TKA Arthroplasty: Optimization and Outcomes

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Certificate of Added Qualification in Sports Medicine
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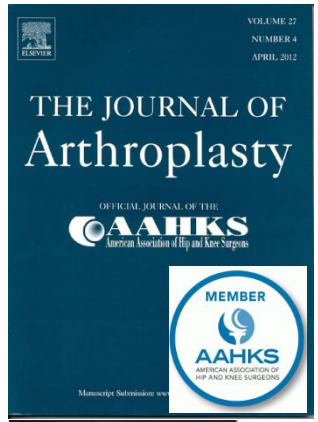
UT Health San Antonio

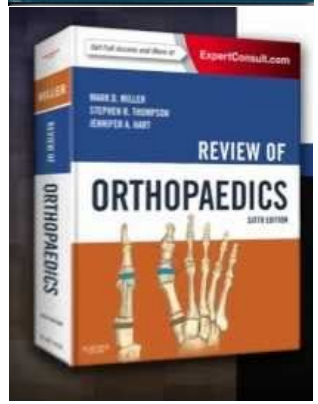
Disclosures:

- Organized Medicine:
  - Texas Orthopaedic Association
    - Presidential Line & Board Position
  - American Academy Orthopaedic Surgeons
    - Board of Councilors
      - CMS Rep for Quality Measures
      - CMS Committees for Cost Measures

- Editorial Review Board:
  - Journal of Arthroplasty

- $:
  - Orthopaedic Board and MOC Review Courses
  - Co-Director of Saudi Board Review Course
  - Chapters for Orthopaedic Books





- Outcomes: Why now?
- What is optimization?
- Is it working?

Outcomes why now?

Why did you become a PA?

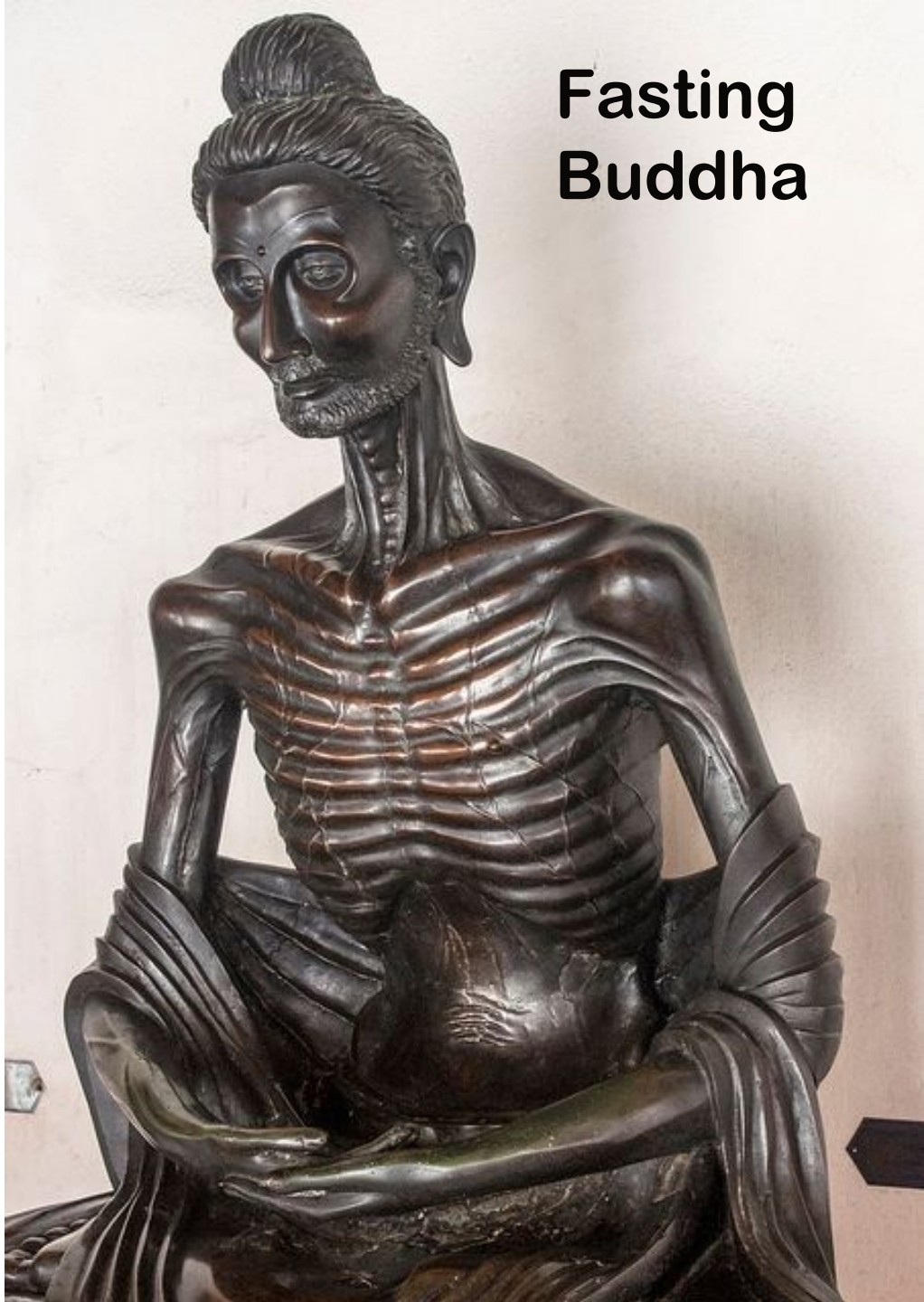
We go into medicine because:

- Intellectually challenging
- Fairly well respected
- Secure job
- Science and Art
- Desire to help people
  - Decrease suffering
  - Save lives
- Rewarding profession
  - Ethically
  - Economically

Buddhism: 1st Noble Truth

Life is suffering

- Human Condition:
  - Sickness
  - Aging
  - Death

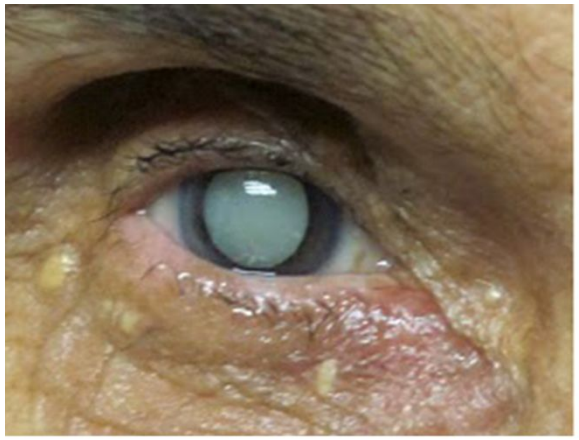


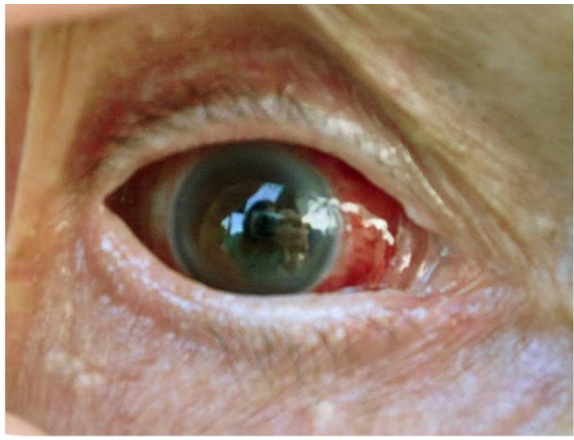
Fasting Buddha

We can make a difference…

Miracles of Medicine

- Ophthalmology: blind to see





Mature Cataract

One day post-op Extracap

- ENT: deaf to hear

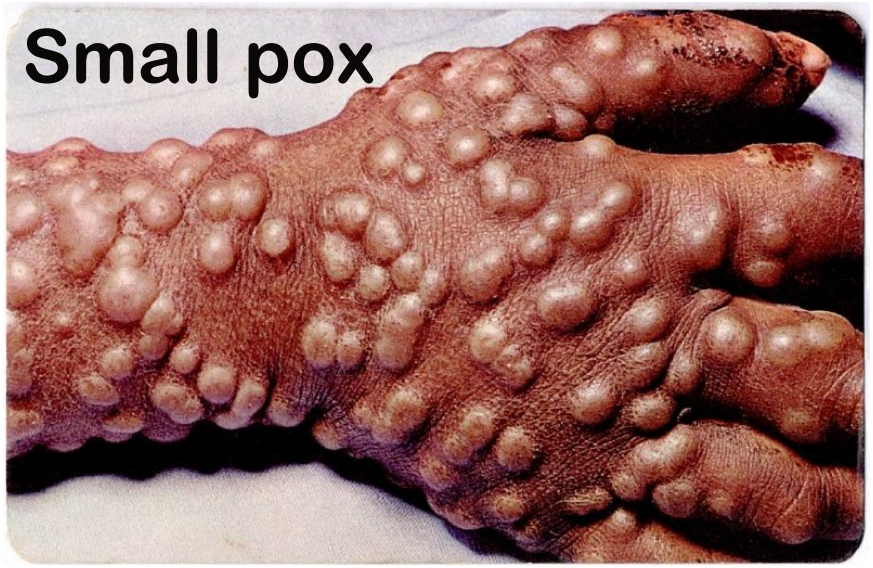
We can make a difference…

Miracles of Medicine

- Psychiatry:

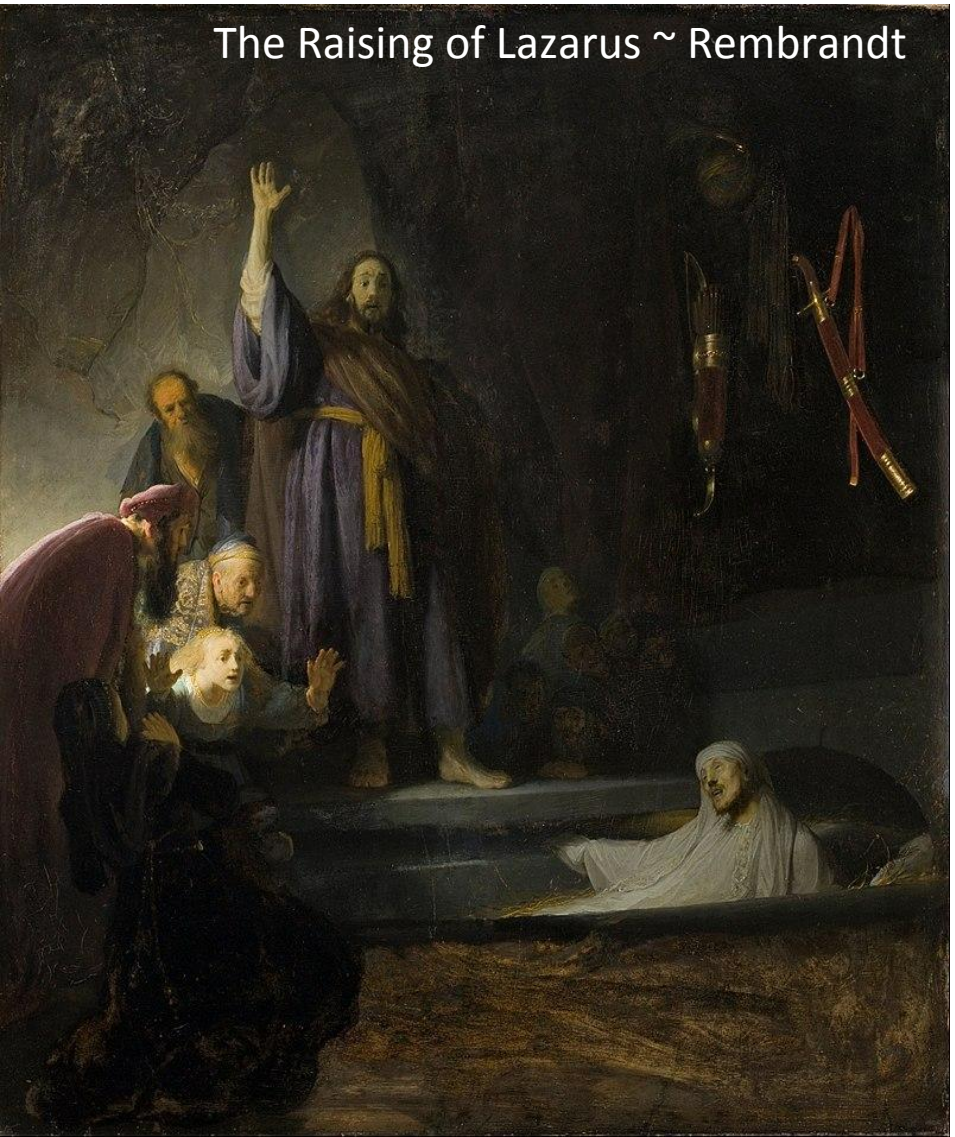
  calm the demons

- Public Health: cure plagues



We can make a difference…

Miracles of Medicine



- Cardiology: raise the dead

- Ortho: lame to walk

Why did we go into medicine?

Paid to MAKE A DIFFERENCE

The Most And Least Meaningful Occupations

No. 1 Most Meaningful Job (tie):
Orthopedic Surgeon

% High Job Meaning: 100%
% Male: 88%
% Female: 12%

Forbes MAGAZINE

PayScale

THE MOST FEEL-GOOD JOBS IN AMERICA

17) Physician Assistants

PERCENT FEEL THEIR JOB MAKES THE WORLD BETTER: 97.1%

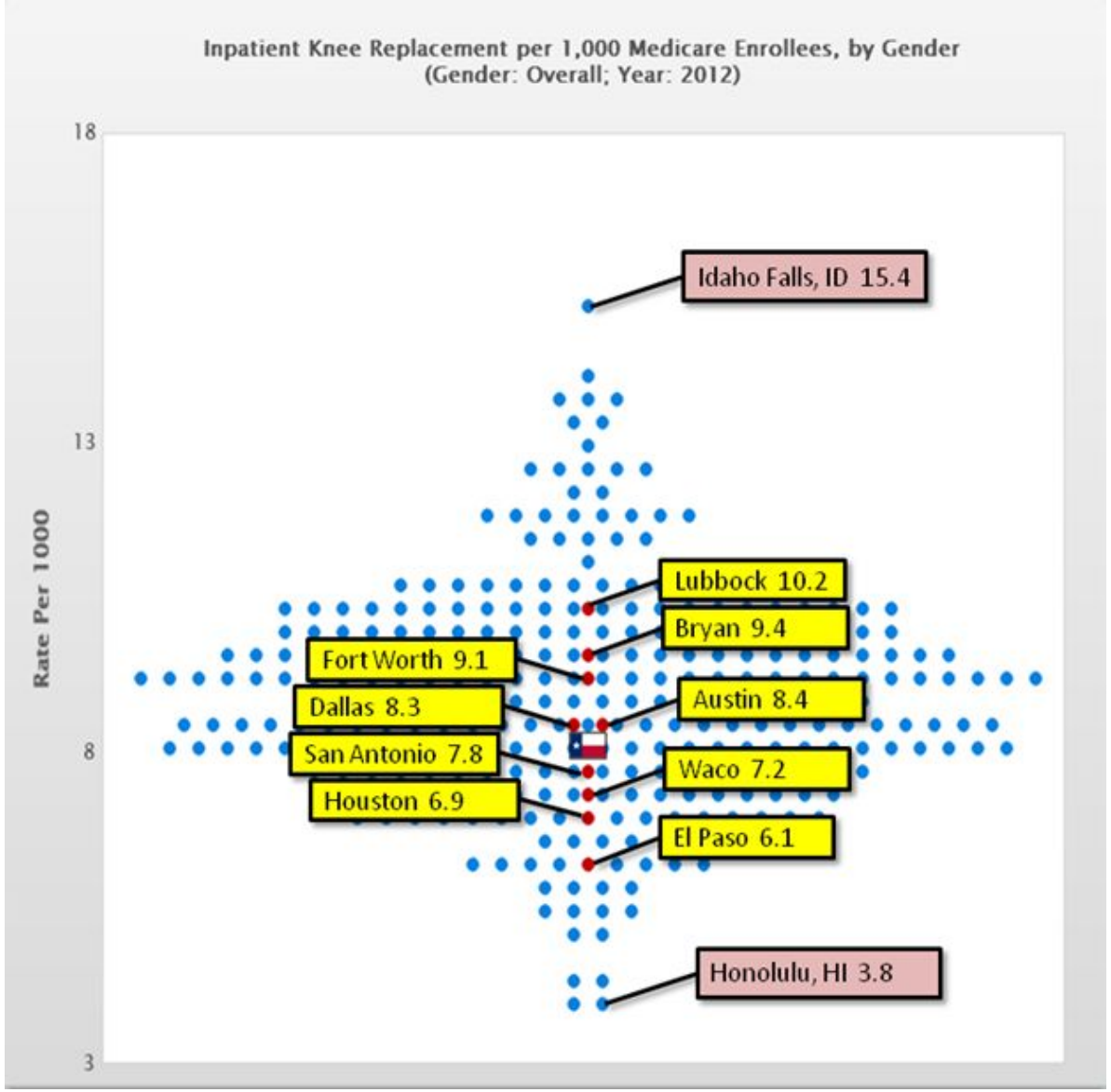
•We make a difference!

Do we all make the same difference?

Substantial Variation

 # TKA/1,000 Medicare Enrollees
~4 in Hawaii to 15 in Idaho!

(Dartmouth atlas)

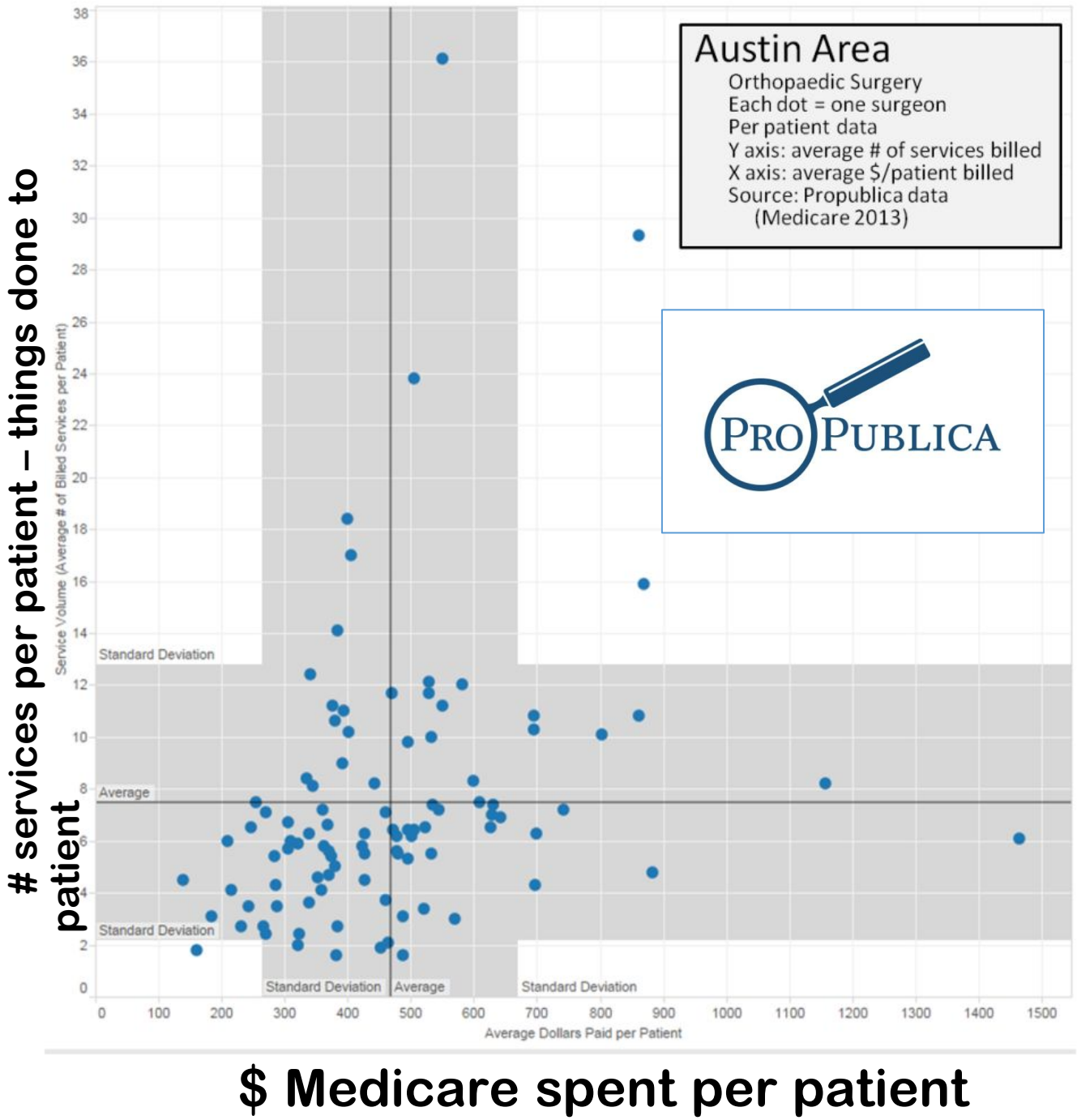


Variation by Doctor
(Orthopaedic)

- Specific provider behavior:
- Per patient data
  (to remove volume data)

  # services per patient
  $ spent per patient

- Austin, Texas 2013



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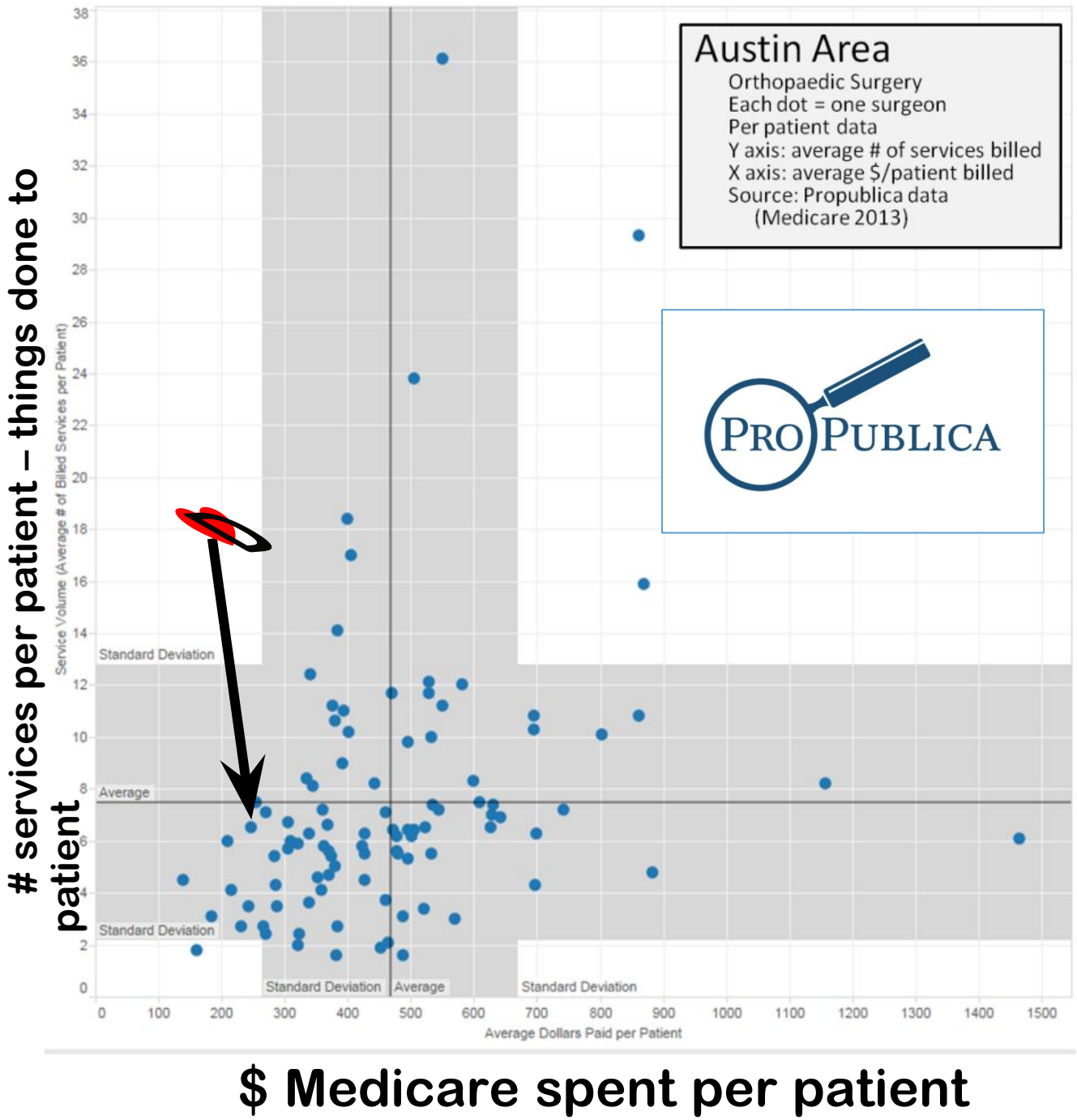
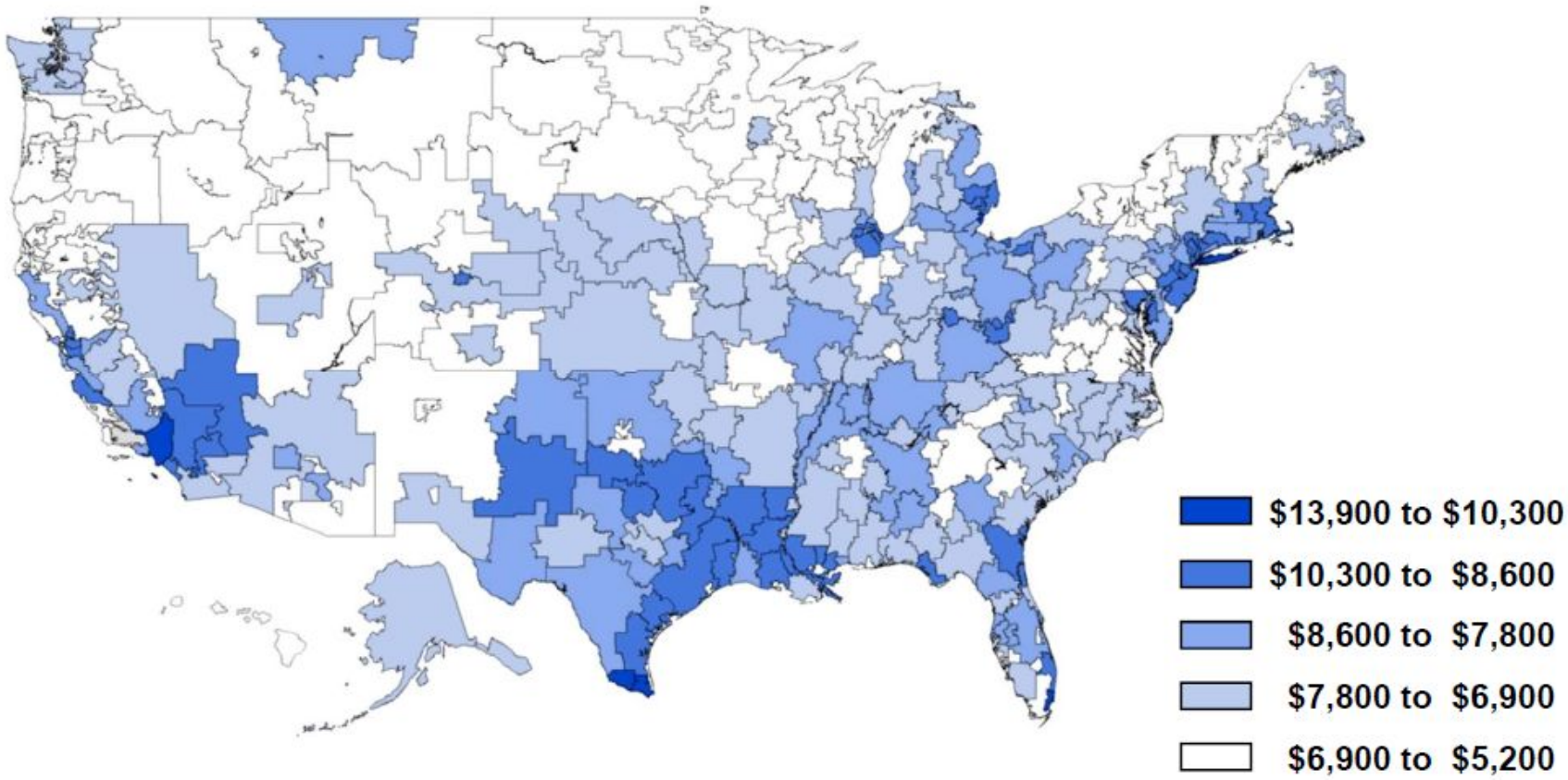


Huge variation in the costs we create for the differences we make…

Policy Makers and Payers Have Declared War on Variation

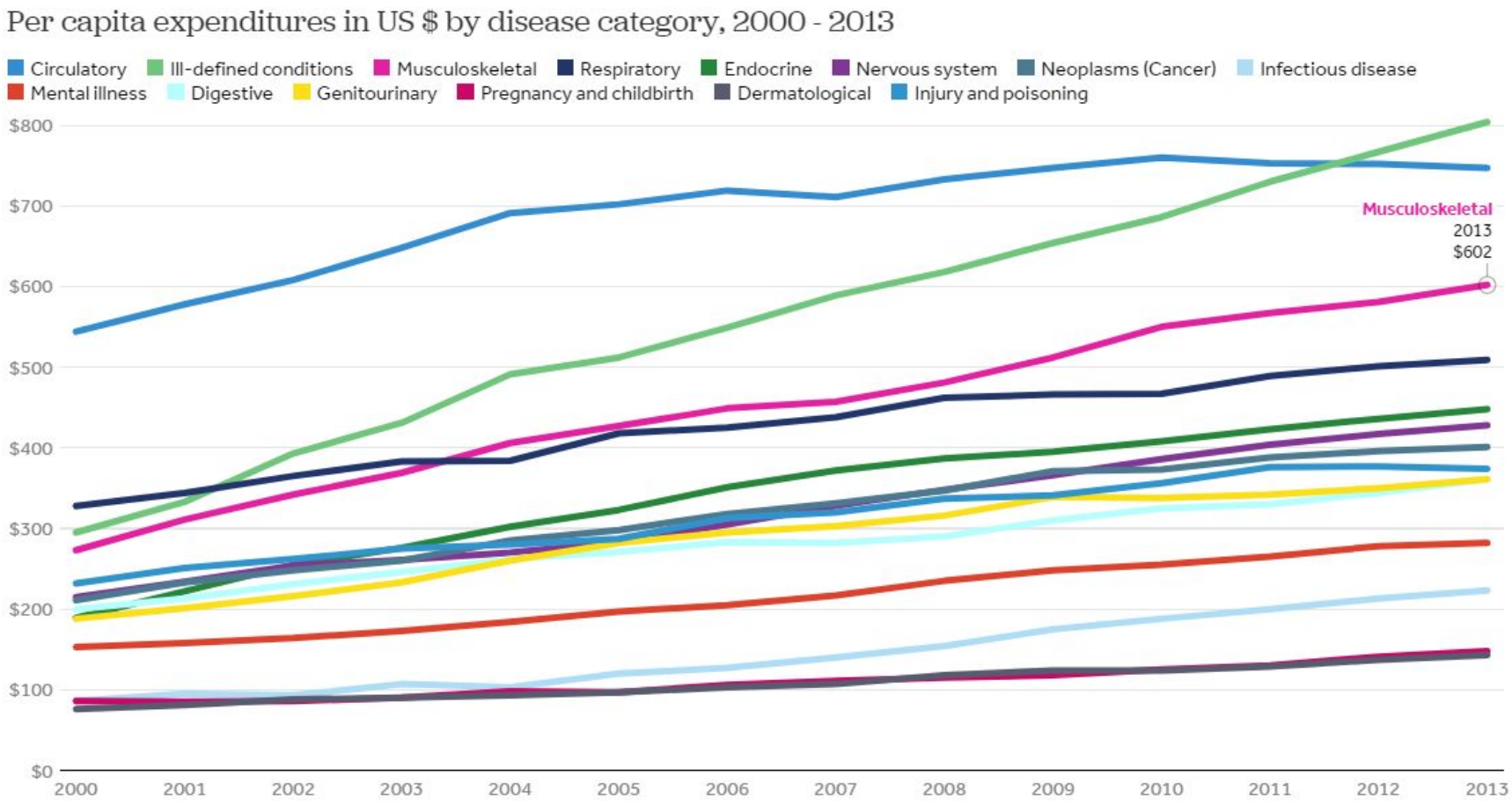
Regional Variation in Medicare Spending per Beneficiary



Musculoskeletal Spend is:
High on the list

COSTS HAVE INCREASED FOR MANY REASONS

- Technology > Evidence base
- Pts: Older/sicker/fatter
- 3rd party payers = ↓ personal costs
- Poor understanding of costs/benefits by Pt & Clinicians
- Corporatization of medicine
- System rewards for volume (FFS)

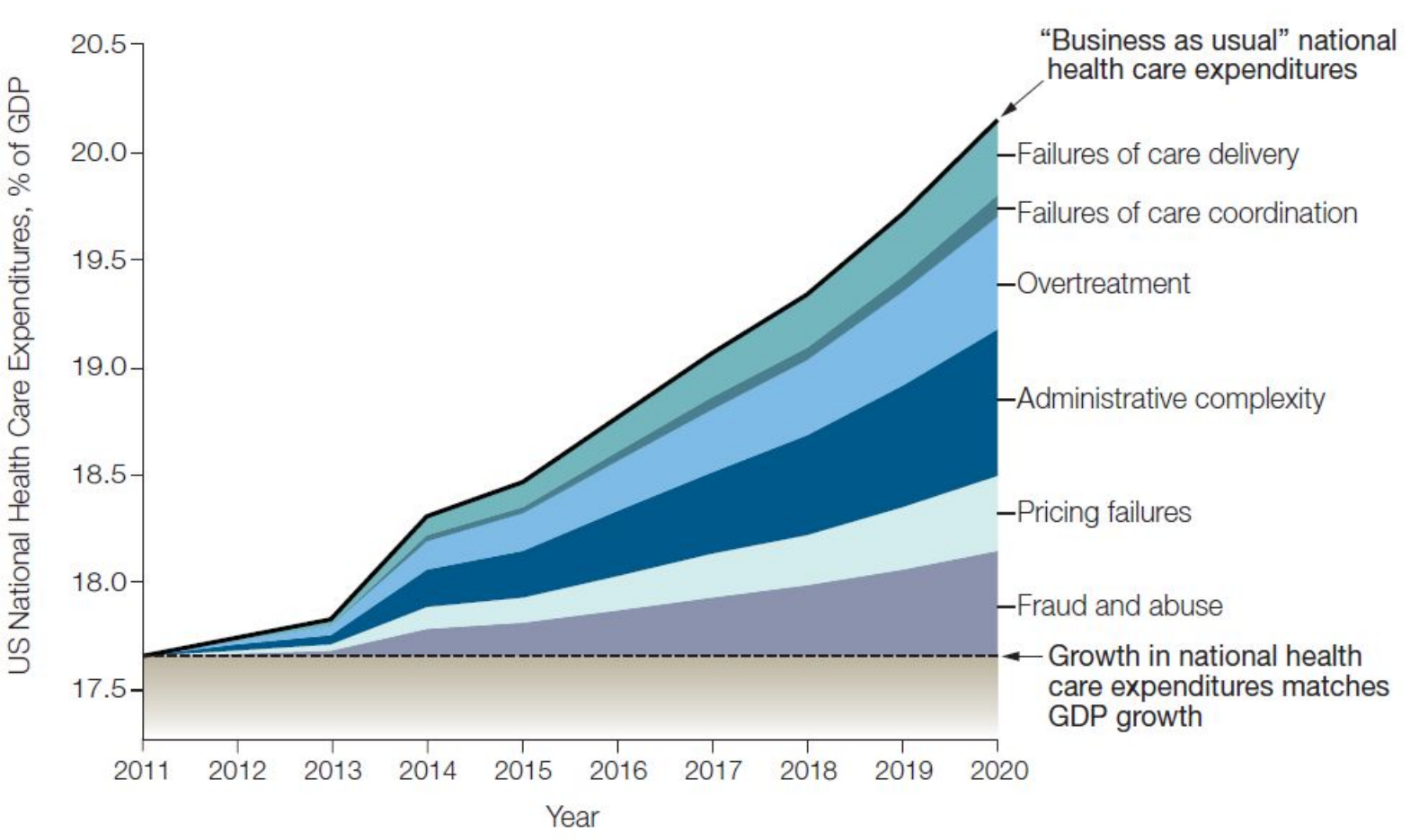


Note: Expenditures on nursing home and dental care are not included in health services spending by disease.

Source: Kaiser Family Foundation analysis of the Bureau of Economic Analysis Health Care Satellite Account (Blended Account). Accessed January 25, 2016. • Get the data • PNG

Peterson-Kaiser Health System Tracker

Figure. Proposed "Wedges" Model for US Health Care, With Theoretical Spending Reduction Targets for 6 Categories of Waste

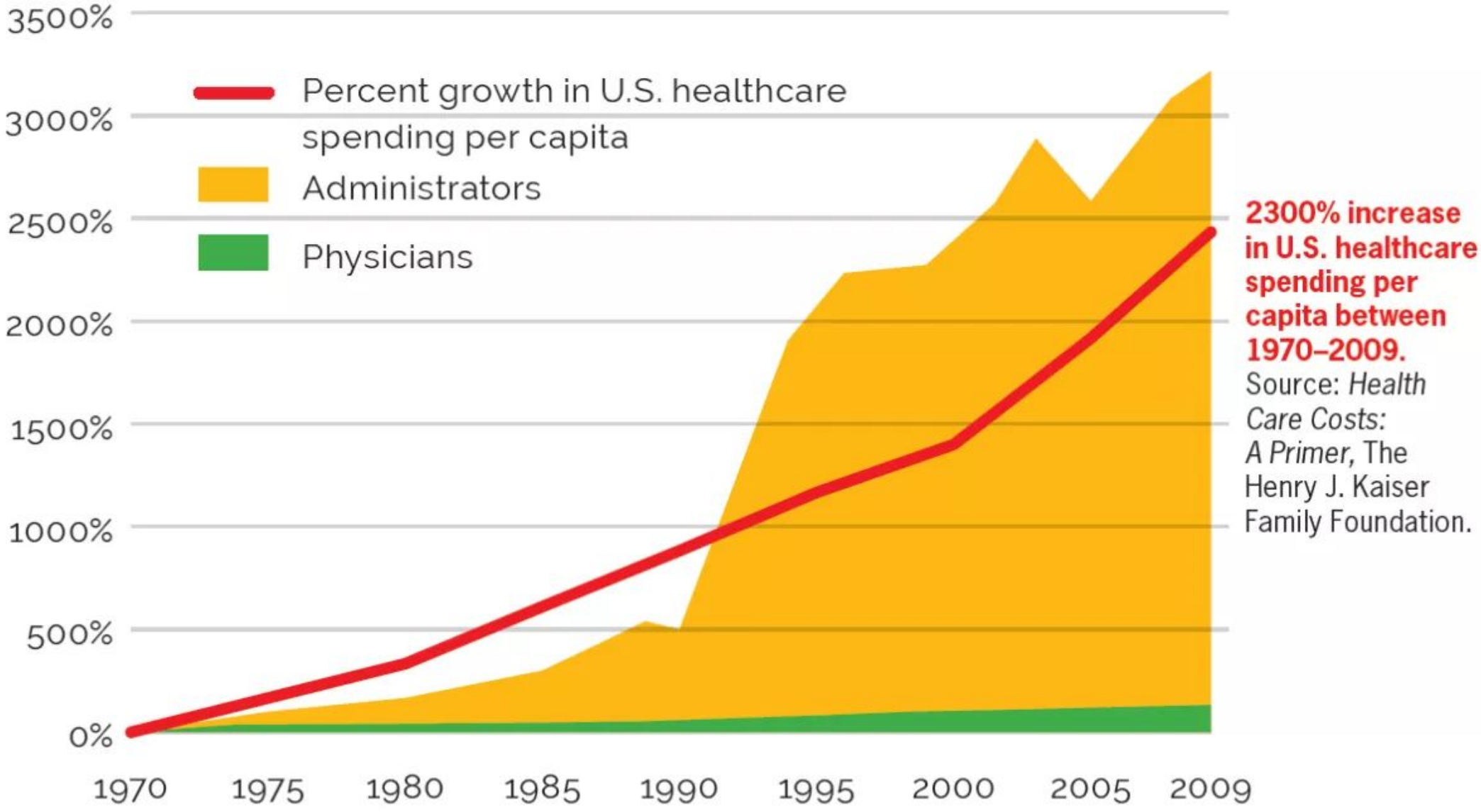


The "wedges" model for US health care follows the approach based on the model by Pacala and Socolow.[9] The solid black "business as usual" line depicts a current projection of health care spending, which is estimated to grow faster than the gross domestic product (GDP), increasing the percentage of GDP spent on health care; the dashed line depicts a more sustainable level of health care spending growth that matches GDP growth, fixing the percentage of GDP spent on health care at 2011 levels. Between these lines lies the "stabilization triangle"—the reduction in national health care expenditures needed to close the gap. The 6 colored regions filling the triangle show one possible set of spending reduction targets; each region represents health care expenditures as a percentage of GDP that could be eliminated by reduction of spending in that waste category

COSTS HAVE INCREASED FOR MANY REASONS

- **Technology > Evidence base**
- **Pts: Older/sicker/fatter**
- **3rd party payers = ↓ personal costs**
- **Poor understanding of costs/benefits by Pt & Clinicians**
- **Corporatization of medicine**
- **System rewards for volume (FFS)**

Growth of Physicians and Administrators
1970–2009



2300% increase in U.S. healthcare spending per capita between 1970–2009.
Source: *Health Care Costs: A Primer,* The Henry J. Kaiser Family Foundation.

