7-27-2007

Lean Healthcare Applications

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Lean Healthcare Applications

Heather Woodward-Hagg

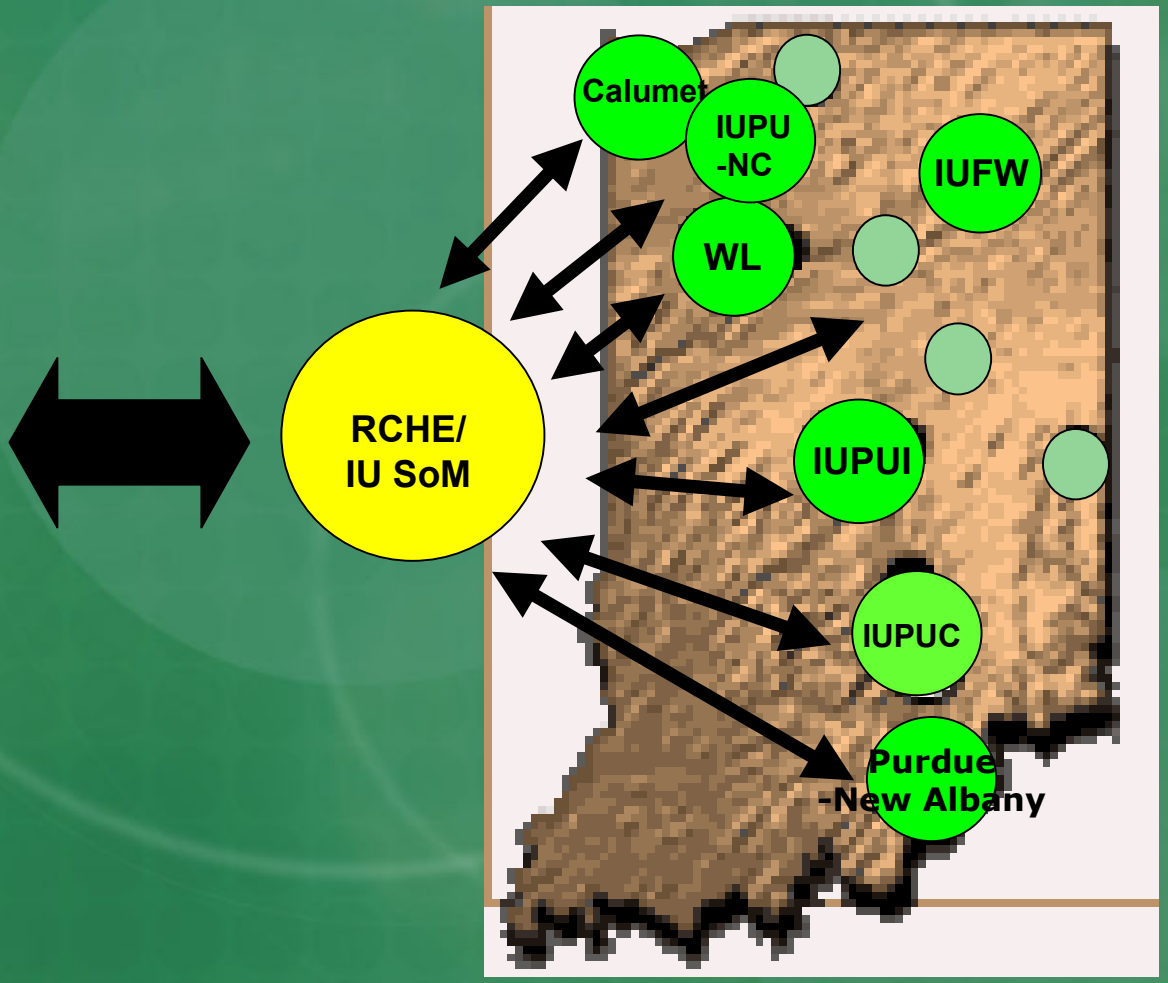
RCHE Purdue Statewide Regional Campus Collaborative

- Interdisciplinary collaborative of Engineering, Technology and Clinical Faculty from Purdue Statewide Campuses
- Focus on partnership with hospitals and healthcare providers to provide training/facilitation through implementation to create self-sustaining programs
  - 35 projects completed, 9 on-going, 22 hospitals, 8 hospital systems
  - 83% implementation rate
  - 81% of implemented sustained at 9-12 months
  - 65% of implemented projects showed good spread

