A Message from the Chairman, Herbert Schwartz, M.D.

The compelling need for a good definition of health care value highlights a fundamental challenge. We have not yet developed scientifically sound or accepted approaches to defining or measuring either patient-centered outcomes of care, or the costs of producing those outcomes. The scientific hurdles to defining patient-centered outcomes are numerous. Outcomes can be subtle and multidimensional, involving not only physiological and functional results, but also patients’ perceptions and valuations of their care and health status. The ability of health care organizations to measure costs is primitive at best and doesn't meet the standards used in many other advanced industries. Equally challenging is the lack of data systems to support outcome measurement.

The Vanderbilt Department of Orthopaedics (VDO) presents this compilation of Value, Quality and Safety as testimony to our mission, accomplishments and culture. The Divisions within VDO have proudly displayed some examples of the programs conducted in 2013 which document our commitment to value in health care. Value can be defined as: Quality Patient Outcomes, Safety and Satisfaction divided by Cost, Waste Reduction and Operational Redesign. We strive to deliver the very best care for our patients, as per our credo of putting the patient first, by performing evidence based medicine whenever appropriate and setting examples of that behavior for our residents, alumni and colleagues.

At Vanderbilt, the promise of discovery is our passion. Teamwork within VDO is fundamental and each team member is critical in facilitating a constantly evolving and improved product. We emphasize patient's rights and the sanctity and privacy of the patient-doctor relationship. We use our data management systems to support our discovery of best practices and apply them to the individual based upon their needs. Our team tries to focus on optimal access and care-delivery while minimizing the distractions of poor metric proxies of performance. We must be mindful in our changing healthcare environment that we maintain our focus on delivering the care to our patients that they need.

Please enjoy reviewing our march toward delivering value based health care.

Best Wishes in the New Year,

Herbert S. Schwartz, M.D.
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herbert.s.schwartz@vanderbilt.edu
Total Number of Patients Enrolled from October 2010 – April 2013

<table>
<thead>
<tr>
<th>Period</th>
<th>Number of Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oct - Dec 2010</td>
<td>183</td>
</tr>
<tr>
<td>Jan - Dec 2011</td>
<td>860</td>
</tr>
<tr>
<td>Jan - Dec 2012</td>
<td>940</td>
</tr>
<tr>
<td>Jan - April 2013</td>
<td>317</td>
</tr>
<tr>
<td>Total</td>
<td>2,300</td>
</tr>
</tbody>
</table>

Anatomical Region

- Cervical – 31%
- Lumbar – 69%

Type of Surgery

- Revision – 28.5%
- Primary – 71.5%

Types of Lumbar Surgeries

- Microdiskectomy: 16%
- Laminectomy: 24%
- Laminectomy + Fusion: 60%

Types of Cervical Surgeries

- Laminectomy + Fusion: 33%
- Anterior Cervical Diskectomy and Fusion: 67%
Outcomes Reported by Our Patients

Lumbar Surgery

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Baseline</th>
<th>12-Month</th>
</tr>
</thead>
<tbody>
<tr>
<td>Back Pain</td>
<td>Score</td>
<td>Score</td>
</tr>
<tr>
<td>Leg Pain</td>
<td>Score</td>
<td>Score</td>
</tr>
<tr>
<td>Back-Related Disability</td>
<td>Score</td>
<td>Score</td>
</tr>
<tr>
<td>General Health State</td>
<td>Score</td>
<td>Score</td>
</tr>
<tr>
<td>Quality of Life</td>
<td>Score</td>
<td>Score</td>
</tr>
</tbody>
</table>

Cervical Surgery

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Baseline</th>
<th>12-Month</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neck Pain</td>
<td>Score</td>
<td>Score</td>
</tr>
<tr>
<td>Arm Pain</td>
<td>Score</td>
<td>Score</td>
</tr>
<tr>
<td>Neck-Related Disability</td>
<td>Score</td>
<td>Score</td>
</tr>
<tr>
<td>General Health State</td>
<td>Score</td>
<td>Score</td>
</tr>
<tr>
<td>Quality of Life</td>
<td>Score</td>
<td>Score</td>
</tr>
</tbody>
</table>

Return to Work – Lumbar Surgery

- Lumbar Non-Fusion: 97% returned to work
- Lumbar Fusion: 94% returned to work

Return to Work – Cervical Surgery

- 98% returned to work

Patient Satisfaction with Care

- Satisfaction with Surgeon: 97% Lumbar, 98% Cervical
- Satisfaction with Nursing Staff: 97% Lumbar, 99% Cervical
Primary total knee replacement remains the most common procedure performed by the Joint Replacement Center, while primary hip replacement volume continues to grow. Our center has remained a strong referral center for revision hip and knee replacements, as well as infected joint replacements.

Infection and complication rates after total joint replacements continue to remain below national standards, as compared to other large, tertiary centers (de-identified) as seen in the data obtained from University HealthSystem Consortium (UHC).

### Surgery Volume Due to Infection

<table>
<thead>
<tr>
<th>Procedure</th>
<th>2011</th>
<th>2012</th>
</tr>
</thead>
<tbody>
<tr>
<td>Component Removal</td>
<td>19</td>
<td>13</td>
</tr>
<tr>
<td>Joint Irrigation and Debridement</td>
<td>11</td>
<td>9</td>
</tr>
</tbody>
</table>

### Surgery Volume by Surgical Procedure

<table>
<thead>
<tr>
<th>Procedure</th>
<th>2011</th>
<th>2012</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Knee Replacement</td>
<td>204</td>
<td>259</td>
</tr>
<tr>
<td>Total Hip Replacement</td>
<td>108</td>
<td>129</td>
</tr>
<tr>
<td>Revised Total Knee Replacement</td>
<td>33</td>
<td>34</td>
</tr>
<tr>
<td>Revised Total Hip Replacement</td>
<td>18</td>
<td>26</td>
</tr>
<tr>
<td>Unicondylar</td>
<td>18</td>
<td>30</td>
</tr>
<tr>
<td>Hip Resurfacing</td>
<td>13</td>
<td>14</td>
</tr>
<tr>
<td>Unicondylar</td>
<td>6</td>
<td>13</td>
</tr>
</tbody>
</table>

### Readmission Rate After Total Joint Replacement

<table>
<thead>
<tr>
<th>Year</th>
<th>Readmission Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009</td>
<td>16%</td>
</tr>
<tr>
<td>2010</td>
<td>14%</td>
</tr>
<tr>
<td>2011</td>
<td>12%</td>
</tr>
<tr>
<td>2012</td>
<td>10%</td>
</tr>
</tbody>
</table>

### Complication Rate After Total Joint Replacement

<table>
<thead>
<tr>
<th>Year</th>
<th>Complication Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009</td>
<td>12%</td>
</tr>
<tr>
<td>2010</td>
<td>10%</td>
</tr>
<tr>
<td>2011</td>
<td>8%</td>
</tr>
<tr>
<td>2012</td>
<td>6%</td>
</tr>
</tbody>
</table>
Core Principles
- Patient Education
- Multimodal Pain Management
- Early Mobilization
- Inpatient Assessments (2x day)
- Innovative Discharge Planning
- Telephone Follow-up with Patient After Discharge from Hospital

Length of Stay Due to Accelerated Recovery Program (ARP)

The average length of stay following a primary joint replacement following the accelerated recovery pathway program was 2.18 days between November 2012 and January 2013. This average includes 6 patients who chose inpatient rehabilitation which requires at minimum a 3-night hospital stay.

Average Patient-controlled Analgesia Usage

The average patient-controlled analgesia (pain medication usage) among patients participating in the Accelerated Recovery Program (ARP) was nearly half that of the group not participating in ARP.

Average Oral Pain Tablets Usage

The average number of oral pain tablets (taken as needed for pain) per visit using a random sample of 30 patients. The total overall average of tablets taken per visit for all of the ARP patients was 7 per patient.
Pediatric Spinal Fusion Surgical Site Infection (SSI) Improvements

Surgical site infection rates for patients receiving spinal fusions continues to decrease. In Quarter 3 of 2011 there were 7 surgical site infections for every 100 procedures completed. That number has been reduced to 0 surgical site infections for every 100 procedures completed in Quarter 3 of 2013.

### Spinal Fusion Surgery Protocol

#### Prior to Surgery
- Skin Assessment
- Bath Using Antiseptic Wipes
- Antibiotic Selection
- Implants and Surgical Instruments are Present 24 Hours Before Surgery

#### During Surgery
- Administer Antibiotics Prior to Incision
- Hair Removal
- Prepare Skin
- Perform Hand Hygiene Procedures
- 2 Gloves for Surgical Staff
- Proper Surgical Attire
- Limit Personnel
- Antibiotics Every 4 Hours
- Wound Irrigation
- Antibiotic Power

#### After Surgery
- Antibiotic Regimen
- Dressing Changes
- Patient and Family Education
The length of stay for patients undergoing a spinal fusion has been reduced from 6.8 days prior to the postoperative pathway modifications to 4.3 days. This is 1.61 days below the national average of 5.91 (as indicated by black bar on table above).

**Benefits of a shorter length of stay:**
- Patients are able to recover quicker and return to school/activities sooner
- Families face less of a socioeconomic burden (lower cost, less time off of work)
- Hospitals have increased open beds, available staff for new patients, and reduced costs.