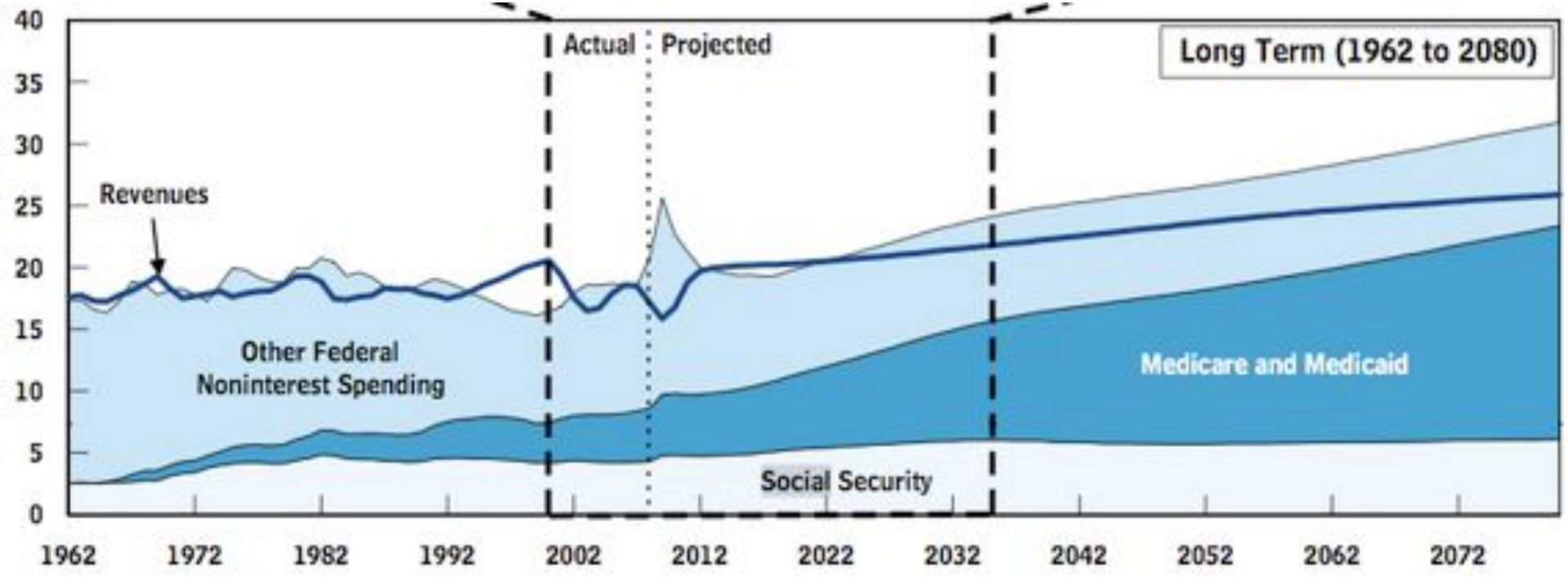
Source: Bureau of Labor Statistics; NCHS; and Himmelstein/Woolhandler analysis of CPS.

1965
Medicare

Since Medicare started, a growing % of Federal spending on health care…

So high now = a threat for spending on:

- Infrastructure
- Education
- Defense



1965
Medicare

1984
PPS
DRGs

1989
OBRA
RVUs

1997
BBA
SGR

2008
PQRS

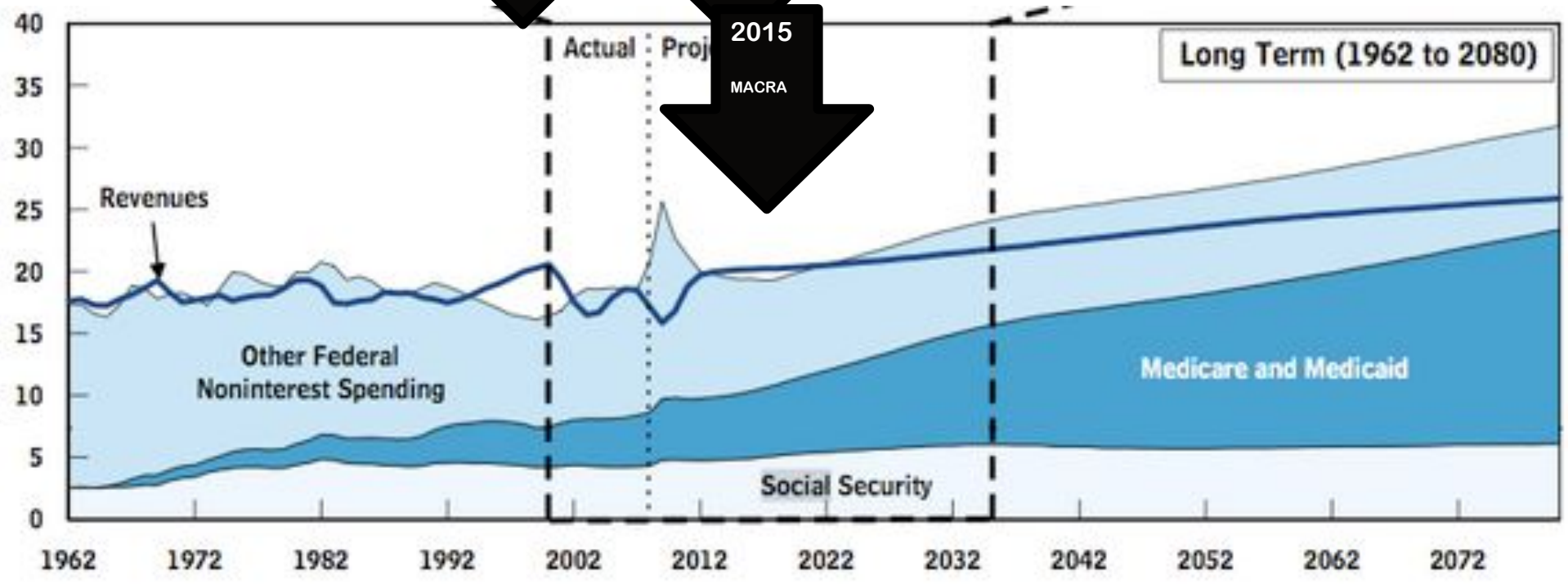
2009
HTECH

2010
ACA
Obama-Care

2014
PAMA
ICD10

2015
MACRA

Increasing costs lead to many laws to “improve” payment systems…

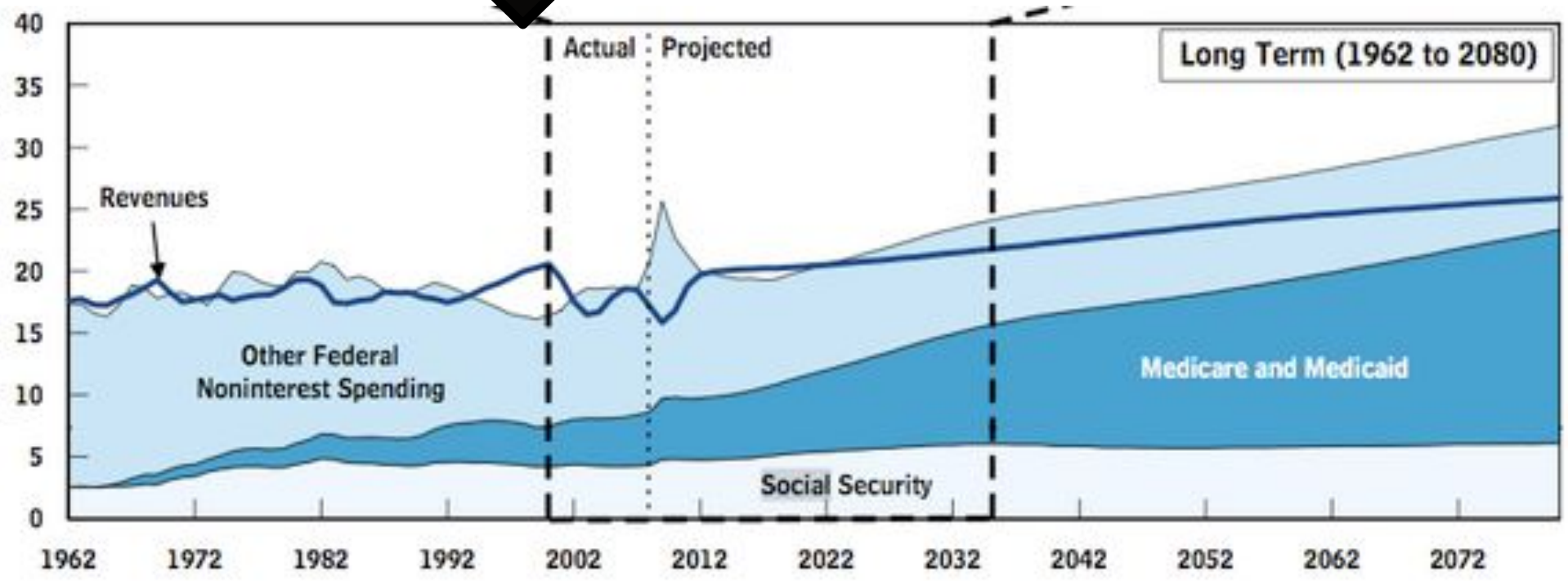


1965
Medicare

Balance Budget Amendment
Sustainable Growth Rate
(all care allowed but divided the pie)

1997
BBA

SGR



SGR – (from the Balanced Budget Amendment)
"fixed the total costs" and the dollars per RVU came down

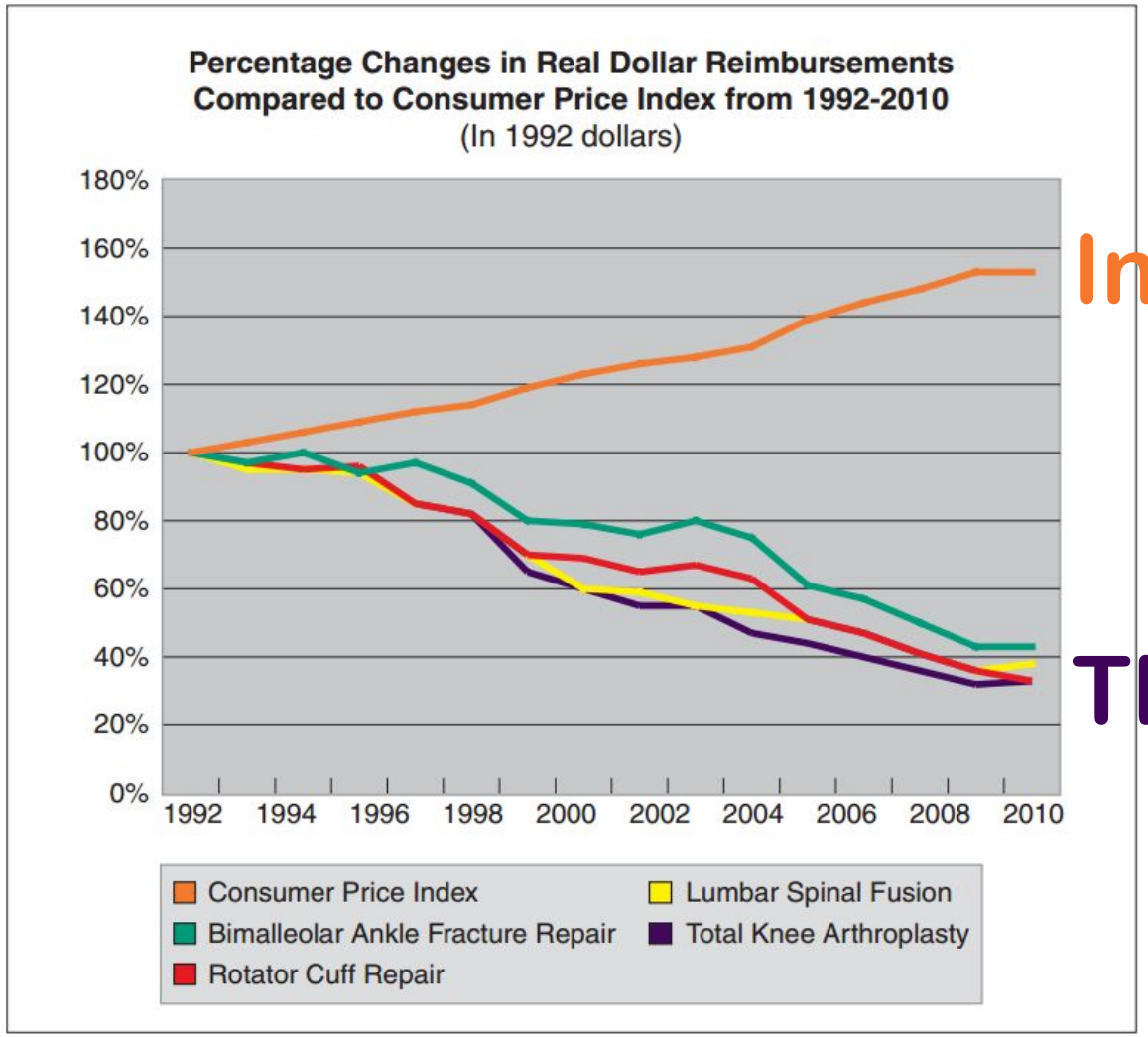
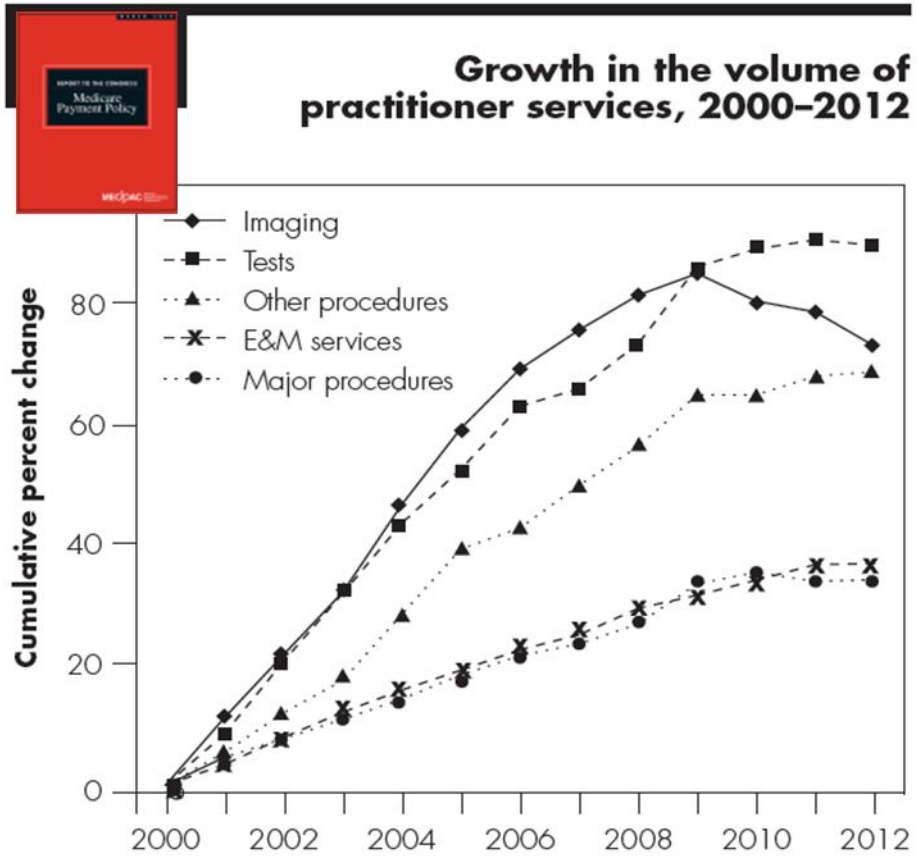


Fig. 1 The Consumer Price Index, an inflationary indicator, has continued to increase since 1992 while reimbursements for orthopaedic procedures have declined, creating an ever-widening gap between what orthopaedic surgeons receive in reimbursements and what they have to pay in operational and practice costs.

Inflation ~ +3%

TKA ~ -60%

As reimbursements go down, the fee for service system responds by increasing volume…



Note: E&M (evaluation and management). Volume growth for E&M from 2009 to 2010 is not directly observable due to a change in payment policy for consultations. To compute cumulative volume growth for E&M through 2011, we used a growth rate for 2009 to 2010 of 1.85 percent, which is the average of the 2008 to 2009 growth rate of 1.70 percent and the 2010 to 2011 growth rate of 2.00 percent.

Source: MedPAC analysis of claims data for 100 percent of Medicare beneficiaries.

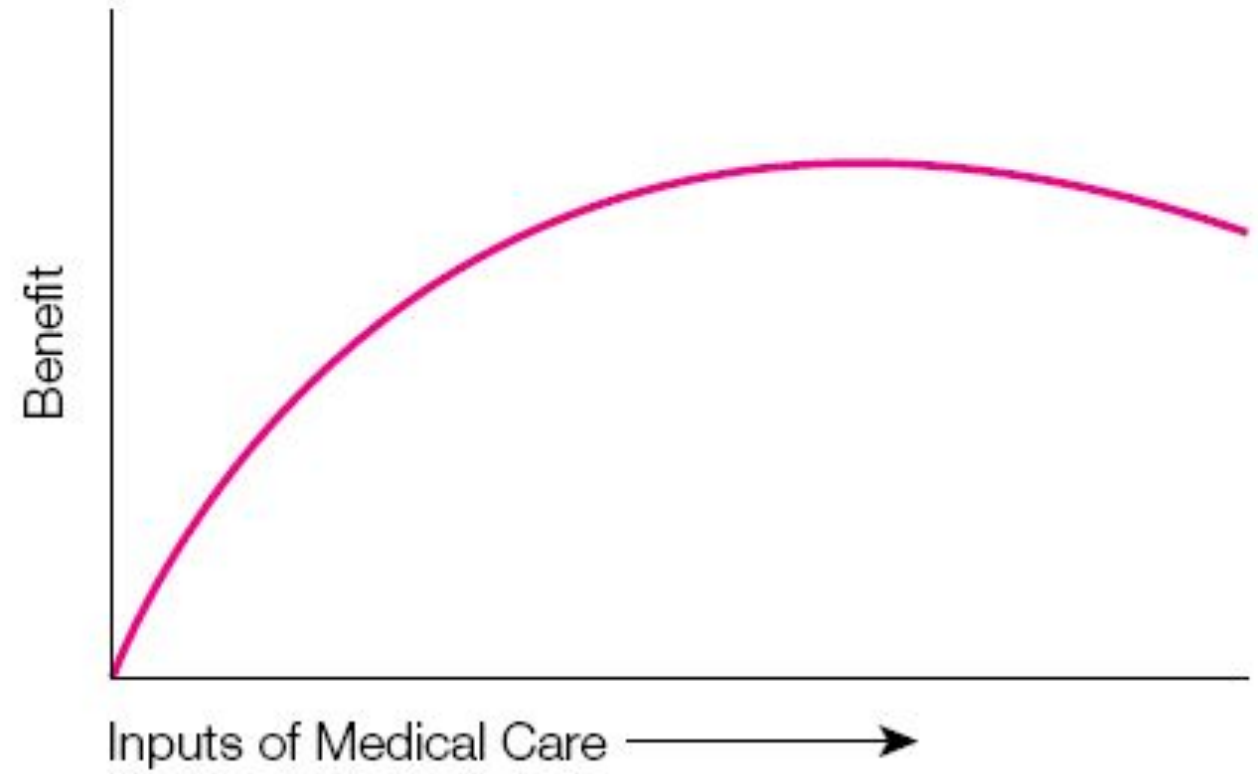
↑ Physician owned ancillaries
↑ MRIs
↑ ASCs
↑ Procedures

Problems with pay for volume?

Benefit = Quality Out comes

Inputs = Volume (Costs) (Profits)

Figure 1. The Law of Diminishing Returns



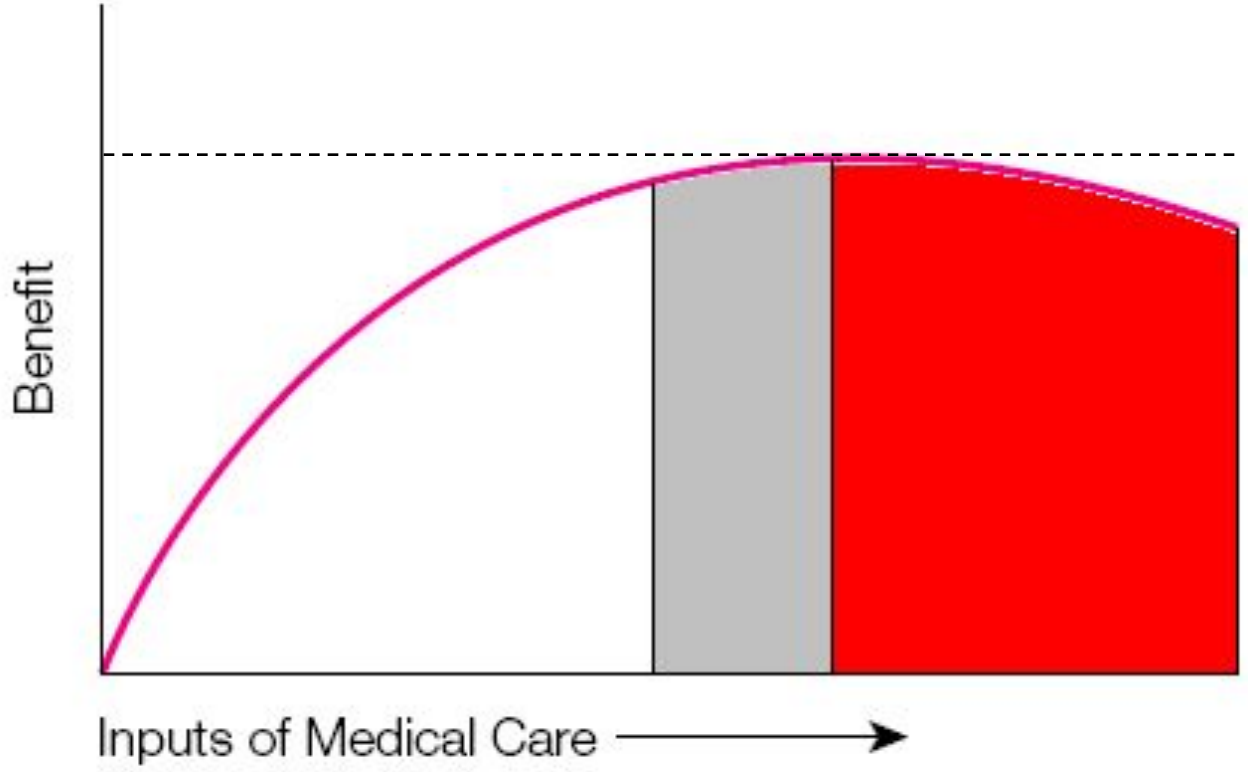
The first unit of input provides substantial benefits (imagine the first physician in a community), while additional units provide declining additional benefit (imagine the thousandth physician). Eventually, increasing inputs lead to no additional benefit (the "flat of the curve"). At some point, in theory, additional inputs lead to harm.

Benefit = Quality Out comes

Inputs = Volume (Costs)

(Profits)

Figure 1. The Law of Diminishing Returns



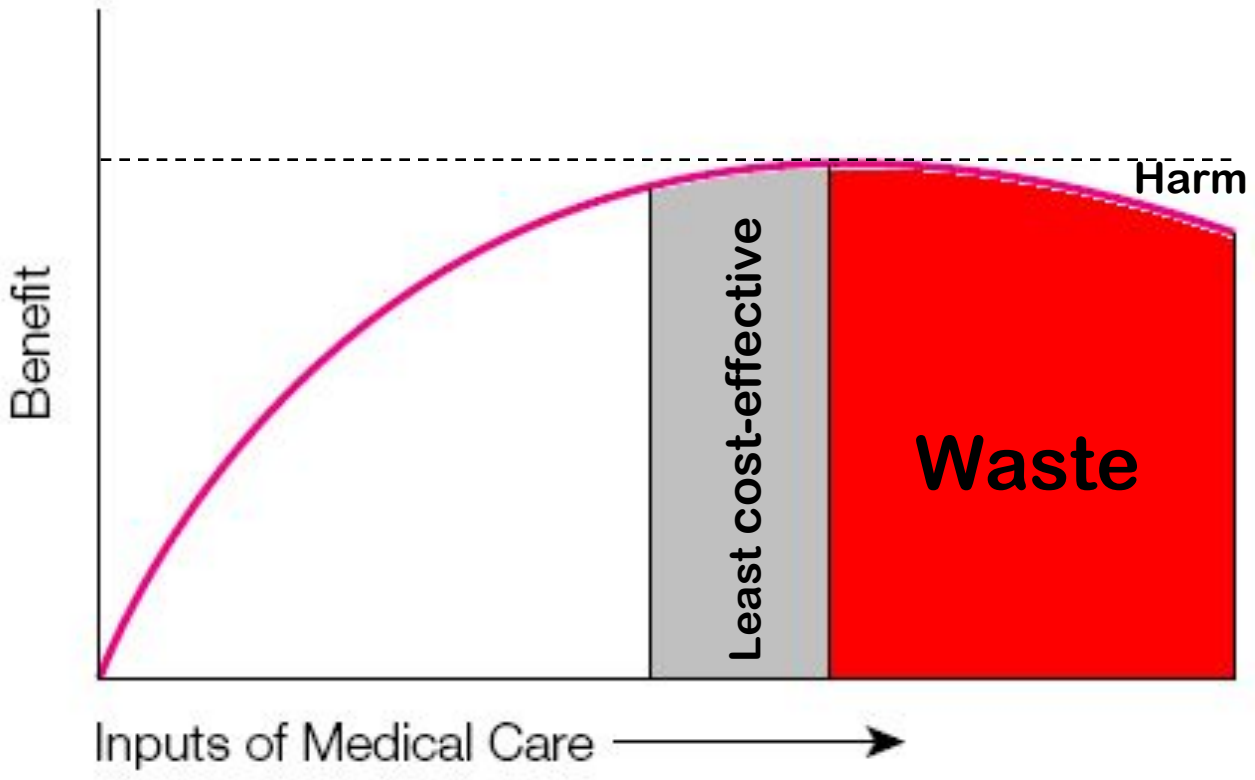
At some point:
for the dollars spent, we get no more benefit…
…and cause harm

Benefit = Quality Out comes

Inputs = Volume (Costs)

(Profits)

Figure 1. The Law of Diminishing Returns

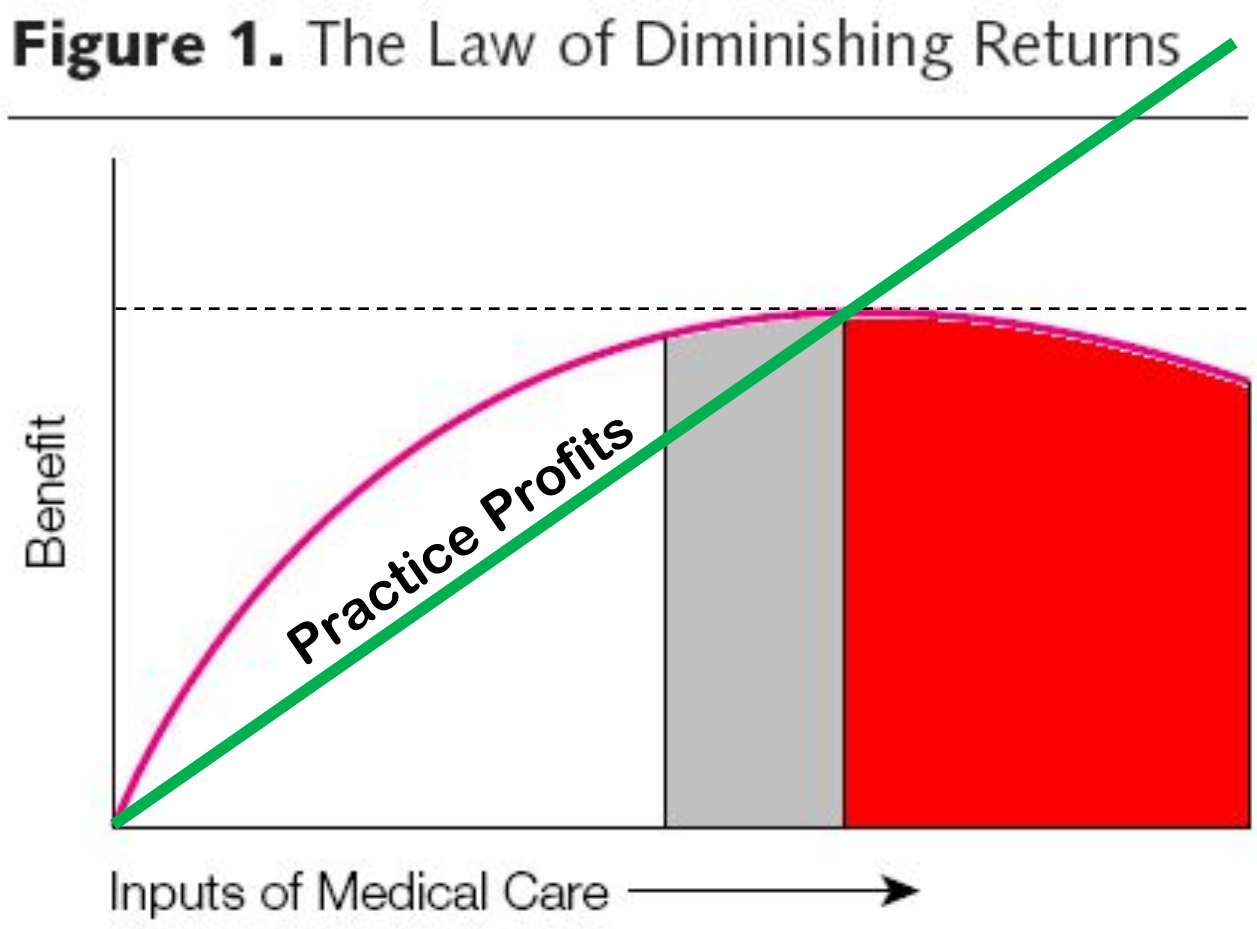


The problem is: we don't know where we are on the curve.

Benefit = Quality Out comes

Inputs = Volume (Costs)

(Profits)



Profits not tied to outcomes

There is as much profit/unit (or more) from causing harm

Very little profit from prevention

In “Ideal Insurance” – Patients would pay by outcome. Arrow 1963

Kenneth Arrow
Youngest Winner
1972 Nobel Prize in Economics

Problems with pay for volume?

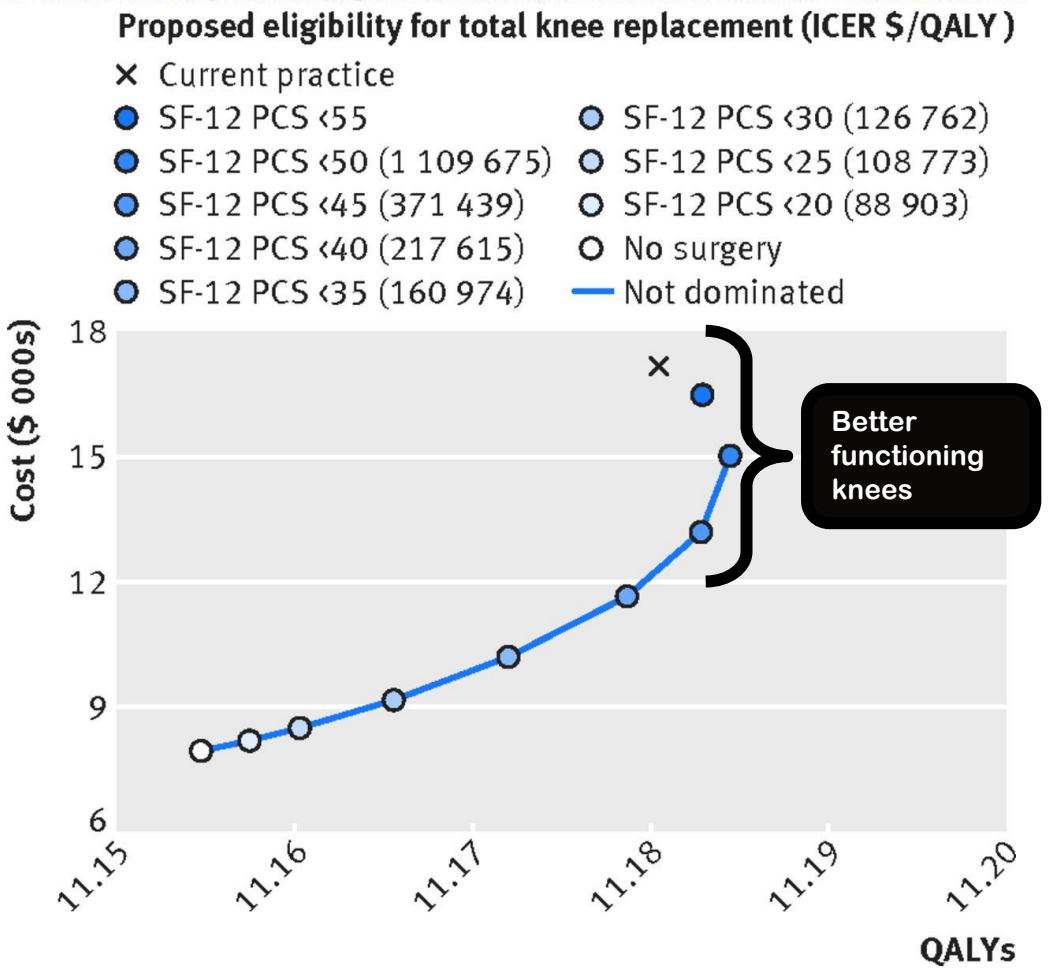
Indications have expanded and as we have included less severe knees,

we have had less improvement for the spend…

thebmj

Impact of total knee replacement practice: cost effectiveness analysis of data from the Osteoarthritis Initiative

Bart S Ferket,[1] Zachary Feldman,[2] Jing Zhou,[1] Edwin H Oei,[3] Sita M A Bierma-Zeinstra,[4,5] Madhu Mazumdar[1]



Problems with pay for volume?

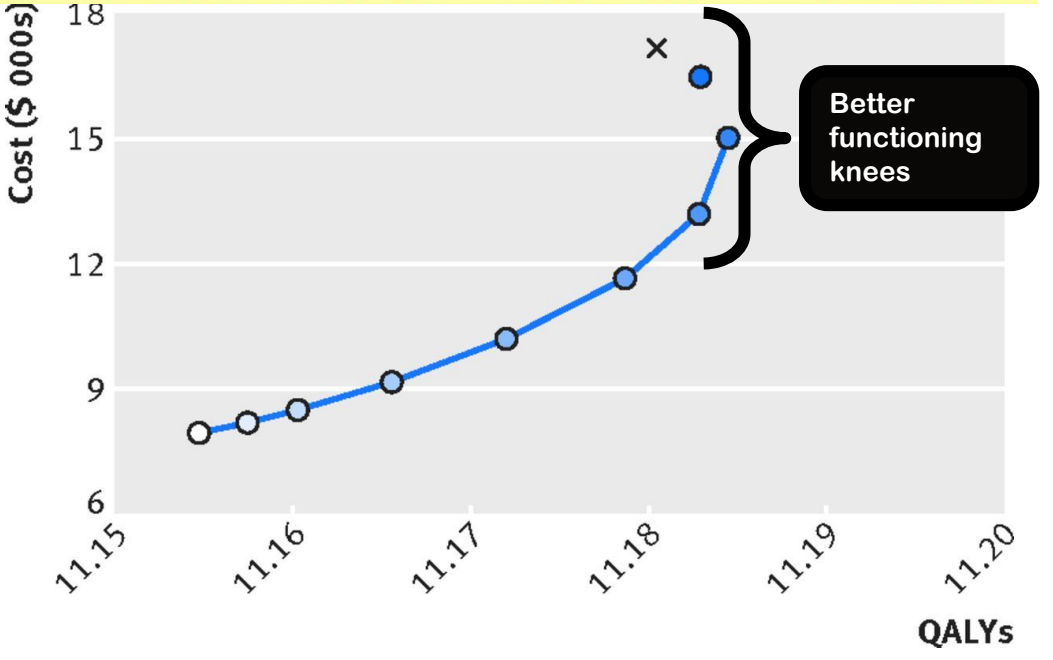
thebmj

Impact of total knee replacement practice: cost effectiveness analysis of data from the Osteoarthritis Initiative

The practice of total knee replacement as performed in a recent US cohort of patients with knee osteoarthritis had minimal effects on QALYs at the group level and was found to be economically unattractive

Total knee replacement practice, however, could be considered cost effective if the procedure were restricted to patients with more severely affected functional status

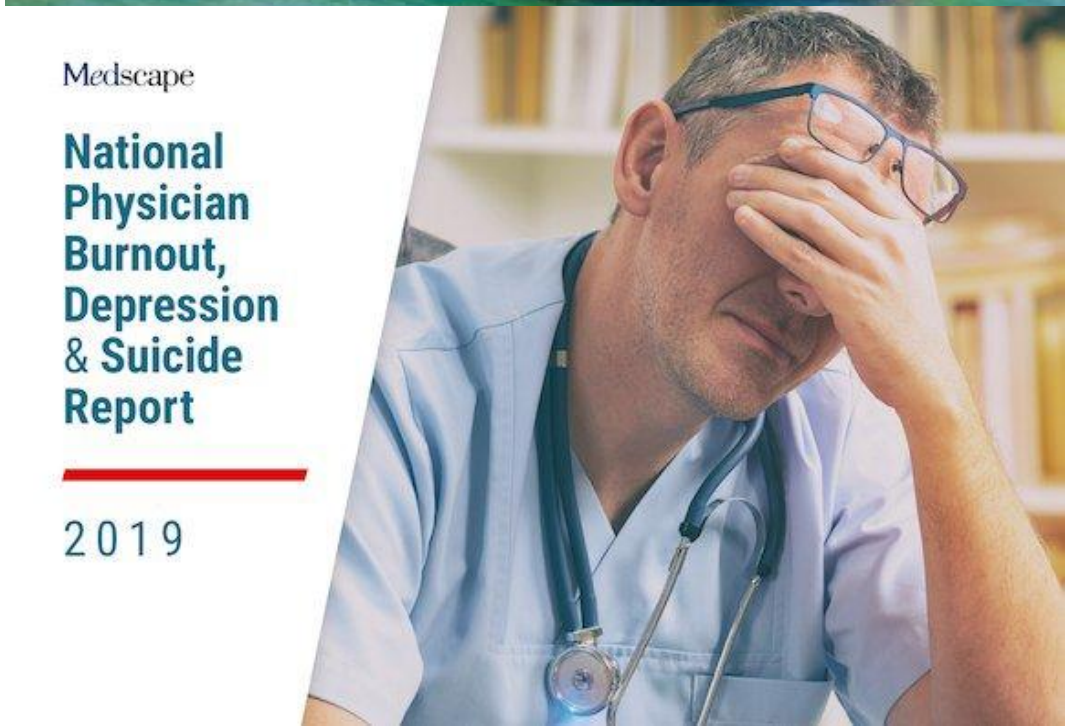
Early – moderate arthritis is best managed nonoperatively



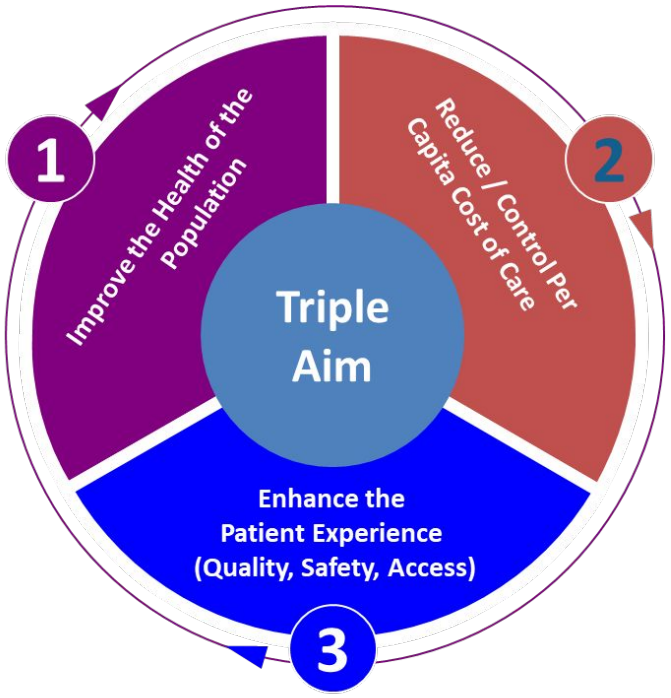
Problems with pay for volume?

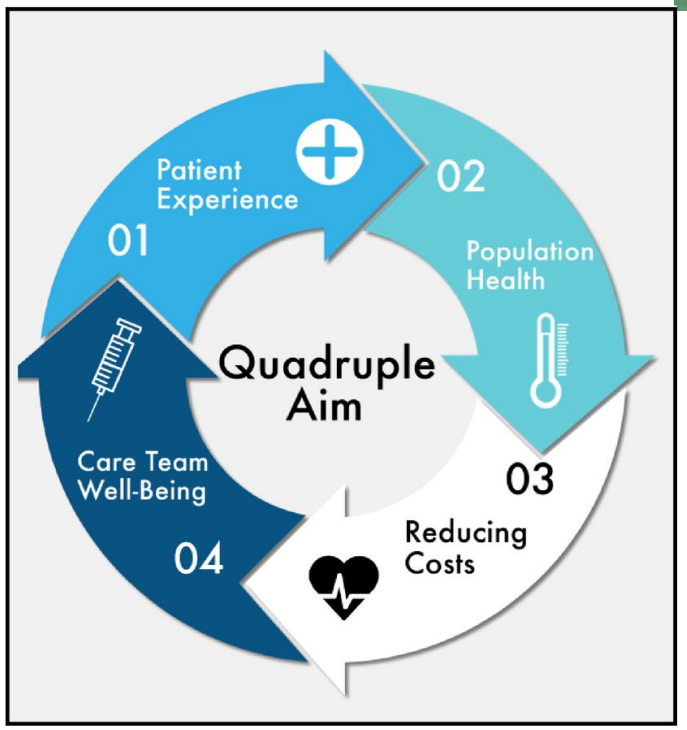
Burn out: emotional exhaustion
depersonalization
fail to meet personal goals

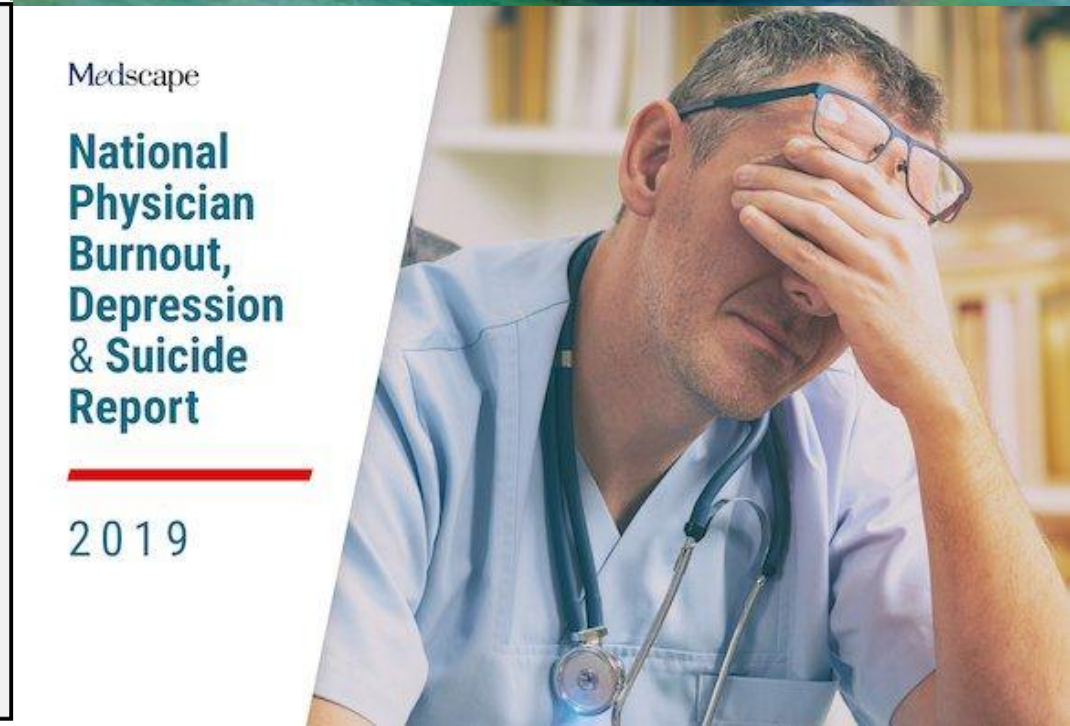
Moral distress ~ when an individual feels that external or internal constraints preclude the performance of an ethically appropriate choice or action.



