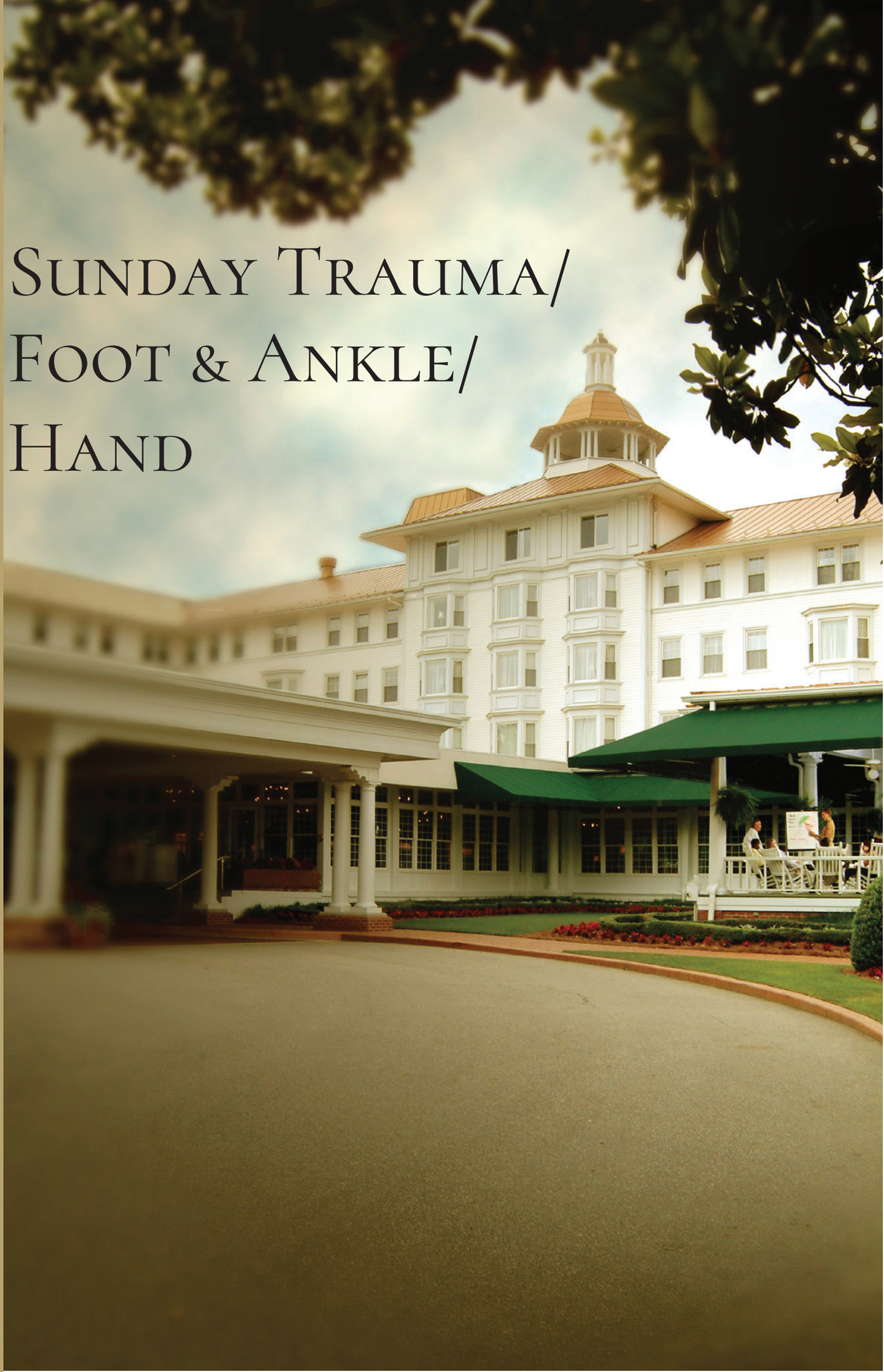
2016 NCOA Annual Meeting

Sunday Trauma/ Foot & Ankle/ Hand



Wake Forest®
School of Medicine

A Biomechanical Comparison of Intrapelvic and Extrapelvic Fixation for Acetabular Fractures Involving the Quadrilateral Plate

Kyle P. McNamara, BS[1,2]

Sharon Babcock, MD[1], Gregory J. Gillispie, MS[2], Philip J. Brown, PhD[2], Arun Aneja, MD[1], Joel D. Stitzel, PhD[2], Eben A. Carroll, MD[1]

[1]Department of Orthopaedic Surgery, Wake Forest School of Medicine

[2]Virginia Tech – Wake Forest Center for Injury Biomechanics

Financial Disclosures

Disclosures:

Sharon N. Babcock (N)

Gregory J. Gillispie (N)

Philip J. Brown (N)

Kyle P. McNamara (N)

Arun Aneja (N)

Joel D. Stitzel (N)

Eben A. Carroll (3B – DePuy Synthes; 3B Smith and Nephew)

FDA Status

Synthes 3.5mm low profile pelvic reconstruction plate approved for intended use

Elderly Acetabular Fractures

- Elderly represent fastest growing population of acetabular fractures
- Fractures result from low energy falls with lateral to medial loading of the proximal femur
- Most commonly anterior column, anterior column posterior hemitransverse, and associated both column fractures
- Morphology characterized by anterior column displacement, quadrilateral plate involvement, and anterocentral femoral head displacement

Elderly Acetabular Fractures

- Fractures involving the quadrilateral plate pose challenges to fixation
  - Insufficient bone stock
  - Close proximity to the articular surface
  - Location within the true pelvis
  - Poor bone quality in elderly

- Nonunion, loss of reduction, secondary displacement are all common modes of failure after fixation, especially in the elderly
- Dual plating techniques buttress the quadrilateral plate, neutralizing displacement, yet intrapelvic plating is technically more challenging and more invasive

Purpose

Evaluate the ability of extrapelvic and intrapelvic plating to withstand fracture redisplacement using a biomechanical model that recreates common modes of failure:

- Laying in bed with pressure on the lateral femur
- Repeat fall onto the greater trochanter
- Change in position from sit to stand

Cadaveric Specimens

10 fresh frozen specimens used

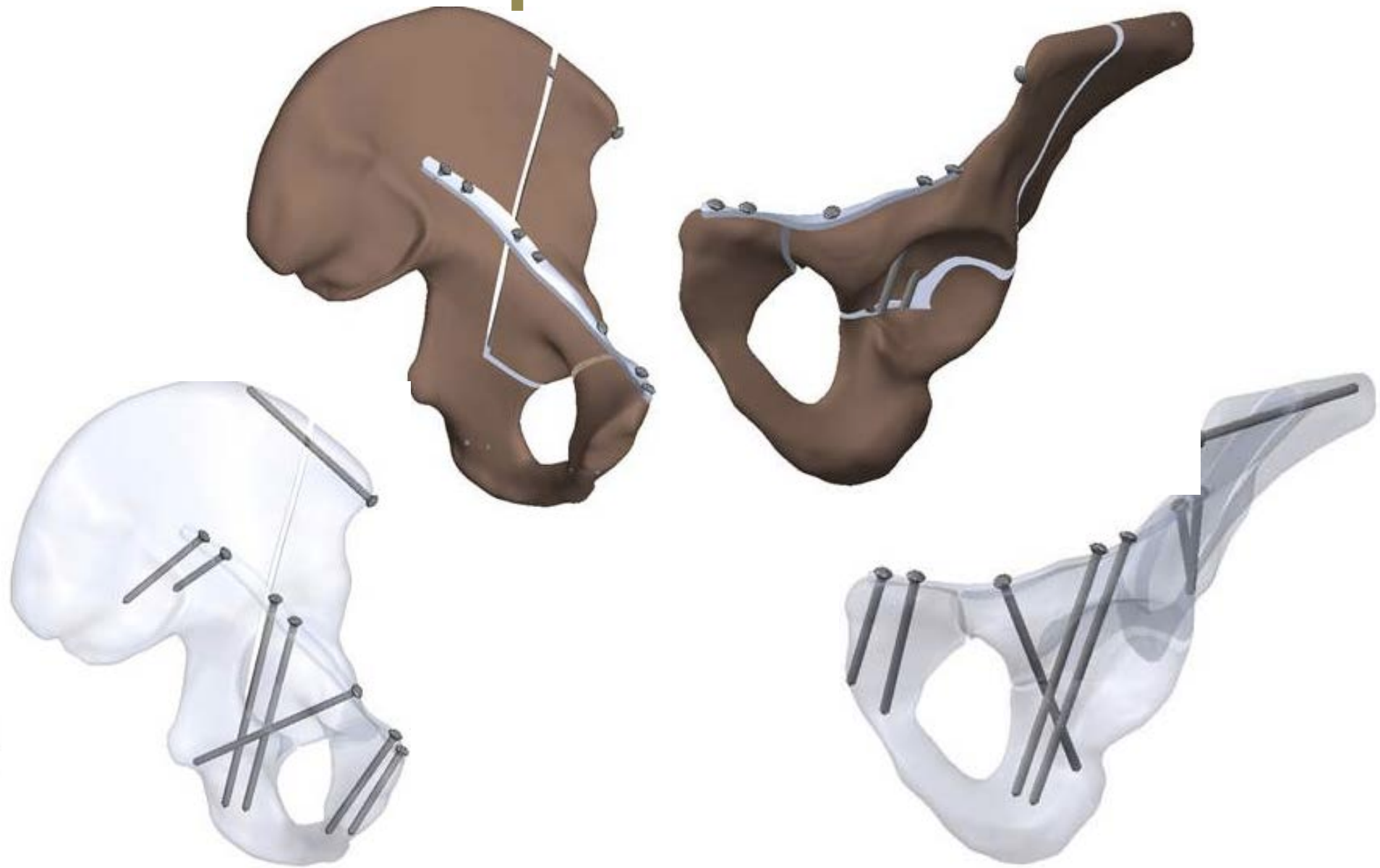
Quantitative CT for bone mineral density evaluation prior

Standardized fracture creation

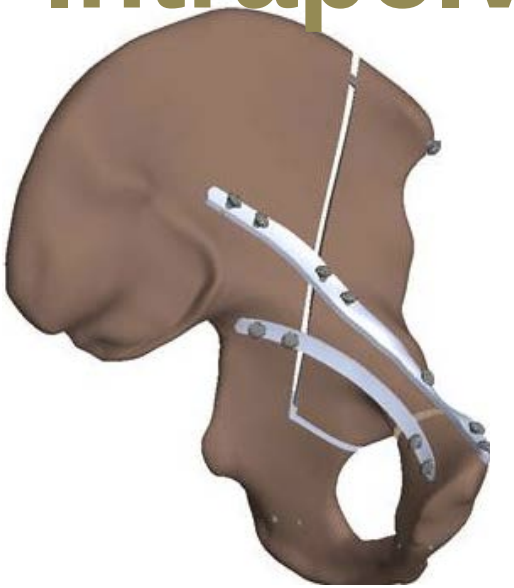
Specimen Demographics

	Weight (lbs)	Age	Height (in)	BMI
Average	171	76	66.7	27
St. Dev	89.3	9.3	4.2	13
Range	80-315	62-89	59-72	15-48

Extrapelvic Fixation



Intrapelvic Fixation



Biomechanical Testing

MTS loading using acetabular trial cups recreating force vector for failure

Parameters Tested at 50% Body Weight

- Displacement at 50% BW
- Stiffness at 50% BW
- Failure Stiffness
- Yield Point Force & Displacement

Parameters Tested at Failure

- Maximum Force
- Displacement at Maximum Force
- Final Displacement
- Force at Clinical Failure
- Elastic Energy
- Plastic Energy

Results

	Displacement at 50% BW (mm)	Stiffness at 50% BW (N/mm)	Failure Stiffness (N/mm)	Yield Displacement (mm)
Extrapelvic Average	1.25 (0.76)	291 (154)	326 (182)	4.9 (1.4)
Intrapelvic Average	0.94 (0.33)	330 (143)	404 (188)	5.1 (1.1)
% Difference	28.3%	12.6%	21.4%	4.0%
P-value	0.089	0.216	0.063	0.366

Those with **intrapelvic fixation** showed less displacement and greater stiffness, although not statistically significant; there was a trend towards significance in failure stiffness for intrapelvic fixation.

Results

	Force at Clinical Failure (N)	Yield Force (N)	Maximal Force (N)	Elastic Energy (kJ)	Plastic Energy (kJ)
Extrapelvic Average	640 (334)	1266 (787)	1608 (896)	3.56 (2.62)	25.89 (14.34)
Intrapelvic Average	787 (337)	1594 (688)	2128 (832)	4.56 (2.38)	38.15 (17.35)
% Difference	20.6%	22.9%	27.8%	24.6%	38.3%
P-value	0.056	0.011	<0.001	0.075	<0.001

Intrapelvic fixation outperformed extrapelvic fixation in all metrics. Statistical significance reached for **yield force, maximal force,** and **plastic energy.**

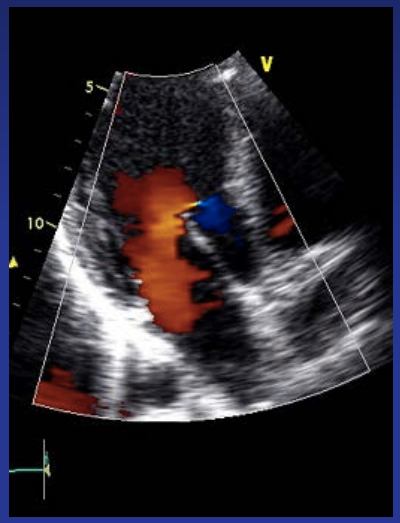
Conclusions

- Early loss of reduction remains area of concern following elderly acetabular fracture fixation
- During this period of nonweight bearing patients are unlikely to experience high loads across the fracture
- 50% BW testing mimics load upon acetabulum with patient laying on side in bed
- Our data indicated that the addition of **intrapelvic fixation** along the quadrilateral plate **offers advantages** to construct strength.

Conclusions

- Intrapelvic buttress plating along the quadrilateral plate **contributes significantly to resist catastrophic failure.**
- Statistically significant values were reached at loads >1000N, which represents the force sustained after a **fall onto the repaired side**.
- The addition of an **intrapelvic plate** should **decrease the likelihood of catastrophic failure and redisplacement** in fall scenarios.

Can Evidence-Based Guidelines Decrease Unnecessary Echocardiograms for Pre-Operative Evaluation of Hip Fracture Patients?



Chris Adair MD, Eric Swart MD, Rachel Seymour PhD, Joshua Patt MD, Madhav Karunakar MD

Disclosures

- Nothing to disclose

Background

- Hip fractures = Medically frail
- Preoperative medical optimization is important
  - TTEs resource intensive
- CPGs exist
  - Developed for elective surgery

Purpose

Evaluate TTE utilization in hip fractures

1. How often are CPGs followed?
2. Do they change management?
3. Can CPGs help us decide who needs TTE?

Methods

- Retrospective review
- Geriatric hip fracture patients (N=100)
  - TTE performed

Evaluate TTE utilization in hip fractures

1. How often are CPGs followed?
2. Do they change management?
3. Can CPGs help us decide who needs TTE?

How often are CPGs followed?

- ACC/AHA guidelines
  - Known cardiac disease without TTE within last year
  - Known cardiac disease with worsened signs or symptoms
  - Suspicion of moderate or severe valvular disease (murmur on exam)
  - New heart failure signs or symptoms

Evaluate TTE utilization in hip fractures

1. How often are CPGs followed?
2. Do they change management?
3. Can CPGs help us decide who needs TTE?

Do they change management?

- TTE reports reviewed for cardiac pathology
  - New left ventricular systolic or diastolic dysfunction
  - Moderate or severe valvular disease
  - Pulmonary hypertension

Affects anesthesia dosing, fluid management

Affects fluid management

Affects anesthesia delivery

Evaluate TTE utilization in hip fractures

1. How often are CPGs followed?
2. Do they change management?
3. Can CPGs help us decide who needs TTE?

Can CPGs help us decide who needs TTE?

