Important Pathologies
Fractures

• Traumatic
  • Simple vs. Compound vs. Comminuted
  • Stable vs. Unstable
  • Open vs. Closed
  • Site (e.g. intra-articular, mid-shaft)

• Pathologic
  • Osteoporosis
  • Neoplasms
Causes of Osteoporosis

- **Disuse**
  - Prolonged bed rest or general inactivity
  - Algodystrophy
  - Paralysis (paraplegia, quadriplegia, hemiplegia, lower motor neuron disease)
  - Space travel (weightlessness)

- **Diet**
  - Deficiency of calcium, protein, vitamin C
  - Alcoholism
  - Anorexia nervosa

- **Drugs**
  - Heparin
  - Methotrexate
  - Ethanol
  - Glucocorticoids

- **Idiopathy**
  - Adolescent (10–18 yrs)
  - Middle-aged male

- **Genetic disorders**
  - Osteogenesis imperfecta
  - Homocystinuria

- **Chronic illness**
  - Rheumatoid arthritis (juvenile, adult)
  - Cirrhosis
  - Sarcoïdosis
  - Renal tubular acidosis

- **Neoplasms**
  - Bone marrow tumors (myeloma, lymphoma, leukemia, mast cell)

- **Pituitary**
  - ACTH hypersecretion, tumor

- **Adrenal cortex**
  - Glucocorticoid excess (hyperplasia, tumor, iatrogenic)

- **Endocrine abnormalities**
  - Ovary
  - Testis
  - Parathyroid
  - Thyroid
  - Estrogen deficiency (postmenopausal, genetic, ovariectomy)
  - Testosterone deficiency (genetic, castration, age)
  - Hyperparathyroidism (primary, secondary)

- **Postmenopausal**
  - Type I osteoporosis

- **Age-related**
  - Type II osteoporosis
  - Male
  - Female
Osteoporosis: Clinical Manifestations

Appendicular

Axial
Deformity from Spinal Osteoporosis
Canine Metacarpal, 40 wks immobilization
Single-Photon Absorptiometry
Dual-Photon Absorptiometry
Quantitative Computed Tomography (QCT)
Bone Biopsy (Trans-iliac)
Arthritis

- Rheumatoid Arthritis
- Osteoarthritis
  - Primary
  - Secondary
Joint Pathology in Rheumatoid Arthritis
Synovial Membrane Changes in Rheumatoid Arthritis
Advanced Hand Involvement in Rheumatoid Arthritis
Foot Involvement in Rheumatoid Arthritis
Major Joint Involvement in Rheumatoid Arthritis
Joint Pathology in Osteoarthritis
Knee Joint
Osteoarthritis
Hand Involvement in Osteoarthritis
Overall Economics

- US GNP \approx $9 \text{ trillion}

- Health care: 14\% of US GNP ($1.26 \text{ trillion})

- UIHC: Orthopaedic billings in 2001 were 8.1\% of total hospital billings

- Orthopaedics: a $100 \text{ billion}^* \text{ “industry”}
Prevalence of Reduced Bone Density

Years of Age

Percent of Women

50-59 years 60-69 years 70-79 years 80 years and over

Osteopenia Osteoporosis

1988-91
Incidence of Rheumatoid Arthritis

> 35 y.o., Rochester MN
Prevalence of Arthritis

1992-94

Prevalence Rates per 1,000

Age

0-17 18-44 45-64 65-74 75 and over

Males  Females
Incidence of Bone Cancer
# Musculoskeletal Neoplasms

<table>
<thead>
<tr>
<th></th>
<th>Incidence (Rate per 1,000,000 persons)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>White Male</td>
</tr>
<tr>
<td>Bone and Joint</td>
<td></td>
</tr>
<tr>
<td>Osteosarcoma</td>
<td>4.1</td>
</tr>
<tr>
<td>Chondrosarcoma</td>
<td>3.5</td>
</tr>
<tr>
<td>Ewing’s Sarcoma</td>
<td>1.6</td>
</tr>
<tr>
<td>Soft Tissue</td>
<td>29.7</td>
</tr>
<tr>
<td>Multiple Myeloma</td>
<td>49.0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Survival Rates (percent of cases)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>White Male</td>
</tr>
<tr>
<td>Bone and Joint</td>
<td></td>
</tr>
<tr>
<td>Osteosarcoma</td>
<td>51</td>
</tr>
<tr>
<td>Chondrosarcoma</td>
<td>43</td>
</tr>
<tr>
<td>Ewing’s Sarcoma</td>
<td>68</td>
</tr>
<tr>
<td>Soft Tissue</td>
<td>39</td>
</tr>
<tr>
<td>Multiple Myeloma</td>
<td>55</td>
</tr>
</tbody>
</table>
Short-Stay Hospitalizations

