Carpal Tunnel Syndrome

## The Original Question


Is this a compensable injury?

Yes vs No = you vote

# Carpal Tunnel Syndrome

- Is which condition a compensable injury?
- Right
- Left
- Both
- What was the date of onset of symptoms?

# Select Best Image

  
**The Hand Center**  
ORTHOPEDICS OF THE HAND & UPPER EXTREMITY

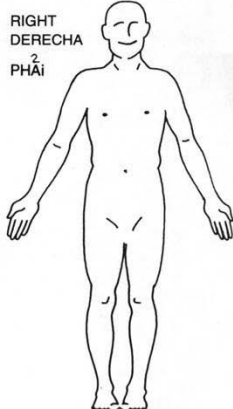
0 1 2 3 4 5 6 7 8 9 10 10 +  
 No Pain Moderate Pain Worst possible pain

Today are your symptoms (circle one) same, better or worse?  
 SPANISH Por favor marca en las partes del cuerpo los síntomas que siente usando los diferentes símbolos para cada sintoma. Marque todas las áreas afectadas.


VIETNAMESE Xin vui lòng khoả chọn những chỗ trên thân thể quý vị có những cảm giác như sau.  
 Xin quý vị dùng những dấu dưới đây Xin khoả điểm tất cả những chỗ bị đau nhức.

numbness DORMIDO	pins & needles PIQUETES	burning QUEMA	stabbing DOLOR FUERTE	aching/pain DOLOR
== == =	kim châm	rát	đau nhói	nhức
== == =	o o o o	x x x x	l l l l	• • • •
	o o o o	x x x x	l l l l	• • • •


RIGHT DERECHA PHẢI <sup>2</sup>



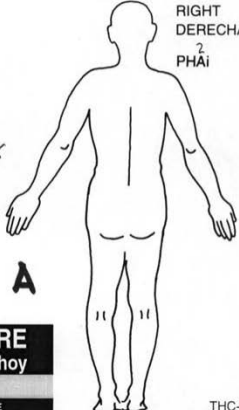
LEFT IZQUIERDA TRÁI




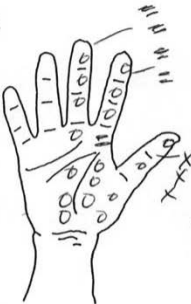
RIGHT DERECHA PHẢI



RIGHT DERECHA PHẢI <sup>2</sup>



RIGHT DERECHA PHẢI <sup>2</sup>

**A**


**PLEASE SIGN HERE**  
Por favor firme aquí

**DATE HERE**  
La fecha de hoy

PATIENT SIGNATURE REQUIRED  
Firma del paciente requerida

TODAY'S DATE

THC-6

  
**The Hand Center**  
ORTHOPEDICS OF THE HAND & UPPER EXTREMITY

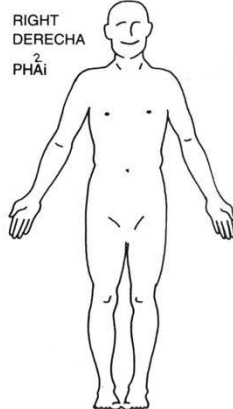
0 1 2 3 4 5 6 7 8 9 10 2  
 No Pain Moderate Pain Worst possible pain

Today are your symptoms (circle one) same, better or worse?  
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 Xin quý vị dùng những dấu dưới đây Xin khoả điểm tất cả những chỗ bị đau nhức.

numbness DORMIDO	pins & needles PIQUETES	burning QUEMA	stabbing DOLOR FUERTE	aching/pain DOLOR
== == =	kim châm	rát	đau nhói	nhức
== == =	o o o o	x x x x	l l l l	• • • •
	o o o o	x x x x	l l l l	• • • •


RIGHT DERECHA PHẢI <sup>2</sup>



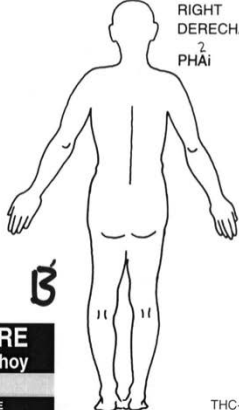
LEFT IZQUIERDA TRÁI





RIGHT DERECHA PHẢI <sup>2</sup>



RIGHT DERECHA PHẢI <sup>2</sup>



RIGHT DERECHA PHẢI <sup>2</sup>

**B**

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Por favor firme aquí


**DATE HERE**  
La fecha de hoy

PATIENT SIGNATURE REQUIRED  
Firma del paciente requerida

TODAY'S DATE

THC-6

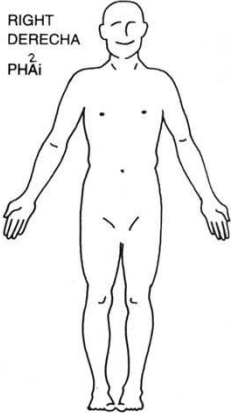




# Select Best Image


  
 THE HAND CENTER  
 ORTHOPEDICS OF THE HAND & UPPER EXTREMITY

0 1 2 3 4 5 6 7 8 9 10  
 No Pain Moderate Pain Worst possible pain

Today are your symptoms (circle one) same, better or worse?  
 Please mark the areas on your body where you feel the following described sensations. Use the symbols as provided. Mark all affected areas.  
 SPANISH Por favor marca en las partes del cuerpo los síntomas que sientes usando los diferentes símbolos para cada sintoma. Marque todas las áreas afectadas.

VIETNAMESE Xin quý vị chỉ chọn một chỗ trên thân thể quý vị có triệu chứng - gejala như sau.  
 Xin quý vị dùng những dấu dưới đây Xin chỉ chọn tất cả những chỗ bị đau nhức.

numbness DORMIDO	pins & needles PIQUETES	burning QUEMA	stabbing DOLOR FUERTE	aching/pain DOLOR	RIGHT DERECHA PHẢI
== == == == == ==	kim châm o o o o o o o o	rát x x x x x x x x	đau nhói      	nhức •••• ••••	
					LEFT IZQUIERDA TRÁI
					RIGHT DERECHA PHẢI
					RIGHT DERECHA PHẢI


**PLEASE SIGN HERE**  
**Por favor firme aqui**

**DATE HERE**  
**La fecha de hoy**

PATIENT SIGNATURE REQUIRED  
 Firma del paciente requerida

TODAY'S DATE

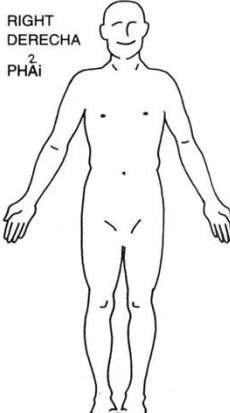




THC-6


  
 THE HAND CENTER  
 ORTHOPEDICS OF THE HAND & UPPER EXTREMITY

0 1 2 3 4 5 6 7 8 9 10  
 No Pain Moderate Pain Worst possible pain

Today are your symptoms (circle one) same, better or worse?  
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numbness DORMIDO	pins & needles PIQUETES	burning QUEMA	stabbing DOLOR FUERTE	aching/pain DOLOR	RIGHT DERECHA PHẢI
== == == == == ==	kim châm o o o o o o o o	rát x x x x x x x x	đau nhói      	nhức •••• ••••	
					LEFT IZQUIERDA TRÁI
					RIGHT DERECHA PHẢI
					RIGHT DERECHA PHẢI