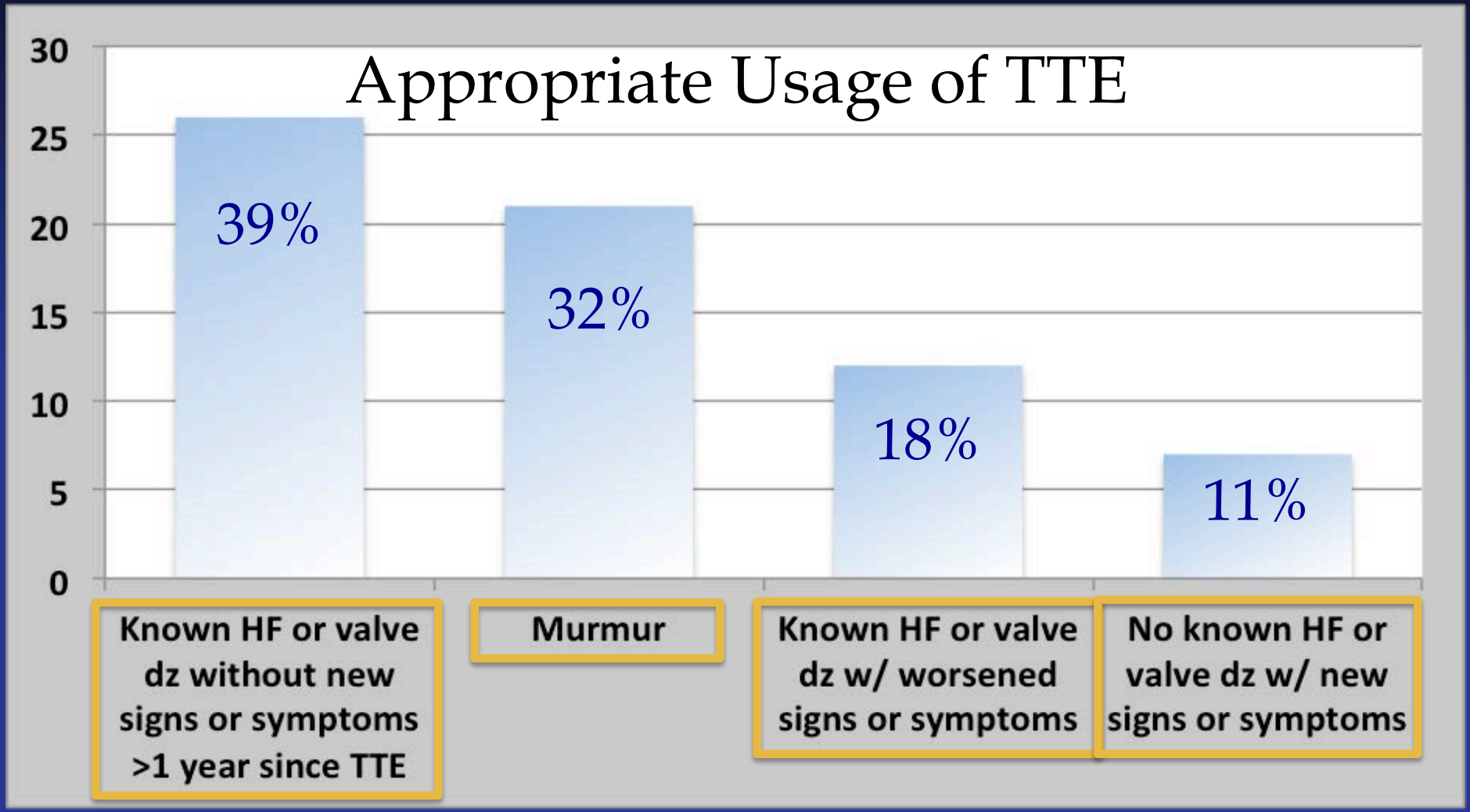
Can CPGs help us decide who needs TTE?

- CPGs as screening tool
- Sensitivity and Specificity

High rate of "True Negative"

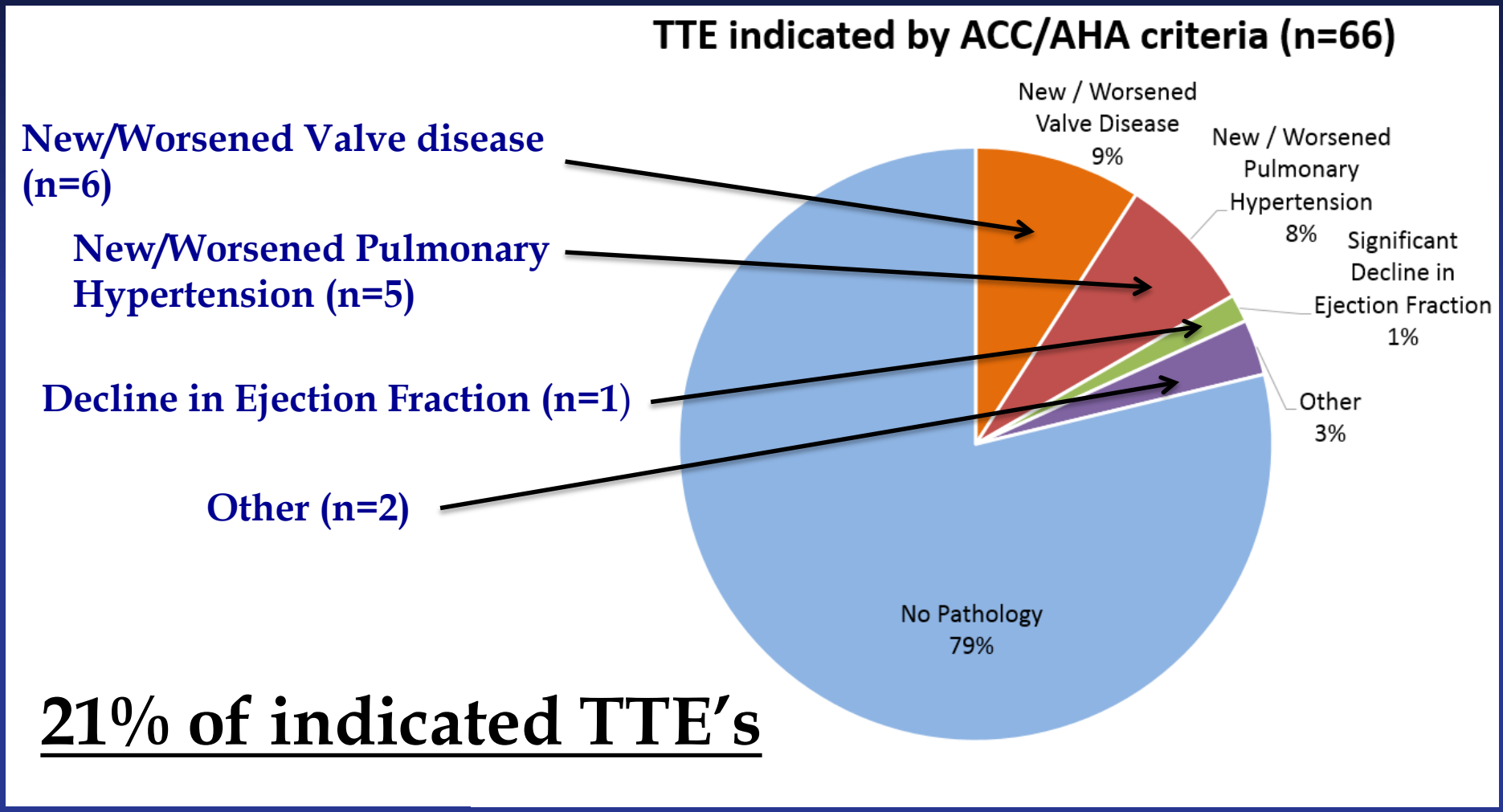
Results - How often are CPGs followed?

66% of TTEs met criteria from ACC/AHA guidelines



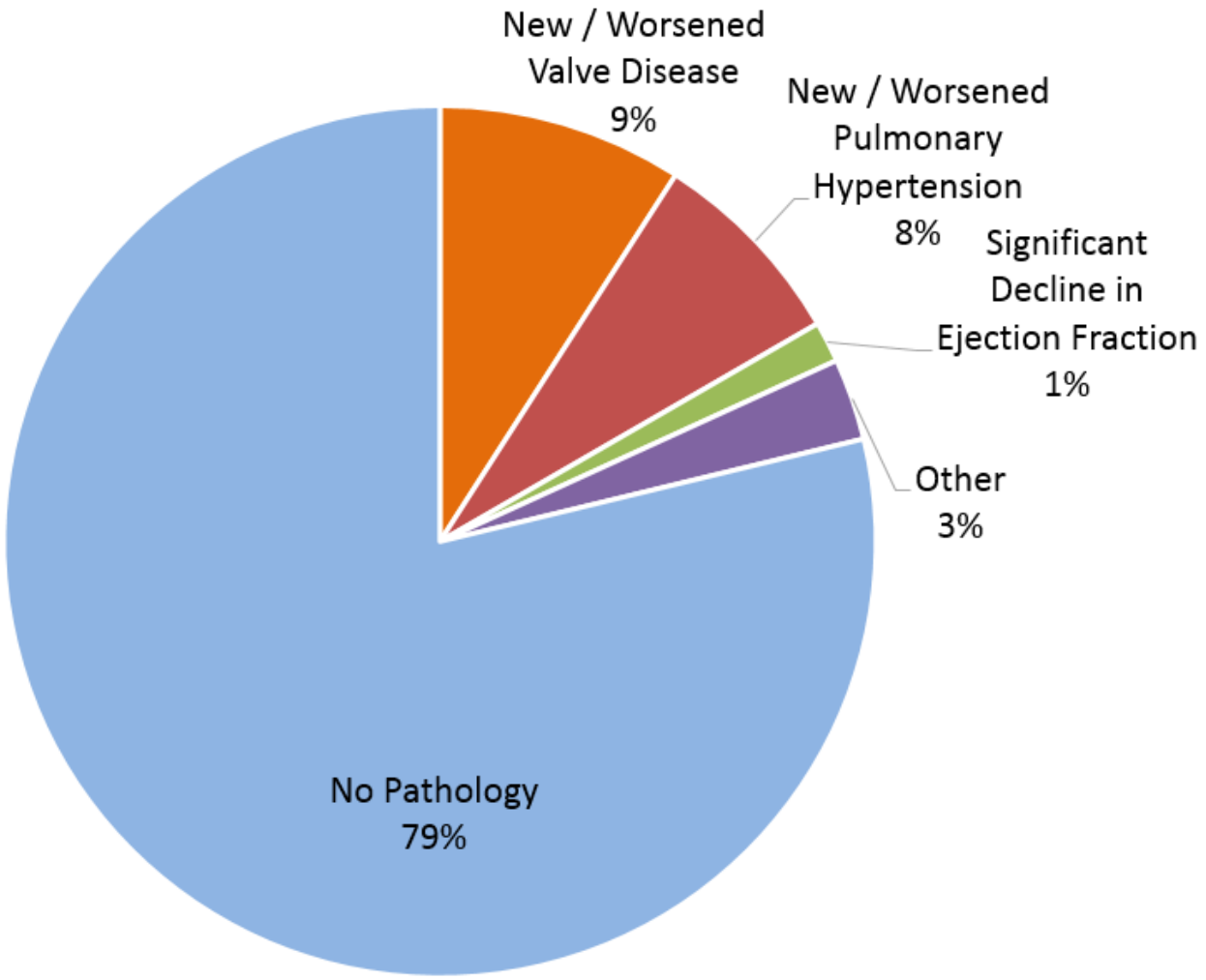
Results - Do they change management?

- **14% of TTEs revealed significant pathology**
- **No pathology in unindicated TTEs**



21% of indicated TTE's

TTE indicated by ACC/AHA criteria (n=66)



Results - Can CPGs help us decide who needs TTE?

2x2 Table	+ Cardiac Pathology	- Cardiac Pathology
TTE indicated	14	52
TTE unindicated	0	34

Sensitivity

Specificity

Results - Can CPGs help us decide who needs TTE?

2x2 Table	+ Cardiac Pathology	- Cardiac Pathology
TTE indicated	14	52
TTE unindicated	0	34

- **100% Sensitivity**
  - **0% of patients had missed pathology**

Results - Can CPGs help us decide who needs TTE?

2x2 Table	+ Cardiac Pathology	- Cardiac Pathology
TTE indicated	14	52
TTE unindicated	0	34

- **40% Specificity**
  - Following CPGs could reduce unnecessary TTEs by 34% without missed pathology

Conclusions

- **Pre-operative TTEs in geriatric patients with hip fractures are frequently ordered outside the recommendations of established CPGs**
- **When ordered according to CPGs, TTEs may find pathology that could change management (21%)**
- **Following ACC/AHA guidelines could reduce unnecessary TTE utilization by 34% without increased risk of missed pathology**

Thank You

Wake Forest®
School of Medicine

Risk factors for 30-day readmission following operative management of geriatric hip fractures

Austin V. Stone MD, PhD[1]; **Alexander Jinnah, MD[1]**; Brian J Wells, MD, PhD[2, 3, 4]; Hal Atkinson, MD[5]; Wendell M. Futrell[2], Anna N. Miller, MD[1]; Cynthia L. Emory, MD

Introduction

- Increasing prevalence of hip fractures in the elderly due to growing elderly population
- Osteoporosis and associated hip fractures carry a high morbidity and mortality for patients
- Early readmission (within 30 days) nearly doubles the 1 year mortality of patients after undergoing operative fixation
- The growing epidemic of hip fractures results in substantial healthcare burden in the US population
- The purpose of this quality improvement (QI) project was to study risk factors for all cause 30-day readmission after treatment of a hip fracture to identify future areas for QI intervention
- We hypothesized that pre-injury nutritional status would predict 30 day readmission following operative management of an isolated hip fracture

Methods

- Patients admitted to our institution between January 2013 and April 2015 with primary diagnosis of a hip fracture were retrospectively reviewed
- Patients who sustained multiple injuries, or were re-admitted to the hospital for less than 24 hours were excluded
- Demographics, pre-injury laboratory values, and socioeconomic indicators were used in a univariate analysis to identify significant risk factors
- A multivariate regression model was then created with predictor variable ranking

Results

- 616 patients were identified and met the inclusion criteria.
- Mean age was 79 years and 372 (60%) were female
- 81 (13%) were readmitted within a 30-day period of discharge
- No significant differences in the readmission group compared to the control group in age, gender, or body mass index
- The type of fracture did not significantly influence readmission
- Patients who were readmitted within 30 days demonstrated significantly lower pre-injury hemoglobin, albumin, and pre-albumin levels than the control group
- Significant predictors within the regression model in order of most to least importance were the baseline pre-albumin, hemoglobin, median income, creatinine, white blood cell count, albumin and total protein.

Discussion

- A systematic review and meta-analysis looked at six studies evaluating the effect of albumin levels on short term mortality and postoperative complications

Rehospitalization After Hip Fracture: Predictors and Prognosis from a National Veterans Study

Dustin D. French, PhD, Elizabeth Bass, PhD,* Douglas D. Bradham, DrPH,†‡ Robert R. Campbell, JD, MPH, PhD,* and Laurence Z. Rubenstein, MD, MPH§‖*

- Short term mortality and post-operative complications were increased with low pre-injury serum albumin (≤ 34 g/l)

Conclusion

- Our results indicate:
  - Nutritional status is among the most important and potentially modifiable risk factors for 30-day readmission after operative management of hip fractures
- Based on our results we postulate that improved nutritional status may decrease the risk for 30-day readmission following a hip fracture

Acknowledgements

- The authors would like to thank Jan Lawlor, Section on Gerontology and Geriatric Medicine, Department of Internal Medicine, for her assistance with research coordination. The authors would also like to express their gratitude to the Donald W. Reynolds Foundation for financial support.

References

1. French DD, Bass E, Bradham DD, Campbell RR, Rubenstein LZ. Rehospitalization after hip fracture: predictors and prognosis from a national veterans study. *Journal of the American Geriatrics Society.* 2008;56:705-710.

2. Rosell PA, Parker MJ. Functional outcome after hip fracture. A 1-year prospective outcome study of 275 patients. *Injury.* 2003;34:529-532.

3. Lau TW, Fang C, Leung F. The effectiveness of a geriatric hip fracture clinical pathway in reducing hospital and rehabilitation length of stay and improving short-term mortality rates. *Geriatric orthopaedic surgery & rehabilitation.* 2013;4:3-9.

4. Haentjens P, Magaziner J, Colon-Emeric CS, et al. Meta-analysis: excess mortality after hip fracture among older women and men. *Annals of internal medicine.* 2010;152:380-390.

