Patient-Reported Functional Outcomes:

How to Collect and Report Risk-Adjusted Musculoskeletal Patient-Reported Functional Outcome Data in an Orthopaedic Practice

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Patient-Reported Outcome Task Force

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How to Collect and Report Risk-Adjusted Musculoskeletal Patient-Reported Functional Outcome Data in an Orthopaedic Practice

This paper was initially commissioned by the California Orthopaedic Association (COA) in 2013. Jill R. Glassman, PhD, MSW and Lisa Unti, MPH of ETR were the principal researchers. The goal of the paper was to provide recommendations on practical, cost-effective processes and standards to encourage more widespread, consistent use of patient-reported outcome (PRO) instruments for orthopaedic surgeons treating shoulder, hand, spine, foot and ankle conditions. Specifically, the objectives were to:

- Educate COA members about the importance of beginning to collect PRO data from their patients;
- Identify the most appropriate, standardized, validated instruments for assessing PROs in patients with musculoskeletal conditions within the named sub-specialties;
- Identify processes and software tools by which these instruments can be administered routinely in clinical practice settings, both pre- and post-procedures;
- Identify PRO data flow issues – e.g., compatibility and integration with Electronic Medical Record/Electronic Health Record (EMR/EHR) systems; and,
- Educate COA members about issues surrounding interpretation and analysis of PRO data in a risk-adjusted manner.

The report outlined available validated PRO for the various orthopedic specialties that had not been previously highlighted. ETR attempted to find data that would support risk adjustment based upon patients' co-morbidities for practices that administered PRO to their patients. ETR determined that, at that time, there was not reliable or sufficient data about normative populations with co-morbidities who had undergone orthopedic surgical procedures to provide a valid body of data for comparison to peri-operative patients that orthopaedists would encounter in their practices. Several years ago, Cardiothoracic Surgeons collected data regarding peri-operative infection and re-admissions in their STS database that was not properly risk adjusted. As a result, some surgeons' surgical performance data was erroneously misinterpreted by public reporting agencies. Orthopaedics has the same problem. Currently the orthopaedic registries do not collect risk adjusted PRO data. Orthopaedic surgeon's peri-operative complication rates are not risk adjusted for more than a minimal number of measures by Medicare. Medicare's current risk adjustment methodology is flawed as their own tools fall below the cutoff for predictive ability and were intended for non-PRO outcome measures such as readmission, peri-operative infection, peri-prosthetic fractures and mortality. https://www.ncbi.nlm.nih.gov/m/pubmed/26604220/

The complete COA 2013 White Paper can be found at: http://coa.org/wp-content/uploads/2015/03/WhitePaperPROsFINAl.pdf

Patient-reported outcomes (PROs), also called patient-reported functional outcomes are being widely recognized as critical tools to improve care management by enabling clinical providers to, in real-time, assess the results of their treatments for the purpose of continuous quality improvement (CQI). Historically, PROs were used routinely in controlled research studies as part of developing evidence-based practices. Now, their promise is to help clinicians ensure they are providing care that is likely to result in the best outcomes for patients, adjusted for various risk profiles. The demand for objective, useable measurement tools is driving the identification, development and study of standardized tools most appropriate for specific disease areas. Risk prediction tools should satisfy the three priorities of enhancing the informed consent process, guiding risk mitigation efforts, including reversible co-morbidities, and calculating accurate risk adjusted outcomes https://www.ncbi.nlm.nih.gov/m/pubmed/26604220/

The Centers for Medicare and Medicaid Services (CMS) have started to require that surgeons collect pre-and post-operative PRO data, particularly for total joint replacement procedures in the Comprehensive Care for Joint Replacement (CJR) demonstration project mandated in many cities nationwide. MACRA and MIPS will require collection and submission of quality measurement data in order to avoid downward penalty payments. The final rules will be announced at the end of October, 2016. It is not likely that any EMR system will realistically be prepared to collect and submit quality data on January, 2017. Group health payors are expected to follow the CMS lead. This PRO data will allegedly help to provide objective quality measurements, which will therefore determine some component of reimbursement levels to surgeons. Thus, begins the shift from volume to value based reimbursement for care.

Some healthcare systems voluntarily enrolled in the CJR program. Many of those smaller, lower volume systems have experienced a few re-admissions that have turned the program payment balance into a substantially negative balance with regards to the fixed payments that were received for patients undergoing total joint replacement surgery. When the data is examined in some of these centers, the re-admissions occurred in patients who had substantial underlying co-morbidities. One significant problem with the CMS CJR project is that the CJR does not permit the collection or submission of data that would allow risk adjustment for recognized co-morbidities in these patients. CMS's own risk adjustment methodology is flawed and does not take into account many of the currently recognized co-morbidities that should result in risk adjustment for patients undergoing surgical intervention. https://www.ncbi.nlm.nih.gov/m/pubmed/26604220/

In the original White Paper, it was important for orthopaedic surgeons to understand the full scope and functionality of possible patient-reported outcome data tools. In the last 3 years, the business climate and payor demands on surgeons to report outcome data has changed dramatically. Payors, including CMS, are starting to consolidate around and require a more limited number of data reporting tools. For example, CMS in CJR mandated counties and Blue Shield in California are requiring patient-reported outcome data to be reported using the HOOS, Jr and KOOS, Jr. for patients undergoing hip and knee arthroplasty as well as health measures such as VR-12. These abbreviated reporting tools have resulted in a higher percentage of patients providing feedback. Other payors may require other reporting tools.

The decision as to which PRO tool will be used for spine, shoulder, elbow, hand, hip, knee, or ankle and foot patients is quickly being taken away from the surgeon and is being decided by the payors. It is now critical that surgeons understand the risk associated with taking patients to surgery and how co-morbidities and other risk factors can affect outcomes. Surgeons need to educate payors to these issues, so that surgeons who take patients with these co-morbidities to surgery can be risk-adjusted when evaluating their outcomes.

Co-Morbidity and Risk Adjustment for Patients Undergoing Orthopaedic Surgery

National orthopaedic sub-specialties are taking a more active role in identifying and recommending the most effective data collection tools to their members. The American Academy of Orthopaedic Surgeons formed the Quality Outcomes Data (QOD) Work Group made up of representatives of the national orthopaedic sub-specialty organizations, to investigate and evaluate data collection tools. The Work Group published a report in March, 2016 which can be found at: http://www.coa.org/docs/WhitePapers/AAOSQualityTaskForce.pdf

To improve patient compliance, the data collection tools are becoming more straightforward with fewer and more focused questions.

The American Association of Hip and Knee Surgeons (AAHKS) has worked with CMS and the Surgical Outcomes Group at Yale University in an attempt to determine which identifiable patient co-morbidities can assist with risk adjustment for outcomes such as readmission and mortality in patients undergoing orthopedic surgical procedures.

The result of the AAHKS committee's work resulted in a publication entitled, "AAHKS Primer on Orthopedic Risk Stratification and Co-Morbidity Coding" by Frank Voss, MD, David Halsey, MD, Thomas Fehring, M.D. and the AAHKS Risk Adjustment Task Force. The AAHKS Primer can be found at: http://www.coa.org/docs/WhitePapers/AAHKSPrimer.pdf

While the AAHKS Task Force performed yeoman's work in starting to define co-morbidity for patients undergoing hip and knee arthroplasty, they did not define patient peri-operative risk factors that are associated with risk adjustment for patients undergoing shoulder, elbow, hand, spine, foot and ankle surgery or sports related reconstruction procedures. Their Primer also asked AAHKS participants to help to improve their documentation within their in-patient facility based EMRs by including a list of various risk factors when they appear in patient history and physical examination.

