Six Sigma
Operational Excellence

Six Sigma In Healthcare

Panel Workshop For
The Quality Colloquium at Harvard University

August 26, 2003

McKESSON
Empowering Healthcare

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YALE-NEW HAVEN HOSPITAL

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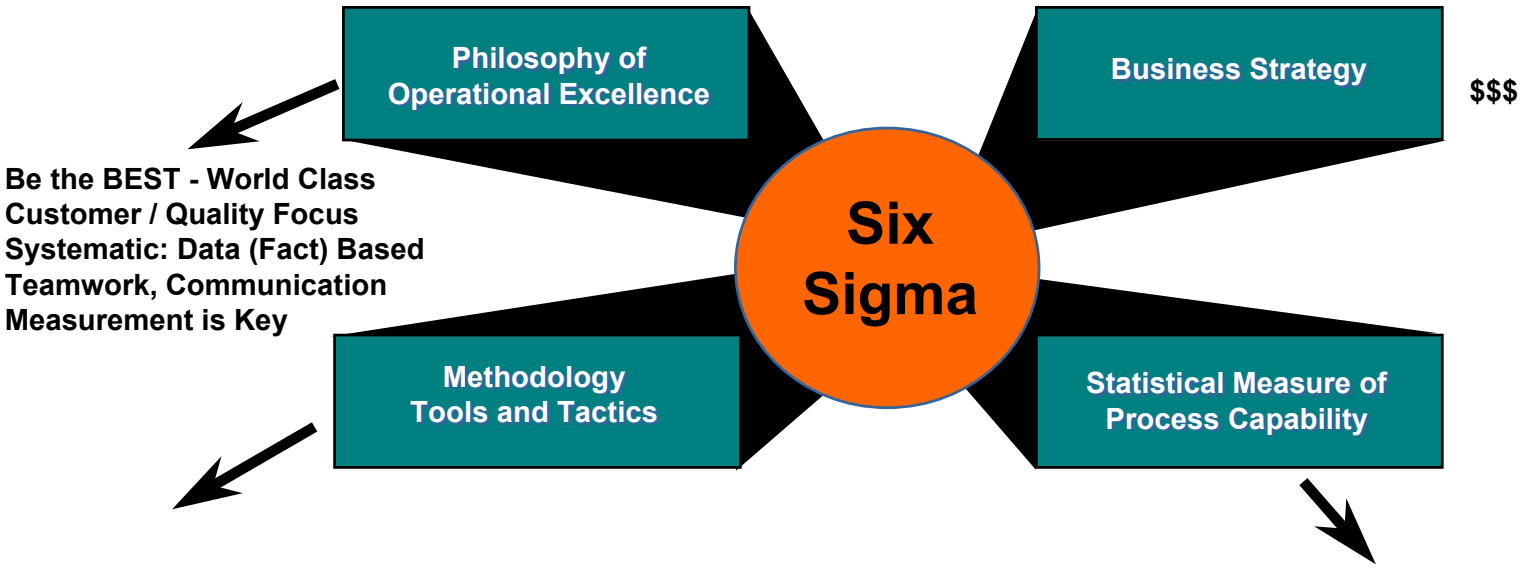
Discussion Topics

- Introductions and brief overview of Six Sigma Methodology
- Application of Six Sigma – Clinical setting
- Application of Six Sigma – Transactional setting
- Deploying Six Sigma – Lessons learned

What Is Six Sigma?



Six Sigma Values

1. **Customer Focus**
   The only real source of a paycheck is a satisfied customer.
2. **The Customer Defines Quality**
   Delight the customer by eliminating defects
3. **Variability is the Enemy!**
   Right the first time = lowest cost
4. **Act on Fact!**
   Make data driven decisions through analysis instead of “gut feel”
5. **Measurement is the Key!**
   What you can’t/don’t measure…..You don’t know!
6. **Employee Brainpower**
   Given leadership, the right tools and knowledge, cross-functional teams will deliver World Class Operations, processes & products

What It Is Not…

- A cult
- Flavor of the month program
- Intended to replace management decision making
- Overnight fix to process defects
- Large scale process redesign tool

The Roadmap

Six Sigma Breakthrough Strategy®

MEASURE

1. Select CTQ Characteristic
2. Define Performance Standards
3. Validate Measurement System

ANALYZE

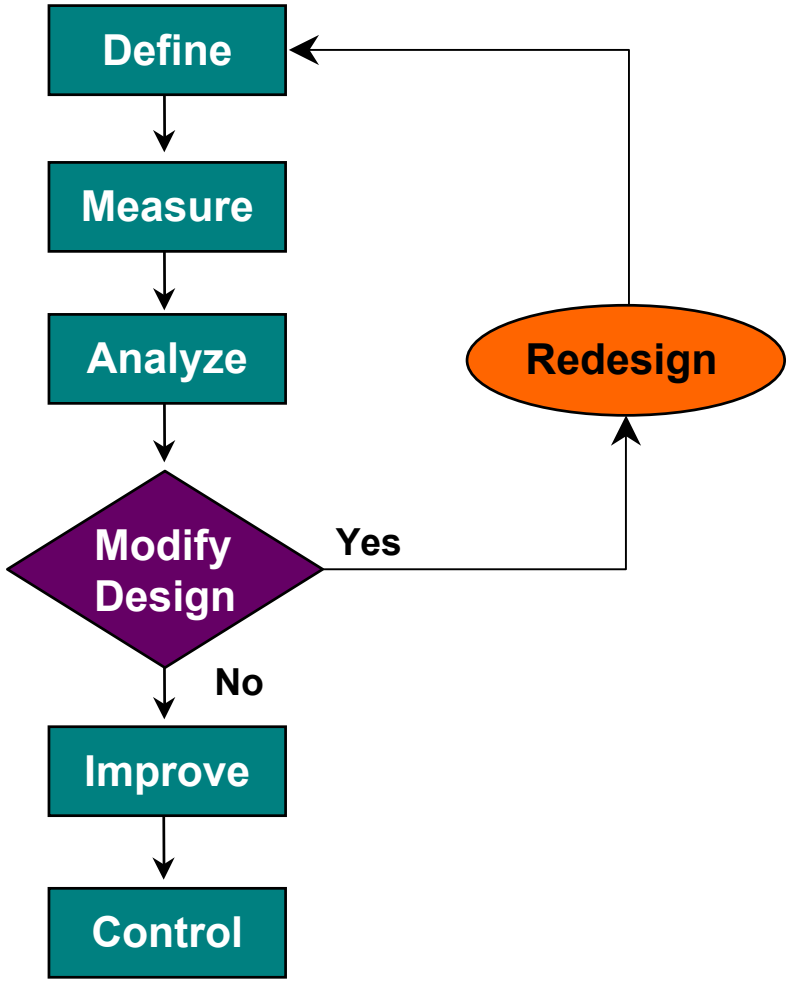
4. Establish Product Capability
5. Define Performance Objectives
6. Identify Variation Sources

IMPROVE

7. Screen Potential Causes
8. Discover Variable Relationships
9. Establish Operating Tolerances

CONTROL

10. Validate Measurement System
11. Determine Process Capability
12. Implement Process Controls



YALE-NEW HAVEN HOSPITAL

Yale-New Haven Hospital
Six Sigma Initiative

The Quality Colloquium At Harvard University: Six Sigma in Healthcare
August 26, 2003

Speaker: Denise J. Fiore

YALE-NEW HAVEN HOSPITAL

Presentation Outline

- Yale-New Haven Hospital Six Sigma Initiative Overview
- Project Case Studies

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Six Sigma Initiative
Overview

About Yale-New Haven Hospital

- Fifth hospital established in the U.S., 175th Anniversary
  - 6,000 employees
    - 2nd largest employer in the local area
    - 2,200 university-based and community physicians practicing in more than 100 medical specialties
  - 944-bed, private, not-for-profit tertiary referral center, which includes:
    - 201-bed Yale-New Haven Children's Hospital
    - 76-bed Yale-New Haven Psychiatric Hospital
  - 420,000 outpatient and emergency visits and 43,000 discharges each year
- Annual budget of $575m
- Part of health system with enterprise-wide budget of approximately $1B

YALE-NEW HAVEN HOSPITAL

Six Sigma Supports The Implementation of the Business Plan

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Six Sigma Roll Out Process

Year 1

- One day executive orientation
- Trained 14 Green Belts on 4 pilot training projects
- Conducted 4 Work-Outs™

Year 2

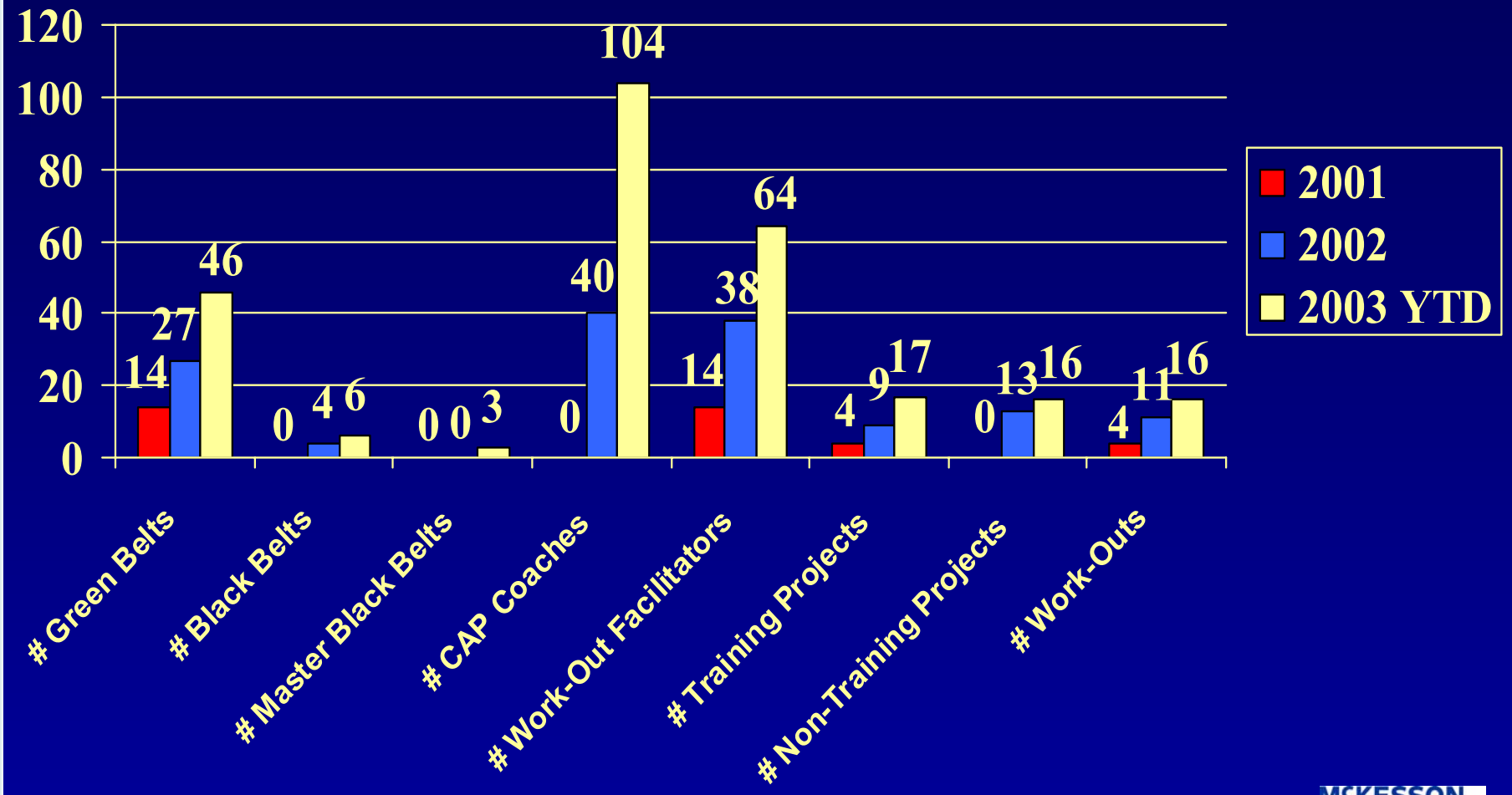
- Appointed 4 part-time Black Belts
- Conducted four day comprehensive Executive Training Session for top 30 senior managers
- Trained 17 Green Belts on 5 training projects
  - **First year Green Belts worked on 5 additional non-training projects**
- Conducted 7 Work-Outs™