5. Zuckerman JD. Hip fracture. *The New England journal of medicine.* 1996;334:1519-1525

Questions

Increased rates of osteomyelitis, decreased rates of transfusion with temporizing skeletal traction in an elderly population; a retrospective study of Medicare claims data

NCOA Annual Meeting

Katie Dederer MD; Edward Jernigan MD; Robert Ostrum MD;
Josh Tennant MD, MPH

Disclosures

None

Background

- Skeletal traction commonly used
- Data on benefit and complications is sparse

Review Article

Review of Lower Extremity Traction in Current Orthopaedic Trauma

Journal of the AAOS
AMERICAN ACADEMY OF ORTHOPAEDIC SURGEONS

- "…traction remains one of the founding pillars of fracture care. Despite its steady use throughout medicine, however, the treatment lacks relevant scientific evidence." [1]

[1] Matullo et al. *JAAOS.* Sept 2016

Traction pins and osteomyelitis

- Case reports of osteomyelitis after traction pin [2–4]
- May take up to several years for osteomyelitis to manifest
  - One report arising 20 years after temporizing traction placed [3]

[2] Green et al, *JBJS* 1984. [3] Vaishya et al, *BMJ Case Rep* 2014. [4] Courvoisier et al *Orthop Traumatol Surg Res* 2011

Hypothesis

- Rate of tibial osteomyelitis will be higher in patients with femur fractures treated with temporizing skeletal traction vs those treated with skin traction
- Rate of blood transfusion will be lower in patients with femur fractures treated with temporizing skeletal traction vs those treated with skin traction

Methods

- Pearldiver Medicare Standard Analytical Files Database (PearlDiver Technologies, Inc., West Conshohocken, PA)
  - insurance claims-based database of patient records
  - contains over 51 million patients from 2005-2012.
- International Classification of Disease, 9th Revision (ICD-9) codes were used to identify patients for study based on codes for specific diagnoses and procedures

Study Population

- Closed fractures only
- Intertrochanteric femur fractures (ICD-9 820.01)
- Subtrochanteric femur fractures (ICD-9 820.02)
- Femoral shaft fractures (ICD-9 821.0)

- Closed or open reduction, internal fixation (ICD-9 79.15, 79.35) **within 2 days of the fracture**

Study Groups

- Skeletal traction (ICD-9 93.44)
- Skin traction (ICD-9 93.46)

Risk factors for osteomyelitis

- Age
  - Available as categorical data
- diabetes (250.00–250.99)
- peripheral vascular disease (440.20–440.29)

Outcomes

- tibial osteomyelitis after surgery (730.06, 73016, 73026).
  - Assumption: traction pins for femoral fractures would have been placed in tibia
- packed red blood cell transfusion within 7 days of surgery (99.04)

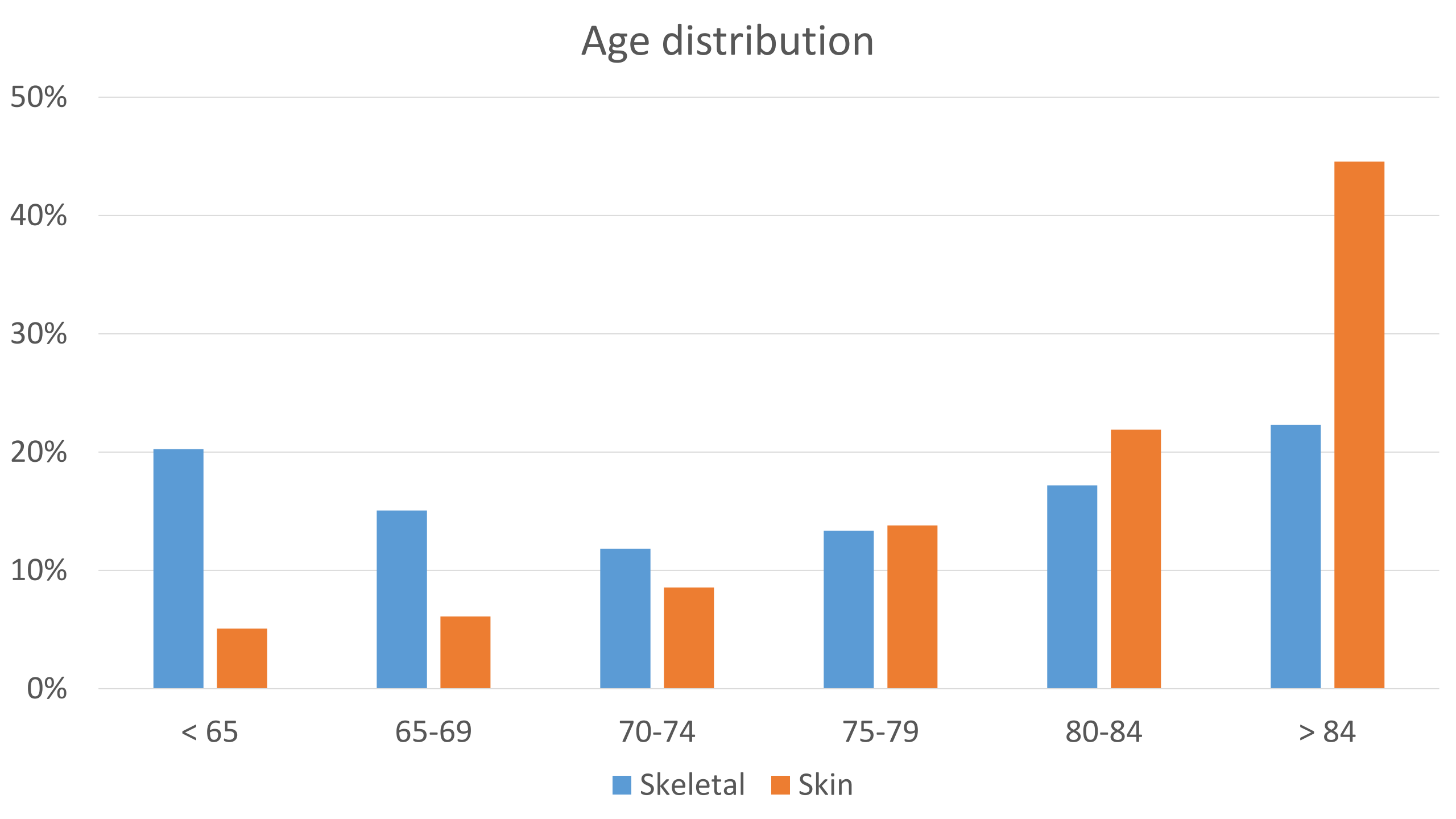
Statistical Analysis

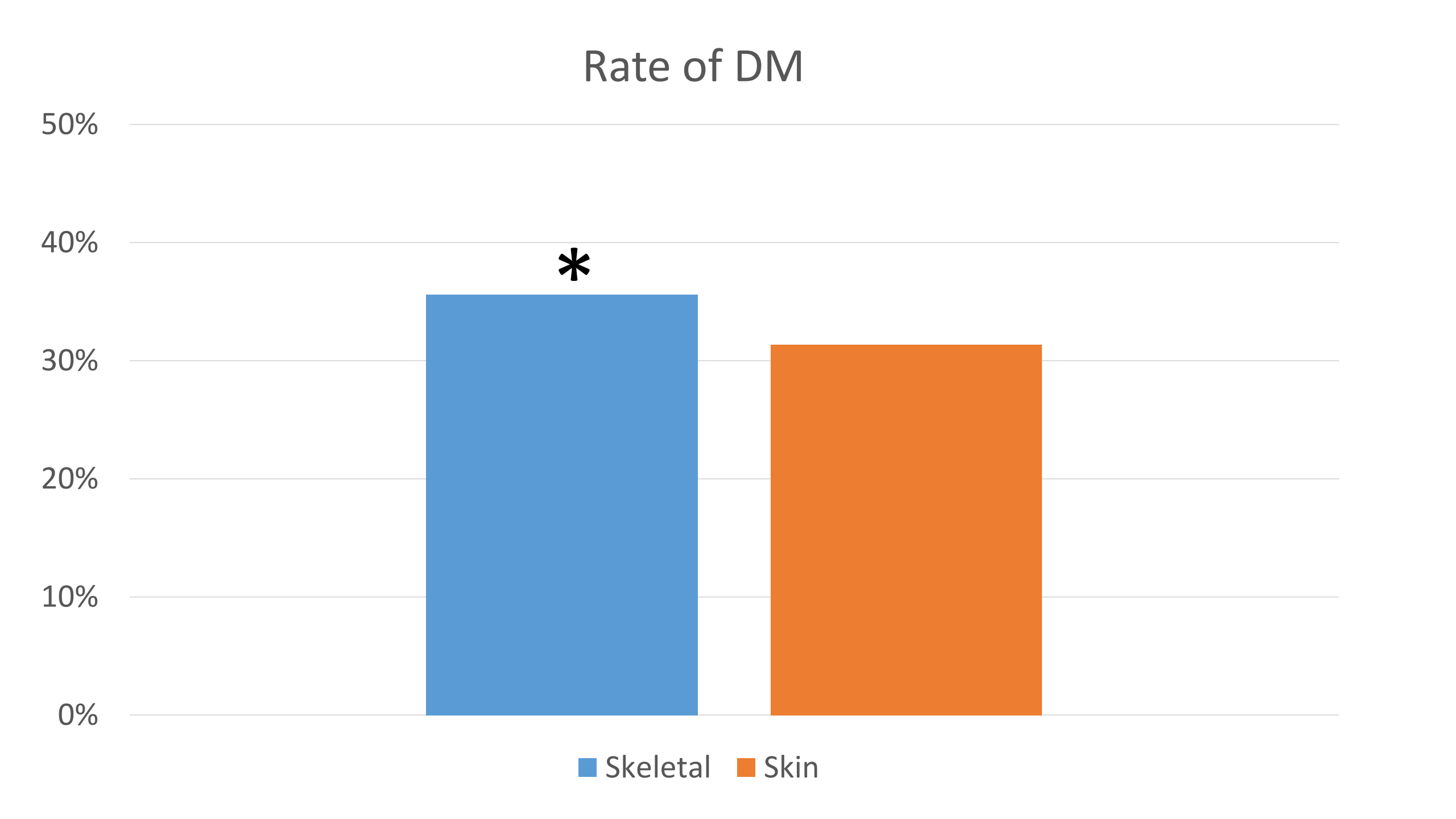
- Pearson chi-squared analysis
- $p < 0.05$ was considered significant
- Reported relative risk (RR) values were calculated with respective 95% confidence intervals (CIs)

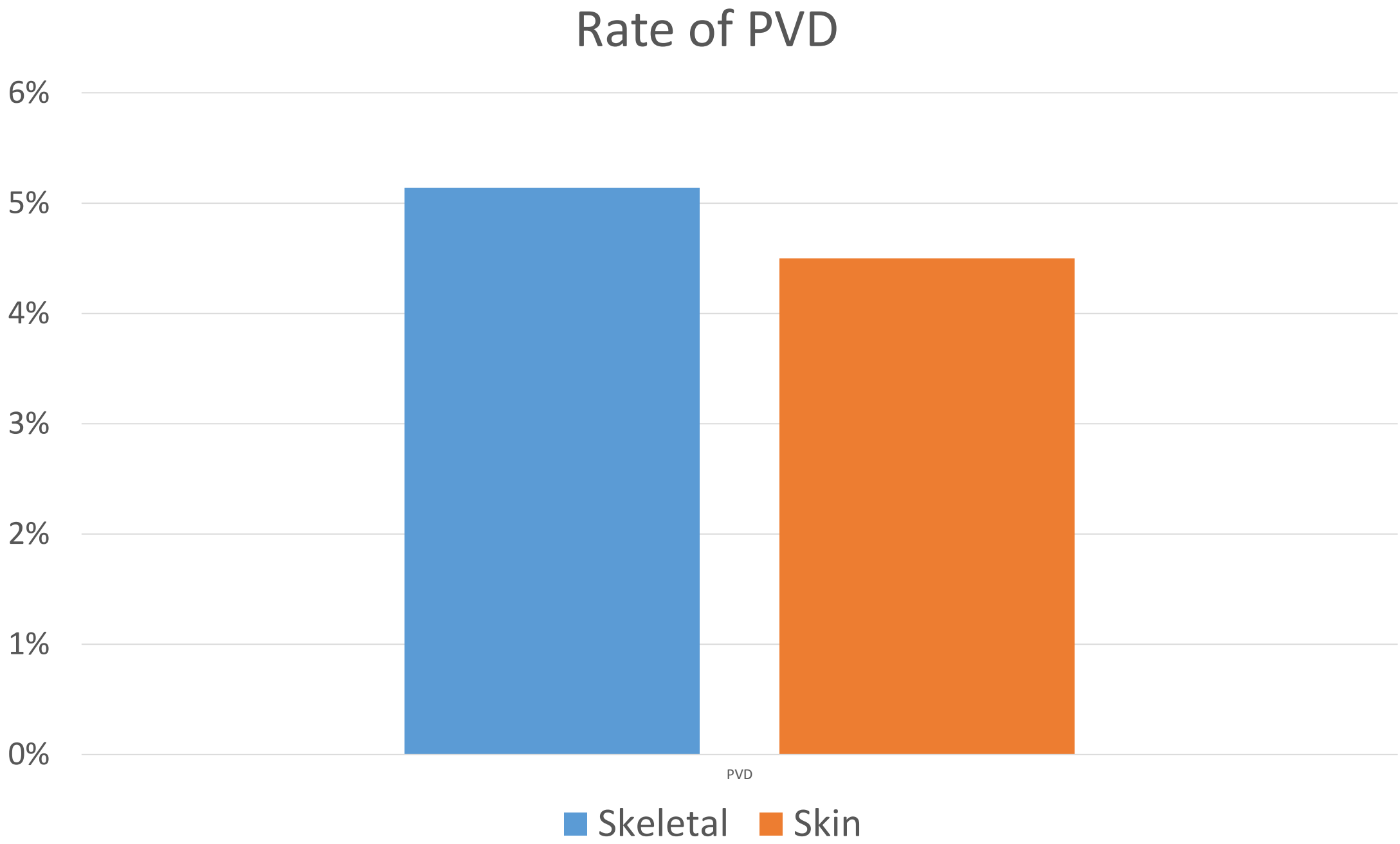
Results

- Skeletal traction:
- Skin traction:
- Total patients with osteomyelitis: 37

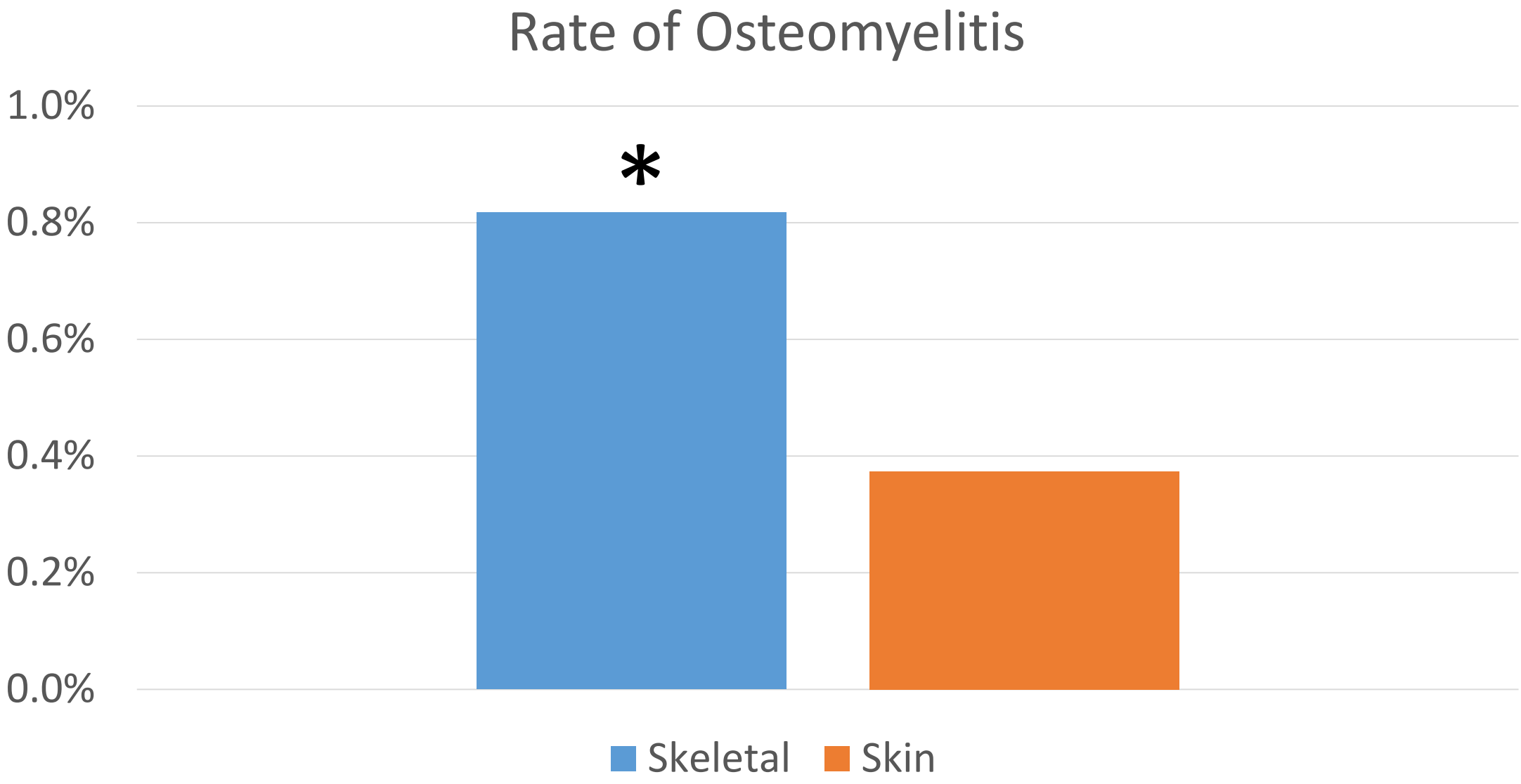
	Skeletal traction	Skin traction	p-value
Total patients	1713	6160	-
Gender (M/F)	688 (40.5%) / 1011 (59.5%)	1581 (26.0%) / 4493 (74.0%)	< 0.001
Age > 75	898 (52.3%)	4878 (80.3%)	< 0.001
Diabetes	610 (35.6%)	1931 (31.3%)	< 0.001
Peripheral vascular disease	88 (5.1%)	277 (4.5%)	0.265