COA's Patient-Reported Outcome Task Force was convened to determine if there is currently enough data in the various orthopedic subspecialty literature or specialty societies to permit simultaneous collection of co-morbidity data that would permit risk adjustment of PRO data at this time. This should also occur in a fashion that would not just be for research purposes, but allow the clinician to determine how their patients are truly functioning prior to and after orthopedic surgery. Some of the goals of risk adjustment include proper informed consent, identifying correctable risk factors, determining which environment is most suitable for patients to undergo operative intervention and subsequent post-operative care. There are many risk adjusting tools cited in an article by Manning (https://www.ncbi.nlm.nih.gov/m/pubmed/26604220/). Most of these models score in the 70% range for overall accuracy of predictability.

Even though pain, function and health assessment PROMIS questionnaires are available for various areas of the body and are license free, they appear to be primarily for aggregate population evaluation and are not as useful as the Hip injury and Osteoarthritis Outcome, Jr. (HOOS, Jr.) and the Knee injury and Osteoarthritis Outcome, Jr. (KOOS, Jr.) for hip and knee surgery. PROMIS are apparently also not widely used for other orthopedic subspecialties.

Co-morbidity and risk adjustment assessments should help clinicians decide which patients are more suitable for an outpatient surgical environment and who might require the resources of an inpatient facility and skilled nursing or acute rehab post-operatively. The current system encourages "cherry picking" and can reduce patient access to qualified care in their local communities. Many of these patients are unnecessarily shifted to the most expensive hospitals in the country which can be located far away from their homes. Most communities have sufficient resources to take care of patients with mild to moderate co-morbidities. Patients with severe co-morbidities might not fare well with orthopedic surgery in any health care environment, tertiary or community.

We need to start to collect and tabulate co-morbidity and patient-reported outcome data in a fashion that will permit assembly of a normative data base for our communities. We should not use this data to penalize practitioners who attempt to mitigate poor peri-operative outcomes.

We can eventually use this data to establish "best practices" and attempt to match patients to the environment where they will experience the optimal peri-operative outcomes. The data currently being released to the public by reporting agencies is not in the strictest sense, properly risk-adjusted.

In the case of purely elective procedures, we would hope that modifiable factors such as anemia, nutritional status and smoking status can attempt to be mitigated or modified in advance of the procedure so that outcomes are optimized. In some cases, there may be a "hard ceiling" (e.g., if a patient has hemoglobin levels below a certain defined floor) so that elective procedures are delayed until the patient is a better surgical risk. Individual surgeons may set their own "hard ceilings."

Ultimately a goal can be to use collected normative co-morbidity data to help calculate the risk of various potential peri-operative complications for a specific individual patient based on complex risk calculators. In this way we can then provide calculated risk of complications such as infection, readmission and venous thromboembolism to the individual patient at the preoperative visit. Risk calculators estimate the chance of an unfavorable outcome (such as a complication or death) after surgery. The risk is estimated based upon information the patient gives to the health care provider about prior health history. The estimates are calculated using data from a large number of patients who had a similar surgical procedure to the one the patient is undergoing. Surgical risk calculators are only estimates. The risk estimate only takes certain information into account. There may be other factors that are not included in the estimate which may increase or decrease the risk of a complication or death. These estimates are not a guarantee of results. A complication after surgery may happen even if the risk is low. (ACS NSQIP Website - http://riskcalculator.facs.org/RiskCalculator/) If the percentage risk of a peri-operative complication is documented for an individual patient in the chart, it enhances the informed consent and shared decision-making with that patient in advance of the procedure.

Our hope is that this discussion will lend itself to further work to define known risks for individual patients for known co-morbidities that help payors understand the unique surgical risks associated with that patient and help to insure that reimbursement rates are set in such a way that surgeons who choose to take on patients with "known risk as defined by co-morbidity" are appropriately compensated if they choose, in consultation with the patient, to operate in a milieu of increased or adjusted risk.

In addition, physicians should improve their documentation of patient co-morbidities in their peri-operative admission notes in their electronic charting as this may eventually start to show up in CMS and hospital databases. We have included in the White Paper a list of potential co-morbidities/risk factors that can be associated with negative outcomes in patients undergoing orthopaedic surgery. Some of these have support in the various subspecialty literature and others do not yet have published support.

Potential Orthopaedic Co-morbidities/Risk Factors:

The following is a list of co-morbidities that may be applicable to the musculoskeletal patient and should be considered by the orthopaedic surgeon prior to surgery:

- Alcoholism - Chronic
- Allergies – Metal, Suture
- Angular Deformity >15 degrees
- Anticoagulant use – Chronic
- Bacterial Colonization - Chronic Pre-op
- Catastrophic Thinking
- Chondrosis
- Chromosomal Translocation
- Chronic Pain Syndrome
- Collagen Vascular Disorder-Rheumatoid Arthritis, Lupus, Psoriatic Arthritis – often Immunocompromised - Ehlers/Danlos Syndrome
- Congenital Deformities of Operative Region
- C-Reactive Protein (CRP)
- COPD
- Depression/Psychiatric Disorders
- Diabetes - Not Well Controlled-HgA1c above 7.0
- Dialysis

- DVT or PE – history of
- Emotional Health
- Erythrocyte Sedimentation Rate (ESR)
- Fractures – Acute/Open
- Fragility
- Heart Disease
- Hemophilia
- Hemoglobin Levels
- Hepatitis C - Chronic Active
- Increased Age – over 80 years of age
- Infection – Active or Previous at Surgical Site
- Insulin - Long-term Use of
- Intra-Articular Infection (previous)
- Liver Disease - Chronic
- Medications – Statins
- Metabolic Syndrome
- Narcotic Use – Chronic - Opioid Abuse, Continuous
- Neurological Disorders –Chronic – Parkinson, prior CVA, Polio, Peripheral Neuropathy, Epilepsy
- Non-Prescription Drug Dependence
- Nutrition Deficiency-low Albumin
- Obesity – Morbid - BMI >40
- Open Reduction of Internal Fixation (ORIF) of a Body Region
- Osteoporosis - Severe - BMD >3.5
- Peripheral Neuropathy
- Peripheral Vascular Disease
- Peritoneal
- Renal Failure-BUN/CR-GFR
- Revision Surgery
- Skin Disorders – Chronic
- Sleep Apnea – Obstructive
- Socioeconomic Factors
- Steroid or Immunosuppressive Medication Usage - Chronic
- Suture or Metal Allergy
- Systemic Inflammatory Disease- Rheumatoid Arthritis, Psoriatic Arthritis, Ankylosing Spondylitis, Gout
- Tobacco Dependency - Smoking
- Ulceration of the Body Area - current or past
- Vascular Disease
- Venous Stasis Disease
- Worker's Compensation Case - Adverse Effects of Work Environment
- Wound Healing Problems (history of) or Plastic Reconstruction of Wound

Other Risk Factors:

- Family Support
- Facility where procedure will be performed
- Ability to engage in pre-op learning
- Primary care provider
- Surgeon's experience
- Surgical TEAM factors – Anesthesia (regional and multi-modal experience)
- Therapy Services

- Race

Demographic Information that is helpful in assessing risk:

- Alcohol Use
- Revision Surgery
- Heart Disease
- Diabetes
- Rheumatoid Arthritis
- Peripheral Vascular Disease
- Peripheral Neuropathy
- History of DVT or PE
- Socioeconomic Status
- Race
- Incarceration

Some risk factors are modifiable and should be discussed with the patient prior to surgery and improved if possible. Some risk factors are absolute and cannot be improved prior to surgery.

Risk factors need to be clearly documented in the patient's record. This will likely be the responsibility of the surgeon. They could also serve as a checklist in the hospital medical record.

These risk factors may not apply to pediatric patients or trauma care.

Co-morbidities/risk factors by orthopaedic sub-specialty

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See Table A for a summary of co-morbidities by orthopaedic sub-specialty.

Co-morbidities/risk factors by orthopaedic sub-specialty

Hand and Wrist

Diabetes
Impact of Diabetes on Outcomes in Hand Surgery.
Brown, E., & Genoway, K. A. (2011). *Journal of Hand Surgery*, *36*(12), 2067–2072.