Year 3

- Appointed 3 part-time Master Black Belts
- Appointed 2 additional part-time Black Belts
- Being integrated into Yale New Haven Health System Performance Management initiative
- In training: 19 Green Belts on 8 training projects
  - **Second year Green Belts are working on 3 additional non-training projects**
- To date, 5 Work-Outs™ have been conducted by second year Green Belts

YALE-NEW HAVEN HOSPITAL

Six Sigma Roll Out Progress (Cumulative)



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Six Sigma Project Benefits

Year 1

- Limited quantifiable financial benefits - training projects not targeted for financial return
- Outcomes were improved patient safety, enhanced customer and employee satisfaction and improved productivity

Year 2

- Three projects (one training, two non-training) resulted in additional revenue of over $1 million
- Other outcomes included improved patient safety, enhanced clinical protocols, enhanced employee satisfaction

Year 3

- Target is at least $1 million in revenue enhancement/expense reduction

YALE-NEW HAVEN HOSPITAL

Project Case Studies

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Reduction in SICU Bloodstream Infections (BSI)

Project Background

- Targeted specific ICU where hospital acquired infections are above benchmark and improvement opportunity existed
- Focused on central line procedure
- Previous attempts to implement evidence based guidelines were not successful

Define

Project Description: **To reduce SICU Blood Stream Infections (BSIs) through improvements in the process of care**

Potential Benefits:

- Lower morbidity and mortality
- Decrease LOS and cost
- Increased capacity and revenue
- Increase patient satisfaction

Alignment with Strategic Plan:

- Improve patient safety
- Improve patient satisfaction
- Reduce unnecessary resource use

Data Source: CDC National Nosocomial Infection Surveillance [NNIS] Program

Project Successful if: **SICU BSI rate reduced to be at or below national guidelines (NNIS median)**

Measure

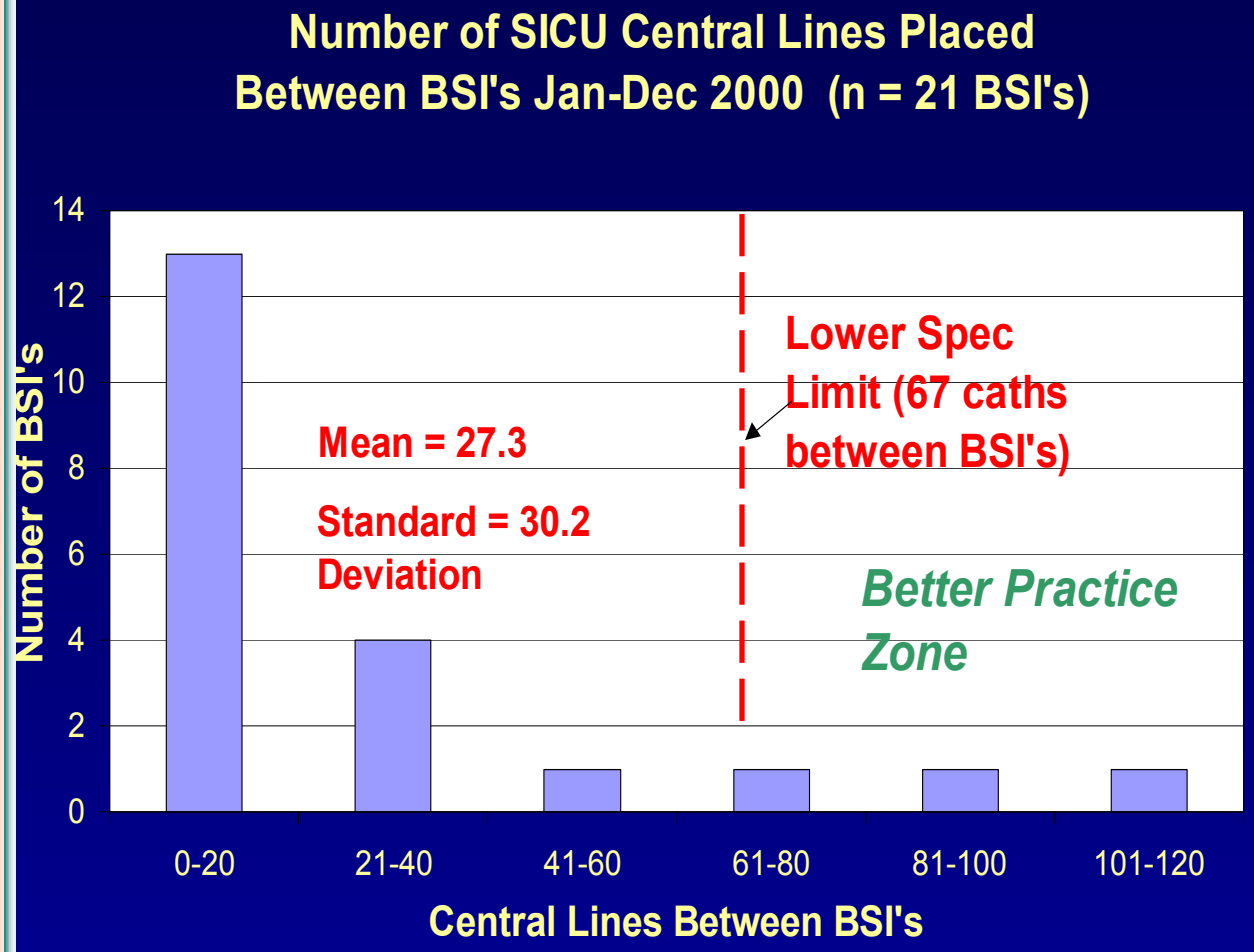
What did we measure?

- **Y:** Number of catheters placed between BSI's (as defined by CDC National Nosocomial Infection Surveillance [NNIS] Program)
- **Defect:** NNIS defined BSI
- **Lower Spec definition:** 67 or more catheters placed between infections
- **Measurement System:** Direct observation and data collection from MD Rounds and medical record

Infections are infrequent, but a reduction from about two per month to one per month would be meaningful. Cost of one BSI, including extra LOS = $50,000 (est.)

Measure

What did we want to know?: What is our process capability for using catheters without infections?



Specification
LSL = 67 or more catheters placed between BSI's will exceed NNIS median

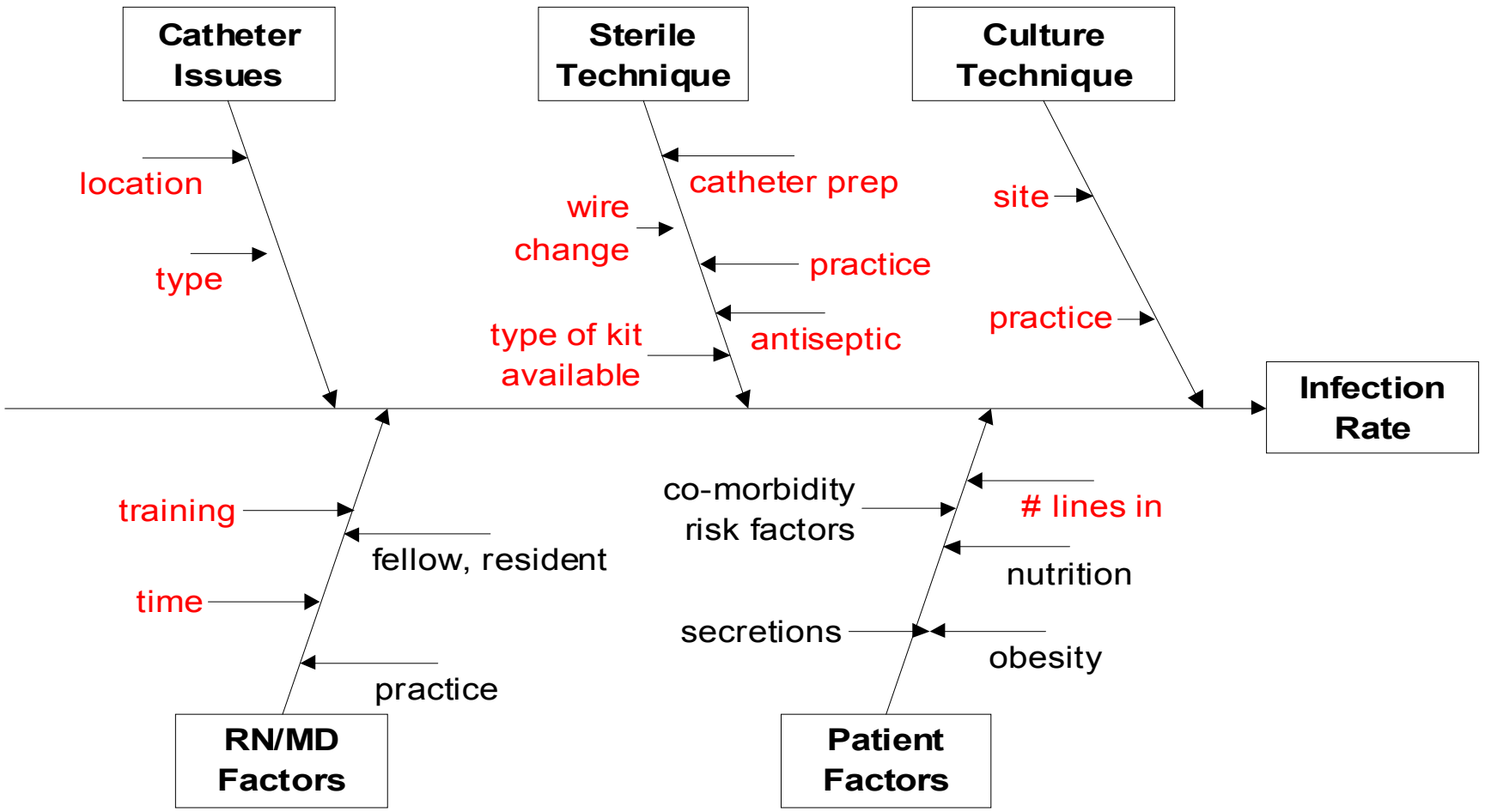
Defect
Any NNIS defined BSI

Initial Capability
Z = 0

What did we learn?: We have both a mean and variability problem

Measure

What did we want to know?: **What contributes to infections?**



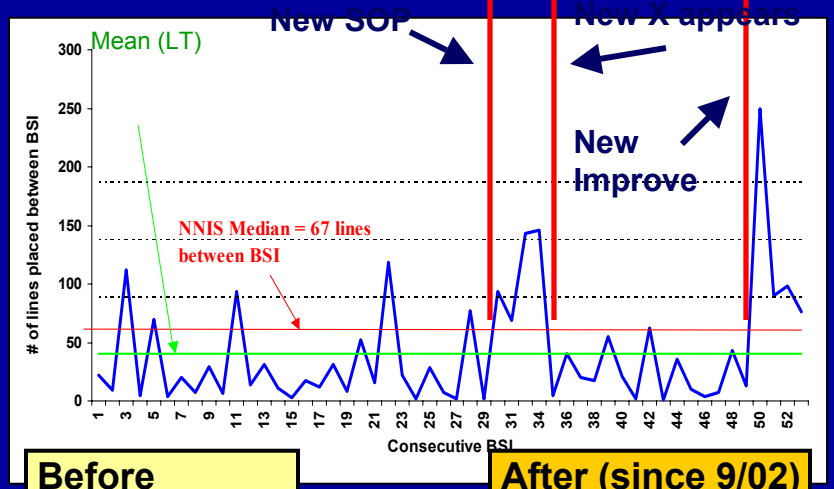
What did we learn? **Need to collect data on numerous elements to better understand overall risks for infection.**

Reduction in SICU Bloodstream Infections (BSI)

Goal: To reduce the incidence of BSIs to at least the CDC NNIS standards for Catheter Days between a BSI.