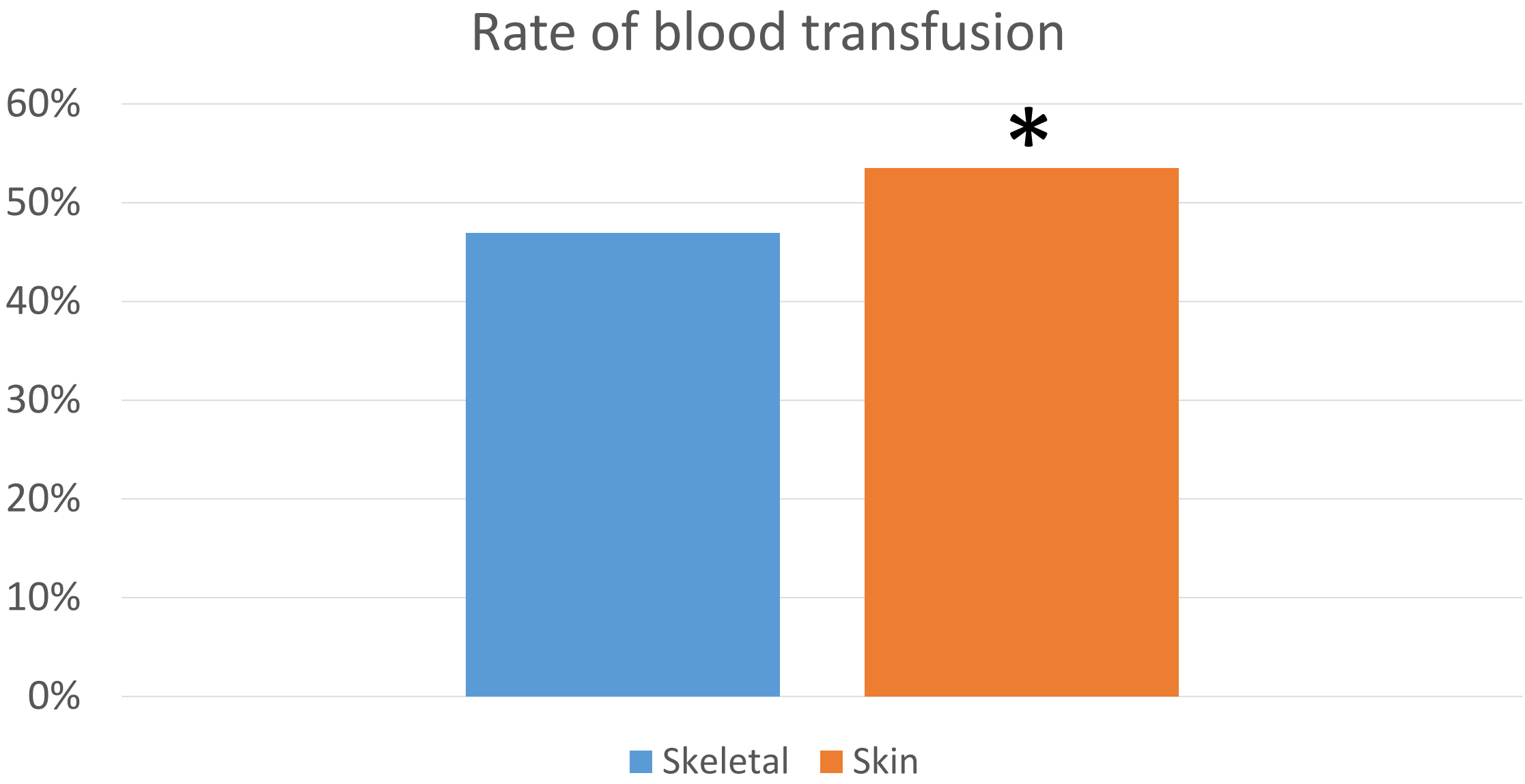

Age distribution
50%
40%
30%
20%
10%
0%
< 65
65-69
70-74
75-79
80-84
> 84
Skeletal
Skin

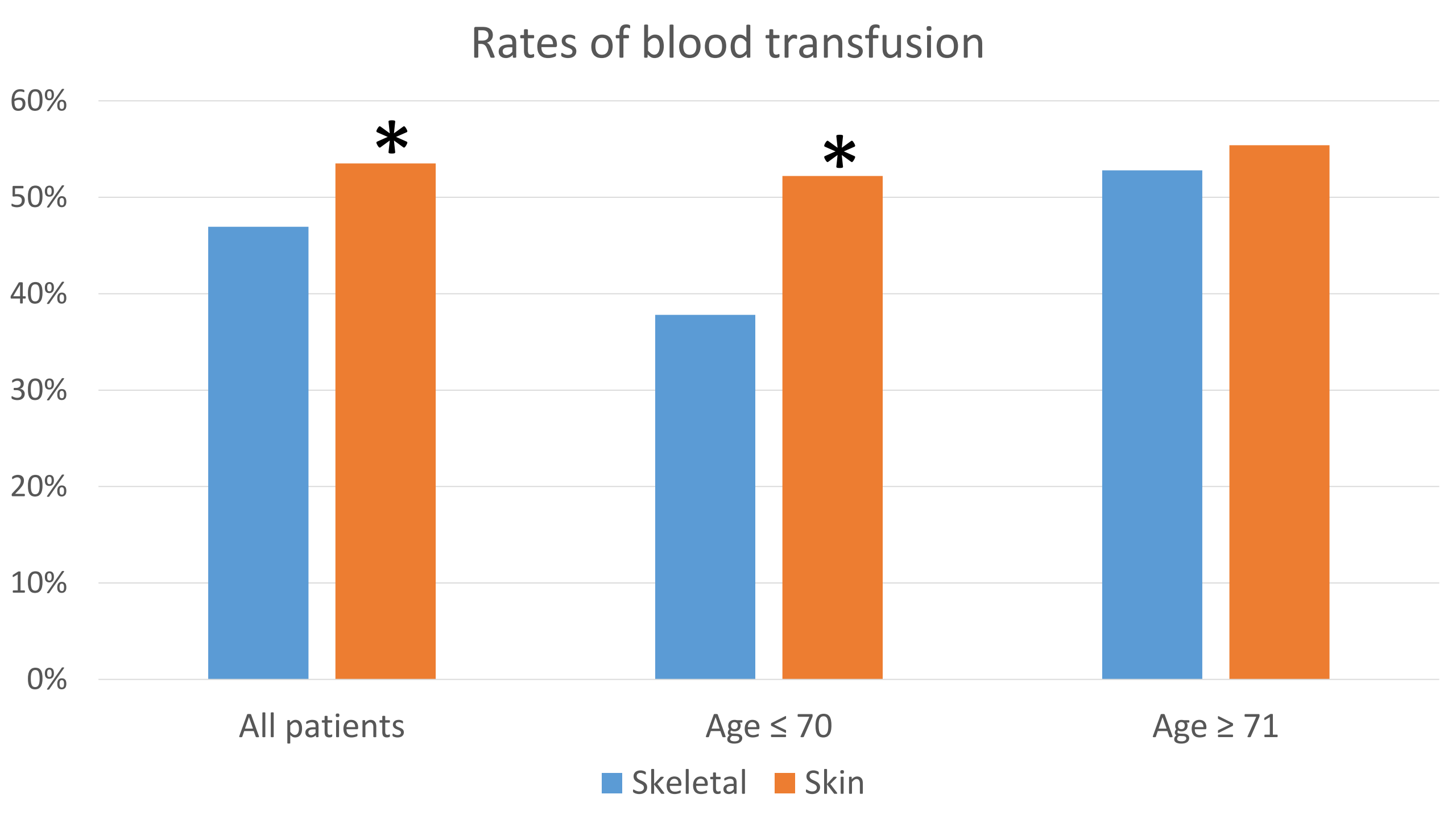

Rate of DM
50%
40%
30%
20%
10%
0%
*
Skeletal
Skin


Rate of PVD
6%
5%
4%
3%
2%
1%
0%
PVD
Skeletal
Skin

	Skeletal traction	Skin traction	Total	Relative risk (95% CI)	p-value
Tibial osteomyelitis	14 (0.82%)	23 (0.37%)	37 (0.47%)	2.18 (1.12 - 4.24)	0.018 *
Transfusion pRBC	804 (46.9%)	3296 (53.5%)	4100 (52.1%)	0.87 (0.83 - 0.93)	< 0.001*


Rate of Osteomyelitis
1.0%
0.8%
0.6%
0.4%
0.2%
0.0%
*
Skeletal
Skin


Rate of blood transfusion
60%
50%
40%
30%
20%
10%
0%
*
Skeletal
Skin


Rates of blood transfusion
60%
50%
40%
30%
20%
10%
0%
*
*
All patients
Age ≤ 70
Age ≥ 71
Skeletal
Skin

Discussion

- Skeletal traction: weighing the risks and benefits

Strengths

- Large number of patients treated with traction
- Presumably long f/u due to nature of Medicare insurance coverage
- Patients not randomized, but no difference in Charlson Comorbidity Index
- Presence of a control group (skin traction)
  - Pts with fractures deemed appropriate for traction by their treating team

Limitations

- Database design
- Reliance on coders, not physicians
- Medicare Standard Analytical Files do not allow for groups of less than 11 pts to be quantified in order to protect confidentiality
  - Limits ability to examine and report specific characteristics of individual cases of osteomyelitis
  - Chart review not possible

Limitations

- Unable to study other purported benefits of traction
  - Decreased surgical time?
  - Increased patient comfort?

- Elderly patient population
  - Younger patient population → ideal
  - Traction used less frequently in elderly populations
  - Recent Cochrane review recommends against traction in elderly patients

Directions for future study

- Younger patients
  - Would be challenging to use insurance database study in US due to patients frequently changing insurance coverage
  - European registries?
- Prospective, randomized data would be challenging

Conclusions

- Overall rate of osteomyelitis after skeletal traction is low (<1%)
- Skeletal traction → higher rate of tibial osteomyelitis in patients with femur fractures (~2x higher than skin traction)
- Skeletal traction → Lower transfusion rates
  - For the younger subgroup (< 71 years old) only

References

- 1. Matullo K, Gangavalli A, Chineye N. Review of Lower Extremity Traction in Current Orthopaedic Trauma Journal of the American Academy of Orthopaedic Surgeons:September 2016 - Volume 24 - Issue 9 - p 600-606.
- 2. Green SA, Ripley MJ. Chronic osteomyelitis in pin tracks. J Bone Joint Surg Am 1984;66:1092-1098.
- 3. Vaishya R, Vaish A. Ring sequestrum of the tibia. BMJ Case Rep 2014;2014:10.1136/bcr-2013-201837.
- 4. Courvoisier A, Grimaldi M, Rubens-Duval B, Chaussard C, Saragaglia D. Flare-up of previously quiescent chronic osteomyelitis 20 years after childhood skeletal traction: a report of two cases. Orthop Traumatol Surg Res 2011;97:886-889.

Eliciting Patient Preferences on Treatment of an Achilles Tendon Rupture

Duke Clinical Research Institute
&
Duke Department of Orthopaedics, Duke University Medical Center

Background

- Preference study will:
  - Provide quantitative evidence on patients' willingness to accept tradeoffs among treatment features and outcomes
  - Provide intuitive preference measures to support regulatory and reimbursement decisions
- Choice-Format Conjoint-Analysis Methods:
  - Also known as discrete-choice experiments or stated-choice surveys
  - Alternatives consist of combinations of attributes
  - Preferences among alternatives depend on the relative importance of attributes
  - Subjects state preference for series of constructed treatment alternatives
  - Choice questions identify trade-off relationships

Attribute Selection

- Attributes
  - Must be clinically relevant and/or of concern to patients
  - Must be meaningful and salient to study respondents
  - Must be independent of each other or specified as compound attributes
- Attribute levels
  - Must be generalizable to clinical trial data wherever possible
  - For equivalence calculations use maximum range over which respondents are willing to accept tradeoffs (often larger than clinically relevant values)
- Number of attributes and levels influences
  - Statistical precision for given sample size
  - Cognitive burden and measurement error
- General rules of thumb
  - Maximum of 5 – 8 treatment attributes
  - 2 – 4 levels for each attribute
    - Linear model: 2 levels
    - Nonlinear model: at least 3
    - Cost and risk: argument for 4

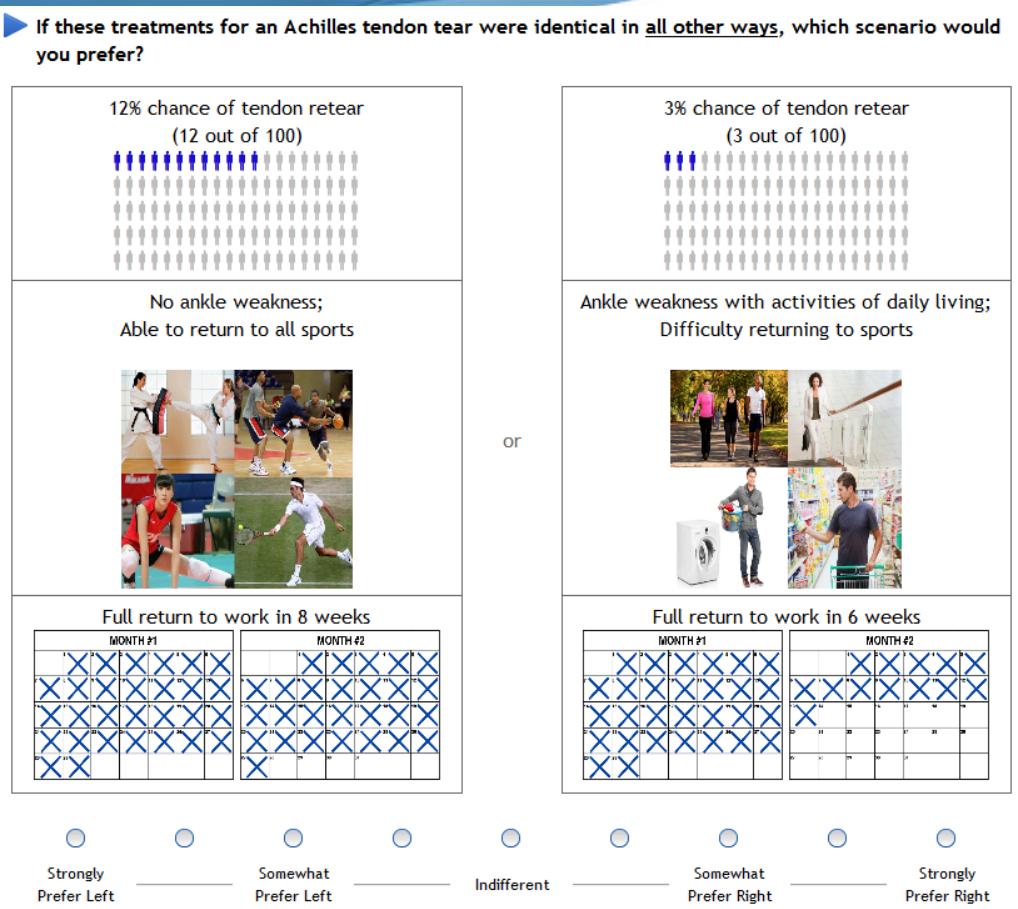
Possible Analytical Products

- Basic analysis
  - Internal validity tests
  - Log-odds relative preference weights for all attribute levels (conditional and mixed logit).
  - Effects of individual characteristics
  - Predicted choice probabilities for AD profiles relative to specified comparators
  - Maximum acceptable risk, minimum acceptable benefit, and time equivalents.
- Advanced analysis
  - Latent-class models, including non-attendance models
  - Hierarchical Bayes
  - Error-components analysis