1995

Total = 30 million (excludes childbirths)
Musculoskeletal Hospitalizations

- Musculoskeletal and Connective Tissue Disorders: 49.2%
- Fractures: 29.8%
- Other Injury: 5.6%
- Other Musculoskeletal Conditions: 2.7%
- Complication or Reaction*: 3.7%
- Neoplasms: 3.5%
- Congenital Anomalies: 0.9%
- Dislocation and Sprains: 4.6%

* Implants or Grafts

1995
<table>
<thead>
<tr>
<th>Procedure</th>
<th>Number of Procedures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open Reduction of Fracture</td>
<td>423,000</td>
</tr>
<tr>
<td>With Internal Fixation</td>
<td>414,000</td>
</tr>
<tr>
<td>Other Reduction of Fracture</td>
<td>151,000</td>
</tr>
<tr>
<td>Excision or Destruction of Intervertebral Disk</td>
<td>273,000</td>
</tr>
<tr>
<td>Spinal Fusion</td>
<td>160,000</td>
</tr>
<tr>
<td>Arthroplasty and Replacement of Knee</td>
<td>312,000</td>
</tr>
<tr>
<td>Total Knee Replacement</td>
<td>216,000</td>
</tr>
<tr>
<td>Revision of Knee Replacement</td>
<td>18,000</td>
</tr>
<tr>
<td>Arthroplasty and Replacement of Hip</td>
<td>264,000</td>
</tr>
<tr>
<td>Total Hip Replacement</td>
<td>134,000</td>
</tr>
<tr>
<td>Revision of Hip Replacement</td>
<td>29,000</td>
</tr>
<tr>
<td>Partial Hip Replacement</td>
<td>97,000</td>
</tr>
<tr>
<td>Arthroplasty and Repair of Upper Extremity</td>
<td>87,000</td>
</tr>
<tr>
<td>Excision of Bone for Graft</td>
<td>40,000</td>
</tr>
<tr>
<td>Amputation of Lower Limb</td>
<td>237,000</td>
</tr>
<tr>
<td>Amputation of Toe</td>
<td>49,000</td>
</tr>
<tr>
<td><strong>Total, All Listed Musculoskeletal Procedures</strong></td>
<td><strong>3,001,000</strong></td>
</tr>
</tbody>
</table>

1995
Arthroplasty Procedures, by Site

- Hand, Finger, or Wrist: 1.1%
- Other: 1.0%
- Shoulder: 12.4%
- Hip: 38.5%
- Knee: 47.0%

Annual Average 1993-1995 = 648,000
## Cause for Total Hip Replacement

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>Percent of Total Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Osteoarthritis and Allied Disorders</td>
<td>70.2%</td>
</tr>
<tr>
<td>Aseptic Necrosis of Bone, Nonunion/Malunion of Fracture, Pathological Fractures, and Other Bone Disorders</td>
<td>9.6%</td>
</tr>
<tr>
<td>Fracture of Neck of Femur</td>
<td>7.4%</td>
</tr>
<tr>
<td>Complication of Implant</td>
<td>3.2%</td>
</tr>
<tr>
<td>Rheumatoid Arthritis and Other Inflammatory Polyarthropathies</td>
<td>2.4%</td>
</tr>
<tr>
<td>Other and Unspecified Arthropathies</td>
<td>2.4%</td>
</tr>
<tr>
<td>All Other</td>
<td>4.8%</td>
</tr>
</tbody>
</table>

1993 - 95
Cost of Hip Reconstruction

- **Endoprosthesis**: $450-$600
- **Modular endoprosthesis**: $575-$800
- **Bipolar prosthesis**: $1,500-$2,000
- **Total hip prosthesis**: $1,600-$2,500

- **Lowest reimbursement**: $6,500
- **Average reimbursement**: $9,900
- **Highest reimbursement**: $12,000

- Highest implant cost as a percentage of lowest reimbursement (38%)
- Lowest implant cost as a percentage of highest reimbursement (4%)
Cost of Total Hip Replacement

- **Low-cost prosthesis**: $1,200-$1,600
- **High-tech prosthesis—cemented**: $2,000-$2,500
- **High-tech prosthesis—cementless**: $3,500-$4,500