Defect: Any BSI occurring more frequently than between placement of 67 catheters

Central Lines for BSIs 1/00 – 4/03



Before
Mean: 27.5
Std. Dev: 30
Z Score: 0

After (since 9/02)
Mean: 128
Std. Dev: 81
Z Score: 5.74

Project Findings

- YNHH SICU had high rate of BSI's compared to national average and other YNHH ICUs
- Minimal data was available, thus success of this project was supported almost exclusively by CAP and Work-Out.
- **Solutions**
- Switched to daily dressing changes and began using new antiseptic for site preparation
- Developed wire (line) change protocol and pre-assembled kits for wire changes
- Developed training video
- Changed documentation and implemented control charts to monitor progress
- After first improve, discovered a new cause and reconvened team to develop new improvements

Impact

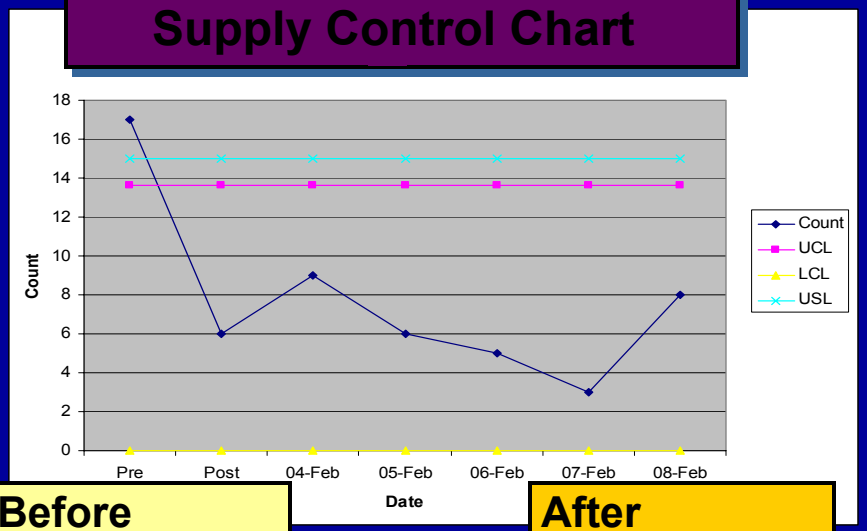
- Decreased LOS for selected patients
- Increased ICU capacity
- Estimated expense savings of $450,000/year

Correct Surgical Case Materials on the OR

Goal: Ensure all functional and specified required materials in the operating room when patient arrives

Defect: Number of times RN has to leave room during a case to get standard equipment.

Supply Control Chart



Before
Mean: 3.4
Std. Dev: 2.66

After
Mean: 1.25
Std. Dev: 1.24

Project Findings

- 77% of the time the RN had to leave the room, it was for one of three items:
  - Linens
  - Room stock
  - Materials not on surgeon "pick-list"
- Team addressed linen and room stock (pick-lists will be a separate project)
  - Held two Work-Outs™ with staff

Solutions

- Developed new SOPs for type and amount of room stock and linens to be in room or on case cart
- Developed PAR levels and reduced numbers and types of materials used
- Revised staffing patterns

Impact

- Statistically decreased number of times an RN had to leave room
- Did not significantly increase overall RN satisfaction, however statistically disconnected RN satisfaction from "having to leave room for a supply"

Enhanced MRI Scheduling

Goal: Reduce the time to human contact for MR appointment scheduling via the phone

Defect:. Any caller who waits > 30 seconds to speak with a scheduler

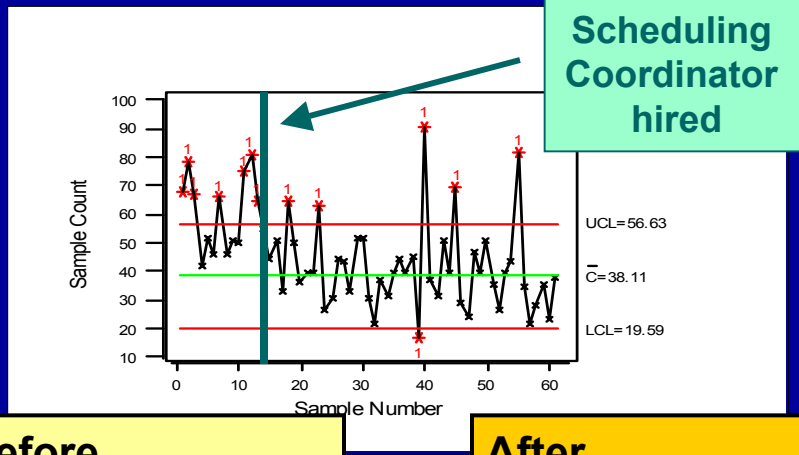
Project Findings

- Schedulers were spending several minutes on phone with each caller simply providing driving and parking directions

Solutions

- Developed and posted a daily digital dashboard in scheduling office tracking oncoming and abandoned calls
- Hired a Scheduling Coordinator
- Identified other staff to fill in during peak call times
- Referred callers to automated sources of information for directions and parking
- Staggered lunch and break periods around peak call times

Control Chart of Defects



Before

Defect Rate: 62%

After

Defect Rate: 29%

Impact

- Reduced average time to human contact on phone from 80 to <30 seconds
- Estimated incremental net revenue of $40-70 k per year

YALE-NEW HAVEN HOSPITAL

Examples of Work-Outs at YNHH

- Increase influenza and pneumonia vaccination rates for patients over 60
- Reduce the amount of time required by managers to utilize the time and attendance system
- Identify priorities in and develop a defined structure and process for bed management
- Ensure accurate charge capture for cardiac AICDs
- Reduce variation in practice in the assessment for and use of “patient sitters”
- Develop a plan for the Development Office to become a central gifts processor
- Ensure accurate room stocking in the OR
- Identify enhancements to performance management process

Six Sigma
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The Harvard Colloquim

Workshop on Six Sigma

August 26, 2003

A Clinical Case Study: Improving Implant Rates at an IVF Clinic

Narendra Kini MD, MHA
GE Health Leadership Institute

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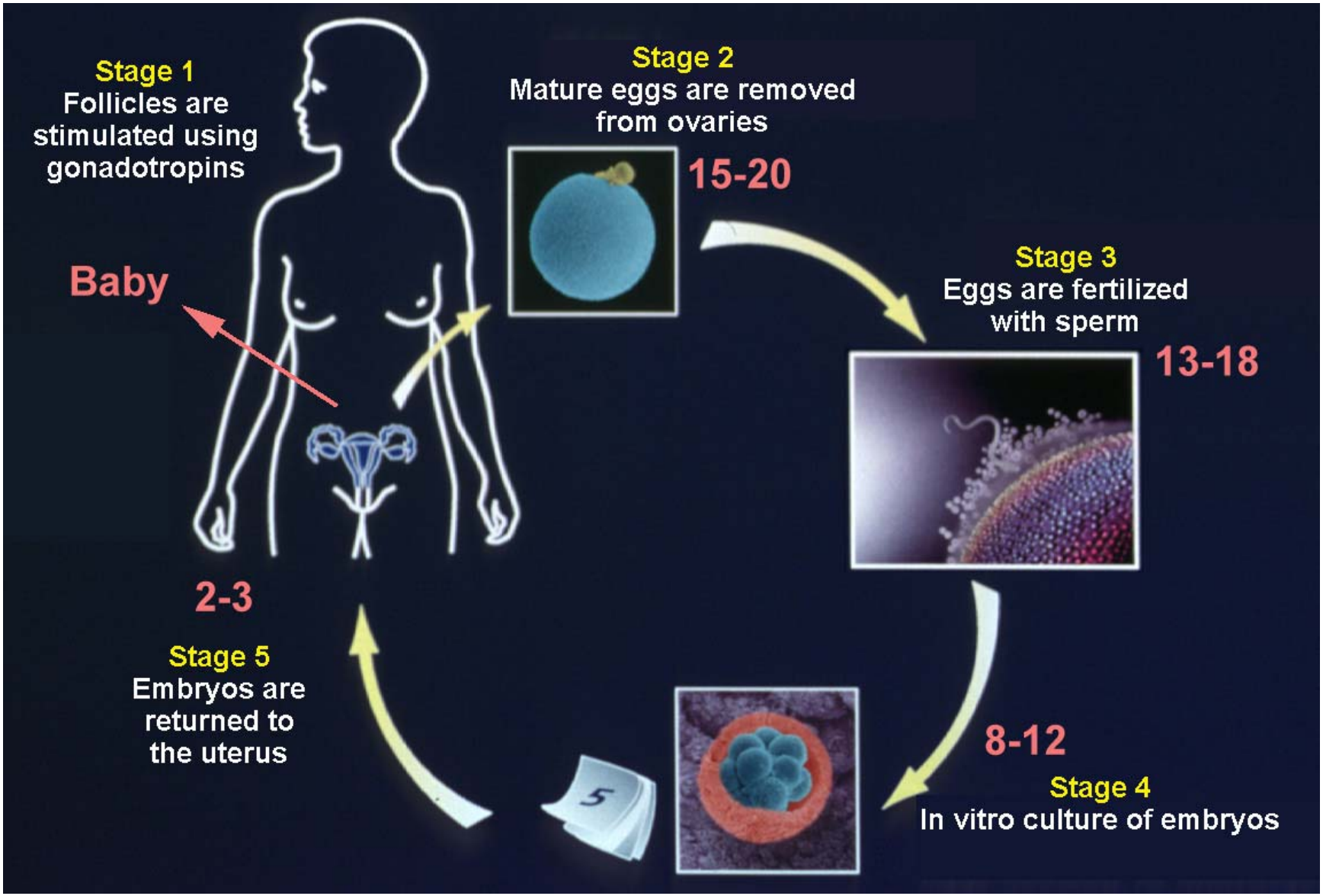
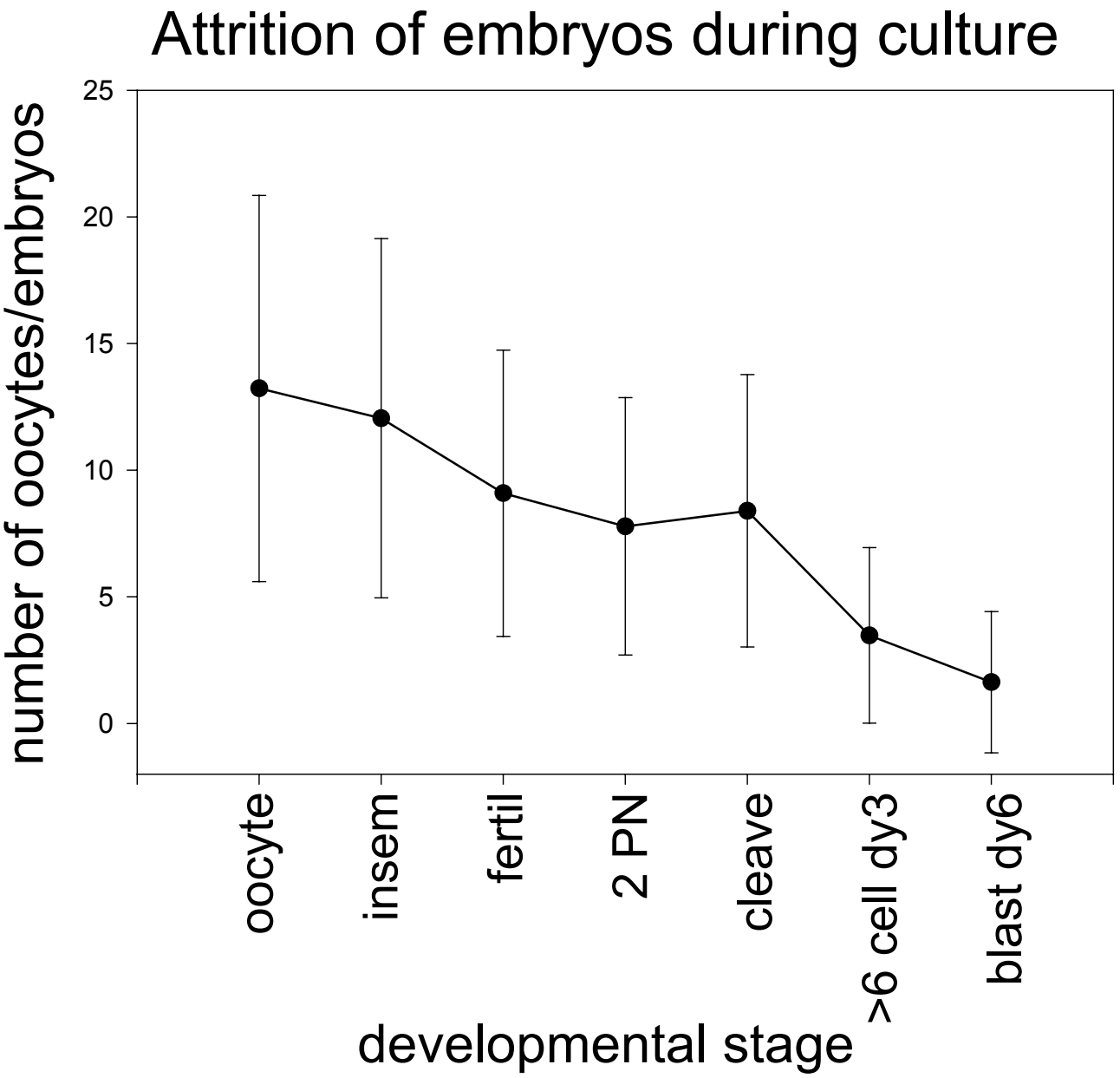
The IVF CYCLE