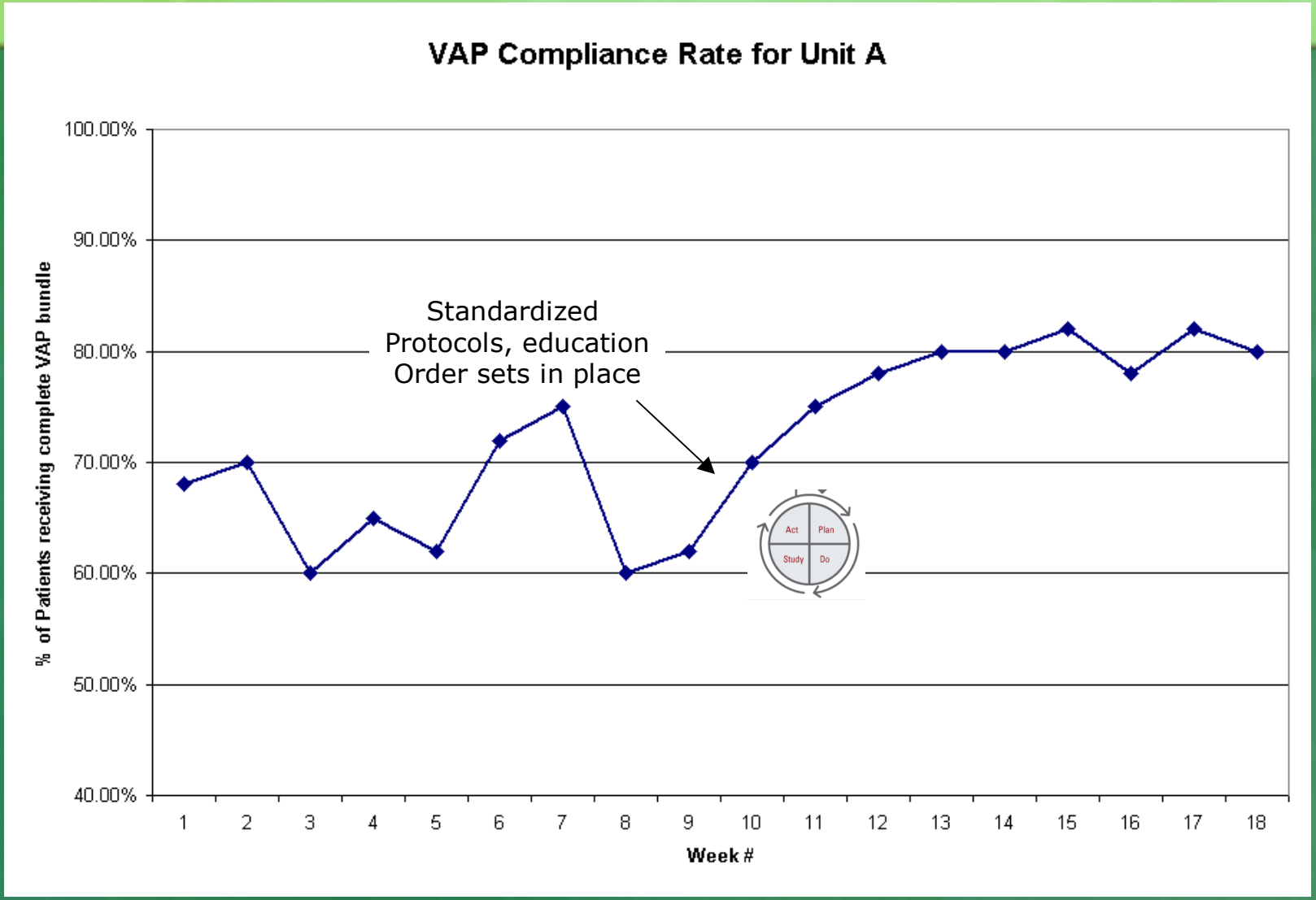
Purdue Statewide/Regional Campus Model

Research in:

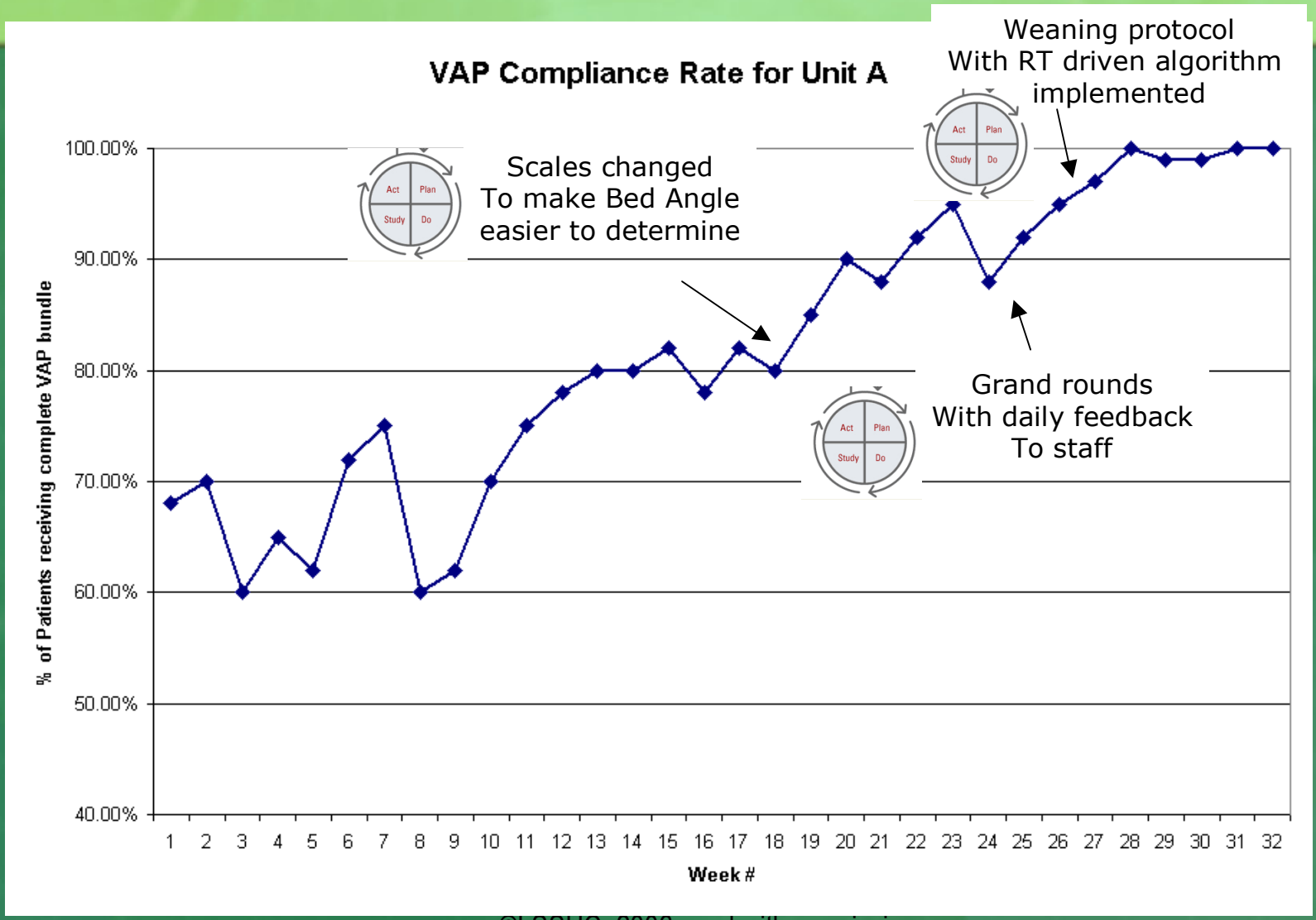
- Clinical Implementation
- Modeling and Simulation
- Supply Chain Management