Peri-operative Management of Diabetic Patients Undergoing Hand Surgery.
Kang, J. R., & Yao, J. (2015). *Journal of Hand Surgery,* 40(5), 1028–1031.

Outcome after carpal tunnel release: impact of factors related to metabolic syndrome.
Zimmerman M1, Dahlin E1, Thomsen NO1, Andersson GS2, Björkman A1, Dahlin LB. *Journal on Plastic Surgery of the Hand,* 2016 Jul 28:1-7. [Epub ahead of print]

Narcotic use – Chronic (limited literature on this)
Outcome of Endoscopic Carpal Tunnel Release in Patients With Chronic Non-hand Pain Compared With Those Without Chronic Pain. Follmar, K. E., Chetelat, M. D., & Lifchez, S. D. (2012). *Journal of Hand Surgery*, 37(8), 1585–1590.

Morbid obesity (BMI > 45)
The Impact of Obesity on Complications of Elbow, Forearm, and Hand Surgeries.
London, D. A., Stepan, J. G., Lalchandani, G. R., Okoroafor, U. C., Wildes, T. S., & Calfee, R.P. (2014). *Journal of Hand Surgery*, *39*(8), 1578–1584.

Open Fractures (Gustilo-Anderson Type 3)
Factors Influencing Infection Rates After Open Fractures of the Radius and/or Ulna.
Zumsteg, J. W., Molina, C. S., Lee, D. H., & Pappas, N. D. (2014). *Journal of Hand Surgery*, 39(5), 956–961

Osteoporosis - Increased age, decreased bone mineral density
Factors Delaying Recovery After Volar Plate Fixation of Distal Radius Fractures.
Roh, Y. H., Lee, B. K., Noh, J. H., Oh, J. H., Gong, H. S., & Baek, G. H. (2014).*Journal of Hand Surgery*, 39(8), 1465–1470.

Depression
Pain catastrophizing, anxiety, depression
London, D., Stepan, J., Boyer, M. I., & Calfee, R. P. (2013).

The Impact of Depression and Pain Catastrophization on Patient-Rated Outcomes Before and After Treatment for Atraumatic Hand Conditions.
Journal of Hand Surgery, 38(10), e48–e49.

Determinants of Grip Strength in Healthy Subjects Compared to That in Patients Recovering From a Distal Radius Fracture.
Bot, A. G. J., Mulders, M. A. M., Fostvedt, S., & Ring, D. (2012). *Journal of Hand Surgery*, 37(9), 1874–1880.

Effect of Anxiety and Catastrophic Pain Ideation on Early Recovery After Surgery for Distal Radius Fractures.
Roh, Y. H., Lee, B. K., Noh, J. H., Oh, J. H., Gong, H. S., & Baek, G. H. (2014). *Journal of Hand Surgery*, 39(11), 2258–2264.e2.

Rheumatoid Arthritis
Peri-operative Management of Rheumatoid Medications.
Thorsness, R. J., & Hammert, W. C. (2012). *Journal of Hand Surgery*, *37*(9), 1928–1931.

Tobacco Dependence: Smoking
Smoking and Hand Surgery.
Wei, D. H., & Strauch, R. J. (2013). *Journal of Hand Surgery*, 38(1), 176–179.

Worker's Compensation
Workers' compensation and outcomes of upper extremity surgery.
Gruson KI, Huang K, Wanich T, Depalma AA. *J Am Acad Orthop Surg.* 2013 Feb;21(2):67-77

Factors predictive of patient outcome following total wrist arthrodesis.
D. H. Owen, P. A. Agius, A. Nair, D. M. Perriman, P. N. Smith, C. J. Roberts. *Bone and Joint Journal.* 2016 May;98-B(5):647-53.

Co-morbidities/risk factors by orthopaedic sub-specialty

Hip and Knee Arthroplasty

Incidence of and risk factors for 30-day readmission following elective primary total joint arthroplasty: analysis from the ACS-NSQIP
AJ Pugely, JJ Callaghan, CT Martin, P Cram… - The Journal of …, 2013 - Elsevier
... Univariate analysis identified the following **patient** characteristics as **risk factors** for 30-day readmission after **...** INR, elevated serum creatinine, elevated ASA Class, and dependent functional status as **risk factors**. **...** Univariate Analysis of TKA **Patients** With and Without Readmission. **...**

Risk factors for readmission of orthopaedic surgical patients
EA Dailey, A Cizik, J Kasten, JR Chapman, MJ Lee - J Bone Joint Surg Am, 2013 - jbjs.org
... these required diagnosis codes to be included, and therefore may not represent actual **patient** use of **...** readmission group (5.9 ± 8.1 days) than it was in the group of **patients** who were **...** Disposition to a skilled nursing facility was associated with a **risk** of readmission that was 2.03 **...**

Angular knee deformity >8 degrees varus and > 11 degrees of valgus
Preoperative Malalignment Increases Risk of Failure After Total Knee Arthroplasty
Merrill A. Ritter, MD; Kenneth E. Davis, MS; Peter Davis, BA; Alex Farris, BA; Robert A. Malinzak, MD; Michael E. Berend, MD; John B. Meding, MD
J Bone Joint Surg Am, 2013 Jan 16; 95 (2): 126 -131

Chronic anticoagulant use - Long-term (current) use of anticoagulants
Patients with Atrial Fibrillation Undergoing Total Joint Arthroplasty Increase Hospital Burden
Vinay K. Aggarwal, BA; Eric H. Tischler, BA; Zachary D. Post, MD; Ian Kane, BS; Fabio R. Orozco, MD; Alvin Ong, MD
J Bone Joint Surg Am, 2013 Sep 04; 95 (17): 1606 -1611

Congenital hip deformity –increased OR times and transfusion and dislocation
Does Previous Osteotomy Compromise Total Hip Arthroplasty? A Systematic Review
Stephen Duncan, Scott Wingerter, Angela Keith, Susan A. Fowler, John Clohisy
The Journal of Arthroplasty, Vol. 30, Issue 1, p79–85

Depression/psychiatric disease
Association of Depression with 90-Day Hospital Readmission After Total Joint Arthroplasty
Heather T. Gold, James D. Slover, Lijin Joo, Joseph Bosco, Richard Iorio, Cheongeun Oh
The Journal of Arthroplasty, Vol. 31, Issue 11, p2385–2388

Preoperative Predictors of Pain Catastrophizing, Anxiety, and Depression in Patients Undergoing Total Joint Arthroplasty
Thomas J. Wood, Patrick Thornley, Danielle Petruccelli, Conrad Kabali, Mitch Winemaker, Justin de Beer Publication stage: In Press Corrected Proof The Journal of Arthroplasty

Previous intra-articular infection - Late effect of other and unspecified infectious and parasitic diseases
Preoperative Hip Injections Increase the Rate of Periprosthetic Infection After Total Hip Arthroplasty
William W. Schairer, Benedict U. Nwachukwu, David J. Mayman, Stephen Lyman, Seth A. Jerabek
The Journal of Arthroplasty, Vol. 31, Issue 9, p166–169.