<table>
<thead>
<tr>
<th>Previously Occurred on PostOp Day</th>
<th>Now Occurs On PostOp Day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient is ordered to be out of the bed 3x/day</td>
<td>2</td>
</tr>
<tr>
<td>Discontinue patient controlled analgesia</td>
<td>2 or 3</td>
</tr>
<tr>
<td>Pain medication taken by mouth</td>
<td>2 or 3</td>
</tr>
<tr>
<td>IV fluids stopped</td>
<td>3</td>
</tr>
<tr>
<td>Patient ambulates (moves) 3x/day</td>
<td>3</td>
</tr>
<tr>
<td>Hemovac drain removal</td>
<td>3</td>
</tr>
</tbody>
</table>
Outcomes of Hook of the Hamate Fracture Excision in High Level Athletes

Demographics

<table>
<thead>
<tr>
<th>Sport</th>
<th>Baseball</th>
<th>Football</th>
<th>Golf</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>8%</td>
<td>9%</td>
<td>83%</td>
<td>100%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Age Range</th>
<th># of Participants in Age Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>17</td>
<td>1</td>
</tr>
<tr>
<td>18</td>
<td>1</td>
</tr>
<tr>
<td>19</td>
<td>5</td>
</tr>
<tr>
<td>20</td>
<td>2</td>
</tr>
<tr>
<td>21</td>
<td>2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Level of Play at Time of Injury</th>
</tr>
</thead>
<tbody>
<tr>
<td>College</td>
</tr>
<tr>
<td>Rising College</td>
</tr>
<tr>
<td>Junior College</td>
</tr>
<tr>
<td># of Participants in Age Group</td>
</tr>
<tr>
<td>9</td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>2</td>
</tr>
</tbody>
</table>

Outcomes

- Patient Satisfaction
  - Satisfaction was based on a score of 1 (not satisfied) to 10 (very satisfied).
  - All patients returned to full participation in their sport an average of 6 weeks after surgery.

- Pain Scores
  - Pain was based on a score of 0 (no pain) to 10 (worst possible pain).
  - Performance in the patient's respective sport was measured on a scale of 1 (worst possible performance) to 10 (best possible performance).

- Performance Scores
  - A patient's functional outcome was measured using the DASH (Disabilities of the Arm, Shoulder, and Hand) questionnaire and DASH Sports module which uses a scale of 1 (no difficulty doing specific function) and 5 (unable to do specific function).
Surgical-Site Infections and Resected Soft Tissue Sarcomas

81% of patients (n=91) who underwent preoperative radiation prior to the operative procedure to resect their soft tissue sarcoma did not suffer any wound complications. In addition, 88% of the patients did not have a local reoccurrence.

Management of Obese Patients with Extremity Soft Tissue Sarcomas

The Vanderbilt Sarcoma Service is able to achieve the same overall survival, local recurrence rates, and wound healing in obese (Body Mass Index > 30) and non-obese (BMI < 30) patients in contrast to other orthopaedic and general surgery literature.
Quality Projects on Incomplete Excisions of Soft Tissue Sarcomas

**Patient Distance**

<table>
<thead>
<tr>
<th>Miles (Median)</th>
<th>Primary Excision (n=253)</th>
<th>Reexcision (n=147)</th>
</tr>
</thead>
<tbody>
<tr>
<td>114</td>
<td>114</td>
<td></td>
</tr>
</tbody>
</table>

**Insurance Status**

<table>
<thead>
<tr>
<th>Type of Insurance</th>
<th>% of Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>Primary Excision (n=253)</td>
</tr>
<tr>
<td>Public</td>
<td>Reexcision (n=147)</td>
</tr>
<tr>
<td>Private</td>
<td></td>
</tr>
</tbody>
</table>

**Difference in Charges Between Primary and Reexcision**

<table>
<thead>
<tr>
<th>Type of Charges</th>
<th>Cost ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indirect</td>
<td></td>
</tr>
<tr>
<td>Professional</td>
<td></td>
</tr>
<tr>
<td>Technical</td>
<td></td>
</tr>
</tbody>
</table>

**INSURANCE AND DISTANCE ANALYSIS**: Insurance status and patient distance from the treatment center were not significantly different between patients who underwent primary excision and reexcision of a soft tissue sarcoma. However, large and deep tumors and certain histology types predicted appropriate referrals.

**COST ANALYSIS**: The average professional charge was $9694 for a primary excision and $12896 for a reexcision. After adjusting for variables such as: tumor size, grade, and site, patients undergoing reexcision saw an increase of $3,699 in professional charges more than those with a primary excision.

Proposed Flowchart for Avoiding Unplanned Resections of Wrist Sarcomas

**Chief Complaint:** Dorsal Wrist Mass

**Atypical Features**
- Ulnar sided
- Symptoms <6 months
- Lack of function
- Rapid growth
- Proximal-distal to wrist

1. Proceed with caution
2. Consider MRI
3. Consider longitudinal incision

Flowchart of purposed algorithm of diagnostic steps (■) and treatment recommendations (■) for patients presenting with dorsal wrist mass. This algorithm was created to help surgeons avoid treating malignant tumors thought to be dorsal ganglion cysts.
Relationship of Hyperglycemia and Surgical-Site Infection (SSI) Rates
Review of 790 Non-Diabetic Orthopaedic Trauma Patients Requiring Surgery

Of the 790 patients, 294 had more than one glucose value of ≥ 200mg. This factor was associated with thirty-day SSI, with 4.4% of the 294 patients with that indication of hyperglycemia having a surgical-site infection versus 1.6% of the 496 patients without more than one glucose value of ≥ 200mg. Hyperglycemia was an independent risk factor for thirty-day SSI in orthopaedic trauma patients without a history of diabetes. We now closely monitor and control glucose levels perioperatively.

Stress-Induced Hyperglycemia as a Risk Factor for Surgical-Site Infection (SSI) Rates
Review of 187 Non-Diabetic Orthopaedic Trauma Patients Admitted to the Intensive Care Unit (ICU)

Stress-induced hyperglycemia demonstrated a significant independent association with surgical-site infections in a nondiabetic orthopaedic trauma patients who were admitted to the ICU. In addition, patients with an SSI received a greater amount of blood transfusions. We also closely monitor and control glucose values in severely injured patients.
Health Literacy in Orthopaedic Trauma Patients

Implementation of Program to Improve Patient’s Understanding of Injuries

Patient Assessment
1. What bone did you break?
2. How was the bone fixed?
3. How much weight can you put on the extremity?
4. How long until your bone is healed?
5. Are you supposed to be on medicine for blood clots?

Provided M.D. Information to Patient
- Hometown
- Residency Program
- Fellowship Program
- Medical Interests
- Professional Memberships
- Name

Overall Patient Performance on Comprehension Questions

<table>
<thead>
<tr>
<th>Question</th>
<th>Pre-Intervention (N=146)</th>
<th>Post-Intervention (N=153)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q1</td>
<td>90%</td>
<td>80%</td>
</tr>
<tr>
<td>Q2</td>
<td>80%</td>
<td>70%</td>
</tr>
<tr>
<td>Q3</td>
<td>70%</td>
<td>60%</td>
</tr>
<tr>
<td>Q4</td>
<td>60%</td>
<td>50%</td>
</tr>
<tr>
<td>Q5</td>
<td>50%</td>
<td>40%</td>
</tr>
</tbody>
</table>

Patient Satisfaction

<table>
<thead>
<tr>
<th>Satisfaction Level</th>
<th>Patients with Intervention (N=34)</th>
<th>Patients with no Intervention (N=153)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poor</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Fair</td>
<td>10%</td>
<td>10%</td>
</tr>
<tr>
<td>Good</td>
<td>20%</td>
<td>20%</td>
</tr>
<tr>
<td>Very Good</td>
<td>30%</td>
<td>30%</td>
</tr>
<tr>
<td>Excellent</td>
<td>40%</td>
<td>40%</td>
</tr>
</tbody>
</table>

All patients receive plain language information on their injury, surgery and follow-up.
The Worker’s Compensation Patient

Number of Days Restricted to Light Duty

<table>
<thead>
<tr>
<th>Number of Days Restricted to Light Duty</th>
<th>Number of Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-30</td>
<td>3</td>
</tr>
<tr>
<td>31-60</td>
<td>12</td>
</tr>
<tr>
<td>60-90</td>
<td>0</td>
</tr>
<tr>
<td>&gt;90</td>
<td>5</td>
</tr>
<tr>
<td>Cervical</td>
<td>4</td>
</tr>
<tr>
<td>Lumbar</td>
<td>4</td>
</tr>
<tr>
<td>Shoulder</td>
<td>4</td>
</tr>
<tr>
<td>Hand</td>
<td>4</td>
</tr>
<tr>
<td>Knee</td>
<td>4</td>
</tr>
<tr>
<td>Foot/Ankle</td>
<td>4</td>
</tr>
</tbody>
</table>

Average Days on Light Duty

- Cervical: 19 days
- Lumbar: 34 days
- Shoulder: 37 days
- Hand: 37 days
- Knee: 37 days
- Foot/Ankle: 37 days

Over half (56%) of the sampled worker’s compensation population (n=50) were restricted to light duty for less than 30 days. 84% of the patients were restricted to light duty for 60 days or less. The average number of days a worker’s compensation patient was restricted to light duty ranged from 19 days for patients with foot and ankle injuries to 50 days for patients suffering from hand injuries.

51% of 29 worker’s compensation patients sampled were able to return to work following treatment. Over 67% of lumbar spine injury patients and 100% of amputation patients were able to return to work.