Problems with pay for volume?







Moral Injury

perpetrating, failing to prevent, bearing witness to, or learning about acts that transgress deeply held moral beliefs and expectations

Doing, failing to prevent, witnessing or learning about practices that violate your moral beliefs and expectations

https://www.medicaleconomics.com/med-ec-blog/beyond-burnout-real-problem-facing-doctors-moral-injury

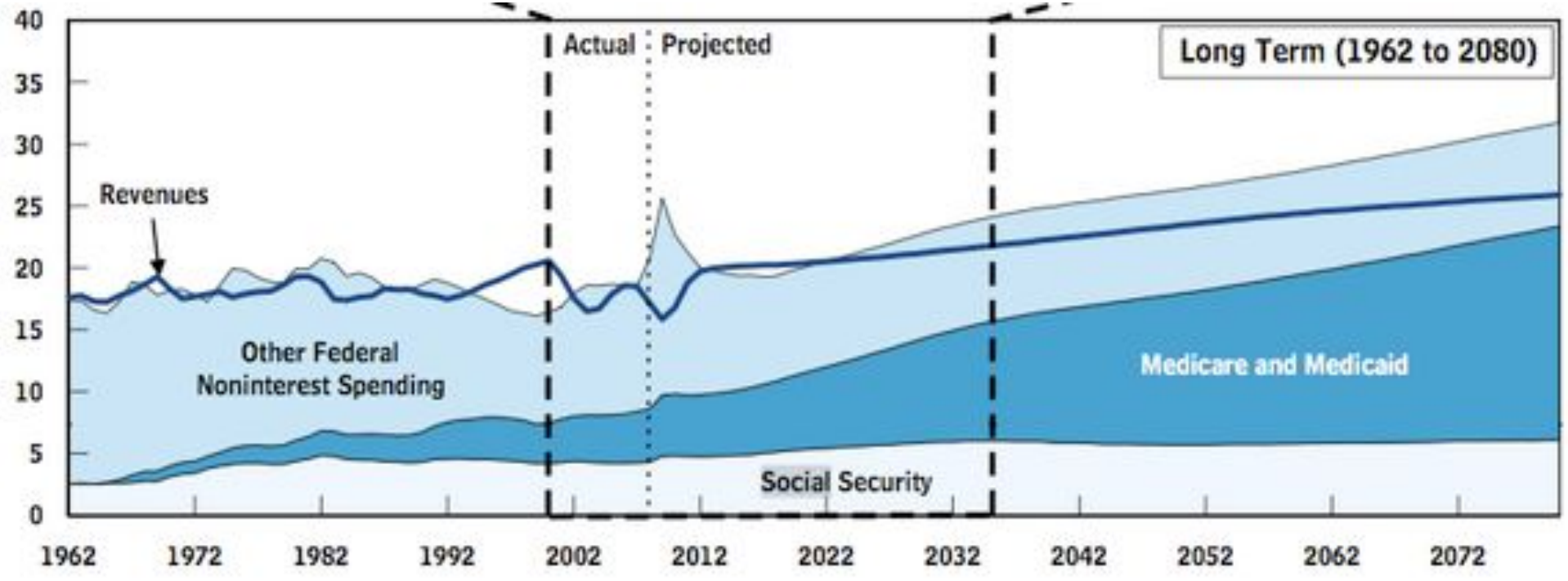
Moral distress ~ when an individual feels that external or internal constraints preclude the performance of an ethically appropriate choice or action.

Moral distress ~ psychic pain we feel when we know we are about to make an unethical action.

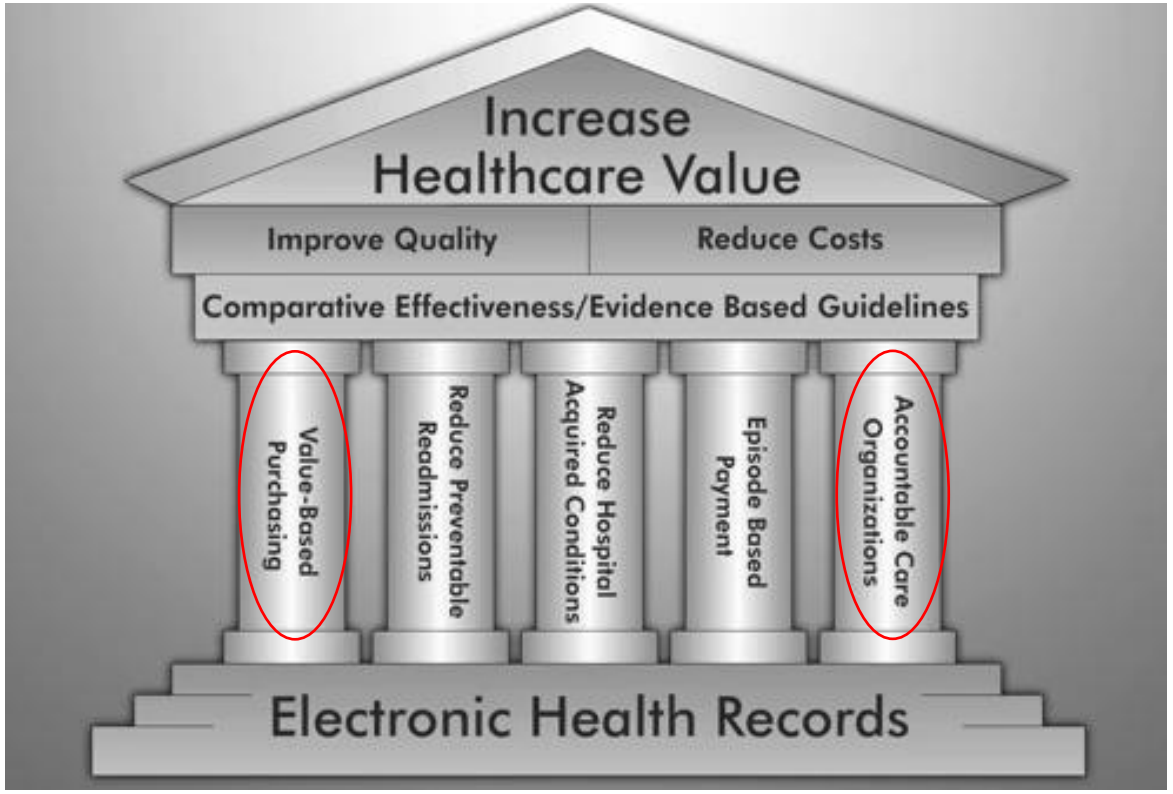
1965
Medicare

ACA: “Obamacare”

2010
ACA
Obama-
Care

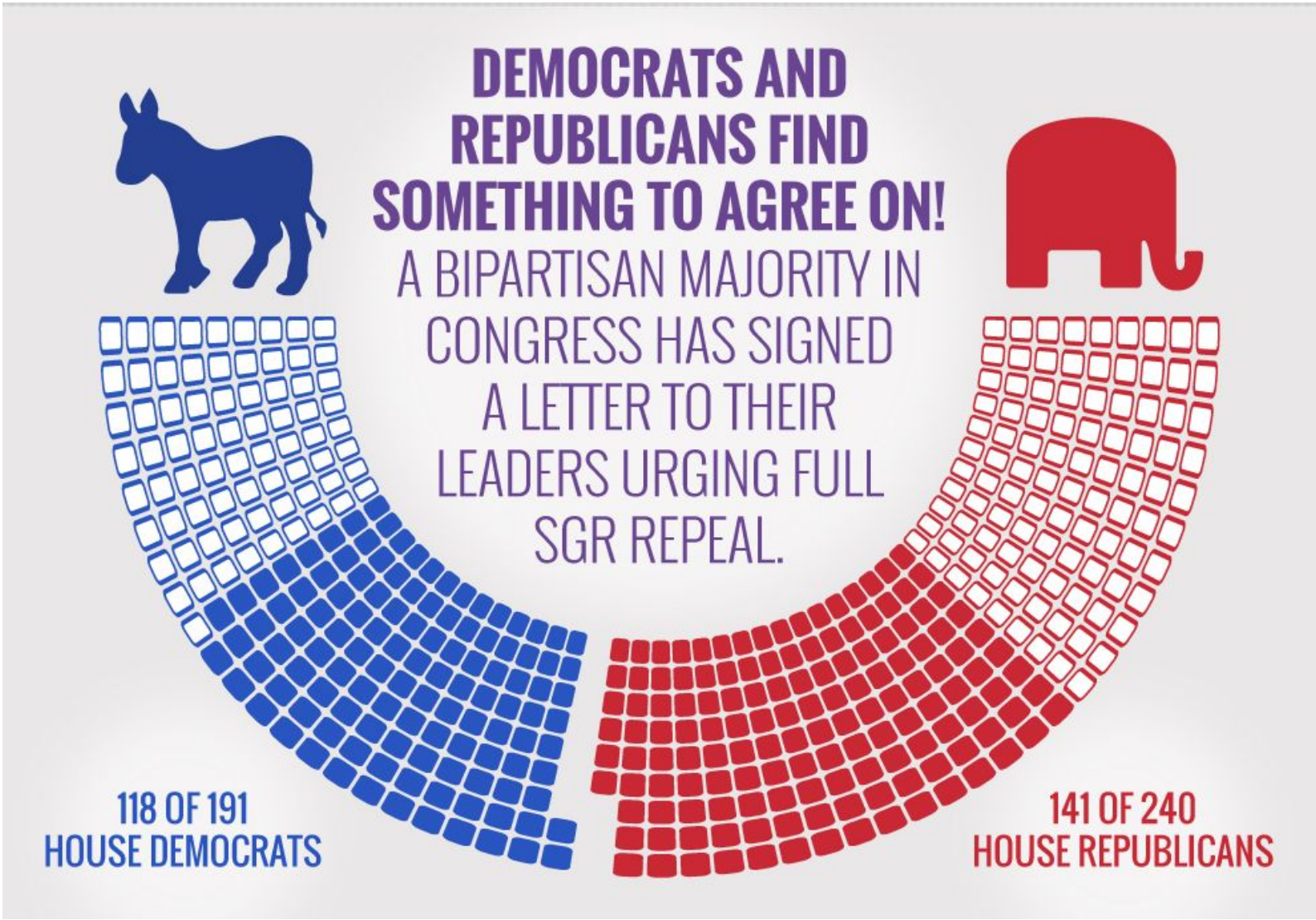


2010
PPACA
"Obamacare"



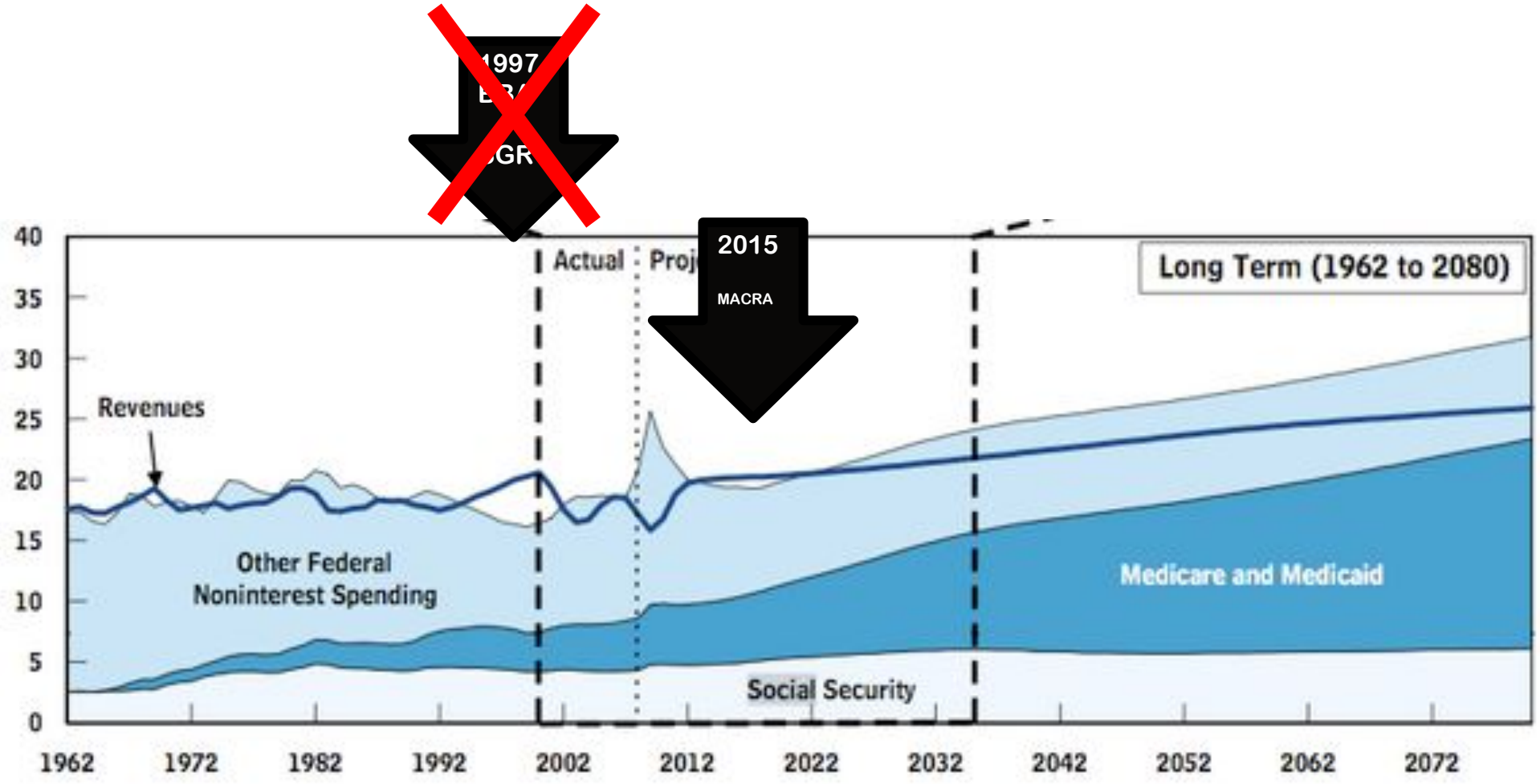
- Access:
  Demand participation
- Medical loss ratio of no less than 85%
- No pre-existing conditions
- No lifetime caps
- Preventive health programs
- Value-Based programs:
  ACO
  Episode payment (bundles)

The most bipartisan government in history finds something to agree on!



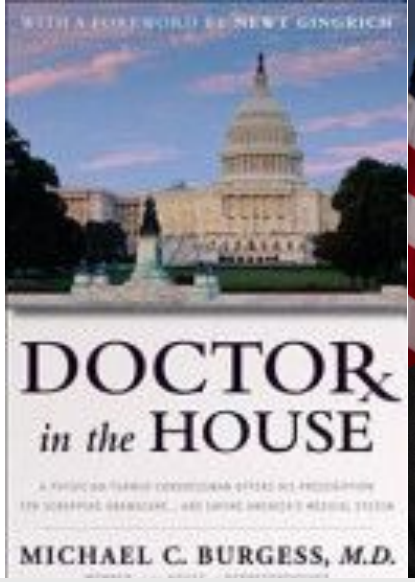
1965
Medicare

MACRA:



2015 MACRA "SGR FIX"

MACRA: stabilize MD payments define quality program



Home > Legislation > 114th Congress > H.R.2

Print Subscribe

H.R.2 - Medicare Access and CHIP Reauthorization Act of 2015

114th Congress (2015-2016) | Get alerts

BILL

Sponsor: Rep. Burgess, Michael C. [R-TX-26] (Introduced 03/24/2015)

Committees: House - Agriculture; Budget; Energy and Commerce; Judiciary; Natural Resources; Ways and Means

Latest Action: 04/15/2015 Message on Senate action sent to the House.

Major Recorded Votes: 04/14/2015 : Passed Senate; 03/26/2015 : Passed House

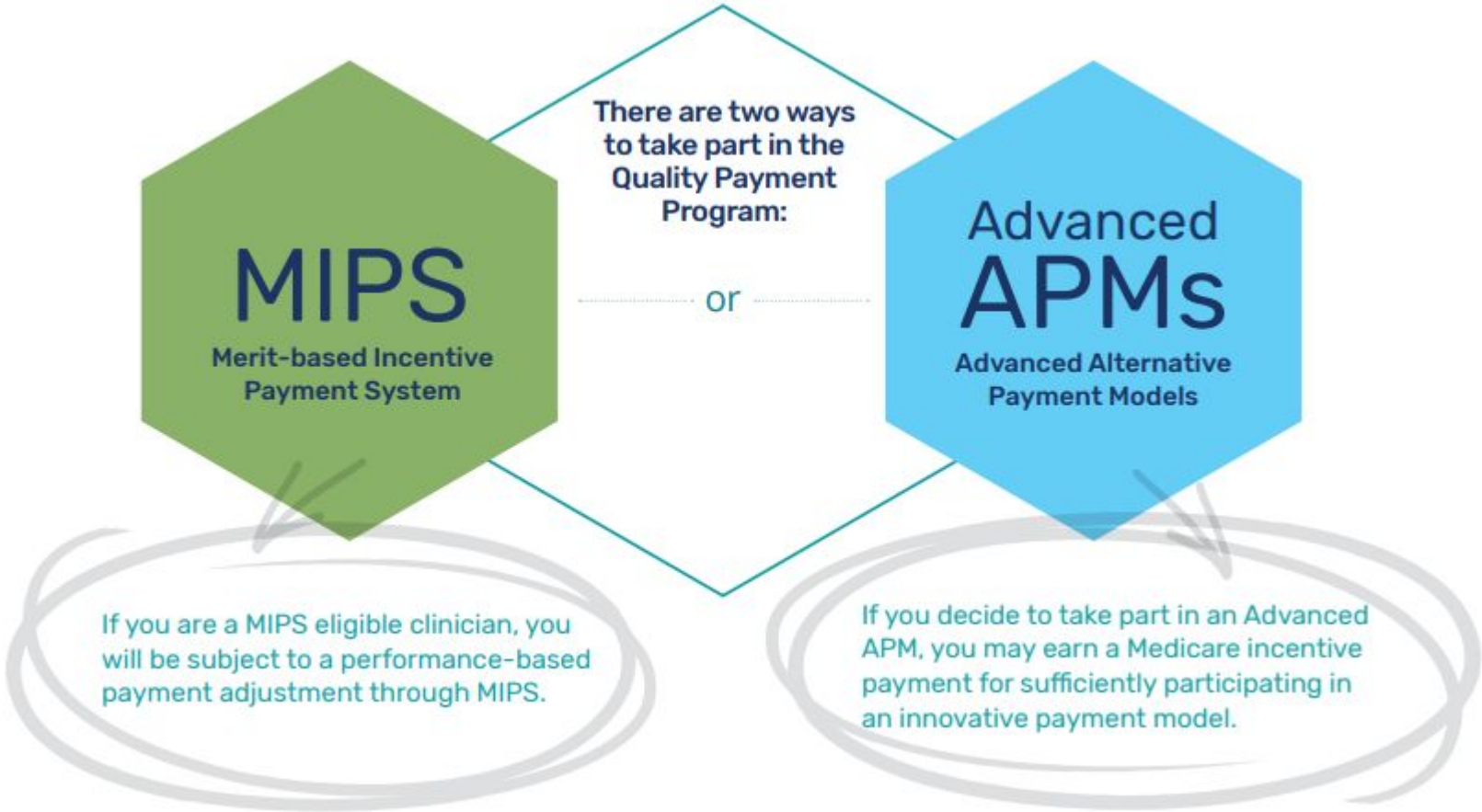
Tracker:

Introduced | Passed House | **Passed Senate** | To President | Became Law

“Nobody spends somebody else's money as carefully as he spends his own.”

Milton Friedman - Nobel Prize in Economics

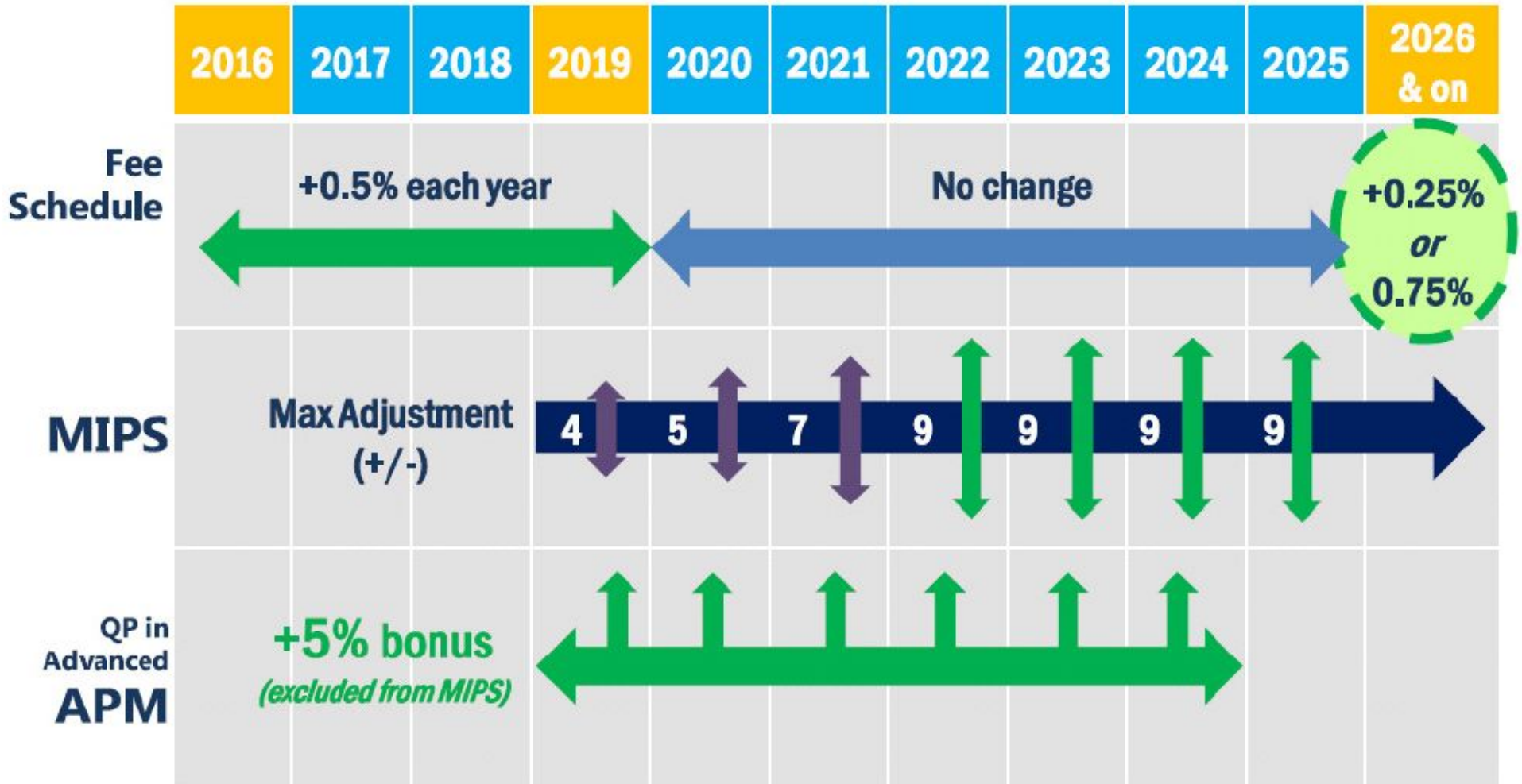
“Value-based care: 2 ways to seek quality payments:



- $ Incentives:
  - Quality Metrics
  - Cost Metrics

- Financial risk + quality metrics:
  - ACO
  - Bundles

MACRA ~
"Pay for Value"



Source: CMS

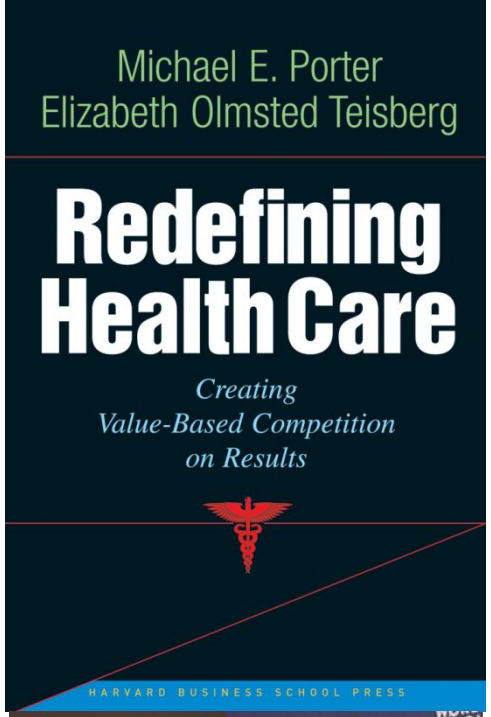
MACRA

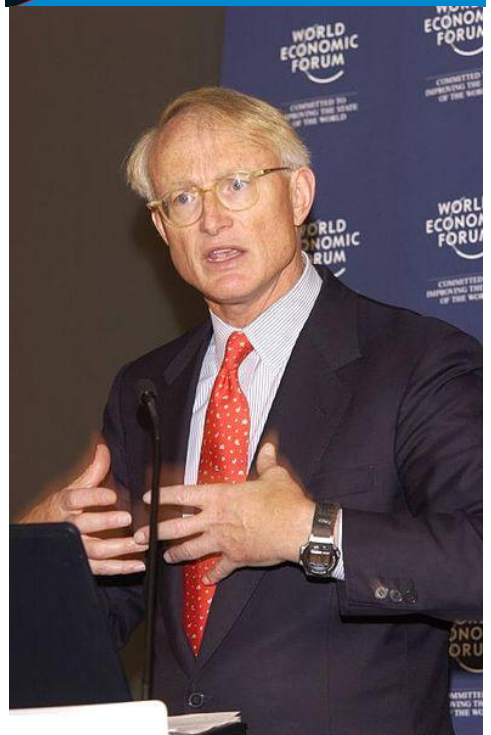
- If we work to have better results and create higher value then get more $

- If non-participator or if participate with no change and have low value:

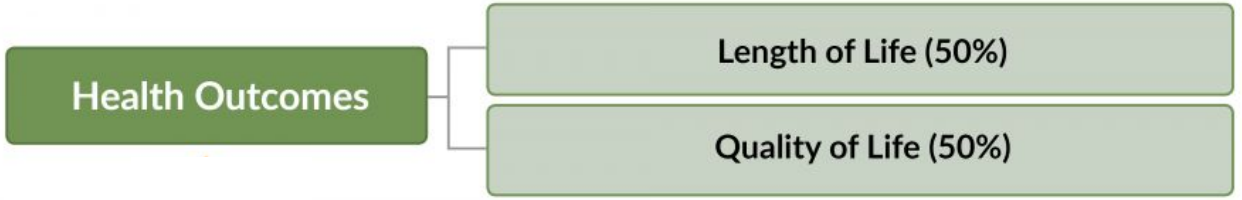
Michael Porter
Harvard Economist

$$\text{VALUE} = \frac{\text{OUTCOME}}{\text{COST}}$$

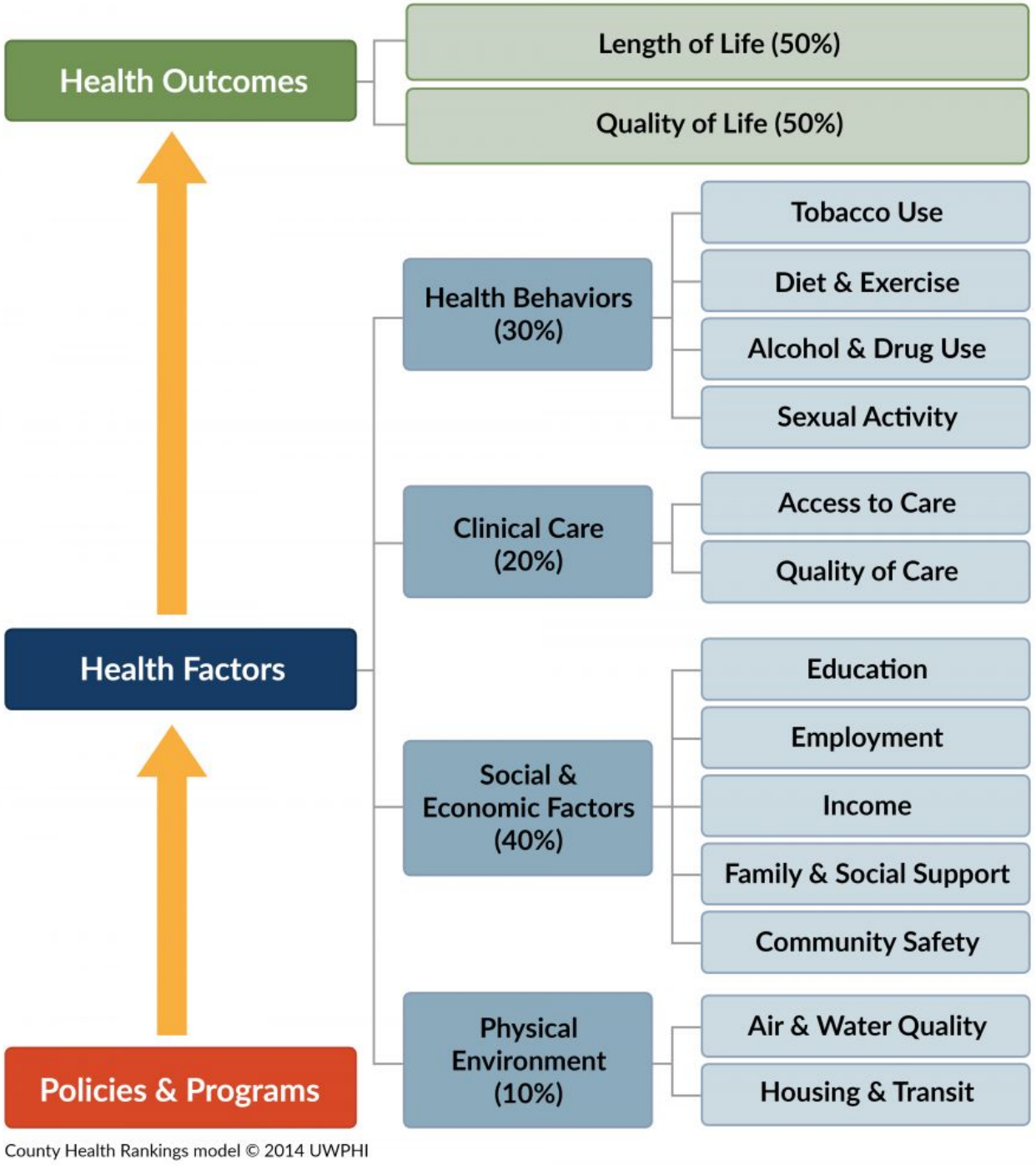




Outcomes

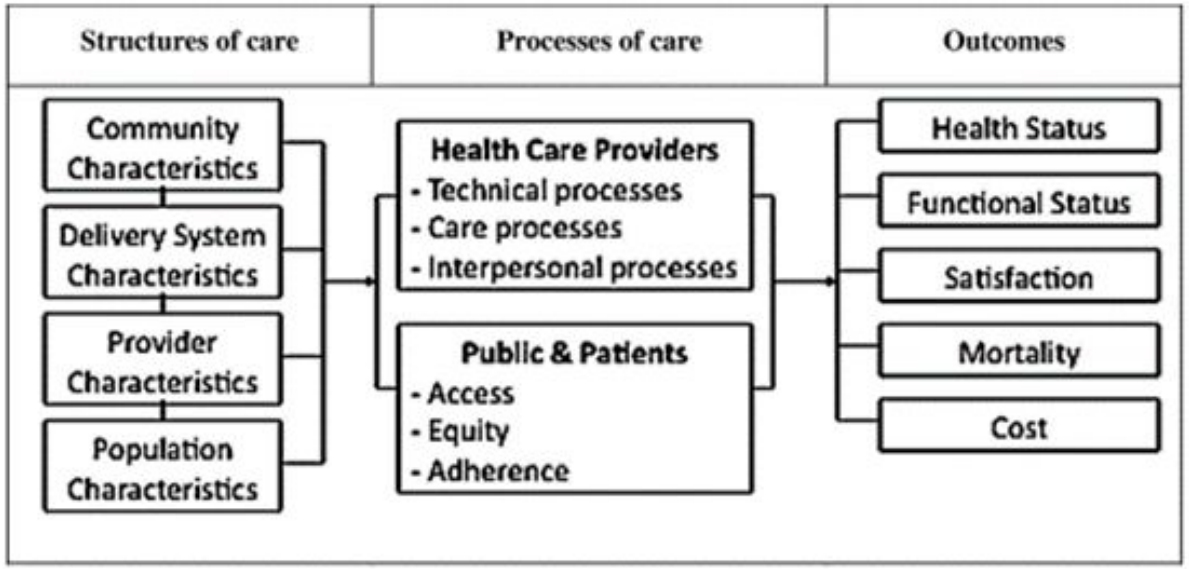


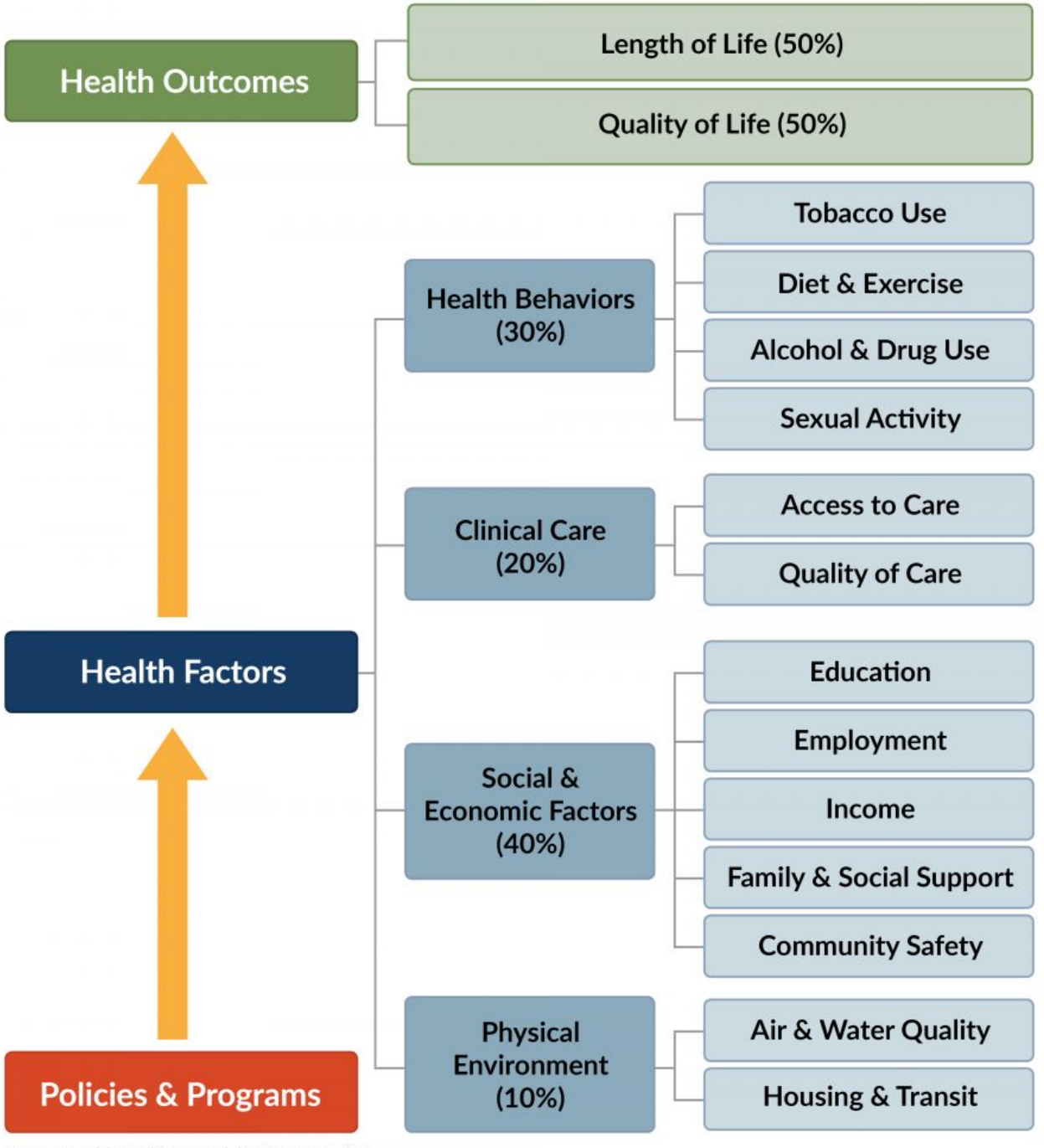
Outcomes


Health Outcomes
Length of Life (50%)
Quality of Life (50%)
Health Factors
Health Behaviors (30%)
Tobacco Use
Diet & Exercise
Alcohol & Drug Use
Sexual Activity
Clinical Care (20%)
Access to Care
Quality of Care
Social & Economic Factors (40%)
Education
Employment
Income
Family & Social Support
Community Safety
Physical Environment (10%)
Air & Water Quality
Housing & Transit
Policies & Programs
County Health Rankings model © 2014 UWPHI

Outcomes

Healthcare Quality Model
Donabedian 1966





Costs of Arthritis Care

Non-operative/Community costs

- Conservative management costs
- Specialist evaluation costs
- Preparation/Optimization costs

Hospital Costs:

- Implant cost – strategies to decrease
  - Price caps vs implant standadization
  - Group purchasing
  - Joint Registry ~ outcomes by component
  - Gain sharing
- Length of Stay
  - Surgical technique improvements
    - No drains
    - Tranexamic acid
    - Pain control ~ spinal/local injection
  - Clinical pathways/Joint camp
    - Expectations
    - Early PT
- Operating Room Costs - time
  - Efficient standardized teams
    - Be prepared – people and supplies
    - Start on time

Post Acute Costs

- Self care vs Home PT vs Outpatient PT
- SNF vs Rehab

Complication Costs

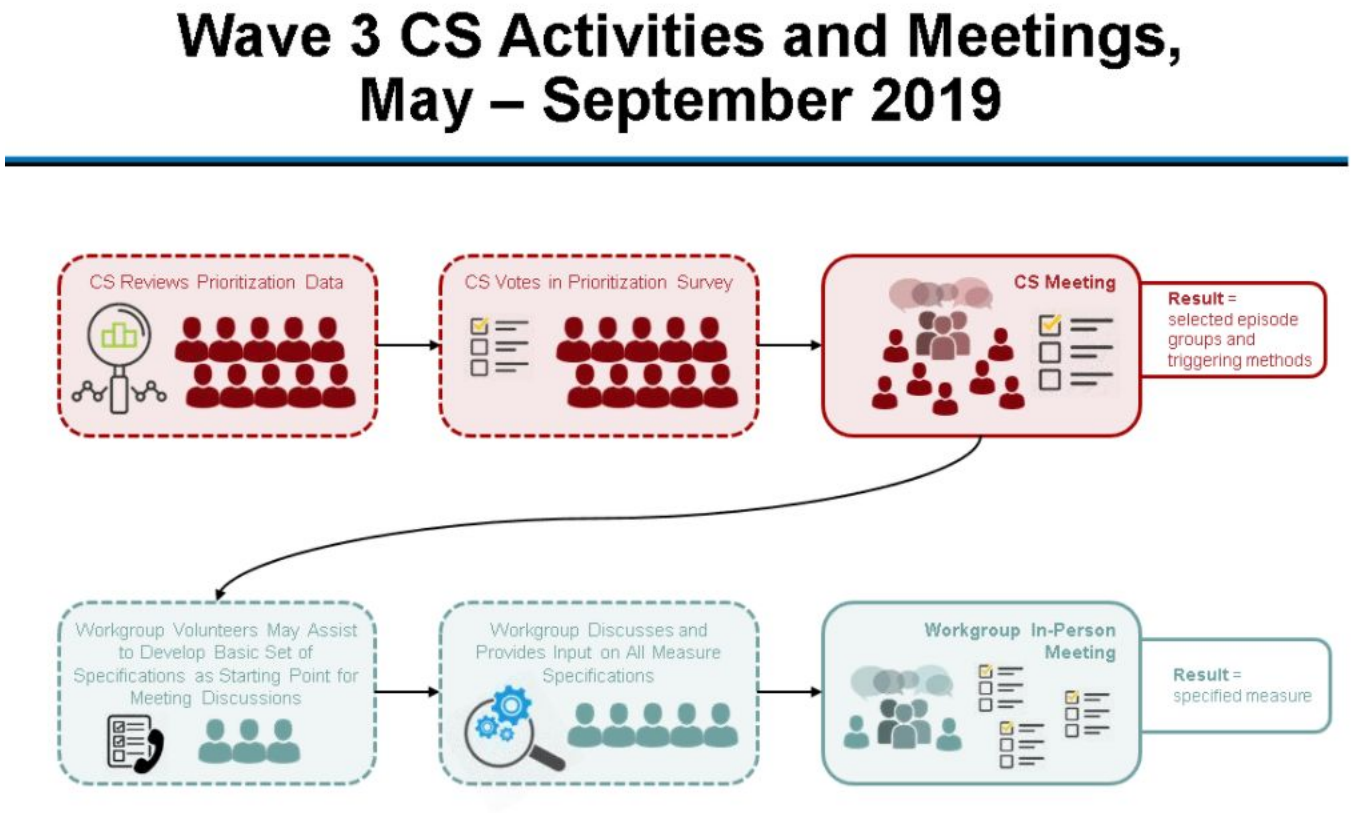
- Early 30 or 90 days
- Long term – revision/reoperation rates

Cost outcome metrics

Acumen – CMS contracted

Crafting episode based cost metrics for everyone

Based exclusively on the claims you bill/collect



COST: (Claims data) already being benchmarked!

