Lessons learned from PSI validation and demonstration projects

Patrick S. Romano, MD MPH
UC Davis Center for Healthcare Policy and Research

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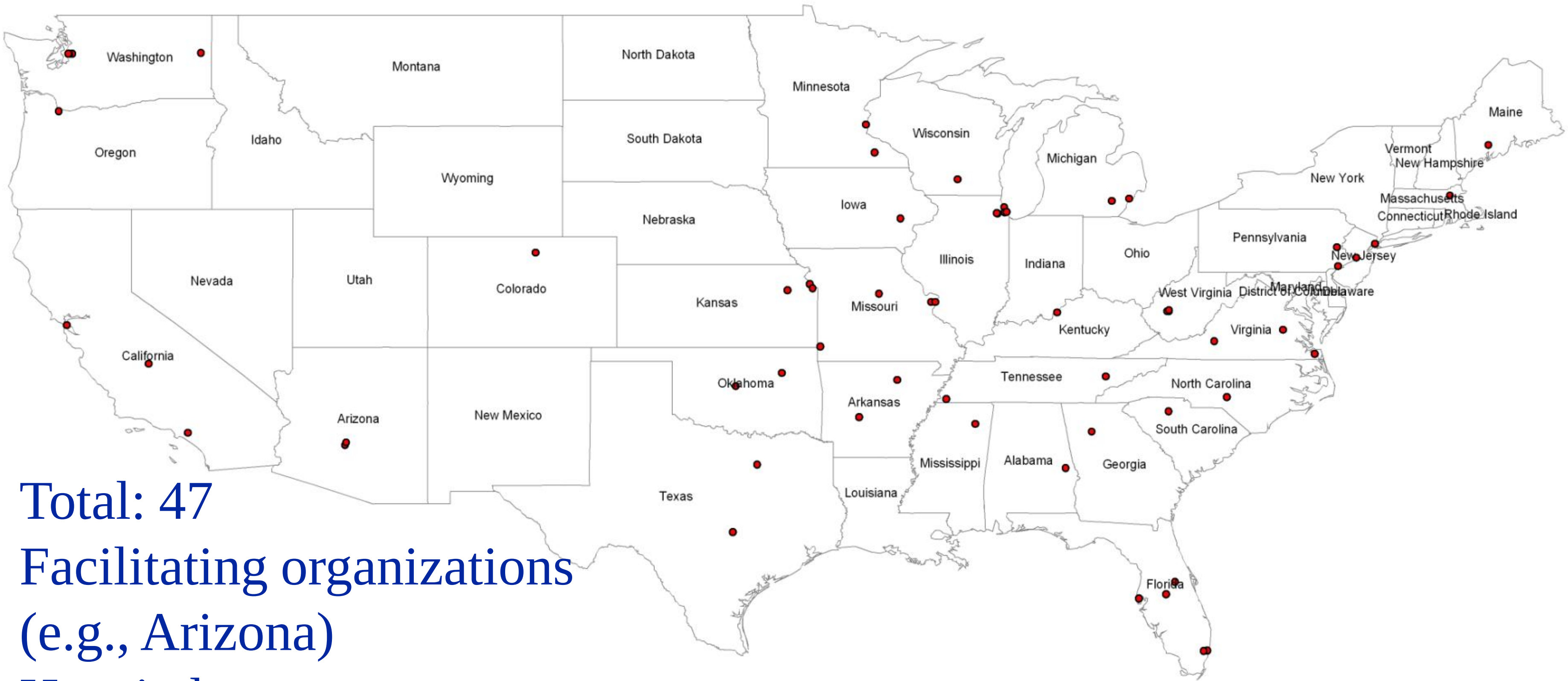
PSI Validation Pilot Methods

- Gather evidence on the criterion validity of the PSIs based on medical record review as "gold standard"
- Improve guidance about how to interpret & use the indicators, and evaluate potential refinements
- Retrospective cross-sectional study design
- Volunteer sample of 47 collaborative partners (78% nonprofit, nonreligious) plus parallel study of VA hospitals by Rosen et al.
- Sampling based on administrative data using AHRQ QI software to generate desired sample size locally (30 per hospital) and nationally (240 per PSI) from 2006-2007
- VA sampled 112 cases per PSI nationwide from 28 randomly selected hospitals (4 per hospital) from FY 2003-2007

Pilot participants (non-VA)



Total: 47

Facilitating organizations

(e.g., Arizona)

Hospital systems

Individual hospitals

Patient Safety Indicators

Phase I	Phase II
Accidental puncture and laceration	Foreign body left in during procedure
Iatrogenic pneumothorax	Postoperative Hemorrhage or Hematoma
Postoperative Pulmonary Embolism or Deep Vein Thrombosis	Postoperative Physiologic and Metabolic Derangement
Postoperative Sepsis	Postoperative Respiratory Failure
Selected Infection due to Medical Care	Postoperative Wound Dehiscence