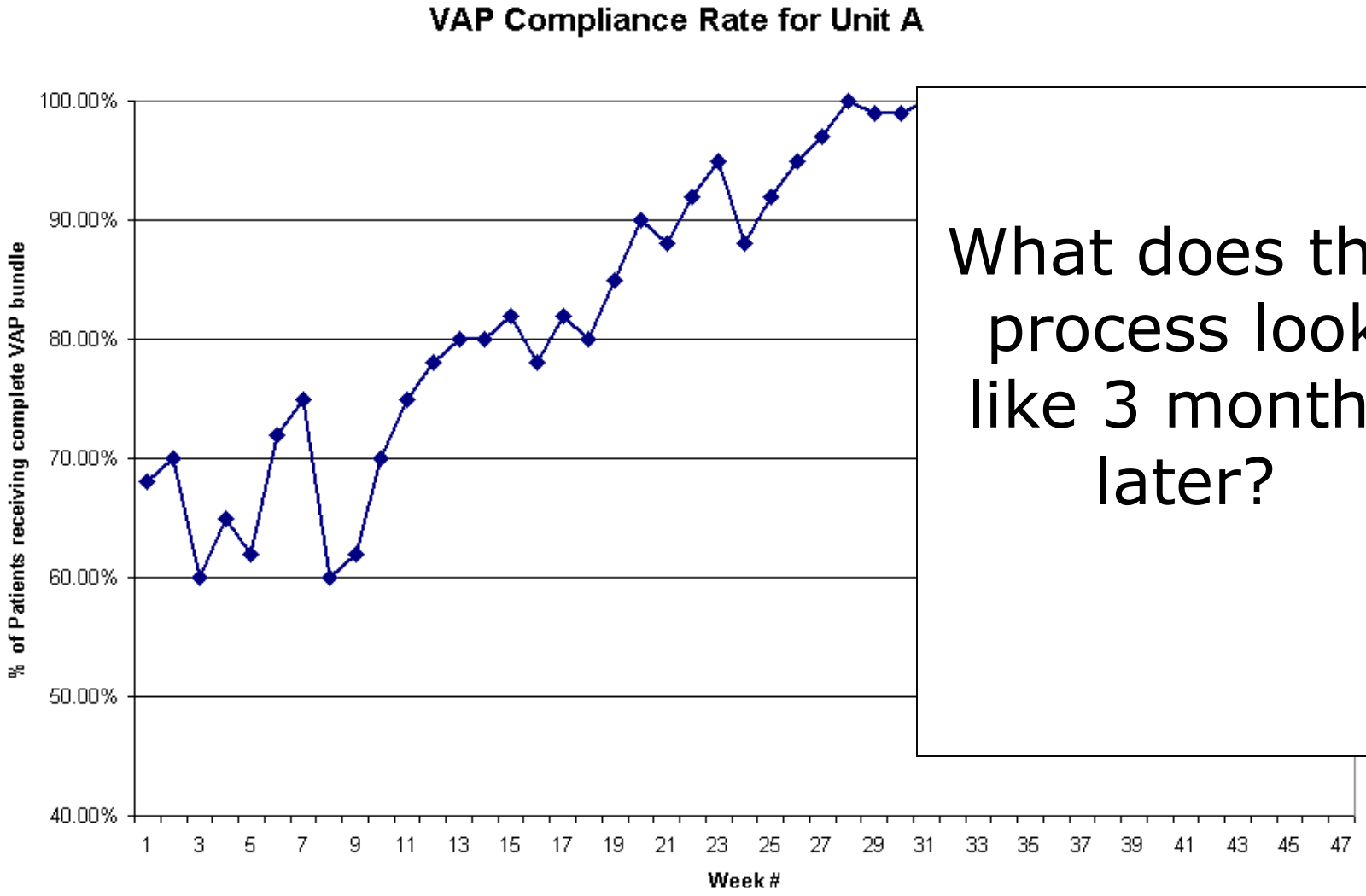
Designing reliable processes…



Designing reliable processes…



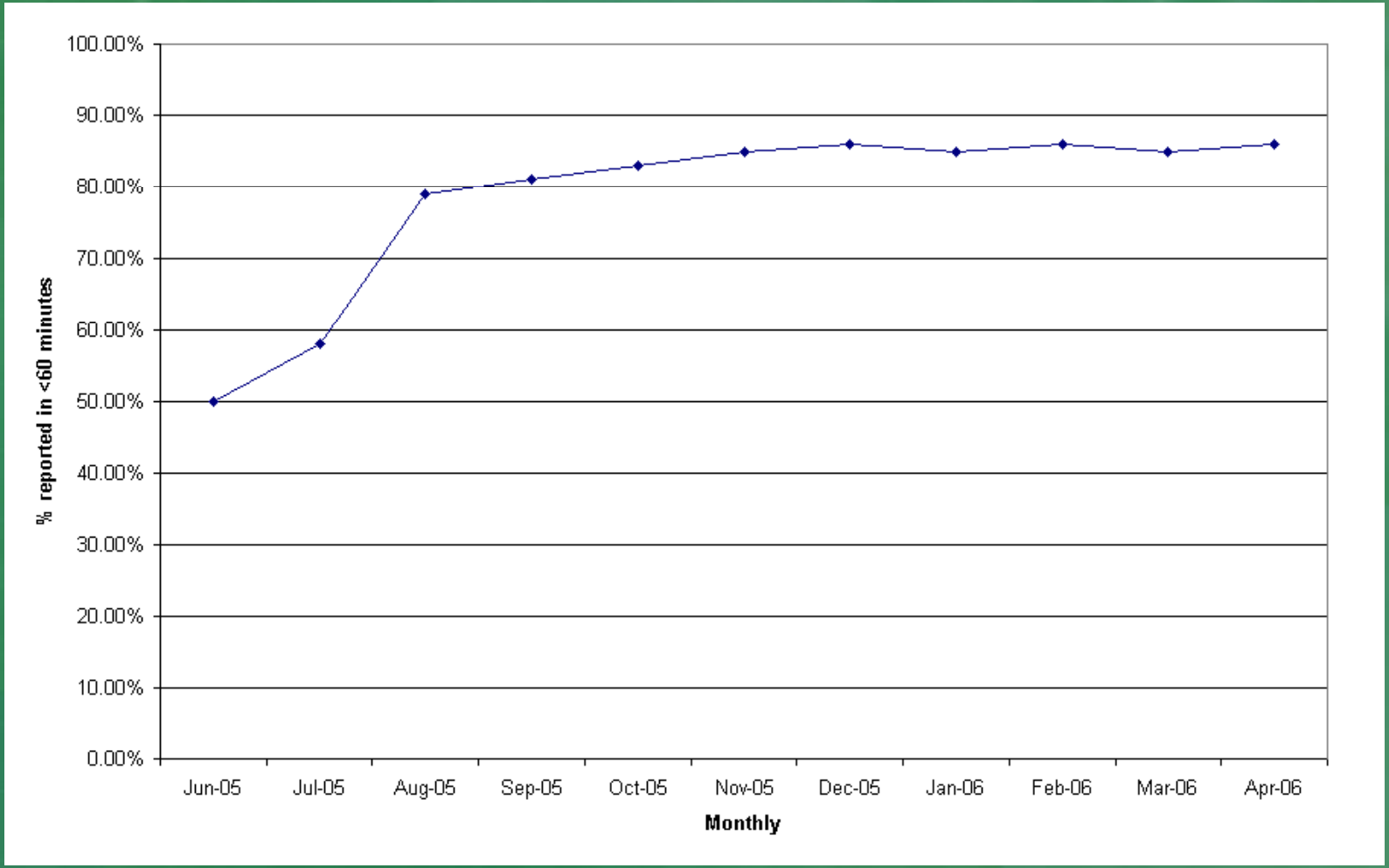
Sustainability



What does this process look like 3 months later?

Woodward-Hagg, H., El-Harit, J., Vanni, C., Scott, P., (2007). Application of Lean Six Sigma Techniques to Reduce Workload Impact During Implementation of Patient Care Bundles within Critical Care – A Case Study. *Proceedings of the 2007 American Society for Engineering Education Indiana/Illinois Section Conference*. Indianapolis, IN. March 2007.

Average Daily % of ED stat orders (Order to Verify) returned within 60 minutes through April, 2006



What is Sustainability?

- The persistence of Performance Improvements over time.
- How is Sustainability assessed?
  - Excellent: Fully implemented, Sustained to goal for greater than 12 months
  - Good: Significant or partial implementation, sustained to goal for greater than 6 months
  - Fair: Some implementation occurred, but did not sustain to goal for greater than 3 months
  - Poor: No Implementation, and/or did not meet goal for at least 3 months following implementation or other sustainability issues

What factors impact Sustainability?

- Bottom up vs Top Down Initiatives: change should be driven from the lowest level possible within the organization
- Small Incremental Tests of Change: change should be gradual, beginning with the lowest levels of implementation complexity and migrating to higher levels over 4-6 weeks.
- Regular (Daily) Data Feedback to front line staff: Process performance data should be presented to the front line staff members on a regular basis (daily is preferred, reducing frequency as process stability is achieved).
- Accountability infrastructure: Performance metrics should be monitored and supervisors, front line staff members held accountable to low performance and recognized/rewarded for high performance.

What is Spread?

- The application of tools and techniques outside of the original project focus area.
- How is Spread assessed?
  - Excellent: Principles spread to other unit or project area with no outside assistance
  - Good: Principles spread to other unit or project area with limited outside assistance
  - Fair: Some evidence of application of principles beyond initial project area
  - Poor: No evidence of application of principles beyond initial project area

What factors impact Spread? [1]

1. Perceived Benefit - organizational and personal
2. Compatibility with existing systems, values, beliefs, current needs
3. Simplicity – Simple innovations spread faster than complicated ones due to the role of adaptation in spread of innovation.
4. Trialability – Changes should be tested and verified prior to full implementation.
5. Observability – Tests of change should be conducted in such a way so as to be readily observable by other 'early adopters'.