Survey Iteration I

Introduction

- Goal/Clinical Question: To measure patient preferences in regard to treatment options for an Achilles tendon tear
- 10 ACA Pairs questions
  - Sawtooth Software programming and analysis
  - First 5 questions compared 3 attributes vs. 3 attributes
  - Last 5 questions compared 4 attributes vs. 4 attributes
- Total of 300 mTurk respondents



Achilles Rupture Survey: Attributes & Levels

1. **Chance of tendon re-tear**
   a. 3% chance of tendon re-tear
   b. 6% chance of tendon re-tear
   c. 12% chance of tendon re-tear

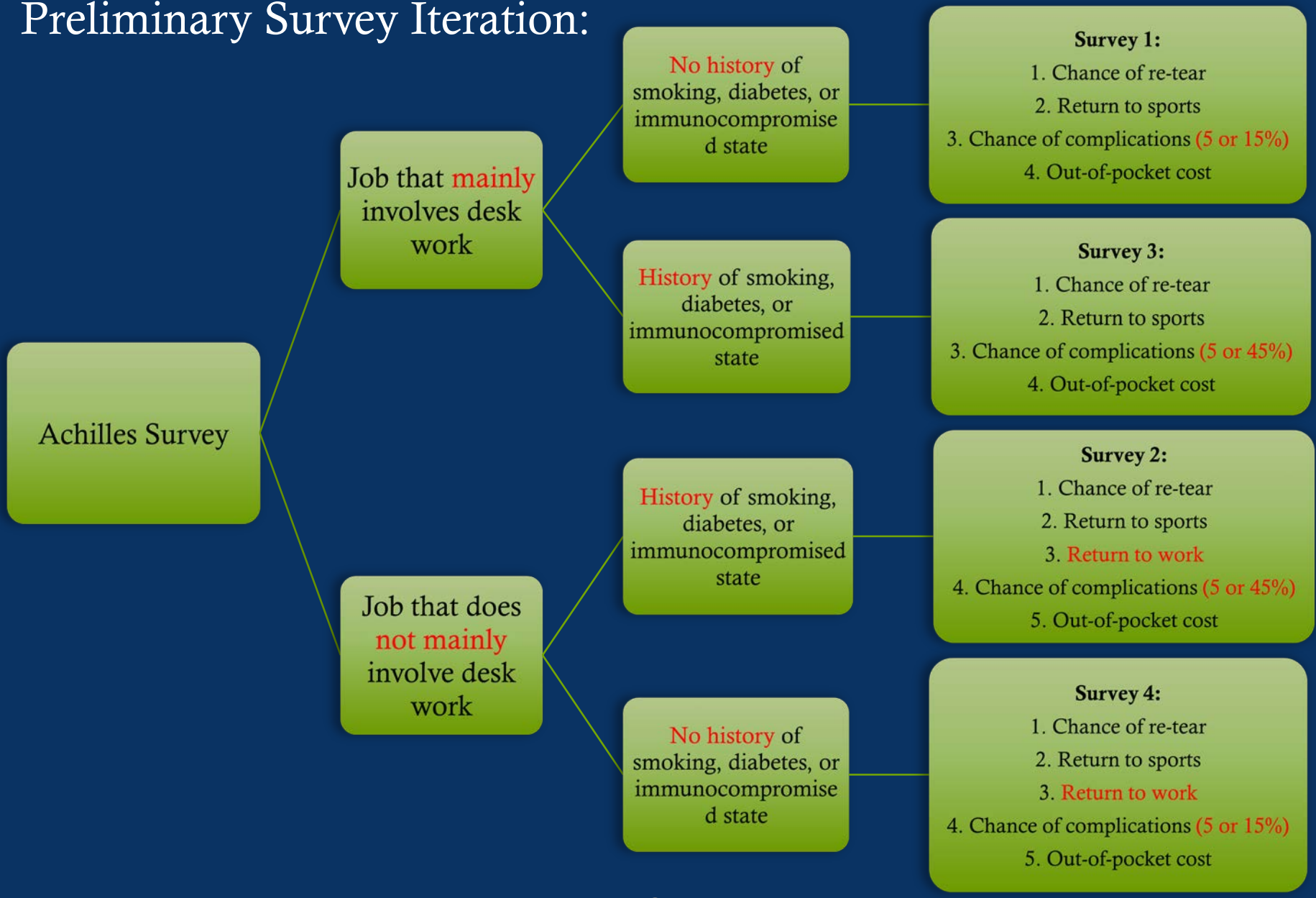
2. **Return to previous level of sports activity**
   a. No ankle weakness; Able to return to all sports
   b. No ankle weakness with activities of daily living; Weakness allowing return to non-explosive sports only
   c. Ankle weakness with activities of daily living; Difficulty returning to sports

3. **Return to work**
   a. Full return to work in 6 weeks
   b. Full return to work in 8 weeks
   c. Full return to work in 10 weeks

4. **Chance of complications**
   1. 5% chance of complications
   2. 15% chance of complications
   3. 45% chance of complications

5. **Out-of-pocket cost**
   a. $500 out-of-pocket cost
   b. $2000 out-of-pocket cost
   c. $4000 out-of-pocket cost

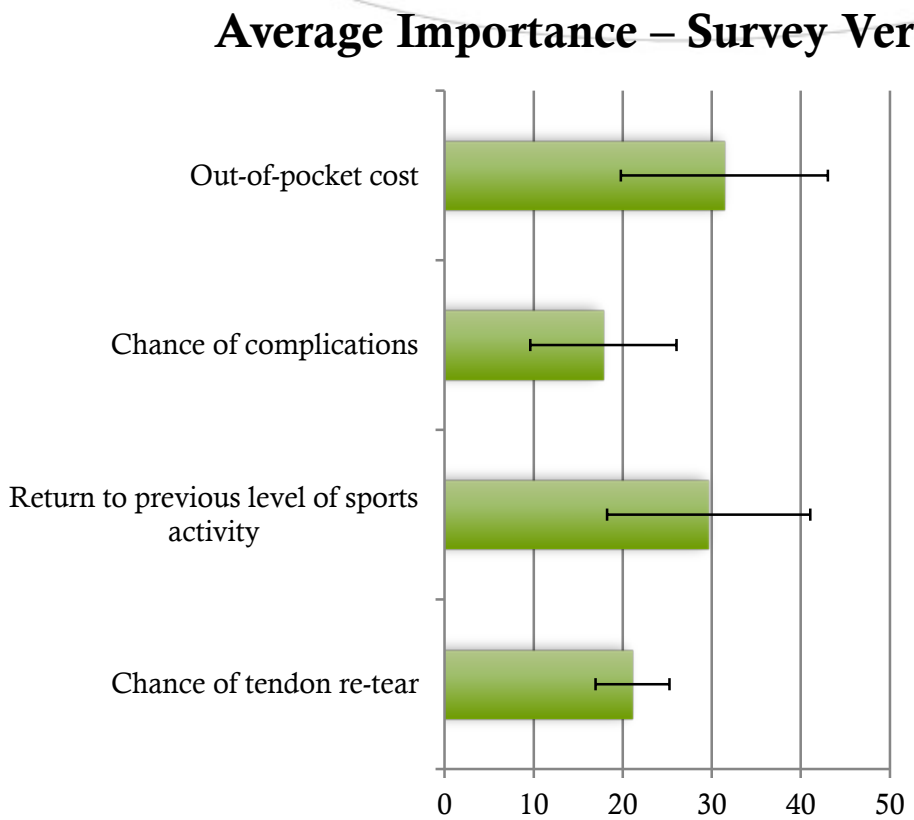
Preliminary Survey Iteration:



Results: Demographic Information

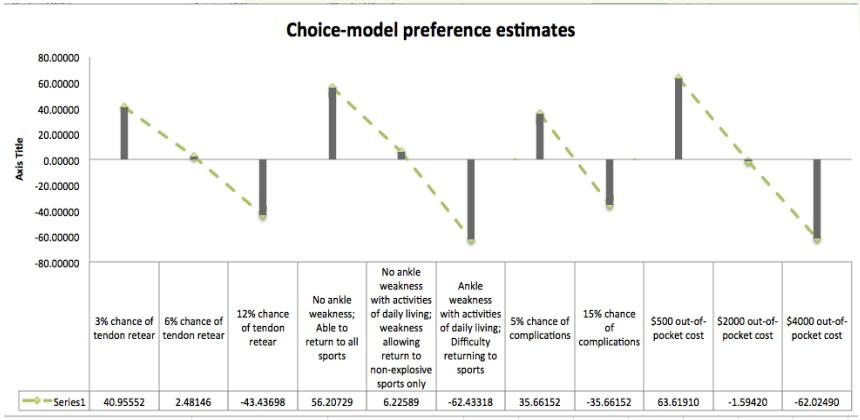
Variables	Results
Average age	35.2
Age Range	25-60
Avg. Time for survey	14.6 minutes
No. males	195
No. females	105
Race	214 white, 18 Hispanic/Latino, 16 Black/African American, 2 Native American/American Indian, 49 Asian/Pacific Islander, 1 Other
Marital Status	156 Single, 115 Married, 20 Divorced
Highest Education Level	28 High school/GED, 88 Some college, 132 Bachelor's, 43 Master's, 8 Advanced Graduate work/PhD
Employment	223 Full time, 36 part time, 40 Not employed

Results: Average Importance

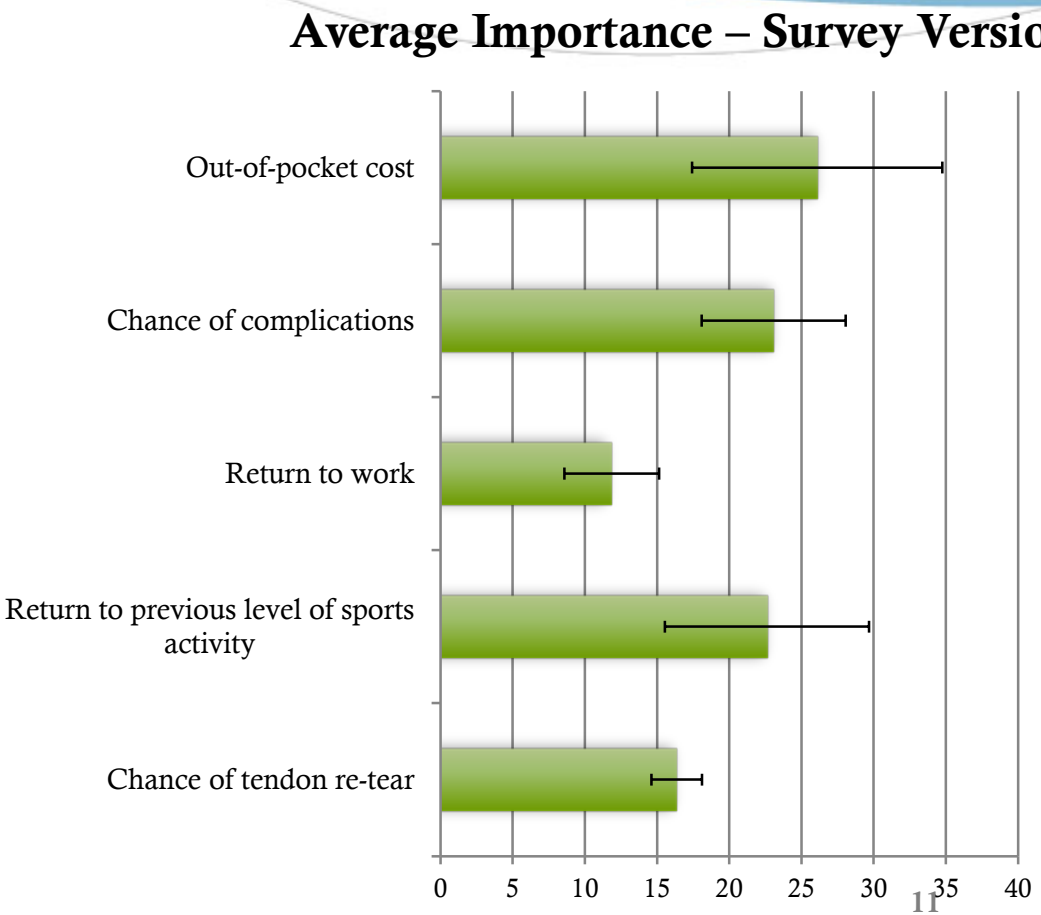


Average Importance	Average Importance	Standard Deviation
Chance of tendon re-tear	21.09813	4.15714
Return to previous level of sports activity	29.66012	11.41903
Chance of complications (5% or 15%)	17.83076	8.21251
Out-of-pocket cost	31.41100	11.62587

No. respondents: 172



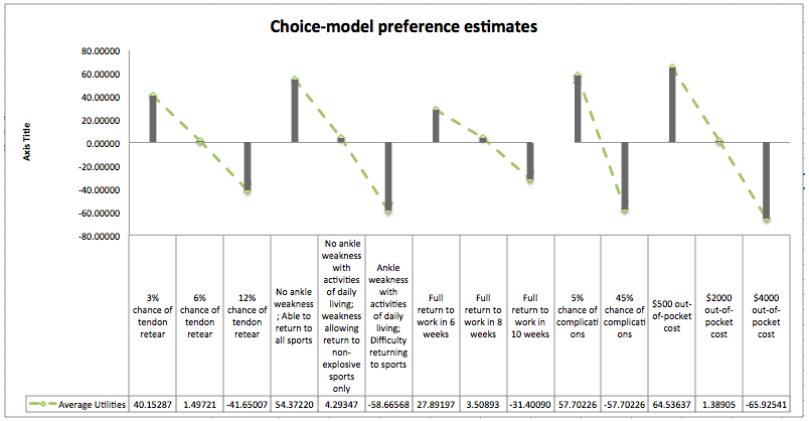
Results: Average Importance



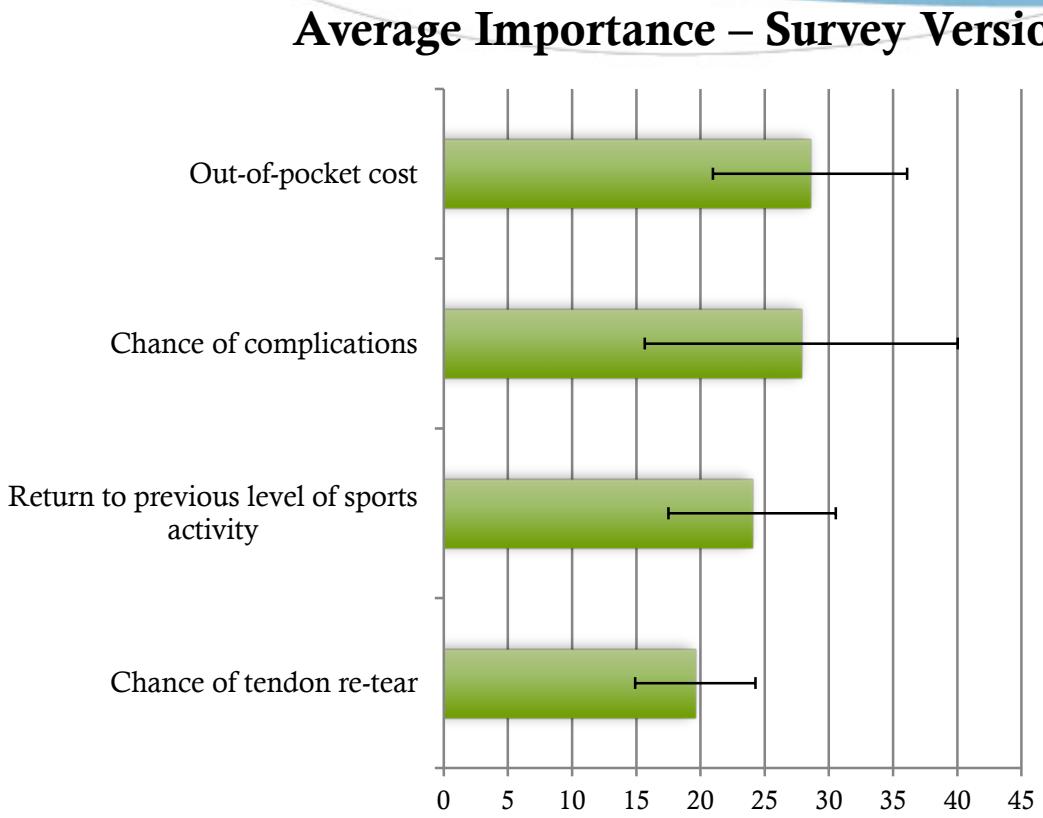
Average Importance	Average Importance	Standard Deviation
Chance of tendon re-tear	16.36059	1.74682
Return to previous level of sports activity	22.60758	7.06473
Return to work	11.85857	3.27492
Chance of complications (5% or 45%)	23.08091	4.98918
Out-of-pocket cost	26.09236	8.66677