Data collection and analysis

- Each hospital identified chart abstractors (except VA did all chart abstraction centrally using VistAWeb EMR)
- Training occurred via series of webinars in early 2007 (onsite training for VA abstractors)
- Medical record abstraction tools & guidelines
  - Pretested in the Sacramento area and in VA
  - Targeted ascertainment of the event, risk factors, evaluation & treatment, and related outcomes
- Positive Predictive Values (PPV) were calculated and adjusted for hospital clustering
- Descriptive analysis of opportunities for quality improvement

PSI 15: Accidental Puncture or Laceration

- N=249 at community hospitals
  - PPV or true events = 91% (95% CI = 88-94%)
    - 170 (75%) potentially consequential
  - 9% (n=23) false positives
    - 2% (n=5) present at admission
    - 7% (n=18) miscoded
      - 4 had disease-related lesions (perforated appendix or ischemic colon, ruptured AAA, rectovesical fistula)
      - 7 had a different complication (4 bleeding due to operative conduct, 1 surgical site infection, 1 dislodged gastrostomy tube, 1 periprosthetic fracture)
      - 7 cases had no apparent event (intentional, rule-out)
- N=112 at VA hospitals
  - PPV = 85% (95% CI = 77-91%)

PSI 6: Iatrogenic Pneumothorax

- N=205 at community hospitals
  - PPV = 78% (95% CI = 73-82%)
  - 11% (n=21) numerator false positives
    - 7% (n=14) present or suspected at admission (n=8 transferred in)
    - 4% (n=7) had no documentation of event (miscoded), but some with suspicion ruled out (n=3)
  - 11% (n=23) had exclusionary diagnosis or procedure (e.g., trauma, metastatic cancer)
- N=112 at VA hospitals
  - PPV = 74% (95% CI = 65-82%)

PSI 12: Postoperative DVT or PE

- N = 155 cases, 121 with OR procedure, at community hospitals
  - Coding perspective:
    - PPV = 84% (95% CI = 72-95%)
    - 17% (n=20) false positives
      - 10% (n=12) present at admission
      - 7% (n=8) no documentation of VTE
  - Clinical perspective:
    - PPV = 48% (95% CI = 42-67%)
    - Additional false positives (n=43) due to hospital-acquired preoperative VTE (20%), upper extremity DVT (9%), superficial/unspecified vein (6%)
- N=112 at VA hospitals
  - PPV = 43% (95% CI = 34-53%) with clinical perspective

Comparing PPV estimates with UHC sample for postoperative DVT/PE

UHC Cohort (n=450)	Coding	Clinical
Sensitivity	80% (46-100%)	100%
Specificity	99.5% (99.3-99.6%)	98.6% (98.6-99.2%)
Positive Predictive Value	72% (67-79%)	44% (36-52%)
Negative Predictive Value	99.6% (98.9-100%)	100%
VA Cohort (n=112)		
Positive Predictive Value		43% (34-53%)
AHRQ Cohort (n=121)		
Positive Predictive Value	84% (72-95%)	48% (42-67%)

University HealthSystem Consortium cohort includes 505 flagged, randomly sampled surgical cases from 33 volunteer hospitals in 21 states; 450 cases were fully abstracted and submitted to UHC.

PSI 7: Selected Infection due to Medical Care (catheter-associated)

- N=191 at community hospitals
  - PPV = 54% (95% CI = 40-69%)
  - 41% (n=79) numerator false positives
    - 20% (n=38) present at admission, with no new infection (indwelling central venous catheters, AV grafts)
    - 21% (n=41) had no clear documentation of infection
  - 7% (n=12) had exclusionary diagnosis (cancer, severe malnutrition, nephrotic syndrome, other immunodeficiency)
- N=112 at VA hospitals
  - PPV pending

