

# Accuracy of ICD-9-Based and Retrospective Assessments of Perioperative Adverse Events: Comparison with a Prospective Assessment of Complications in Spine Surgery

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Associate Professor  
Thomas Jefferson University



# Conflicts of Interest

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- Royalties: Stryker  
Biomet
- Consulting: Stryker
- Stock Ownership: JNJ

# Acknowledgements

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- Philip Dagostino, BA
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# Why assess operative complications? Three reasons...

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1. Improve outcomes by assessing areas for improvement



# Three reasons...

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## 2. Proactive approach to impending governmental activity

P4P?

(pay for performance)

PQRI?

(Physicians' Quality  
Reporting Initiative)

# Reason #3

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- Understand when to intervene
- Correct surgery on the correct patient at the correct time

# Outcomes are relevant for reimbursement

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- Complications are the low hanging fruit for outcomes assessment
- If you want to to publish in *Spine*...
- How long does your follow-up need to be?
- What else could be assessed?
  - Occur in the immediate perioperative period
  - Easily assessed
  - Easily recorded

# Present literature may underestimate complication incidence

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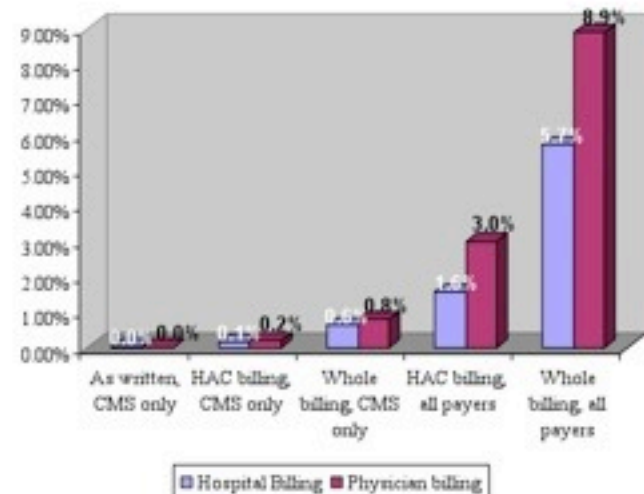
- Data from other specialties clearly demonstrates that retrospective reviews consistently underestimate operative complications
- For most of our procedures, there is no IDE level prospective assessments in the literature
- Most data available is retrospective



# Financial Impact

- Restrict reimbursement for never events
- No allowance for relative risk of patient diagnosis, comorbidities
- May severely impact academic centers

Figure 1. Economic impact of present and speculated HAC payment restrictions on hospital and physician billings



See the corresponding editorial. DOI: 10.3171/2009.7.JNS01040.

DOI: 10.3171/2009.7.JNS0753

Potential financial impact of restriction in "never event" and perioperative hospital-acquired condition reimbursement at a tertiary neurosurgical center: a single-institution prospective study

Clinical article

SONIA G. THEURACK, M.D., PETER CAMPBELL, M.D., PASCAL JARBOUC, M.D., MITCHELL MALINSFOR, P.H.D., JAMES EVANS, M.D., AND JOHN K. RATLIFF, M.D.

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*After the needless death of his father, the author, a business executive, began a personal exploration of a health-care industry that for years has delivered poor service and irregular quality at astonishingly high cost. It is a system, he argues, that is not worth preserving in anything like its current form. And the health-care reform now being contemplated will not fix it. Here's a radical solution to an agonizing problem.*

by David Goldhill

## How American Health Care Killed My Father

**A**lmost two years ago, my father was killed by a hospital-borne infection in the intensive-care unit of a well-regarded nonprofit hospital in New York City. Dad had just turned 83, and he had a variety of the ailments common to men of his age. But he was still working on the day he walked into the hospital with pneumonia. Within 36 hours, he had developed sepsis. Over the next five weeks in the ICU, a wave of secondary infections, also acquired in the hospital, overwhelmed his defenses. My dad became a statistic—merely one of the roughly 100,000 Americans whose deaths are caused or influenced by infections picked up in hospitals. One hundred thousand deaths: more than double the number of people killed in car crashes, five times the number killed in homicides, 20 times the total number of our armed forces killed in Iraq and Afghanistan. Another victim in a building American tragedy.