No. respondents: 20

Average Importances

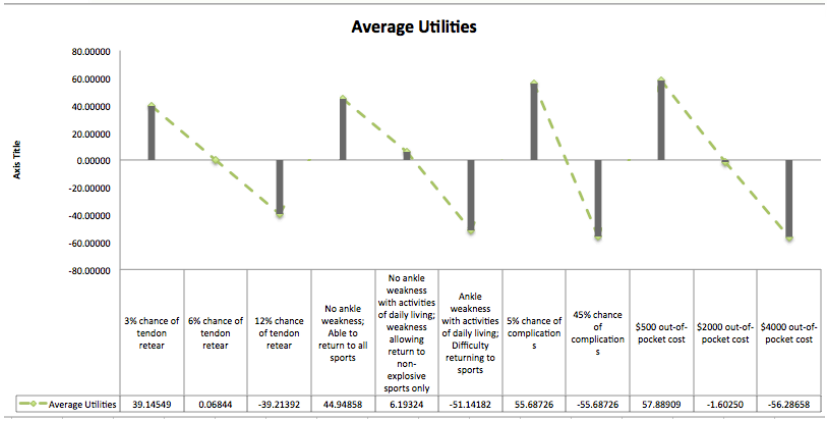


Results: Average Importance

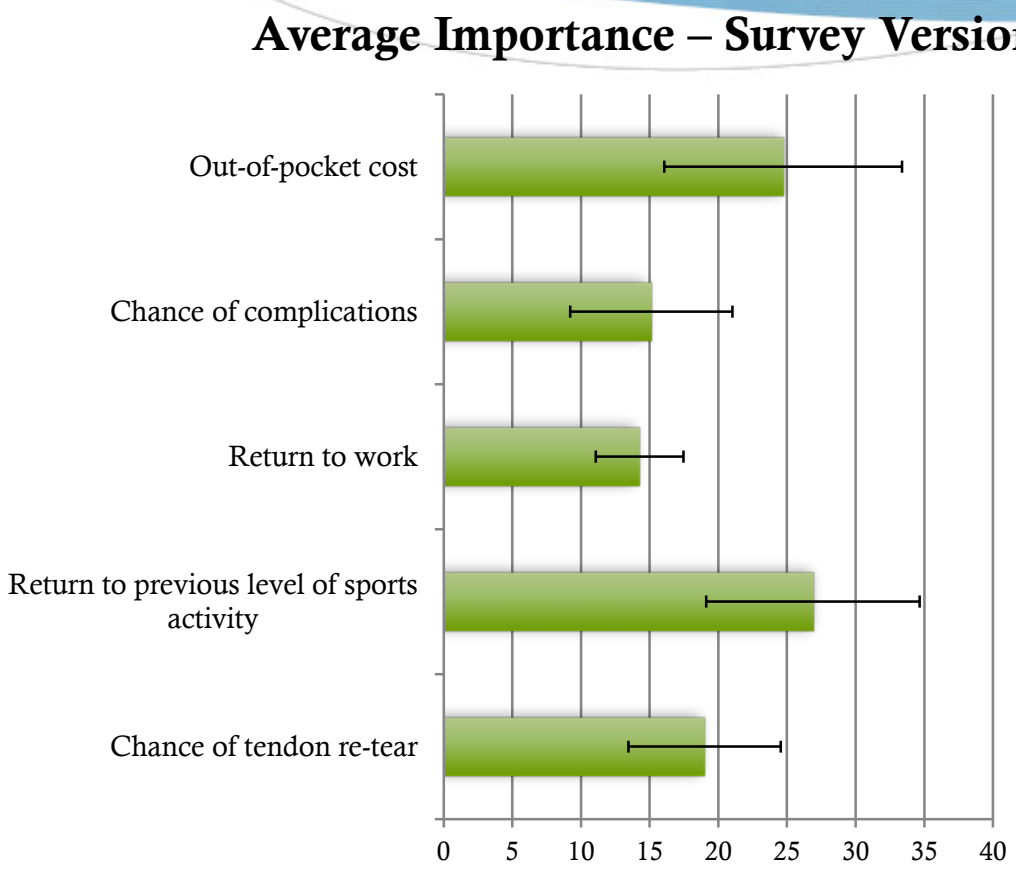


Average Importance	Average Importance	Standard Deviation
Chance of tendon re-tear	19.58985	4.68709
Return to previous level of sports activity	24.02260	6.51725
Chance of complications (5% or 45%)	27.84363	12.18410
Out-of-pocket cost	28.54392	7.56362

No. respondents: 36

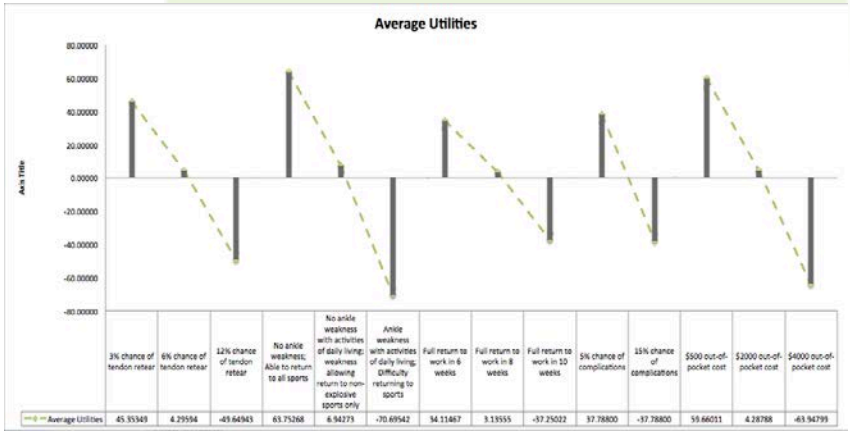


Results: Average Importance



Average Importance	Average Importance	Standard Deviation
Chance of tendon re-tear	19.00058	5.54632
Return to previous level of sports activity	26.88962	7.77497
Return to work	14.27298	3.19100
Chance of complications (5% or 15%)	15.11520	5.90029
Out-of-pocket cost	24.72162	8.66259

No. respondents: 57



Results

- They were then asked to rank how sure they were of their decision on a scale from 0 (unsure) to 100 (sure)
  - Average rank before: 65.54
  - Average rank after: 74.48
- 61% of individuals were more confident in their decision after going through the tool, 11% experienced no change, and 28% indicated decreased confidence in their decision
- 46% of respondents changed their treatment choice after going through the tool
- 21% identified as a smoker, diabetic, and/or immunocompromised individual
- 12% stated they had previously torn their Achilles tendon
- 61% had been under anesthesia for a prior operation or had previously spent the night in the hospital as a patient
- 74% of respondents had jobs where they primarily worked at a desk
- 56% said they would find it 'very' or 'extremely' difficult to pay a $3000 out-of-pocket cost for treatment
- 44.7% said the results reflected their preferences "very well", 42.7% said "well", 12.6% said "fairly well", and 0% said "poorly"

Survey I	Survey II	Survey III	Survey IV
• 1. Chance of re-tear • 2. Return to sports • 3. Chance of complications (5 or 15%) • 4. Out-of-pocket cost	• 1. Chance of re-tear • 2. Return to sports • 3. Return to work • 4. Chance of complications (5 or 45%) • 5. Out-of-pocket cost	• 1. Chance of re-tear • 2. Return to sports • 3. Chance of complications (5 or 45%) • 4. Out-of-pocket cost	• 1. Chance of re-tear • 2. Return to sports • 3. Return to work • 4. Chance of complications (5 or 15%) • 5. Out-of-pocket cost

- Although "Return to work" was often mentioned as an important factor in one-on-one interviews, it was never the most important attribute for individual patients in making the treatment decision in the ACA exercise, which prompted us to remove it for future iterations
- "Chance of complications" was typically an attribute of lower importance except for individuals with a history of smoking, diabetes, or an immunocompromised state, where it was of second highest importance in both survey II & III
- Out-of-pocket cost was consistently one of the most important attributes to patients followed by "Return to sports"

Survey Iteration II

Introduction

- Goal/Clinical Question: To measure patient preferences in regard to treatment options for an Achilles tendon tear
- Total of 100 mTurk respondents
- Changes from iteration I to iteration II
  - The work attribute was removed since it was never the utility with the highest weight
    - Although time missed from work is important to patients as noted in the interviews, this is not a deciding factor in treatment choice
    - Additionally, the amount of time to return to work is still debated in the literature; the majority of studies state that there is no difference with work leave b/w the 2 treatment groups
  - The levels of re-tear were changed from 3, 6, and 12% to 3, 6, and 16% to see if respondents would continue re-coding
  - The levels for OOPC were also changed from $500, $1000, and $2000 to $100, $500, and $2500

Attributes & Levels

1. **Chance of tendon re-tear**
   a. 3% chance of tendon re-tear
   b. 6% chance of tendon re-tear
   c. 16% chance of tendon re-tear

2. **Return to previous level of sports activity**
   a. No ankle weakness; Able to return to all sports
   b. No ankle weakness with activities of daily living; Weakness allowing return to non-explosive sports only
   c. Ankle weakness with activities of daily living; Difficulty returning to sports

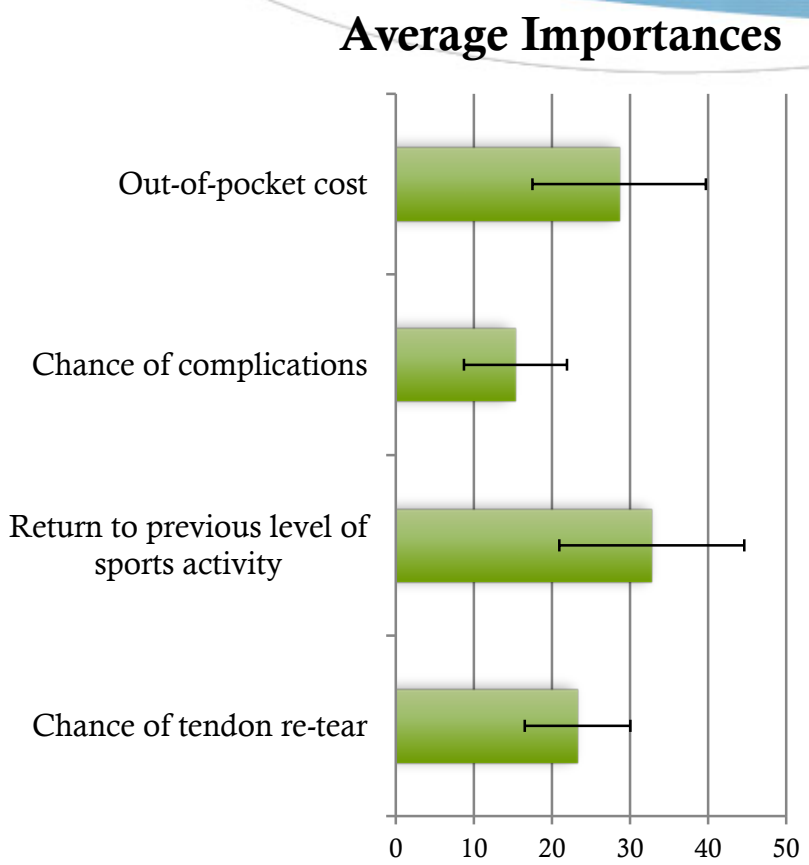
3. **Chance of complications**
   1. 5% chance of complications
   2. 15% chance of complications

4. **Out-of-pocket cost**
   a. $100 out-of-pocket cost
   b. $500 out-of-pocket cost
   c. $2500 out-of-pocket cost

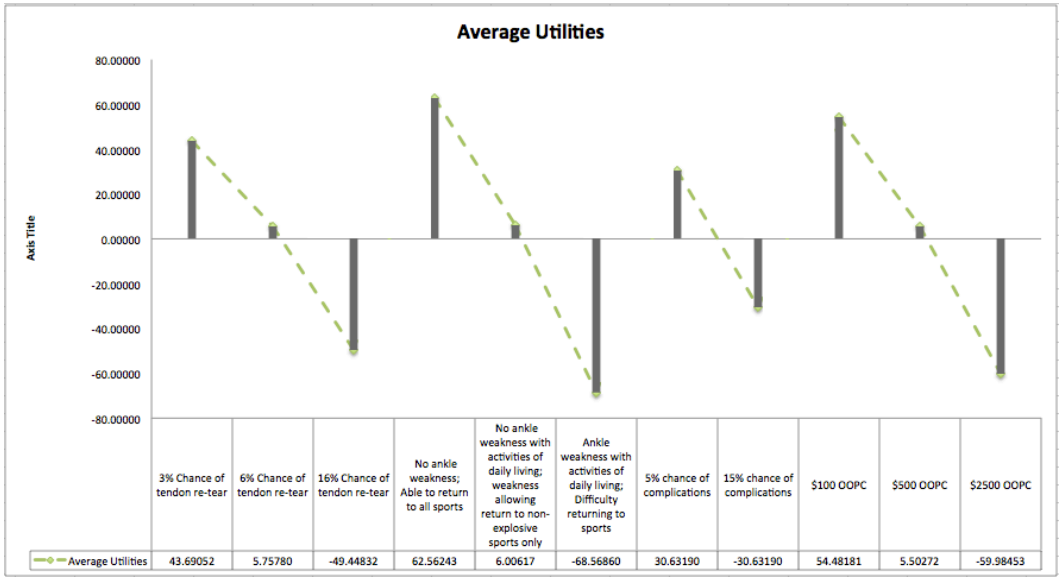
Demographic Information

Variables	Results
Average age	35.3
Age Range	25-59
Avg. Time for survey	12.9 minutes
No. males	54
No. females	46
Race	80 white, 6 Hispanic/Latino, 8 Black/African American, 1 Native American/American Indian, 4 Asian/Pacific Islander, 1 Other
Marital Status	59 Single, 32 Married, 7 Divorced, 2 Other
Highest Education Level	17 High school/GED, 36 Some college, 41 Bachelor's, 5 Master's, 1 Advanced Graduate work/PhD
Employment	64 Full time, 20 part time, 15 Not employed

Sawtooth Results

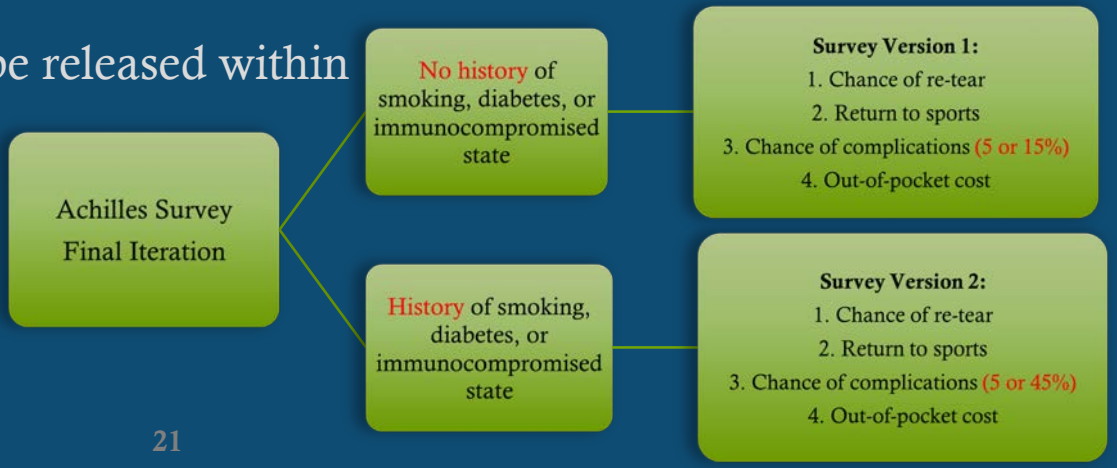


Average Importance	Average Importance	Standard Deviation
Chance of tendon re-tear	23.28471	6.77439
Return to previous level of sports activity	32.78276	11.85550
Chance of complications	15.31595	6.58778
Out-of-pocket cost	28.61659	11.11170



Summary

- "Return to previous level of sports activity" was the most important attribute in terms of group preference measurement
- The graph of average utilities showed non-linearity indicating recoding was not occurring in this iteration of the survey
- The most important attribute varied widely among individual respondents
  - 21% said Chance of tendon re-tear was the most important attribute
  - 47% said Return to previous level of sports activity was the most important attribute
  - 4% said Chance of complications was the most important attribute
  - 28% said Out-of-pocket cost was the most important attribute
- Next step: A final iteration will be released within the patient population and will include four attributes
  - Respondent sampling will be 250 individuals in order to reach study power



Thank you!