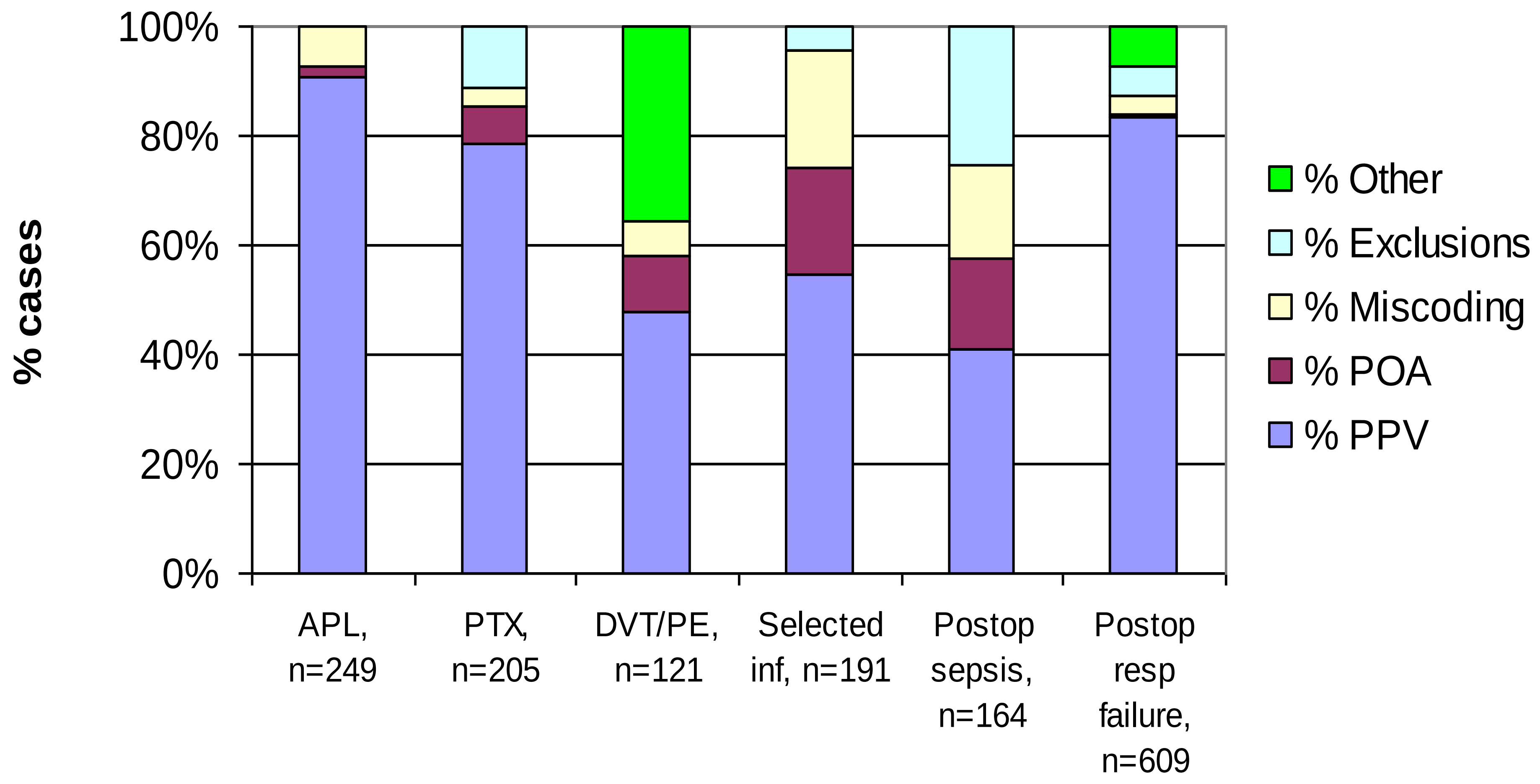
PSI 13: Postoperative Sepsis

- N=164 at community hospitals
  - PPV = 41% (95% CI = 28-54%)
  - 34% numerator false positives (ESTIMATE)
    - 17% had infection or sepsis present on admission
    - 17% had no documentation of bacteremia, septicemia, sepsis or SIRS
  - 25% did not have elective surgery (arguable)
- N=112 at VA hospitals
  - PPV = 62% (95% CI = 52-71%) preliminary

PSI 11: Postoperative Respiratory Failure

- N=609 at 18 UHC member hospitals
  - Coding perspective:
    - PPV = 90% (95% CI = 86-94%)
    - 4% (n=25) numerator false positives
      - 1% (n=5) present at admission
      - 3% (n=20) no documentation of acute respiratory failure
    - 5% (n=33) did not have elective surgery (n=30) or had an exclusionary diagnosis (n=3)
  - Clinical perspective:
    - PPV = 83% (95% CI = 77-89%)
    - Additional false positives (n=44) due to hospital-acquired preoperative respiratory failure (n=6), intubation/ventilation to protect airway or manage secretions (n=27), cardiac arrest (n=8), other (n=3)
- N=112 at VA hospitals
  - PPV = 80% (95% CI = 72-87%) with clinical perspective

Summary of PPV estimates from community hospitals



PSI 18-19: Obstetric trauma

- California Obstetric Validation Study (Romano et al.):
  - Stratified random cluster sample of 1,662 records from 52 hospitals (51% vaginal)
  - Sensitivity=90% (95% CI, 82-96%) and PPV=90-95%
  - Adjusting for complex stratified sampling design, Sensitivity=93% (95% CI, 82-97%) and PPV=73%
- Clinical research data set (Brubaker et al. 2007):
  - 393 PSI-positive and 383 PSI-negative vaginal deliveries
  - Sensitivity=77% (95% CI, 72-81%)
  - Specificity=99.7% (95% CI, 98.5-99.4%)
  - PPV could not be estimated due to the sampling design, but approximately 93% given a typical prevalence of 5%
- English NHS study (Bottle and Aylin, 2008):
  - 955 cases from 18 English NHS trusts
  - PPV=85% (none present at admission, 15% miscoded)