**PLEASE SIGN HERE**  
**Por favor firme aqui**

**DATE HERE**  
**La fecha de hoy**

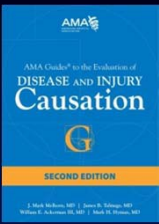
PATIENT SIGNATURE REQUIRED  
 Firma del paciente requerida

TODAY'S DATE

THC-6

# Use the Causation Book

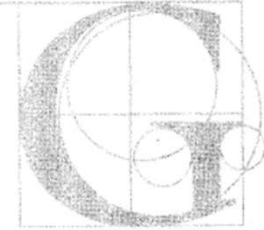
- Use the Dx to find the correct Chapter



## Chapter 9

### Upper Limb

J. Mark Melhorn, MD,  
Douglas Martin, MD,  
Charles N. Brooks, MD, and Shirley Seaman, MS, PA-C



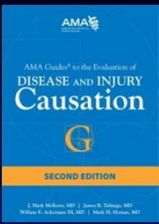
#### Search Criteria

- Ganglions of Tendon Sheaths in Digits and Hand
- Ganglions of Hand and Wrist
- Dupuytren's Disease or Contracture
- Osteoarthritis of the Thumb Carpometacarpal Joint
- Trigger Digits
- de Quervain's Disease
- Intersection Syndrome of the Wrist or Forearm
- Triangular Fibrocartilage Complex Injuries or Tears
- Painful Elbow—Lateral and Medial Epicondylitis (Tennis Elbow)
- Median Nerve Entrapment at the Wrist (Carpal Tunnel Syndrome)**
- Ulnar Nerve Entrapment at the Elbow (Cubital Tunnel Syndrome or UNE)
- Ulnar Nerve Entrapment at the Wrist (Cubital Tunnel Syndrome or UNW)
- Ulnar Nerve Entrapment at the Elbow (Cubital Tunnel Syndrome or UNE)
- Radial Nerve Entrapment at the Wrist (Wartenberg's Syndrome or RNW)
- Radial Nerve Entrapment at the Elbow (Radial Tunnel Syndrome or RNE)
- Shoulder Tendinopathy, Impingement, and Rotator Cuff Tears
- Summary

# Carpal Tunnel Syndrome

Carpal tunnel syndrome (CTS) is a constellation of symptoms and signs resulting from mononeuropathy of the median nerve in the carpal tunnel.

Symptoms typically include numbness, paresthesias, dysesthesias, and/or pain in the radial palm and palmar aspect of the thumb, index, middle, and perhaps ring fingers.



# Table 3-2 NIOSH / ACOEM

1. Identify evidence of the disease = Dx
2. Review and assess the available epidemiological evidence for a causal relationship
3. Obtain and assess the evidence of exposure
4. Consider other relevant factors
5. Judge the validity of testimony
6. Form conclusions about the work-relatedness of the disease in the person undergoing evaluation



# Keyboard - CTS

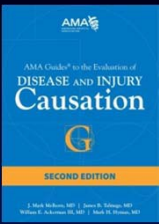
1. Identify evidence of the disease = Dx  
Can you confirm her diagnosis as CTS?

## **Median Nerve Entrapment at the Wrist (Carpal Tunnel Syndrome)**

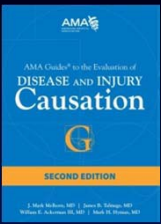
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Carpal tunnel syndrome (CTS) is a constellation of symptoms and signs resulting from mononeuropathy of the median nerve in the carpal tunnel. Symptoms typically include numbness, paresthesias, dysesthesias, and/or pain in the radial palm and palmar aspect of the thumb, index, middle, and perhaps ring fingers. The sensory complaints sometimes also extend proximally in the limb and often occur or worsen at night.

No single physical examination test absolutely confirms this diagnosis. Because electrodiagnostic testing is considered the “gold standard” for diagnosis, the best studies on CTS risk factors include nerve conduction testing (NCT) as a requirement





# Keyboard - CTS




2. Review and assess the available epidemiological evidence for a causal relationship

Her reported risk factor: Keyboards

## Occupational Risk Factors for Median Nerve Entrapment at the Wrist

- Combination of risk factors (eg, force and repetition, force and posture): very strong evidence; national and international epidemiologic surveillance data has consistently demonstrated that the highest rates of CTS occur in occupations with high upper-extremity physical demands, including meatpacking, poultry processing, automobile assembly work, and other occupations requiring intensive manual exertion of distal upper limbs
- Vibration: low risk evidence
- Highly repetitive work alone: conflicting evidence; widely varied definitions for repetitive work, making association difficult
- Highly repetitive work or in combination with other factors: strong evidence; but again the widely varying definitions for repetitive work makes association difficult
- Forceful work: very strong evidence
- Awkward postures: low risk evidence: the lack of evidence is possibly due to individual variability in work methods among those in similar jobs and differing body posture while measuring postural characteristics of jobs; there is some evidence of postural factors in laboratory-based studies of extreme postures
- Keyboard activities: insufficient evidence 
- Cold environment: insufficient evidence
- Length of employment: insufficient evidence
- Job satisfaction: some evidence 

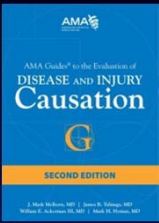
## Nonoccupational Risk Factors for Median Nerve Entrapment at the Wrist

- Age: very strong evidence; risk increases with increasing age
- BMI: very strong evidence; high BMI increases risk
- Gender: very strong evidence; female 
- Biopsychosocial factors: very strong evidence. The biopsychosocial approach looks at the mind and body of an individual as 2 important and interrelated systems.<sup>236</sup> Pain and other neuromusculoskeletal symptoms that may be causally related to conditions such as CTS are reported differently by each individual.<sup>237</sup> Examining physicians must broaden their evaluation to consider how developmental, psychological, cognitive, familial, occupational, and economic factors affect the
- Diabetes: very strong evidence
- Dominant hand: insufficient evidence
- Comorbidity: very strong evidence, especially with a history of other upper-limb musculoskeletal disorders, inflammatory arthritis such as rheumatoid, thyroid disease, diabetes, or a wrist fracture; those with a family history of CTS are also predisposed thereto
- Smoking: low risk evidence
- Genetic: very strong evidence
- Alcohol consumption: insufficient evidence
- Carpal tunnel or wrist size (wrist ratio): some evidence
- Nonoccupational activities: some evidence for gardening and knitting