MOPEDS:

The Cost Of Cheap And Unregulated Transportation For Intoxicated Drivers

NCOA Annual Meeting
Oct 9, 2016

Gabriella E. Ode, MD
Carolinas Medical Center, Charlotte NC

Disclosures

- Authors have nothing to disclose

Moped (ˈmōˌped) n.

A vehicle that has two or three wheels, no external shifting device, and a motor that does not exceed 50 cc piston displacement and cannot propel the vehicle at a speed greater than 30 mph on a level surface."

North Carolina - No License, Registration or Insurance Required

MOPED STANDARD EQUIPMENT

A Legal Loophole?

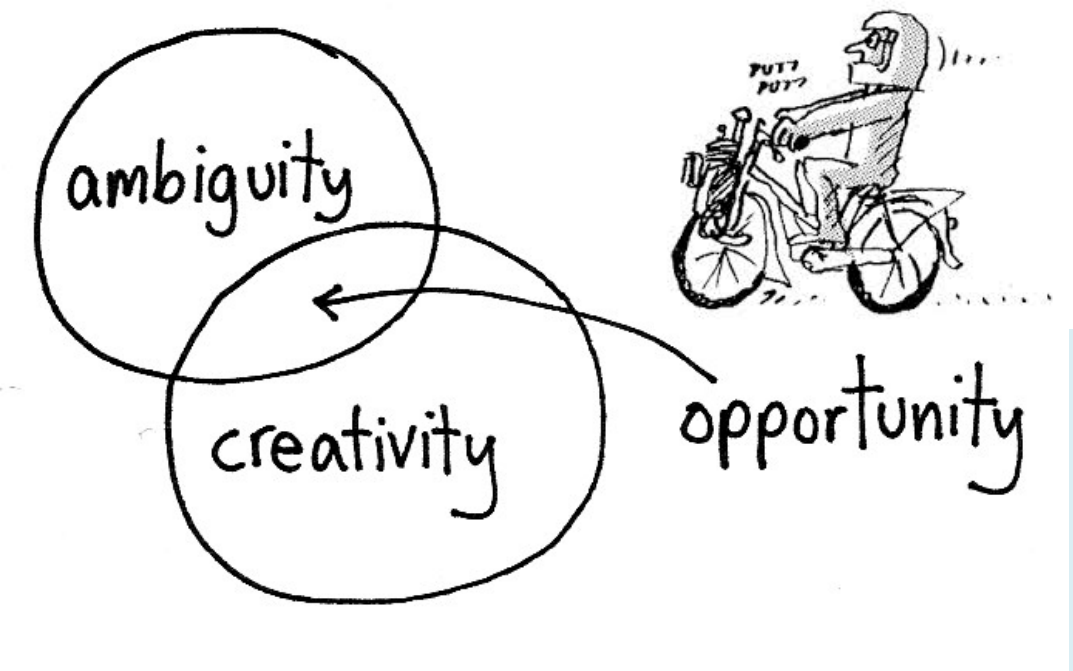
Strict NC DWI Laws

- DWI Arrest – Immediate 30 Day License Suspension
- DWI Conviction = 60 days - 1 Year
- Multiple Convictions = 1 - 4 Year (or Permanent)

Weak NC Moped Laws

- No Drivers License
- No Registration
- No Liability Insurance

No Problem!



Previous Literature

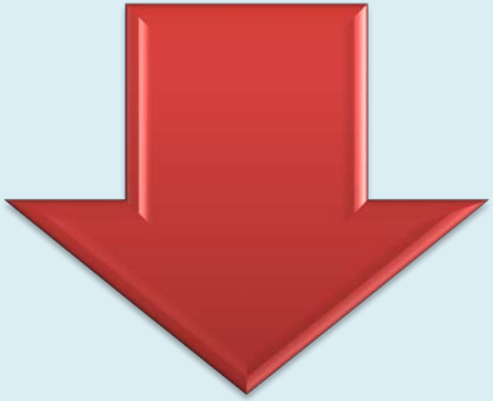
- **MOPEDS: Motorized Objects Propelling Ethanol Drinking Subjects** Christmas et al (2008)
  - 113 moped crashes at CMC (1995 to 2006)
    - **Driving with ETOH+**
      - **39%** moped (24.8% MCC; 23.4% MVC) **(p<0.004)**
    - **Mortality**
      - **9.7%** mopeds (8.5% MCCs; 6.7% MVC) (p<0.064)

- **MOPEDS: the legal loophole for repeat driving while intoxicated offenders** Brintzenhoff et al (March 2011)
  - 65 moped operators at CMC (2007 to 2009)
    - **49%** positive BAC
    - **45%** previous DWI (73% repeat offenders)
    - **38%** revoked license (76% repeat offenders)

A Growing Problem in NC
(2001-2012)

258% Increase in Moped Crashes/Year

- Motorcycle - 63%
- Bicycle – 0.5%

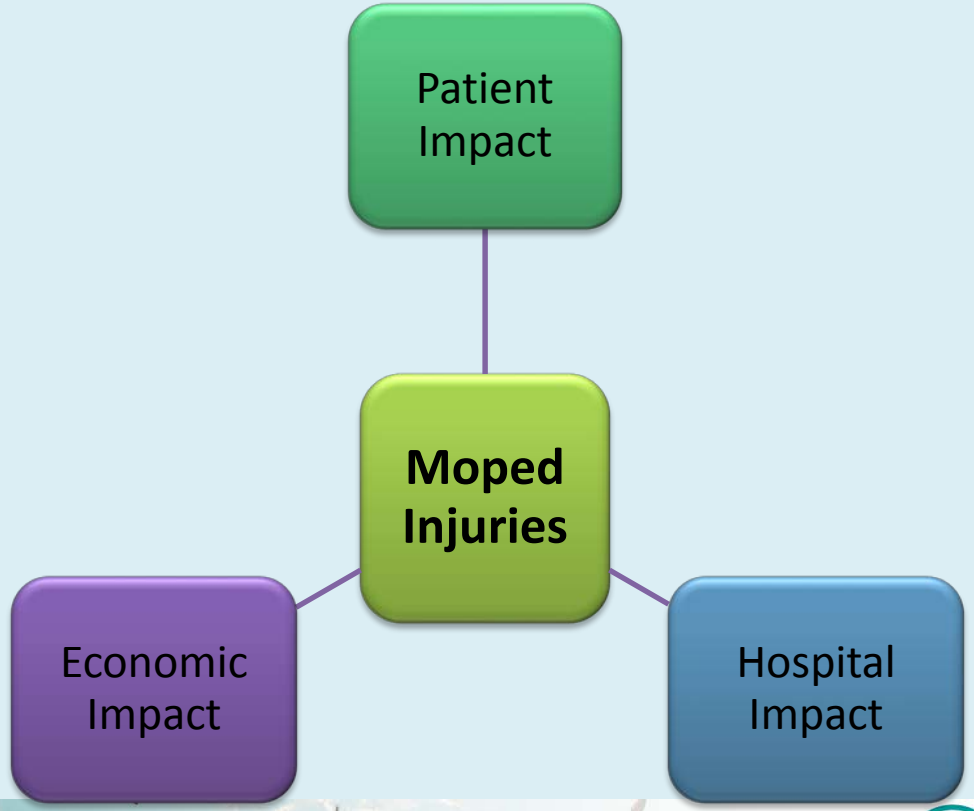


3.3% Decrease in Passenger Vehicle Crashes

Courtesy of UNC Highway Safety Research Center

Purpose

To evaluate the societal burden of moped injuries in a state without moped legislation.



Study Design

- **Inclusion Criteria:**
  - NC residents injured in moped crash occurring in NC
  - Crash occurred between 2008-2013
  - Presented to Carolinas Medical Center (Level I)
    - Identified by CMC Trauma Registry

Study Design

Hospital Records – CHS Trauma Registry

- Demographics
- Injuries
- ETOH Level/Toxicology
- Healthcare Resource Utilization – Inpatient stay, ICU, Vent, Outpatient services

Criminal History - NC Dept. of Public Safety

- DWIs, License Revocations

Injury Cost Analysis

- **Direct Cost of Injury - Hospital Records**
  - CHS billed charges per patient
- **Indirect Cost of Injury – CDC-WISQARS**
  - Estimated lifetime medical costs and work loss costs

WISQARS™

- CDC National Database – Statistics on fatal and nonfatal injuries if treated and released from hospital or ED
- Estimates indirect cost of injury based on:
    - Clinical Outcome – Inpatient, ED, Death
    - Mechanism - Motor Vehicle, Motorcycle, Falls, Firearms, etc
    - Body Region and Nature of Injury
    - Age
    - Sex
- **No reported moped data** - estimates based on average cost of motorcycle + bicycle

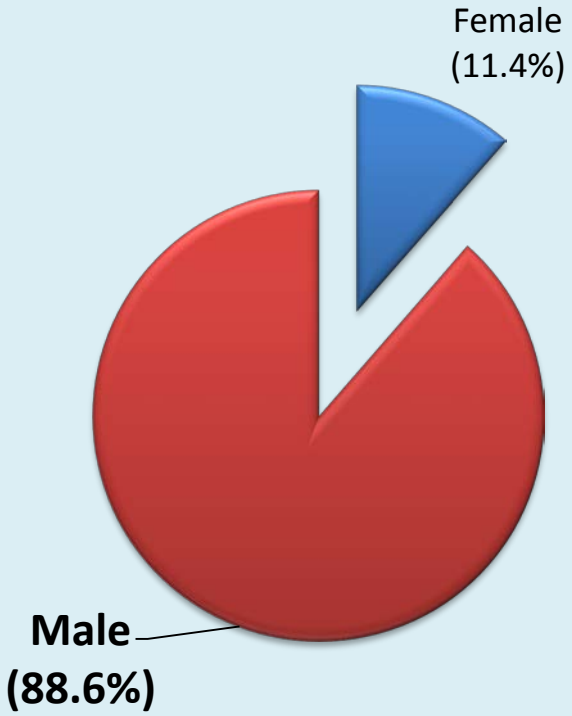
*Centers for Disease Control and Prevention, National Center for Injury Prevention and Control, Office of Statistics and Programming

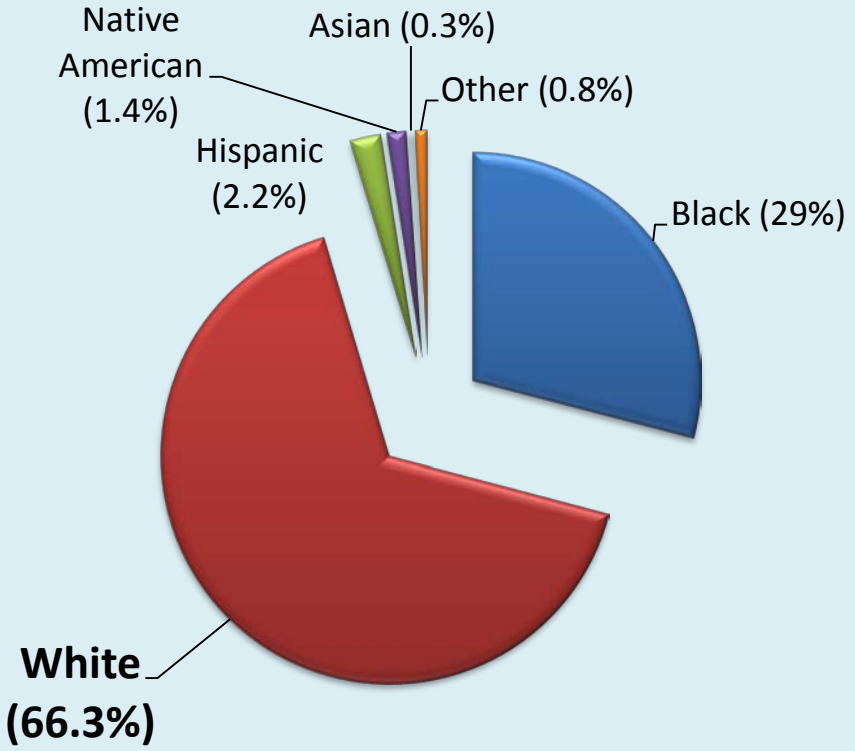
Results

- 373 Crashes from Jan 2008 to Dec 2013
  - 368 Subjects
    - 5 subjects with multiple crashes in study
  - 358 Drivers; 15 Passengers

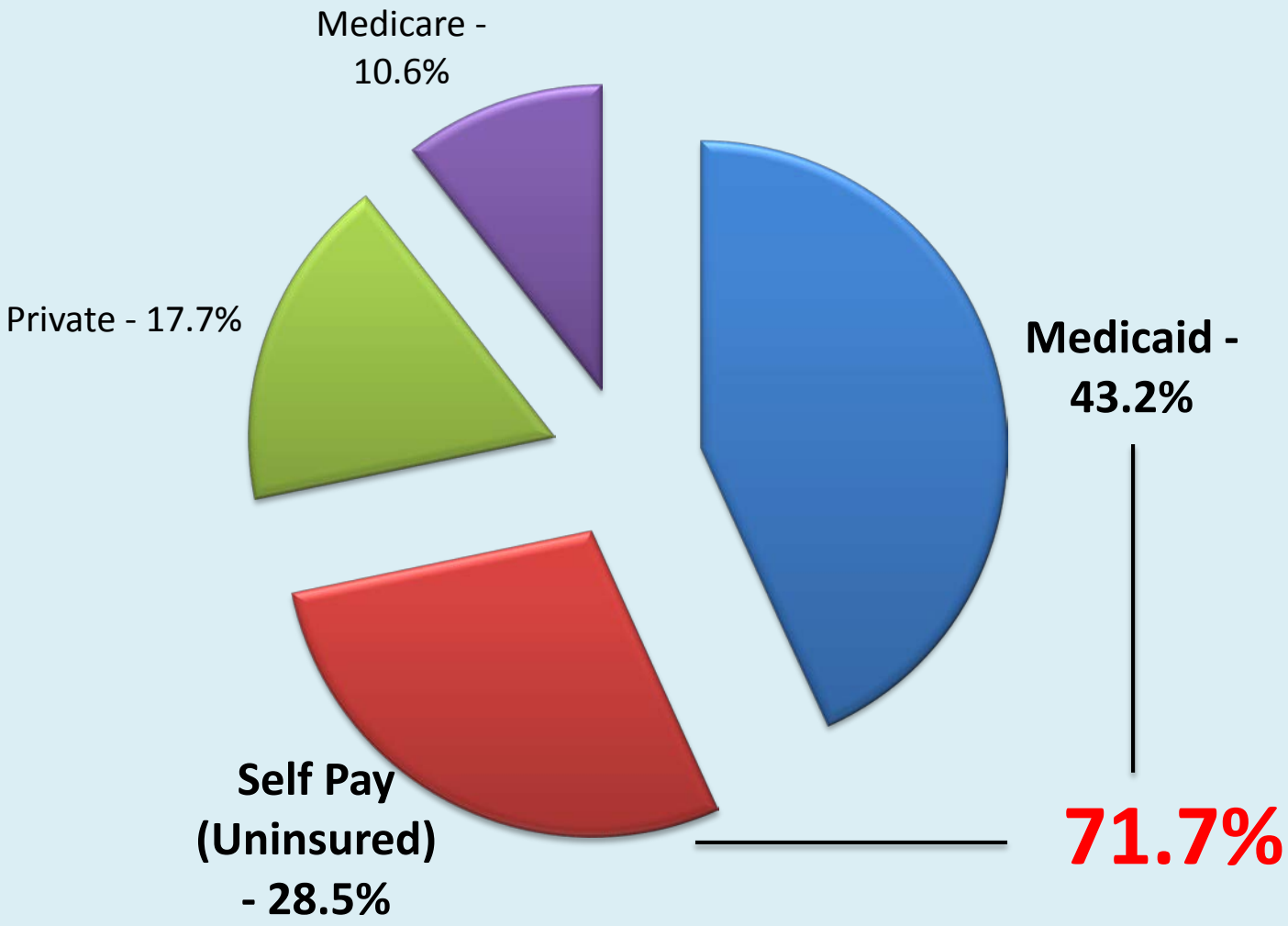
Demographics

Age - 41.2 ± 14.4 yrs (3-90)