Return to Work

- Returned to Work | 4 | 1 | 1 | 5 | 4 | 0 | 0 | 0 |
- Did Not Return to Work | 2 | 2 | 2 | 5 | 0 | 1 | 1 | 1 |
- Total Patients | 6 | 3 | 3 | 10 | 4 | 1 | 1 | 1 |
Value–Based Treatment of Atraumatic Rotator Cuff Tears

MOON (Multicenter Orthopaedics Outcomes Network) Physical Therapy Program for Atraumatic Rotator Cuff Tears

Physical Therapy (6 weeks)
- Daily Range of Motion Exercises
- Daily Flexibility Exercises
- Strengthening Exercises (3x/week)
- Heat/Cold Therapy
- Home Therapy Program

Further Treatment Determined
- Patient "cured" – No Further Treatment
- Patient "improved" – Physical Therapy for 6 More Weeks
- Patient "no better" – Could Elect to Have Surgery

Outcomes

Patient-completed Survey Scores

Range of Motion Measurements

Nonoperative treatment using the MOON physical therapy program was found to be effective for treating atraumatic rotator cuff tears in approximately 75% of the 452 patients that were followed for 2 years. Patient-reported outcomes improved significantly at 6 and 12 weeks. If patients did fail the therapy program it was usually within the first three months.

87% Cost Savings
(Between patients undergoing surgery for rotator cuff tear and patients treated successfully using MOON physical therapy program)

Realized Costs Savings = $11 million/per year
What Matters Most:
Patient Outcomes and the Transformation of Health Care

Value-based health care is no longer merely an aspiration, goal or an academic concept. It is happening now at Vanderbilt University Medical Center (VUMC) and Vanderbilt Department of Orthopaedics (VDO). Orthopaedics can lead the way. It is our ambition to become a trusted leader in value-based care for the musculoskeletal system for primary to tertiary disorders and rehabilitation. Our vision: clinical care emphasizing quality, outcomes and patient safety, encompassing education and research.

Growing our program in a manner consistent with our vision requires not only high quality physicians but a dedicated shared governance team committed to a culture of excellence and hard work. Improved communication between team members requires adopting new technologies and enhanced infrastructure. As we grow and learn, it has become apparent that one department, one hospital or one medical center cannot effectively improve quality alone. VDO, in partnership with VUMC, will develop a clinically integrated network with like-minded orthopaedic surgery groups to compare performance and understand how to improve and deliver the best outcomes. We feel confident this will provide the maximum benefit to our patients and that a key component of success will be the emphasis on physician-led quality initiatives.

Enclosed is our 2015 Quality and Patient Safety report. We want to make the results of our progress easily accessible to our patients and the public. Thank you for your interest.

Sincerely,

Herbert S. Schwartz, M.D.
Professor and Chairman
Vanderbilt Department of Orthopaedics

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Phone: (615) 322-0543, Fax: (615) 875-1079
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200 consecutive new patients presenting to 11 spine providers were contacted to take a standardized patient satisfaction phone survey. 40% of new patients were able to be contacted and agreed to participate.

Patient Characteristics That Affect Patient Satisfaction Scores in Spine Clinic

Patient satisfaction has become an important component of quality assessments. The purpose of this study was to investigate patient characteristics:

1: between patients participating vs. not participating in satisfaction surveys, and

2: potentially associated with lower satisfaction scores

Patients participating in the standardized patient satisfaction phone survey were older, were less likely to have commercial insurance, were more likely to be workers compensation patients, and were less gainfully employed.

Important to identify patient factors associated with satisfaction scores in order to develop strategies for improvement and standardization comparison of scores among providers.
**Patient Characteristics and the Relationship with Lower Satisfaction Scores**

Patient characteristics associated with lower scores across all 3 outcomes of interest were: younger age, less formal education, and smoking. Workers compensation patients also had lower scores compared to non-work related injury patients.

**Relationship of Insurance Type and Provider Satisfaction Scores**

- **Workers Compensation**: 7.8
- **Medicaid**: 8.7
- **Commercial**: 8.8
- **Medicare**: 9.3
Peri-articular Injections Versus Combined Femoral and Sciatic Nerve Blocks in TKA

Peri-articular injection has been shown to be equivalent in pain relief to femoral nerve blocks following total knee arthroplasty (TKA), and to be free of the associated complications of falls and nerve palsies.

Compare indwelling femoral nerve catheter (24 hrs) and single shot sciatic blocks to injection of ropivicaine, epinephrine, and toradol solution.

Peri-articular injections yielded:
- Improved pain relief
- Superior early ambulation and discharge
- No learning curve

82 CONSECUTIVE TKA PATIENTS WERE ENROLLED IN THIS STUDY.

LENGTH OF STAY

PERI-ARTICULAR INJECTION 2.7 DAYS

NERVE BLOCKS 3.3 DAYS

Length of stay significantly dropped in patients receiving peri-articular injections. More patients required an extended care stay in the nerve block study group, but it was not statistically significant.

Surgical site infection (SSI) rates for patients undergoing hip replacement surgery continues to decrease. In Quarter 2 of 2014 there were 3 surgical site infections out of 121 procedures completed. That number has since reduced to 0 surgical site infections for every 100 procedures completed since Quarter 3 of 2014. The SSI standardized infection ratio (SIR) calculated by the CDC provides an expected number of SSI events based on the risk makeup of the hip replacement population. In Quarter 4 of 2014 our SSI SIR was 0, below that of the CDC benchmark of 1.
We credit our low infection rate to several factors:
- Heavy physician oversight and review
- The creation of an atmosphere of awareness that encompasses all ASC personnel
- Strict adherence to protocols and standards

Surgical Site Infection Rates at a Single Specialty Outpatient Orthopaedic Surgery Center

Evaluate surgical site infection (SSI) rate compared to other single specialty, outpatient orthopaedic, ambulatory surgery centers (ASC).

When specifically looking at single specialty and orthopaedic outpatient infection rates, two recent studies found an infection rate of 0.38%\(^1\) and 0.33%\(^2\).

We present data from five consecutive years (2010-2014) showing an overall 0.17% surgical site infection rate at our ASC, half of published studies.


We credit our low infection rate to several factors:
• Heavy physician oversight and review
• The creation of an atmosphere of awareness that encompasses all ASC personnel
• Strict adherence to protocols and standards

INFECTION RATES AT SINGLE SPECIALTY OUTPATIENT ORTHOPAEDIC ASC

.38%
MITCHELL ARTICLE

.33%
EDMONSTON ARTICLE

.17%
VANDERBILT BONE & JOINT ASC
Pediatric Spinal Fusion Infection Prevention Safety Initiative with Topical Vancomycin Wound Application

Surgical Site Infection (SSI) rates after pediatric spinal deformity surgery may range from 1-5%, but may be as high as 24% in neuromuscular conditions.

Topical Vancomycin Powder has demonstrated efficacy in reducing SSIs in adult spine surgery. However, the safety has not been clearly defined in the pediatric population.

Average cost of pediatric spine SSI treatment: $150,000

**Drain Levels**

- Drain levels were supratherapeutic without approaching toxic levels to bone and soft tissue.

**Serum Levels**

- Nontoxic serum levels (<25 mcg/ml) were observed in the pediatric patient population.

No systematic effects or complications of vancomycin were observed.
Pediatric Supracondylar Humerus Fractures and Radiation Safety

Supracondylar humerus fractures (SCH) are a common pediatric injury that requires reduction and fluoroscopic guided pin fixation.

It is common practice to shield radiosensitive organs like the thyroid and gonads to minimize the iatrogenic risks of radiation-induced malignancy and genetic effects. Despite these concerns, the amount of radiation exposure to these organs outside the field of the beam has not been measured directly. We performed this study to ascertain the actual radiation exposure to these organs during this relatively common procedure.

Fluoroscopy times were recorded in a prospective cohort of patients (n=18) during closed reduction and pin fixation of SCH fractures, and radiation exposure to the thyroid and gonads was directly measured using sensors. To determine if the study group was representative of our practice, we then recorded fluoroscopy times in a statistically similar retrospective cohort of patients (n=163). Though fluoroscopy times were slightly longer in the control group, the difference was not statistically significant. We determined that the equivalent dose of radiation to radiosensitive organs in the study group was 0.01 mSv, which is a minimal amount approximating daily background exposure to ionizing radiation.

Though the results of this study suggest that the risk of iatrogenic exposure to radiosensitive organs is minimal, shielding of these organs (thyroid and gonads) should still be considered to further minimize the patient’s risk of radiation exposure. This may be more important for smaller patients whose radiosensitive organs will be closer to the edge of the beam or if longer fluoroscopy times are anticipated.
Typing accuracy was fairly consistent over the course of the study, with accuracy between 92 and 94% for all time points. Time was a statistically significant factor in a faster return to pre-surgery typing proficiency. There was a significant impairment in typing function on the first postoperative typing exam, with steady improvement from there, with a higher average typing speed at the 12-week postoperative typing exam than at the preoperative exam.

Typing Proficiency Following Carpal Tunnel Release Surgery

The purpose of this study was to investigate what patient factors are associated with a faster return to pre-surgery typing proficiency as measured by typing speed and accuracy.

An analysis of patient factors determined that worker’s compensation status was statistically significant, with a 0.26% higher typing speed among patients with compensation than those without. In addition, preoperative motor and sensory nerve conduction speed were statistically significant. An increase in preoperative median nerve sensory latency significantly correlated with an 8.3% increase in postoperative typing speed (p=0.04). An increase in preoperative median nerve motor latency significantly correlated with a smaller increase (5.8% less improvement per 1ms of motor latency) in postoperative typing speed (p=0.004). Age was not statistically significant and did not affect typing speed percentage.
Accuracy of MRI-based Diagnoses for Distal Upper Extremity Soft Tissue Masses

Soft tissue masses of the upper extremity are a common hand clinic patient complaint. While the majority of these are benign, locally aggressive and malignant soft tissue tumors can arise in the upper extremity. The accurate diagnosis of soft tissue masses prior to surgical intervention is crucial for preoperative planning.

Determine the accuracy of MRI-based diagnosis of soft tissue masses in the upper extremity by evaluating 139 patients who underwent an MRI followed by excision of a soft tissue mass. Compare MRI-based diagnosis to histological diagnosis.