Illustration by Mark Hooper

# Four questions...

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- Are retrospective assessments accurate?
- Can you define a complication in spine surgery?
- Can you prospectively assess complication incidence and limit bias?
- Are ICD-9-based assessments accurate measures of perioperative adverse events? How do they compare to retrospective measures?

# What are ICD-9 studies?

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- Use coder data to assess patient hospital stay, interventions, complications
- Assumed to have limited bias
- Huge “n” values
  - Hence must be great
- Compile data into large databases on entire US population
- NIS, CMS databases



Online article and related content  
current as of April 18, 2010.

## Expenditures and Health Status Among Adults With Back and Neck Problems

Brook I. Martin; Richard A. Deyo; Sohail K. Mirza; et al.

*JAMA*. 2008;299(6):656-664 (doi:10.1001/jama.299.6.656)

<http://jama.ama-assn.org/cgi/content/full/299/6/656>

assess patient  
hospital stay,  
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complications

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limited bias

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# JAMA<sup>®</sup>

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complete patient limited bias

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Online article and related content  
current as of March 2, 2010.

## Prevalence, Complications, and Hospital Charges Associated With Use of Bone-Morphogenetic Protein Spinal Fusion Procedures

Kevin S. Cahill; John H. Chi; Arthur Day; et al.

*JAMA*. 2009;302(1):58-66 (doi:10.1001/jama.2009.956)

<http://jama.ama-assn.org/cgi/content/full/302/1/58>

- Compile data into large databases on entire US population
- No, only databases





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Online article and related content  
current as of April 18, 2010.

## Expenditures and Health Status Among Adults With Back and Neck Problems

Brook I. Martin; Richard A. Deyo; Sohail K. Mirza; et al.

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open patient limited bias

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## Prevalence, Complications, and Hospital Charges Associated With Use of Bone-Morphogenetic Protein Spinal Fusion Procedures

SPINE Volume 34, Number 19, pp 2077-2084  
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## Trends in Health Care Expenditures, Utilization, and Health Status Among US Adults With Spine Problems, 1997-2006

Brook I. Martin, MPH,\*† Judith A. Turner, PhD,‡§ Sohail K. Mirza, MD, MPH,¶  
Michael J. Lee, MD,† Bryan A. Comstock, MS,|| and Richard A. Deyo, MD, MPH\*\*††



# Complications and Mortality Associated With Cervical Spine Surgery for Degenerative Disease in the United States

Marjorie C. Wang, MD, MPH,\* Leighton Chan, MD, MPH,† Dennis J. Maiman, MD, PhD,\* William Kreuter, MPA,‡ and Richard A. Deyo, MD, MPH‡

## Health Status Among US Adults With Spine Problems, 1997–2006

Brook I. Martin, MPH,\*† Judith A. Turner, PhD,‡§ Sohail K. Mirza, MD, MPH,¶ Michael J. Lee, MD,† Bryan A. Comstock, MS,|| and Richard A. Deyo, MD, MPH\*\*††