[1] Berwick DM. Disseminating innovations in health care. JAMA. 2003 Apr 16;289(15):1969-75

100 Day
Lean Healthcare Projects

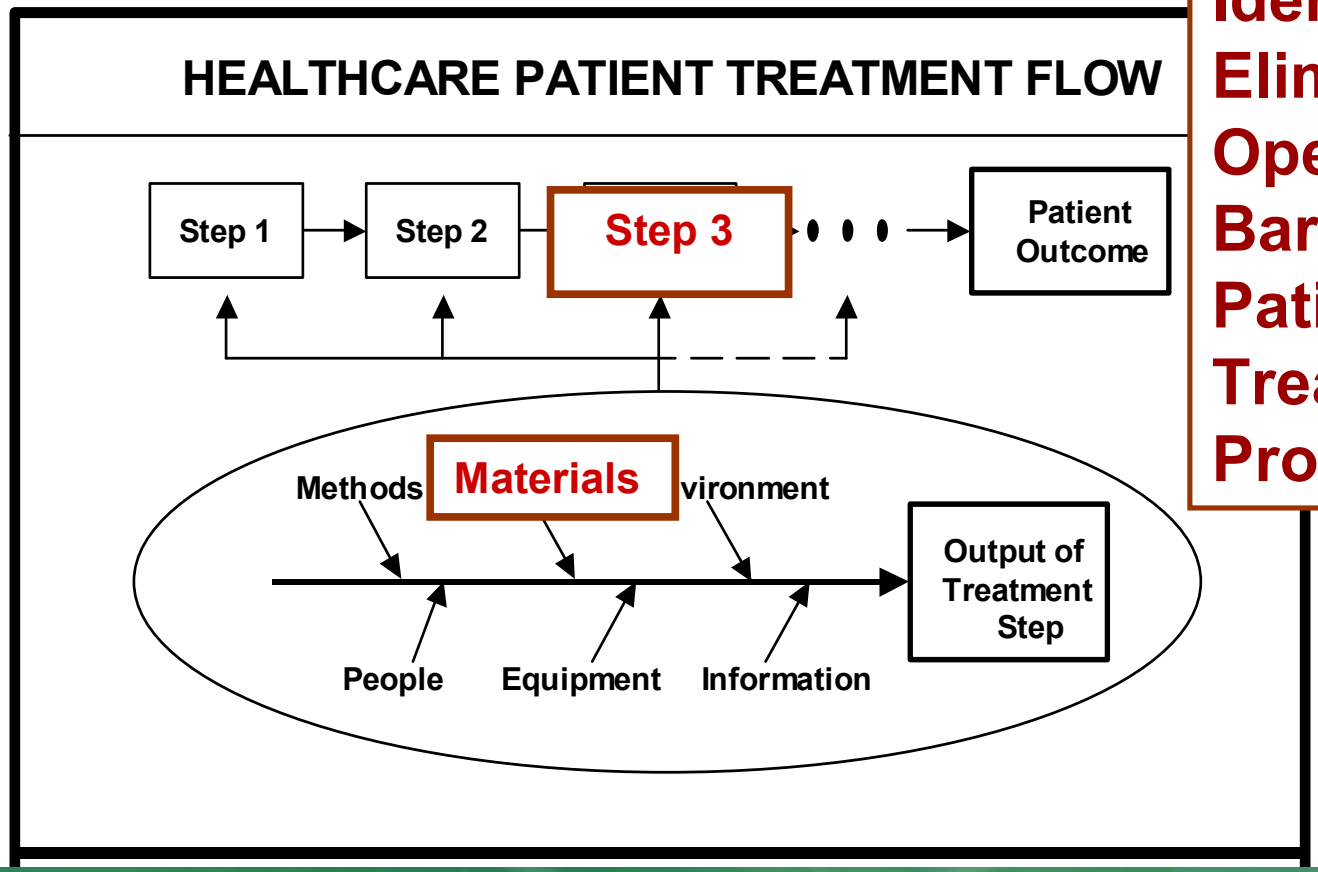
Key Lean Concepts

- Value
  - Determined by the “customer” (patients; ordering provider; traveler)
- Waste
  - Anything that does not add value from the customer’s perspective

  (or, is not necessary for compliance)
- Value stream
  - The actions (and waste) taken to create value