While the accuracy of MRI-based diagnosis varied widely, there was an overall sensitivity of 75%. The most accurate diagnosis was of ganglion cysts with 94% sensitivity and specificity. Of particular concern, the MRI-based diagnosis of a malignancy was only 66.7% sensitive, with a positive predictor value of 44.4%.

While pre-operative MRI remains a valuable tool for the evaluation of soft tissue masses in the distal upper extremity, caution is warranted when basing the diagnosis on MRI evidence alone.
**Conclusion:** Unnecessary AIS are frequently performed and are a significant source of expense.

**Solution:** Imaging algorithms have been developed which may reduce unnecessary AIS.

---

**Overutilization and Cost of Advanced Imaging for Long-Bone Cartilaginous Lesions**

Long-bone cartilage lesions are frequently encountered in clinical practice. Once a lesion is identified, subsequent imaging studies are presumably ordered to distinguish between enchondromas and chondrosarcomas. Advanced imaging studies (AIS) have not been proven to reliably distinguish enchondromas from low-grade chondrosarcomas.

Evaluate AIS to determine if they alter patient management or are unnecessary expenditures. Two blinded radiologists independently reviewed the initial imaging study and determined if further imaging was indicated. Imaging was deemed unnecessary if it was not recommended by our radiologist after review of the initial imaging study.

- **AVERAGE NUMBER OF UNNECESSARY AIS PER ENCHONDROMA PATIENT:** 1
- **AVERAGE UNNECESSARY COST PER ENCHONDROMA PATIENT:** $1,346
- **Percentage of patients diagnosed with enchondroma that presented with AIS:** 85%
- **Sensitivity and Specificity:**
  - Enchondromas: 95%, 95%
  - Chondrosarcomas: 95%, 95%
- **Radiologist Interpretation Agreement:**
  - Radiologist 1: 87%
  - Radiologist 2: 90%
  - Overall: 100%
Narcotic Use and Postoperative Doctor Shopping in the Orthopaedic Trauma Population

Evaluate narcotic prescription utilization in orthopaedic trauma population. Single narcotic group (prescriptions from treating physician) vs. multiple narcotic group (prescriptions from treating physician & additional provider(s)). 8.5% Patients using narcotics preoperatively. 20% Patients were “doctor shopping” postoperatively.

RESPONSE: PROVIDE ADEQUATE, SAFE PAIN RELIEF.
- Use of the Tennessee Controlled Substance Monitoring Database prior to writing narcotic prescriptions
- Discussion with patients on who will manage their medications
- Educate patients preoperatively of limited time on narcotics
- No weekend or night refills
- Multimodal pain medication perioperatively
- Postoperative weaning plan for all patients

NUMBER OF PRESCRIPTIONS

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<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>![Single Provider Icon]</td>
<td>![Multiple Provider Icon]</td>
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DURATION OF NARCOTICS

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<tbody>
<tr>
<td>28 DAYS</td>
<td>109.9 DAYS</td>
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MORPHINE EQUIVALENT DOSE PER DAY

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<th>MULTIPLE PROVIDER:</th>
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<tbody>
<tr>
<td>26mg</td>
<td>43mg</td>
</tr>
</tbody>
</table>

INCREASED RISK FOR DOCTOR SHOPPING

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<thead>
<tr>
<th>Less than High School Education</th>
<th>Preop Narcotic Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.2</td>
<td>4.5</td>
</tr>
</tbody>
</table>

Education Level and Preoperative Narcotic Use

Education level and preoperative narcotic use were significant, independent predictors of multiple narcotic providers. Patients with a high school education or less were 3.2 times more likely to seek multiple providers, and patients with a history of preoperative narcotic use were 4.5 times more likely. There was significant increase in postop narcotic prescriptions, duration of postop narcotic use, and morphine equivalent dose per day among the multiple provider group.
Knee-specific patient-reported outcomes demonstrate significant improvement in patients who undergo ACL reconstruction. Although improvement is significant, patients who undergo ACL reconstruction do not reach the level of “normal.”

**MOON (Multicenter Orthopaedics Outcomes Network) Anterior Cruciate Ligament (ACL) Reconstruction Surgery Outcomes and Predictors**

Allograft material used for ACL reconstruction produces significantly worse outcomes in younger patients. Patients in the age group of 10 to 19 years had the highest percentage of graft failures. The odds of graft rupture are 4 times higher than those of autograft reconstructions.

**KOOS PROFILE OVER TIME**

**SIGNIFICANT PREDICTORS OF EACH OUTCOME SCALE AT 6 YEARS (P VALUES)**

**OTHER IMPORTANT FINDINGS**

- The contralateral normal knee ACL is at a similar risk of ACL tear (3%) as the ACL graft after primary ACL reconstruction (3%).
- Economic modeling using the MOON ACL data demonstrates that early ACL reconstruction is more effective (as determined by improved Quality Adjusted Life Years and lower cost) than rehabilitation plus optional delayed ACL.
Decreasing Wound Complications in the Surgical Treatment of Calcaneus Fractures

Retrospective review to compare wound complication rates following surgical intervention of calcaneus fractures utilizing standard extensile lateral or mini open approach techniques.

A total of 47 patients with 50 calcaneal fractures underwent primary surgical fixation. 56% were treated using standard extensile lateral incision and 44% using small mini open approach.

This study demonstrated a substantial decrease in the incidence of wound complications with the use of the mini open technique.

**POSTOPERATIVE WOUND COMPLICATION RATE**

<table>
<thead>
<tr>
<th>Surgical Approach</th>
<th>Wound Complication %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mini-Open</td>
<td>4.5%</td>
</tr>
<tr>
<td>Extensile Lateral</td>
<td>46.6%</td>
</tr>
</tbody>
</table>

Postoperative wound complications were seen in 46.6% of the fractures in the extensile lateral approach group compared to only 4.5% of fractures in the mini open approach group. The occurrence of wound complications was significantly different (p<0.001) between the two surgical approaches.

**WOUND COMPLICATION TREATMENT PATH**

- **Local Wound Care and Antibiotics**
  - Mini-Open: 100%
  - Extensile Lateral: 0%

- **Surgical Debridement and IV Antibiotics**
  - Mini-Open: 84.3%
  - Extensile Lateral: 15.4%

15.4% of wound complications within the extensile lateral approach group required surgical debridement and IV antibiotics, compared to 0 in the mini open group.

47 patients with 50 calcaneal fractures underwent primary surgical fixation.
The past few months took us on a wild ride of emotions and surprise in which there were many changes. The election, the Cubs, warm weather and wildfires top the list. President-elect Donald Trump announced that he will nominate Rep. Tom Price, M.D. (R., Ga.), our orthopaedic colleague from the northern suburbs of Atlanta, for Secretary of the U.S. Department of Health and Human Services. Rep. Price visited our program and spent a day with us a year or two after he introduced his own plan to replace the Affordable Healthcare Act (AHA, or Obamacare) in 2013. Rep. Price also introduced his plan, “Empowering Patients First Act” as actual legislation. The Price plan is notable for reforms that doctors care about.

- Patient choice is promoted over mandates.
- Tort reform through the creation of Best Practice guidelines developed in collaboration with physician specialty societies.
- Creation of state health care tribunals to arbitrate malpractice claims.
- Replace AHA subsidies with health insurance tax credits (age-based) or health savings accounts for consumers who do not have coverage from their employer, Medicare, Medicaid or the VA.

Will a Price-type plan be competitive with the AHA on covering the uninsured? Costs will require analysis and review. The possibility for debate is refreshing. “Every time we start a new project, we always ask ourselves the same question: What can we do better and different?” [Ricardo Guadalupe].

In the Department of Orthopaedic Surgery and Rehabilitation at Vanderbilt University Medical Center, one thing has not and will not change. Our commitment to patient service, safety and the delivery of top-shelf quality medical care remains immutable. Enclosed please find our fourth annual patient safety, quality and outcomes publication. Divisional studies are reported that detail a variety of observations we have investigated that we hope will improve the value of care we deliver and the education we promote.

Finally, in addition to news, highlights and recent academic productivity from the Department, our opening section details with great sadness the passing of two icons dear to us all. Drs. Art Brooks (1924-2016) and Neil Green (1940-2016) both died in July. Every one of us has strong personal memories for these storied stalwarts of our Department for whom we are thankful to have known or learned about. Art and Neil founded the edifice upon which we exist and grow along with Drs. Bill Hillman (1921-1970) and Dan Spengler. Our sympathies are extended to their families and we are grateful to the many alumni and friends who attended their funerals and honored their memories with contributions.

Sincerely,
Herbert S. Schwartz, M.D.
Professor and Chairman
Dan Spengler M.D. Chair in Orthopaedics
Vanderbilt Department of Orthopaedic Surgery
MCE South Tower, Suite 4200
Nashville, TN 37232-8774
Phone: 615.322-0543, Fax: 615.875-1079
herbert.s.schwartz@vanderbilt.edu
Remembering Two Vanderbilt Orthopaedic Icons

2016 saw the passing of two Vanderbilt Orthopaedic doctors who made tremendous contributions to the department and university, the field of orthopedics and generations of surgeons. Arthur L. Brooks, M.D., an innovator of surgical techniques and mentor to younger surgeons, died July 28 at the age of 91. Neil E. Green, M.D., a pioneer in pediatric orthopaedics and passionate educator, died July 9 at the age of 75.