## Complications and Mortality Associated With Cervical Spine Surgery for Degenerative Disease in the United States

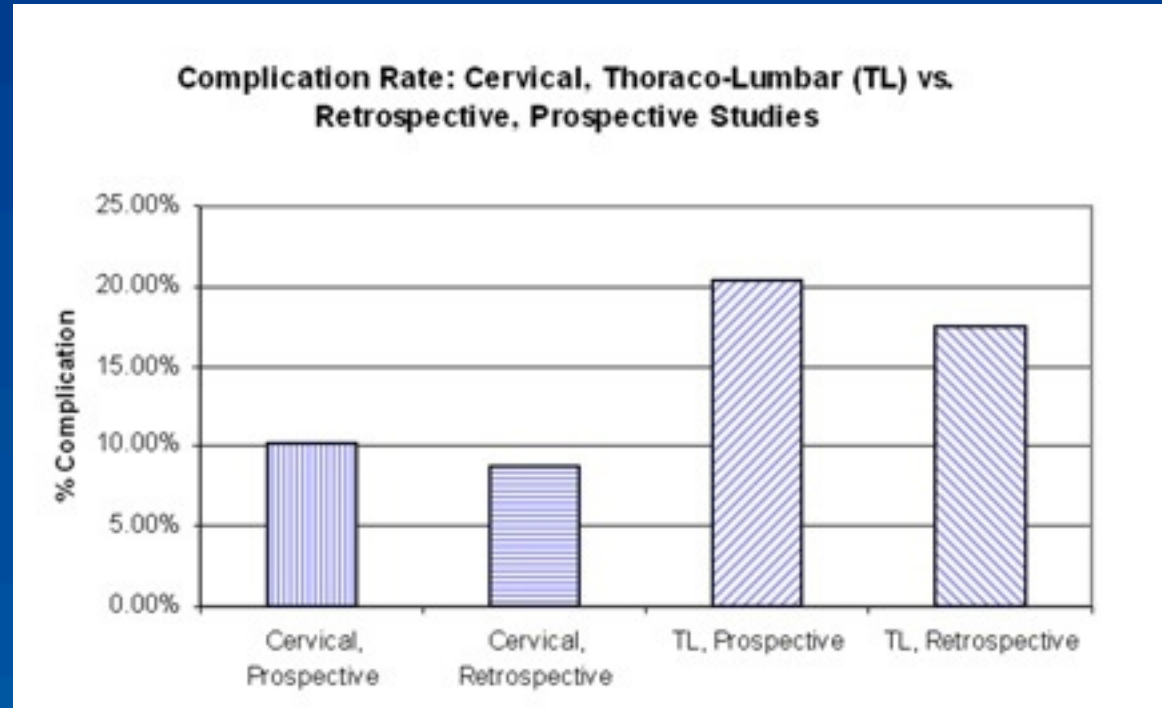
## Reoperation Rates Following Lumbar Spine Surgery and the Influence of Spinal Fusion Procedures

Brook I. Martin, MPH,\*† Sohail K. Mirza, MD, MPH,†‡ Bryan A. Comstock, MS,\*†  
Darryl T. Gray, MD, ScD,†§|| William Kreuter, MPA,†§ and Richard A. Deyo, MD, MPH\*†‡§

Brook I. Martin, MPH,\*† Richard A. Deyo, MD, MPH,†‡ Sohail K. Mirza, MD, MPH,†‡||  
Michael J. Lee, MD,† Bryan A. Comstock, MS,|| and Richard A. Deyo, MD, MPH\*\*††

# #1: Retrospective reviews

- Retrospective articles underestimate complication incidence



## Complications in spine surgery

A literature review

RANI NASSER, B.S.,<sup>1</sup> SANJAY YADLA, M.D.,<sup>1</sup> MITCHELL G. MALTENFORT, PH.D.,<sup>2</sup> JAMES S. HARROP, M.D.,<sup>1</sup> D. GREG ANDERSON, M.D.,<sup>2</sup> ALEXANDER R. VACCARO, M.D., PH.D.,<sup>2</sup> ASHWINI D. SHARAN, M.D.,<sup>2</sup> AND JOHN K. RATLIFF, M.D.<sup>2</sup>

<sup>1</sup>Temple University School of Medicine, and Departments of <sup>2</sup>Neurosurgery and <sup>3</sup>Orthopedic Surgery, Thomas Jefferson University, Philadelphia, Pennsylvania