Does Timing of Previous Intra-Articular Steroid Injection Affect the Post-Operative Rate of Infection in Total Knee Arthroplasty?
Jourdan M. Cancienne, Brian C. Werner, Luke M. Luetkemeyer, James A. Browne
The Journal of Arthroplasty, Vol. 30, Issue 11, p1879–1882

Morbid obesity BMI >40
Obesity and Total Joint Arthroplasty: A Literature Based Review
A Workgroup of the American Association of Hip and Knee Surgeons (AAHKS) Evidence Based Committee
The Journal of Arthroplasty, Vol. 28, Issue 5, p714–721

Morbid Obesity in Total Hip Arthroplasty: Redefining Outcomes for Operative Time, Length of Stay, and Readmission
Richard J. Hanly, Salman K. Marvi, Sarah L. Whitehouse, Ross W. Crawford
The Journal of Arthroplasty, Vol. 31, Issue 9, p1949–1953

BMI >50
Primary Total Knee Arthroplasty in Super-obese Patients: Dramatically Higher Postoperative Complication Rates Even Compared to Revision Surgery
Brian C. Werner, Cody L. Evans, Joshua T. Carothers, James A. Browne
The Journal of Arthroplasty, Vol. 30, Issue 5, p849–853
Published online: December 18, 2014

Chronic narcotic use - Opioid abuse, continuous
Preoperative and Postoperative Opiate Use by the Arthroplasty Patient
Bradley J. Zarling, Sanar S. Yokhana, Darren T. Herzog, David C. Markel
The Journal of Arthroplasty, Vol. 31, Issue 10, p2081–2084

Preoperative Reduction of Opioid Use Before Total Joint Arthroplasty
Long-Co L. Nguyen, David C. Sing, Kevin J. Bozic
The Journal of Arthroplasty, Vol. 31, Issue 9, p282–287
Published online: March 16, 2016

Open Reduction of Internal Fixation (ORIF)
Previous ORIF hip-increased incidence of periprosthetic fracture and dislocation
Total Hip Arthroplasty After Failed Internal Fixation of Proximal Femoral Fractures
Michael J. Archibeck, Joshua T. Carothers, Krishna R. Tripuraneni, Richard E. White Jr.
The Journal of Arthroplasty, Vol. 28, Issue 1, p168–171

Previous ORIF knee-increased infection, wound healing complications
Total Knee Arthroplasty in Patients With a Prior Tibial Plateau Fracture: A Long-Term Report at 15 Years
Matthew P. Abdel, Philipp von Roth, William W. Cross, Daniel J. Berry, Robert T. Trousdale, David G. Lewallen
The Journal of Arthroplasty, Vol. 30, Issue 12, p2170–2172

Tobacco Dependency - Smoking
Tobacco Use May Be Associated With Increased Revision and Complication Rates Following Total Hip Arthroplasty
Bhaveen H. Kapadia, Kimona Issa, Robert Pivec, Peter M. Bonutti, Michael A. Mont
The Journal of Arthroplasty, Vol. 29, Issue 4, p777–780

Increased Revision Rates After Total Knee Arthroplasty in Patients Who Smoke
Bhaveen H. Kapadia, Aaron J. Johnson, Qais Naziri, Michael A. Mont, Ronald E. Delanois, Peter M. Bonutti
The Journal of Arthroplasty, Vol. 27, Issue 9, p1690–1695

Worker's Compensation - Adverse effects of work environment
Workers' Compensation Patients After Total Joint Arthroplasty: Do They Return to Work?
Corey T. Clyde, Nitin Goyal, Wadih Y. Matar, Daniel Witmer, Camilo Restrepo, William J. Hozack
The Journal of Arthroplasty, Vol. 28, Issue 6, p883–887

Total knee arthroplasty in patients on workers' compensation: Matched cohort study with an average follow-up of 4.5 years
Khaled Saleh, Charles Nelson, Rida Kassim, Patrick Yoon, Steven Haas
The Journal of Arthroplasty, Vol. 19, Issue 3, p310–312

Co-morbidities/risk factors by orthopaedic sub-specialty

Foot and Ankle

Anticoagulant Use – Chronic
Balancing the risk of complications in foot and ankle surgical patients taking antithrombotic medication.
Miller S, Nitzki-George D, Caprini JA.
Foot Ankle Spec. 2014 Dec;7(6):507-14. doi: 10.1177/1938640014543356. Epub 2014 Jul 21

Depression/Psychiatric disease
Psychosocial Risk Factors for Postoperative Pain in Ankle and Hindfoot Reconstruction.
Mulligan RP, McCarthy KJ, Grear BJ, Richardson DR, Ishikawa SN, Murphy GA.
Foot Ankle Int. 2016 Oct;37(10):1065-1070.

Infection – Active or previous at surgical site
Current concepts review: risk factors for nonunions in foot and ankle arthrodeses.
Thevendran G, Younger A, Pinney S.
Foot Ankle Int. 2012 Nov;33(11):1031-40.

Chronic Pain and Narcotic Use – Chronic
Psychosocial Risk Factors for Postoperative Pain in Ankle and Hindfoot Reconstruction.
Mulligan RP, McCarthy KJ, Grear BJ, Richardson DR, Ishikawa SN, Murphy GA.
Foot Ankle Int. 2016 Oct;37(10):1065-1070.

Obesity – BMI >40
Obesity Is Associated With Increased Complications After Operative Management of End-Stage Ankle Arthritis.
Werner BC, Burrus MT, Looney AM, Park JS, Perumal V, Cooper MT.
Foot Ankle Int. 2015 Aug;36(8):863-70

Effect of Obesity on Outcomes of Forefoot Surgery.
Stewart MS, Bettin CC, Ramsey MT, Ishikawa SN, Murphy GA, Richardson DR, Tolley EA.
Foot Ankle Int. 2016 May;37(5):483-7.

Effect of Obesity on Total Ankle Arthroplasty Outcomes.
Schipper ON, Denduluri SK, Zhou Y, Haddad SL.
Foot Ankle Int. 2016 Jan;37(1):1-7.

Rheumatoid Arthritis
Risk factors for surgical site infection and delayed wound healing after orthopedic surgery in rheumatoid arthritis patients.
Kadota Y, Nishida K, Hashizume K, Nasu Y, Nakahara R, Kanazawa T, Ozawa M, Harada R, Machida T, Ozaki T.
Mod Rheumatol. 2016;26(1):68-74. doi: 10.3109/14397595.2015.1073133. Epub 2015 Sep 10.

Sleep Apnea – Obstructive
The effect of obstructive sleep apnea on amputation site healing.
Andrews KL, Dib M, Shives TC, Hoskin TL, Liedl DA, Boon AJ.
J Vasc Nurs. 2012 Jun;30(2):61-3.

Tobacco Dependency
Risk factors for wound complications in patients after elective orthopedic foot and ankle surgery.
Wiewiorski M, Barg A, Hoerterer H, Voellmy T, Henninger HB, Valderrabano V.
Foot Ankle Int. 2015 May;36(5):479-87. doi: 10.1177/1071100714565792. Epub 2014 Dec 30.

Ankle fusion in a high risk population: an assessment of nonunion risk factors.

Perlman MH, Thordarson DB.
Foot Ankle Int. 1999 Aug;20(8):491-6.

Steroid use
Risk factors for incision-healing complications following total ankle arthroplasty.
Raikin SM, Kane J, Ciminiello ME.
J Bone Joint Surg Am. 2010 Sep 15;92(12):2150-5

Ulceration of the foot or ankle – prior or current
Study of risk factors and outcome of patients with diabetic foot ulcers.
Chiraniya S, Shejol D, Bhagat V, Yadav S, Moulick N.
J Assoc Physicians India. 2016 Jan;64(1):92

Diabetic heel ulcers: a major risk factor for lower extremity amputation.
Younes NA, Albsoul AM, Awad H.
Ostomy Wound Manage. 2004

Venous Stasis Disease
Risk Factors in Patients with Venous Stasis-Related Skin Lesions without Major Abnormalities on Duplex Ultrasonography.
Suehiro K, Morikage N, Yamashita O, Harada T, Samura M, Takeuchi Y, Mizoguchi T, Hamano K.