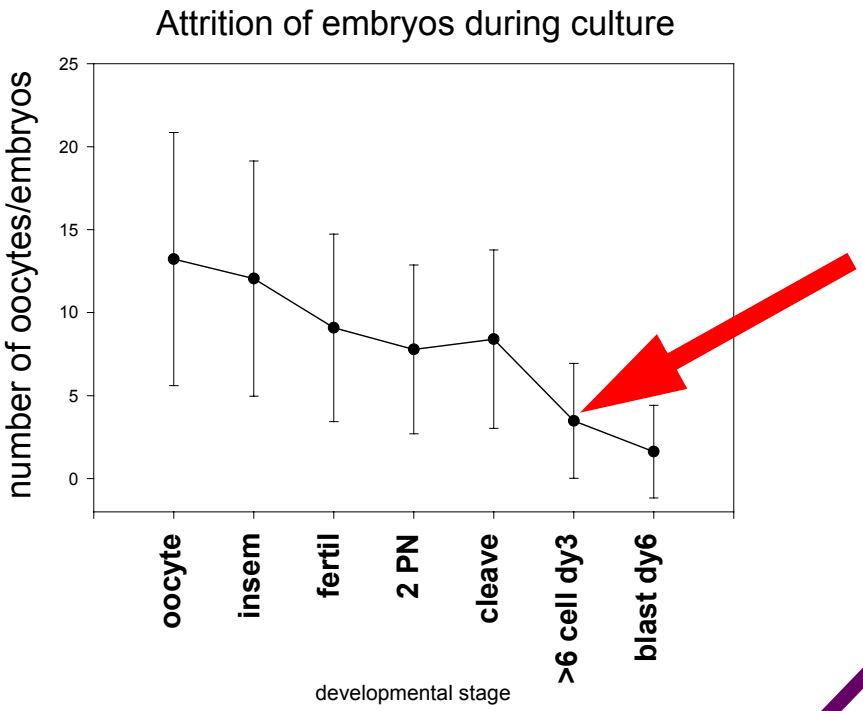


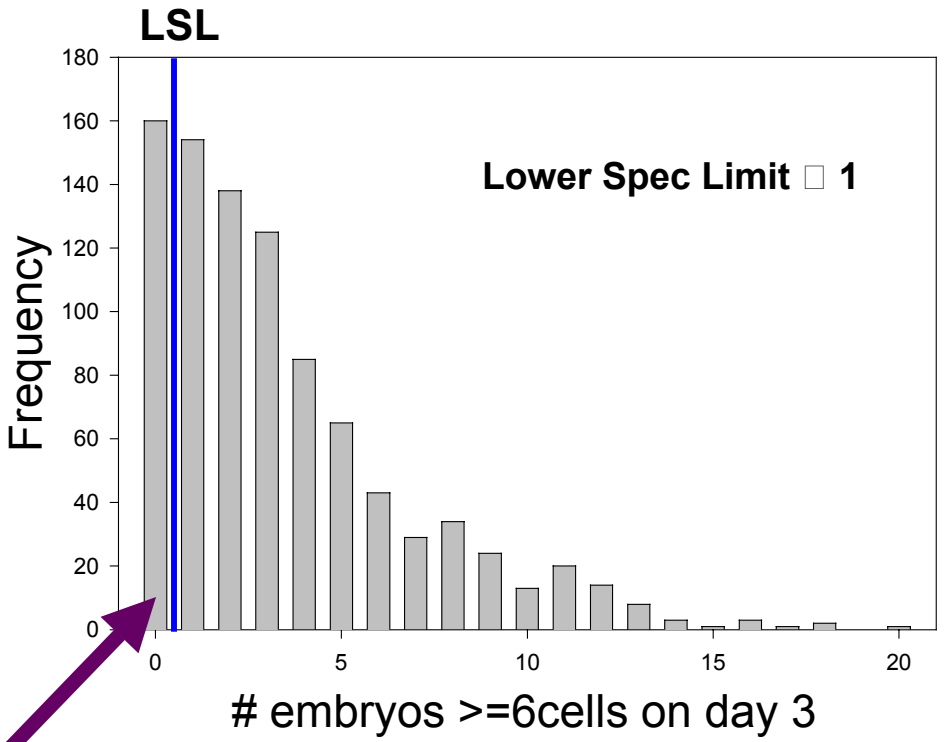
IVF = In Vitro Fertilization

Case Study: Improving embryo growth using Six Sigma



Present situation- Jan 2000- May 2001





17.3% of cycles without high quality embryos on day 3.

Mean = 3.48 embryos/cycle
Standard Dev. = 3.46 embryos/cycle
N = 924 cycles

R0 Template

Six Sigma Project # Women and Infants Hospital (WIH)

Project Title: In vitro fertilization (IVF) optimization.

Sponsor: Dr. David Keefe
Master BB: Jill Dunham
Black Belt: Mike Case
Finance Approver: Vesela Andreeva
Project Start Date: May 29, 2001

Team Members:

Jill Dunham	Mike Case
Ed Pisarchick	David Keefe
Rick Hacket	IVF Team

Project Description / Problem Statement: Increase "take-home baby" rate from IVF clinic by ensuring that all cycles have suitable embryos to transfer.

Project Scope: Patient data Jan 2000-May 2001 from Blackstone WIH IVF clinic (~1000 cycles of IVF).

Potential Benefits: Increase patient satisfaction. Decrease cost of procedure to payers. Increase market share for WIH IVF clinic.

Alignment with Strategic Plan: WIH seeks to increase patient satisfaction, quality of patient care, while increasing market share.

Six Sigma improves availability of 6-cell embryos

- Y: IVF cycles producing at least one 6-cell embryo on day 3
- Defect: Any cycle without at least one 6-cell embryo on day 3
- Unit: The IVF cycle
- Upper / Lower Spec: LSL □ 1 6-cell embryo per cycle
- Target Spec: 0% of IVF cycles without 6-cell embryos on day 3
- Validation of Specification: Published literature (next slide)
- Measurement System: Counting embryos under microscopic observation (400X magnification), prior to loading catheter.
- Impact on Business: Improvement in clinical outcome will prevent repeat cycles and attract more patients.

Increase IVF cycles with most suitable embryos for transfer.

Present process is ~ 2.5 sigma

All IVF CYCLES

95% Confidence Intervals for defects

Confidence -->	0.95
Units -->	924
Opportunities -->	1
TOP's -->	924
Defects -->	160