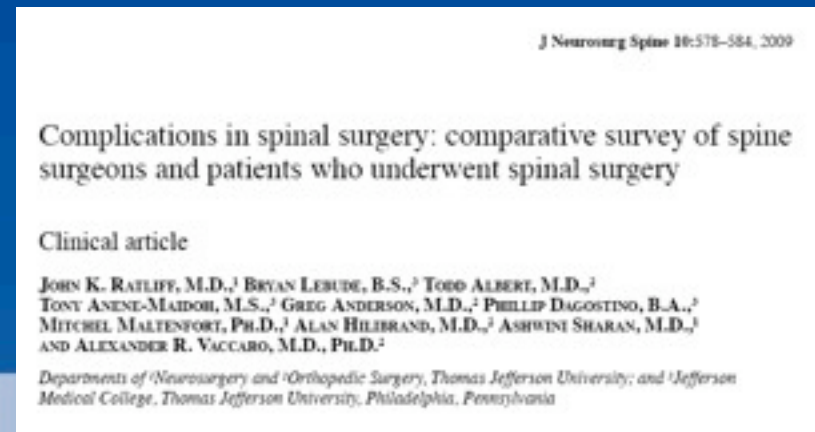
# #2: Can you define a complication?

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- Given surgeons set of 11 clinical scenarios
- Asked if each represented
  - A. No complication
  - B. Minor complication or adverse event
  - C. Major complication
- Purposely left definitions vague
- Foucault, *Archaeology of Knowledge*
  - Truth and meaning are not *a priori*, but depend upon historical discursive and practical relationships. Follow truth within historical context.
  - Not relative. But may change with relationships.

# Patient study

- Repeated study with spine surgery patients
  - Give questionnaire in clinic
  - Only spine patients
    - No pain patients, no general neurosurgery patients
- Blinded patient info
  - No data on pre-op, post-op, outcomes
- Reworded scenarios
  - Lay language
- IRB approved



# Complication severity

- When differences found, patients were consistently more critical than surgeons in assessing complication severity
  - 4 of 11 scenarios, patient more likely to term the scenario a complication and find it more severe than surgeons ( $p < 0.01$ )
  - In 3 additional scenarios, patients more likely than surgeons to find a major as opposed to minor complication had occurred ( $p < 0.001$ )
  - In only 1 scenario (scenario 4, deep wound infection) were patients less likely to report a complication than surgeons ( $p < 0.001$ )

Eur Spine J  
DOI 10.1007/s00586-009-1005-x

ORIGINAL ARTICLE

## The patient's perspective on complications after spine surgery

Dieter Grob · Anne F. Mannion



# Complication definition

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- Overall, patient and surgeons agreed:
  - Major complication: An adverse perioperative event that produces permanent detrimental effect or requires re-operation. This entails all medical adverse events occurring in the perioperative period.
  - Minor complication: An adverse perioperative event that produces only transient detrimental effect. Again, all medical adverse events in the perioperative period are included.
- Medical complications are relevant to operative assessment

# #3: Prospective assessment

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- Independent auditor
  - Followed all operative patients on spine surgery service
  - Assessed occurrence and severity of all perioperative and post-operative adverse events
  - Included all medical events
  - Followed our validated definition

# Inclusion criteria

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- Availability of the auditor
  - No exclusionary criteria
- Maintained prospective database
- Study completed over 6 month period
- 30 day follow-up
- Single clinic site for follow-up visits



# #4: Retrospective Assessment

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- Fourth year medical student working with resident
- Given a set of 100 patients from the overall patient cohort, given the same definition of complications
- Not blinded

## #4: ICD-9-Based Assessment

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- ICD-9 coding data extracted from each chart, used same 100 patient cohort as the retrospective review
- Same methodology as reported to CMS, other bodies
- Broad inclusion of ICD-9 data
  - Essentially all ICD-9 tagged HACs included