Information used courtesy of Peter Woodbridge

Lean Process Design…

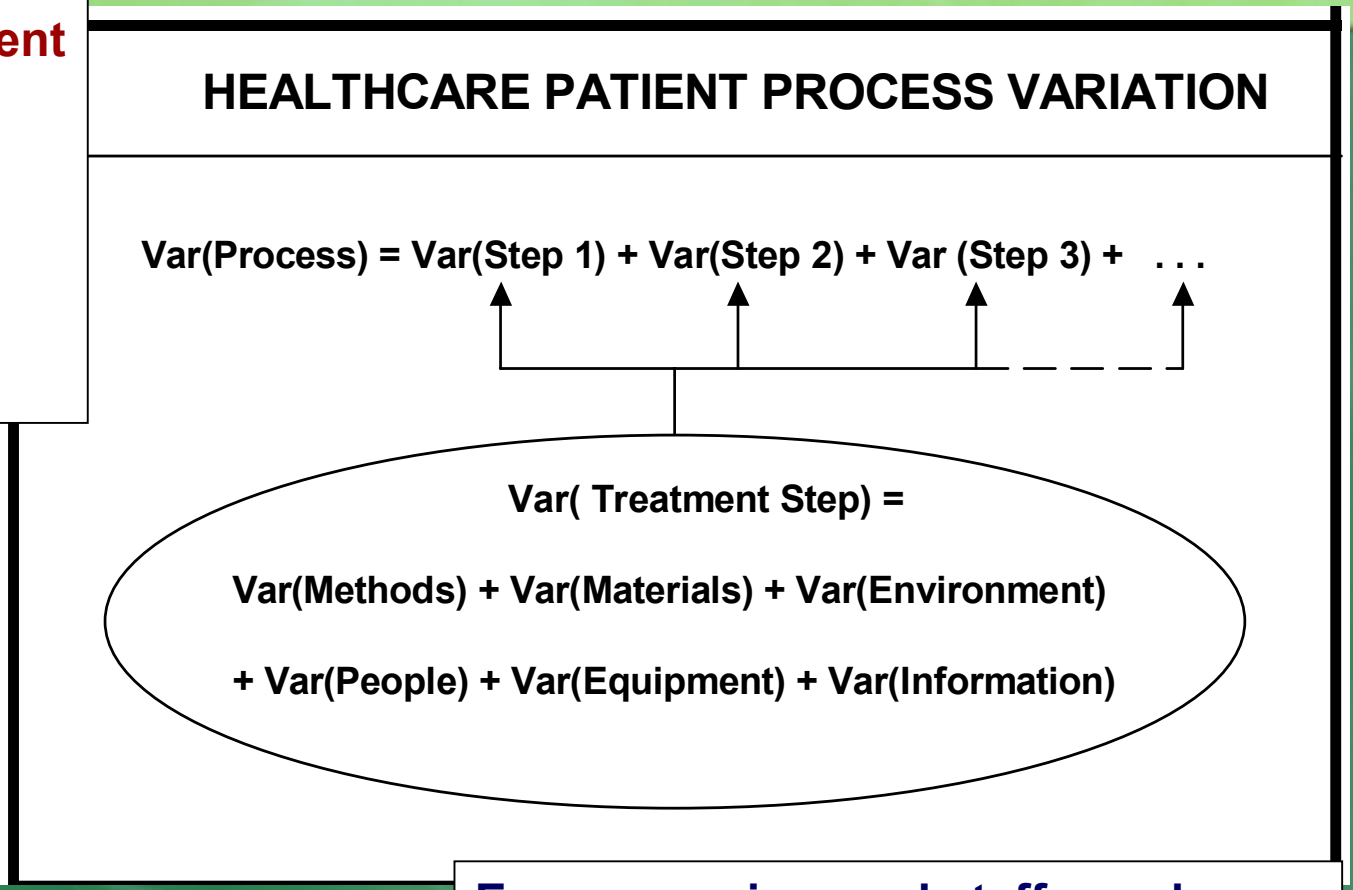


Identifying and Eliminating Operational Barriers within Patient Treatment Processes

Reducing sources of variation…

Every step in the patient treatment process contributes to the:

- **Patient Outcome**
- **Patient Satisfaction**
- **Cost of Treatment**



Every caregiver and staff member must be active in reducing variation.