2.5 SIGMA
That's pretty good!

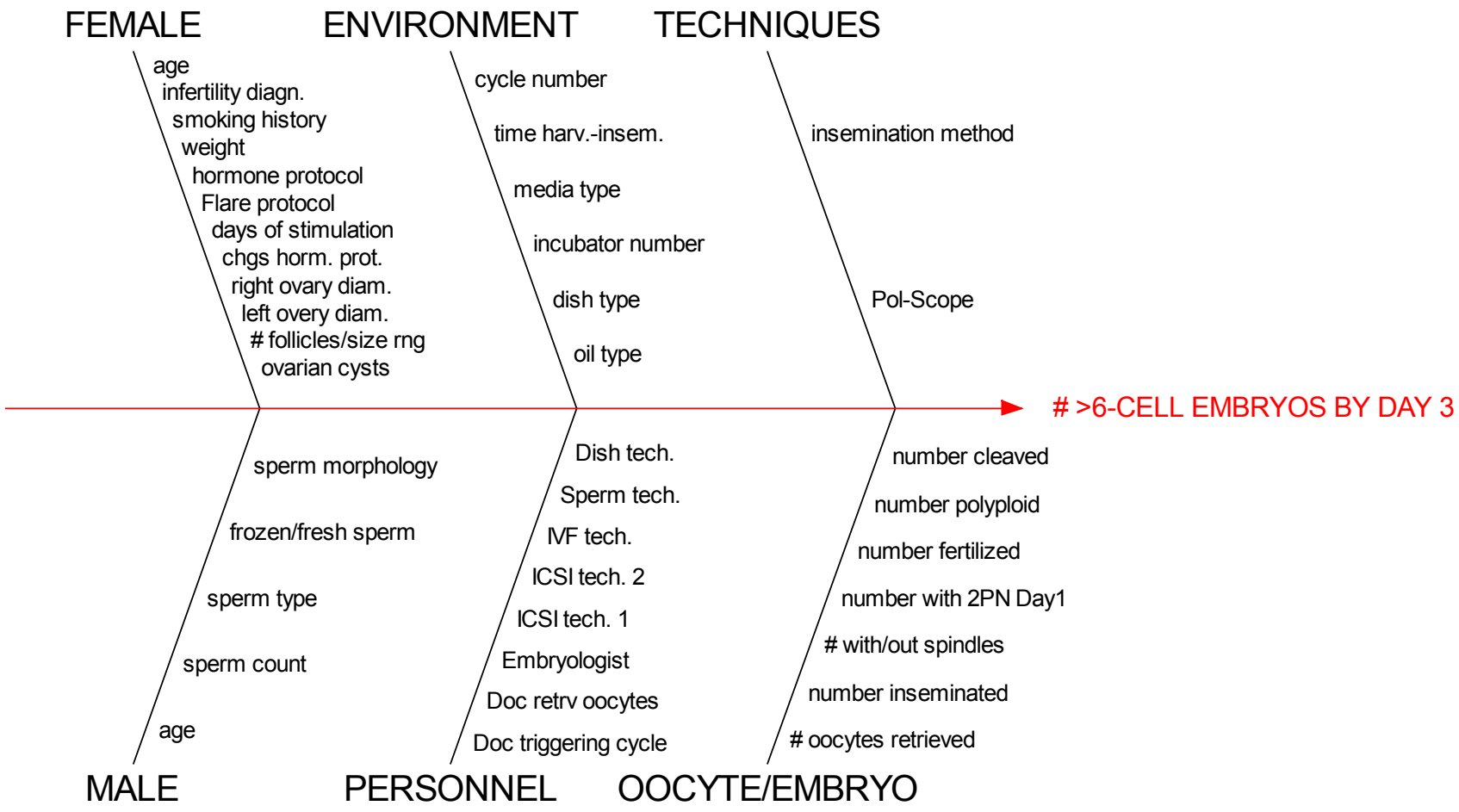
	p(d)	Percent	ppm	Z_{ST}		Defects	
Upper Limit on Failure Rate	0.1991	19.9%	199130	2.34	<= "worst case" =>	184	95%
Nominal Value	0.1732	17.3%	173160	2.44	<= "best estimate"		Confidence
Lower Limit on Failure Rate	0.1493	14.9%	149294	2.54	<= "best case" =>	138	Interval

Defect = cycles with 0 embryo □ 6 cells

Summary of survey of IVF staff for critical X's influencing number of 6-cell embryos available on day 3.

	number occurrences	controllable	uncontrollable	Doc issue	Embryol issue	measured/unmeasured
PATIENT						
age	10		x			
smoking	2	x	x	x		measured
patient weight	2		x			
infertility diagnosis	1		x			
egg quality (aneuploidy)	5		x			
sperm quality	1	x	x	x	x	measured
poor self administration of hormone	1	x		x		?
stimulation response	12	x	x	x		measured (controlled?)
ENVIRONMENT						
time outside incubator	7	x			x	unmeasured
media quality	5	x			x	monitored
culture conditions	2	x			x	partially monitored
incubator CO2 level	2	x			x	monitored
temperature	4	x			x	partially monitored
environment inside incubator	2	x			x	monitored
media pH	1	x			x	unmeasured
STIMULATION						
stimulation protocol	12	x		x		measured (controlled?)
egg quality	5	x	x	x		unmeasured?
TECHNICAL						
too many steps in protocl	1	x		x	x	?
time outside incubator	7	x			x	unmeasured
transfer technique	1	x		x		monitored
temperature control	4	x		x	x	partially measured
manipulation skill (ICSI, egg stripping)	3	x		x	x	unmeasured
number surveyed	15					
RED= the 2 most dominant controllable responses						

PARAMETERS INFLUENCING EMBRYO DEVELOPMENT



WIH IVF maintains a database of >140 parameters/cycle

23 parameters survived Chi-sq. analysis

(cycles with v.s. cycles without 6-cell embryos)

			DIRECTLY CONTROLLABLE	CLASSIF. Patient	CLASSIF. Horm stim.	CLASSIF. Internal biology	CLASSIF. External Manip.
1	age	0.005		X			
2			X				X
3	Incubator no.		X				X
4		0	X		X		
5	no.stim change	0	X		X		
6	FSH initial	0	X		X		
7	Total FSH calc.	0	X		X		
8	day3 FSH	0		X			
9	dose pre-FSH	0	X		X		
10	dose on FSH	0.034	X		X		
11	pre HCG E2	0			X		
12	days pre-HCG	0.71	X		X		
13	HCG E2	0		X			
14	large	0.024				X	
15	small	0				X	
16	large2	0.003				X	
17	small2	0				X	
18	5 to 14	0				X	
19	15	0				X	
20	16	0.007				X	
21	17	0.016				X	
22	18	0.128				X	
23	20	0.016				X	
			R-Sq(adj)	P-value			
	Total FSH calc		7.1	0			
	HCG E2		14.6	0			
	small (mm)		7.4	0			
	15 mm		7.5	0			
	all 5 variables		19.3	0.048			

Summary of data base analysis

age	older is bad
incubator no.	incubator 3 is bad
flare/antag	flare is bad
hormone change	1 hormone change is good
FSH initial	high FSH is bad
total FSH calc	more FSH is bad
day 3FSH	too high or too low is bad
dose pre-FSH	10 is good, else is bad
dose on FSH	low is bad
pre-hCG E2	low is bad
hCG E2	low is bad
large, large2	low is bad
small, small2	low is bad

Incubator 3 was having trouble maintaining CO_2 levels

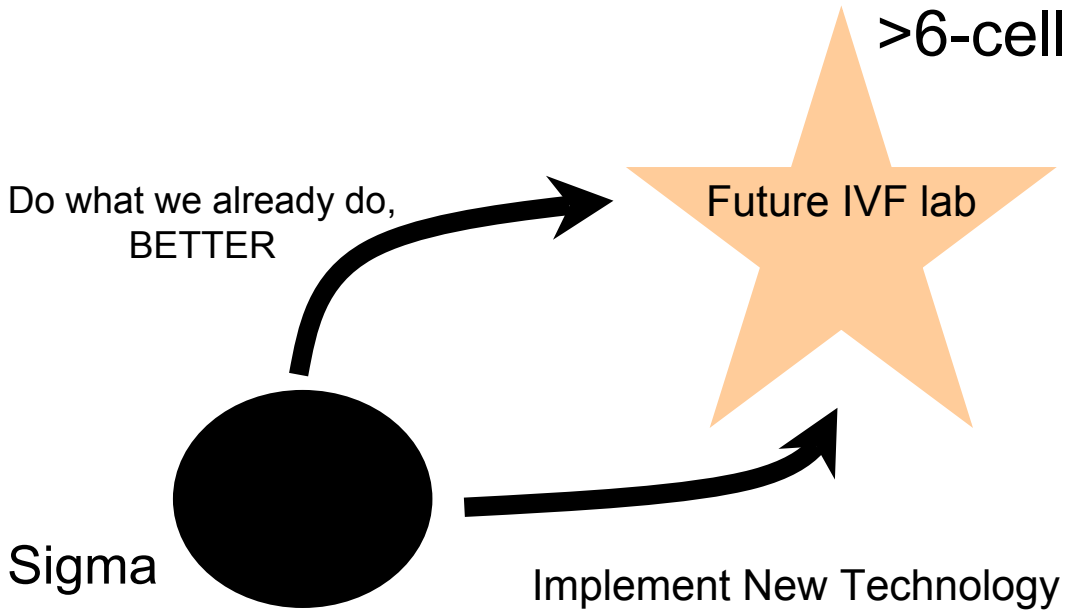
Took it out of service

Some Xs were predicted by the Work-Out survey

Impact of Six Sigma on the "Y" - number of >6-cell embryos

After Six Sigma

13.3% of cycles did not have >6-cell embryos

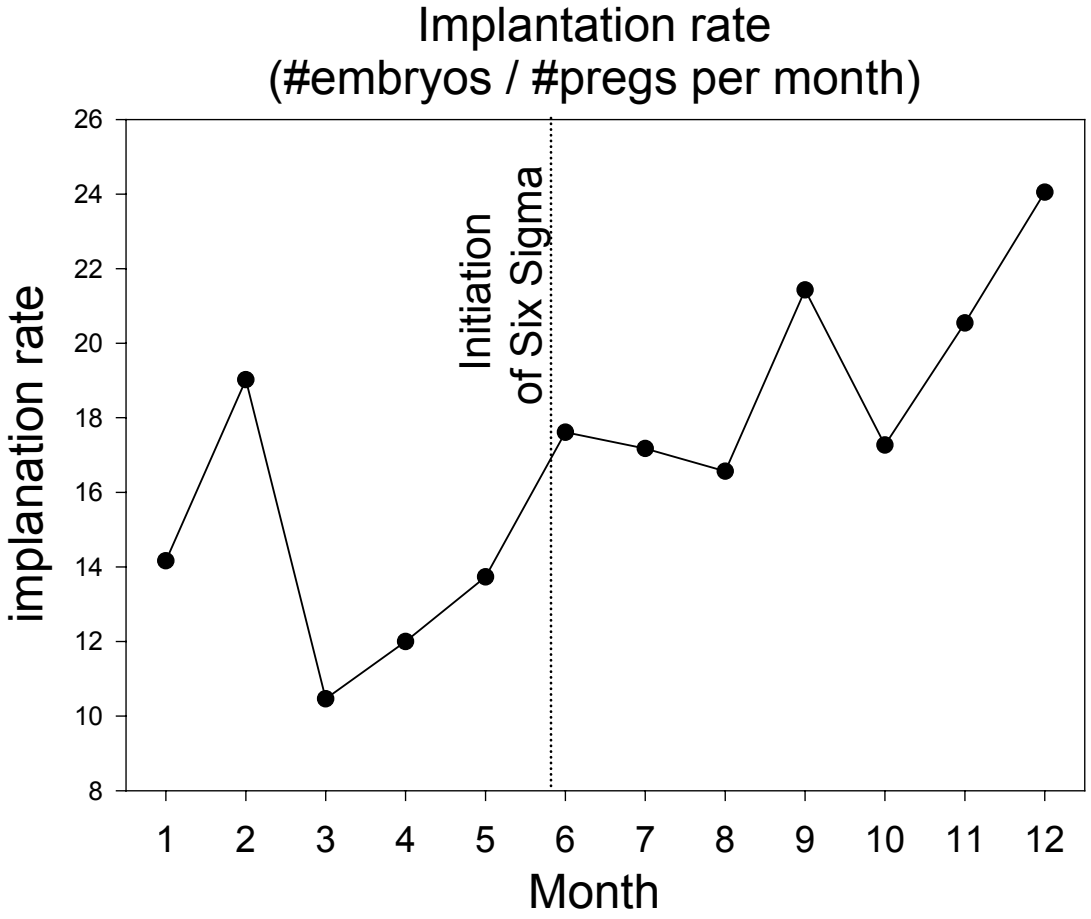


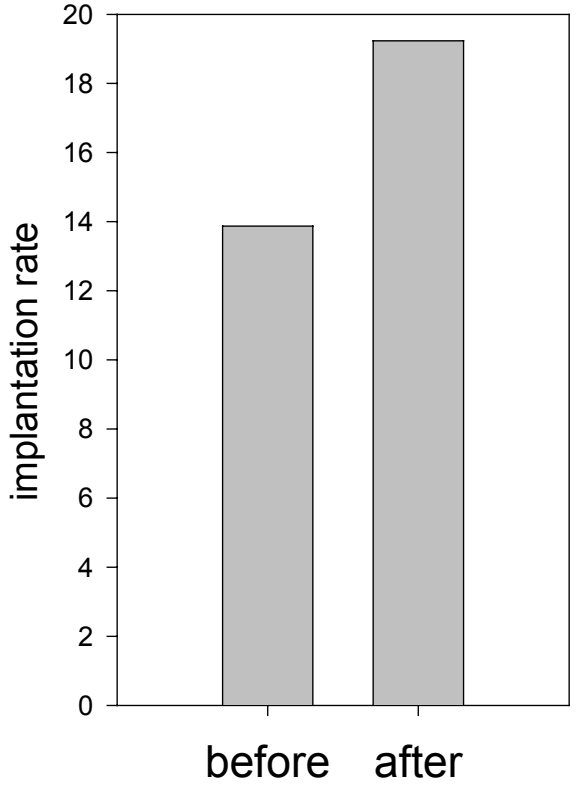
17.3% of cycles did not have >6-cell embryos