**Table 9-21** References and Comments for CTS

Risk Factor	References and Comments
Combination of risk factors (eg, force and repetition, force and posture)	<p>Very strong evidence. A prospective cohort study<sup>233</sup> of 536 workers at 10 diverse manufacturing facilities reported an association but a problematic dose-response relationship. For TLV for HAL score, with the easiest jobs (TLV for HAL = 0.0) the hazard ratio was set as 1.0. In multivariate analysis, as TLV for HAL increased, the hazard ratio for CTS peaked at 5.4 for moderate-difficulty jobs, but then decreased as jobs got harder and was 1.1 for the most difficult jobs. The Strain Index score similarly had a hazard ratio of 1.0 assigned to the easiest jobs. The CTS hazard ratio increased with increasing job difficulty and peaked at 5.3 for moderate-difficulty jobs but then decreased as jobs became even more difficult. The most difficult (highest Strain Index) jobs had a hazard ratio of only 1.3. <b>Thus, there was no consistent dose-response relationship.</b> Survivor bias may explain this, but the study does not clearly state how many of the 429 workers dropped out during the study.</p> <p>The results are confounded by the study's definition of an abnormal nerve conduction test as having the median nerve sensory conduction latency exceed the ulnar nerve sensory latency by &gt; 0.55 msec. This definition results in false positive tests in that the absolute motor and sensory latencies can be normal yet a bit slower than the ulnar latencies and be considered abnormal. In the prevalence study from Sweden cited earlier<sup>224</sup> using a definition of having the median sensory latency exceed ulnar sensory latency by &gt; 0.8 msec, Atroshi found 18% of asymptomatic controls had an "abnormal" nerve conduction study.</p> <p>Excluded from the study were 10.2% of the workers because they were not included in the study.</p>



# Keyboa

3. Obtain and assess the evidence of exposure

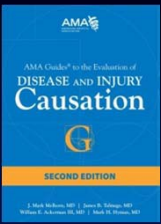
Standard forms can be helpful



Date:	Page 1 of 1
Job:	
Dept:	
Group:	
Area:	

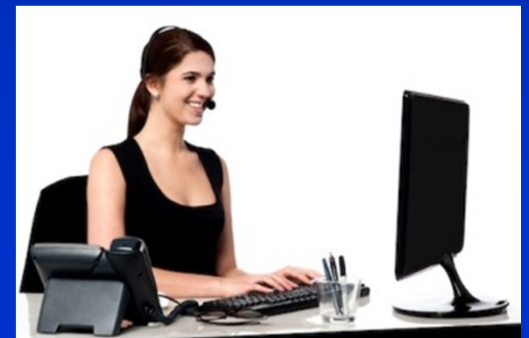
Circle the appropriate box for Hours of Exposure						Circle the appropriate box for Hours of Exposure								
<b>Fingers/Hand</b>						<b>Neck</b>								
Repetition:	Intermittent	0	2	4	6	8	10	Repetition: 4-10 motions/min	0	2	4	6	8	10
	Intensive	0	2	4	6	8	10	> 10 motions/min	0	2	4	6	8	10
Force:	Pinch > 2 lbs	0	2	4	6	8	10	Posture: Forward >20°	0	2	4	6	8	10
	Power > 10 lbs	0	2	4	6	8	10	backward >5°, rotate >20°	0	2	4	6	8	10
Posture:	Flexed (holding)	0	2	4	6	8	10	<b>Activities</b>						
	Extended (straight)	0	2	4	6	8	10	Environmental: Cold <60°F for	0	2	4	6	8	10
Contact Stress:	punch points	0	2	4	6	8	10	sedentary or <40°F light or	0	2	4	6	8	10
		0	2	4	6	8	10	<20°F med heavy work	0	2	4	6	8	10
<b>Wrist</b>						<b>Other</b>								
Repetition:	4-20 motions/min	0	2	4	6	8	10	Machine paced work?	yes	no				
	20 or more motions/min	0	2	4	6	8	10	Incentive pay or piece rate work?	yes	no				
Force:	Flex or extend > 10 lbs	0	2	4	6	8	10	Job rotation occurs?	yes	no				
	Radial or Ulnar > 5lbs	0	2	4	6	8	10	Task rotation occurs?	yes	no				
Posture:	Flexed >20°	0	2	4	6	8	10	Constant job monitoring or direct management	yes	no				
	or extended >30°	0	2	4	6	8	10	oversite?	yes	no				
	Radial or Ulnar noticeable	0	2	4	6	8	10	Is there constant pressure to keep working?	yes	no				
Contact Stress:	ie hammer	0	2	4	6	8	10	Does there seem to be a rush or urgency	yes	no				
	in palm; utility knife in palm	0	2	4	6	8	10	about everything at work?	yes	no				
		0	2	4	6	8	10	Unpleasant physical conditions like noise, dust,	yes	no				
<b>Forearm/Elbow</b>						<b>Intervention</b>								
Repetition:	4-20 motions/min	0	2	4	6	8	10	Work Station evaluation performed?	yes	no				
	20 or more motions/min	0	2	4	6	8	10	Job redesigned for ergonomic tasks?	yes	no				
Force:	Flex or extend > 10 lbs	0	2	4	6	8	10	MotionRisk Assessment completed?	yes	no				
	Rotation > 10 lbs	0	2	4	6	8	10	Ergo Intervention completed?	yes	no				
Posture:	Flexion >135° or	0	2	4	6	8	10	Other Intervention completed?	yes	no				
	Extension <15°	0	2	4	6	8	10							
	Rotation > 45°	0	2	4	6	8	10							
Contact Stress:	ie lean on edge	0	2	4	6	8	10							
<b>Shoulder</b>														
Repetition:	4-20 motions/min	0	2	4	6	8	10							
	20 or more motions/min	0	2	4	6	8	10							
Force:	>45° from side or >10lbs	0	2	4	6	8	10							
	90° from side >10 lbs	0	2	4	6	8	10							
Posture:	45° side or unsupported	0	2	4	6	8	10							
	90° from side	0	2	4	6	8	10							
Contact Stress:	ie lean on edge	0	2	4	6	8	10							
<b>Instructions:</b>						<b>Definitions:</b>								
The CtdMAP uses three primary job assessment instruments labeled as Job Activities, Ergo Activities, and Essential Functions. Ergo Activities is a follow-up to Job Activities and is designed to convert the postural targeting method (qualitative) for estimating the job risk with objective numbers (quantitative).						Repetition: intermittent if <33% of work period or intensive if >33% of work period or by the number of motions per minute								
Start by reviewing the essential functions of the job. Observe the use of the finger/hand, wrist, forearm/elbow, shoulder, and neck. Record sample times to estimate total hours of exposure for a typical work day for each anatomical area by activity type. Activity type is defined as repetition, force, posture, and contact stress as defined below.						Force: in pounds (lbs) for pinch and power and mass; include a posture for angle requirement								
Review the job and ask employee or employer for insight into the section "Other" and "Intervention" and select the appropriate "yes" or "no".						Posture: flexion, flexed means to bend or move down; extension, extend means to bend or move up; radial is thumb side; ulnar is little finger side; forearm rotation is supination/pronation (palm up/palm down)								
Remember, these are approximate hours of exposure. If you are unsure or can not decide between two numbers, select the larger number. For example between 4 or 6 select 6 hours. If unsure for "Other" select "yes" and for unsure for "Intervention" select "no" for this form.						Contact Stress: body; part against or rests on a sharp or narrow edge, tool held put pressure on finger/stand								
						Environmental: sedentary; work is <10lbs, light<20, med heavy; >75 lbs								
						Vibration: localized = holding onto part or tool, whole body = auto or plane								