- **Lowest reimbursement**: $7,100
- **Average reimbursement**: $9,500
- **Highest reimbursement**: $14,200

- Highest implant cost as a percentage of lowest reimbursement: 63%
- Lowest implant cost as a percentage of highest reimbursement: 8.5%
Cost of Total Knee Replacement

- **Polyethylene tibial component**
  - $2,500-$3,000
  - Lowest reimbursement: $6,500
  - Average reimbursement: $9,000
  - Highest reimbursement: $14,000

- **Metal-backed tibial component — cemented**
  - $3,000-$3,500

- **Total knee prosthesis — cementless**
  - $3,500-$4,500
  - Highest implant cost as a percentage of lowest reimbursement: 70%
  - Lowest implant cost as a percentage of highest reimbursement: 18%
Cost of Total Shoulder Replacement

- **Hemiarthroplasty**: $900-$1,200
  - **Lowest reimbursement**: $4,100
  - **Average reimbursement**: $6,100
  - **Highest reimbursement**: $9,500

- **Total replacement—cemented**: $2,000-$2,500
  - Highest implant cost as a percentage of lowest reimbursement: 85%
  - Lowest implant cost as a percentage of highest reimbursement: 9.5%

- **Total replacement—cementless**: $2,500-$3,500
Visits to Physician Offices

System or Disease Category

- Musculoskeletal Conditions**
- Respiratory System
- Nervous System/Sense Organs
- Circulatory System
- Genitourinary System
- Skin & Subcutaneous System
- Mental Disorders
- Endocrine, Nutritional & Metabolic
- Digestive System
- Infectious & Parasitic Diseases
- Neoplasms

1995

Millions

- 98.6
- 98.4

- 72.3
- 51.6
- 38.6
- 34.0
- 31.7
- 27.1
- 26.7
- 23.1
- 19.6
Cost of Musculoskeletal Conditions

Total: $215 Billion

1995
Categories of Direct Costs

- Hospital Care: $33.6 billion
- Physician Services: $14.9 billion
- Other Practitioners: $2.7 billion
- Drugs: $2.5 billion
- Home Health Care: $0.9 billion
- Nursing Home Care: $19.2 billion
- Administration: $4.7 billion
- Nonhealth Sector: $11.0 billion

Year: 1995
## Changes in Musculoskeletal Disease Costs

<table>
<thead>
<tr>
<th>Type of Cost</th>
<th>1988</th>
<th>1995</th>
<th>Percent Change</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Direct Costs, Total</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hospital Inpatient</td>
<td>$22,137</td>
<td>$19,878</td>
<td>$−10.2</td>
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<tr>
<td>Hospital Outpatient</td>
<td>$5,600</td>
<td>$13,749</td>
<td>$145.5</td>
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<tr>
<td>Physician Inpatient</td>
<td>$3,159</td>
<td>$4,152</td>
<td>$31.4</td>
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<tr>
<td>Physician Outpatient</td>
<td>$4,008</td>
<td>$10,765</td>
<td>$168.6</td>
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<tr>
<td>Other Practitioners</td>
<td>$2,507</td>
<td>$2,726</td>
<td>$8.7</td>
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<tr>
<td>Home Health Services</td>
<td>*</td>
<td>$936</td>
<td></td>
</tr>
<tr>
<td>Drugs</td>
<td>$680</td>
<td>$2,532</td>
<td>$272.4</td>
</tr>
<tr>
<td>Nursing Home Care</td>
<td>$12,391</td>
<td>$19,231</td>
<td>$55.2</td>
</tr>
<tr>
<td>Prepayment/Administration</td>
<td>$2,934</td>
<td>$4,711</td>
<td>$60.6</td>
</tr>
<tr>
<td>Nonhealth Sector</td>
<td>$7,571</td>
<td>$10,955</td>
<td>$44.7</td>
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<tr>
<td><strong>Indirect Costs, Total</strong></td>
<td>$64,975</td>
<td>$126,218</td>
<td>$94.3</td>
</tr>
<tr>
<td>Morbidity</td>
<td>$59,619</td>
<td>$111,928</td>
<td>$87.7</td>
</tr>
<tr>
<td>Mortality†</td>
<td>$5,356</td>
<td>$14,290</td>
<td>$166.8</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>$125,962</td>
<td>$214,917</td>
<td>$70.6</td>
</tr>
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</table>
Orthopaedic Implants