Continue to monitor #>6-cell embryos

Six Sigma Quality Improvement has increased our success

35% increase in implantation rate





- Improvement resulted from reducing variance at several IVF steps indicated by Six Sigma analysis

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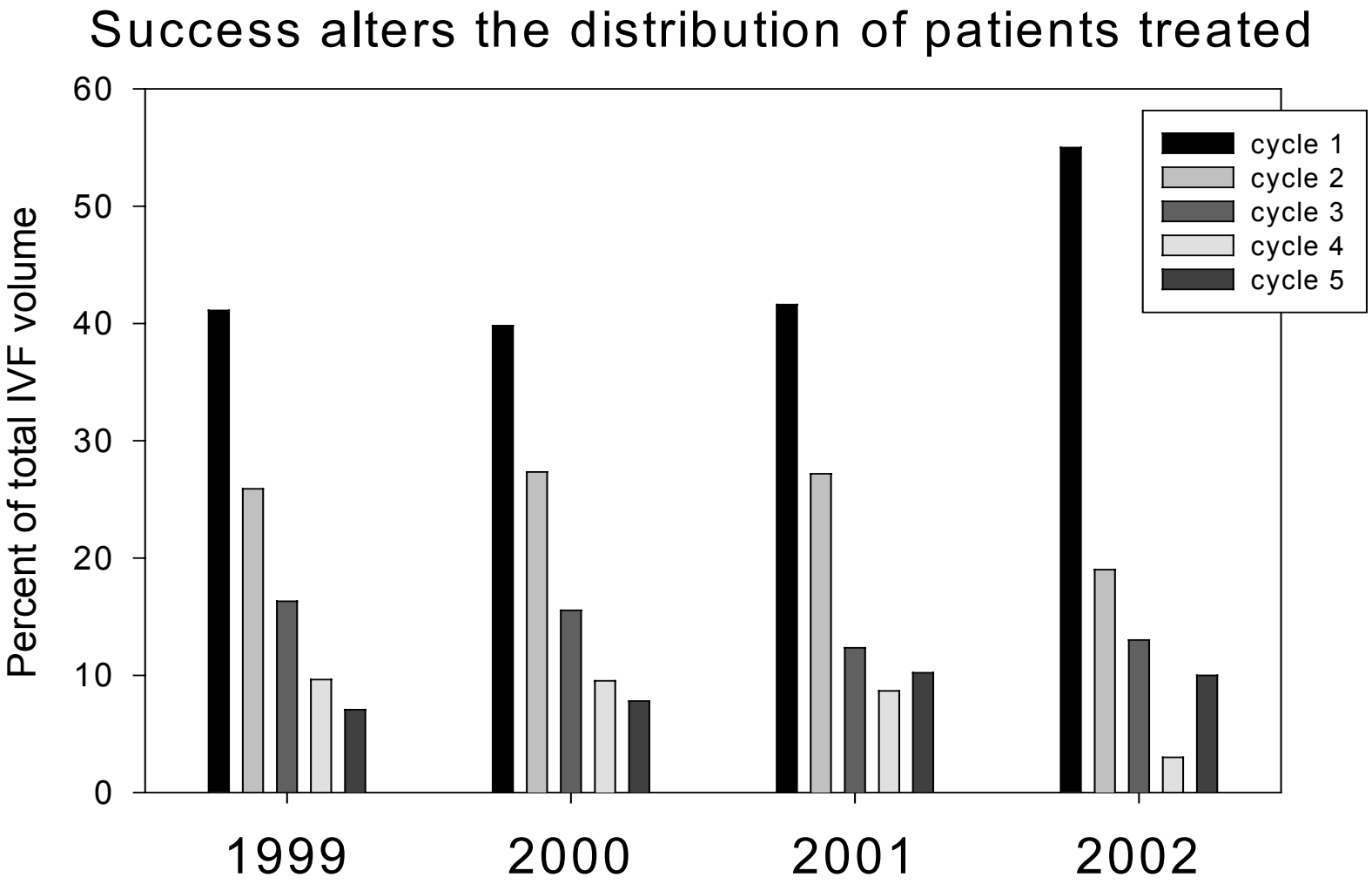
Beware, success rapidly changes your organization and can change where you focus your efforts



Must now focus on new patient recruitment-
referring physician outreach, advertising, new patient enrollment???

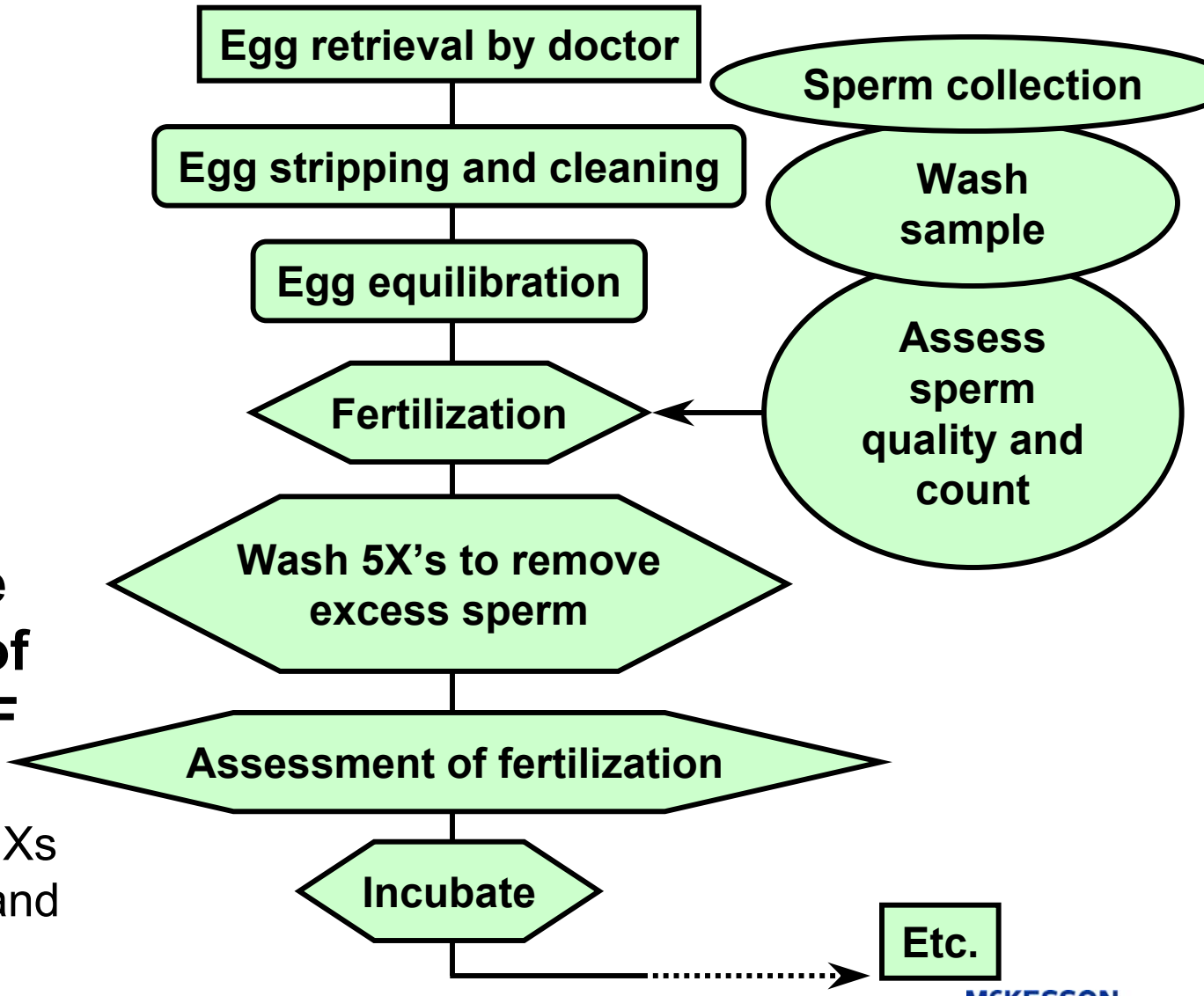
Problems with data base analysis

Other than the incubator, we simply identified a profile of a difficult patient

Can only analyze what has been measured
and entered into data base
(e.g. embryo morphology data, E2 levels
measured throughout stimulation)

Now what?

A more detailed process map is necessary



Currently there are hundreds of steps in the IVF process

Identify the critical Xs driving each step and optimize

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Another example of Six Sigma at work – diffusing a debate
Threshold for flagging cases with low fertilization rates

- Presently if <30% of the eggs of a cycle fertilize, the case is reviewed by physicians for poor fertilization.

THE DEBATE

- Some physicians have argued that <30% fertilization may be too low of a threshold for flagging case review.
  -set threshold at 2 standard deviations from the mean.

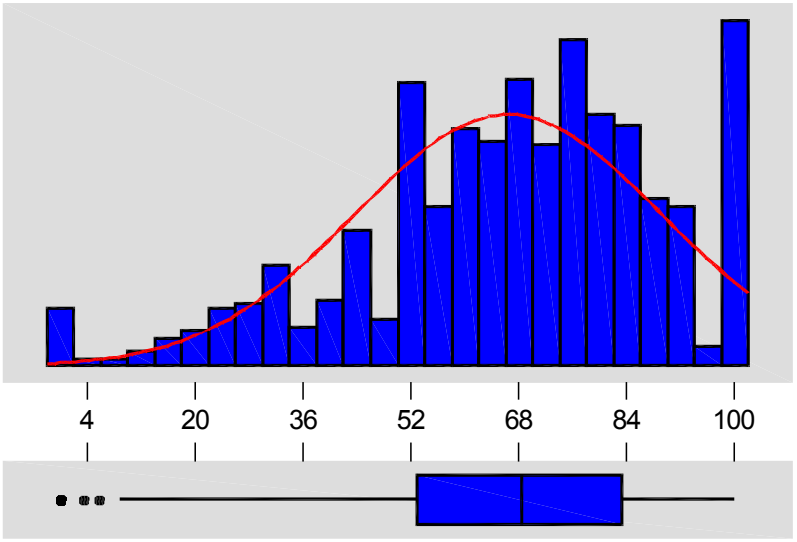
- Some embryologists have argued that <30% fertilization is at about the proper level for flagging case review.