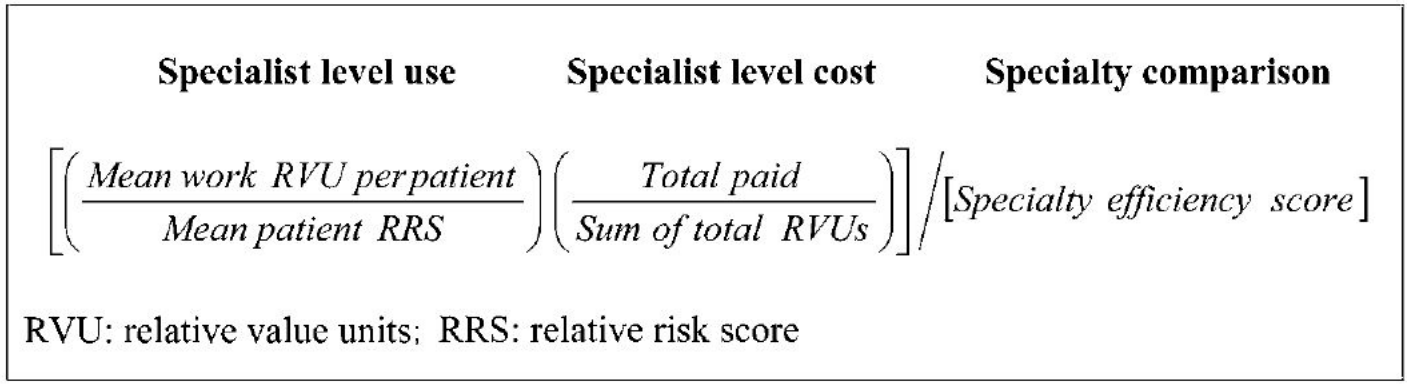


Figure 1 Specialist efficiency index formula

- Michigan BCBS
- Specialist "cost efficiency reporting" to specialists and their referrers
- Orthopaedics - ↓ utilization by 13%
  (without direct plan reward or consequences)

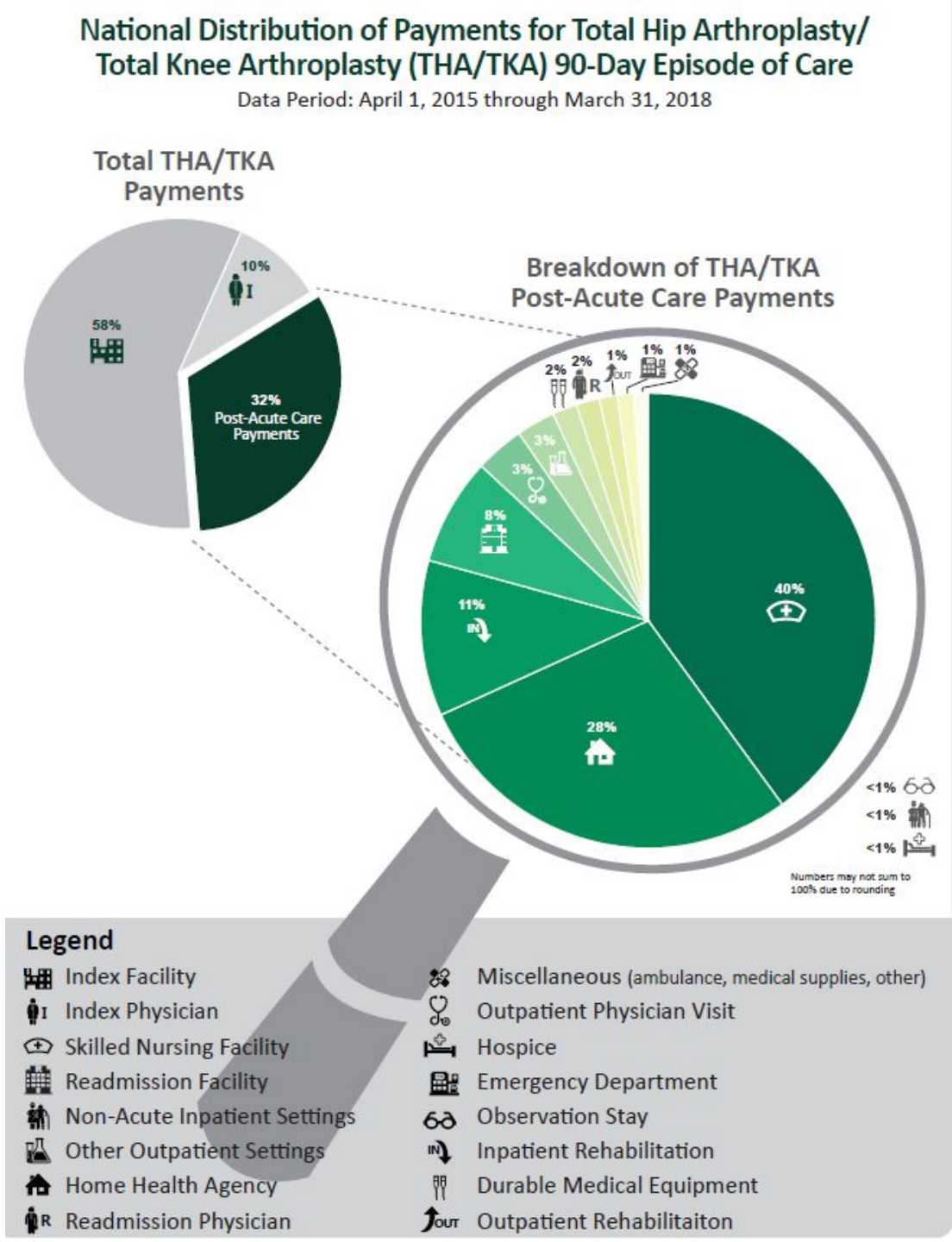
Goodman HSMR 2012

TKA METRICS ~ 90 day costs

10% collected by providers

58% paid to hospitals

32% paid to **Post-Acute Care**
Home Discharges best
Unless problems that cause readmissions



Readmissions are very costly

~ $8,500

- **Joint Related**

  91/325 **~1/3**

- **Medical Issues**

  234/325 **~2/3**

The Journal of Arthroplasty 34 (2019) 819–823

Contents lists available at ScienceDirect

The Journal of Arthroplasty

journal homepage: www.arthroplastyjournal.org

Health Policy & Economics

How Much Does a Readmission Cost the Bundle Following Primary Hip and Knee Arthroplasty?

Jessica L.H. Phillips, MD, Alexander J. Rondon, MD, MBA, Chris Vannello, RN, BSN, Yale A. Fillingham, MD, Matthew S. Austin, MD, P. Maxwell Courtney, MD *

Department of Orthopaedic Surgery, The Rothman Institute at Thomas Jefferson University, Philadelphia, PA

Mean Claims Costs of Readmission by Reason Following THA and TKA.

Reason for Readmission	N	Mean Readmission Costs (SD)
Periprosthetic joint infection	40	$11,952 ($5988)
Periprosthetic fracture	14	$16,852 ($6475)
Other revision surgery	14	$17,263 ($6146)
Venous thromboembolic event	23	$6334 ($2459)
Acute kidney injury	22	$7040 ($4658)
Cardiac event	40	$9689 ($10,926)
Gastrointestinal	38	$5389 ($2080)
Respiratory	17	$8092 ($5844)
Neurologic	32	$5936 ($2726)
Other medical pathology	53	$6969 ($4738)
Fever or cellulitis without any surgical intervention	32	$7387 ($3889)
Total	325	$8560 ($6511)

SD, standard deviation; THA, total hip arthroplasty; TKA, total knee arthroplasty.

Easy Quality Outcomes metrics:
"Claims Based"

Post-op complications at 90 days
Readmissions in 90 days
Secondary procedures in 90 days

More important for long term: (FOR FUTURE PROGRAMS)

Did patient improve from preop?
PROM ~ patient reported outcome measures

How much did patient improve from preop?
PROM at 1 year

How long did improvement last before next surgery?
Quality of life years

Quality Metrics:
Joint Commission

THKR-1 Regional Anesthesia
THKR-2 Day #0 Postoperative Ambulation
THKR-3 Discharged to Home
THKR-4 Preoperative Functional/Health Status Assessment

Quality Metrics:
AAHKS

AAHKS®
AMERICAN ASSOCIATION OF HIP AND KNEE SURGEONS

» Measure #1a-1c: Assessment of Patient Hx & PE, Radiographic Evidence of Arthritis

» Measure #2: Shared Decision Making: Trial of Conservative (Non-surgical) Therapy

» Measure #3: DVT/PE and Cardiac Risk Evaluation

» Measure #4: Preop Antibiotic prior to Tourniquet

» Measure #5: Identification of Implant in Op Report

Detailed Methodology for the 2018 Value Modifier and the 2016 QRUR

Exhibit B.4 *(continued)*

PQRS or QCDR Number (GPRO/eCQM Number)	Measure Name	Quality Domain
330*	Adult Kidney Disease: Catheter Use for Greater Than or Equal to 90 Days	Patient Safety
335	Maternity Care: Elective Delivery or Early Induction Without Medical Indication at ≥ 37 and < 39 Weeks	Patient Safety
347*	Rate of Endovascular Aneurysm Repair (EVAR) of Small or Moderate Non-Ruptured Abdominal Aortic Aneurysms (AAA) Who Die While in Hospital	Patient Safety
348*	HRS-3: Implantable Cardioverter-Defibrillator (ICD) Complications Rate	Patient Safety
351	Total Knee Replacement: Venous Thromboembolic and Cardiovascular Risk Evaluation	Patient Safety
352	Total Knee Replacement: Preoperative Antibiotic Infusion with Proximal Tourniquet	Patient Safety
353	Total Knee Replacement: Identification of Implanted Prosthesis in Operative Report	Patient Safety
354*	Anastomotic Leak Intervention	Patient Safety
355*	Unplanned Reoperation Within the 30 Day Postoperative Period	Patient Safety

NATIONAL QUALITY FORUM

Quality Metrics:
National Quality Forum

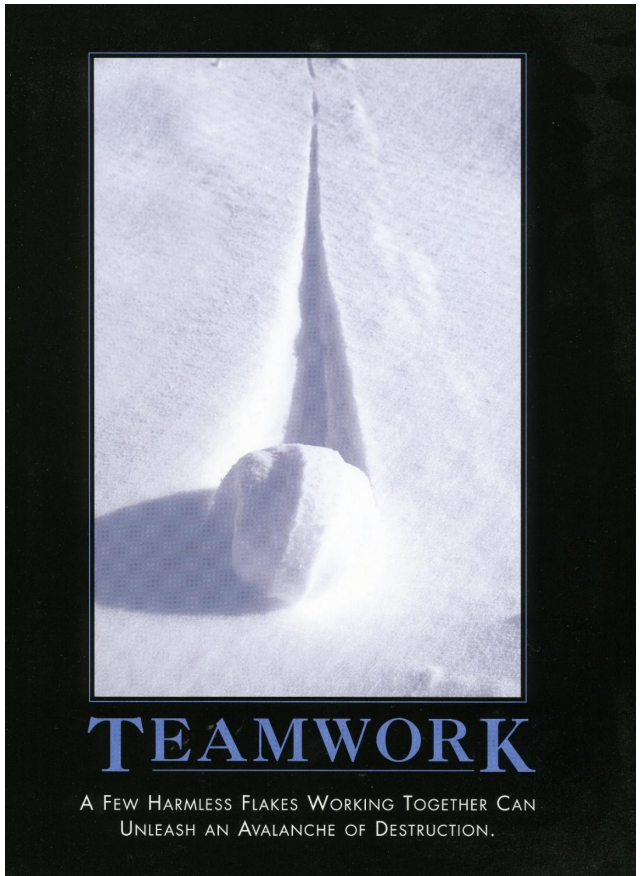
Healthcare Sector	Percentage by Healthcare Sector
Provider	43%
Patient/Caregiver	1%
Consumer	4%
Health Professional	19%
Supplier/Industry	2%
Health Plan	6%
QMRI	6%
Health Agency	1%
Health Plan	6%
Public/ Community Health	4%
Public Health and Measurement Researcher (PHMR)	7%

"consensus based entity" recognized by US Congress

Public/Private partnership
in 2008 expenses were $18.8 Million (Feds pay $14 million)

Reports annually to Congress and Health and Human Services
via "Measure Applications Partnership" (MAP)
3 work groups: Hospital
Clinicians
Post-acute/Long-Term Care
Membership: patients, clinicians, providers, purchasers, payers

Endorses "Performance Measures"
for both federal, public and private payers
encourages alignment between payers ~ "harmonization"



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Public/Private partnership "consensus based entity"

Reports to Congress

Membership: patients
clinicians
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payers

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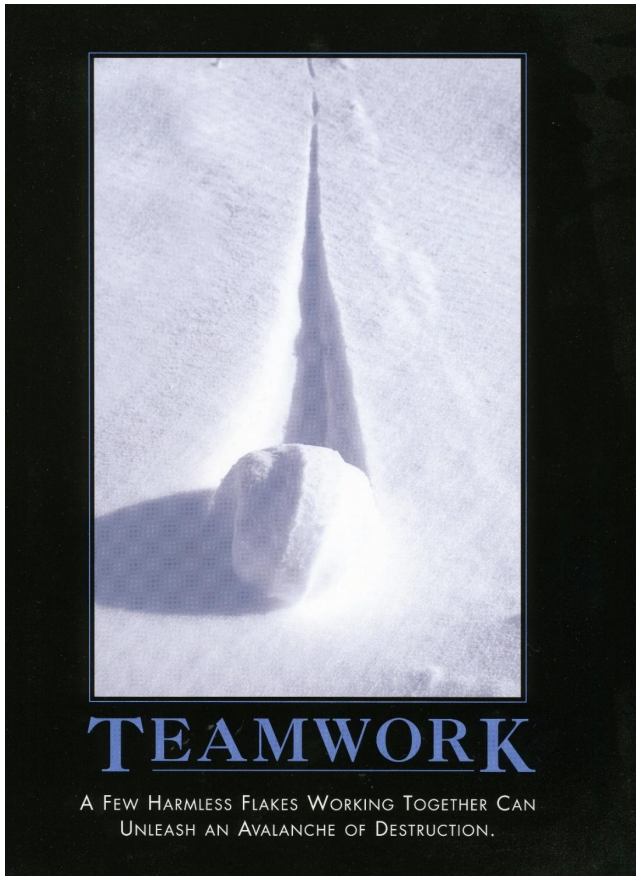


Core Quality Measures Collaborative (Hosted by National Quality Forum)

CMS ~ Centers for Medicare & Medicaid Services

AHIP ~ America's Health Insurance Plans

1550 Hospital-level
Risk-standardized **complication rate** (RSCR)
Within **90 days after arthroplasty**

1551 Hospital-level
All-cause risk-standardized **readmission rate** (RSRR)
Within **30 days after arthroplasty**

1741 Patient Experience with Surgical Care Based on the Consumer Assessment of Healthcare Providers and Systems (CAHPS®) Surgical Care Survey

Public Reporting

1550 Hospital-level
Risk-standardized **complication rate** (RSCR)
Within **90 days after arthroplasty**

1551 Hospital-level
All-cause risk-standardized **readmission rate** (RSRR)
Within **30 days after arthroplasty**

1741 Patient Experience with Surgical Care Based on the Consumer Assessment of Healthcare Providers and Systems (CAHPS®) Surgical Care Survey

Medicare.gov | Hospital Compare
The Official U.S. Government Site for Medicare

	UNIVERSITY HEALTH SYSTEM 4502 MEDICAL DR SAN ANTONIO, TX 78229 (210) 358-2637 Overall rating: ★★●●● Learn more Distance: 0.2 miles Add to My Favorites Maps and directions	METHODIST HOSPITAL 7700 FLOYD CURL DR SAN ANTONIO, TX 78229 (210) 575-4000 Overall rating: ★★★●● Learn more Distance: 0.4 miles Add to My Favorites Maps and directions	NATIONAL RESULT
Rate of complications for hip/knee replacement patients	No Different Than the National Rate	Worse Than the National Rate	2.5%

	UNIVERSITY HEALTH SYSTEM 4502 MEDICAL DR SAN ANTONIO, TX 78229 (210) 358-2637 Overall rating: ★★●●● Learn more Distance: 0.2 miles Add to My Favorites Maps and directions	METHODIST HOSPITAL 7700 FLOYD CURL DR SAN ANTONIO, TX 78229 (210) 575-4000 Overall rating: ★★★●● Learn more Distance: 0.4 miles Add to My Favorites Maps and directions	NATIONAL RESULT
Rate of readmission after hip/knee replacement	No Different Than the National Rate	No Different Than the National Rate	4%

	UNIVERSITY HEALTH SYSTEM 4502 MEDICAL DR SAN ANTONIO, TX 78229 (210) 358-2637 Overall rating: ★★●●● Learn more Distance: 0.2 miles Add to My Favorites Maps and directions	METHODIST HOSPITAL 7700 FLOYD CURL DR SAN ANTONIO, TX 78229 (210) 575-4000 Overall rating: ★★★●● Learn more Distance: 0.4 miles Add to My Favorites Maps and directions	NATIONAL AVERAGE PAYMENT
Payment for hip/knee replacement patients	No Different Than the National Average Payment	Greater Than the National Average Payment	$21,392

QualityNet

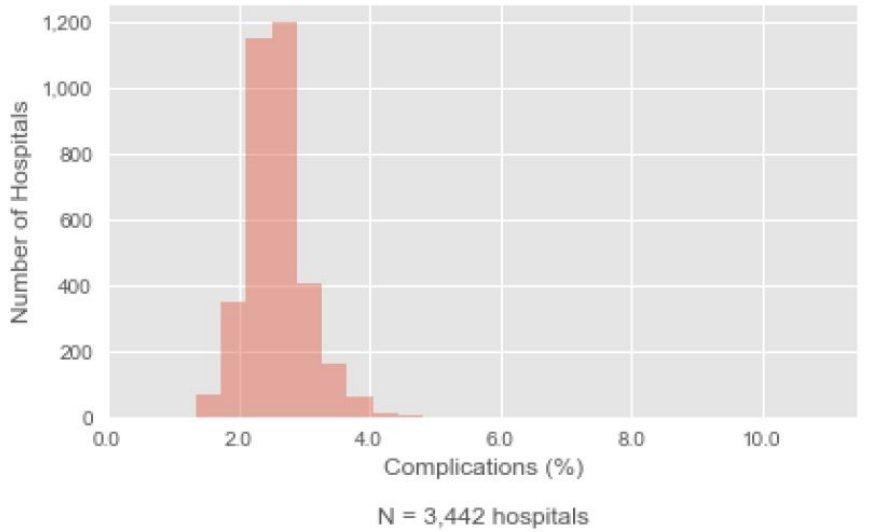
http://www.qualitynet.org

CMS-approved website for secure communications and healthcare quality data

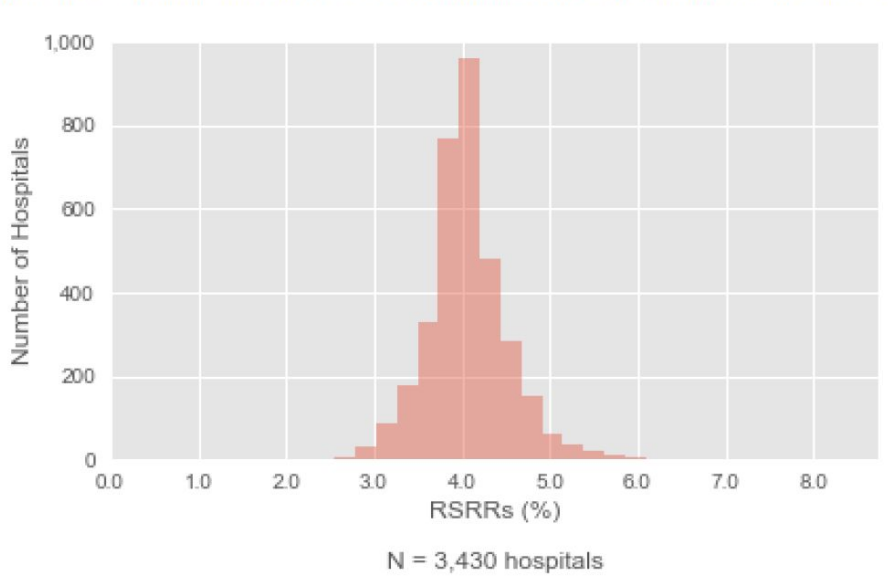
WHERE TO FIND YOUR DATA

2019 Procedure-Specific Complication Measure Updates and Specifications Report

Figure 4.2.2 – Distribution of Hospital THA/TKA RSCRs between April 2015 and March 2018



2019 Procedure-Specific Readmission Measures Updates and Specifications Report



How to affect Outcomes:

Preoperative Risk Factors

Intra-operative Risk Factors

Postoperative Risk Factors

AAOS American Academy of Orthopaedic Surgeons
American Association of Orthopaedic Surgeons

Surgical Risk Reduction Toolkit

The intent of the Surgical Risk Reduction Toolkit is to provide physicians with strategies to mitigate risk factors that have been demonstrated to contribute to complications. This toolkit includes:

- A full review of major surgical risk factors
- A temporal approach to addressing risk factors – preoperative, intra-operative, postoperative
- Multilayered content stating general information and delving into deeper detail with guides to help reduce risk

This guide will have a positive effect on orthopaedic practice, patients' preoperative and overall health, reduce complication rates and help surgeons ensure the best possible outcomes

Preoperative Risk Factors

Optimize your patients' preoperative risk factors (e.g., nutrition, diabetes, depression, etc.) to reduce postoperative complications and improve outcomes.

LEARN MORE

Intraoperative Risk Factors

Be prepared and have a plan to address critical situations during surgery.

LEARN MORE

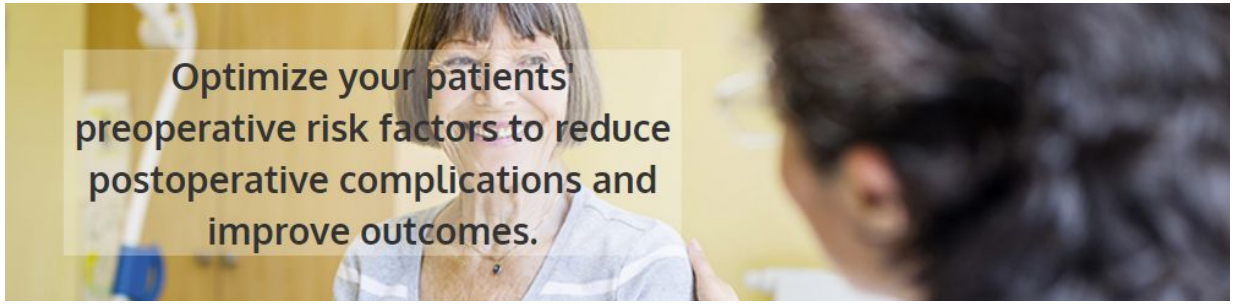
Postoperative Risk Factors

Address critical postoperative risk factors (e.g., blood mgmt.) and prepare patients for recovery and discharge.

LEARN MORE

AAOS American Academy of Orthopaedic Surgeons
American Association of Orthopaedic Surgeons

Preoperative Risk Factors



“Patient Optimization”

Surgical Risk Reduction Toolkit

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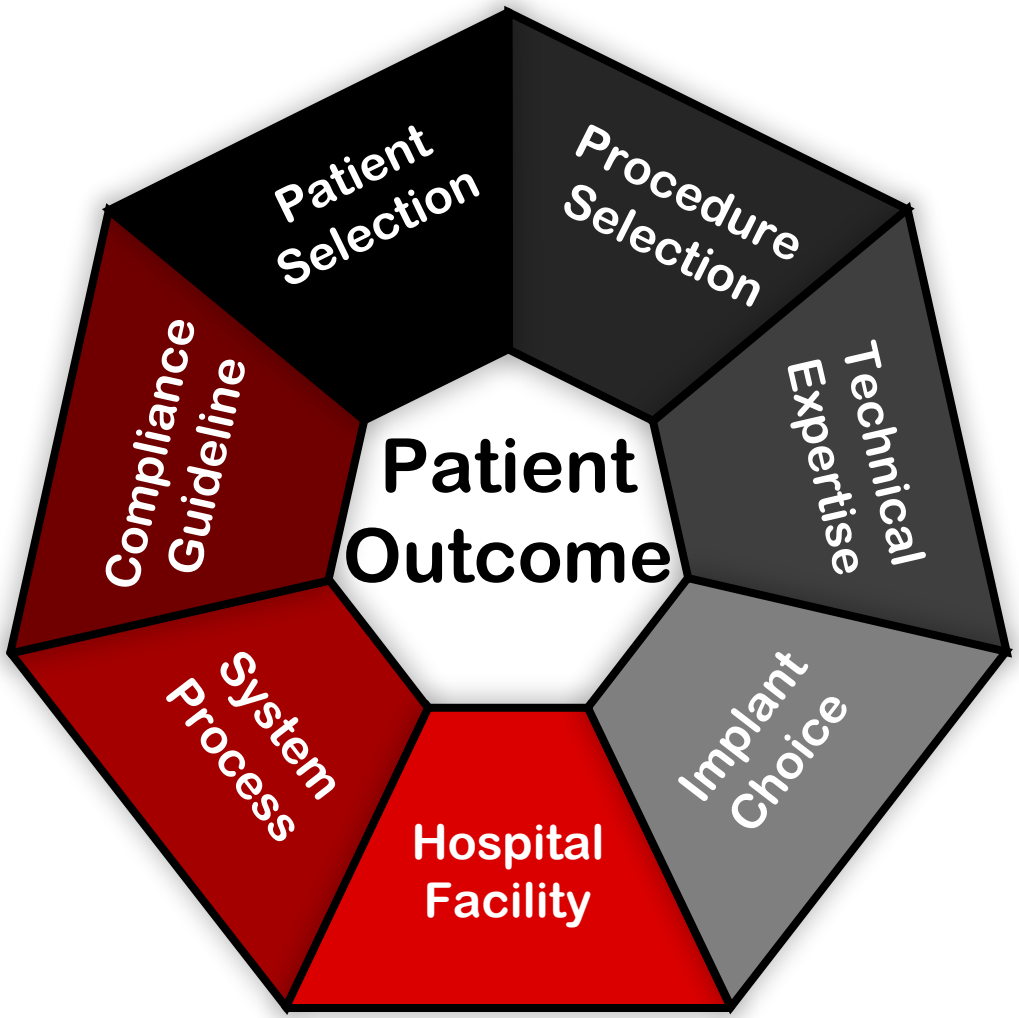
LEARN MORE

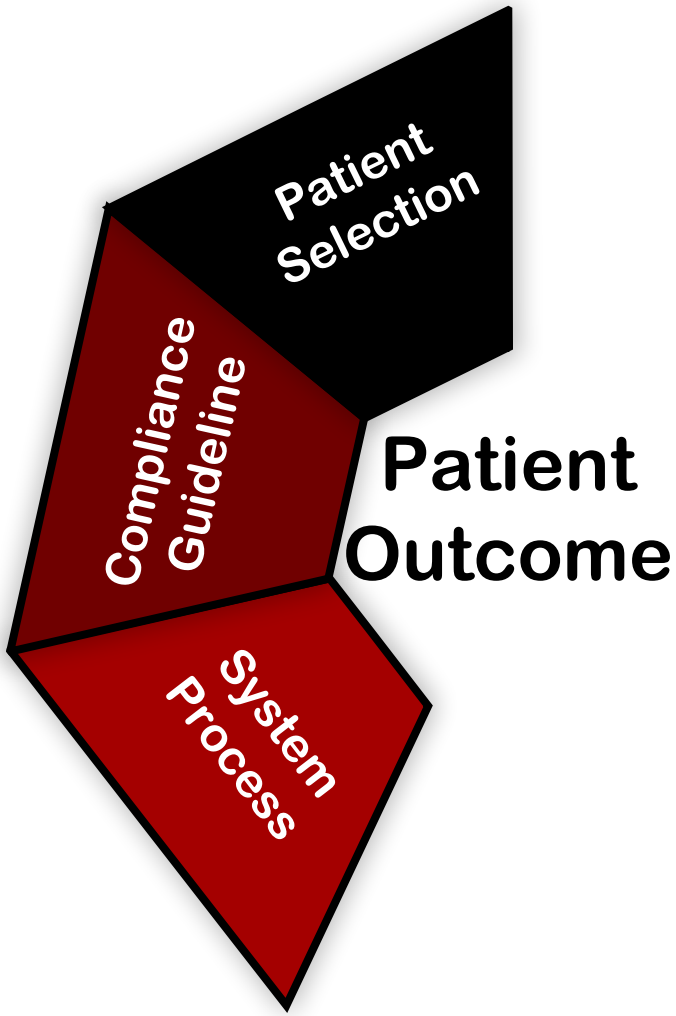
Seven Controllable Variables in Orthopaedic Surgery Patient Outcomes



Barber 2015

Optimization:

~making the best or most effective use of a situation or resource

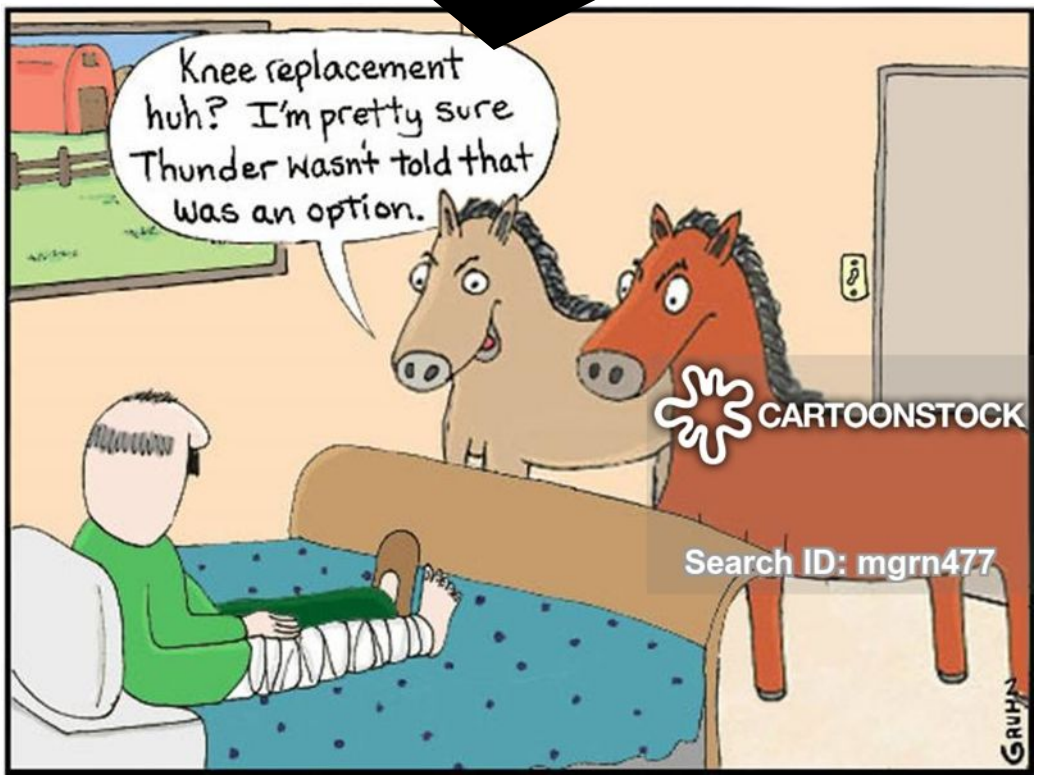


- **Selecting patients**
  - Where Benefits >> Risks
  - To improve both patient and population health
- **Processes preparing**
  - Minimize complications
  - Improve chances for success
- **Compliance to guidelines**
  - Consistency to see what works
    - For best results
    - For cost efficiency

Optimization:

~making the best or most effective use of a situation or resource

Patient Selection



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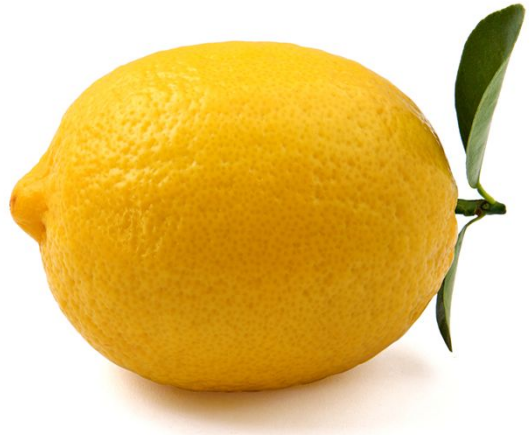


Sites of Optimization:

Perioperative Surgical Home

Perioperative Enhancement Team (POET)

PASS clinic ~ perioperative anesthesia surgical screening

Preop Clinic

Medical Optimization Team

Joint Camps

Team Approach: Perioperative Optimization for Total Joint Arthroplasty

JBJS REVIEWS 2018;6(10):e4 · http://dx.doi.org/10.2106/JBJS.RVW.17.00147

	1	2	3
Infection	*Not Applicable*	*Not Applicable*	(+) **MRSA** - Decolonize (+) **HIV** - Viral load undetectable (+) **HCV** - Antiviral treatment/cure
Smoking	**History of Smoking** Enroll in Smoking Cessation Program 4 to 8 Weeks Prior to Surgery	*Not Applicable*	*Not Applicable*
Obesity	**BMI 30-34.9** Nutritional Counseling Program	**BMI 35-39.9** Nutritional Counseling + Acute Weight Loss Program	**BMI ≥ 40** Nutritional Counseling + Long-term Weight Loss +Bariatric Consult
Cardiovascular Disease	**History of CVD*** Enroll into cardiac optimization program	*Not Applicable*	*Not Applicable*
Venous Thromboembolic Disease	**VTE Risk Factors****	**History of PE or DVT** IVC Filter or Aggressive VTED Management	*Not Applicable*
Neurocognitive Psychological Behavioral	**Neurocognitive Deficits** or **≥ 7 catastrophizing, PHQ-9**	**Alcohol Abuse** or **Chronic Active Narcotic Dependency**	*Not Applicable*
Physical Deconditioning	**Frailty** or **Physical Function/Ambulation**	**Nonambulatory** or **Requires Transfer Assistance**	*Not Applicable*
Diabetes	**Well Controlled**	**HgbA1c ≥ 8** Refer to Endocrinologist	**Fasting Glucose > 180 mg/dl** Must correct prior to surgery

Risk Factor Subtotal

Figure Legend

HARD STOP

Total _____

Fig. 1

RRAT. Patients undergoing total joint arthroplasty may be risk-stratified for the risk of readmission using this tool. Modifiable risk factor categories are listed in the left column with their respective risk factors in the 3 adjacent columns. Risk factors are graded on the basis of severity (columns 1, 2, and 3) and the total score is summed. RRAT scores of ≥ 3 should result in a hard stop until the patient is optimized. The stop hand indicates a hard stop until the modifiable risk factor is resolved. A single asterisk indicates that the patient has a history of coronary artery disease, had had a cerebrovascular accident, has peripheral vascular disease, venous thromboembolic disease, at least 2 cardiac risk factors, renal insufficiency (creatinine clearance, <60 mL/min), diabetes, chronic obstructive pulmonary disease, hypertension, cancer, or heart failure; has an age of ≥ 60 years; and is a recent smoker (quit within < 30 days). Two asterisks indicate that the patient has venous thromboembolic disease (VTED) risk factors: cerebrovascular accident, chronic obstructive pulmonary disease, BMI of ≥40 kg/m^2, coronary artery disease, peripheral vascular disease, or thrombophilia (activated protein C resistance, elevated factor VIII and lipoprotein A). MRSA = methicillin-resistant *Staphylococcus aureus*, HIV = human immunodeficiency virus, HCV = hepatitis C virus, CVD = cardiovascular disease, PE = pulmonary embolism, DVT = deep venous thromboembolism, Hgb = hemoglobin, and IVC = inferior vena cava.