# Results

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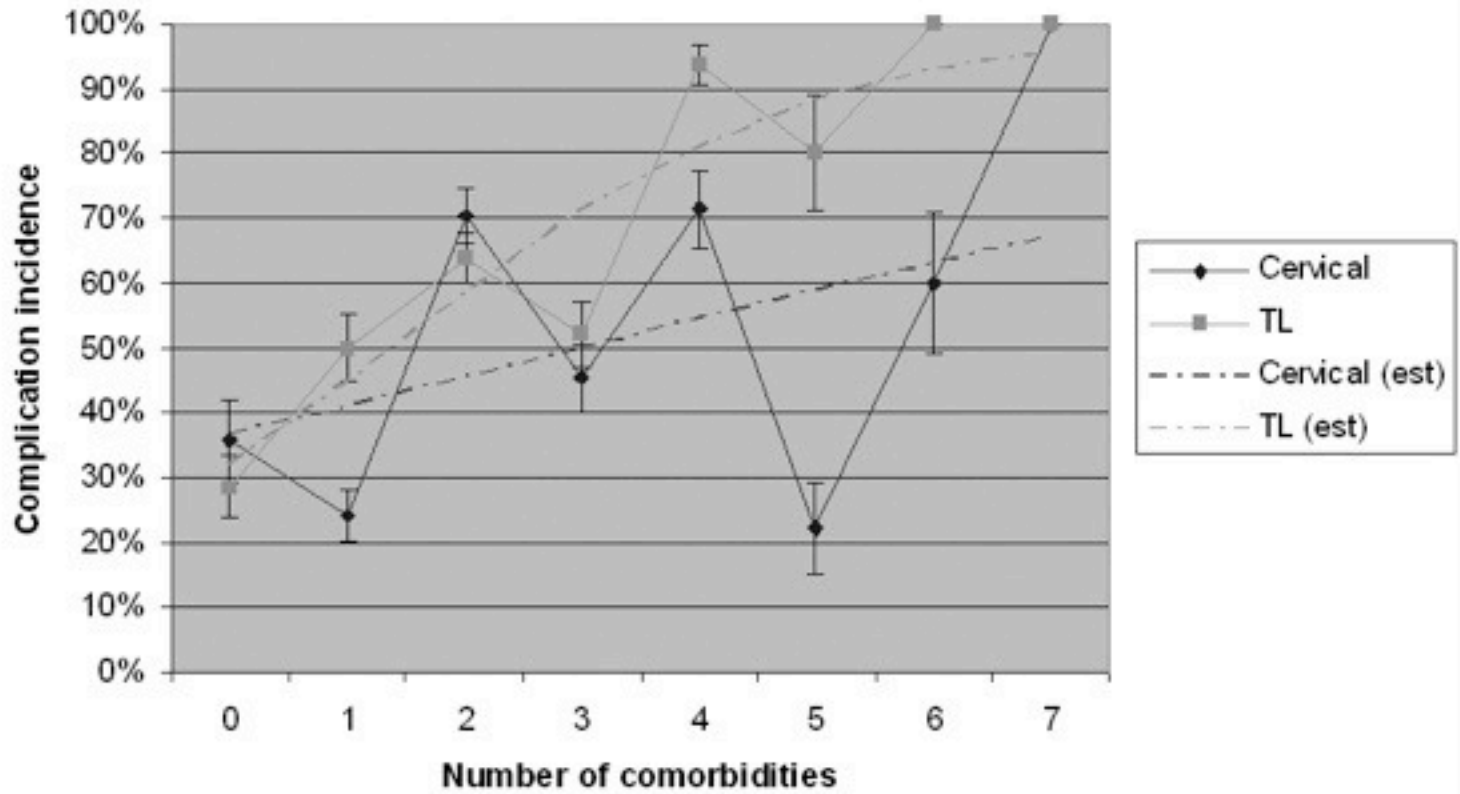
- 240 patients
  - 256 procedures
- Age: 55 years (+/- 14.8)
- BMI: 29.7 (+/- 8)
- 80% fusions
  - 28% AP
- Majority for degenerative pathologies (64%)
- Complication incidence: 59.4%
  - Major: 21.4%
  - Minor: 46.4%
- Age, diagnosis, instrumentation increased complication incidence
- Comorbidities increased risk of complication

# Discussion

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- Complication incidence is high
  - But within realm of published data
- Complex patient population
  - 80% fusions
  - 28% AP fusions
- Significant number of neoplasm, trauma patients
- Significant comorbidities