THE SOLUTION

- Analyze data, determine mean and stdev and set fertilization threshold for flagging case review.

Fertilization rate- percent inseminated that fertilized

Descriptive Statistics



Variable: C1

Anderson-Darling Normality Test

A-Squared:	7.191
P-Value:	0.000
Mean	66.3900
StDev	22.6725
Variance	514.041
Skewness	-6.6E-01
Kurtosis	0.204198
N	923
Minimum	0.000
1st Quartile	52.941
Median	68.421
3rd Quartile	83.333
Maximum	100.000

95% Confidence Interval for Mu

64.925 67.855

95% Confidence Interval for Sigma

21.683 23.757

95% Confidence Interval for Median

66.667 70.000

Mean +/- stdev = 66 +/- 23%

NOT NORMALLY DISTRIBUTED

Solution using data

- Established consensus that cases with fertilization rates
- in the lower 10% of the population should be reviewed
- (the lower 10% of the class).

- This presently re-sets the threshold fertilization rate to 40%

- Results in the review of 2 cases per week (up from 1 per week)

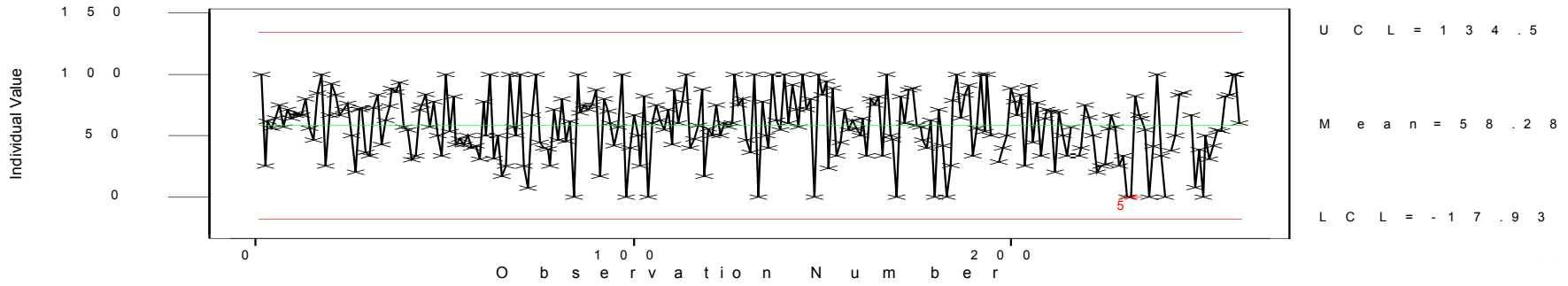
- **Debate logically diffused using 6-sigma.**

- **Benefit:** As fertilization rate creeps up the threshold can be reset to continue to review 10% of the cases and thereby obtain continual improvement in fertilization rates.

Summary of fertilization threshold

-Reset threshold for flagging cases for review
to 40% fertilization

-Use individual and moving range control charts to;
* monitor progress
* guard against slipping fertilization rates
* indicate when fertilization is exceptionally good (identify positive situations)



Six Sigma Healthcare

Projects

It is a pivotal moment in the history of medicine—one offering great promise through rapidly advancing *physical and intellectual* technology and tremendous pressure to deliver better care to more people for less cost.

Don L Redinius - Agillist Group Inc – 602-617-7337

Sample of Healthcare Improvement Areas

Some of the many healthcare improvement areas

- **Administrative Errors**
  - In admission
  - In the patient record
  - In discharge
  - In any financial statements
  - In coding
  - Claim submission
  - Cycle time
  - Hiring and timeliness
  - Payroll and payments
  - Receivables
  - Reporting
  - Compliance

- **Clinical Errors**
  - Incorrect or untimely diagnosis
  - Medication type, frequency and amount
  - In therapy or other treatment
  - Untimely treatment
  - Departure from nursing and any other professional standards
  - Lab Timing and errors
  - Errors in take home instructions
  - Errors in operating room care carts
  - Incorrect or untimely diagnosis
  - General patient safety
  - Malpractice and litigation

Six Sigma Project Results

As Operations Manager, Mary Ellen Pratt oversees Thibodaux's Six Sigma quality improvement program. Some examples of her Six Sigma successes:

- Reduced medication errors by 42%
- UTIs (urinary tract infections) by 38%
- Radiology turn-around time for inpatient results by 29%
- Financial Improvements for Six Sigma projects have increased the hospital's operating margin to 12% and created a cash reserve of $24 million in just two years.
- Examples:
  - Six Sigma Accounts Receivable (AR) Project done by the Finance organization. At the start of the project, the team calculated that $3.3 million of hospital revenue was "sitting in limbo" because the related claims lacked the coding or processing necessary to collect it. The project resulted in nearly $2 Million of added revenue by reducing the average number of AR days by ten. Each AR day was costing the hospital roughly $178,000.
  - Six Sigma Inventory project reduced inventory and supply costs by $489,000

Data Courtesy of MINITAB

Project: Insurance Claim Cycle Time

Business Problem Statement

The Hospital was experiencing excessive cycle times for processing insurance claims. 79% were exceeding the target of 10 days and 48% were exceeding the upper limit of 15 days to mail the claim to the insurance company. This created an undesirable outlay of cash estimated at $5 million.

Goals and Objectives

The project had a target to reduce the average claim cycle time (Y) from 16 days to 9 days. The quantity of claims submitted over 15 days will be reduced to less than 10%. The project will complete within 3 months.

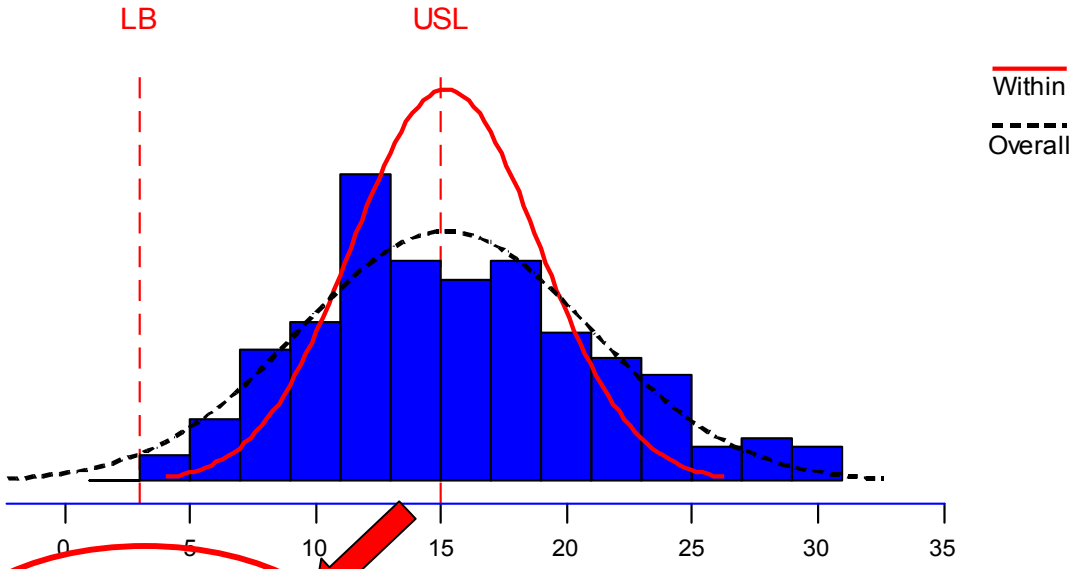
The expected annualized benefit will be a reduction receivables over $4 million and hard savings from the reduced cost of working capital of $210,000 in support the hospitals objective to improve asset utilization

Project: Insurance Claim Cycle Time

Measure Phase

This phase primarily used process mapping, the XY matrix and capability analysis. Capability analysis was performed with an upper specification limit of 15 days and a lower expectation limit of 3 days (represents the fewest days possible to prepare a claim), with a target of 10 days.

Initial Process Capability Analysis for Insurance Claim Submittal



Process Data	
USL	15.0000
Target	*
Lower Bound	3.0000
Mean	15.1787
Sample N	207
StDev (Within)	3.70353
StDev (Overall)	5.81481

Potential (Within) Capability	
Cp	*
CPU	-0.02
CPL	*
Cpk	-0.02
Cpm	*

Overall Capability	
Pp	*
PPU	-0.01
PPL	*
Ppk	-0.01

Observed Performance	
PPM < LB	0.00
PPM > USL	478260.87
PPM Total	478260.87

Exp. "Within" Performance	
PPM < LB	*
PPM > USL	519246.72
PPM Total	519246.72

Exp. "Overall" Performance	
PPM < LB	*
PPM > USL	512261.33
PPM Total	512261.33

Project: Insurance Claim Cycle Time

Analyze Phase

In this phase five overall process areas were confirmed as major contributing process steps (X's) using graphical analysis and hypothesis tests, these were:

1. Claim Reconciliation (Slow)

2. Services Recording (17 % had Incorrect/Missing Information)

3. Manager Review (Failure to Review)

4. Internal Mail Routing (Inconsistent Delivery Location and Time)

5. Queue Method (First in first out). For example a claim could sit in Accounts Receivables between 1 and 12 days before being worked on.

Of the 36 activities identified in the process map, 21 were designated as non-value added. The non-value added steps alone accounted for approximately 7 days of the current cycle time.

Project: Insurance Claim Cycle Time

Improve Phase

In this phase, five improvement actions were implemented:

1) Elimination of 14 of the 21 non value adding steps which reduced the claims loop cycle time 3 days (Of which one was the Manager's review)

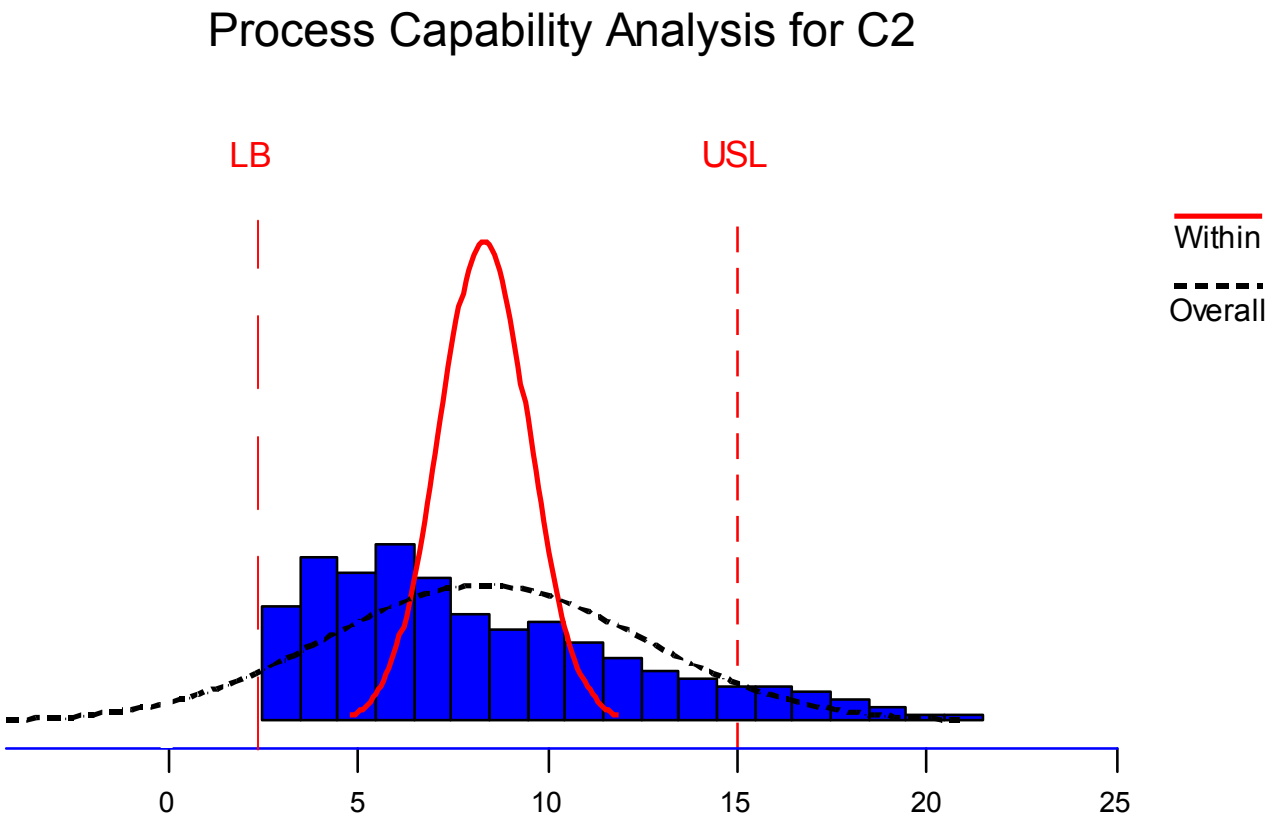
2) Revised form layout reducing service reporting errors to less than 5% accounted for an additional 2 days