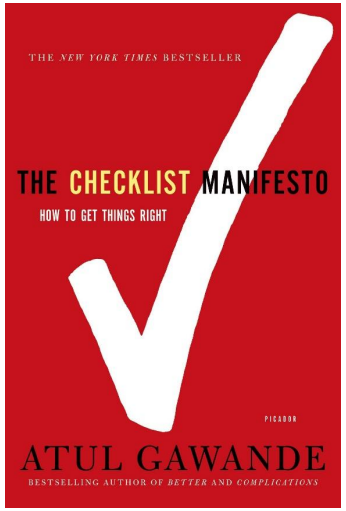
Duke's Program: PASS

Perioperative Anesthesia Surgical Screening Clinic

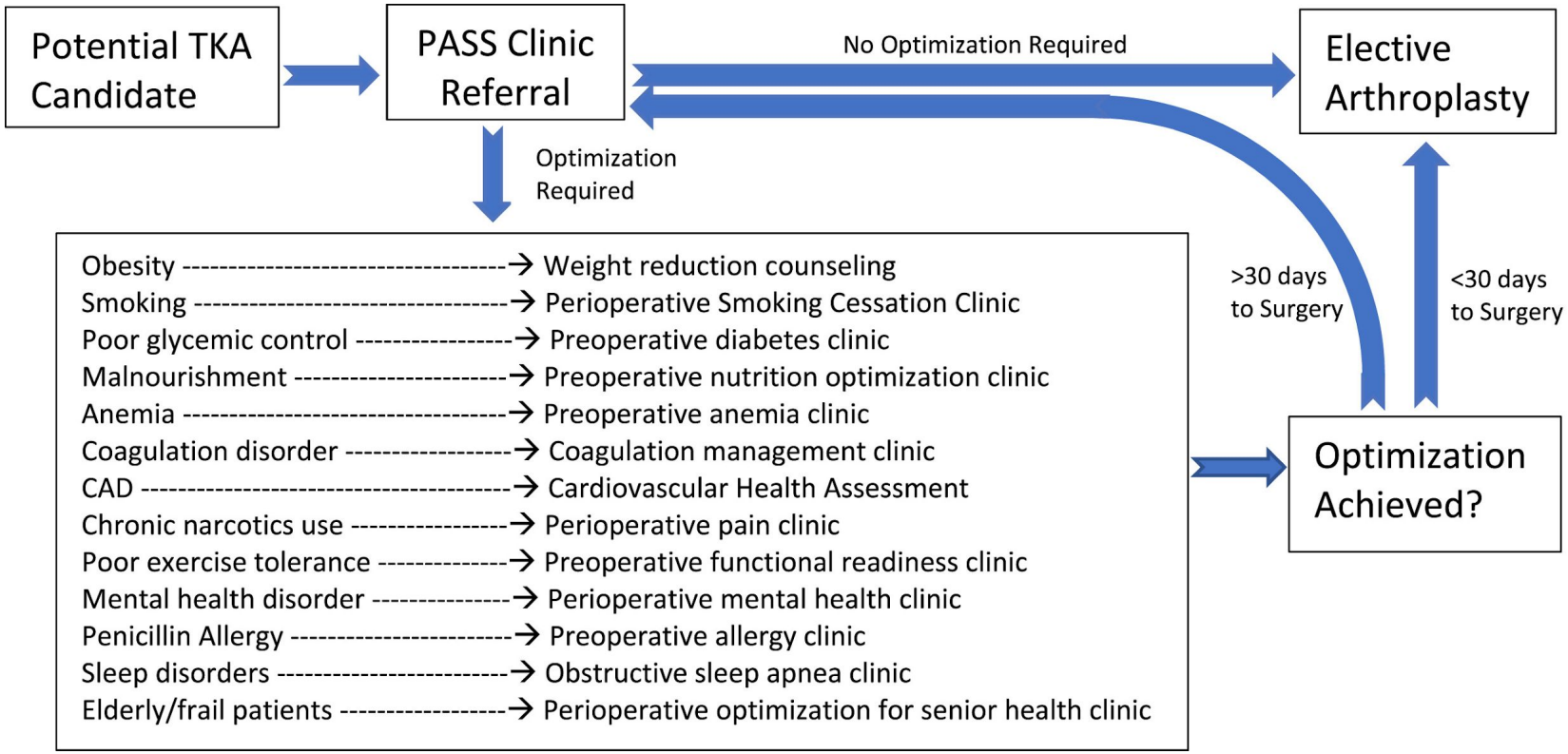
Check List @ PASS clinic

Risk Stratification Checklist for Total Joint Replacement

- ❑ BMI ≥ 40 kg/m^2
- ❑ Active smoking
- ❑ HgA1C >7.5%
- ❑ Albumin ≤ 3 g/dL
- ❑ Hemoglobin < 11 g/dL
- ❑ Thrombocytopenia (platelets < 50K/L)
- ❑ ESRD on Dialysis
- ❑ CAD (with or without AMI in past 6 months)
- ❑ Stroke or TIA within past 6 months
- ❑ Active infections
- ❑ Chronic narcotics use (addiction)

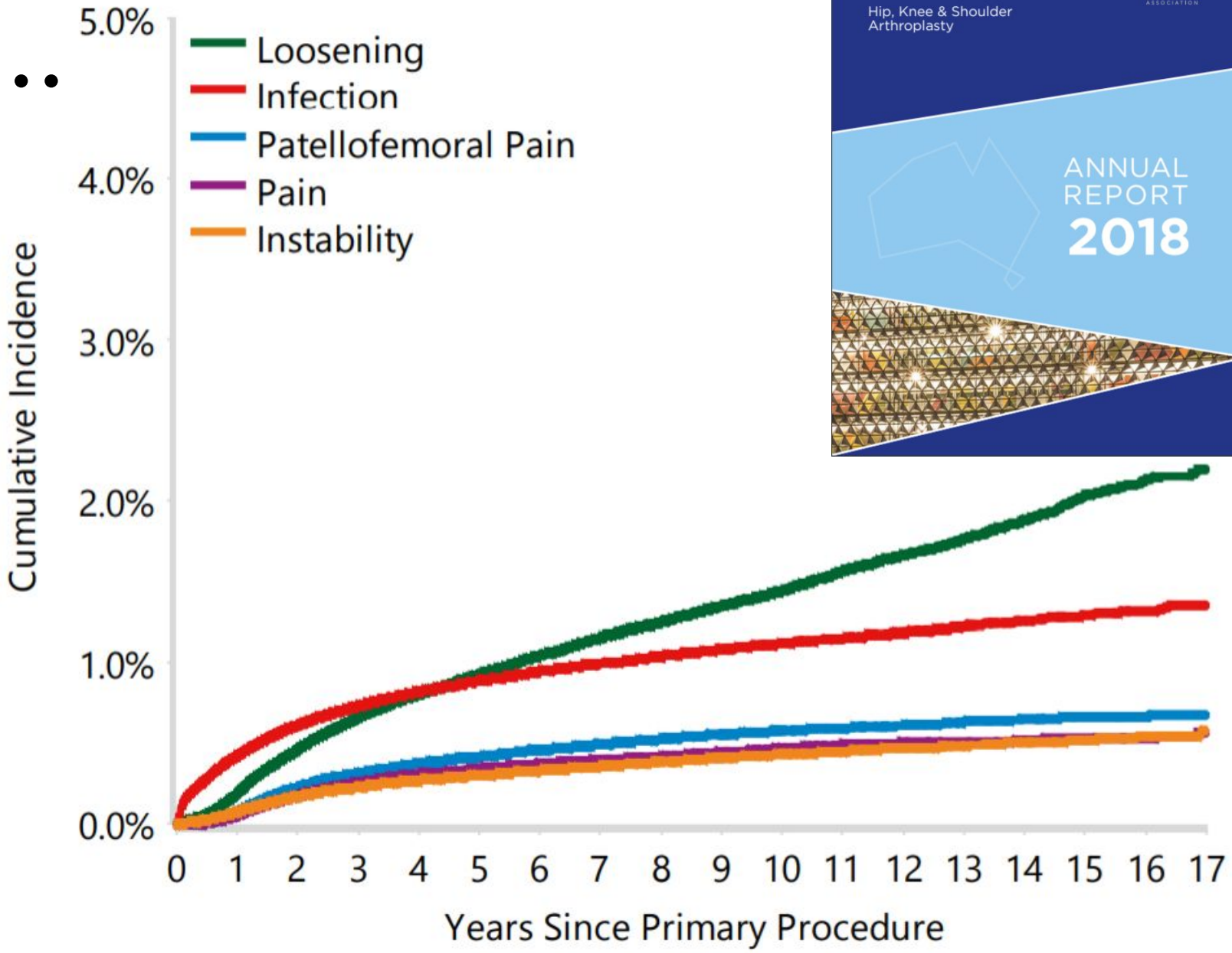


Referral Specialty Clinics for optimization when needed



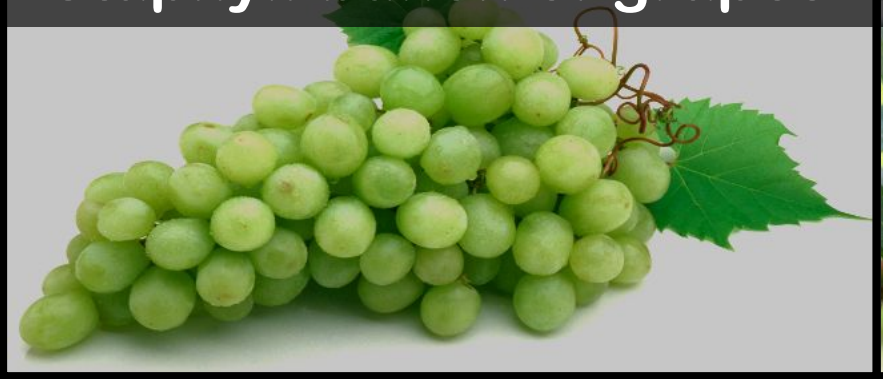
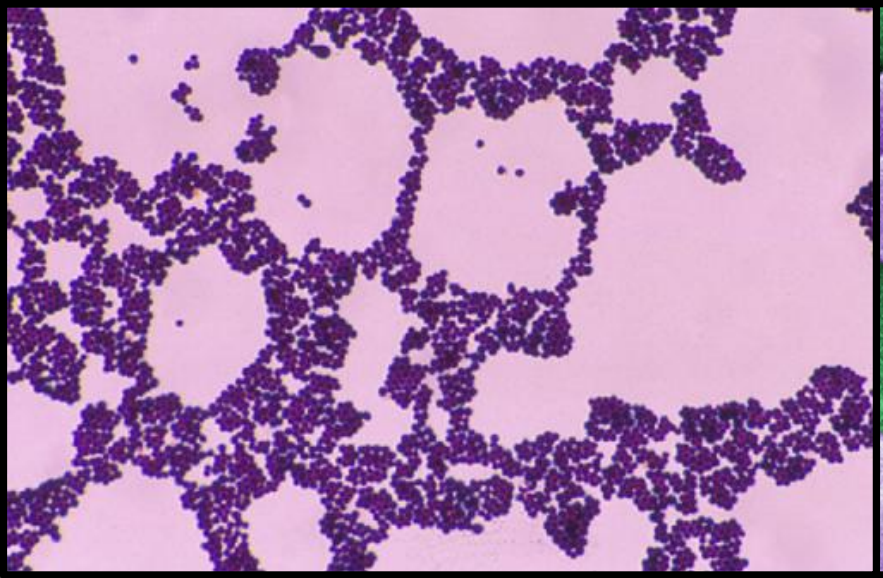
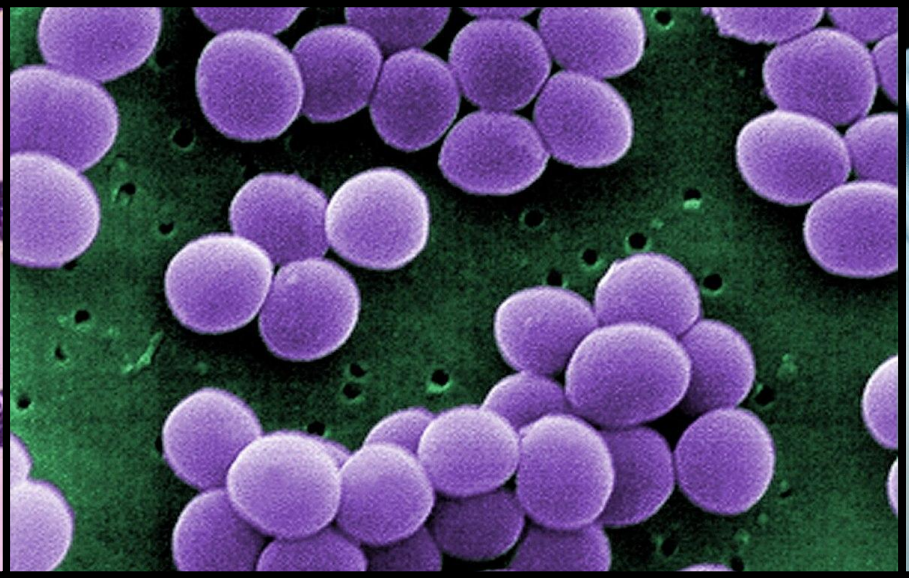
TKA:
How knees fail…

- Early PUS
- Later Loosening



Staphylococcus Aureus

80% of orthopaedic infections

Staphyl: bunch of grapes	Coccos: berry or grain	Aureus: golden coins
		
		

Longer term outcomes matter too!

- 25% of Revisions for Total Joint Infection fail in by 5 years

- 35% of patients dead 5 years after joint infection

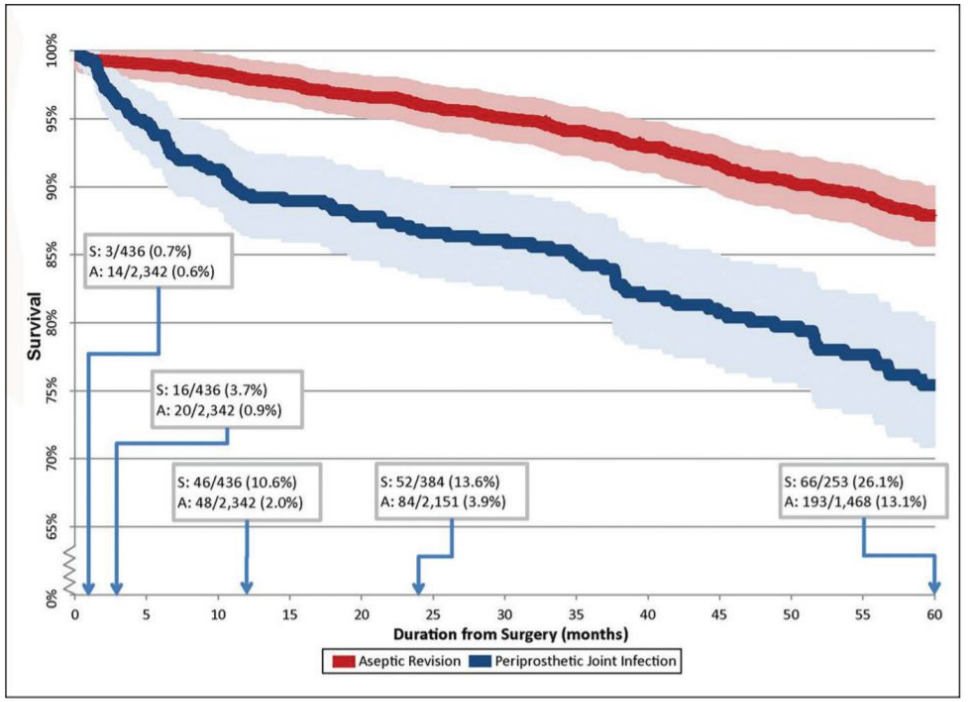


Fig. 1 Five-year survival rate comparing septic versus aseptic revision TJA.
COURTESY OF BRYAN D. SPRINGER, MD.

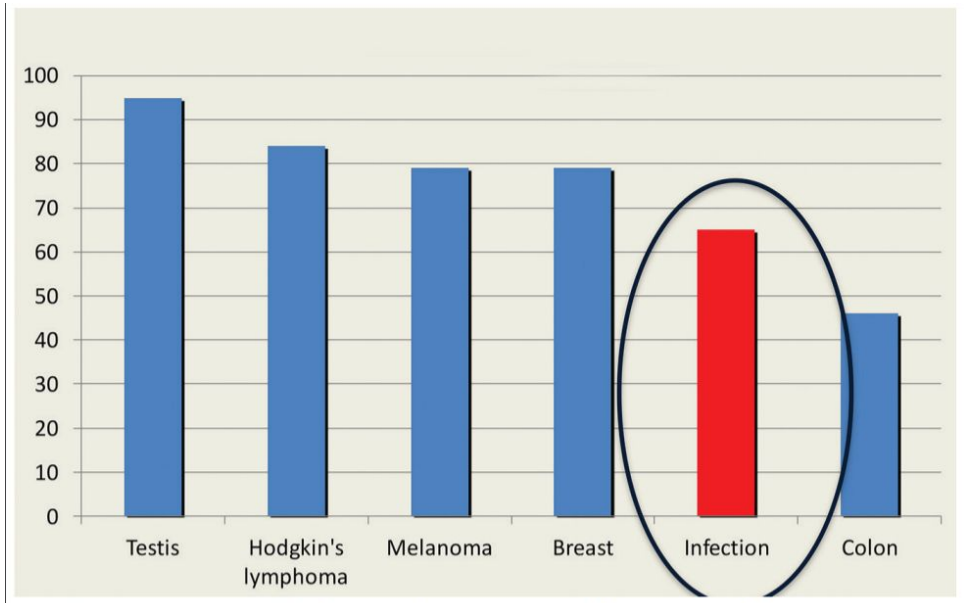
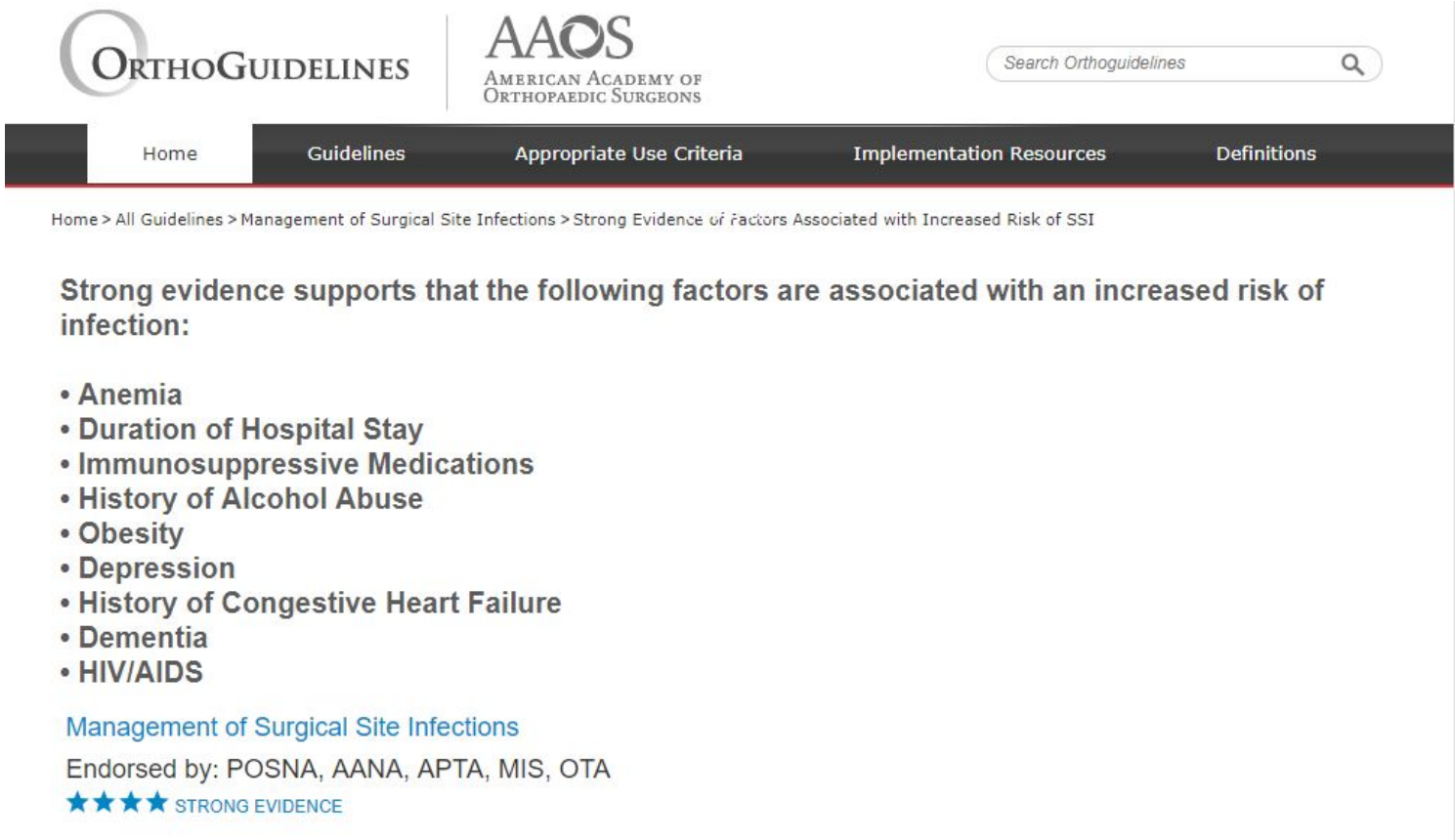


Fig. 2 Five-year survival rate for PJI and the five most commonly diagnosed (U.S.) cancers.
COURTESY OF JAVAD PARVIZI, MD, FRCS/ROTHMAN INSTITUTE AT THOMAS JEFFERSON UNIVERSITY

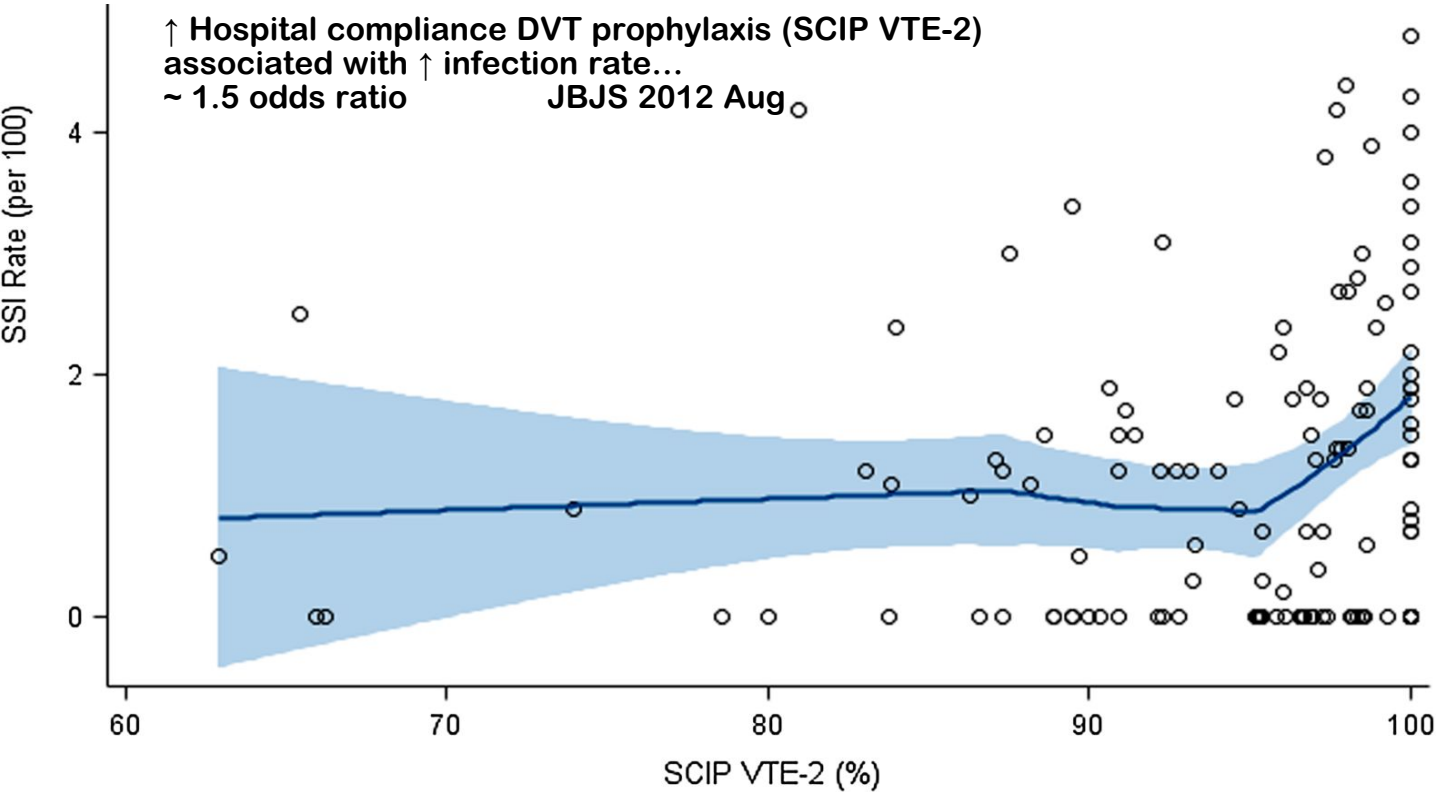
Strong Evidence of Increased Infection

AAOS American Academy of Orthopaedic Surgeons
American Association of Orthopaedic Surgeons



Reoperations ~ ↑PUS
Bleeding = Hematomas = Reoperations

Use of stronger anticoagulants have been associated with:
- more bleeding/hematomas/wound ooze
- more infections
- less early ROM
- no decrease in fatal PEs



Most joint surgeons have gone to aspirin prophylaxis + compression

(Cardiac patients on blood thinners have a higher rate of infection too…)

Identify the bleeders

AAOS guidelines:
- Ask about bleeding history/risks:
  - Hemophilia/Von Willebrand's disease
  - Liver disease

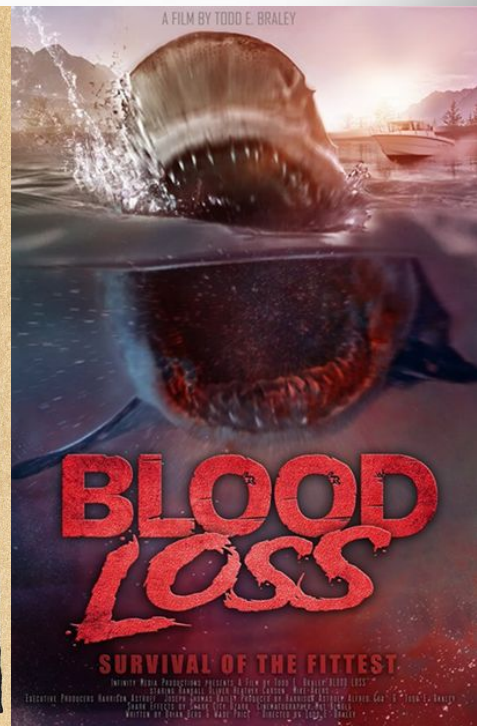
ISTH-SSC Bleeding Assessment Tool
https://bleedingscore.certe.nl/

Identify the bleeders
Hold medicines that ↑ risk of bleeds

ASA – 10 days preop
NSAID – 5 ½ lives preop
Clopidrel/Prasugrel – 7days

Coumadin – 5 days preop
DOACs: Dabagatran – 4 days preop
Rivaroxaban – 3 days preop
Apixaban – 3 days preop

Hold “supplements”:
Garlic, Ginkgo, Ginseng,
Fish oil, Flax seed oil
Saw palmetto



Anemia/Blood Loss/Transfusions

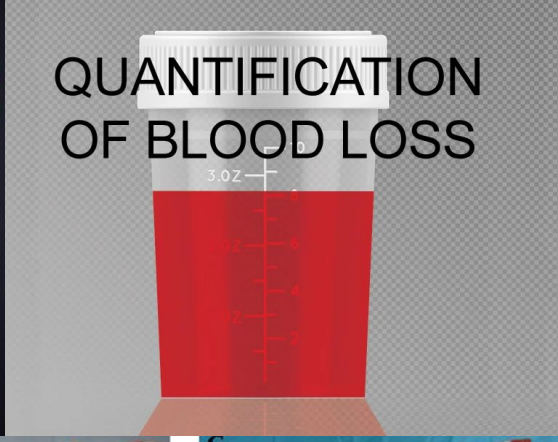
Preoperative anemia is common & usually treatable
Preop Hgb most significant predictor of transfusion

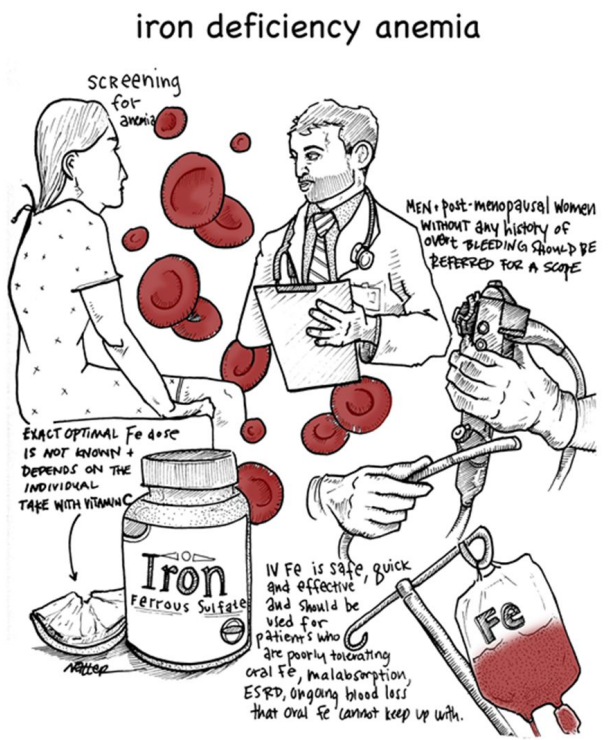
Anemia common sign of other diseases
(prevent colon cancer!)

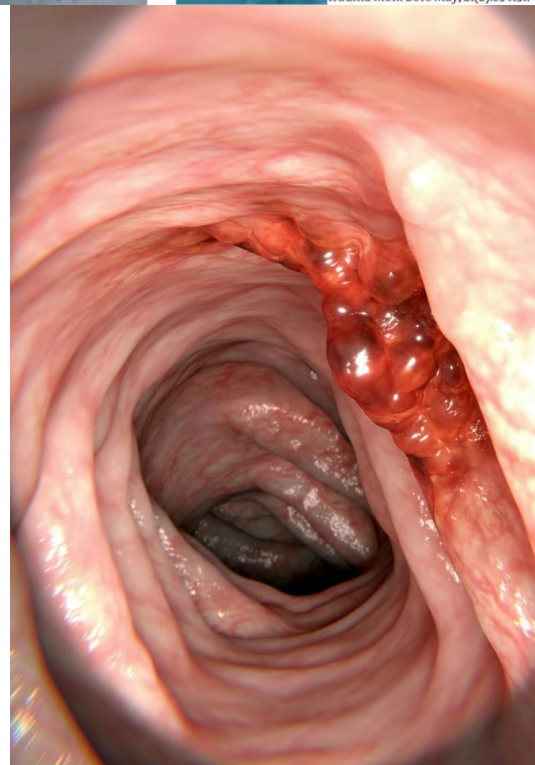
TKA is a "high bleed risk" case

Blood loss is predictable

Transfusions are to be avoided:
causes clinical problems and cost $







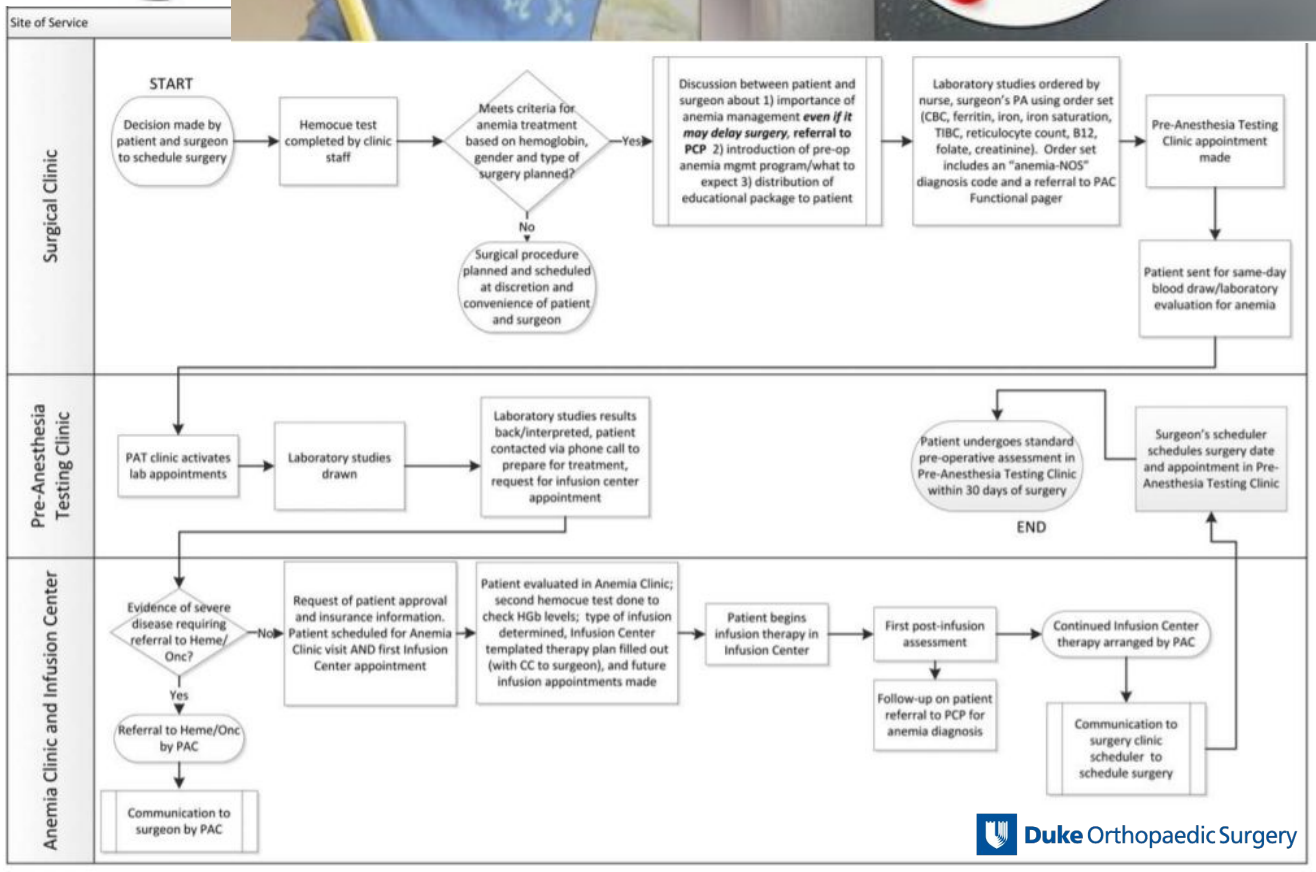
Anemia:
Identify and Treat

“THE MOST COMMON Blood Disorder”

- Iron deficiency ~ most common
- Vitamin deficiency ~ B12 and Folic acid
- Aplastic
- Hemolytic – autoimmune, mechanical

Point of service Hgb Test Screen
Preop clinic testing

Anemia clinic vs anemia order set



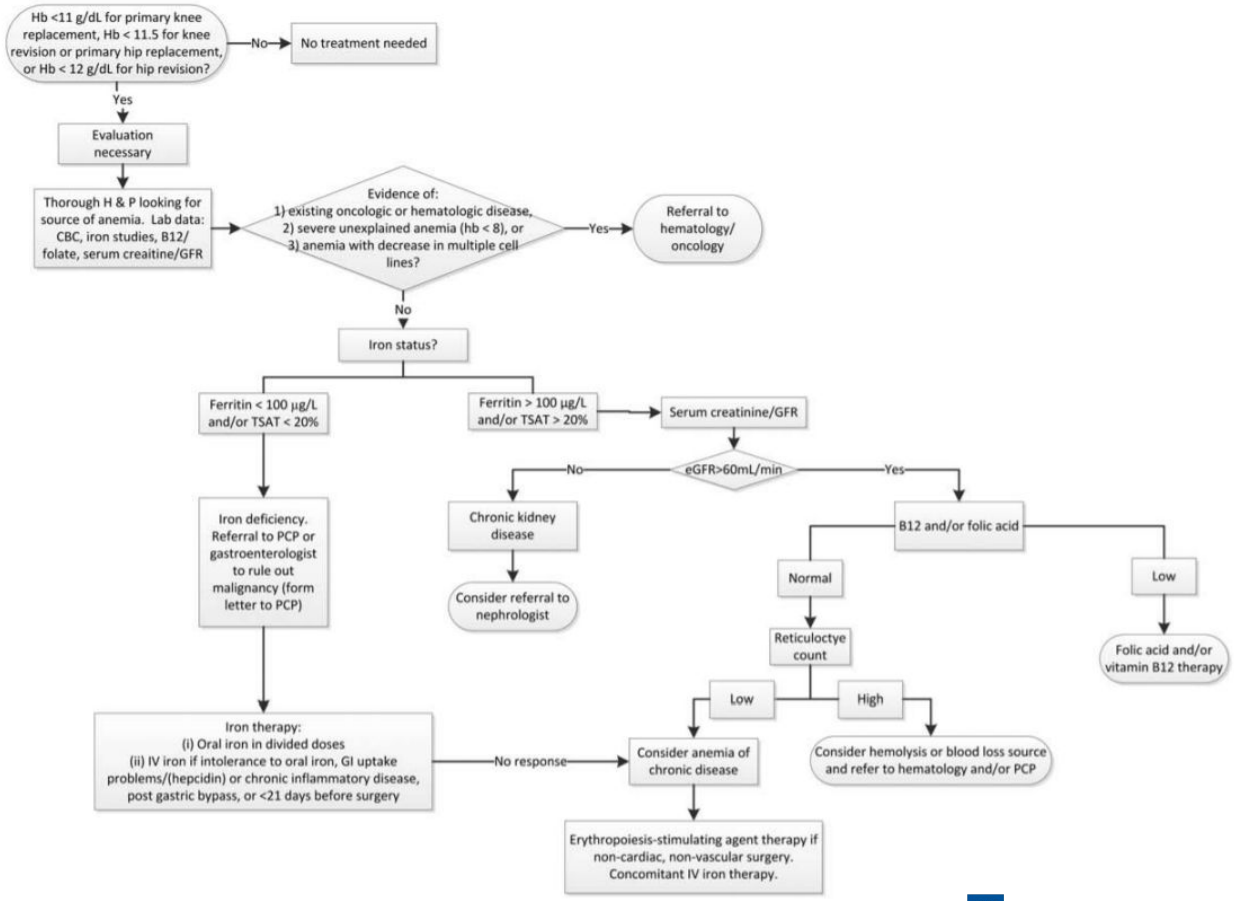
Anemia clinic flow

If HGB < 11 - 12 G/dL for primary TKA

Blood loss is predictable ~
Average TKA Hgb drops: 3.85 +/- 1.4 G/dL

Transfusion Trigger ~ 7-8 G/dL

Medical team: Fe, vitamins
Infusion Fe
Infusion
Erythropoietin



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shm
Society of Hospital Medicine
Empowering hospitalists. Transforming patient care.

Transfusions:
Risky and Costly

↑ periprosthetic infections – immunomodulatory effect

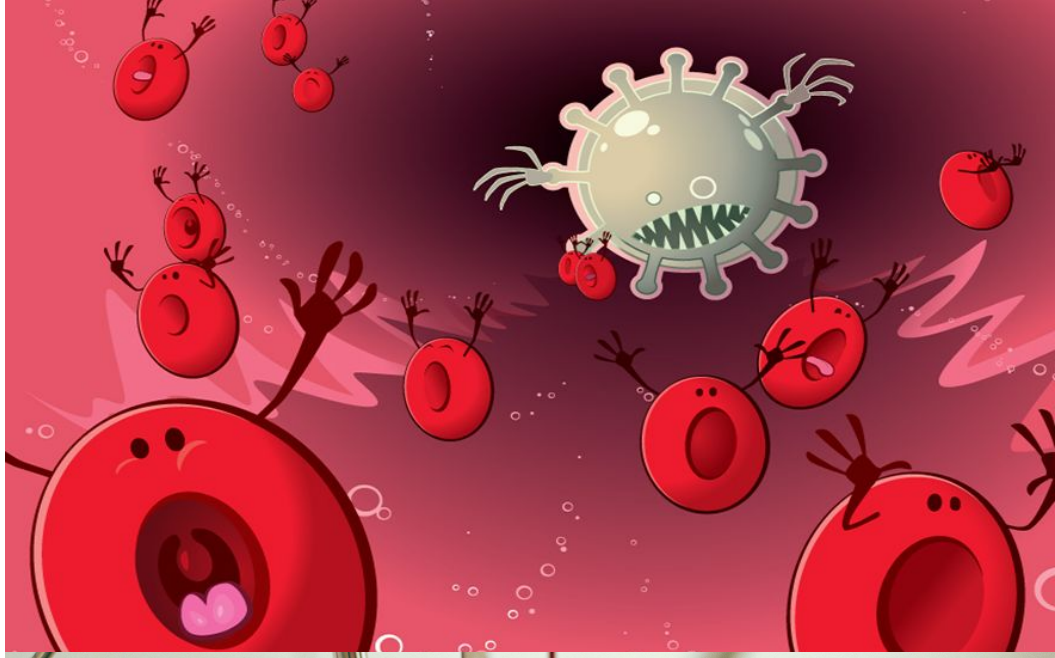
Linear increase per unit (Everhart JBJS 2018)

Transfusion Reactions:

- Allergic reaction 1:100
- Fever or Urticaria 1:100
- Non fatal hemolytic reaction 1:6,000
- Fatal hemolytic reaction <1:600,000
- Viral Infections:
  - HIV 1:2,000,000
  - HBV 1:100,000
  - HCV 1:1,600,000
  - HTLV,CMV 1:500 – 1:200,000

Cost issues:

- increased rehabilitation times
- lengthened hospital stays

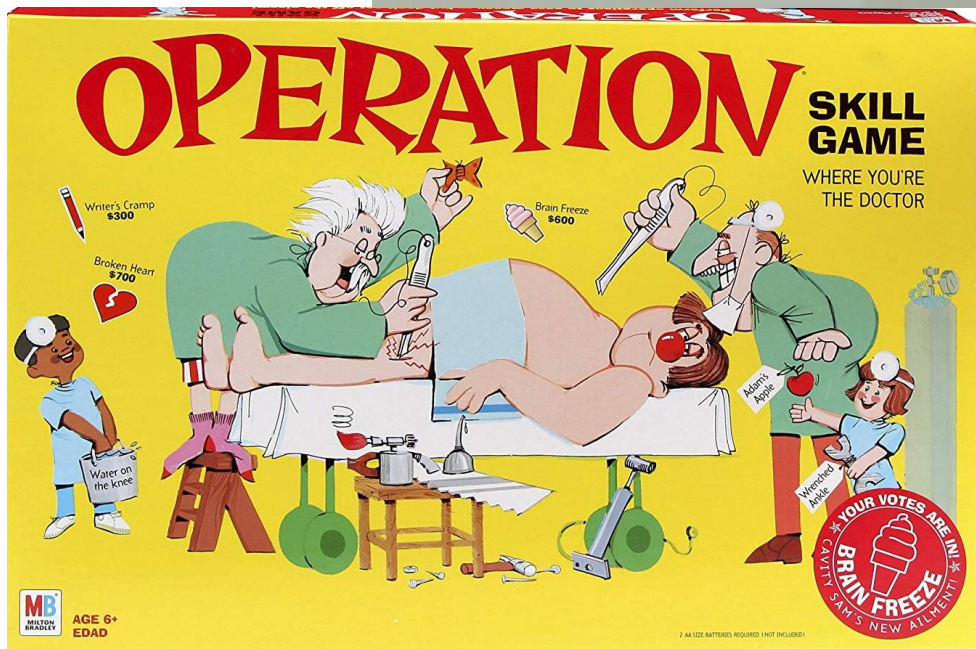


Avoid Transfusions:
Avoid blood loss

Be prepared:
Operate quickly and be technically brilliant…

Prepare patient for Spinal Anesthesia
less blood loss

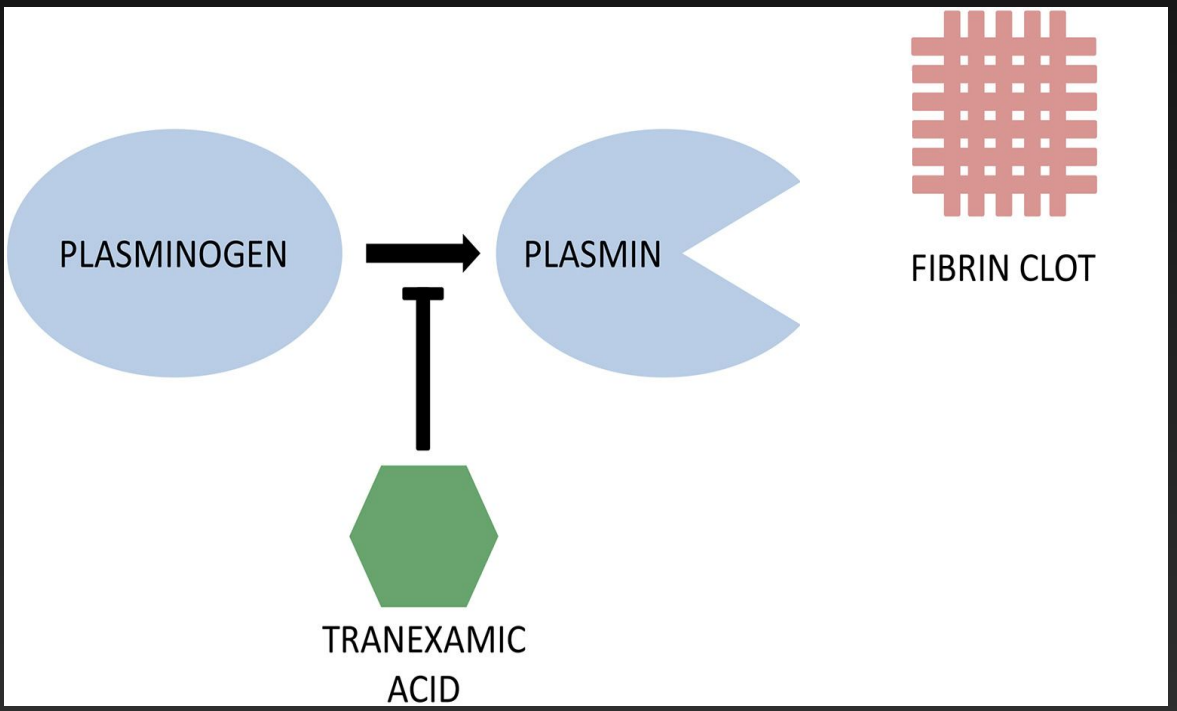
Use meds that limit bleeds



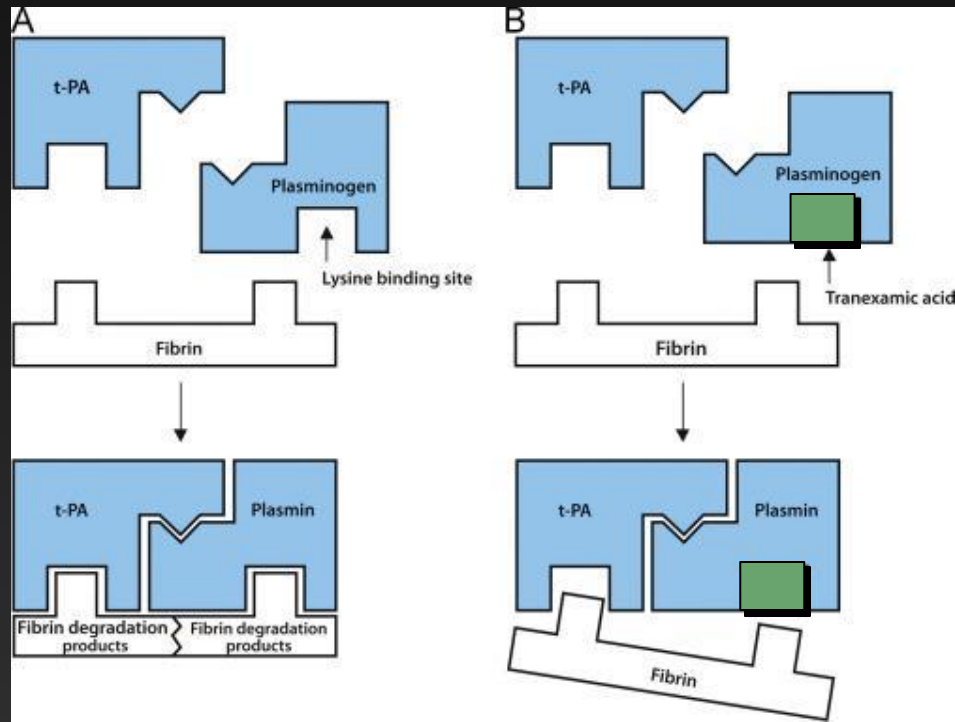
Tranexamic acid:

↓ bleeding by inhibiting fibrinolytic system
cost effective: IV, Topical, or PO
safe ~ no increased DVT/PE in many large studies

Fibrinolytic system:
ends in plasmin
~ dissolves clots



- Mechanism of action:
  Lysine analog
  Binds plasminogen
  Inhibits fibrinolysis



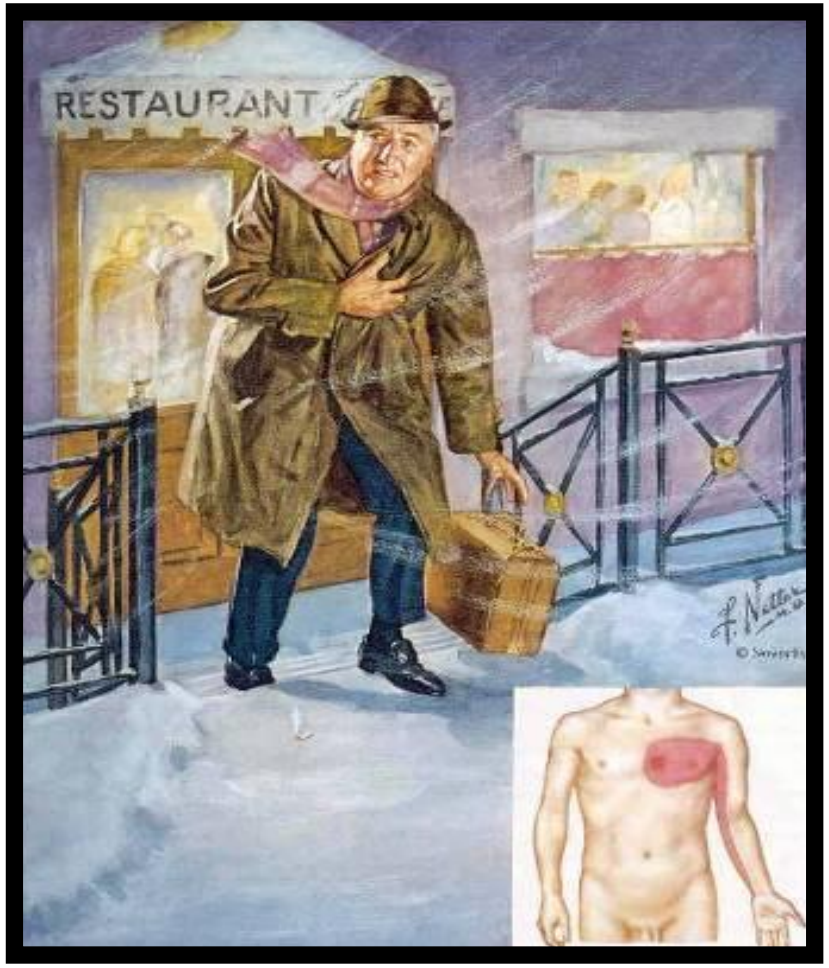
Cardiac Optimization

The most common cause of death = Cardiac
The most common cause of death after TKA = Cardiac

13.5% arthroplasty patients had elevated cardiac troponin T POD#2

Delay surgery:
- **6 mos after stenting**
- **6 mos after MI**

If unable to do moderate functional capacity (4 MET) then invasive testing
- **Light housework**
- **Climbing flight of stairs**
- **Walk up hill**
- **Walking 4 mph level**



CLINICAL PRACTICE GUIDELINE

2014 ACC/AHA Guideline on Perioperative Cardiovascular Evaluation and Management of Patients Undergoing Noncardiac Surgery

Cardiac Optimization
KNOW YOUR patient's CARDIAC MEDS!