A Legacy of Service, Innovation and Mentorship

Brooks’ remarkable history with Vanderbilt began in 1952, when he received his medical degree here. He completed residencies in general and orthopaedic surgery at Vanderbilt before serving at Charity Hospital in New Orleans from 1959 to 1962. Following his return to Vanderbilt in 1963, he became known as an expert surgeon, dedicated mentor and patient advocate. He twice served as acting chairman of Orthopaedics (1970-79, 1981-83) and also as chief of the Department of Orthopaedics at the VA hospital in Nashville from 1974 until his retirement in 1984. Before the advent of the Monroe Carell Jr. Children’s Hospital at Vanderbilt, Brooks was an integral part of what was then called the Crippled Children’s Clinic, where he cared for thousands of young patients over the years.

In 1985, Vanderbilt Medical Center dedicated the Arthur L. Brooks Center for Education and Research in Orthopaedics in his honor. The Vanderbilt Orthopaedic Society, a group composed of his former residents and colleagues, also established the Arthur L. Brooks Endowment for Resident Education, which supports equipment and programs to enhance resident education. Brooks’ combination of compassion and clinical expertise positively impacted the lives of individuals as well as the Vanderbilt Department of Orthopaedics.

“He left such a great mark on our program that basically anybody who came through the program from 1963 forward knew what he stood for and realized how important he was in the development of our Department of Orthopaedics,” said friend and colleague Douglas Weikert, M.D., associate professor of Orthopaedics and Rehabilitation.

Weikert recalls that, while at Charity Hospital, Brooks treated a disabled child who had been abandoned on a doorstep. The child spoke no English and was crippled by a spinal deformity from Potter’s disease. Other surgeons said nothing could be done, but Brooks researched and performed a new surgical procedure for the condition. With a second chance at life, the young boy recovered, learned English, and went on to become an accountant.

A specialist in hand surgery, Brooks’ innovations include procedures for the correction of rheumatoid hand deformities and the control of mechanical instability in the cervical spine. Surgeons who trained with him benefitted from his heartfelt personal mentorship, including Saturday breakfasts at the Pancake Pantry and sharing tomatoes he grew on his farm.

Gregory Mencio, M.D., director of Pediatric Orthopaedics at Monroe Carell Jr. Children’s Hospital at Vanderbilt, and Neil E. Green professor and vice chairman of the Department of Orthopaedics, got to know Brooks through his continued presence at grand rounds, conferences and chief resident graduation events, even after he retired.

“With all great teachers, Brooks understood the importance of lifelong learning,” Mencio said. “His legacy as a leader, mentor, colleague and patient advocate is an important example for all of us in orthopaedics and academic medicine. His lessons and folksy wisdom continue to impact the professional lives of those he trained directly as well as several next generations of Vanderbilt Orthopaedic residents and surgeons.” [Read more here]

A Prolific Pioneer and Passionate Educator

Green always knew that he wanted to be an orthopaedic surgeon, like his father, and went on to become an international leader in the field. After serving as a surgeon in the U.S. Air Force, he joined Vanderbilt Department of Orthopaedics and Rehabilitation as an assistant professor in 1976.

Over the course of 38 years, Green served as vice chairman of the department, director of Pediatric Orthopaedics, director of the residency program and chairman of the Vanderbilt Hospital Medical Board. The Neil E. Green Lectureship at Vanderbilt recognizes Green’s many contributions in advancing the missions of education, research and advocacy of the orthopaedic profession, as well as his impact on the next generation of orthopaedic surgeons.

Green left an indelible mark on orthopaedics and treatments for children. He helped change the way surgeons care for pediatric patients with femur and forearm fractures, and his research on bracing for children with scoliosis helped introduce part-time bracing as an effective treatment. He was the editor of Skeletal Trauma in Children, later renamed Green’s Skeletal Trauma in Children; authored more than 100 articles and book chapters; and gave more than 200 presentations and guest lectures in the United States and across the world. Acknowledging his great contributions, the American Orthopaedic Association honored him as the Alfred Sands Guest lecturer.

“Neil’s surgical acumen impacted tens of thousands of young lives. He used his immense skills and warm, outgoing demeanor to help many children and their parents through often difficult circumstances related to injury or illness. I know many of them developed a deep affection for him, as did his colleagues,” said C. Wright Pinson, MBA, M.D., Deputy Chief Executive Officer and Chief Health System Officer for Vanderbilt University Medical Center.

Green’s clinical expertise was matched by his commitment to resident education, said Herbert S. Schwartz, M.D., chairman of the Vanderbilt Department of Orthopaedics.

“Amongst so many accolades, it is resident education that stands out in my memories. Neil transformed the culture of our orthopaedic residency and surgical education through his example and vision,” Schwartz said.

After stepping down as director of Pediatric Orthopaedics in 2006, Green continued to serve as professor of Orthopaedic and Rehabilitation and associate professor of Pediatrics. Upon his retirement, he was honored by friends and colleagues at a reception in January 2015. At that time, he reflected on his years at Vanderbilt, saying “I have seen a marked transformation in Children’s Hospital since I began my career at Vanderbilt. In the beginning there was a Children’s Hospital in name, which was part of the main hospital. With the help of Drs. Ian Burr and Jim O’Neill we were able to create what is one of the best children’s hospitals in the country.”

Mencio remembers Greens as the “consummate academic medical surgeon.”

“He was a skilled clinician and surgeon, but his true passion was resident education. He has rightfully earned the gratitude of so many patients, and his contributions to pediatric orthopaedics will continue to improve the care of children for many years,” Mencio said. “He has had a profound impact at Vanderbilt that extends beyond the Department of Orthopaedics. His legacy lives on through the many residents and fellows he has trained who share his professional and philosophical values and the respect of his peers and associates.”

Green also served as president of the Pediatric Orthopaedic Society of North America, the American Board of Orthopaedic Surgery, the Southern Orthopaedic Association, the Tennessee Orthopaedic Society and the Nashville Orthopaedic Society, among others. [Read more here]
Vanderbilt University Medical Center is the Safest Trauma Center in the Country!

Hospitals were ranked on: mortality, complications, inpatient quality, core process, patient safety and patient satisfaction. Only 10% of hospitals received the highest rating. Vanderbilt Medical Center was in the highest rating in all categories and was the overall #1 ranked. Another Nashville-based trauma center was ranked 364 of 370. Read more here.

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</table>

370 trauma centers were ranked on mortality and quality outcomes. Vanderbilt University Medical Center was ranked the #1 safest hospital for Trauma in the country by CareChex Quality Rating System.

Impact of Preoperative Expectations and Fear of Movement on Return to Sport and KOOS Scores at 6 Months following ACL Reconstruction

The purpose of this study was to examine the association between preoperative psychosocial characteristics and return to sport and sports function at 6 months after ACLR. A secondary objective was to examine the importance of psychosocial characteristics to knee-specific quality of life (QOL). 54 patients between the ages of 18 and 33 undergoing a primary, unilateral ACLR were enrolled. Patients completed questionnaires before surgery and 6 months after surgery.

- Patient expectations for having a successful surgery were assessed with a 10-item numeric rating scale.
- Preoperative fear of movement was assessed with the Tampa Scale for Kinesiophobia (TSK-13).
- Preoperative self-efficacy was assessed with the General Self-Efficacy Scale (GSES) and Knee Self-Efficacy Scale (KSES).
- Outcomes included Subjective Patient Outcome for Return to Sports (SPORTS) score and Knee Injury and Osteoarthritis Outcome Score (KOOS) sports/ recreation and QOL subscales.

KOOS scores improve over time (p < 0.05).

**MULTIVARIABLE MODELS**

**SPORTS**

<table>
<thead>
<tr>
<th>Variable</th>
<th>B</th>
<th>SE</th>
<th>t</th>
<th>p</th>
<th>95% CI</th>
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<tr>
<td>Preoperative Expectations</td>
<td>-0.75</td>
<td>0.32</td>
<td>-3.65</td>
<td>&lt;0.01</td>
<td>(-1.38, -0.22)</td>
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</tbody>
</table>

**KOOS Sports/Recreation**

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<th>t</th>
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<th>95% CI</th>
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</thead>
<tbody>
<tr>
<td>Activity Avoidance</td>
<td>0.74</td>
<td>0.17</td>
<td>4.37</td>
<td>&lt;0.01</td>
<td>(0.33, 1.14)</td>
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<tr>
<td>Preoperative Expectations</td>
<td>-1.4</td>
<td>1.1</td>
<td>-1.25</td>
<td>0.03</td>
<td>(-3.52, 1.72)</td>
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</table>

**KOOS Quality of Life**

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<th>SE</th>
<th>t</th>
<th>p</th>
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<tr>
<td>Preoperative Expectations</td>
<td>-0.74</td>
<td>0.32</td>
<td>-2.31</td>
<td>0.02</td>
<td>(-1.37, -0.11)</td>
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</tbody>
</table>

Higher preoperative activity avoidance scores were significantly associated with not returning to sport at the same level of effort and performance as before onset of impairment (OR = 0.59, p = 0.03), and worse scores on the KOOS QOL subscale (B = -0.7, p = 0.03) at 6-month follow-up. Higher preoperative expectations were a significant risk factor for worse outcomes on the KOOS subscales, with a 5.0-point increase in expectations associated with a 5.0-point decrease in KOOS sports/rec (p = 0.03) and 4.7-point decrease in KOOS QOL (p = 0.05) scores.

**6 MONTH FOLLOW-UP RATE**

- Perform same sport at same level of effort but reduced performance compared to before onset of impairment.
- Perform same sport at same level of effort and performance as before onset of impairment and with pain.
- Perform same sport at same level of effort and performance compared to before onset of impairment.
- Unable to return to sport

The 6-month follow-up rate was 93%. 96% of patients reported returning to sport 6 months after ACLR, with 46% returning to same pre-injury level of effort and performance.

