National Surgical Quality Improvement Program (NSQIP)

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NSQIP Objectives

- Provide patient risk-adjusted surgical outcomes to surgical programs to permit valid comparisons with other programs
- Provide reliable, believable data
- Empower surgeons to review their quality and make quality improvements (not intended to point out "bad apples")
- Emphasize that quality resides primarily in systems, at program level

NSQIP Objectives

- Develop performance measures for surgery for use by chiefs of surgery in quality improvement programs
- Maintain a registry of major operations for use by investigators to answer important surgical research questions
- Through these objectives, improve surgical health care

NSQIP History

1986 – Public law mandated VA to compare their surgical outcomes to those in private sector

1987 – Denver VAMC investigators (Drs. Karl Hammermeister, Fred Grover) awarded HSR&D grant to collect patient risk-adjusted outcome cardiac surgery data at 44 VAMCs

1987-1991 – VA study retrospectively collected administrative data on surgical outcomes in selected noncardiac operations to compare to literature

NSQIP History

1991 – Start of National VA Surgical Risk Study to collect risk-adjusted data for noncardiac operations at 44 VAMCs

1994 – Non cardiac study evolved into present-day VA National Surgical Quality Improvement Program (NSQIP) that collects data on major surgery at 132 VAMCs

1999 – NSQIP started at 3 non-VA sites on pilot basis (Emory, Univ of Michigan, Univ of Kentucky)

2001-2004 – AHRQ grant to conduct NSQIP in 14 academic medical centers

2004 – Am College of Surgeons offered NSQIP to surgical services nationwide

NSQIP Patient Population

- All major operations requiring general, spinal, or epidural anesthesia
- Minor operations (some operations known to have low mortality and morbidity excluded)
- Limited accrual of some very common operations (e.g., TURP, inguinal hernias)
- High volume centers limited to 36 cases/8-day cycle (systematic sample taken)

Data Collection

Pre-operative Risk Factors – 70	
Demographic	3
General	7
Pulmonary	3
Hepatobiliary	4
Cardiac	6
Renal	2
Vascular	3
CNS	11
Nutritional/Immune/Other	6
Lab values	17
Other	8

Data Collection (continued)

<u>Operative Variables – 11</u>	
<u>Post-operative Outcomes – 24</u>	
	Vital status
	Length of stay
	Return to OR
	Complications – 21
<u>Other</u>	
	Post-op lab values – 12
	(automatically downloaded)

Statistical Analysis

Logistic Regression

    Dependent variable = dead/alive, complication (Y/N)

    Independent variables = patient risk factors

O/E Ratio for each VAMC

    O = # of observed events

    E = # of expected events based on patient risk factors

    = sum of probabilities of event for all patients from logistic regression equation

    O/E ratio above 1 – high outlier (more events than expected)

    O/E ratio below 1 – low outlier (fewer events than expected)

Top Predictors of 30-Day Mortality and Overall Morbidity In NSQIP, 1991-1997 (Average Rank Entering the Models)		
Risk Factor	Rank for Mortality	Rank for Morbidity
Serum albumin	1	1.3
ASA class	2	2
Disseminated cancer	3.3	--
Emergency operation	4.3	4
Age	5	8.3
BUN > 40	7	20.3
DNR	7.3	--
Operation complexity score	11	2.8
SGOT > 40	11.3	--
Weight loss > 10% in last 6 months	11.5	13.3
Functional status	12.3	5
WBC > 11,000	14	10
History of COPD	--	7.5
Hematocrit < 38%	--	9.5
Ventilator dependent	--	16.5