Work-related injury
Risk Factors for Open Malleolar Fractures: An Analysis of the National Trauma Data Bank (2007 to 2011).
Shibuya N, Liu GT, Davis ML, Grossman JP, Jupiter DC.
J Foot Ankle Surg. 2016 Jan-Feb;55(1):94-8. doi: 10.1053/j.jfas.2015.07.016.
PMID: 26403573

Demographic Information that is helpful:

- **Alcohol Use**
- **Revision Surgery**
- **Heart Disease**
- **Diabetes**
- **Rheumatoid Arthritis**
- **Peripheral Vascular Disease**
- **Peripheral Neuropathy**
- **History of DVT or PE**

Co-morbidities/risk factors by orthopaedic sub-specialty

Shoulder and Elbow

Alcoholism
Analysis of peri-operative morbidity and mortality in shoulder arthroplasty patients with preexisting alcohol use disorders.
Ponce BA, Oladeji LO, Raley JA, Menendez ME. *Journal Shoulder and Elbow Surgery.* 2015 Feb;24(2):167-73. doi: 10.1016/j.jse.2014.05.019. Epub 2014 Aug 29. PubMed PMID: 25168344.

Increased Age
Over 80 Years of Age: Increased risk of prolonged hospitalization
Foruria, A. M., Sperling, J. W., Ankem, H. K., Oh, L. S., & Cofield, R. H. (2010). Total shoulder replacement for osteoarthritis in patients 80 years of age and older. *The Journal of Bone and Joint Surgery. British Volume*, *92*(7), 970–974. http://doi.org/10.1302/0301-620X.92B7.23671

Need for Revision of a RCR higher with higher age, co-morbidity, lower surgeon volume
Sherman, S. L., Lyman, S., Koulouvaris, P., Willis, A., & Marx, R. G. (2008). Risk Factors for Readmission and Revision Surgery Following Rotator Cuff Repair. *Clinical Orthopaedics and Related Research*, *466*(3), 608–613. http://doi.org/10.1007/s11999-008-0116-8

Increased Age/Decreased Bone Mineral Density
Osteoporosis and shoulder osteoarthritis: incidence, risk factors, and surgical implications.
Pervaiz K, Cabezas A, Downes K, Santoni BG, Frankle MA. *Journal Shoulder and Elbow Surgery.* 2013 Mar;22(3):e1-8. doi: 10.1016/j.jse.2012.05.029. Epub 2012 Aug 29. Review.

Allergies – Metal
Shoulder arthroplasty in the patient with metal hypersensitivity
Morwood MP, Garrigues GE. *Journal Shoulder and Elbow Surgery.* 2015 Jul;24(7):1156-64. doi: 10.1016/j.jse.2015.01.015. Epub 2015 Mar 20. Review. PubMed PMID: 25799922.

Angular Deformity>15 degrees
The impact of residual angulation on patient reported functional outcome scores after non-operative treatment for humeral shaft fractures.
Shields E, Sundem L, Childs S, Maceroli M, Humphrey C, Ketz JP, Soles G, Gorczyca JT. *Injury*. 2016 Apr;47(4):914-8. doi: 10.1016/j.injury.2015.12.014. Epub 2015 Dec 23. PubMed PMID: 26754807.

Collagen Vascular Disorder-Rheumatoid Arthritis, Lupus, Psoriatic Arthritis – often Immunocompromised - Ehlers/Danlos Syndrome
Open inferior capsular shift for multidirectional shoulder instability in adolescents with generalized ligamentous
hyperlaxity or Ehlers-Danlos syndrome.
Vavken P, Tepolt FA, Kocher MS. *Journal Shoulder and Elbow Surgery.* 2016 Jun;25(6):907-12. doi: 10.1016/j.jse.2015.10.010. Epub 2016 Jan 14. PubMed PMID: 26775746.

Medication, surgery, and physiotherapy among patients with the hypermobility type of Ehlers-Danlos syndrome.
Rombaut L, Malfait F, De Wandele I, Cools A, Thijs Y, De Paepe A, Calders P. Arch *Phys Med Rehabil*. 2011 Jul;92(7):1106-12. doi: 10.1016/j.apmr.2011.01.016. Epub 2011 Jun 2. PubMed PMID: 21636074.

Catastrophic Thinking (ruminating about irrational worst-case outcomes)

Psychological Distress Is Associated with Greater Perceived Disability and Pain in Patients Presenting to a Shoulder Clinic.
Menendez ME, Baker DK, Oladeji LO, Fryberger CT, McGwin G, Ponce BA. *The Journal of Bone and Joint Surgery American*. 2015 Dec 16;97(24):1999-2003. doi: 10.2106/JBJS.O.00387. PubMed PMID: 26677233.

Chronic Colonization

Propionibacterium acnes: an agent of prosthetic joint infection and colonization.
Zeller V, Ghorbani A, Strady C, Leonard P, Mamoudy P, Desplaces N. *J Infect*. 2007 Aug;55(2):119-24. Epub 2007 Apr 5. PubMed PMID: 17418419.

The Incidence of Propionibacterium acnes in Shoulder Arthroscopy.
Chuang MJ, Jancosko JJ, Mendoza V, Nottage WM. *Arthroscopy*. 2015 Sep; 31 (9):1702-7. doi: 10.1016/j.arthro.2015.01.029. Epub 2015 Mar 29. PubMed PMID: 25823673.

Depression

The influence of a history of clinical depression on peri-operative outcomes in elective total shoulder arthroplasty: a ten-year national analysis.
Mollon B, Mahure SA, Ding DY, Zuckerman JD, Kwon YW. *Bone Joint J.* 2016 Jun;98-B(6):818-24. doi: 10.1302/0301-620X.98B6.37208. PubMed PMID: 27235526

Causes of poor postoperative improvement after reverse total shoulder arthroplasty.
Werner BC, Wong AC, Mahony GT, Craig EV, Dines DM, Warren RF, Gulotta LV.
Journal Shoulder and Elbow Surgery. 2016 Aug;25(8):e217-22. doi: 10.1016/j.jse.2016.01.002. Epub 2016 Apr 7. PubMed PMID: 27068387.

Anxiety and depression predict poor outcomes in arthroscopic subacromial decompression.
Dekker AP, Salar O, Karuppiah SV, Bayley E, Kurian J. *Journal Shoulder and Elbow Surgery.* 2016 Jun;25(6):873-80. doi: 10.1016/j.jse.2016.01.031. Epub 2016 Apr 7. PubMed PMID: 27068379.

Diabetes

Diabetes as a risk factor for poorer early postoperative outcomes after shoulder arthroplasty.
Ponce, B. A., Menendez, M. E., Oladeji, L. O., & Soldado, F. (2014). *Journal of Shoulder and Elbow Surgery / American Shoulder and Elbow Surgeons [Et Al]*, *23*(5), 671–678.
http://doi.org/10.1016/j.jse.2014.01.046

Diabetes is independent risk factor for TEA
Comparison of peri-operative complications after total elbow arthroplasty in patients with and without diabetes. Toor, A. S., Jiang, J. J., Shi, L. L., & Koh, J. L. (2014). *Journal of Shoulder and Elbow Surgery / American Shoulder and Elbow Surgeons [Et Al]*, *23*(11), 1599–1606.
http://doi.org/10.1016/j.jse.2014.06.045

The influence of diabetes mellitus on clinical and structural outcomes after arthroscopic rotator cuff repair.
Cho NS, Moon SC, Jeon JW, Rhee YG. *American Journal of Sports Medicine,* 2015 Apr; 43(4):991-7. doi: 10.1177/0363546514565097. Epub 2015 Jan 26.

Diabetes mellitus increases the risk of rotator cuff tear repair surgery: A population-based cohort study.
Huang SW, Wang WT, Chou LC, Liou TH, Chen YW, Lin HW. *J Diabetes Complications*. 2016 Jul 25. pii: S1056-8727(16)30294-X. doi: 10.1016/j.jdiacomp.2016.07.015. [Epub ahead of print] PubMed PMID: 27600100.