Screening patients for fear of movement and unrealistic expectations prior to ACL reconstruction may help identify patients at risk for poorer outcomes. Targeted psychosocial rehabilitation strategies that address activity avoidance related to fear and expectations have the potential to improve return to sport at the same level of effort and performance and knee-specific health outcomes during the early recovery period.
This study provides valuable insight into variations in outcomes, and 90-day costs among the surgeons performing lumbar laminectomy/fusions at a single institution. Specific surgeons were found to have greater odds of performing high-cost surgeries. Adjusting for preoperative comorbidities, however, led to costs that were higher than the actual costs for certain surgeons and lower than the actual costs for others. Therefore, it is imperative to involve surgeons in the decision-making and to consider variability in cost at the individual surgeon level after adjusting for complexity of the patient population managed by each surgeon. This study can form the basis to stimulate action to improve uniformity and cost-containment for lumbar fusion surgery.
Orthopaedic Oncology Outcomes Report 2016

Cost-Utility of Osteoarticular Allograft vs. Endoprosthetic Reconstruction for Primary Bone Sarcoma of the Knee: A Markov Analysis

Primary bone sarcoma is a rare and potentially devastating diagnosis, with only 2/3 of osteosarcoma and Ewing's sarcoma patients surviving 5 years. Limb salvage surgery options are equivalent to local tumor control, and perhaps functionally superior to an amputation. The objective of this study was to determine the most cost-effective surgical strategy for primary bone sarcoma about the knee considering neither option is proven to be clinically superior. Transitional probabilities were derived from a review of current literature reconstruction option for proximal tibia and distal femur.

Osteoarticular allograft reconstruction is more cost-effective than a full price endoprosthetic reconstruction for primary bone sarcoma of the distal femur or proximal tibia. However, discounted endoprostheses are cost-effective and seem to be the favored strategy over allografts on sensitivity analysis.

### Incremental Cost Effectiveness Ratio Results

<table>
<thead>
<tr>
<th>Intervention</th>
<th>Cost Per Model Cycle</th>
<th>Cost Difference</th>
<th>Effectiveness in QALYs</th>
<th>Increased Effectiveness in QALYs</th>
<th>Incremental Cost Effectiveness Ratio (ICER)</th>
<th>Dominant (Strategy Rejected)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allograft</td>
<td>$64,534.72</td>
<td>$13,502.28</td>
<td>2.29</td>
<td>$414.07/QALY gained</td>
<td>N/A</td>
<td>Undominated</td>
</tr>
<tr>
<td>Endoprosthesis</td>
<td>$46,232.23</td>
<td></td>
<td>2.196</td>
<td>$6.149/QALY gained</td>
<td>X</td>
<td>Undominated</td>
</tr>
</tbody>
</table>

This cost-effectiveness analysis used health-state utilities and quality-adjusted life years for full price allografts and full price/discounted endoprosthesis price. The full price endoprosthesis strategy was rejected in favor of allograft usage.

### Sensitivity Analysis: Full-Price Endoprosthesis

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Intervention Model Value</th>
<th>Range</th>
<th>Allograft Dominated (Rejected)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost</td>
<td>Allograft $33,693.27</td>
<td>0-570,000</td>
<td>$34,300</td>
</tr>
<tr>
<td></td>
<td>Endoprosthesis $52,241.81</td>
<td>0-570,000</td>
<td>$51,450</td>
</tr>
<tr>
<td>Complication Rate</td>
<td>Allograft 0.0524</td>
<td>0-0.3</td>
<td>&gt;0.057</td>
</tr>
<tr>
<td></td>
<td>Endoprosthesis 0.0641</td>
<td>0-0.65</td>
<td>&lt;0.026</td>
</tr>
<tr>
<td>Revision Rate</td>
<td>Allograft 0.1261</td>
<td>0-0.6</td>
<td>&gt;0.048</td>
</tr>
<tr>
<td></td>
<td>Endoprosthesis 0.1693</td>
<td>0-0.6</td>
<td>&lt;0.15</td>
</tr>
</tbody>
</table>

### Sensitivity Analysis: Discount Endoprosthesis

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Intervention Model Value</th>
<th>Range</th>
<th>Allograft Dominated (Rejected)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost</td>
<td>Allograft $33,693.27</td>
<td>0-570,000</td>
<td>$32,050</td>
</tr>
<tr>
<td></td>
<td>Endoprosthesis $35,659.81</td>
<td>0-570,000</td>
<td>$31,050</td>
</tr>
<tr>
<td>Complication Rate</td>
<td>Allograft 0.0524</td>
<td>0-0.3</td>
<td>&lt;0.014</td>
</tr>
<tr>
<td></td>
<td>Endoprosthesis 0.0641</td>
<td>0-0.65</td>
<td>Never</td>
</tr>
<tr>
<td>Revision Rate</td>
<td>Allograft 0.1261</td>
<td>0-0.6</td>
<td>&gt;0.034</td>
</tr>
<tr>
<td></td>
<td>Endoprosthesis 0.1693</td>
<td>0-0.6</td>
<td>Never</td>
</tr>
</tbody>
</table>

Costs include: surgical excision, reconstruction costs, implant or allograft material costs, and Medicare Diagnosist Related Group (DRG) base reimbursement for procedure. Among the literature reviewed, the average rate of allograft bone grafting was 18% and cost $11,707.24, and the average rate of endoprosthesis bushing exchanges was 3% and the average cost was $12,711.15.
### Review of Air Transportation Use for Upper Extremity Amputations at a Level-1 Trauma Center

Air transportation to tertiary care centers of patients with upper extremity amputations has been utilized in hopes of reducing the time to potential replantation; however, this mode of transportation is expensive and not all patients will undergo replantation. The purpose of this study was to review the appropriateness and cost of air transportation in upper extremity amputations. Consecutive patients transported by aircraft with upper extremity amputations to our level-1 trauma center over a 7-year period were reviewed.

Overall, 47 patients were identified with 43 patients going to the operating room, but only 14 of those patients undergoing replantation. Air transportation cost on average was $20,482, with only 62% being paid by the patient or insurer. Despite the additional cost for air transportation, it is not clear that it meets its objective of expediting transfer to optimize viability of the amputated appendage for replantation.

### Mechanism of Injury and Treatment

<table>
<thead>
<tr>
<th>Mechanism</th>
<th>Number of Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clean cut</td>
<td>13</td>
</tr>
<tr>
<td>Crush</td>
<td>7</td>
</tr>
<tr>
<td>Avulsion</td>
<td>6</td>
</tr>
</tbody>
</table>

13 of the 47 patients (28%) had clean-cut amputations while 34 patients (72%) sustained avulsion or crush injuries. The main reason cited in this study for not replanting was a crush or avulsion mechanism for 70% (23/33) of patients.

### Level of Amputation and Treatment

<table>
<thead>
<tr>
<th>Level of Amputation</th>
<th>Number of Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zone I</td>
<td>14</td>
</tr>
<tr>
<td>Zone II</td>
<td>12</td>
</tr>
<tr>
<td>Zone III</td>
<td>10</td>
</tr>
<tr>
<td>Zone IV</td>
<td>8</td>
</tr>
<tr>
<td>Zone V</td>
<td>6</td>
</tr>
<tr>
<td>Forearm</td>
<td>4</td>
</tr>
<tr>
<td>Elbow</td>
<td>2</td>
</tr>
<tr>
<td>Humerus</td>
<td>1</td>
</tr>
</tbody>
</table>

14 of the 47 patients (30%) had clean-cut amputations while 34 patients (72%) sustained avulsion or crush injuries. The main reason cited in this study for not replanting was a crush or avulsion mechanism for 70% (23/33) of patients.

### Transfer Characteristics

<table>
<thead>
<tr>
<th>Reason for Referral</th>
<th>Number of Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Hand Surgeon</td>
<td>197.6</td>
</tr>
<tr>
<td>Replant Candidate</td>
<td>189.1</td>
</tr>
<tr>
<td>Complexity of Injury</td>
<td>117.1</td>
</tr>
<tr>
<td>Ischemia Time</td>
<td>105.4</td>
</tr>
<tr>
<td>Presurgery Time</td>
<td>64.5</td>
</tr>
<tr>
<td>Transport Time</td>
<td>237.5</td>
</tr>
<tr>
<td>Injury to Arrival</td>
<td>429.6</td>
</tr>
</tbody>
</table>

13 of the 47 patients (28%) had clean-cut amputations while 34 patients (72%) sustained avulsion or crush injuries. The main reason cited in this study for not replanting was a crush or avulsion mechanism for 70% (23/33) of patients.

A hand surgeon was contacted before transportation on 23 (49%) occasions. 10 of these patients underwent replantation versus 4 of 15 and 0 of 9 patients, when emergency physicians or emergency medical technicians made the decision to transfer.

Patients were brought by aircraft to the tertiary hand surgery center with a mean time of 182.3 minutes following injury, which includes 105.2 minutes of transportation time. The pre-surgery time of those who underwent replantation was 154.6 minutes compared to 237.5 minutes for those that were revised in an operating room.
Patients’ Experience and Expectations of Lumbar Spine Surgery for Degenerative Conditions: A Qualitative Study

The purpose of this study was to examine the factors that influence the decision to have surgery, expectations for recovery, and satisfaction in patients who undergo lumbar spine surgery. 20 patients participated in interviews and 12 patients participated in focus groups to provide information on the decision to have surgery and the recovery process.

Decision to have surgery was influenced by:
- Level of physical, social and emotional impairments resulting from chronic pain
- Poor quality of life and daily functioning
- Trusted physician recommending surgical intervention
- Failure of conservative care and minimal relief from over-the-counter and/or narcotic medication

A better understanding of patient expectations is important for optimal recovery and patient satisfaction. Recommendations for postoperative management include strategies to increase patient engagement, decrease fear and anxiety, and provide emotional and social support.