# Keyboard - CTS

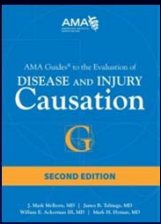


## 3. Obtain and assess the evidence of exposure

- Is this her only risk exposure?
- Hobbies – none
- ROS and comorbidities are negative
- Ergonomic modifications????



# Keyboard - CTS



## 4. Consider other relevant factors

### Occupational Risk Factors:

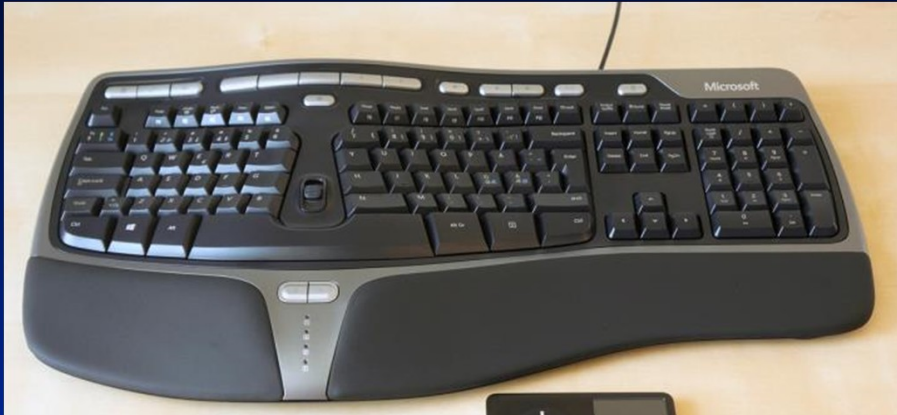
- Keyboard activities: insufficient evidence

### Nonoccupational Risk Factors:

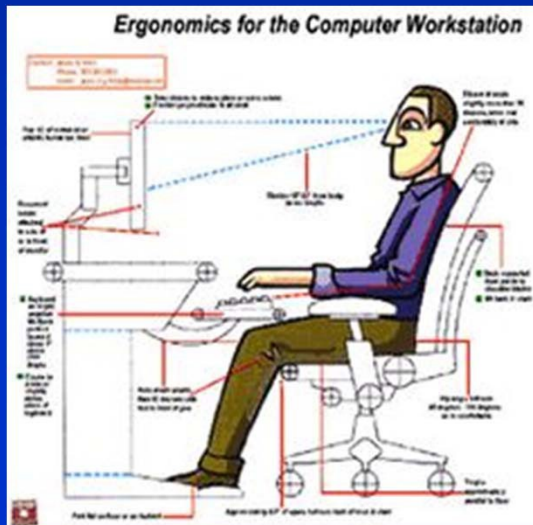
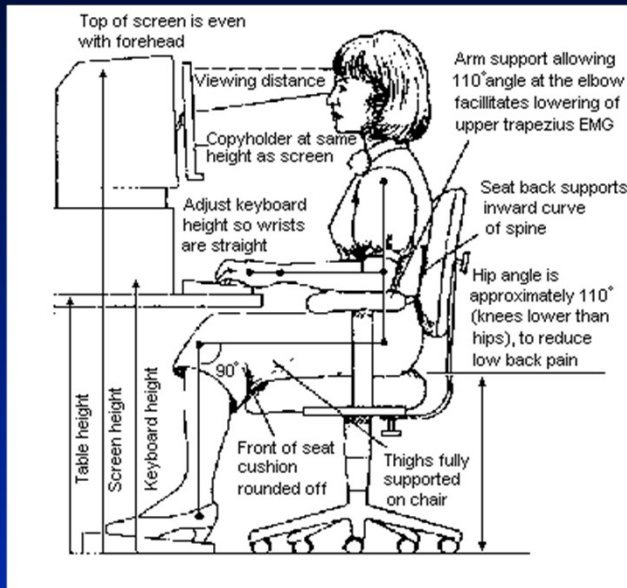
- Gender = very strong evidence = female
- Biopsychosocial = very strong evidence



# Keyboard - CTS



# Work Station Ergonomics



## Setting up your workstation

**HEAD**  
Directly over shoulders, without straining forward or backward, about an arm's length from screen.

**NECK**  
Elongated and relaxed

**SHOULDERS**  
Kept down, with the chest open and wide.

**BACK**  
Upright or inclined slightly forward from the hips. Maintain the slight natural curve of the lower back.

**ELBOWS**  
Relaxed, at about a right angle.

**WRISTS**  
Relaxed and in a neutral position, without flexing up or down.

**KNEES**  
Relaxed and in a neutral position, without flexing up or down.

**CHAIR**  
Sloped slightly forward to facilitate proper knee position.

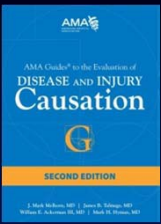
**SCREEN**  
At eye level or slightly lower.