Other evidence re PSI criterion validity

- Catheter-associated BSI
  - National Healthcare Safety Network 24 hospitals: sensitivity=9%
- Postoperative DVT/PE
  - Single US teaching hospital: PPV=50%, sensitivity=87%
- Pressure ulcer
  - UHC 32 hospitals: PPV=60% (after excluding POA) but NPV=85% (low) in high-risk cases not reported as having PU
  - Veterans Affairs: PPV=29% not excluding POA
- Postoperative wound dehiscence
  - Veterans Affairs 28 hospitals: PPV=88%

Implications of validation work

- Coding changes are needed to enhance PPV for some indicators
  - AHRQ proposed new codes for DVT (adopted)
  - CMS proposed new code for catheter-associated bloodstream infection (adopted)
  - New codes needed for postoperative sepsis
- "Present at admission" data will substantially improve PPV of multiple PSIs
  - New PSI software release (V4.1) "requires" POA or estimates its mean value at the hospital level
- With these changes, most PSIs should have high PPV
- Data on sensitivity (false negatives) are still needed, but preliminary data raise concerns for Pressure Ulcer and Selected Infections

Moore Demonstration Project Goals

- Develop a collaboration with three regional hospitals in northern CA to show that it is possible to review cases flagged by PSIs in a collaborative manner
- To provide information useful to the three participating hospitals for improving coding and quality of care in the future
- To investigate potential safety-related events to identify specific opportunities for improvement

Moore Demonstration Project Methods

- Retrospective cross-sectional design
- Consecutive sampling using AHRQ QI software to generate desired sample size of up to 100 cases of at least four PSIs at each hospital (10/07-2/09)
- "Present on admission" (POA) logic was used in V3.2, March 2008 software to reduce false positives
- Each hospital identified one or more abstractors (RN or MD), who were trained individually to use the "root cause" PSI tools and guidelines
- Coordinating center (UC Davis) entered data from paper forms and identified discrepancies
- Descriptive analysis of opportunities for QI provided at meetings with key staff at each hospital

PSI 6: Iatrogenic pneumothorax Opportunities for improvement

- Watch for inadequate documentation, such as “rule out” pneumothorax without alternative diagnosis established after study (CXR or CT)
- Consider greater use of radiologic adjuncts in placement of central venous catheters, especially in the OR and ED (proven to reduce iatrogenic injuries)

PSI 7: CVC-related bloodstream infection
Opportunities for improvement

- Identify tunneled catheters that are infected at admission and code as POA
- Minimize use of femoral venous catheters, which are associated with higher rates of infection
- Remove catheters at earliest opportunity consistent with patient safety

PSI 9: Postoperative hemorrhage/hematoma
Opportunities for improvement

- Logic of indicator may sometimes capture both intraoperative and postoperative hemorrhage
- Impact of true positive cases was significant (i.e., most returned to OR), but opportunities for improvement are unclear

PSI 10: Postoperative physiologic/metabolic
Opportunities for improvement

Postoperative renal failure requiring dialysis

- Earlier recognition of renal failure may be beneficial
- Evaluate use of nephrotoxic medication, especially NSAIDs in postoperative setting
- Review ionic contrast documentation & use

Postoperative diabetic complications

- Tighter blood sugar control and monitoring in type I DM post-operatively
- Consider insulin drips instead of implanted pumps and/or SQ in the immediate postop period

PSI 11: Postoperative respiratory failure Opportunities for improvement

- Overuse of 96.04 code when intubation was an expected part of procedure
- Two cases of oversedation leading to respiratory complications
- Reasons for re-intubation or prolonged intubations were often not documented
- Some patients could probably have been extubated earlier (and would then not have counted as respiratory failure)
- Several cases had massive blood loss which seemed to precipitate postoperative respiratory issues

PSI 12: Postoperative DVT/PE Opportunities for improvement

- Watch for inadequate documentation, such as “rule out” DVT or PE without alternative diagnosis established after study
- More timely (day 0) use of pharmacologic prophylaxis may be beneficial, especially for perioperative patients at intermediate risk and without contraindications
- Chronic VTE that was present on admission – new codes now available

PSI 15: Accidental puncture or laceration
Opportunities for improvement

- Occasional overcoding of intraoperative bleeding or other routine events as accidental puncture or laceration
- Most true positive cases had extenuating circumstances, although some were probably still preventable with earlier conversion of laparoscopic to open abdominopelvic surgery, or use of Doppler ultrasound
- Hospitals with inexperienced operators performing technically difficult procedures may experience patterns of similar events

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