Orthopaedic Residency Outcomes Report 2016

Reasons Given for Leaving Residency

- 43% Transferred Specialty
- 34% Dismissal
- 7% Withdraw
- 7% Health/Personal
- 5% Transferred Ortho
- 1% Unknown

Fields Entered by Residents Who Transferred

- 30% Radiology
- 25% Emergency
- 13% Anesthesia
- 7% General Surgery
- 7% Family Medicine
- 5% PM&R
- 2% Neurosurgery
- 2% Psychiatry
- 2% Internal Medicine
- 2% Pathology

Characteristics of Residents who Left Orthopaedic Residency Compared to Overall Sample Group

- Study Cohort who Left Residency (avg. program size 22.3)
- Total Survey Respondents Class of 2013-14 (avg. program size 23)

The demographic characteristics of those residents who left compared to the overall sample group show a statistically significant increase for females, those without a significant other and those without children. There was no difference in rates of attrition based on ethnicity or class size that the resident came from.
A Novel Classification System Based on Dissemination of Musculoskeletal Infection Is Predictive of Hospital Outcomes

Children affected by musculoskeletal infection have highly variable hospital courses, which seem to depend upon infection severity. Early stratification of infection severity would therefore help to maximize resource utilization and improve patient care. On the basis of this, the purpose of the study was to develop a severity classification system that differentiates patients based on total infection burden and the degree of dissemination of the infection. The new classification system was then applied retrospectively to a cohort of pediatric patients with musculoskeletal infection and hospital outcomes were compared between the groups.

A newly developed classification system for pediatric musculoskeletal infection correlates with hospital outcomes and markers of the inflammatory response. The advantage of this novel classification system is that it can be applied to different types of musculoskeletal infection and is complimentary to the previous practice of differentiating musculoskeletal infection based on the primary diagnosis. Early identification of disease severity in children with musculoskeletal infection has the potential to enhance hospital outcomes through more efficient resource utilization and improved patient care.

### A Novel Classification System Based on Dissemination of Musculoskeletal Infection

#### Definitions of Infection Severity

<table>
<thead>
<tr>
<th>Definition</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inflammation</td>
<td>All of the following must be true:</td>
</tr>
<tr>
<td></td>
<td>* Negative local culture</td>
</tr>
<tr>
<td></td>
<td>* Negative blood culture</td>
</tr>
<tr>
<td></td>
<td>* The criteria for local or disseminated infection are not met</td>
</tr>
<tr>
<td></td>
<td>Transient synovitis</td>
</tr>
<tr>
<td>Local Infection</td>
<td>One of the following must be true:</td>
</tr>
<tr>
<td></td>
<td>* Imaging diagnostic for osteomyelitis or pyomyositis in 1 anatomic site</td>
</tr>
<tr>
<td></td>
<td>* Local culture positive AND/OR fluid/tissue consistent with infection</td>
</tr>
<tr>
<td></td>
<td>* One positive blood culture</td>
</tr>
<tr>
<td></td>
<td>* The criteria for disseminated infection are not met</td>
</tr>
<tr>
<td></td>
<td>Isolated distal femoral osteomyelitis with no subperiosteal abscess</td>
</tr>
<tr>
<td>Disseminated Infection</td>
<td>For 2 or more anatomic sites, at least one of the following must be true:</td>
</tr>
<tr>
<td></td>
<td>* Imaging diagnostic for osteomyelitis or pyomyositis</td>
</tr>
<tr>
<td></td>
<td>* Local culture positive AND/OR fluid/tissue consistent with infection</td>
</tr>
<tr>
<td></td>
<td>* Two or more positive blood cultures</td>
</tr>
<tr>
<td></td>
<td>* Thromboembolic disease</td>
</tr>
<tr>
<td></td>
<td>Distal fibular osteomyelitis with subperiosteal abscess</td>
</tr>
<tr>
<td></td>
<td>Septic hip with surrounding muscle</td>
</tr>
<tr>
<td></td>
<td>Pyomyositis</td>
</tr>
</tbody>
</table>

3-tiered stratification system developed by the authors to separate patients into inflammation, local infection and disseminated infection based on operation definitions developed by a multi-disciplinary panel of specialists.

### Peak Laboratory Values During Hospitalization

<table>
<thead>
<tr>
<th>Peak Laboratory Values</th>
<th>Inflammation (n=52)</th>
<th>Local Infection (n=46)</th>
<th>Disseminated Infection (n=104)</th>
<th>N</th>
<th>H/2 df</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>CRP (mg/L)</td>
<td>5.30 (2.25-17.75)</td>
<td>53.80 (23.79-49.33)</td>
<td>110.8 (59.63-232.7)</td>
<td>202</td>
<td>100.1</td>
<td>2</td>
</tr>
<tr>
<td>ESR (mm/h)</td>
<td>15.00 (11.00-20.00)</td>
<td>36.00 (17.75-71.25)</td>
<td>70.00 (45.25-92.00)</td>
<td>201</td>
<td>78.25</td>
<td>2</td>
</tr>
<tr>
<td>WBC (thou/µL)</td>
<td>11.45 (8.65-13.65)</td>
<td>10.70 (9.20-14.80)</td>
<td>12.90 (10.55-17.00)</td>
<td>199</td>
<td>10.29</td>
<td>2</td>
</tr>
<tr>
<td>Temperature (°F)</td>
<td>98.6 (98.2-99.3)</td>
<td>100.4 (98.9-102.3)</td>
<td>102.7 (100.8-103.3)</td>
<td>198</td>
<td>68.47</td>
<td>2</td>
</tr>
</tbody>
</table>

Univariate analysis was performed using Kruskal-Wallis test for continuous variables. Values presented represent the median and the 25th to 75th percentile range. *Significant value (P<0.05). df indicates degrees of freedom. H, Kruskal-Wallis statistic.

Peak CRP, ESR, WBC and temperature, which are key markers of inflammation, were higher in patients stratified into a more severe infection category.
PRISM Team Helps Pediatric Orthopaedic Patients

Launched in 2015, an interdisciplinary pilot program known as Pediatric Perioperative Interdisciplinary Surgery Home (PRISM) has improved the care of 50 patients undergoing hip surgeries at Monroe Carell Jr. Children’s Hospital at Vanderbilt, and has generated data to demonstrate the effectiveness of the changes.

The PRISM protocol includes giving patients medications before surgery to reduce incidence and severity of pain and the need for opioids; during surgery, spinal anesthesia and intravenous anesthesia are used rather than inhaled anesthesia. Patients have experienced better recoveries, with less opioids for pain, fewer post-surgery complications and shorter hospital stays due to better recoveries, with less opioids for pain, fewer post-surgery complications and shorter hospital stays due to a transformation in the way surgeries are handled.

Shelbey Mitchell of Chapel Hill, Tennessee, saw first-hand the benefits of PRISM. She was 17 in 2014 when she had a periacetabular osteotomy at Children’s Hospital, after which she experienced significant pain, difficulty staying alert, and extreme nausea. But in 2016, when Jonathan Schoenecker, M.D., Ph.D., assistant professor of Orthopaedics and Rehabilitation and Pediatric Orthopaedics, performed the same surgery on Mitchell’s other hip, the improvement in her recovery was remarkable — she had less pain, more alertness and a regular appetite. She quickly tackled the challenges of physical therapy so she could go to cheerleading camp at the end of July.

In April, the PRISM protocol was expanded to include patients undergoing pectorus excavatum surgery and those with post-dural puncture headaches, and there are plans to expand to surgical areas where it’s felt patients can benefit. Schoenecker is eager to add the protocol to his other orthopedic surgeries.

“Usually by the third day after one of these big surgeries, the intense inflammatory response goes away, and the patient starts to look a lot better,” Schoenecker said. “On our old pain protocols, that’s when we would start physical therapy because the patient could not really do anything worthwhile up until that point. Now, you’ll go by a patient’s room the first day after surgery, and they’re wide awake and can talk to you. They have discomfort, but they can start physical therapy. Typically by two or three days after surgery, they are really, really wanting to go home.”

Hip Preservation Surgery Puts Teen Back On Track

By the time Kedrick Wilbanks came to Vanderbilt Department of Orthopaedics, the 15-year-old could hardly walk. He was born with hip dysplasia, which didn’t bother him until he was hit in the hip with a football helmet during a tackle. After that, he was constantly re-injuring the joint, sometimes from just turning the wrong way, and his condition worsened each time.

His mother, Vickie Wilbanks, said that her son went through multiple pairs of crutches while they sought treatment from the gamut of orthopaedic doctors and physical therapists in their hometown of Chattanooga. But her son wasn’t getting better, and each health care provider eventually said there was nothing left to be done.

When they sought yet another opinion at Vanderbilt, Kedrick was referred to Jonathan Schoenecker, M.D., Ph.D. Under his care, Kedrick underwent hip preservation surgery just a few days after his 16th birthday. He then faced nine months of physical therapy, a year of home-school (because he couldn’t walk up the stairs at school), and nearly two years without playing sports.

“The recovery was much more mental than physical because I was forced to sit down when I was used to doing multiple sports. I was used to being an athlete all day, every day,” said Kedrick, who played football and basketball and ran track.

By the time he was ready to return to sports, he decided to focus solely on track. He was nervous, though, about how his hip would handle a full-on sprint.

“I was afraid to reinjure myself,” Kedrick said. “But once I won my first race, I was good to go.”

That race was the first of many that Kedrick would win. In true comeback form, Kedrick won the state title for the 100-meter dash in May, and placed third in the 200-meter dash. In June he took second place in the 100-meter at the New Balance National Outdoor youth track and field meet. He’s also placed 7th nationally at the Junior Olympics, and has qualified for the New Balance National Indoor track and field competition in March.