**FINGERS**  
Gently curved.

**KEYBOARD**  
Best when kept flat (for proper wrist positioning) and at or just below elbow level.

**FEET**  
Firmly planted on the floor. Shorter people may need a footrest.

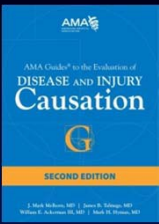
# Keyboard - CTS



## 5. Judge the validity of testimony

- Patients says "the job is the cause"
- Job description by patient
- Job description by employer
- Video of job
- Onsite viewing of job

# Keyboard - CTS



## 5. Judge the validity of testimony

5. Assess the studies using the Updated Hill Criteria; apply the criteria to individual studies (especially 5a–5c) and to the studies as a whole (5a–5l)
  - a. Temporality
  - b. Strength of association
  - c. Dose-response relationship
  - d. Consistency
  - e. Coherence
  - f. Specificity
  - g. Plausibility
  - h. Reversibility
  - i. Prevention/elimination
  - j. Experiment
  - k. Analogy
  - l. Predictive performance



# Observational Studies

Characteristic	Cross-Sectional	Case Control	Historical Cohort	Nested Case Control	Prospective Cohort
Work "backward" to identify exposures	Yes	Yes	Yes	No	No
Prone to recall bias	Yes	Yes	Yes	No	No
Prone to false associations (artifact)	Yes	Yes	Yes	No	No
Appropriate for disease with long latency	Yes	Yes	Yes	No	No
Expense	Low	Low	Low	Medium	High
Strength of evidence on etiology	Low	Low	Medium	Medium	Good

Majority of studies here

For CTS  
 2 prospective studies exist  
 And both say work does  
 NOT  
 Cause CTS

# Prospective (Longitudinal) Study

- Nathan PA, Meadows KE, Istvan JA- Predictors of carpal tunnel syndrome in an 11 year study of industrial workers *J Hand Surg 2002; 27A: 644-651*
- *Largest known prospective study*
- 1984 Baseline evaluation, free of CTS symptoms, and normal NCVs.
  - Used “inching technique” which is overly sensitive, so **probably over-diagnosed CTS by NCT.**
- 111 women and 145 men found 11 years later, and re-evaluated (including repeat NCV).
- **Work place variables were observed** and classed by quintile of exposure: **force, repetition, vibration, amount of keyboard time, and amount of heavy lifting.**

# Prospective (Longitudinal) Study

- Factors at baseline that **predicted development of CTS** over the next 11 years:
  1. Female Gender
  2. Greater Age
  3. Obesity
  4. Vibration (marginal)

# Prospective (Longitudinal) Study

- Factors at baseline that did **not** predict the development of CTS over the next 11 years:
  1. Repetition
  2. Force
  3. Heavy Lifting
  4. Keyboard Use



Is It Safe  
to Use a  
Keyboard?



# Yes Keyboards Safe

- JAMA 2003; 289 (22): 2963 or5296
- Neurology 2001; 56 (11):1568-70 or4149
- Occ & Environ Med 1997; 54 (10): 734-740 or5676
- JOEM 1996; 38 (5): 469-484 or5677
- JOEM 1996; 38 (11): 1079-1084 or5678

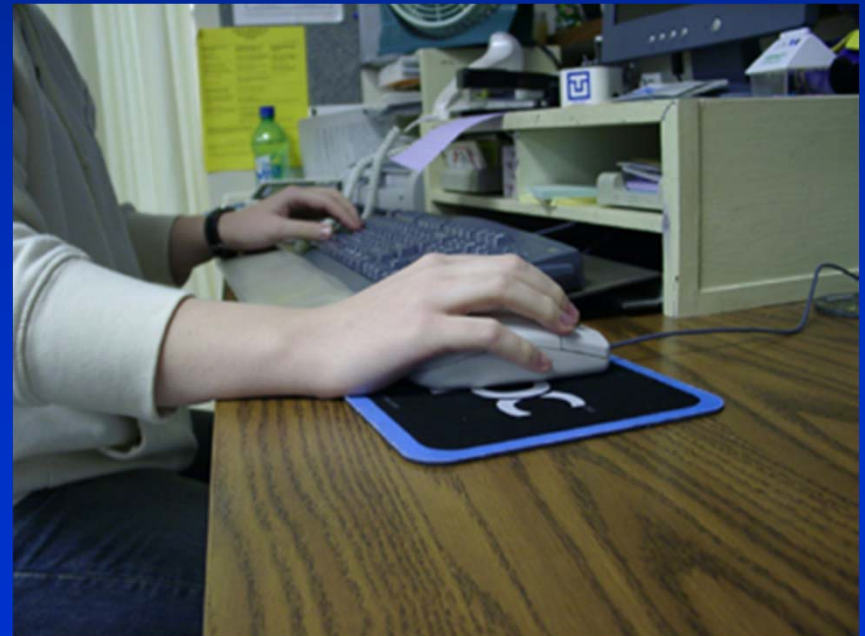
# Yes Keyboards Safe

- Arch Environ Health 1996; 51 (5): 395-407 or2744
- J Hand Surg 2002; 27 A: 644-651 or4863
- Hand Clinics 2002; 18: 211-217 or5679
- Occupational Musculoskeletal Disorders, 2nd Ed. Norton Hadler MD, Lippincott Williams & Wilkins, Philadelphia, PA, 1999 (433 pages) ISBN 0-7817-1495-8 or3894

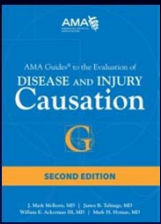
# Yes Keyboards Safe

Keyboard Redesign = No decrease in CTS

- *JOEM* 1999; 41: 111-119 or3647
- *Am J Prev Med* 2000; 18: 37-50 or4276



# Keyboard - CTS



6. Form conclusions about the work-relatedness of the disease in the person undergoing evaluation.

- The scientific evidence would suggest that this individual has occupational and nonoccupational (individual) risk factors for the onset of CTS

# Keyboard - CTS

The Original Question  
was

Is this a compensable injury?

Yes vs No = you vote

# Keyboard - CTS

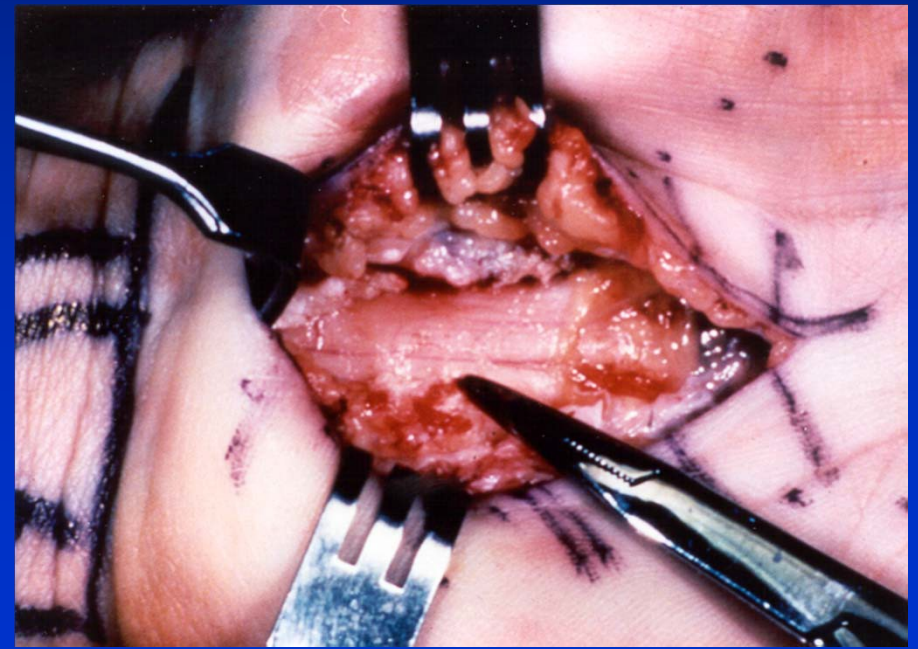


- What is the legal threshold?
- No

in my opinion based on the current information available. However, I reserve the right to change my opinion if additional information is provided. (jmm)