Predictors of shoulder pain and shoulder disability after one year in diabetic outpatients.
Laslett LL, Burnet SP, Redmond CL, McNeil JD. *Rheumatology* (Oxford). 2008 Oct;47(10):1583-6. doi: 10.1093/rheumatology/ken333. Epub 2008 Aug 18. PubMed PMID: 18713767.

Diabetes mellitus impairs tendon-bone healing after rotator cuff repair.
Bedi A, Fox AJ, Harris PE, Deng XH, Ying L, Warren RF, Rodeo SA. *Journal Shoulder and Elbow Surgery.* 2010 Oct;19(7):978-88. doi: 10.1016/j.jse.2009.11.045. Epub 2010 Mar 19. PubMed PMID: 20303293.

The influence of diabetes mellitus on clinical and structural outcomes after arthroscopic rotator cuff repair.
Cho NS, Moon SC, Jeon JW, Rhee YG. *Am J Sports Med.* 2015 Apr;43(4):991-7. doi: 10.1177/0363546514565097. Epub 2015 Jan 26. PubMed PMID: 25622985.

Increased risk in arthroplasty among acute fracture patients
Factors predicting complication rates after primary shoulder arthroplasty.
Farng, E., Zingmond, D., Krenek, L., & SooHoo, N. F. (2011). *Journal of Shoulder and Elbow Surgery*, *20*(4), 557–563. http://doi.org/10.1016/j.jse.2010.11.005

Hepatitis C
Is Hepatitis C Infection Associated With a Higher Risk of Complications After Total Shoulder Arthroplasty?
Cancienne JM, Dempsey IJ, Holzgrefe RE, Brockmeier SF, Werner BC. *Clin Orthop Relat* Res. 2016 Jul 22. [Epub ahead of print] PubMed PMID: 27448222.

Systemic Inflammatory Disease
The shoulder girdle in ankylosing spondylitis.
Emery RJ, Ho EK, Leong JC. *JBone Joint Surg Am*. 1991 Dec;73(10):1526-31. PubMed PMID: 1748701.

An analysis of factors affecting the long-term results of total shoulder arthroplasty in inflammatory arthritis.
Figgie HE 3rd, Inglis AE, Goldberg VM, Ranawat CS, Figgie MP, Wile JM. *J Arthroplasty*. 1988;3(2):123-30. PubMed PMID: 3397742.

Metabolic Syndrome
Metabolic syndrome and shoulder arthroplasty: epidemiology and peri-operative outcomes.
Murphy AB, Menendez ME, Watson SL, Ponce BA. *Int Orthop*. 2016 Sep;40(9):1927-33. doi: 10.1007/s00264-016-3214-3. Epub 2016 May 2. PubMed PMID: 27138608.

Neurological Disorders –Chronic – Parkinson, prior CVA, Polio, Peripheral Neuropathy, Epilepsy
Epilepsy
Early Postoperative Complications After Shoulder Arthroplasty in Patients With Epilepsy.
Churchill J, Menendez ME, Ponce BA. *Orthopedics.* 2016 Jul 19:1-5. doi: 10.3928/01477447-20160714-02. [Epub ahead of print] PubMed PMID: 27458894.

Parkinsons
Shoulder arthroplasty in patients with Parkinson's disease is associated with increased complications.
Burrus MT, Werner BC, Cancienne JM, Gwathmey FW, Brockmeier SF. *Journal Shoulder and Elbow Surgery.* 2015 Dec;24(12):1881-7. doi: 10.1016/j.jse.2015.05.048. Epub 2015 Jul 18. PubMed PMID: 26198684.

Obesity
Obesity higher risk for need for HHR revision
Risk factors for revision surgery after humeral head replacement: 1,431 shoulders over 3 decades.
Singh, J. A., Sperling, J. W., & Cofield, R. H. (2012). *Journal of Shoulder and Elbow Surgery / American Shoulder and Elbow Surgeons [Et Al]*, *21*(8), 1039–1044. http://doi.org/10.1016/j.jse.2011.06.015

Obesity – morbid (BMI > 45)
Outcomes of primary reverse shoulder arthroplasty in patients with morbid obesity.
(No effect)

Statz JM, Wagner ER, Houdek MT, Cofield RH, Sanchez-Sotelo J, Elhassen BT, Sperling, JW. *Journal of Shoulder and Elbow Surgery*. 2016 Jul25(7):e 191-8, doi: 10.1016/j.jse.2015.12.008. Epub 2016 Feb 19.

Super obesity (body mass index >50 kg/m2) and complications after
Total shoulder arthroplasty: an incremental effect of increasing body mass index. (Causative Effect)
Werner BC, Burrus MT, Browne JA, Brockmeier SF. *Journal of Shoulder and Elbow Surgery*, 2015 Dec;24(12): 1868-75. doi:10.1016/j.jse.2015.05.046. Epub 2015 Jul 17.

Effect of Metabolic Syndrome and Obesity on Complications After Shoulder Arthroplasty.
Garcia GH, Fu MC, Webb ML, Dines DM, Craig EV, Gulotta LV. *Orthopedics.* 2016 Sep 1;39(5):309-16. doi: 10.3928/01477447-20160517-03. Epub 2016 May 25. PubMed PMID: 27220114.

Reverse total shoulder arthroplasty in patients of varying body mass index.
Gupta AK, Chalmers PN, Rahman Z, Bruce B, Harris JD, McCormick F, Abrams GD, Nicholson GP. *Journal of Shoulder and Elbow Surgery* 2014 Jan;23(1):35-42. doi: 10.1016/j.jse.2013.07.043. Epub 2013 Sep 30. PubMed PMID: 24090984.

After operative management of proximal humerus fractures.
Werner BC, Griffin JW, Yang S, Brockmeier SF, Gwathmey FW. *Journal of Shoulder and Elbow Surgery*, 2015 Apr;24(4):593-600. doi: 10.1016/j.jse.2014.08.028 Epub 2014 Oct 30.

Previous ORIF of body region
Humeral head necrosis rate at mid-term follow-up after open reduction and angular stable plate fixation for proximal humeral fractures.
Greiner S, Kääb MJ, Haas NP, Bail HJ. *Injury*. 2009 Feb;40(2):186-91. doi: 10.1016/j.injury.2008.05.030. Epub 2008 Dec 18. PubMed PMID: 19100544.

Osteoporosis
The Effect of Osteoporosis Management on Proximal Humerus Fracture
Singh A, Adams AL, Burchette R, Dell R, Funahashi TT, and Navarro RA. *The Journal of Shoulder and Elbow Surgery*, 24 February (2), 1912-198, 2015 (corrected copy published online September 18, 2014).

Osteoporosis and shoulder osteoarthritis: incidence, risk factors, and surgical implication
Pervaiz K, Cabezas A, Downes K, Santoni BG, Frankle MA. *Journal Shoulder and Elbow Surgery.* 2013 Mar;22(3):e1-8. doi: 10.1016/j.jse.2012.05.029. Epub 2012 Aug 29. Review. PubMed PMID: 22938788.

Race
Persisting Racial Disparities in Total Shoulder Arthroplasty Utilization and Outcomes.
Singh JA, Ramachandran R. *J Racial Ethn Health Disparities*. 2016 Jun;3(2):259-66. doi: 10.1007/s40615-015-0138-3. Epub 2015 Aug 15. PubMed PMID: 27271067.

Does Racial Variation Influence Preoperative Characteristics and Intra-operative Findings in Patients Undergoing Anterior Cruciate Ligament Reconstruction, **Navarro RA**, Inacio MI, Maletis G., *The American Journal of Sports Medicine* 43 December (12):2960-5, 2015 (corrected copy published online September 21, 2015) doi:10.1177/0363546515603053.

Minimizing Disparities in Osteoporosis Care of Minorities with an Electronic Medical Record Care Plan, Navarro RA, Greene DF, Burchette R, Funahashi TT, and Dell R., *Clinical Orthopaedics and Related Research*, Jul;469 (7):1931-5, 2011.