### All complications



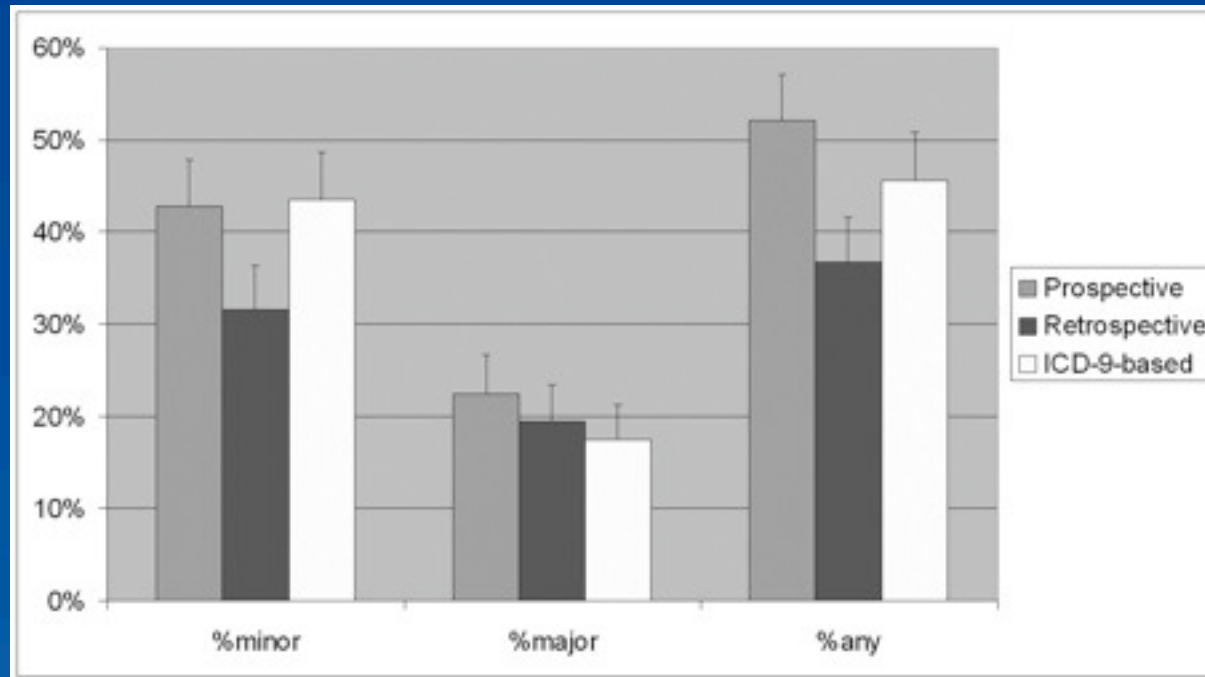
# Retrospective review and ICD-9 assessments

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- To validate ICD-9 and retrospective assessments, we compared them to our prospective measure
- 92 patients with adequate chart data for ICD-9 assessment, 98 patients with adequate data for retrospective analysis
- Overall results very similar

# Results

- Prospective approach yielded higher number of complications ( $p=0.003$ )



# Results

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- Clear that there were significant differences between the approaches in some complication types
- Reviewed data, looking at common, clinically significant events
  - Infection, need for revision, deep wound infection, pulmonary, DVT, UTI/GU, cardiac issue, new neuro deficit



# Results

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- Assessment of individual clinically significant complications showed discrepancies
- In 5 of 8 categories, ICD-9 assessment underreported complication incidence
- In 3 of 8 categories, retrospective review underreported incidence