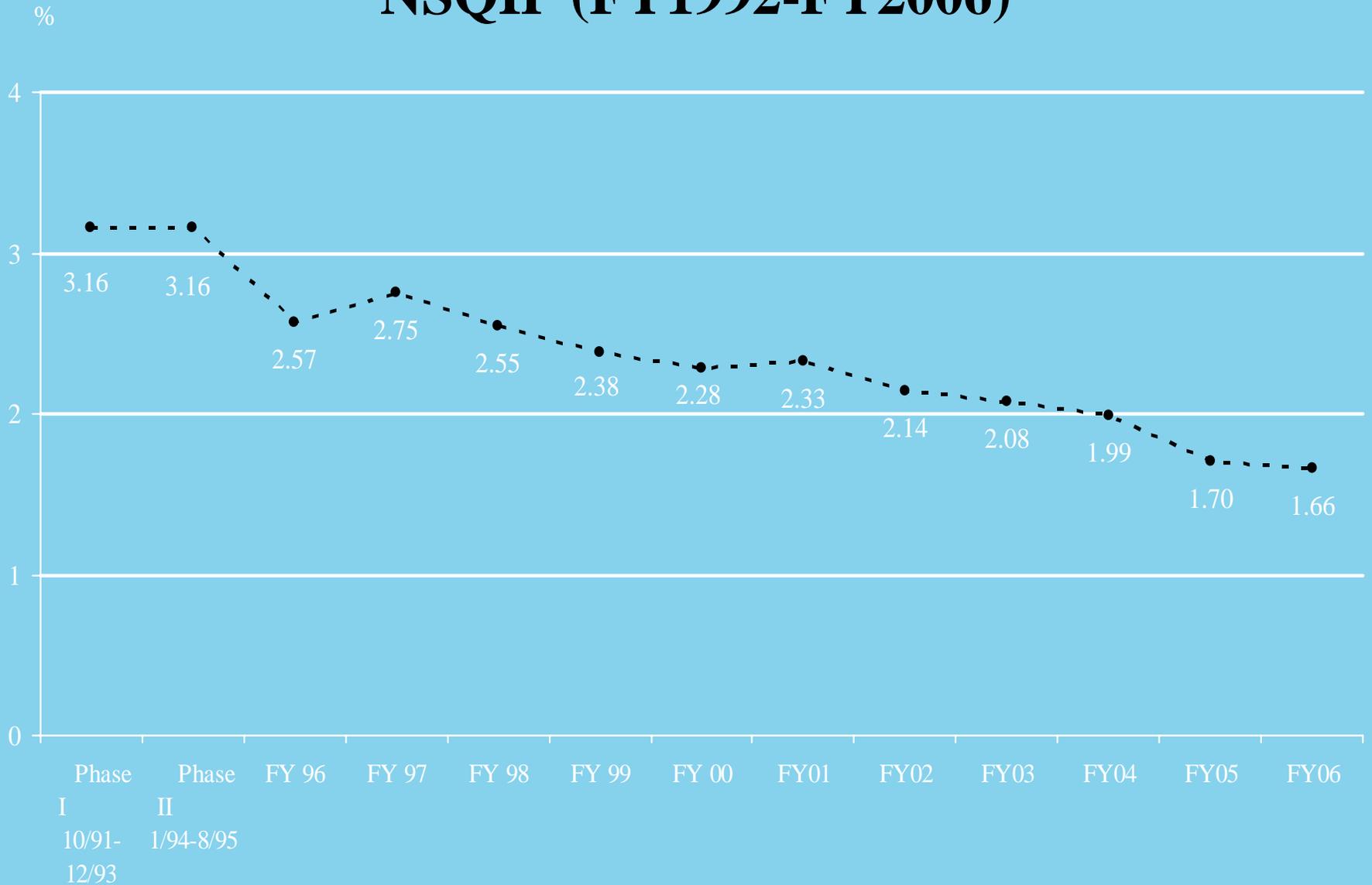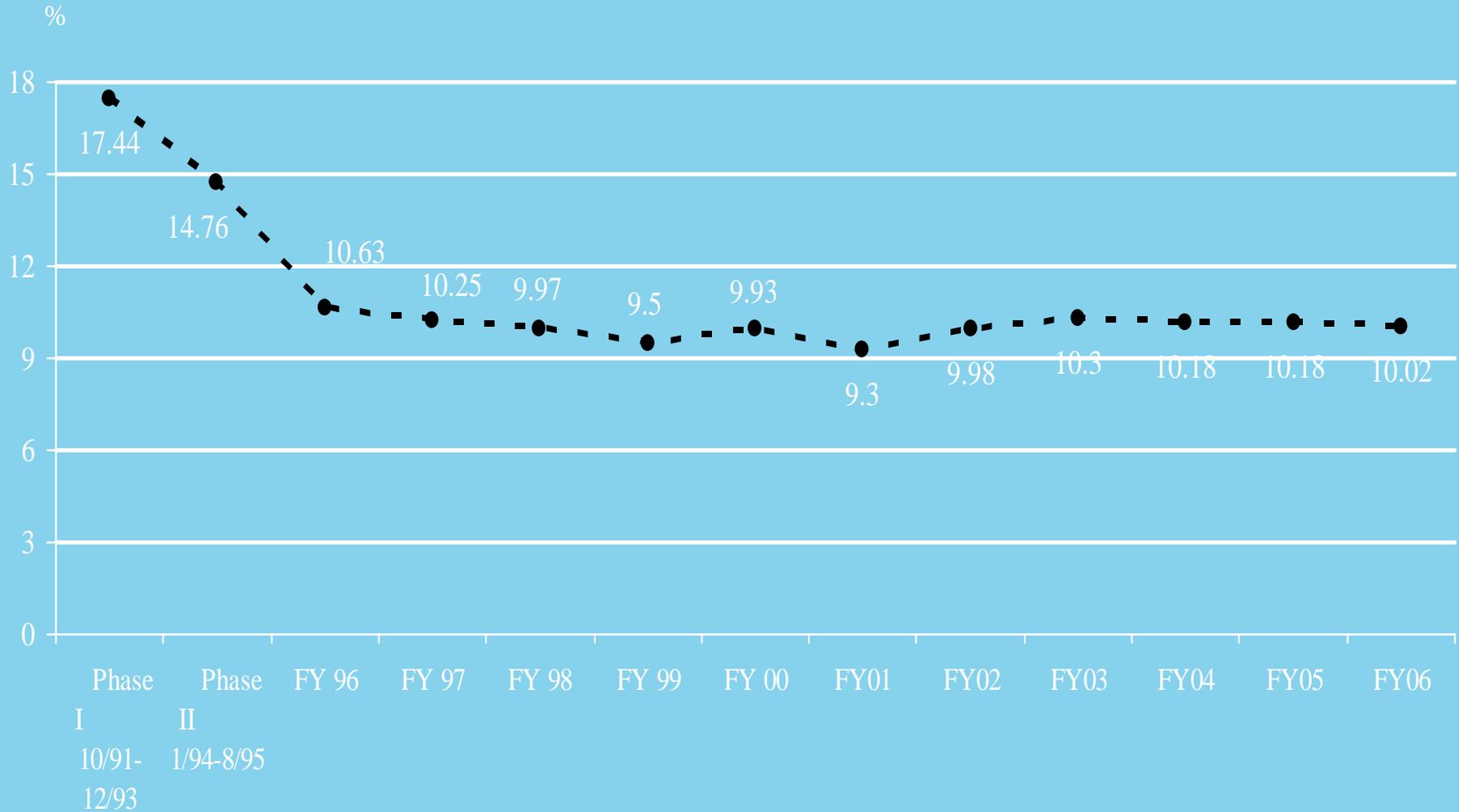| Groups of Operations	Mortality	Overall Morbidity	Specific Morbidities
C-Indexes for NSQIP Models Predicting 30-Day Postoperative Mortality and Morbidity From Preoperative Patient Characteristics			
All operations	0.889	0.777	Resp. Failure, 0.846 Pneumonia, 0.805
General surgery	0.892	0.783	Wnd. Dehis., 0.731
Orthopedics	0.913	0.763	
Urology	0.861	0.729	
Vascular	0.794	0.689	
Neurosurgery	0.896	0.762	
Otolaryngology	0.906	0.793	
Thoracic	0.766	0.717	
Plastic	0.912	0.752	
Proctectomy	0.755	0.684	
Pulmonary resection	0.729	0.623	
Nephrectomy	0.741	0.64	
Below knee amputation	0.81	--	
Above knee amputation	0.79	--	
Gastrectomy	0.735	0.722	
Esophagectomy	0.69	0.62	
Hip replacement	--	0.654	
Knee replacement	--	0.633	
Pancreaticoduodenectomy	0.692	--	