Renal Failure
Inpatient surgical site infection after shoulder arthroplasty.
Smucny M, Menendez ME, Ring D, Feeley BT, Zhang AL. *Journal Shoulder and Elbow Surgery.* 2015 May;24(5):747-53. doi: 10.1016/j.jse.2014.12.024. Epub 2015 Feb 18. PubMed PMID: 25704827.

Magnetic resonance imaging classification of haemodialysis-related amyloidosis of the shoulder: risk factors and arthroscopic treatment.
Ando A, Hagiwara Y, Sekiguchi T, Koide M, Kanazawa K, Watanabe T, Itoi E. *Knee Surg Sports Traumatol Arthrosc*. 2016 Feb 9. [Epub ahead of print] PubMed PMID: 26860102.

Upper extremity complications in patients with chronic renal failure receiving haemodialysis.
Hurton S, Embil JM, Reda A, Smallwood S, Wall C, Thomson L, Zacharias J, Dascal M, Trepman E, Koulack J. *J Ren Care*. 2010 Dec;36(4):203-11. doi: 10.1111/j.1755-6686.2010.00197.x. PubMed PMID: 20969739.

Tumoral calcinosis of the shoulder.
Hung TH, Hung JK, Chang IL, Yu CT, Chen SJ. *Int Surg*. 2007 Sep-Oct;92(5):300-3. PubMed PMID: 18399103.

Chronic Skin Disorders/Lymphedema
The Influence of Arm Swelling Duration onShoulder Pathology in Breast Cancer Patients with Lymphedema.
Jang DH, Kim MW, Oh SJ, Kim JM. *PLoS One*. 2015 Nov 16;10(11):e0142950. doi: .1371/journal.pone.0142950. eCollection 2015. PubMed PMID: 26571274; PubMed Central PMCID: PMC4646430.

Lymphedema after breast cancer: incidence, risk factors, and effect on upper body function.
Hayes SC, Janda M, Cornish B, Battistutta D, Newman B. *J Clin Oncol*. 2008 Jul 20;26(21):3536-42. doi: 10.1200/JCO.2007.14.4899. PubMed PMID: 18640935.

C-Reactive Protein (CRP)
Increased CRP/Sed Rate
Shoulder adhesive capsulitis in the early freezing phase: correlations between blood exams and Constant Score.
Gumina S, Carbone S, Perugia D, Vestri AR, Postacchini F. *Musculoskelet Surg*. 2011 Jul;95 Suppl 1:S37-42. doi:
10.1007/s12306-011-0121-z. PubMed PMID: 21479867.

Socioeconomic status
Heterogeneity in health status and the influence of patient characteristics across patients seeking musculoskeletal orthopaedic care – a cross-sectional study.
Perruccio AV, Gandhi R, Rampersaud YR; Arthritis Program, University Health Network. *BMC Musculoskelet Disord*. 2013 Mar 7;14:83. doi: 10.1186/1471-2474-14-83. PubMed PMID: 23497192; PubMed Central PMCID: PMC3599249.

Medications – Statin
Effect of Statins (Beneficial)
Simvastatin reduces fibrosis and protects against muscle weakness after massive rotator cuff tear.
Davis, ME, Korn MA, Gumucio JP, Harning JA, Saripalli AL, Bedi A, Mendias CL. *Journal of Shoulder and Elbow Surgery*, 2015 Feb;24(2):280-7. doi 10.1016/j.jse.2014.06.048. Epub 2014 Sep 9.

Statins enhance rotator cuff healing by stimulating the COX2/PGE2/EP4 Pathway: an in vivo and in vitro study.
Dolkart O, Liron T., Chechik O, Somjen D, Brosh T, Maman E, Gabet Y. *American Journal of Sports Medicine,* 2014 Dec;42(12):2869-76. doi: 10.1177/0363546514545856. Epub 2014 Sep 2.

Effect of Fluoroquinolones
Fluoroquinolones impair tendon healing in a rat rotator cuff repair model: a preliminary study.
Fox AJ, Schar MO, Wanivenhaus F, Chen T, Attia E, Binder NB, Otero M, Gilbert SL, Nguyen JT, Chaudhury S, Warren RF, Rodeo SA. *American Journal of Sports Medicine,*2014 Dec;(42(12):2851-9.doi: 10.1177/0363546514545858. Epub 2014 Aug 20.

Bench Press/Lifting
Distal clavicular osteolysis in adults: association with bench pressing intensity.
Nevalainen MT, Ciccotti MG, Morrison WB, Zoga AC, Roedl JB. *Skeletal Radiology,* 2016 Aug 22.

Depression/Psychiatric Disorders
The influence of psychiatric comorbidity on peri-operative outcomes after shoulder arthroplasty.
Bot, A. G. J., Menendez, M. E., Neuhaus, V., & Ring, D. (2014). *Journal of Shoulder and Elbow Surgery / American Shoulder and Elbow Surgeons [Et Al]*, *23*(4), 519–527.
http://doi.org/10.1016/j.jse.2013.12.006

Cost of RSA correlated with Co-morbidity burden
Preparing for the bundled-payment initiative: the cost and clinical outcomes of reverse shoulder arthroplasty for the surgical treatment of advanced rotator cuff deficiency at an average 4-year follow-up.
Virani, N. A., Williams, C. D., Clark, R., Polikandriotis, J., Downes, K. L., & Frankle, M. A. (2013). *Journal of Shoulder and Elbow Surgery / American Shoulder and Elbow Surgeons [Et Al]*, *22*(12), 1612–1622. http://doi.org/10.1016/j.jse.2013.01.003

Psychological Distress/Pain Catastrophizing, Anxiety, Depression
Psychological distress negatively affects self-assessment of shoulder function in patients with rotator cuff tears.
Potter MQ, Wylie JD, Greis PE, Burks RT, Tashjian RZ. *Clinical Orthopaedics and Related Research,* Res. 2014 Dec;472(12):3926-32. Doi: 10.1007/s11999-014-3833-1, Epub 2014 Jul 31.

Smoking
The effect of smoking on rotator cuff and glenoid labrum surgery: a systematic review.
Santiago-Torres J, Flanigan DC, Butler RB, Bishop JY. *American Journal of Sports Medicine*, 2015 Mar;43(3):745-51. doi 10.1177/0363546514533776. Epub 2014 May 23. Review.

The impact of preoperative smoking habits on the results of rotator cuff repair.
Mallon WJ, Misamore G, Snead DS, Denton P. *Journal of Shoulder and Elbow Surgery*, 2004 Mar-Apr;13(2):129-32.

Smoking Predisposes to Rotator Cuff Pathology and Shoulder Dysfunction: A Systematic Review.
Bishop JY, Santiago-Torres JE, Rimmke N, Flanigan DC. *Arthroscopy.* 2015 Aug;31(8):1598-605. doi: 10.1016/j.arthro.2015.01.026. Epub 2015 Mar 19. Review. PubMed PMID: 25801046.

Tobacco Dependency/Opioid Use
Preoperative opioid use and outcomes after reverse shoulder arthroplasty.
Morris BJ, Laughlin MS, Elkousy HA, Gartsman GM, Edwards TB. *Journal of Shoulder and Elbow Surgery*, 2015 Jan;24(1):11-6. doi: 10.1016/j.jse.2014.05.002 Epub 2014 Jul 16.

Wound Healing
History of previous wound healing problems or plastic reconstruction of wound
Surgical treatment of severe or moderate axillary burn scar contracture with transverse island scapular flap and expanded transverse island scapular flap in adult and pediatric patients--A clinical experience of 15 cases.
Chen B, Xu M, Chai J, Song H, Gao Q. *Burns*. 2015 Jun;41(4):872-80. doi: 10.1016/j.burns.2014.10.029. Epub 2015 Feb 16. PubMed PMID: 25698549.