# ICD-9 approach underestimates complication incidence

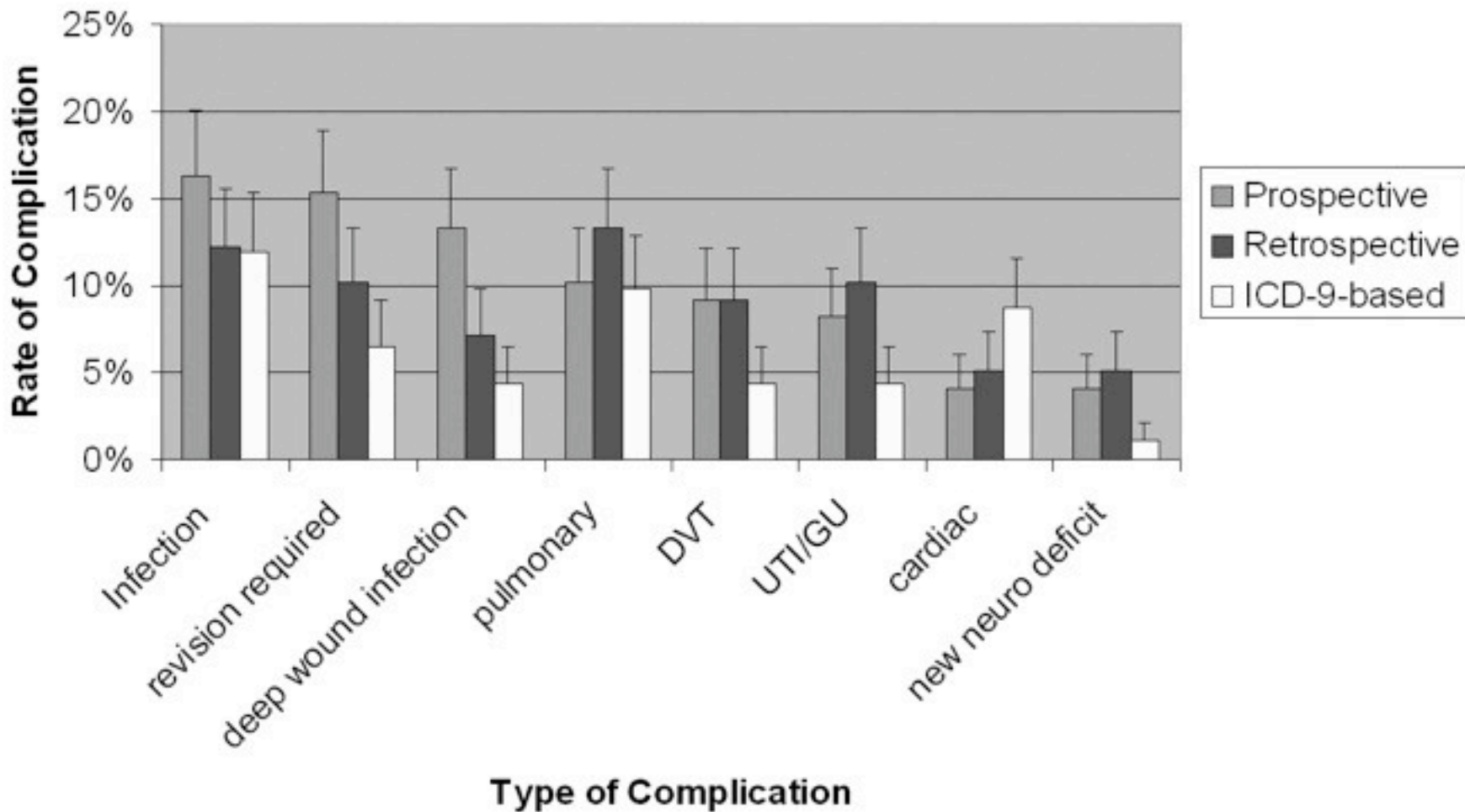
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- Underestimated incidence in
  - Infection ( $p=0.003$ )
  - Need for reoperation ( $p<0.0001$ )
  - Deep wound infection ( $p<0.0001$ )
  - DVT ( $p=0.0025$ )
  - New neuro deficit ( $p=0.04$ )
- Found greater number of cardiac events ( $p=0.04$ )

# Retrospective review underestimates complication incidence

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- Infection ( $p < 0.0001$ )
- Need for revision ( $p < 0.0001$ )
- Deep wound infection ( $p < 0.0001$ )
  
- Found greater number of pulmonary complications, UTI/GU, and new neuro deficits



# How are overall numbers the same but individual items so different?

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- ICD-9 assessment captured many medical HACs of limited clinical import
  - Hyponatremia, acid-base disorders, need for enteric feeds, etc.
  - Not deemed a complication by our auditor

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"I think I speak for all of us when I say what in God's name are you talking about?"