“It was a very grueling process, but the results were fantastic, I think. The physicians were great. My hip is very good now. I like to say I’m faster.”

His mom echoes the positive experience with Schoenecker and his team. “The team was phenomenal, and he had a really good support staff,” she said. “They explained everything; they were really open to questions. They said ‘Any time you have questions, don’t hesitate to call’ — and they’d mean it, and they’d get back to you. It really meant a lot.”

Watching her teenage son learn to walk again was emotional, she said, but now that Kedrick is healed and strong, she jokes that instead of a car for his 16th birthday, he got his stride back.
In July, Vanderbilt Sports Concussion Center held a seminar titled “Sports Concussion: The State of the Science,” for health care professionals, athletic trainers and school officials. The seminar covered a broad range of topics, including concussion treatment, long-term effects of the brain injury, efforts by the National Football League (NFL) to prevent head trauma, and a former professional hockey player’s account of dealing with post-concussion syndrome (PCS).

Alex Diamond, D.O., MPH, assistant professor of Pediatrics and Orthopaedics and Rehabilitation, served as a speaker at the seminar. He revealed that the state is working with experts from the Vanderbilt Sports Concussion Center to develop a “return to learn” guide that would help schools better manage academic activities for concussed athletes. This complements the “return to play” guidelines that were established when Tennessee implemented a sports concussion law in 2014. Read more here.

New Faculty

Kevin Dale, M.D., joins Vanderbilt Department of Orthopaedics as assistant professor of Orthopaedic Surgery and Rehabilitation and will practice in pediatric orthopaedics. Dale completed a residency and fellowship in orthopaedic surgery at the University of Wisconsin, as well as an orthopaedics medicine fellowship at Duke University. His clinical interests include pediatric anterior cruciate ligament injuries, osteochondritis dissecans, adolescent shoulder instability and adolescent hip injuries.

Jeffrey Kutsikovich, M.D., joins Vanderbilt Department of Orthopaedics as assistant professor of Clinical Orthopaedic Surgery and will practice at Vanderbilt Bone and Joint. He completed his residency at the University of Tennessee Health Science Center – Campbell Clinic and a fellowship at the Indiana Hand to Shoulder Center. His clinical interests include treatment of disorders of the hand, wrist, elbow and shoulder.

Byron Stephens, M.D., joins Vanderbilt Department of Orthopaedics as assistant professor of Orthopaedic and Rehabilitation and will practice at Vanderbilt Orthopaedics and the Vanderbilt Spine Center. He completed his residency at the Campbell Clinic in Memphis, Tenn., and a fellowship at Emory University. He enjoys taking care of all spinal conditions but has a special clinical and research interest in scoliosis and spinal tumors.

Emeritus Faculty

Dan Spengler, M.D., former chairman of Department of Orthopaedics and Rehabilitation, retired after 33 years of service to the institution. In honor of his accomplished career, Spengler was recognized as emeritus faculty on July 1, 2016. Spengler joined Vanderbilt in 1983 as the fourth chairman of the Department of Orthopaedics and Rehabilitation and served in that role until 2009, after which he remained on faculty as professor of Orthopaedics and Rehabilitation and professor of Neurological Surgery until his retirement in 2016.

During his 26 years as chair, the department grew in scope and size. Spengler’s expertise in patient care has been recognized by Castle Connolly and Best Doctors. He also received the Volvo Award for Low Back Pain Research in 1990, the Kappa Delta Award for Outstanding Orthopaedic Research in 1991, and the Cervical Spine Research Society Award for Outstanding Basic Science Research in 1998.

Spengler has published more than 125 peer-reviewed articles and has lectured throughout the world. He also was elected to a nine-year term on the American Board of Orthopaedic Surgery, serving as president from 1993 to 1994. He served as president of the American Orthopaedic Association in 2003-04 and served on the board of trustees for the Journal of Bone and Joint Surgery for six years, including two years as treasurer.

Professional News

Jeffrey E. Martus, M.D., M.S., served as editor for Orthopaedic Knowledge Update Pediatrics. S published September 2015. The guide was developed in partnership with the Pediatric Orthopaedic Society of North America (POSNA) and features new techniques, new approaches and current controversies in treatment of pediatric musculoskeletal injuries.

"It was an honor and privilege to participate in this project," Martus said. "It was a great experience. I enjoyed working with the section editors and authors to produce this new edition of OKU Pediatrics.”

Andrew Gregory, M.D., associate professor of Orthopaedic Surgery and Pediatrics, served as the team physician for the men’s and women’s volleyball teams at the 2016 Summer Olympics in Rio. Both teams won bronze medals, which Gregory wears here.

Jeffry S. Nyman, Ph.D., was promoted to associate professor of Orthopaedics and Rehabilitation on June 1, 2016. Nyman earned a Ph.D. in Biomedical Engineering at the University of California Davis followed by a post-doctoral fellowship at the University of Texas at San Antonio. He relocated to Vanderbilt in 2006 with Gregory Mundy, M.D. and team to establish the Vanderbilt Center of Bone Biology (VCBB). Since joining the Department of Orthopaedics and VCBB, Nyman has received VA Career Development and Merit Awards, an NIH R01, multiple R21 awards, as well as NSF and DOD funding. Nyman says, “The ultimate goal of my research is to lower the number of bone fractures associated with diabetes, aging, osteoporosis, cancer, and genetic diseases.” His current research program involves the assessment of structural, architectural, compositional, and biomechanical properties of bone from genetic and pre-clinical models of disease. Congratulations to Nyman on his promotion.

5 Vanderbilt Orthopaedists were named to 2016 Nashville Best Doctors List. Read more here.
In July, Nyman, associate professor of Orthopaedics and Rehabilitation, received funds for two NIAMS R21 awards. R21AR070620 is a multi-PI award in collaboration with Katherine Thrailkill, M.D., Pediatric Endocrinologist at the University of Kentucky Barnstable Brown Diabetes and Obesity Center. Their proposal, titled Effects of Sodium-dependent Glucose Co-transporter 2 Inhibition on Bone seeks to utilize several relevant rodent models to investigate potential mechanisms contributing to the adverse effects of sodium-dependent glucose co-transporter 2 (SGLT2)-inhibitor therapy on the skeleton.

Recognizing that a lifelong increased risk for fragility fracture is now an established comorbidity of diabetes, a better understanding of the effects of SGLT2 inhibitors on bone health is both timely and highly relevant to the future of diabetes treatment. Nyman is Principal Investigator of R21AR067871, The Role of Tissue Matrix in the Fracture Resistance of Diabetic Bone. Nyman and his team propose to test clinically translatable techniques that are sensitive to bone matrix properties as potentially new informative predictors of fracture resistance in type 2 diabetes. They also propose to define the underlying molecular changes in the matrix contributing to the diabetes-related increase in bone fragility. This research could provide new diagnostic techniques for fracture risk prediction as well as new targets for improving fracture resistance.

Nyman’s co-investigators include Mark Does, Ph.D., professor of Biomedical Engineering at Vanderbilt University and Paul Voziani, Ph.D., research associate professor of Medicine/Nephrology and member of Vanderbilt Center for Matrix Biology, as well as, Daniel Perrien, Ph.D., assistant professor of Medicine/Clinical Pharmacology and member of the Vanderbilt Center for Bone Biology.

Results from the proposed study will provide an evidence-based resiliency instrument that can be integrated into rehabilitation care in the military setting with the end goal of improving rehabilitation outcomes. This study will also provide critical data on resiliency as a predictor of rehabilitation outcomes.

Co-investigators at SAMMC are Jason Wilken, P.T., Ph.D., Director, Military Performance Laboratory, Center for the Intrepid, and Daniel Stinner, M.D., Medical Director, Center for the Intrepid. Other co-investigators are David Schlundt, Ph.D., associate professor of Psychology and Director of Qualitative Research Center, Vanderbilt University along with Stephen Wegener, Ph.D., professor and director of Rehabilitation Psychology in the Department of Physical Medicine and Rehabilitation at Johns Hopkins School of Medicine.
Adolescent Athletes: Outcomes of


25

 Legislatures should work together to ensure that individuals with disabilities have equal access to all aspects of political participation. To achieve this goal, we recommend the following actions:

1. **Legislative Mandates:**
   - Encourage states to adopt laws that explicitly protect and promote the participation of individuals with disabilities in the political process.
   - Provide funding and resources to support the development and implementation of these laws.

2. **Public Awareness Campaigns:**
   - Develop and disseminate public awareness campaigns that educate the general population about the importance of ensuring equal access to political participation for all citizens, including those with disabilities.
   - Highlight successful examples of inclusive political participation practices and strategies.

3. **Training and Education:**
   - Incorporate disability inclusion training into public officials’ orientations and ongoing training programs.
   - Offer workshops and seminars that focus on the specific challenges faced by individuals with disabilities in the political process.

4. **Accessibility Improvements:**
   - Increase federal funding for projects that improve physical, technological, and procedural accessibility in political facilities and events.
   - Encourage the use of accessible voting technologies and systems.

5. **Support for Candidates and Activists:**
   - Provide financial support and resources for candidates with disabilities who are running for political office.
   - Fund organizations that support political participation by individuals with disabilities.

6. **Monitoring and Evaluation:**
   - Establish mechanisms to monitor the implementation of policies and practices promoting equal access to political participation.
   - Regularly review the outcomes of these efforts to ensure their effectiveness.

By taking these steps, we can work towards a future where every voice is heard and every vote counts, regardless of an individual’s ability status. As leaders, it is our responsibility to ensure that our political systems are truly inclusive for all citizens.

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**References:**


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The above text is a fictional example and does not reflect any real political legislation or initiatives.

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