Stopping Beta-blockers increases death

continue those –ol drugs!

twice as many DEATHS if you don't (ACC and AHA)

Continuing some can cause post-induction hypotension & AKI

STOP –il drugs (ACE inhibitors)

STOP –sartan drugs (ARBs)

(Discuss with cardiology/medical team)

Pulmonary Risk Assessment

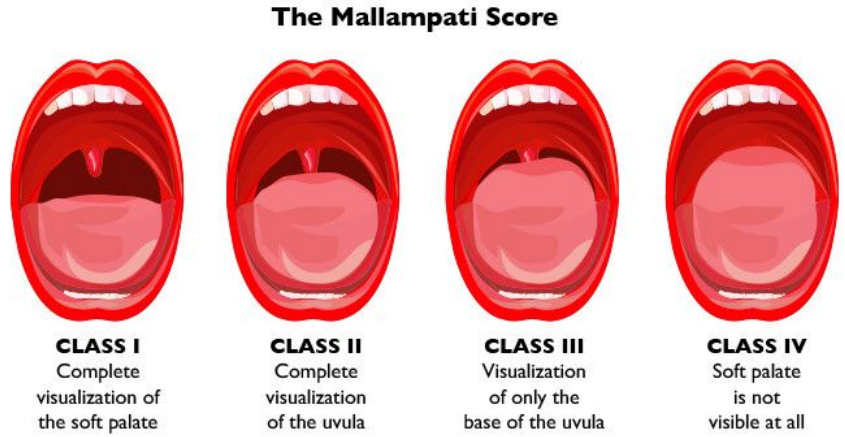
Pulmonary Risk Assessment.
Risk Assessment
Current or past smoker>20 packets per y and PEFR <60%
Positive OSA screening (score 2 or more) (without prior Dx/treatment)
Pre-existing CPAP/BiPAP (need to use consistently min 2 wk pre-op)
Pulmonary hypertension (PAP >50) (non-cardiac)
Pulmonary fibrosis/ILD
History of asthma
History of COPD
Respiratory insufficiency (oxygen)
O2 sat <90% on ABG
BMI >40 (if not already on OSA path)

If high then pulmonary complications prevention intervention protocol order set was started.

Obstructive Sleep Apnea Tools

Screen: **STOPBANG**
Rothman OSA screen
Mallampati Score

Sleep study prior to elective surgical procedures
If apnea-hypopnea index > 20 then pulmonology consult



STOP-BANG Scoring Method

Every Yes answer = 1 point

Snoring: Do you snore loudly (loud enough to be heard through closed doors)?	☐ Yes	☐ No
Tired: Do you often feel tired, fatigued, or sleepy during daytime?	☐ Yes	☐ No
Observed: Has anyone observed you stop breathing during your sleep?	☐ Yes	☐ No
Blood **P**ressure: Do you have or are you being treated for high blood pressure?	☐ Yes	☐ No
BMI more than 35?	☐ Yes	☐ No
Age older than 50 years?	☐ Yes	☐ No
Neck circumference greater than 40 cm?	☐ Yes	☐ No
Gender male?	☐ Yes	☐ No

5 or more = high risk for Obstructive Sleep Apnea
Initiate or continue CPAP machine
Avoid/minimize narcotics – maximize local blocks

Obstructive Sleep Apnea Screening.

Category	Score
Loud snoring	1
Neck circumference: male 17" or greater and female 16" or greater (if neck circumference not available, then BMI >35)	1
Awakening with headaches	1
Witnessed apnea or awakening with choking/gasping	2
Morning or daytime sleepiness, especially if this interferes with ability to keep alert in situations where you should keep alert (driving, work, meetings)	2
Mallampati class 4 oropharynx	1 (on examination)
Tonsillar hypertrophy (nearly touching)	2 (on examination)
Prior diagnosis of sleep apnea which is not treated (ie, consistently using the CPAP or with proven effective alternate treatment)	2

All patients were evaluated based on reported history or current symptoms of obstructive sleep apnea. If the score is 2 or higher, the patient was ordered a polysomnography. If the apnea-hypopnea index was higher than 20 in the mentioned study, the patient was referred for a pulmonary consultation.
Italics, patient or family member reported.
BMI, body mass index; CPAP, continuous positive airway pressure.

Pulmonary Risk Protocol

Interventions:

Smoking cessation
RX/optimize pulmonary dx
Perioperative Inhaler
Spinal anesthesia
Aspiration precautions: resting bed > 20° eating bed > 45°
O2 sats at 92%
Incentive spirometry

Results:

↓ pulmonary complication rate

from 5.7% to .09%

A Simple Protocol to Stratify Pulmonary Risk Reduces Complications After Total Joint Arthroplasty

Luis Grau, MD, Fabio R. Orozco, MD, Andres F. Duque, MD, MSc *, Zachary D. Post, MD, Danielle Y. Ponzio, MD, Alvin C. Ong, MD

Department of Orthopaedic Surgery, Rothman Orthopaedics at Thomas Jefferson University, Egg Harbor Township, NJ

L. Grau et al. / The Journal of Arthroplasty 34 (2019) 1233–1239

Pre-Operative

1. Chart Flagged as Pulmonary Risk
2. Patient Instructed on smoking cessation
3. If patient has OSA, bring CPAP mask to hospital and know setting
4. Optimize inhaler use before admission
5. Albuterol nebulizer in Pre-Op holding area
6. Oxygen via humidified nasal cannula to keep oxygen saturation > 92%

Post Anesthesia Care Unit

1. Elevate head of bed > 20 degrees while resting
2. Aspiration precautions
3. Initiate Incentive spirometer
4. Monitor continuous pulse oxymetry
5. Avoid hypoxia, hypocapnia and hypoperfusion
6. Avoid heavy narcotics or sedating medicines if possible

Intra-Operative

1. Avoid hypoxia, hypocapnia, hypoperfusion and hypotensive anesthesia
2. Continuous oxygen and blood pressure monitoring
3. Consider Intra-Op nebulizers
4. Avoid general anesthesia if possible
5. Consider aspiration precautions

Post-Operative

1. Continuous pulse oxymetry
2. Oxygen with humidifier to keep saturation > 92%
3. Elevated head of bed > 20 degrees resting, > 45 with eating
4. Aspiration precautions
5. Direct supervision of first meal
6. Incentive spirometer every 1 hour while awake
7. Respiratory therapy consult within 24 hours
8. If OSA, use CPAP per home protocol
9. Patient ambulating no later than the evening of the surgery
10. Monitor carbon dioxide emission
11. Mantain high level of suspicion for pulmonary problems
12. Notify provider immediately for any of the following:
    * Difficulty breathing or significant change in breathing
    * Significant and sustained drop in oxygen saturation
    * Any suspicion of aspiration
    * Increasing coughing or exudates
    * Any significant change in breath sounds

Diabetes

- Chronic issues of Diabetes Mellitus (Hgb A1C > 6.9)
  Small vessel disease:
  CAD, CVD, CRF, neuropathy

- Acute hyperglycemia:
  Collagen synthesis suppressed at 200 mg/dL
  Impaired wound healing

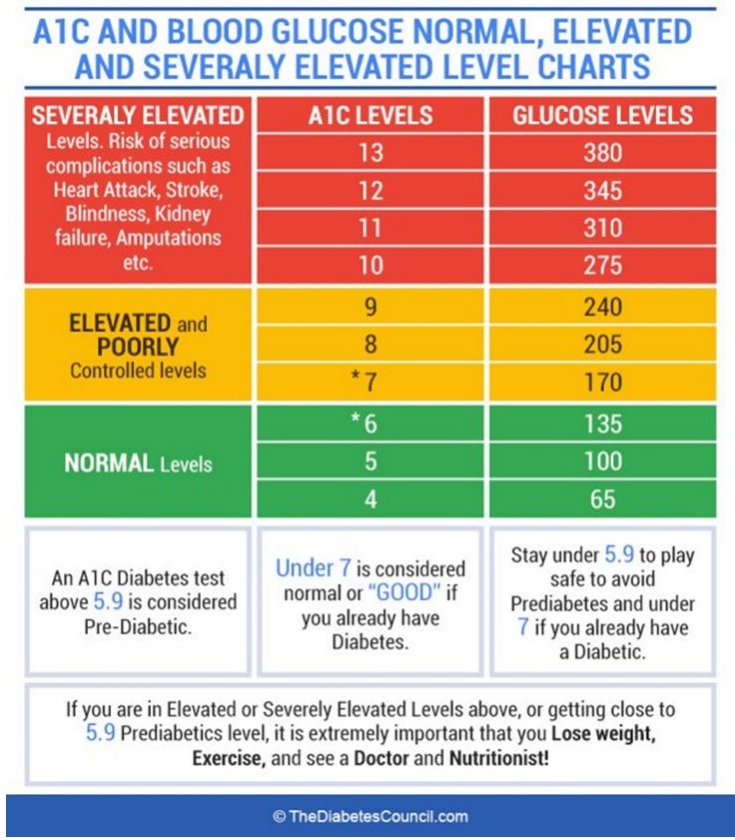
  WBC phagocytosis impaired at 250 mg/dL
  ↓ ability to fight infection

Diabetes

- Postop complications more common:
  UTI, Pneumonia, Anemia
  Joint infections
  Death

- HGB-A1c < 7.5-8%

- NO glucose levels > 200mg/dL
  NO fasting glucose > 180mg/dL



A1C AND BLOOD GLUCOSE NORMAL, ELEVATED AND SEVERALY ELEVATED LEVEL CHARTS

	A1C LEVELS	GLUCOSE LEVELS
SEVERALY ELEVATED Levels. Risk of serious complications such as Heart Attack, Stroke, Blindness, Kidney failure, Amputations etc.	13	380
	12	345
	11	310
	10	275
ELEVATED and **POORLY** Controlled levels	9	240
	8	205
	*7	170
NORMAL Levels	*6	135
	5	100
	4	65

An A1C Diabetes test above 5.9 is considered Pre-Diabetic.

Under 7 is considered normal or "GOOD" if you already have Diabetes.

Stay under 5.9 to play safe to avoid Prediabetes and under 7 if you already have a Diabetic.

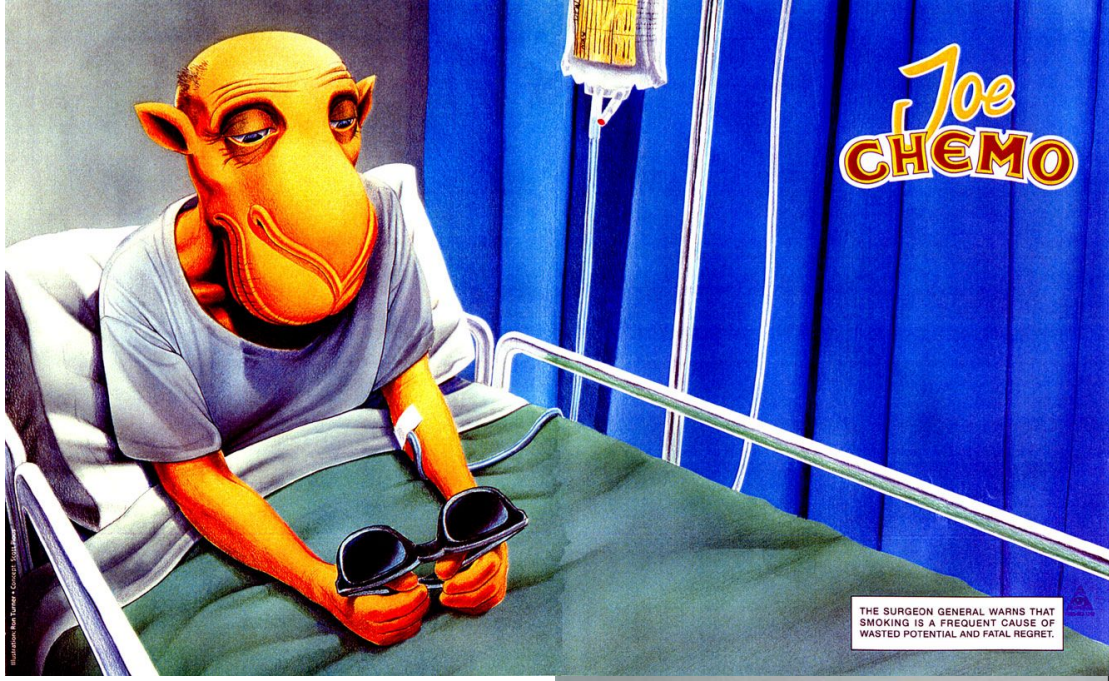
If you are in Elevated or Severely Elevated Levels above, or getting close to 5.9 Prediabetics level, it is extremely important that you **Lose weight, Exercise,** and see a **Doctor** and **Nutritionist!**

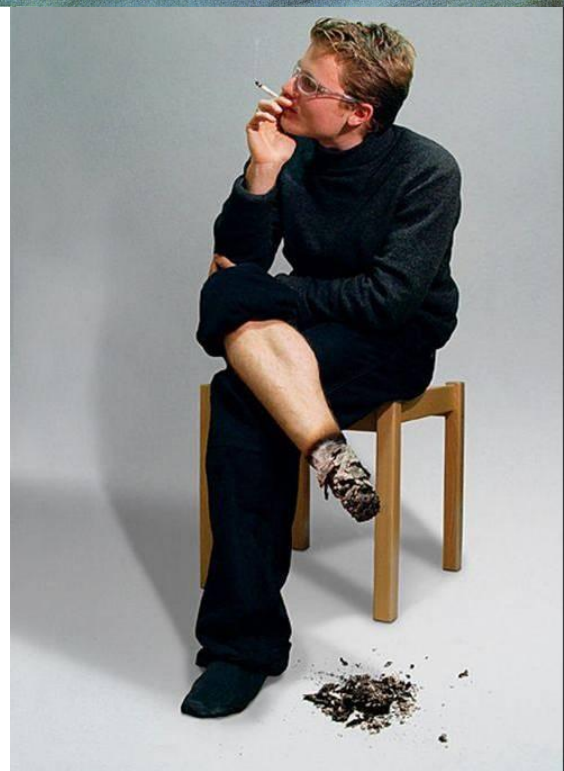
Bad Habits
Smoking

- Tissue Hypoxia:
  Nicotine - microvascular vasoconstriction
  CO binds to HGB = carboxyhemoglobin

- ↓ bone, skin, soft tissue healing
  Current smokers:
  2x more TKA infections
  More readmissions (Tischler JBJS 2016)

- Stopping: proven to decrease postop complications!





Smoking Increases the Rate of Reoperation for Infection within 90 Days After Primary Total Joint Arthroplasty

JBJS

Conclusions: This study, after controlling for confounding factors, demonstrated not only that current smokers have a significantly increased risk of reoperation for infection within 90 days of a surgical procedure compared with nonsmokers, but also that the amount that one has smoked, regardless of current smoking status, significantly contributed to increased risk of nonoperative readmission.

Effect of Smoking Cessation Intervention on Results of Acute Fracture Surgery

A Randomized Controlled Trial

JBJS

Conclusions: Our results indicate that a smoking cessation intervention program during the first six weeks after acute fracture surgery decreases the risk of postoperative complications.

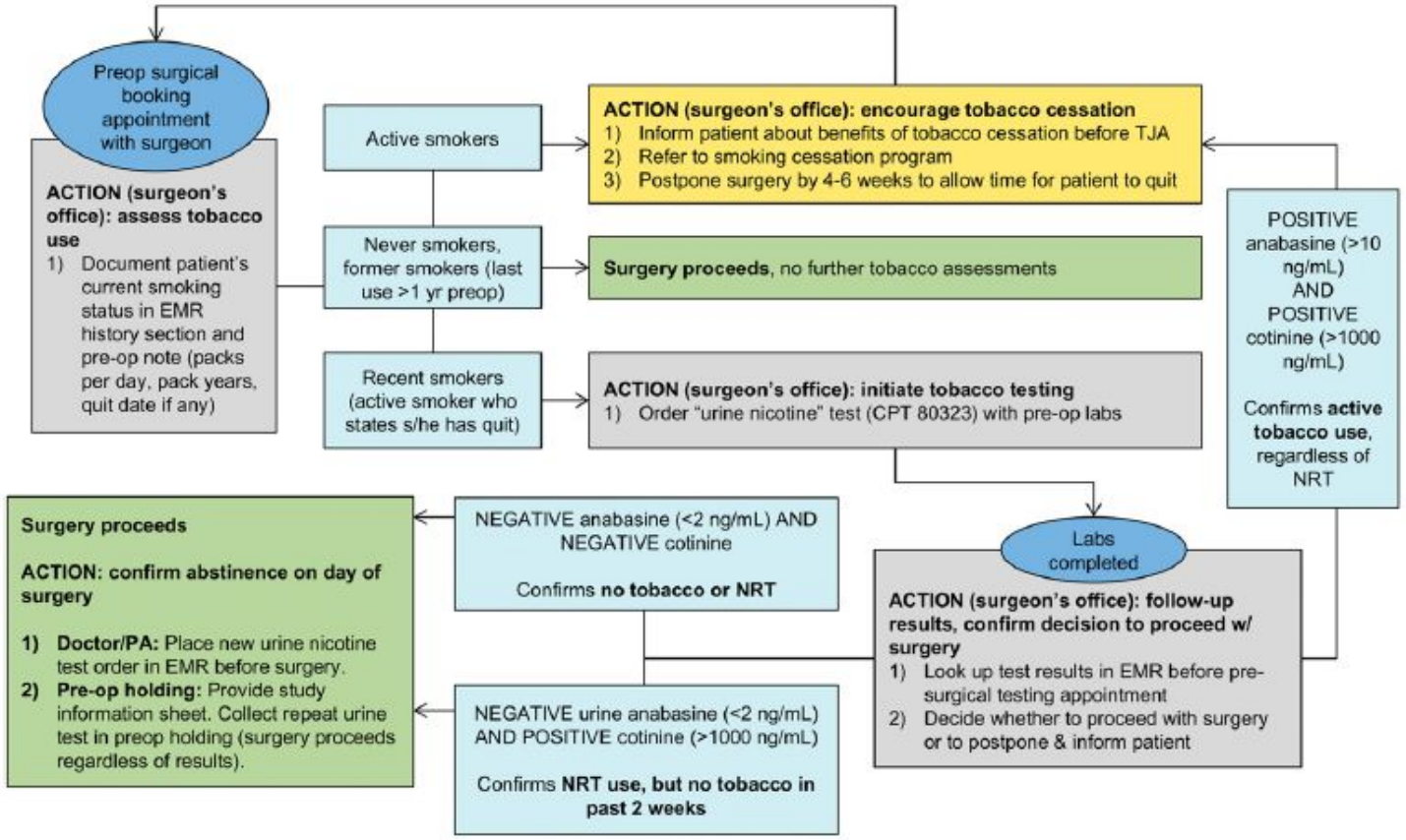
Level of Evidence: Therapeutic Level I. See Instructions to Authors for a complete description of levels of evidence.

- **"HARD STOP" for smokers**
- **Help patients stop:**
  Smoker cessation plan
  Trust but verify…
- **Recommend**
  6 weeks preop
  + 6 weeks postop

Team Approach: Perioperative Optimization for Total Joint Arthroplasty

JBJS REVIEWS 2018;6(10):e4 · http://dx.doi.org/10.2106/JBJS.RVW.17.00147

TOBACCO-FREE TOTAL JOINT ARTHROPLASTY: CONFIRMING TOBACCO CESSATION



Smoking status definitions:
- **Never smoker:** has never used tobacco
- **Former smoker:** has not smoked within 1 year before date of surgery (document quit date and total pack years in Epic)
- **Active smoker:** current every-day smokers (document start date and current packs per day)
- **Recent smoker:** has been an every-day smoker within the past 1 year, but has quit within 1 week of surgery (document start & quit dates, and packs per day just prior to quitting)

Explanation of "urine nicotine" tests:
- **Anabasine:** a breakdown molecule found only in tobacco products
- **Cotinine:** derivative of nicotine, found in both tobacco and nicotine replacement therapies (NRT) like the patch or gum

Fig. 3

Flowchart showing the tobacco cessation pathway. TJA = total joint arthroplasty, EMR = electronic medical record, NRT = nicotine replacement therapy, and PA = physician assistant.

Bad habits:

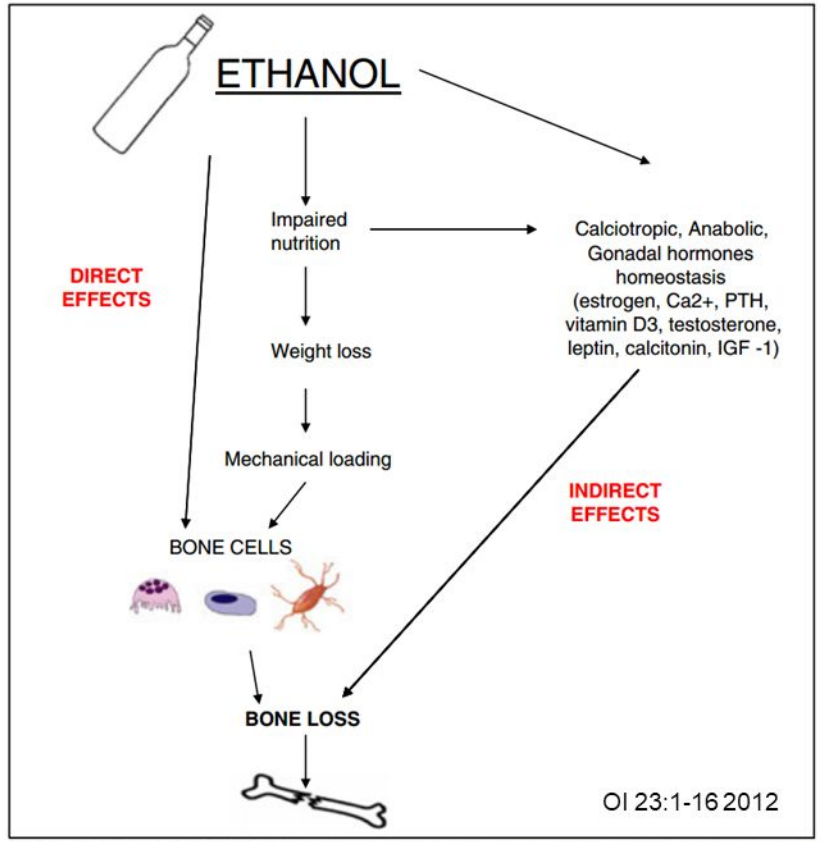
Alcohol ~ strong evidence ↑ pus

- **Heavy ETOH:**
  - [Blood ETOH] > 200mg/dl ~ 3x infections
  - ↓ fibroblast production of collagen type I
  - 5 x higher risk of postoperative bleeding

- **Cirrhosis ~ Liver failure 2-3x infection rate**
  - Osteomalacia: ↓ 25 OH Vit D
  - MELD score >10 ~ higher surgical complications

- **Malnutrition**

- **Bad behavior choices**

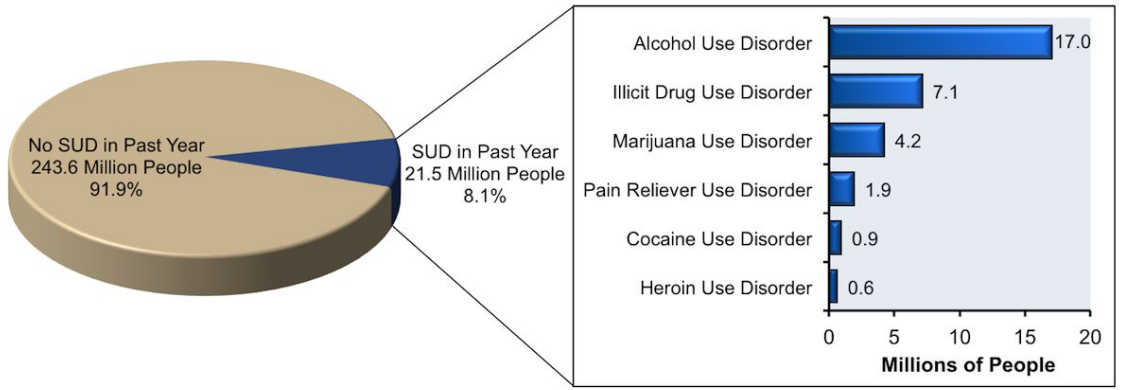


Bad habits: IVDA

- **NO DON'T DO IT**

- All patients developed multiple re-infections after insertion of a drug-eluting spacer or THA (Ramczykowski ArOrthoTraSurg 2018)
- 10year failure rates 50%
  - 40% from septic failure
  - wait 1 year "clean"
  - verify with hair analysis (Wieser ArOrthoTraSurg 2012)
- Bugs in IVDA osteomyelitis:
  - Staph Aureus ~ 50%
  - Staph Epi ~ 20%
  - Pseudomonas ~12%
  - Anaerobes ~ 19%
  - (> 50% polymicrobial)

Bad Habits
Screening process

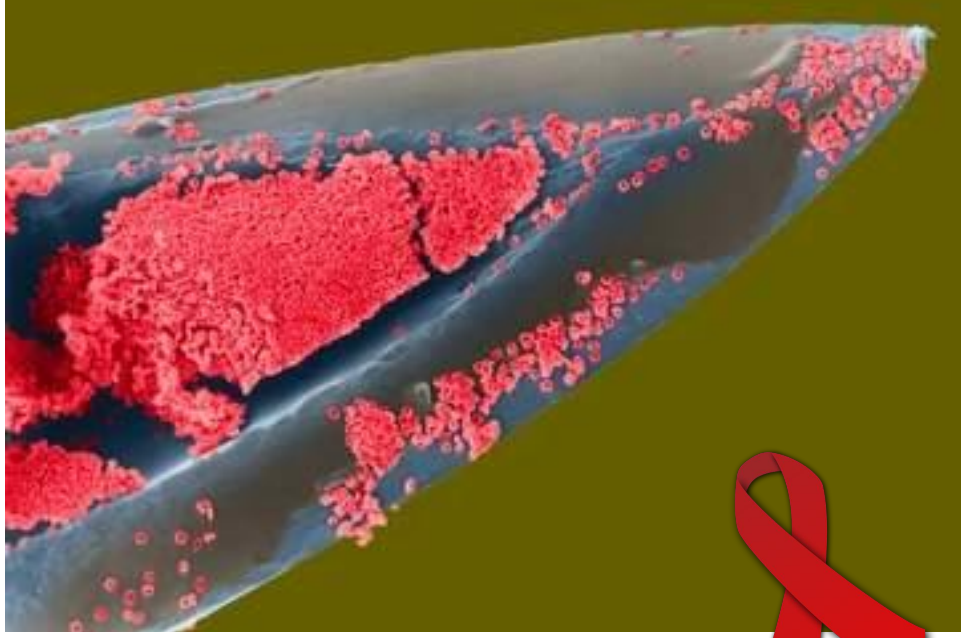


HHS Publication No. SMA 15-4927

Instruction: Please check one box √ for each question	**Three or more days** in the past 12 months	**One or two days** in the past 12 months	**Never** in the past 12 months
In the past 12 months, on how many days did you use... **Tobacco**?			
In the past 12 months on how many days did you have... **4 or more alcoholic drinks in a day,** including wine or beer?			
In the past 12 months on how many days did you use... any **Illegal Drug**, including marijuana?			
In the past 12 months on how many days did you use... any **Prescription Medications "*recreationally*"** (just for the feeling, or using more than prescribed)?			

Consider a "drink" to be a **can or bottle of beer** (12 ounces), a **glass of wine** (5 ounces), a **wine cooler** (12 ounces) or a **shot of hard liquor** like gin, vodka or whiskey (1.5 ounces).

"Recreationally" means taking medications **just for the feeling or experience** they cause, **to get high**, or taking them **more often** or at **higher doses** than prescribed. Prescription Medications are those that are prescribed to you or to someone else.

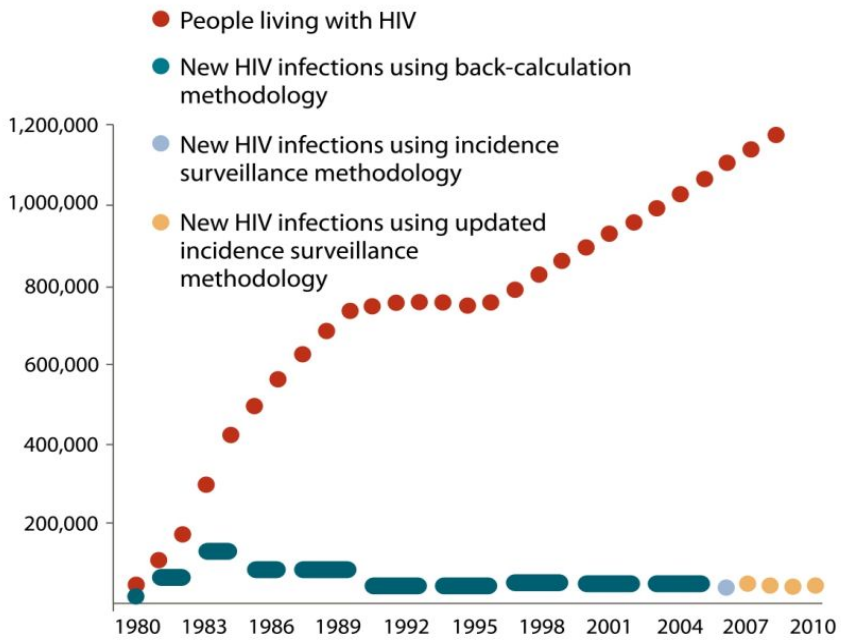


- Single needle stick: ~ 0.3% transmission
- Prophylactic antivirals after stick:
  80%↓ transmission

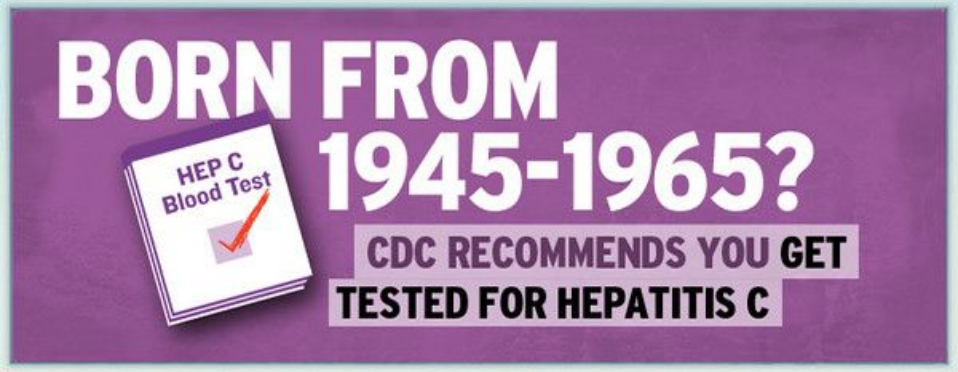
- Most studies show ↑ rate of postop pus
  Hemophiliac studies – high bleed ↑↑↑ risk
  HIV from IVDA ↑↑↑ risk

- Modern studies (new drugs) only slight ↑
  if good [CD4] count and low viral load

Figure 7: HIV Prevalence and Incidence, 1980-2010



Hepatitis C (Non A, Non B)



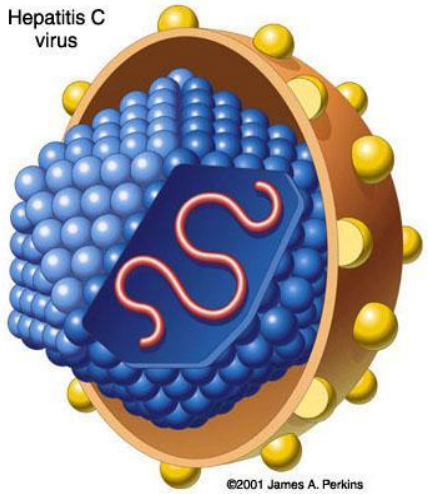
- Single stick transmission: ~ 2 - 3%
- WAS Most common transfusion-associated hepatitis
- Etiology US: 75% US patients hx of IV drug use
  2% from health care occupation exposure
  NO VACCINE… …now Rx ~ $$$ Antivirals
- Cirrhosis, hepatocellular carcinoma

Comparison of Postoperative Complications in Patients With Hepatitis C and Matched Control Patients Treated With Total Knee Arthroplasty

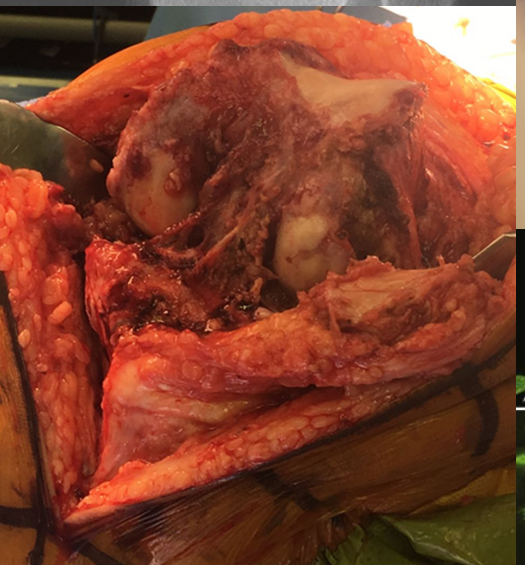
Complication	Patient Group: No. With Hepatitis C[a] (%)	Patient Group: No. of Matched Controls[b] (%)	Statistical Comparison: Odds Ratio (95% Confidence Interval)	Statistical Comparison: *P* Value
Infection				
Within 3 mo	458 (3.0)	2,389 (1.6)	1.9 (1.7–2.0)	<0.0001
Within 6 mo	743 (4.8)	4,011 (2.7)	1.8 (1.7–2.0)	<0.0001
Within 1 yr	1,026 (6.7)	5,533 (3.8)	1.8 (1.7–2.0)	<0.0001
Aseptic revision total knee arthroplasty				
Within 6 mo	261 (1.7)	1,370 (0.9)	1.8 (1.6–2.1)	<0.0001
Within 1 yr	503 (3.3)	3,178 (2.2)	1.5 (1.4–1.7)	<0.0001
Within 2 yr	797 (5.2)	5,450 (3.7)	1.5 (1.3–1.5)	<0.0001
Up to 8 yr	1,152 (7.5)	8,081 (5.5)	1.4 (1.3–1.5)	<0.0001
Venous thromboembolism (3 mo)	235 (1.5)	2,045 (1.4)	1.1 (1.0–1.3)	0.198
Stiffness (3 mo)	185 (1.2)	1,974 (1.3)	0.9 (0.8–1.0)	0.147
Medical (3 mo)	901 (5.9)	5,909 (4.0)	1.5 (1.4–1.6)	<0.0001
Allogeneic blood transfusion (3 mo)	3,905 (25.4)	28,284 (19.3)	1.4 (1.4–1.5)	<0.0001

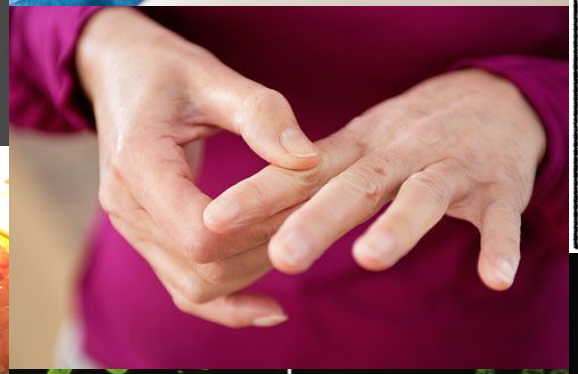
[a] Total number = 15,383
[b] Total number = 146,541

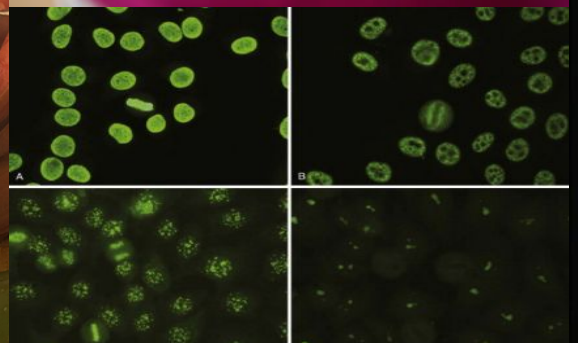
- 78% ↑ risk of a surgical complication
- 15% ↑ risk of postop medical complication (Issa JBJS 2015)
- ~2 times increase in TKA infections (Kidow 2018 JOA, Brown 2017 JAAOS)
- Preop Treatment may help:
  postoperative infections (15.5% vs 4.3% if Rx)
  surgical complications (21.1% vs 7.1% if Rx) (Schwarzkopf Bone Joint J. 2019)