# CTS - Causation



# CTS - Causation



- 40 year old female
- 20 years on production line plastic cooler called "jugs"
- Recently switched to new line – larger cooler
- 2 year history of progress numbness at night thumb, index, and middle finger bilateral

# CTS - Causation

- Symptoms are worse at end of day
- Awaken at night – shakes hands out
- BMI 29 (moderately overweight – age appropriate ?)
- Smokes 2 ppd
- Social EtOH
- Likes to play with grand children

# CTS - Causation

- Treated with night splint – some improvement
- NSAID's – maybe help
- Wrist injection x 2 with improvement
- X-rays shown slight CMC thumb OA
- NCT consistent with median nerve entrapment wrist

# CTS - Causation

- Filed WC claim
- Insurer is requesting a causation opinion.
- Is her work as a plastic production line employee the cause for her CTS for which you have recommend surgery?

# CTS - Causation

The Original Question  
was

Is this a compensable injury?

Yes vs No = you vote

# CTS - Causation

- Patient said “the job is the cause”
- Many physician’s repeat this statement in their medical record
- The job then becomes “the cause”
- But what is the science?

# CTS - Causation

- Combination of force & repetition, force & posture = very strong evidence
- Vibration = low risk
- Highly repetitive work alone = conflicting
- Highly repetitive work in combination = strong evidence



# CTS - Causation

- Forceful work = very strong evidence
- Awkward postures = low risk
- Keyboard = insufficient evidence
- Cold environment = insufficient evidence
- Length of employment = insufficient evidence
- Job satisfaction = some evidence

# CTS - Causation

## 3. Obtain and assess the evidence of exposure

- Primary job is making coolers
- What does that involve?
- Hours per day
- Days per week
- Essential Functions of the Job

# CTS - C

3. Obtain and assess the evidence of exposure

Standard forms can be helpful



Date:	Page 1 of 1
Job:	
Dept:	
Group:	
Area:	

Circle the appropriate box for Hours of Exposure						Circle the appropriate box for Hours of Exposure									
<b>Fingers/Hand</b>						<b>Neck</b>									
Repetition:	Intermittent	0	2	4	6	8	10	Repetition:	4- 10 motions/min	0	2	4	6	8	10
	Intensive	0	2	4	6	8	10		> 10 motions/min	0	2	4	6	8	10
Force:	Pinch > 2 lbs	0	2	4	6	8	10	Posture:	Forward >20°	0	2	4	6	8	10
	Power > 10 lbs	0	2	4	6	8	10		backward >5°, rotate >20°	0	2	4	6	8	10
Posture:	Flexed (holding)	0	2	4	6	8	10	<b>Activities</b>							
	Extended (straight)	0	2	4	6	8	10	Environmental:	Cold <60°F for	0	2	4	6	8	10
Contact Stress:	punch points	0	2	4	6	8	10		sedentary or <40°F light or						
<b>Wrist</b>															
Repetition:	4 - 20 motions/min	0	2	4	6	8	10		<20°F med heavy work						
	20 or more motions/min	0	2	4	6	8	10	Vibration:	localized	0	2	4	6	8	10
Force:	Flex or extend > 10 lbs	0	2	4	6	8	10		whole body	0	2	4	6	8	10
	Radial or Ulnar > 5lbs	0	2	4	6	8	10	Keyboard,	typing, data entry	0	2	4	6	8	10
Posture:	Flexed >20°	0	2	4	6	8	10	Mouse or push screen		0	2	4	6	8	10
	or extended >30°	0	2	4	6	8	10	TrackBall or Digital Device		0	2	4	6	8	10
	Radial or Ulnar noticeable	0	2	4	6	8	10	<b>Other</b>							
Contact Stress:	ie hammer in palm; utility knife in palm	0	2	4	6	8	10		yes	no					
<b>Forearm/Elbow</b>															
Repetition:	4 - 20 motions/min	0	2	4	6	8	10	Machine paced work?	yes	no					
	20 or more motions/min	0	2	4	6	8	10	Incentive pay or piece rate work?	yes	no					
Force:	Flex or extend > 10 lbs	0	2	4	6	8	10	Job rotation occurs?	yes	no					
	Rotation > 10 lbs	0	2	4	6	8	10	Task rotation occurs?	yes	no					
Posture:	Flexion >135° or Extension <15°	0	2	4	6	8	10	Constant job monitoring or direct management oversight?	yes	no					
	Rotation > 45°	0	2	4	6	8	10	Is there constant pressure to keep working?	yes	no					
Contact Stress:	ie lean on edge	0	2	4	6	8	10	Does there seem to be a rush or urgency about everything at work?	yes	no					
<b>Shoulder</b>															
Repetition:	4 - 20 motions/min	0	2	4	6	8	10	Unpleasant physical conditions like noise, dust, fumes, etc.	yes	no					
	20 or more motions/min	0	2	4	6	8	10	Poor lighting: bright or dark or glare computer	yes	no					
Force:	>45° from side or >10lbs	0	2	4	6	8	10	<b>Intervention</b>							
	90° from side >10 lbs	0	2	4	6	8	10	Work Station evaluation performed?	yes	no					
Posture:	45° side or unsupported	0	2	4	6	8	10	Job redesigned for ergonomic tasks?	yes	no					
	90° from side	0	2	4	6	8	10	MotionRisk Assessment completed?	yes	no					
Contact Stress:	ie lean on edge	0	2	4	6	8	10	Ergo Intervention completed?	yes	no					
<b>Instructions:</b>						<b>Definitions:</b>									
The CtdMAP uses three primary job assessment instruments labeled as Job Activities, Ergo Activities, and Essential Functions. Ergo Activities is a follow-up to Job Activities and is designed to convert the postural targeting method (qualitative) for estimating the job risk with objective numbers (quantitative).						Repetition: Intermittent if < 33% of work period or intensive if > 33% of work period or by the number of motions per minute									
Start by reviewing the essential functions of the job. Observe the use of the finger/hand, wrist, forearm/elbow, shoulder, and neck. Record sample times to estimate total hours of exposure for a typical work day for each anatomical area by activity type. Activity type is defined as repetition, force, posture, and contact stress as defined below.						Force: in pounds (lbs) for pinch or power and mm; include a posture for angle requirement									
Review the job and ask employee or employer for insight into the section "Other" and "Intervention" and select the appropriate "yes" or "no".						Posture: flexion, flexed means to bend or move down; extension, extend means to bend or move up; radial is thumb side; ulnar is little finger side; forearm rotation is supination/pronation (palm up/palm down)									
Remember, these are approximate hours of exposure. If you are unsure or can not decide between two numbers, select the larger number. For example between 4 or 6 select 6 hours. If unsure for "Other" select "yes" and for unsure for "Intervention" select "no" for this form.						Contact Stress: body; part leans against or rests on a sharp or narrow edge, tool held put pressure on finger/strand									
						Environmental: sedentary; work is <10lbs, light <20, med heavy; >75 lbs									
						Vibration: localized = holding onto part or tool, whole body = auto or plane									