3) It was also discovered that the originating departments were already maintaining electronic files of the patient record. The Accounts Receivable department was allowed to access this system which eliminated the need to request the patients' files via hardcopy, eliminating the internal mail issues which eliminated 1 day

4) A first in first out (FIFO) process was implemented in all process steps which eliminated 2 days

5) Developed training for personnel to implement the new process/procedures

Project: Insurance Claim Cycle Time



Process Data	
USL	15.0000
Target	*
Lower Bound	0.0000
Mean	8.3184
Sample N	201
StDev (Within)	1.18697
StDev (Overall)	4.19070

Potential (Within) Capability	
Cp	*
CPU	1.88
CPL	*
Cpk	1.88
Cpm	*

Overall Capability	
Pp	*
PPU	0.53
PPL	*
Ppk	0.53

Observed Performance	
PPM < LB	0.00
PPM > USL	79601.99
PPM Total	79601.99

Exp. "Within" Performance	
PPM < LB	*
PPM > USL	0.01
PPM Total	0.01

Exp. "Overall" Performance	
PPM < LB	*
PPM > USL	55424.80
PPM Total	55424.80

Project: Insurance Claim Cycle Time

Control Phase

In the control phase four control mechanisms were adopted.

1) An upper limit of one day was placed on the claim reconciliation process as an "early warning system" for the process

2) Services recording error rates were monitored with an SPC chart.

3) The total claim submittal times were monitored with an SPC chart via a daily sample

4) Quarterly audit of the process to assure conformance and consistency

Project: Insurance Claim Cycle Time

Results and Benefits Obtained

A total of 7 days of average cycle time was removed from the insurance claim submission process, this reduced the average cycle time from 15.2 days to 8.3 days.

Service recording errors were reduced from 17% to < less than 5%

This has improved revenue collection from an average of $16.1 million per month to $20.3 million. The annualized net reduction of $4.2 million of operating cash valued at a 5.4% weighted annual cost of capital has resulted in a net annual savings of $226,800.

Less than 8% vs. the original of 48% of all claim submittals are expected to exceed the upper limit of 15 Days.

Six Sigma
Operational Excellence

Sample of Healthcare Reported Projects

Project	Problem Statement	Objective	Savings
Long-Stay Outpatient Status	Observation and O/P-in-a-Bed Not Compliant With Managed Care Payor Definitions/Requirements	Long-Stay Patients Either Changed to I/P Status or Discharged by End of 23-Hour Period	$320,000
Documentation of Services Provided by Health Providers	Higher Level Services are Provided but Not Billed Due to Lack of Appropriate Documentation	Reduce Physician Time Spent On Documentation While Improving Quality of Documentation	$220,000
Documentation of Complications and Co-Morbidities for Spinal Fusions	Down-Coding of Spinal Fusion Patients	Improve Clinical Documentation and Increase Number of Diagnoses by 13%	$157,000
Medication Use Process	Delays in the Medication Use Process	Reduce Re-Worked Order Entry Errors From 1,510 to 453 Hours Annually	$38,000
Cash Collections	Delays Occur Throughout HME Billing Process Adversely Affecting	Increase Cash Collections From $100,000 to $275,000 Per Month	$168,000
E.R. Diversions Related to Staffing	Number of Hours E.R. on Diversion	Reduce Number of Diversion Hours by 25% From Average of 120.5 Hours to 90.4 Hours Per Month	$200,000
Patient Status Denials	Managed Care Denials Due to Patient Status Type	Correct Current Pre-Certification Process and Assure Patient Type Matches Payor Authorization	$575,000
Health Information Management Coding	Delay in Completion of Medical Record Coding	Code Medical Records Within 4 Days of Patient Discharge	$148,000
Discharge Notification Process	Delay in Notifying Support Services Departments of Patient Discharge	Decrease Range of Notification Times to Support Services Departments About a Patient Discharge	$150,000

Six Sigma
Operational Excellence

Sample of Healthcare Reported Projects

Project	Problem Statement	Objective	Savings
E.R. Throughput	Delay In Moving Admitted Out of E.R. Into a Bed	Reduce Time Taken To Place Patients in a Bed From 125 To 110 Minutes	$167,000
Materials Logistics for Surgical Services	Inaccurate Case Carts and Instrument Trays	Decrease Defects On Case Carts and Instrument Trays By 70%	$222,000
Health Plan HCFA Workflow	Discrepancies On HCFA Reconciliation Report	Correct Erroneous Member Identifiers and Reconcile Report Monthly	$300,000
Safety and Efficacy of Acute Anticoagulation Services	Incidents of "over anticoagulated" and safety are exceeding benchmark levels	For patients requiring acute, full-dose anticoagulation with heparin, improve patient outcomes by increasing effectiveness of current heparin protocol, reduced heparin adverse drug reactions, reduced medication errors and associated liability. Seek opportunities.	$168,700
New Born Speical Care Unit Improvement	Improve patient safety, enhancing quality of care and improving satisfaction of families and caregivers in the New Born Special Care Unit by optimizing utilization of resources and caregiver skill mix.	Identify all non level II/III infants currently on the unit, understand their clinical, resource, operational and financial impact and determine the optimal alternative care setting for them. Model the NBSCU without this population to understand the benefits	N/A
Operating Room Care Cart	Inaccurate case carts being delivered to the OR on a daily basis are causing rework and procedural delays. The current process functions at 4.38 defects per unit. Staff are very dissatisfied with the process and one OR is being used as a supply storage area	Decrease defects per unit (DPU) on case carts from 4.38 DPU to 1.3 DPU by November 2001.	$189,000

Sample of Healthcare Reported Projects

Project	Problem Statement	Objective	Clinical or Admin	Results	Savings
Reduction in SICU Bloodstream Infections (BSI)	**YNHH SICU has high rate of BSIs compared to national average and other YNHH ICUs.**	**To reduce the incidence of BSIs to at least the CDC NNIS standards for Catheter Days between a BSi.**	**Clinical**	**Decreased LOS for selected patients, increased ICU capacity**	**$450,000 per year**
Correct Surgical Case Materials in the OR	**RNs having to leave the OR too often during a case to get standard equipment.**	**Ensure all functional and specified materials in the operating room when patient arrives.**	**Clinical**	**Statistically decreased number of times an RN had to leave the room, disconnected RD satisfaction from "having to leave room for a supply"**	
Enhanced MRI Scheduling	**Schedulers were spending several minutes on phone with each caller simply providing driving and parking directions.**	**Reduce the time to human contact for MR appointment scheduling via the phone.**	**Admin**	**Reduced average time to human contact on phone from 80 to <30 seconds.**	**Estimated incremental net revenue of $40K to $70K per year.**
Accurate Patient Registration at Outpatient Lab	**Registration process was very complex, included many manual interventions and required human and well as systems communications across multiple departments.**	**Accurately and thoroughly capture patient demographic data at outpatient laboratory registration to ensure accurate billing for services**	**Admin**	**Eliminated timely filing issues and improved cash flow**	**Annual net revenue enhancement of $300,000**

Six Sigma
Operational Excellence

Sample of Healthcare Reported Projects

Project	Problem Statement	Objective	Clinical or Admin	Results	Savings
Operating Room Automated Time Charging	**Registration process was very complex, included many manual interventions and required human and well as systems communications across multiple departments**	**Accurately and thoroughly capture and bill adult and pediatric operating room time charges.**	**Admin**	**Reduced defect rate from 7% to <1%.** **"Rigorous Six Sigma measurement process led to a solution that may not have otherwise been found or been sustained over time." – quote from the Director of Reimbursement**	**Annual net revenue enhancement of $618,000**
Blood Bank Charge Capture	**Blood bank services that should have had a charge were not charged**	**Accurately and thoroughly capture and bill Blood Bank charges**	**Admin**	**SOP developed and implemented, including automated steps, improved verification checks and clear protocol for time-off coverage**	**Annual net revenue enhancement of $326,428**

McKESSON
Empowering Healthcare

Healthcare's Evolution of Six Sigma

We Believe the Following Adoption and Maturity Sequence will Occur

1. **Awareness and Early Implementer Phase (Complete)**
2. **Communication of Early Successes Phase (Nearly Complete)**
3. **Adaptive/Customization Phase (In-Progress)**
4. **High Acceptance Phase (One to Two Years Out)**
5. **Way of Doing Business Phase (Three to Five Years Out)**

SIGMA

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Six Sigma at YNHH
Supporting Factors

- Initiative driven by CEO & Senior Management
  - Senior Executives trained as sponsors
- Rolled out as "toolset to support Business Plan implementation"
- Three year skills transfer partnership with GEMS
- Pre-existing culture of performance excellence
- Data driven emphasis, key especially for physicians
- Successfully achieved significant financial benefits from projects by Year Two
- Project decisions made based on business criteria, not just quality criteria
- Offers real management development, variety of skills
  - Career development steps for Green & Black Belts
- Offers consistent problem solving technique and language
- Pays attention to change management

YALE-NEW HAVEN HOSPITAL

Six Sigma at YNHH
Hindering Factors

- No full time resources yet
- Difficult to free up staff time required for training and project work
- Requires culture change - slow process
- Results take time - “patience required”
- Sponsors need ongoing support and guidance
- Discipline required in Control Phase

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YALE-NEW HAVEN HOSPITAL

Lessons Learned

- Must be driven by Senior Management
  - Executive Training required up front
- Project Selection is key
  - Focus on high priority projects with tangible benefits
  - Focus within each project - don't solve world hunger
- People selection is key
  - Choose high potential staff from multiple disciplines, including physicians
  - Ensure mix of quantitative versus qualitative skills in trainees
- Resource commitment required up front for effective roll-out
  - Infrastructure
  - Black Belts/Master Black Belts
- Work-OutTM/CAP tools beneficial and can be applied to non-Six Sigma projects