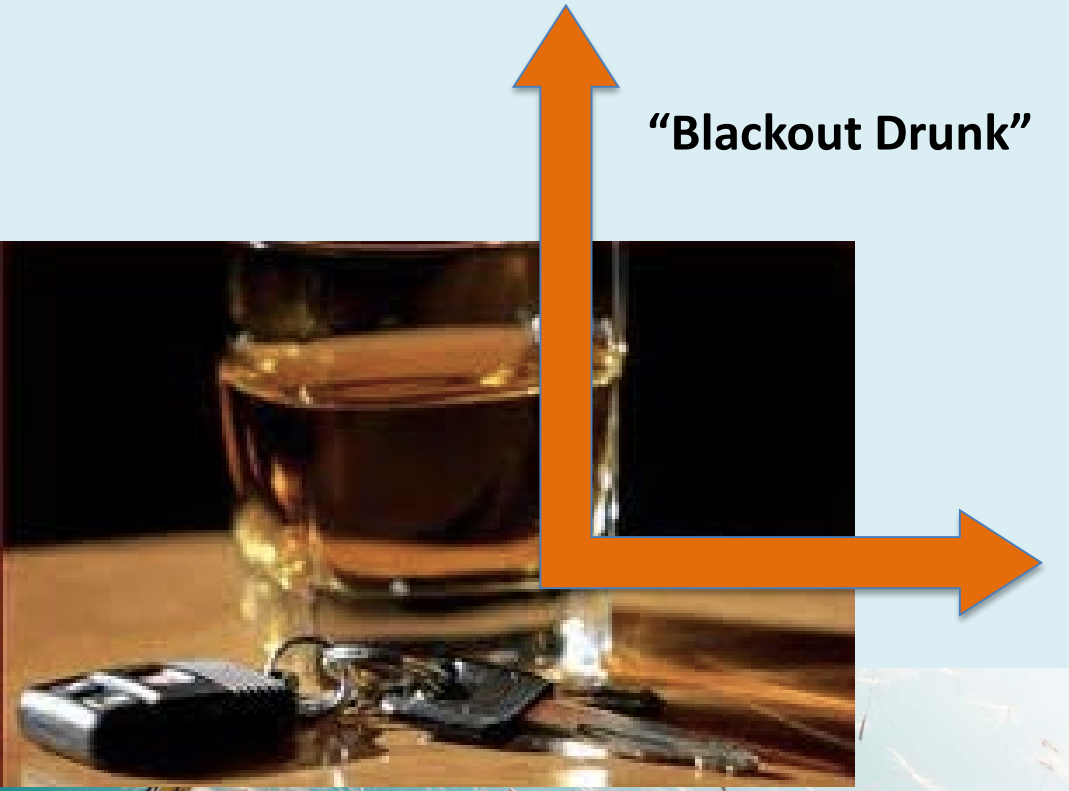


Payer Status



Intoxication (358 Drivers)

- **51.4%** (n=184) - Under influence of ETOH +/- Drugs
- **29%** (n=104) - ETOH > Legal Limit (BAC >0.08)
- Mean BAC = **0.20** (.001 – **0.7**)



BAC	Predictable Effects
.02% to .04%	Lightheaded – Relaxation, sensation of warmth, "high," minor impairment of judgment
.05% to .07%	Buzzed– Relaxation, euphoria, lower inhibitions, minor impairment of reasoning and memory, exaggerated emotions (good and bad)
.08% to .10%	Legally Impaired – Euphoria, fatigue, impairment in balance, speech, vision, reaction time and hearing, judgment and self-control are impaired
.11% to .15%	Drunk – "High" reduced and depressive effects (anxiety, depression or unease) more pronounced, gross motor impairment, judgment and perception severely impaired
.16% to .19%	Very Drunk – Strong state of depression, nausea, disorientation, dizzy, increased motor impairment, blurred vision, judgment further impaired
.20% to .24%	Dazed and Confused – Gross disorientation to time and place, increased nausea and vomiting, may need assistance to stand/walk, impervious to pain, blackout likely
.25% to .30%	Stupor – All menal, physical and sensory functions are severely impaired, accidents very likely, little comprehension, may pass out suddenly
.31% and up	Coma – Level of surgical amnesia, onset of coma, possibility of acute alcohol poisoning, death due to respiratory arrest is likely in 50 % of drinkers

Criminal History (353 Drivers)

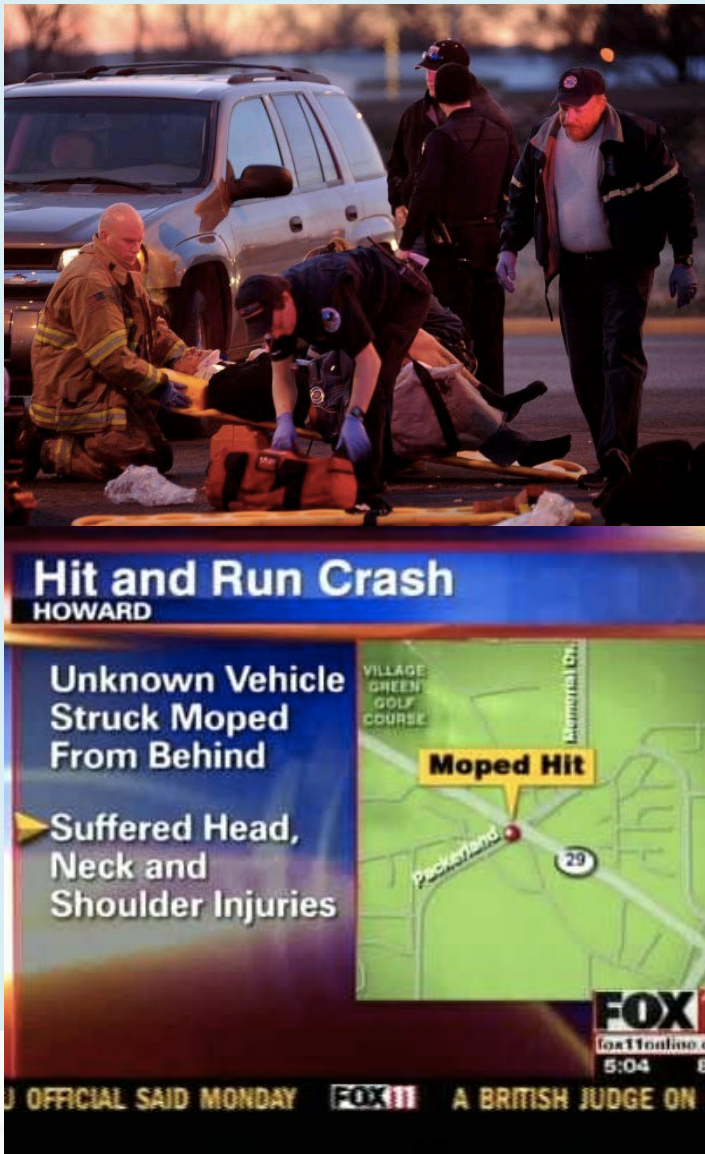
- **59.5%** - Had Criminal Record (n=216)
  - **31.2%** - Convicted Felons (n=110)
- **37.7%** - Prior DWI (n=133)
  - Range: 1 - **11** DWIs
- **26.3%** - Prior Revoked License (n=93)
  - Range: 1- **14** Revocations

Repeat Offenders

- **22%** - Multiple DWIs (n=78)
- **10%** - Multiple revocations (n = 35)
- **9.6%** - Multiple moped crashes (n=28)
  - 5 within study period

Moped Injuries

- **3.8% Death Rate**
  - 2 ED; 12 Inpatient
- **Injury Severity**
  - Median ISS - **9** (Moderate Injury)
  - **25.5%** **ISS ≥16** (Severe/Polytrauma) (n= 95)
- **33.5% Head Injuries** (n=125)
- **66% Orthopaedic Injuries**(n=248)
  - **48% Long Bone Fractures** (n=180)
  - **16% Spinal Column Injuries** (n=60)
  - **13.1% Open Fractures** (n=49)
  - **8.8% Pelvic Fractures** (n=33)



Healthcare Resource Utilization

Pre-Hospital	Inpatient	Outpatient
31.1% - Interfacility Transfer (n=116)	**82%** - Inpatient Care (n=306) LOS = **8.8 days** (1-81)	**16.9%** - Rehab/SNF/Home Health Discharge (n=63)
14.7% - Air Transport (n=55) 	**30.8%** - ICU Support (n=115) LOS = **6.1 days** (1-44)	**7.8%** - Permanently Disabled (n=29) 
	12.1% - Ventilator Support (n=45) LOS = **6.8 days** (1-28)	
	55.7% - Operative Intervention (n=208) Mean = **2.1 Surgeries** (1-14)	

Direct Cost By Payer

TOTAL DIRECT COST = $26,319,277

- Medicaid (n=162)
  - **$13,082,214** (49.7%)
- Self Pay/Uninsured (n=105)
  - **$4,428,544** (16.8%)
- Private Insurance (n=65)
  - **$5,522,405** (19.9%)
- Medicare (n=41)
  - **$3,584,113** (13.6%)

$70,561/crash

Total Indirect Cost

(Medical + Work Loss)

TOTAL INDIRECT COST = **$44,549,955**

- Hospitalized (n=288)
  - **$44,104,076** (99%)
- ED Treat and Release (n=66)
  - **$372,772** (0.8%)
- Death (n = 14)
  - $**76,525** (0.2%)

Carolinas HealthCare System

Direct Costs for State

- 2008-2012
  - **3,381 people** involved in Moped crashes
  - **2,768 people (79.4%)** Suspected/Confirmed Injured
  - **308 (9.11%)** Fatal or Disabling Injuries

$70,561 per crash x 2,768 Injured

$37.9 Million/Year

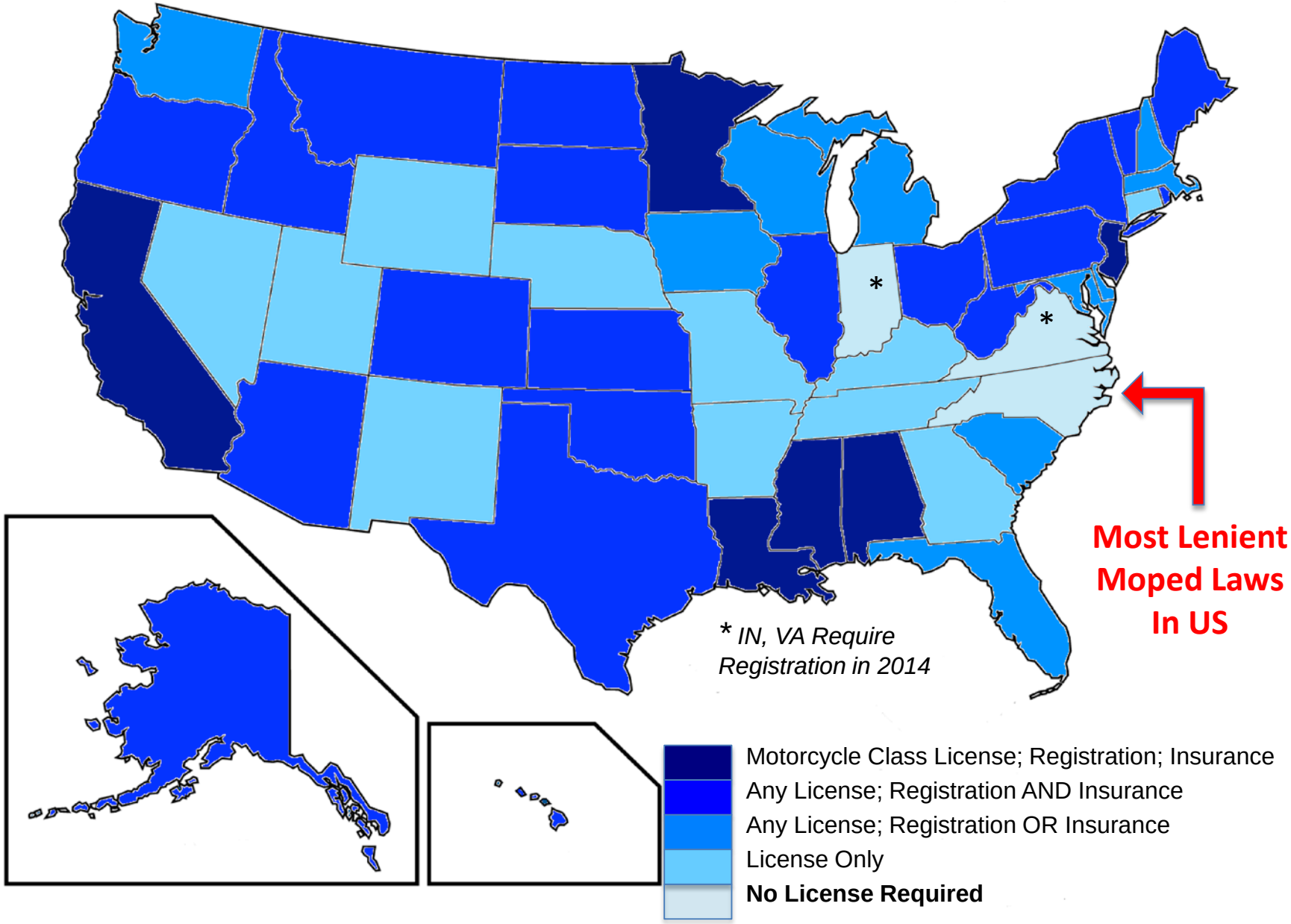
THE UNIVERSITY OF NORTH CAROLINA HIGHWAY SAFETY RESEARCH CENTER

Carolinas HealthCare System

Discussion

- Moped crashes lead to:
  - Serious injuries
  - Substantial healthcare resource utilization
  - Exorbitant financial burden
    - Direct + Indirect Cost = **>$70 Million** for 368 subjects
      - Majority at cost to hospital and state.
- Majority driving under influence (51%)
- The legal loophole is real
  - Opportunity for known law breakers
    - 60% Convicts/ 38% DWIs/ 26% Revoked Licenses

Behind the Curve



A Slow Legislative Battle

- 2011 and 2013 Moped bills **failed to pass.**
- **2014 Moped bill**
  - **Insurance mandate fails to pass**
  - **Registration mandate passes - Aug 2014**
    - **Effective since July 2015**
- **2015 Moped Bill**
  - **Insurance mandate passes**
  - **Effective since July 2016**

Still no license requirements

Conclusion

It's time to close the loophole.

- Mopeds pose an unnecessary risk to public health and safety.
- Study provides stronger evidence for mandated moped licensing, registration and liability insurance.

Thank You!

Acknowledgements

Michael Bosse, MD
Joseph Hsu, MD
Ronald Sing, DO
Rachel Seymour, PhD
Carolinas Trauma Network

*** Special Thanks to Dayley Wilson-Keil**