Feedback Mechanisms

1. **Quarterly reports:** case volumes, preliminary O/E ratios for all operations

2. **Annual report:** volumes, patient characteristics, O/E ratios over time for mortality, morbidity, LOS comparing VAMC to all others in system; "best surgical practices" reports from Chiefs of Surgery whose services are low O/E outliers or who have shown improvement in O/E ratios

3. **Chart audits:** of low risk patients who experienced AE

4. **Upon request:** site visit experienced surgeons, OR/ICU nurses, and researchers

Trends in Unadjusted 30-day Mortality Rate for Major Non-Cardiac Surgery (All Operations) NSQIP (FY1992-FY2006)

%

| Phase I 10/91-12/93 | Phase II 1/94-8/95 | FY 96 | FY 97 | FY 98 | FY 99 | FY 00 | FY01 | FY02 | FY03 | FY04 | FY05 | FY06 |

3.16 3.16 2.57 2.75 2.55 2.38 2.28 2.33 2.14 2.08 1.99 1.70 1.66

Trends in Unadjusted 30-day Morbidity Rate:
Major Non-Cardiac Surgery (All Operations)
NSQIP (FY1992-FY2006)

%

18

17.44

15

14.76

12

10.63

10.25

9.97

9.5

9.93

9

9.3

9.98

10.3

10.18

10.18

10.02

6

3

0

| Phase I 10/91-12/93 | Phase II 1/94-8/95 | FY 96 | FY 97 | FY 98 | FY 99 | FY 00 | FY01 | FY02 | FY03 | FY04 | FY05 | FY06 |

VA NSQIP Research Use: >1 Million Cases

- Guidelines for access & use of data
- Use requires review & approval of 3-4 page protocol by NSQIP Executive Board
- >100 scientific publications

Areas of Publication

- Main results papers (e.g., mortality/morbidity, validation studies, NSQIP as quality improvement program)
- Processes and structures of care (e.g., volume/outcome relationship, teaching vs. non-teaching hospitals)
- Modeling of specific operations (e.g., amputation, appendectomy, carotid endarterectomy)

Areas of Publication (cont.)

- Articles about specific risk factors (e.g., serum albumin, creatinine)
- Other outcomes (e.g., LOS, pneumonia, respiratory failure, wound dehiscence)
- Surgical outcomes in special populations (diabetes, elderly, minorities)
- Methods articles (modeling clustered count data, use of clinical vs. administrative databases)

Some Selected Findings from Research Using the NSQIP Database

1. Surgical services with a high feedback & programming had lower morbidity O/E ratios, but not mortality O/E ratios

2. Laparoscopic cholecystectomy in VA did not increase total volume of cholecystectomies; in private sector, laparoscopic cholecystectomy associated with increase in the total # cholecystectomies

3. Preoperative serum albumin has an inverse linear relationship & is the best predictor of operative mortality and morbidity (obtained only in 60% of VA surgical cases).

Selected Findings from NSQIP Database (cont.)

4. No relationship between surgical volume and risk-adjusted outcomes in 8 major types of operations in the VA system.

5. Sensitivity and positive predictive value for surgical risk factors and outcomes using *administrative* data compared to NSQIP data are poor.

6. NSQIP analyses reasonably predicts postoperative mortality and morbidity in non-VA hospitals.

7. Risk-adjusted postoperative mortality and morbidity is higher in the early compared to latter portion of academic year.

Cost of NSQIP

- **Nurse data collectors, chairman's office, statistical center**

- **$38 per major surgical case done in VA ($12 per major & minor cases)**

- **Cost of one prolene suture**

- **Cost of NSQIP might be offset by savings in reduced complication rates**

Surgical Costs at a VAMC

Type of Post–Operative Complication

	None	Infection	CV	Thrombolic	Respiratory
Sample Size	2266	107	26	11	103
Median cost	$16,065	$25,194	$36,332	$29,504	$65,528

Hank Wu, et al. Levels of Preoperative Hct Predict Postoperative Cardiovascular and Fatal Outcomes in Elderly Patients Undergoing Major Non-Cardiac Surgery (JAMA, '07)

30-Day Postoperative Mortality Risk According to Preoperative Hematocrit Categories