# Discussion: The literature

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- ICD-9 based reviews may not be accurate
- Woodworth et al.
  - Aneurysm data inaccurate in 10 of 12 categories
- White et al.
  - Poor predictive value of ICD-9 assessment of DVT incidence
- Inaccuracies in
  - DVT and PE reporting in pregnancy
  - Preeclampsia
  - Cervical spine fractures
  - Surgical site infections
  - Central venous catheter infections

# Discussion: This report

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- ICD-9 based assessment underreported complication incidence in many clinically significant events
- For overall complication incidence, ICD-9 and retrospective reviews were similarly inaccurate
- Gold standard: prospective assessment
- Inaccurate does not always mean inaccurate in our favor



# Conclusions

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- Complications may be underestimated in the surgical literature
- “Gold standard” for complication assessment

# Retrospective reviews

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- Review of the literature, our comparative study show that retrospective reviews significantly underestimate the incidence of complications in spine surgery
- Lower quality data

# ICD-9-based Assessment

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- ICD-9 data accrual also substantially underestimated complication incidence
- As inaccurate as a retrospective review
- May imply that data from ICD-9 assessments are of lower quality

# Conclusions

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- Must be critical
- Fallacy of the “n”
- Poor data accrual methodology will produce poor data
- Poor data produces terrible amalgams of data

# ICD-9 Methodology

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- Averaging over huge populations may not be valid
- Meta-analysis
- Cochrane review

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### Research Agenda & Findings

#### **The population-based, small area analysis strategy**

Over the past two decades, the Dartmouth Atlas Project (DAP) has developed a national strategy of providing continuous feedback of population-based information describing resource inputs, utilization and outcomes of care among the 3,436 hospital service areas and 306 hospital referral regions in the United States. The aggregation of up to 12 years of Medicare data in a single site has resulted in a rich source of information that can be used in evaluating the performance of the national, regional, and local health care systems. Much of the variation among areas in per capita resource inputs and utilization has proven to be unwarranted; it cannot be adequately explained on the basis of differences among regions in illness rates, patient preferences or the dictates of evidence-based medicine. Much of the variation relates to provider quality defects. In addition to variations in medical errors such as mortality following surgery, the DAP documents unwarranted variation in three categories of service: (1) systematic underuse of effective care such as beta-blockers after heart attack, or diabetic eye care; (2) misuse of preference-sensitive care such as discretionary surgery (as documented by striking variations among neighboring communities in rates of surgery); and (3) overuse of supply-sensitive care such as physician visits and hospitalization rates among chronically ill patients. The categories are important because the causes, as well as the remedies, of unwarranted variation differ according to category.

### *A Dartmouth Atlas Project Topic Brief*



Center for the  
Evaluative Clinical Sciences

## Effective Care

There is unwarranted variation in the practice of medicine and the use of medical resources in the United States. There is underuse of effective care, misuse of preference-sensitive care, and overuse of supply-sensitive care.

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- Yes  
 No

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## A Map to Bad Policy — Hospital Efficiency Measures in the Dartmouth Atlas

Posted by NEJM • February 17th, 2010 • [Printer-friendly](#)

Peter B. Bach, M.D., M.A.P.P.

*The Debate over Regional Variation in Health Care Spending*

### Effective Care

There is unwarranted variation in the practice of medicine and the use of medical resources in the United States. There is underuse of effective care, misuse of preference-sensitive care, and overuse of supply-sensitive care.





- Thanks for joining us in Philadelphia!
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