Workers' Compensation Patients
Workers Compensation patients poorer outcomes after RCR
Henn, R. F., Kang, L., Tashjian, R. Z., & Green, A. (2008). Patients with Workers' Compensation Claims Have Worse Outcomes After Rotator Cuff Repair. *The Journal of Bone and Joint Surgery (American)*, *90*(10), 2105–2113. http://doi.org/10.2106/JBJS.F.00260

Workers' Compensation claims and outcomes after reverse shoulder arthroplasty.
Morris BJ, Haigler RE, Laughlin MS, Elkousy HA, Gartsman GM, Edwards TB. *Journal of Shoulder and Elbow Surgery*, 2015 Mar;24(3):453-9. Doi 10.1016/j.jse.2014.07.009. Epub 2014 Oct 8.

Anatomic total shoulder arthroplasty for patients receiving workers' compensation.
Jawa A, Dasti UR, Fasulo SM, Vaickus MH, Curtis AS, Miller SL. *Journal of Shoulder and Elbow Surgery*, 2015 Nov;24(11):1694-7. doi: 10.1016/j.jse.2015.04.017. Epub 2015 Jul 6. PubMed PMID: 26159842.

ASES vs. European Shoulder Society Outcomes data
No agreement on co-morbidity factors in their literature.

Co-morbidities/risk factors by orthopaedic sub-specialty

Sports Medicine
Rotator Cuff

Alcohol
Association between alcohol consumption and rotator cuff tear.
Passaretti, D. etal, *Acta Orthop* 2016:87(2):165-8

Emotional Health- education level, employment, pain tolerance, patient perception of normalcy
What factors are predictors of emotional health in patients with full thickness RCT?
Barlow JD, Bishop, JY, etal, *MOON Shoulder Group*, JSES, 2016 Jun 6,

ACL
Obesity/Tobacco Dependence/Chondrosis
Prediction of patient-reported outcome after single bundle anterior cruciate ligament reconstruction
Kowalchuk, Harner, Fu, Irrgang, *Arthroscopy* 2009 May: 25(5)457-63

Diabetes
Outcomes of ACL reconstruction in patients with diabetes
Brophy RH, etal. *Medicine in Science and Sports & Exercise,* 2016June:48(6):969-73 slightly worse clinical outcomes than non-diabetics

Tobacco Dependency
The Effect of Smoking on ACL Reconstruction: A Systematic Review"
Novikov Da, etal, /*The Physician and Sportsmedicine* 2016 Jul 25. Epub - smoking associated with significantly worse outcomes

Microfracture
Tobacco Dependency
Effects of knee compartment, concomitant surgery and smoking on medium term outcomes of microfracture
Balain B, etal, *Knee,* 2012 Aug:19(4): 440-4, Smoking associated with lower satisfaction rate

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Co-morbidities/risk factors by orthopaedic sub-specialty

Spine

Anticoagulant use / Coagulation profile / Bleeding disorders / Hemophilia
Coagulation Profile as a Risk Factor for 30- Day Morbidity and Mortality Following Posterior Lumbar Fusion.
Bronheim RS, Oermann EK, Cho SK, Caridi JM. Spine (Phila Pa 1976). 2016 Oct 17.

Bacterial Colonization - Chronic Pre-op
Spine Update: Prevention of Postoperative Infection in Patients Undergoing Spinal Surgery.
Brown EM, Pople IK, de Louvois J, Hedges A, Bayston R, Eisenstein SM, et al. Spine. 2004;29(8):938-45.

Nasal MRSA colonization: impact on surgical site infection following spine surgery
Thakkar V, Ghobrial GM, Maulucci CM, Singhal S, Prasad SK, Harrop JS, Vaccaro AR, Behrend C, Sharan AD, Jallo J.. Clin Neurol Neurosurg. 2014 Oct;125:94-7.

Cardiovascular Disease
Cerebral Vascular Accidents After Lumbar Spine Fusion. Spine.
Marquez-Lara A, Nandyala SV, Fineberg SJ, Singh K. 2014;39(8):673-7.

Incidence and mortality of perioperative cardiac events in cervical spine surgery.
Fineberg SJ, Oglesby M, Patel AA, Singh K. Spine (Phila Pa 1976). 2013 Jul 1;38(15):1268-74.

Medical Complications after Adult Spinal Deformity Surgery: Incidence, Risk factors, and Clinical Impact.
Soroceanu A, Burton DC, Oren JH, Smith JS, Hostin R, Shaffrey CI, Akbarnia BA, Ames CP, Errico TJ, Bess S, Gupta MC, Deviren V, Schwab FJ, Lafage V; International Spine Study Group. Spine (Phila Pa 1976). 2016 Apr 19.

Chronic Pain
Medical Complications after Adult Spinal Deformity Surgery: Incidence, Risk factors, and Clinical Impact.
Soroceanu A, Burton DC, Oren JH, Smith JS, Hostin R, Shaffrey CI, Akbarnia BA, Ames CP, Errico TJ, Bess S, Gupta MC, Deviren V, Schwab FJ, Lafage V; International Spine Study Group. Spine (Phila Pa 1976). 2016 Apr 19.

Depression / Psychiatric Disorders / Emotional Health
Impact of preoperative depression on 2-year clinical outcomes following adult spinal deformity surgery: the importance of risk stratification based on type of psychological distress.
Theologis AA, Ailon T, Scheer JK, Smith JS, Shaffrey CI, Bess S, Gupta M, Klineberg EO, Kebaish K, Schwab F, Lafage V, Burton D, Hart R, Ames CP; International Spine Study Group. J Neurosurg Spine. 2016 Oct;25(4):477-485

Psychological Factors Affecting Rehabilitation and Outcomes Following Elective Orthopaedic Surgery.
Flanigan DC, Everhart JS, Glassman AH. J Am Acad Orthop Surg. 2015 Sep;23(9):563-70.

Diabetes / Insulin Dependence
Clinical factors associated with unexpected critical care management and prolonged hospitalization after elective cervical spine surgery. Harris OA1, Runnels JB, Matz PG. Crit Care Med. 2001 Oct;29(10):1898-902.

Impact of Glycemic Control on Morbidity and Mortality in Adult Idiopathic Scoliosis Patients Undergoing Spinal Fusion.
Shin JI, Phan K, Kothari P, Kim JS, Guzman JZ, Cho SK. Clin Spine Surg. 2016 Oct 19.

Complication rates following elective lumbar fusion in patients with diabetes: insulin dependence makes the difference.
Golinvaux NS, Varthi AG, Bohl DD, Basques BA, Grauer JN. Spine (Phila Pa 1976). 2014 Oct 1;39(21):1809-16.

Passias PG, Soroceanu A, Smith J, Boniello A, Yang S, Scheer JK, et al. Spine. 2015;40(5):283-91.

Postoperative Cervical Deformity in 215 Thoracolumbar Patients With Adult Spinal Deformity: Prevalence, Risk Factors, and Impact on Patient-Reported Outcome and Satisfaction at 2-Year Follow-up.
Schuster JM, Rechtine G, Norvell DC, Dettori JR. The influence of perioperative risk factors and therapeutic interventions on infection rates after spine surgery: a systematic review. Spine (Phila Pa 1976). 2010 Apr 20;35(9 Suppl):S125-37.

Dialysis
The influence of perioperative risk factors and therapeutic interventions on infection rates after spine surgery: a systematic review.
Schuster JM, Rechtine G, Norvell DC, Dettori JR. Spine (Phila Pa 1976). 2010 Apr 20;35(9 Suppl):S125-37.

Fragilty
Frailty Index is a Significant Predictor of Complications and Mortality Following Surgery for Adult Spinal Deformity.
Leven DM, Lee NJ, Kothari P, Steinberger J, Guzman J, Skovrlj B, Shin JI, Caridi JM, Cho SK. Spine (Phila Pa 1976). 2016 Aug 31

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