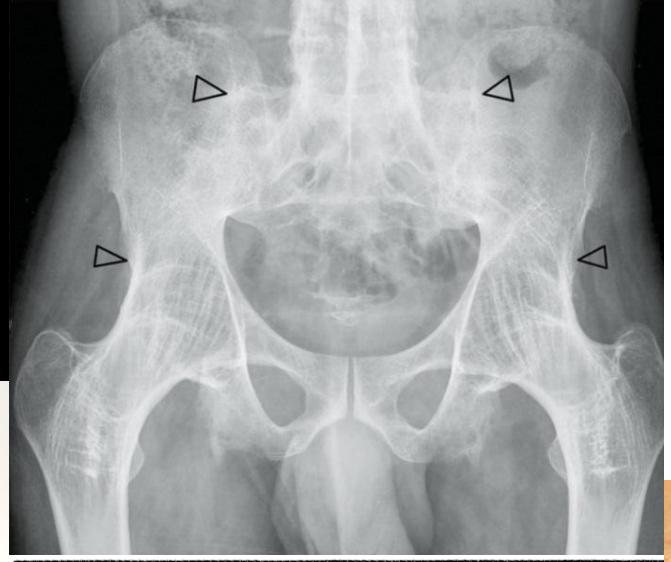


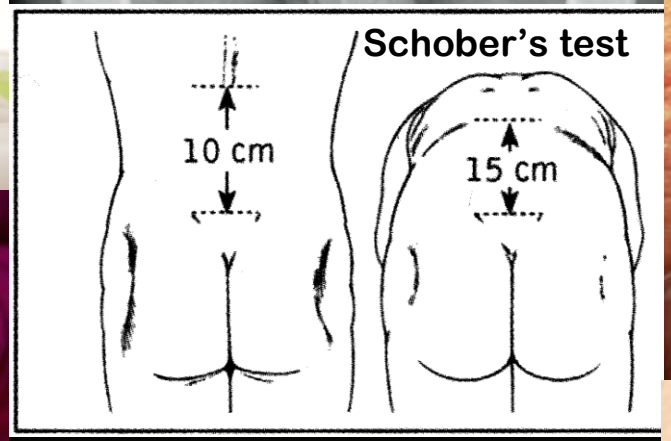
Symmetrical joint space narrowing

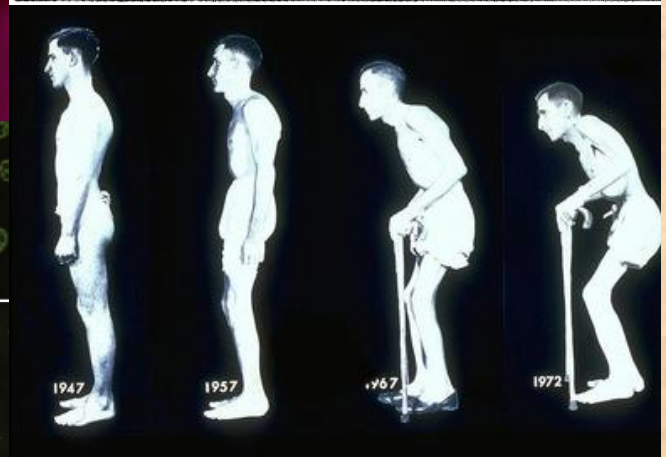













Symmetrical joint space narrowing
Inflammatory Arthritides
all have increased risks
of infections!
10 cm
1947
1957
1972

Biologic Agents ~ Anti-cytokine drugs

- TNFα blockers - etaner**cept** (Enbrel) re**cept**or fusion protein
  infli**xi**m**ab** (Remicade) chimeric IgG
  adalimu**mab** (Humira) monoclonal antibody
- IL-1 blockers - anakinra receptor antagonist
- IL-6 blocker - tocilizu**mab** - anti-human IL-6 receptor antibody
- (B cells antibodies - (Rituxan) rituxi**mab**)

- **Nomenclature:** **"-mab" monoclonal antibody (mAb)**
  "-ximab" chimeric mAb (x cross species mouse+human)
  "-zumab" a humanized mAb
  "-cept" fusion of a receptor to the Fc part of human IgG1

- **Very Effective!**
- **But many ↑ risk of pus & atypical infections…**
  -mab = maybe you should stop them before surgery

Immune System Drugs Guideline

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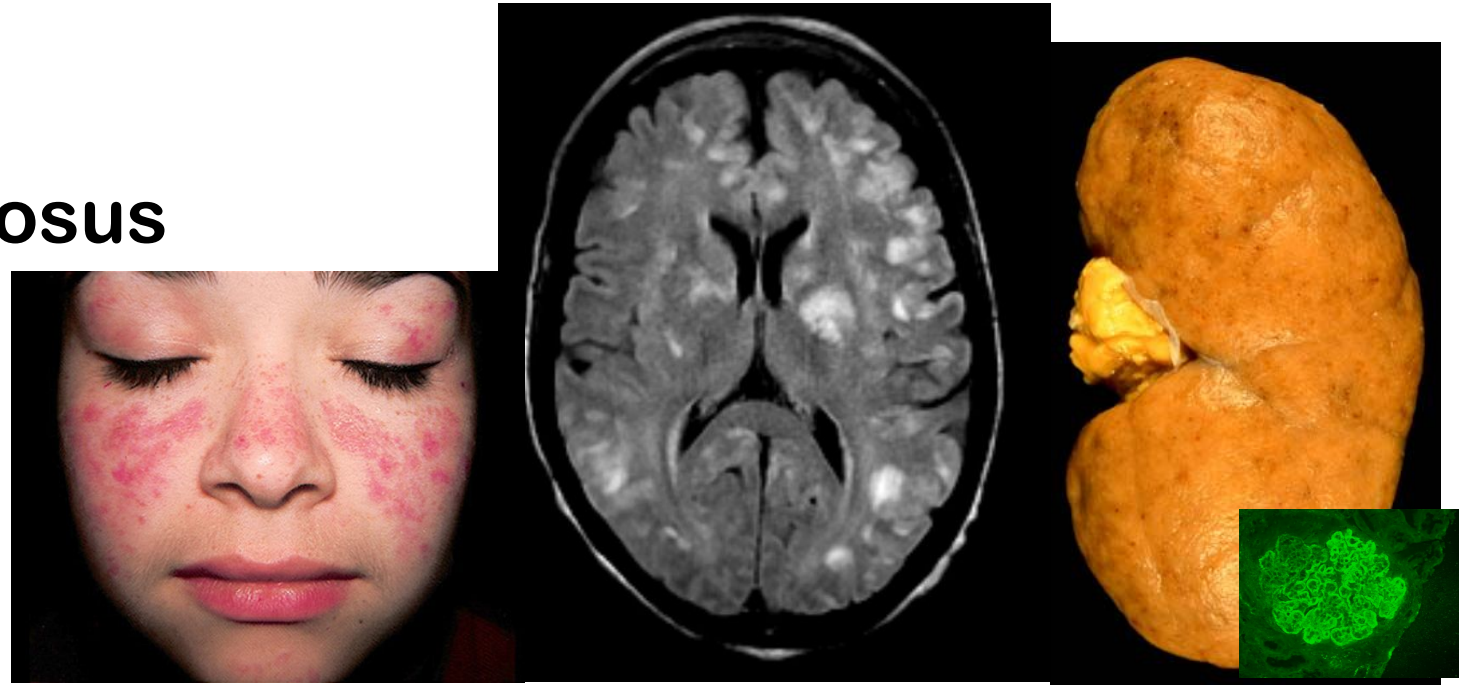
AAHKS
AMERICAN ASSOCIATION OF HIP AND KNEE SURGEONS

BIOLOGIC AGENTS: STOP these medications prior to surgery and schedule surgery at the end of the dosing cycle. RESUME medications at minimum 14 days after surgery in the absence of wound healing problems, surgical site infection, or systemic infection.	**Dosing Interval**	**Schedule Surgery (relative to last biologic agent dose administered) during**
Adalimumab (Humira)	Weekly or every 2 weeks	Week 2 or 3
Etanercept (Enbrel)	Weekly or twice weekly	Week 2
Golimumab (Simponi)	Every 4 weeks (SQ) or every 8 weeks (IV)	Week 5 Week 9
Infliximab (Remicade)	Every 4, 6, or 8 weeks	Week 5, 7, or 9
Abatacept (Orencia)	Monthly (IV) or weekly (SQ)	Week 5 Week 2
Certolizumab (Cimzia)	Every 2 or 4 weeks	Week 3 or 5
Rituximab (Rituxan)	2 doses 2 weeks apart every 4-6 months	Month 7
Tocilizumab (Actemra)	Every week (SQ) or every 4 weeks (IV)	Week 2 Week 5
Anakinra (Kineret)	Daily	Day 2
Secukinumab (Cosentyx)	Every 4 weeks	Week 5
Ustekinumab (Stelara)	Every 12 weeks	Week 13
Belimumab (Benlysta)	Every 4 weeks	Week 5
Tofacitinib (Xeljanz): STOP this medication 7 days prior to surgery.	Daily or twice daily	7 days after last dose
DMARDs: CONTINUE these medications through surgery.	**Dosing Interval**	**Continue/Withhold**
Methotrexate	Weekly	Continue
Sulfasalazine	Once or twice daily	Continue
Hydroxychloroquine	Once or twice daily	Continue
Leflunomide (Arava)	Daily	Continue
Doxycycline	Daily	Continue

Immune system drugs: Systemic Lupus Erythematosus



- If lupus is severe **continue drugs**
  - nephritis, CNS, hemolytic anemia < 9, platelets < 50K, vasculitis, myocarditis, pneumonitis, enteritis, pancreatitis, cholecystitis, hepatitis, malabsorption protein-losing enteropathy, orbital inflammation/myositis, keratitis/uveitis/scleritis retinal vasculitis, optic neuritis

- If lupus is not severe **stop drugs**

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SEVERE SLE-SPECIFIC MEDICATIONS: CONTINUE these medications in the perioperative period.	Dosing Interval	Continue/Withhold
Mycophenolate mofetil	Twice daily	Continue
Azathioprine	Daily or twice daily	Continue
Cyclosporine	Twice daily	Continue
Tacrolimus	Twice daily (IV and PO)	Continue
NOT-SEVERE SLE: DISCONTINUE these medications 1 week prior to surgery	**Dosing Interval**	**Continue/Withhold**
Mycophenolate mofetil	Twice daily	Withhold
Azathioprine	Daily or twice daily	Withhold
Cyclosporine	Twice daily	Withhold
Tacrolimus	Twice daily (IV and PO)	Withhold

Inflammatory Arthritides
Biologic

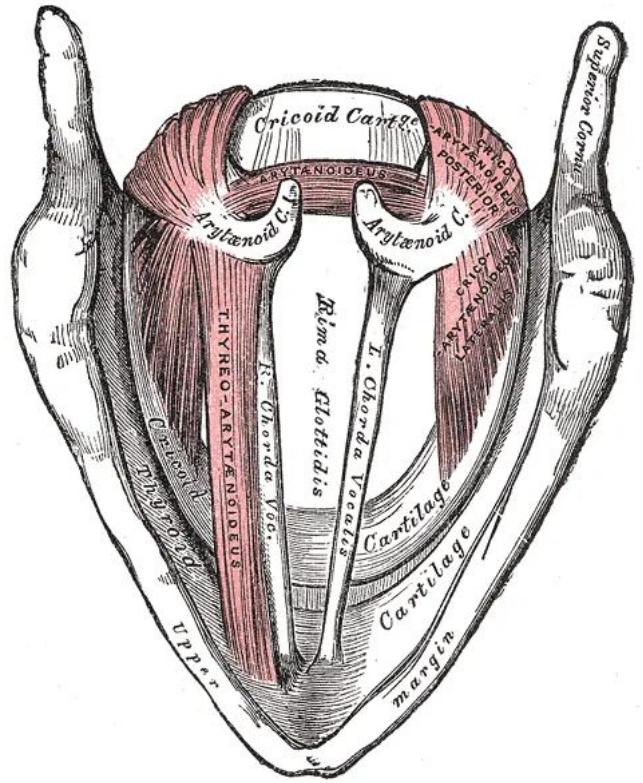
- Rheumatology and AAHKS 2017 guidelines
  - DMARDS ~ continue
  - Biologics ~ stop for the duration of dosing + 1 week
    - restart ~14 days postop (after staples and healing)
  - Systemic Lupus: depends on if disease is severe

  - Longer term/higher dose prednisone bad
    - Guidelines favor NO stress doses – continue usual daily dose

Optimization for RA
Spinal block if able, but be prepared…

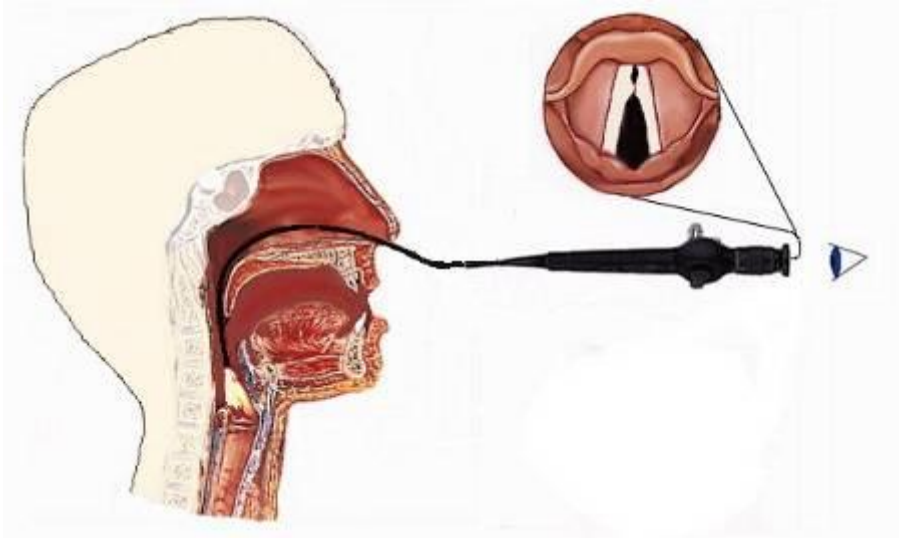
- NECK PAIN in ~ 25%
  - C1-C2 instability
  - Atlanto-Axial impaction
  - “Basilar invagination”

- Cricoarytenoid arthritis
  - Pain with speaking
  - Odynophagia
  - Hoarseness
  - Breathing difficulties



If cervical symptoms,

To avoid pithing…
Be prepared!
Indirect laryngoscopy

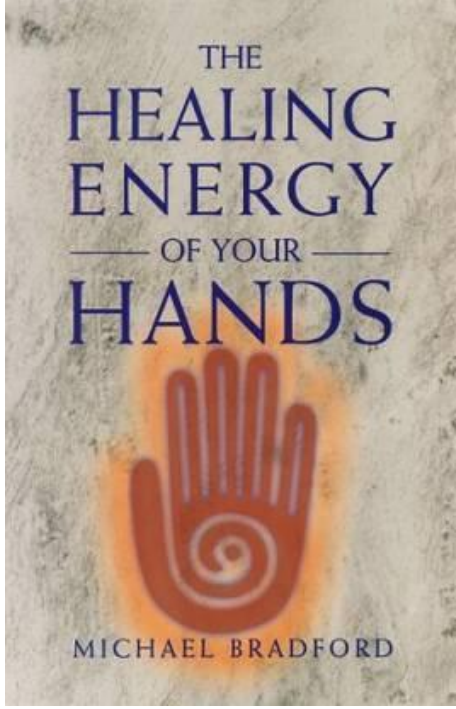


Surgical Nutrition

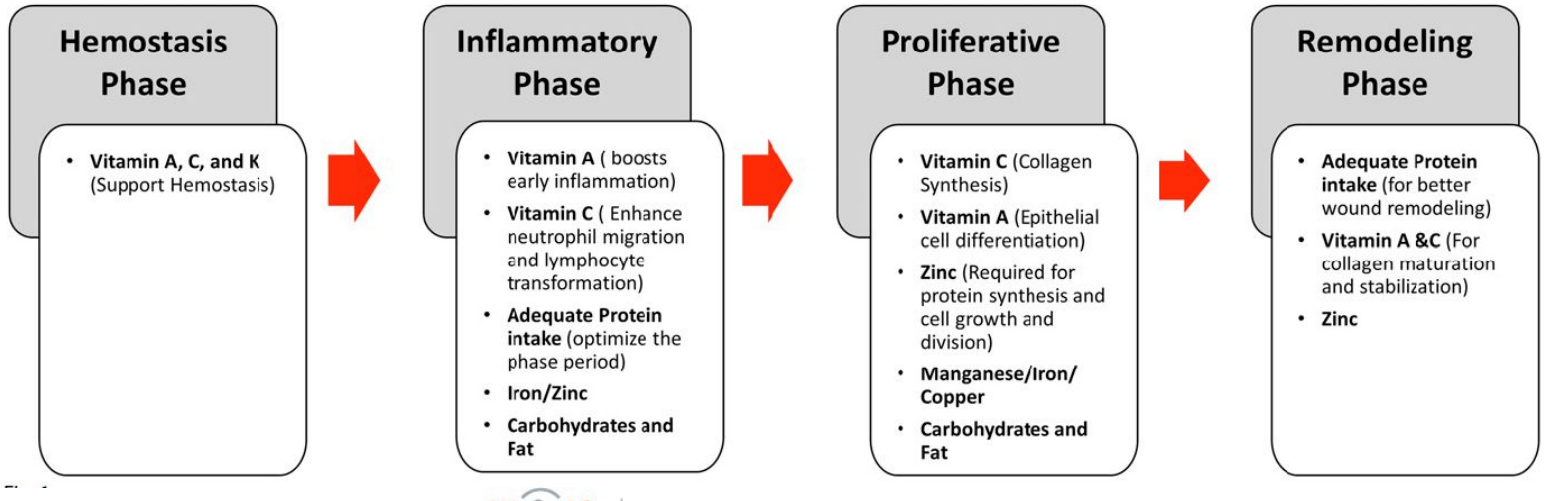
Malnutrition

- 40% of ortho patients are malnourished
- Up to *60% of elderly are malnourished*

- Healing requires energy

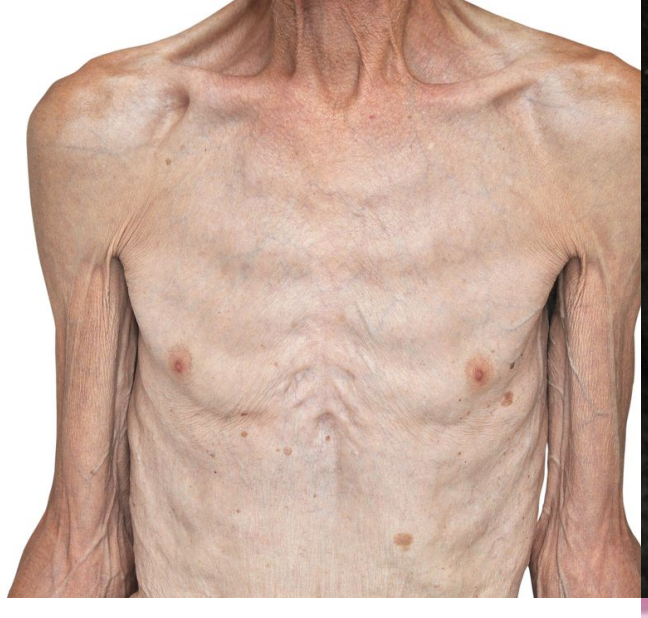


- Risks:
  - hematoma formation
    - wound healing
  - infection
  - renal complications
  - cardiac complications



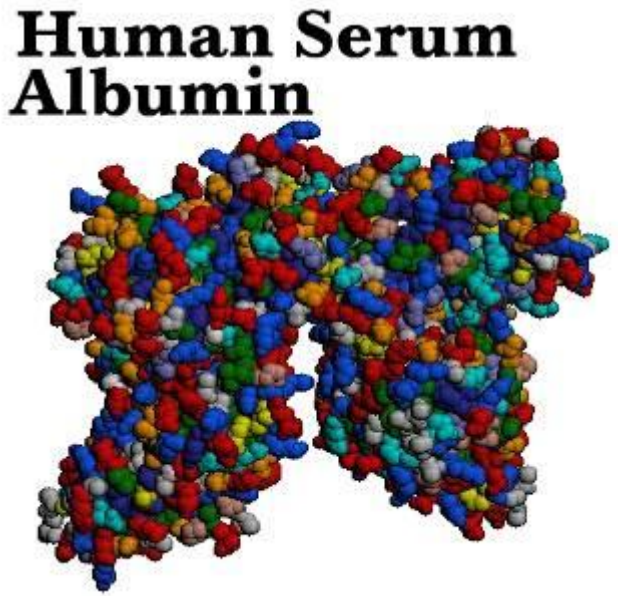
JB&JS REVIEWS | *Markers for Malnutrition and BMI Status in Total Joint Arthroplasty*

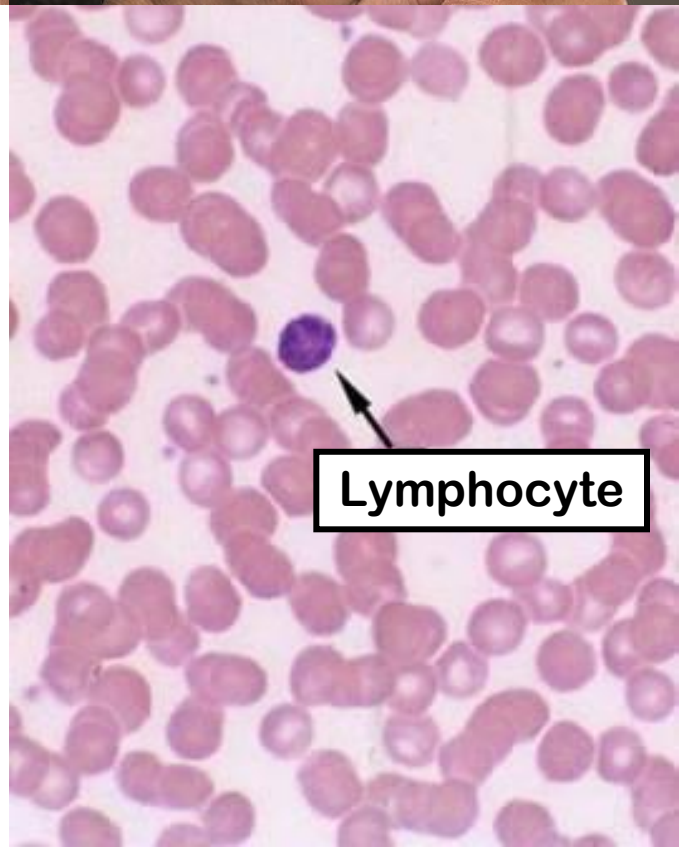
Malnutrition
Measures of nutritional status



- History of weight loss:
  - > 10% over 6 months
  - > 5% over a month
- PE: BMI < 18.5
- Labs: Albumin < 3.0 – 3.5 g/dl
  Total Lymphocytes < 1,500/ml

Laboratory Parameter/Threshold for Malnutrition:	
Albumin	<3.5 g/dL
Prealbumin	<18 mg/dL
Total Protein	<6.0 g/dL
Total Lymphocyte Count	<1,500 Cells/mm3
Iron	<45 microg/dL
Serum Transferrin	<200 mg/dL
25-OH Vitamin D	<30 mg/dL
Calcium	<9 mg/dL
Zinc	<0.66 mcg/mL





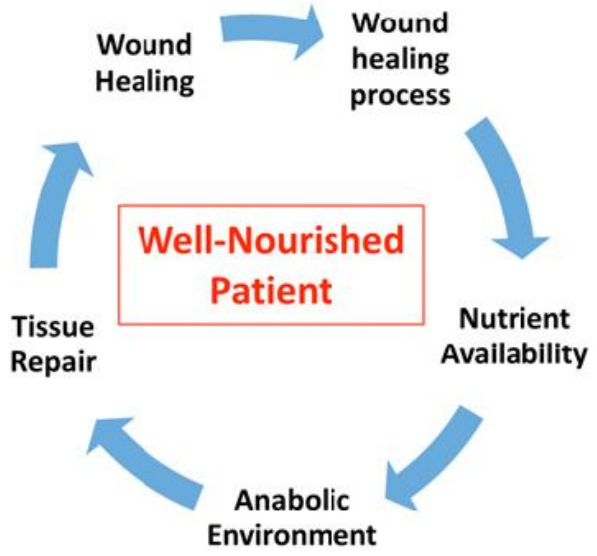
Malnutrition Labs

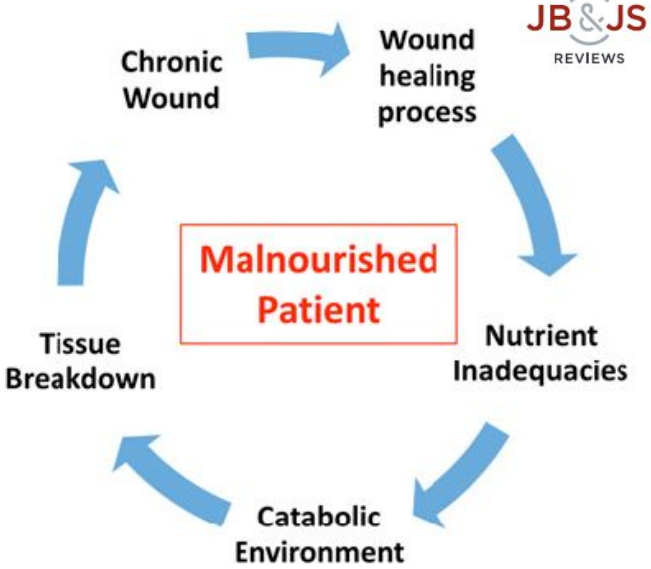
Albumin < 3.0-3.5 g/dL

Transferrin <200 mg/dL

Total Lymphocytes: <1500/mm^3

40-50% of patients with low values get poor wound healing &/or infection





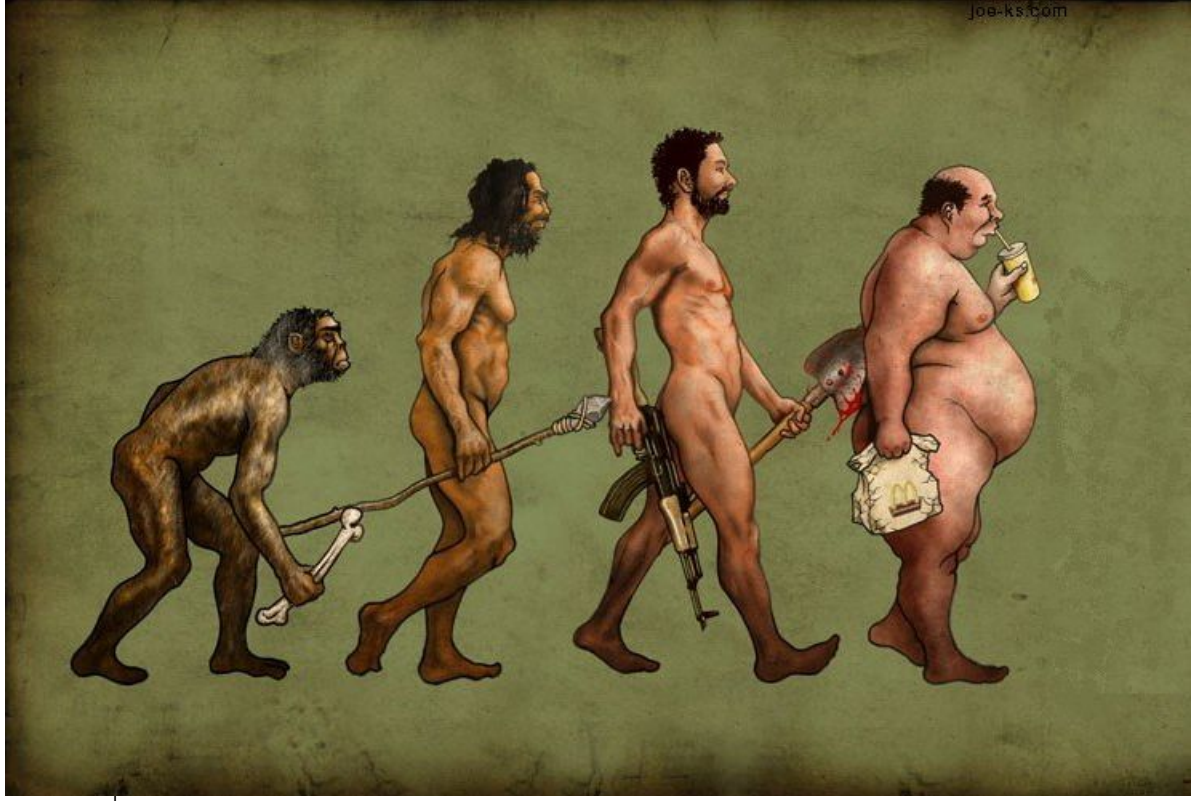
Obesity ~ a growing problem

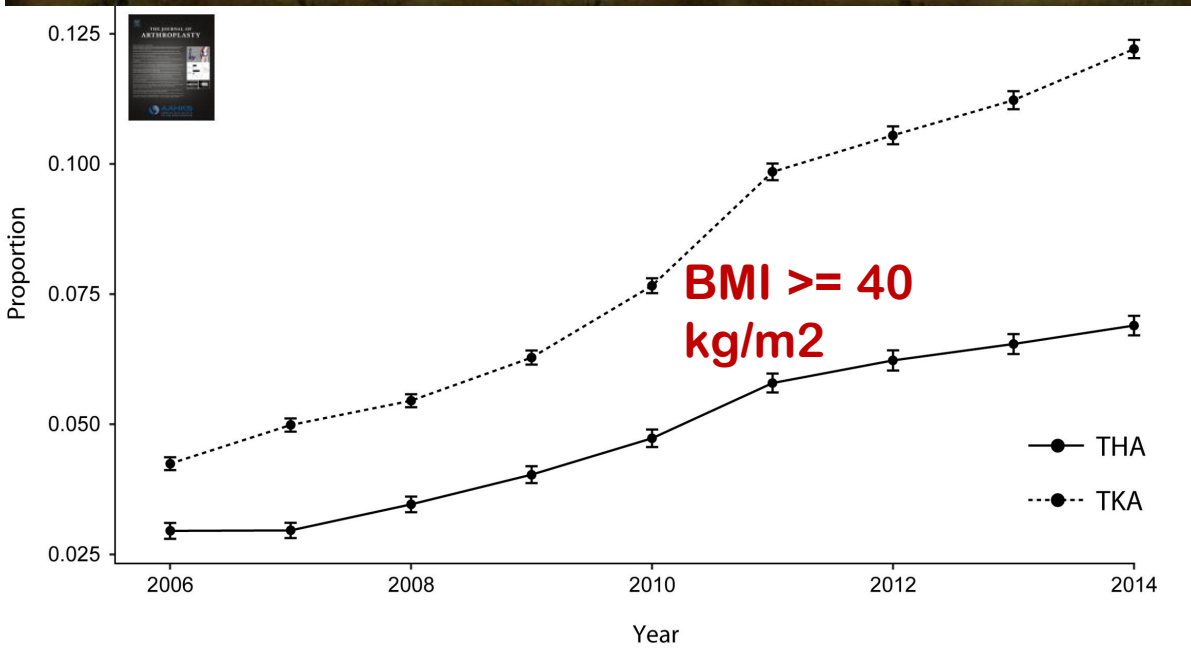
2nd leading cause of preventable death in US (NIH)
(first is smoking)

40% US prevalence of any obesity (BMI > 30)

Medical costs in US:
~$150 Billion/year
~$2000/year per person
(Kim Value Health 2016)

Proportion of total joints done with BMI > 40 ↑





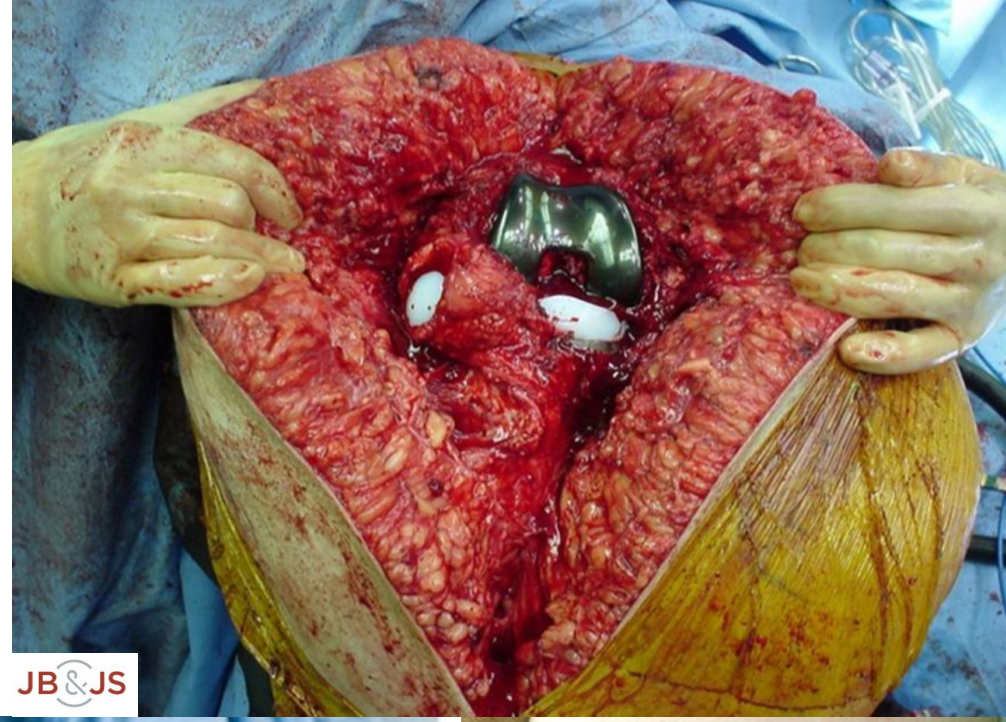
Arthroplasty in Obesity

Improvements in pain and function (Mont JOA 1996, Baker JBJS 2012)

Challenging surgery

Increased complications
- Wound healing
- Infection higher in meta-analysis (Kerkhoffs JBJS 2012)
- Deep infection: ~ 3-9 x higher. (Samson Anz J Surg 2010)
  BMI>50 ~ 18x higher (Malinzak JOA 2009)

Revision rates
- Increased in meta-analysis (Kerkhoffs JBJS 2012)
- Increased x2 if >35 (Zingg Int Orth 2016)



Obesity ~ sign of poor health

High BMI associated with:
Less improvement in patient outcomes

Worse results/Higher Costs = lower value care

AAOS:
“Accepted threshold for safe elective surgery is BMI < 40”

OrthoGuidelines | AAOS American Academy of Orthopaedic Surgeons

Search Orthoguidelines

Home | Guidelines | Appropriate Use Criteria | Implementation Resources | Definitions

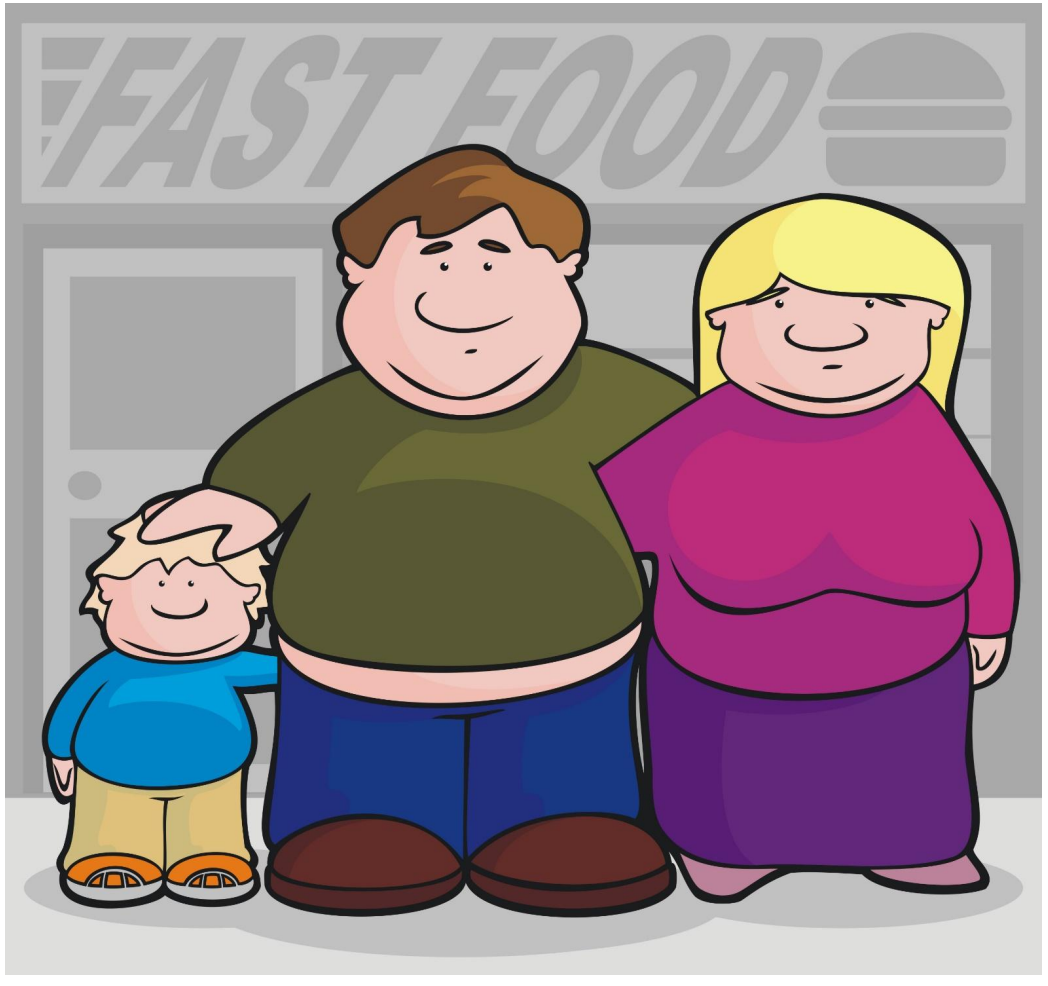
Home > All Guidelines > Surgical Management of Osteoarthritis of the Knee > BMI as A Risk Factor

Strong evidence supports that obese patients have less improvement in outcomes with total knee arthroplasty (TKA).

Surgical Management of Osteoarthritis of the Knee

Endorsed by: The Knee Society, SOMOS, AAHKS, ACR, AGS, AANA

★★★★ STRONG EVIDENCE



Obesity pathways:

- “Teachable moment” to help individual and population health

- Preop considerations:
  - Nutritional status – often malnourished
  - Weight loss plan/Nutritional Counseling
  - Verbal/written contracts for weight loss goals
  - Bariatric Surgery?

Obesity pathways:

- “Teachable moment” to help individual and population health

- Preop considerations:
  - Nutritional status – often malnourished
  - Weight loss plan/Nutritional Counseling
  - Verbal/written contracts for weight loss goals
  - Bariatric Surgery?

Obesity pathways:

- **BMI > 40 ~ "Hard stop" for elective cases at risk**

The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

Weight and Metabolic Outcomes 12 Years after Gastric Bypass

Ted D. Adams, Ph.D., M.P.H., Lance E. Davidson, Ph.D., Sheldon E. Litwin, M.D., Jaewhan Kim, Ph.D., Ronette L. Kolotkin, Ph.D., M. Nazeem Nanjee, Ph.D., Jonathan M. Gutierrez, B.S., Sara J. Frogley, M.B.A., Anna R. Ibele, M.D., Eliot A. Brinton, M.D., Paul N. Hopkins, M.D., M.S.P.H., Rodrick McKinlay, M.D., et al.

- **Multiple National Guidelines:**
  - **consider bariatric surgery if:**
    - **BMI>35 with co-morbidities**
    - **BMI>40**

ASMBS American Society for Metabolic & Bariatric Surgery

American Association of Clinical Endocrinologists

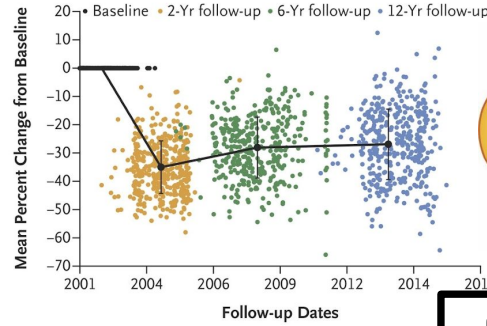
AACE

American Heart Association

American Diabetes Association

International Diabetes Federation

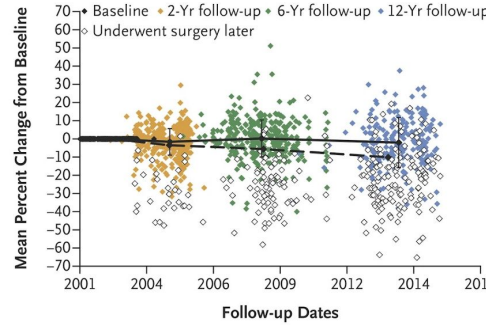
A Mean Percent Change in Body Weight from Baseline to Years 2, 6, and 12 in the Surgery Group



No. of Patients	Baseline	2 Yr	6 Yr	12 Yr
Surgery group	418	409	379	387
Deaths	—	3	9	14
Total	418	412	388	401

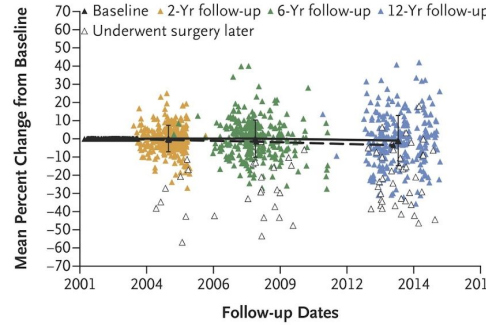
Down 30% At 12 years!