# CTS - Causation

## 3. Obtain and assess the evidence of exposure

- The coolers weight is 15 lbs.
- Requires knife to cut of plastic tails
- Forceful grasping and repetition
- Machine paced

# CTS - Causation

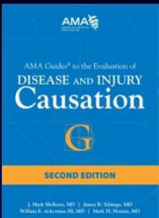
## 3. Obtain and assess the evidence of exposure

- Is this her only risk exposure?
- Hobbies – watches TV with grandkids
- ROS and comorbidities are negative

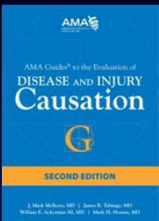
# CTS - Causation

**Table 4-2** Causation: Strength of Evidence Definitions

Evidence Level	Definition	If Work Related, Threshold Is Reasonable Medical Probability or > 50% Evidence Standard	If Work Related, Threshold Is Any Contribution, but Decision Is Evidence Based	If Apportionment of Risk Factor Creates Accepted Threshold, Making Case Legally Defined as Work Related
Very strong evidence (> 500) or strong evidence (300-500)	At least 3 studies with sufficient methodological quality agree that the factor is a risk factor for the disease, and the relative risk is > 2.0, <i>and</i> at least 2 high-quality prospective cohort studies agree	Yes	Yes	Likely large attributable proportion (> 50%) for occupational causation assuming significant exposure of the individual and few nonoccupational risk factors present
Some evidence (100-299)	Does not qualify for "strong evidence," yet at least 2 studies with sufficient methodological quality that generally agree that the factor is a risk factor for the disease, and the relative risk is > 2.0, <i>and</i> at least 1 of the studies is a high-quality prospective cohort study	Possible, depending on the level of individual's work exposures and number and magnitude of nonoccupational risk factors present	Yes	Apportionment of > 50% to the work exposure may or may not be opined depending on the magnitude(s) of individual's occupational exposures and number and magnitude of nonoccupational risk factors present



# CTS - Causation



**Table 4-7** Strength of Evidence of Causation in Epidemiologic Studies

<b>Evidence</b>	<b>Point Value</b>
Very strong	> 500
Strong	300-500
Some	100-299
Insufficient	< 100
Conflicted	See conflicted evidence
Insufficient risk	See insufficient risk



# CTS - Causation

## 4. Consider other relevant factors

- Age = very strong evidence
- BMI = very strong evidence
- Gender = very strong evidence = female
- Biopsychosocial factors = very strong evidence
- Diabetes = very strong evidence



# CTS - Causation

## 4. Consider other relevant factors

- Dominant hand = insufficient evidence
- Smoking = low evidence
- Genetic = very strong evidence
- Alcohol consumption = insufficient evidence
- Carpal tunnel size (ratio) = some evidence

# CTS - Causation

## 4. Consider other relevant factors

- Non occupational (gardening & knitting)  
= some evidence



# CTS - Causation

## 5. Judge the validity of testimony

- Patients says "the job is the cause"
- Job description by patient
- Job description by employer
- Video of job
- Onsite viewing of job

# CTS - Causation

## 5. Judge the validity of testimony

### Occupational risk factors

1. Combination of force & repetition, force & posture = very strong evidence
2. Highly repetitive work in combination = strong evidence
3. Forceful work = very strong evidence
4. Job satisfaction = some evidence

# CTS - Causation

5. Judge the validity of testimony

Nonoccupational risk factors:

1. Age = very strong evidence

2. BMI = very strong evidence

3. Gender = very strong evidence

4. Biopsychosocial factors = very strong evidence

# CTS - Causation

6. Form conclusions about the work-relatedness of the disease in the person undergoing evaluation.

- The scientific evidence would suggest that this individual has occupational and nonoccupational (individual) risk factors

# CTS - Causation

- So how to do you answer the original question –
- Is her work as a plastic production line employee the cause for her CTS for which you have recommend surgery?

# Carpal Tunnel Syndrome

## Confounders

- NIOSH case surveillance definition of CTS has created confusion with regard to risk factors
- Most retrospective studies based on symptoms



# Carpal Tunnel Syndrome

## Confounders

- Baseline prospective longitudinal study found female, age, and obesity not job
- Tenosynovium swelling? – does not match the pathology
- What is the mechanism of entrapment?

# Carpal Tunnel Syndrome

Ok

So how does a physician consider Carpal Tunnel Syndrome as caused by work

Back to the legal threshold definition and the onset of symptoms

# Carpal Tunnel Syndrome

## Summary

- Individual factors predominate
- Age, BMI, Gender, biopsychosocial, diabetes, genetic, wrist size

# Carpal Tunnel Syndrome

## Summary

- But
- Occupational risk factors
- Forceful grip in combination with repetition, awkward posture, job dissatisfaction, but not length of employment

# CTS - Causation

The Original Question  
was

Is this a compensable injury?

Yes vs No = you vote

# Keyboard - CTS



- What is the legal threshold?
- Yes

in my opinion based on the current information available and the legal threshold. However, I reserve the right to change my opinion if additional information is provided. (jmm)

# Keyboard - CTS



- What if 65 year old female, obese, diabetic, family history, legal secretary (types 2 hours per day, answers phones, greets people?)
- Occupational all low risk
- Individual = Age, BMI, gender, comorbidities = all high risk

# Keyboard - CTS



- What if 40 year old female, normal BMI, no comorbidities, legal secretary (types 2 hours per day, answers phones, greets people?)
- Occupational all low risk
- Individual = low risk = other factors?



# CTS - Causation

- Remember
- Medical – Science
- Legal – Social justice
- The judge has the final say.