B Mean Percent Change in Body Weight from Baseline to Years 2, 6, and 12 in Nonsurgery Group 1



No. of Patients	Baseline	2 Yr	6 Yr	12 Yr
Nonsurgery group 1	417	373	294	217
Underwent surgery later	—	28	89	146
Deaths	—	3	11	25
Total	417	404	394	388

C Mean Percent Change in Body Weight from Baseline to Years 2, 6, and 12 in Nonsurgery Group 2

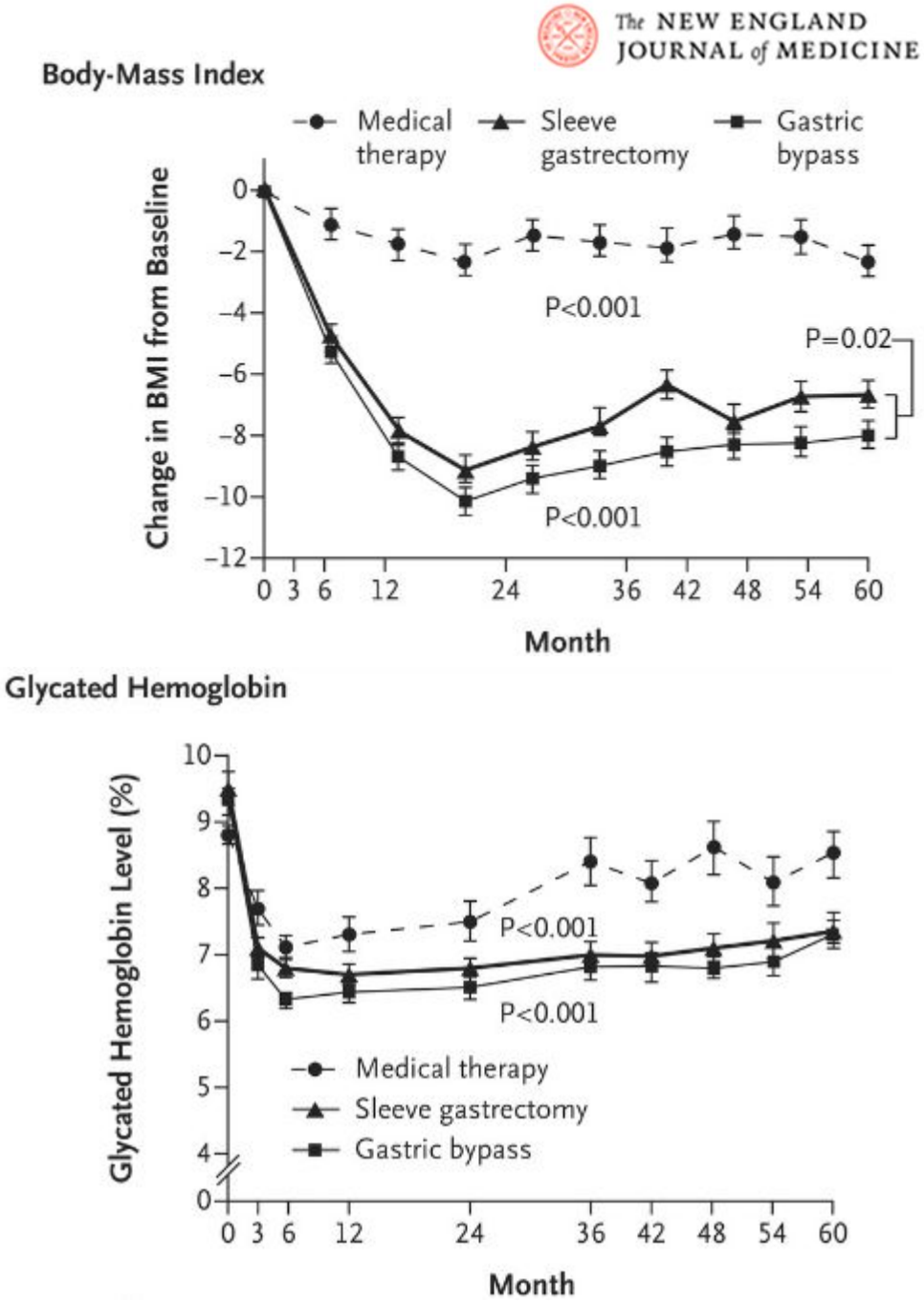


No. of Patients	Baseline	2 Yr	6 Yr	12 Yr
Nonsurgery group 2	321	312	294	262
Underwent surgery later	—	8	19	39
Deaths	—	—	3	15
Total	321	320	316	316

Bariatric Surgery

Not just improving BMI
But often curing diabetes!

Lowering overall health care costs.



TKA and THA after Bariatric surgery

Impact of Bariatric Surgery on Inpatient Complication, Cost, and Length of Stay Following Total Hip or Knee Arthroplasty

Yicun Wang, PhD [a], Zhantao Deng, PhD [b], Jia Meng, PhD [a], Qiying Dai, MD [c], Tao Chen, PhD [d], Nirong Bao, MD, PhD [a,*]

Retrospective Review 2006-2014
530,160 THA patients and 1,113,116 TKA patients
2006-2014 Nationwide Inpatient Sample
(All patients, all payers of 20% of US community hospitals)

Arthroplasty after Bariatric surgery vs Morbid obesity (BMI>40)
Comorbidity matched
In house complications only

THA ~ fewer PE
shorter length of stay

TKA ~ fewer PE & respiratory complications
shorter length of stay
fewer deaths

↑ risk of anemia & transfusion

TKA and THA after Bariatric surgery

Bariatric Surgery Improves Outcomes After Lower Extremity Arthroplasty in the Morbidly Obese: A Propensity Score-Matched Analysis of a New York Statewide Database

Alexander S. McLawhorn, MD, MBA [a,*], Ashley E. Levack, MD, MAS [a], Yuo-yu Lee, MS [b], Yile Ge, MS [b], Huong Do, MA [b], Emily R. Dodwell, MD, MPH [a]

Bariatric surgery prior to TJA
reduced co-morbidity burden at the time of TJA
reduced post-TJA complications

However, ***did not*** reduce the risk for revision

TKA and THA after Bariatric surgery

Bariatric Surgery Improves Outcomes After Lower Extremity Arthroplasty in the Morbidly Obese: A Propensity Score-Matched Analysis of a New York Statewide Database

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Bariatric surgery prior to TJA
reduced co-morbidity burden at the time of TJA reduced post-TJA complications

However, *did not* reduce the risk for revision

Consider bariatric consult at first arthritis visit!

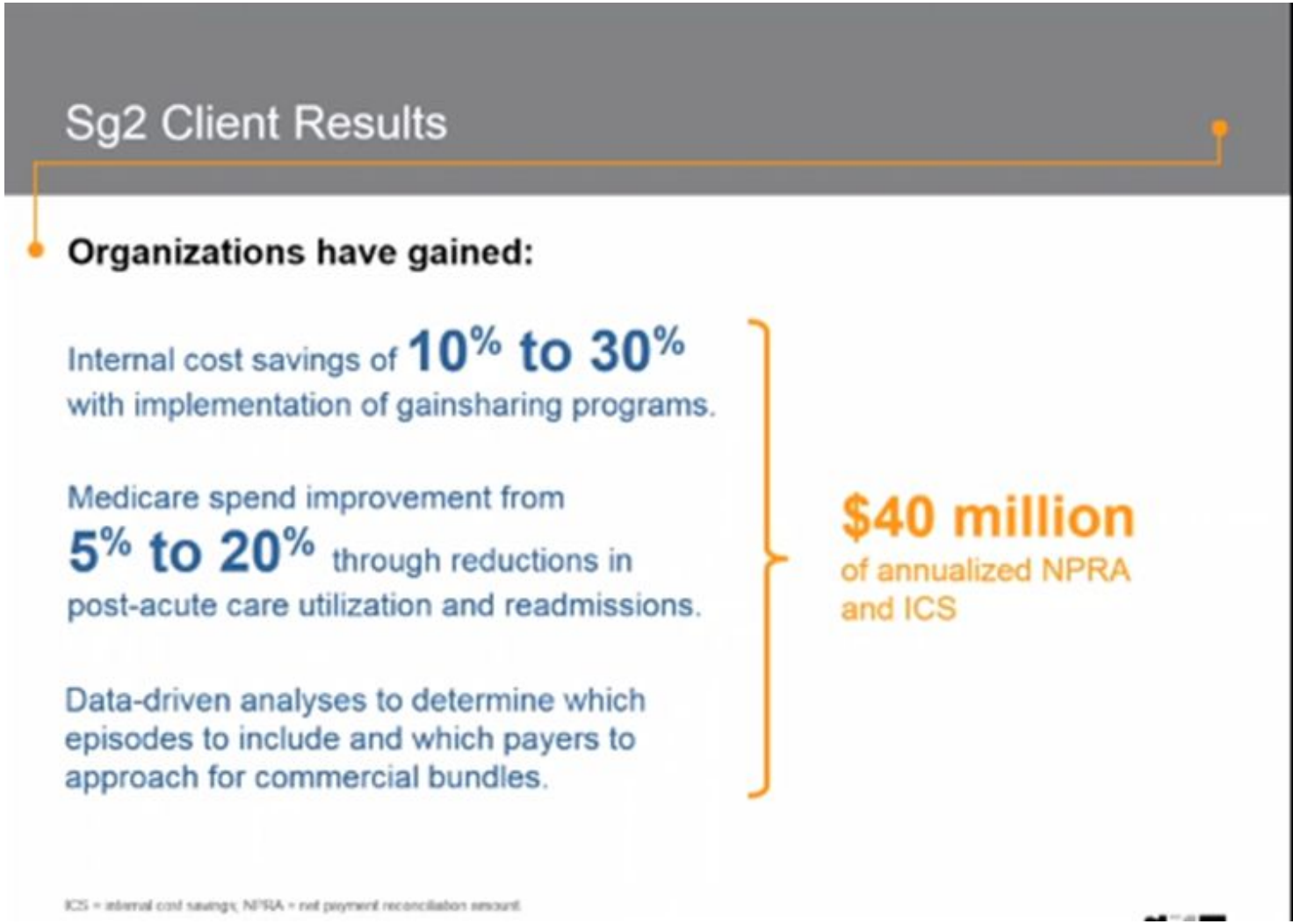
Optimization

HOW DOES IT WORK

National Consultants

Well oiled programs claim:

- **Lower costs for hospital**
- **Decreased readmissions**



UC Irvine ~ lower costs

“Perioperative Surgical Home”

California Private Insurers set cap ~$30K

Benchmark TKA ~ $17,588 + implants

UC Irvine costs ~ $10K + implants

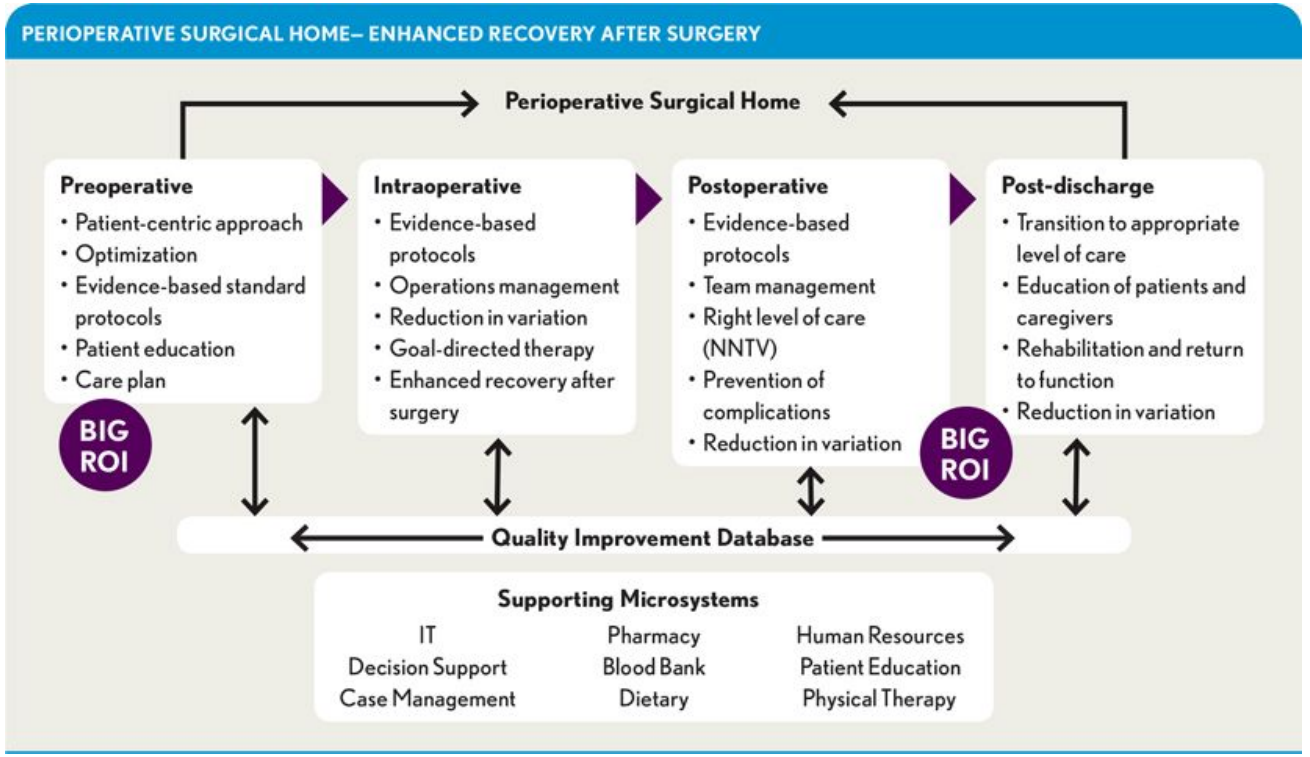


Table 5 Benchmark cost comparison: average hospital cost excluding implants[a]

	Total Joint-PSH	Benchmark [16]
TKA	$10,042 ± 1,305	$17,588
THA	$9952 ± 1,294	$16,267

PSH, perioperative surgical home; THA, total hip arthroplasty; TKA, total knee arthroplasty.
[a]Data are expressed as mean ± SD.

Raphael *et al. Perioperative Medicine* 2014, **3**:6
http://www.perioperativemedicinejournal.com/content/3/1/6

Matsen, Sharkey, et al

“Infection Reduction Committee”
At one hospital

Rothman Institute
Decreased infections from 1% to .4%

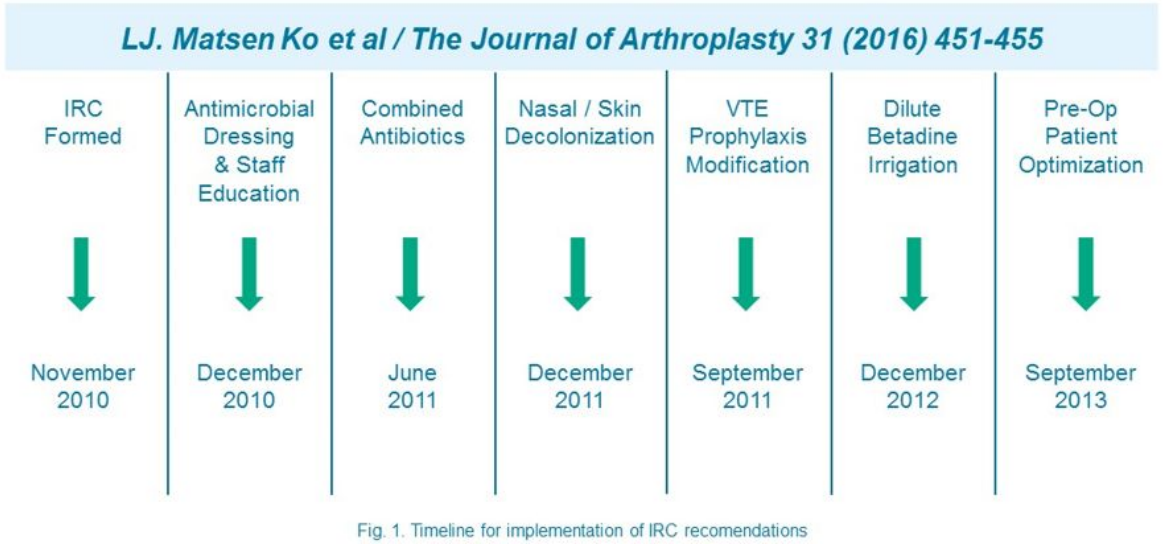


Fig. 1. Timeline for implementation of IRC recomendations

Contents lists available at ScienceDirect

The Journal of Arthroplasty

journal homepage: www.arthroplastyjournal.org

The Effect of Implementing a Multimodal Approach on the Rates of Periprosthetic Joint Infection After Total Joint Arthroplasty

Laura J. Matsen Ko, MD, Joanne Y. Yoo, BS, Mitchell Maltenfort, PhD, Amy Hughes, RN, Eric B. Smith, MD, Peter F. Sharkey, MD

The Rothman Institute at Thomas Jefferson University, Philadelphia, Pennsylvania

ABSTRACT

Introduction: We examined the efficacy of implementing a multimodal program aimed at reducing the incidence of periprosthetic joint infection (PJI) after total joint arthroplasty (TJA) in a mid-size community hospital.

Methods: An infection reduction committee (IRC) was formed at our hospital in November 2010. The IRC consisted of two orthopaedic surgeons, an infectious disease specialist, an internist with extensive experience in perioperative medical management of TJA patients, an anesthesiologist, the hospital infection control nurse, and two additional nurses. Their goals were to 1) evaluate the current incidence of PJI at our institution, compare it with the reported national data, and consider measures already in place directed at preventing PJI; 2) review and routinely evaluate recently published studies or information obtained from continuing medical education events related to PJI to determine if practice changes were warranted (based on intervention efficacy, cost, and safety) and then develop a plan to implement appropriate alterations in perioperative protocols using a multimodal strategy; and 3) evaluate the effect and safety of newly-introduced infection reduction strategies on the incidence of PJI.

Results: In 2008, the incidence of PJI at our hospital was 1.0%. By 2013, this rate had reduced to 0.4%. In absolute numbers, in 2009, 20 of 1,150 TJAs developed a PJI in the 12-month period following partial, primary, or revision TJA. In 2013, PJI occurred in only 4 of 1,053 TJA patients.

Conclusion: We found that formation of an IRC focused on evaluating and implementing strategies to reduce PJI following TJA can be effective.

Veterans Hospital

2017 JOA

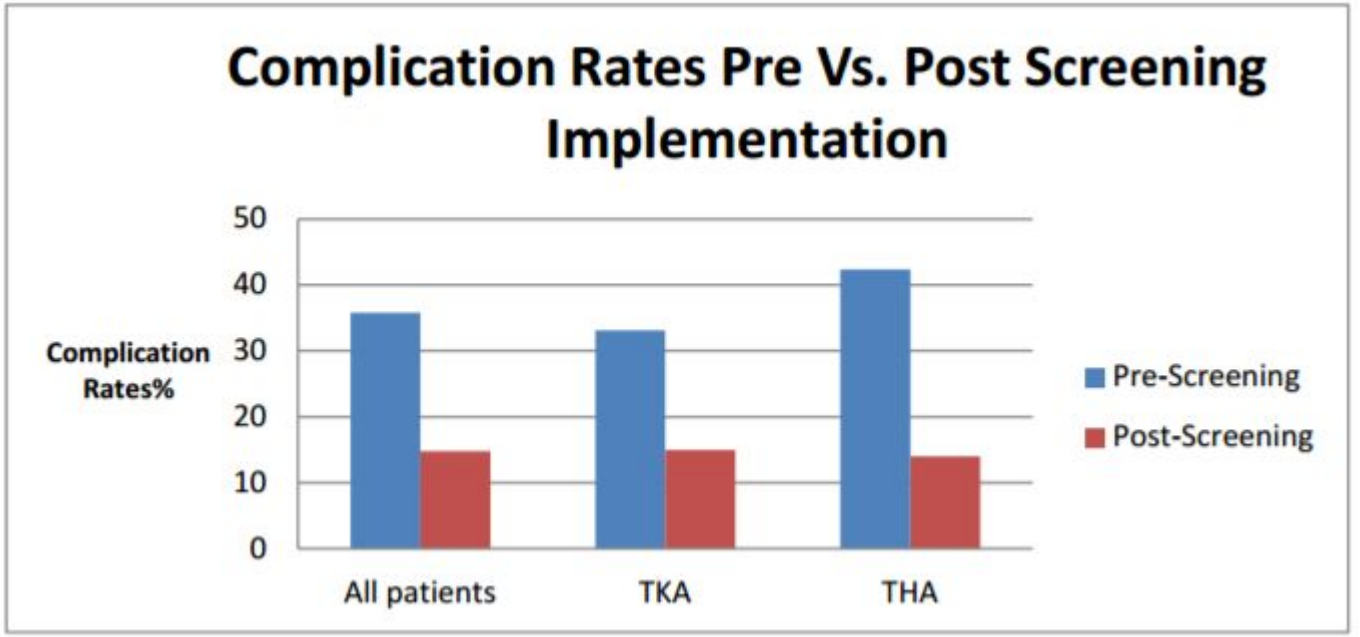
- VA population with 2 year f/u
- Screens: BMI <= 35
  HgbA1C <= 7
  Alb >= 3.5
  HGB >= 11

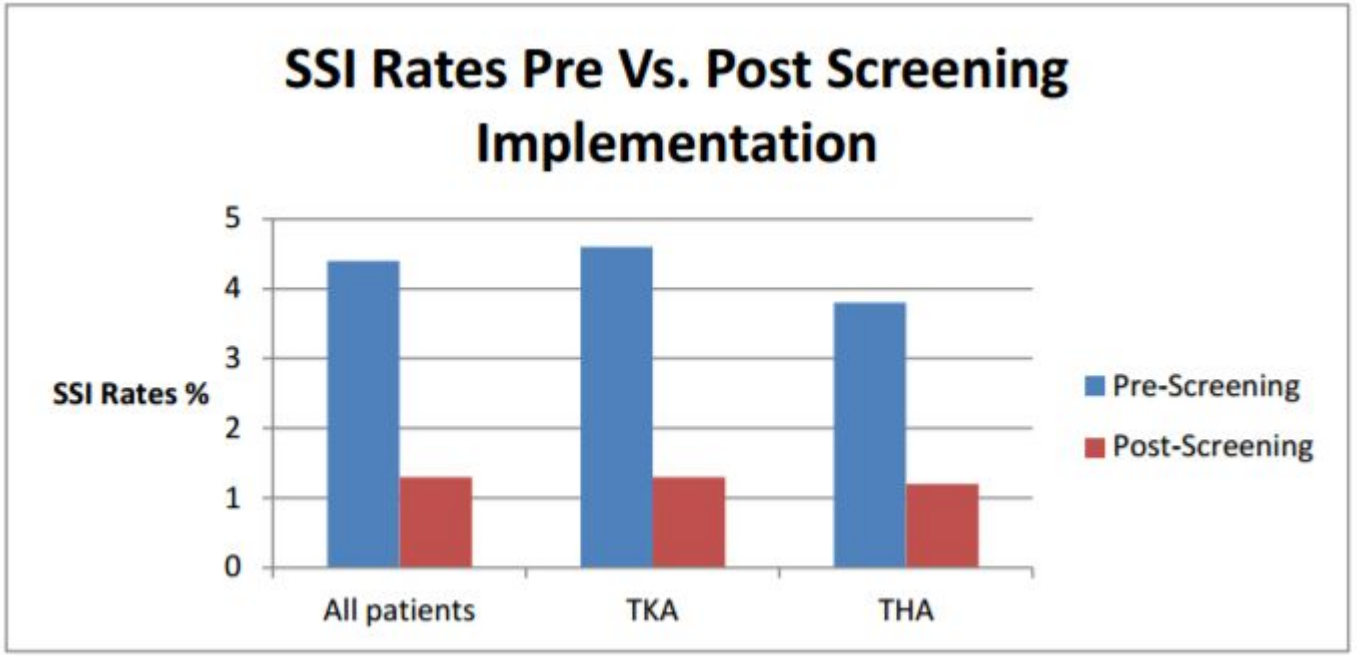
- Results:

↓SSI (by MSIS): 4% vs 1%

↓Total complications: 35% vs 15%

~ intra-op, return to OR, readmits < 90 days
~ SSI (deep and superficial)
~ transfusion, pressure ulcers, UTIs
~ DVT/PE, MI and death



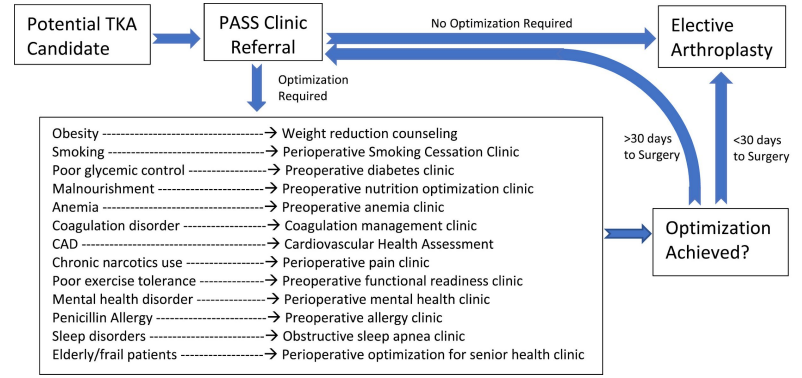


Duke PASS clinic
Did NOT pass!

2019 JOA

Risk Stratification Checklist for Total Joint Replacement

- ❑ BMI ≥ 40 kg/m^2
- ❑ Active smoking
- ❑ HgA1C >7.5%
- ❑ Albumin ≤ 3 g/dL
- ❑ Hemoglobin < 11 g/dL
- ❑ Thrombocytopenia (platelets < 50K/L)
- ❑ ESRD on Dialysis
- ❑ CAD (with or without AMI in past 6 months)
- ❑ Stroke or TIA within past 6 months
- ❑ Active infections
- ❑ Chronic narcotics use (addiction)

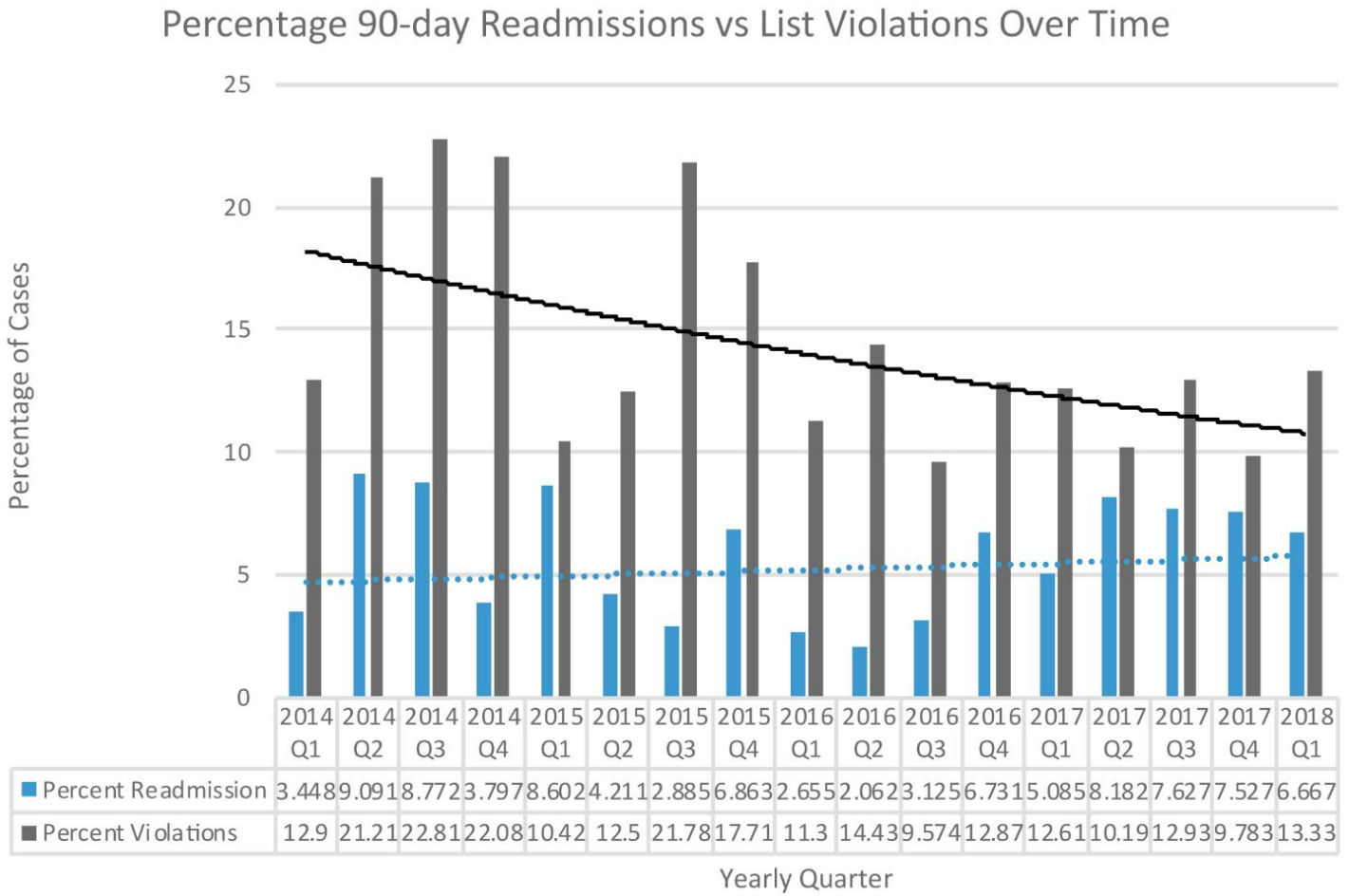


Multiple hospitals in a system
Some participating in bundles
Some not

Some improvement in the # of "violations"
(failure to follow their own process)

No improvement in Readmissions

May depend on
how strict rules of optimization are followed
how low readmissions were before



SIGNATURE MEDICAL GROUP

Total joint results at Large multi-specialty Practice (Missouri)

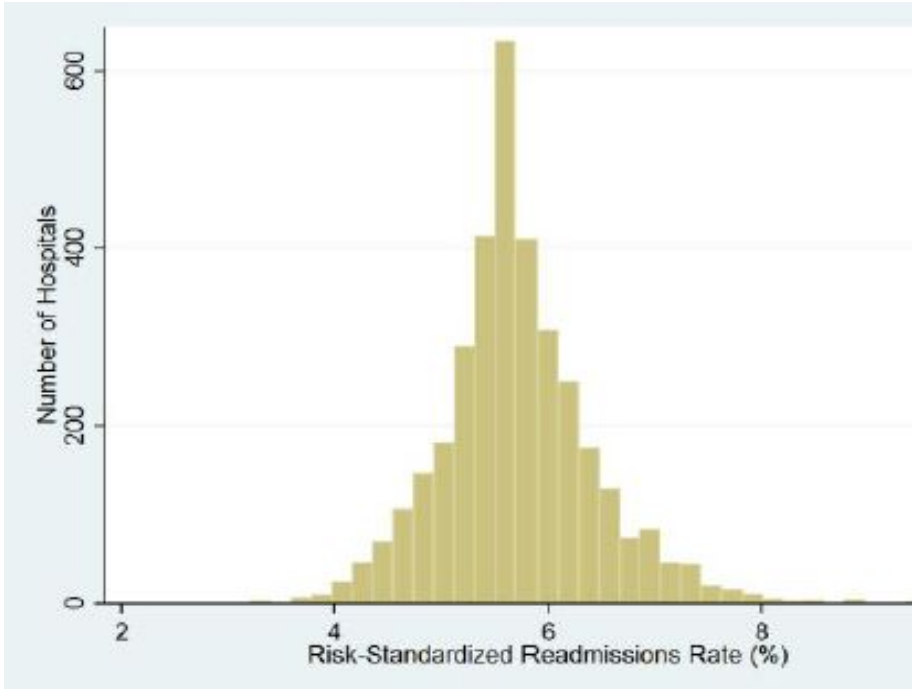
1/3 less infections
25% less readmissions

Metric	Percentage Reduction (from baseline)*
90-day Readmission Rate	26%
30-day Readmission Rate	28%
Pulmonary Embolism during Index Admission	72%
Surgical Site Infection	37%
DVT During Index Admission	51%
UTI During Acute Admission	41%
Acute MI within 7 days post surgery	23%

* Results generated by Signature Medical Group from Medicare claims data.

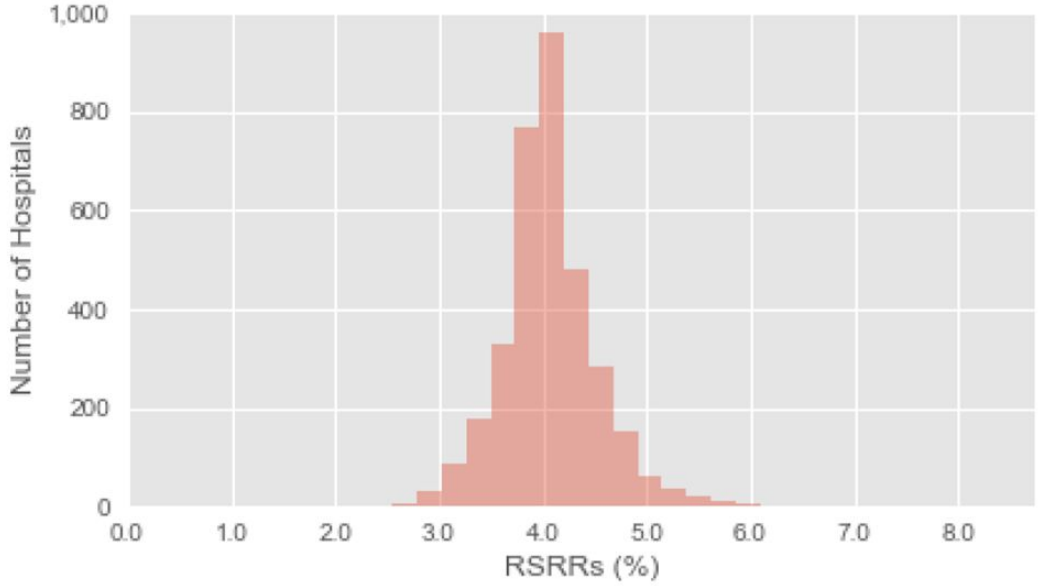
NQF Endorsed Quality Measure For THA/TKA
CMS Medicare data national "overall effect"
Risk-Standardized Readmission Rate (RSRR)

- 2012 5.7%
- 2019 ~4%



2019 Procedure-Specific Readmission Measures Updates and Specifications Report

Figure 4.3.2 – Distribution of Hospital 30-Day THA/TKA RSRRs between July 2015 and June 2018



N = 3,430 hospitals

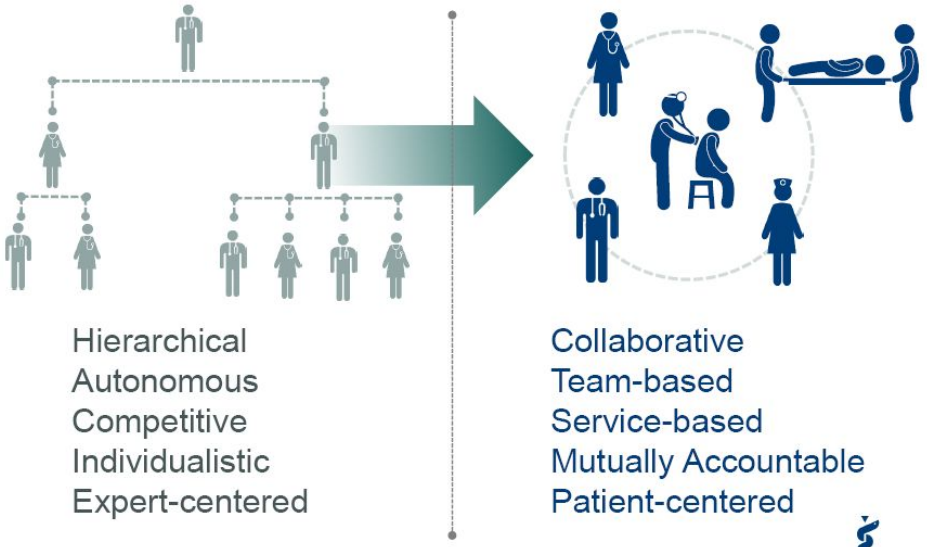
Optimization: not a destination but a work in progress:

Value based programs only growing in number of participants and programs.

Folly is rewarding A, while hoping for B

Steven Kerr, PhD
Organizational Behavior Expert

Focus On Creating the Desired Culture



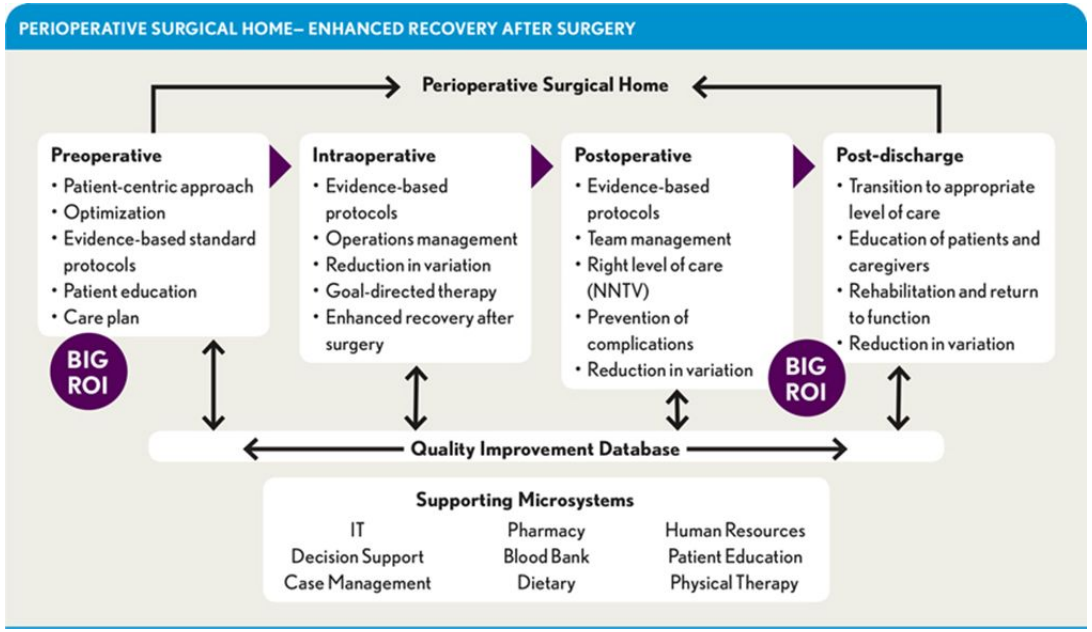
AAMC

The best reward in medicine is to get paid to make a difference!

Perioperative Orthopedic Surgical Home (POSH)

S Aureus colonization
Neurocognitive
Psychological and behavioral problems
Catastrophizing avoidance

Fall education prevention
Physical deconditioning Frailty assessment



Pre-surgical

- Indication
- Optimization
- Education

Periop

- Day of surgery prep
- Premedication

Postop

Postdischarge

Why MACRA – Metrics
- Cost
- Quality

Bundles – for THA and TKA
- Comprehensive Care for Joint Replacement.
  - Financial accountability
  - BUT share savings if quality measures

MACRA:
- MIPS – incentive for quality & costs
- ACO ~ Accountable Care Organization
  - Financial risk with quality metrics

Optimization: change the way we practice

Guidelines to prevent PUS

Centers for Disease Control and Prevention
CDC 24/7: Saving Lives, Protecting People™

Centers for Disease Control 2017 Guidelines for Prevention of Surgical Site Infection

Core Section	Relevant Recommendations
Parenteral Antimicrobial Prophylaxis	• Administer preoperative antimicrobial agents only when indicated; timed such that serum/tissue bactericidal concentration is established prior to incision • Weight-adjusted dosing – No literature to support effects on risk of SSI • Do not administer additional antibiotics after surgical incision is closed for clean/clean-contaminated procedures
Nonparenteral Antimicrobial Prophylaxis	• Do not apply antimicrobial agents to surgical incision • Application autologous platelet-rich plasma not necessary • Antimicrobial dressings applied to surgical incision after primary closure
Glycemic Control	• Implement perioperative glycemic control; blood glucose target < 200 mg/dL • Optimal HbA1C target
Normothermia	• Maintain perioperative normothermia
Oxygenation	• Administer increased fraction of inspired oxygen during surgery and immediate postoperative period to optimize tissue oxygen delivery, maintain perioperative normothermia and adequate volume replacement (normal pulmonary function)
Antiseptic Prophylaxis	• Advise patients to shower/bathe with soap or antiseptic agent on at least the night before operative day • Application microbial sealant after intraoperative skin preparation not necessary • Consider intraoperative irrigation of deep or subcutaneous tissues with aqueous iodophor solution
Blood Transfusion	• Do not withhold transfusion of necessary blood products from surgical patients s a means to prevent SSI
Systemic Immunosuppressive Therapy	• Available evidence suggests uncertain trade-offs between benefits and harms of systemic corticosteroid or immunosuppressive therapies on risk of SSI
Intra-articular Corticosteroid Injection	• Available evidence suggests uncertain trade-offs between benefits and harms of use and timing of perioperative intra-articular corticosteroid infection on SSI
Anticoagulation	• Available evidence suggests uncertain trade-offs between benefits and harms of venous thromboembolism prophylaxis on incidence of SSI
Orthopaedic Surgical Space Suit	• Available evidence suggests uncertain trade-offs between benefits and harms of orthopaedic space suits or the healthcare personnel who should wear them
Drain Use	• Do not administer additional antibiotics after surgical incision is closed in presence of a drain
Biofilm	• Prosthesis modifications or usage of biofilm control agents; dispersants quorum sensing inhibitors novel antimicrobial agents for prevention of biofilm formation or SSI

Cost and Quality Combined for profit = Bundle

Qualitative and quantitative analysis to drive episode recommendations:

Sg2 Client Results

Organizations have gained:

Internal cost savings of **10% to 30%** with implementation of gainsharing programs.

Medicare spend improvement from **5% to 20%** through reductions in post-acute care utilization and readmissions.

Data-driven analyses to determine which episodes to include and which payers to approach for commercial bundles.

$40 million of annualized NPRA and ICS

ICS = internal cost savings; NPRA = net payment reconciliation amount

Target Pricing Will Incorporate Multiple

Target prices will be provided prospectively for ea
Three major components make up the target price
episode at an acute care hospital:

HBP = SBS * PCMA *

Hospital Benchmark Price	Standardized Baseline Spending	Patient Case Mix Adjustment	Pe Tr
	Accounts for a hospital's own historical experience *(efficiency measure)*	Accounts for patient characteristics	A re oth pa

BPCI Advanced Analyzation

PHASE 1	PHASE 2	PHASE 3	PHASE 4
Participation Strategy and Application Completion	Education and Infrastructure	Episode Selection and Pro Forma Development	Physician Sharing Arrangements and CMS Documents

	MAY–JUN	JUL–AUG	SEPT–OCT	OCT–DEC

KEY DELIVERABLES	• Participation Strategy
	  • Non-convener
	  • Convener
	  • Third-party convener
	  • Multiple applications
	• Application Completion
	  • 28 open-ended questions
	  • Participating organization list
		• Infrastructure Assessment
		  • Governance
		  • Analytics
		  • Care navigation
		  • PAC network
		• Hospital and Physician Education
		• Care Redesign Strategies
			• Episode Data Analysis and Benchmarking
			• Recommended Clinical Episodes
			  • Financial and strategic criteria
			• Financial Modeling and ROI
			  • Conservative and moderate scenarios
				• Physician Sharing and Alignment Models
				• Participation Agreement
				• Required CMS Forms
				  • Financial arrangement lists
				  • Participation profile
				  • QPP lists

Sg2 Experience: Three decades of bundled payment experience; 9 Medicare BP Programs, 100+ physician sharing arrangements; support of 170+ EIs in BPCI, CJR, BPCI Advanced

Bundled Payments Keys to Success

Physician alignment and leadership	Create engagement and financial incentives that align interests with physicians to support care redesign across episodes of care and support margin improvement.
Care plan redesign & care navigation	Design and implement care protocols that promote excellent patient outcomes and reduce non–value-added provider services from prehospitalization to 90 days postsurgery.
Preferred post-acute care network	Create a network of high-quality, post-acute care providers who will work with you to implement optimal care plans for your patients.
Informed data analytics	Add actionable and relevant data tools to measure current and predicted Medicare reconciliation payments and internal cost savings.

Healthcare Quality Model
Donabedian 1966