# Causation Summary

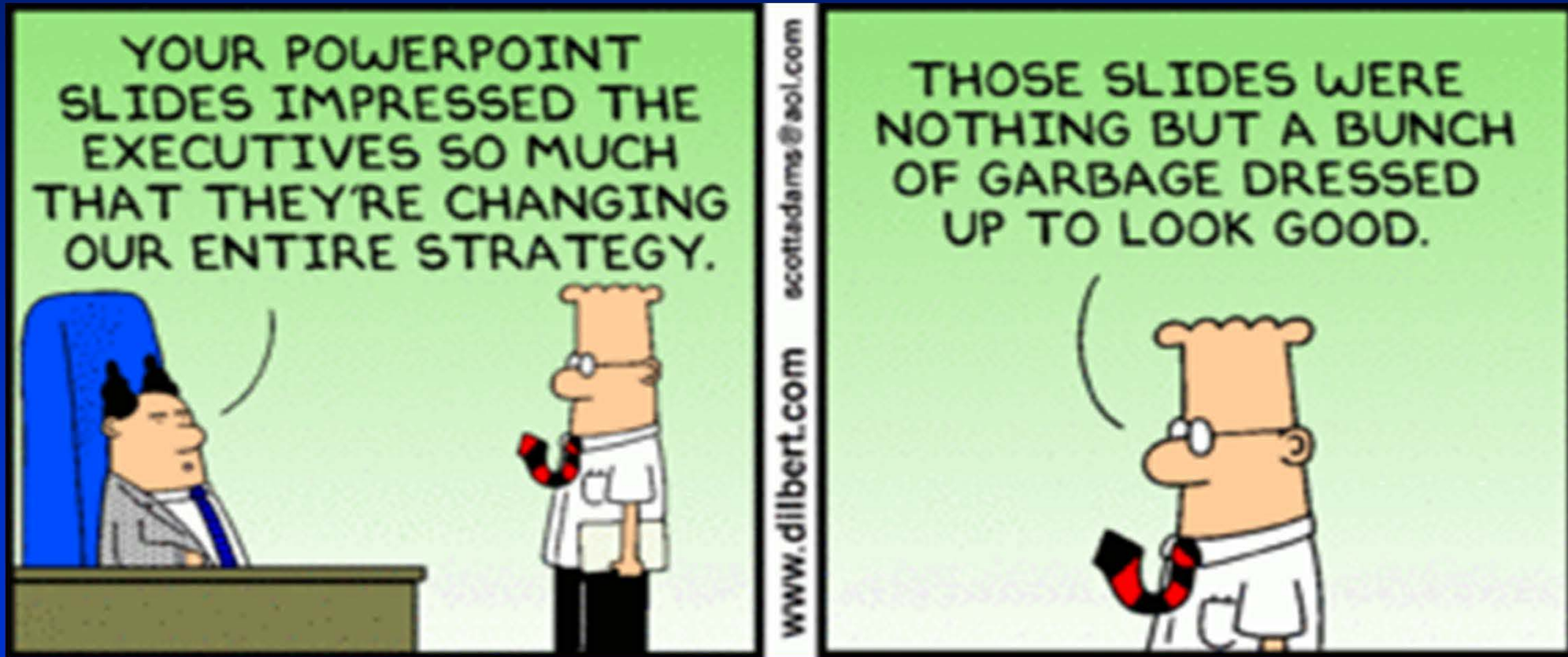
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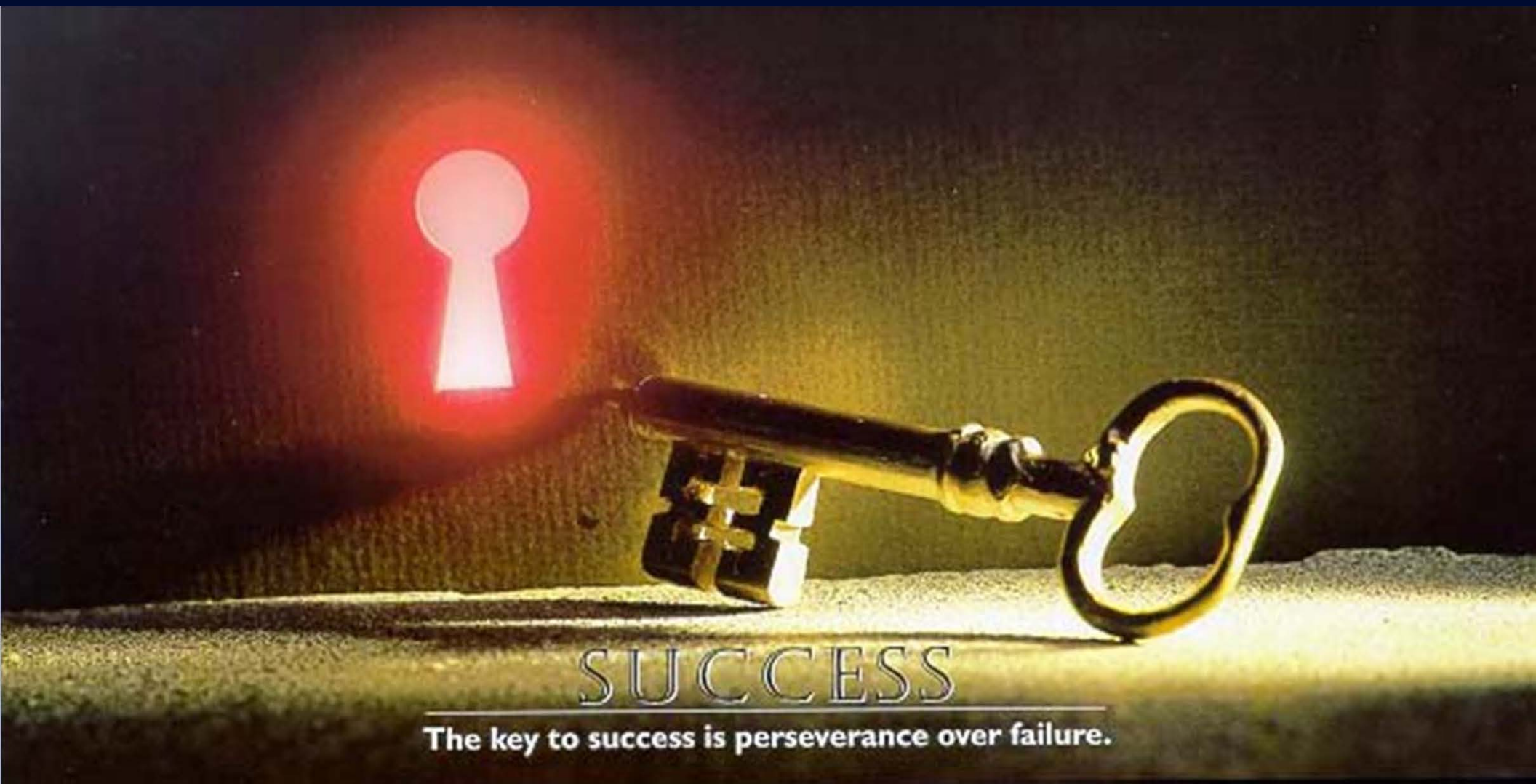
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# Thank You for Your Attention







# SUCCESS

The key to success is perseverance over failure.

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DRIVE  
CAREFULLY  
*Come Back*  
SOON

More to come

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