100 Day Lean Healthcare Project

- Goal: Provide Lean Healthcare training and facilitation over 100 day project cycle to build basic knowledge and proficiency in Lean methods and tools:
  - Drive Improvements to the Front Line Staff Level
  - Begin Adaptation Cycle
    - Simplicity
    - Compatibility

100 Day Lean Healthcare Training

- Steps:

Define the Problem

Baseline Current Processes

Identify Operational Barriers

Develop Future State Process

Process Control Strategy

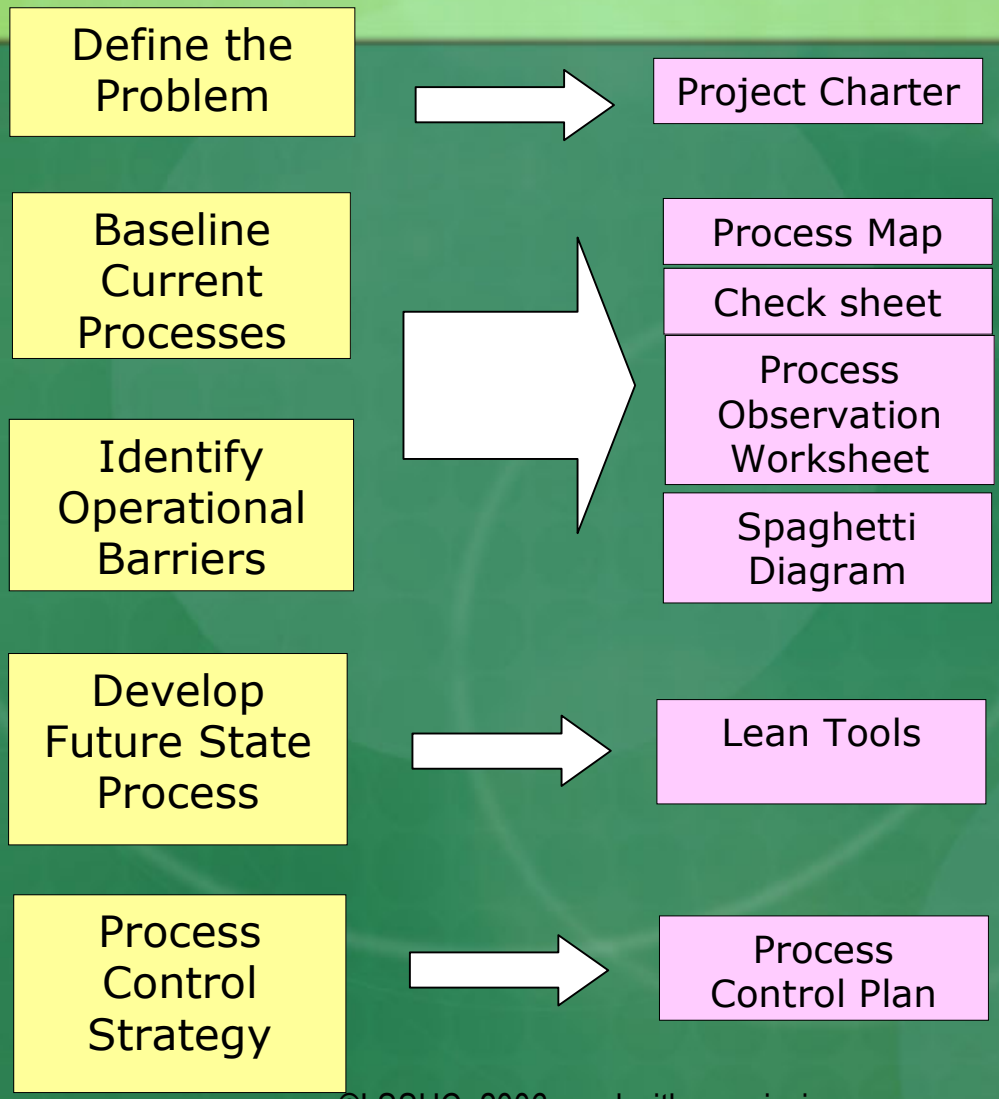
1. Define the Problem
2. Baseline current processes
3. Identify operational barriers and failure modes in the current process
4. Create the ‘future state process’ by applying Lean techniques to eliminate operational barriers and failure modes.
5. Create a ‘process control strategy’ – a strategy for insuring long term sustainability and spread adoption

100 Day Lean Healthcare Training

- Define the Problem
- Baseline Current Processes
- Identify Operational Barriers
- Develop Future State Process
- Process Control Strategy

- Expected Outcomes:
  - Participants will learn how to define the problem under investigation
  - Participants will learn how to collect data to baseline process performance
  - Participants will learn how to observe processes to identify operational barriers within their processes.
  - Participants will learn how to apply basic and advanced Lean techniques, such as 5S and visual controls to create robust ‘future state processes’.
  - Participants will learn how to design and implement long term control strategies to insure sustainability and spread adoption

Lean Tools

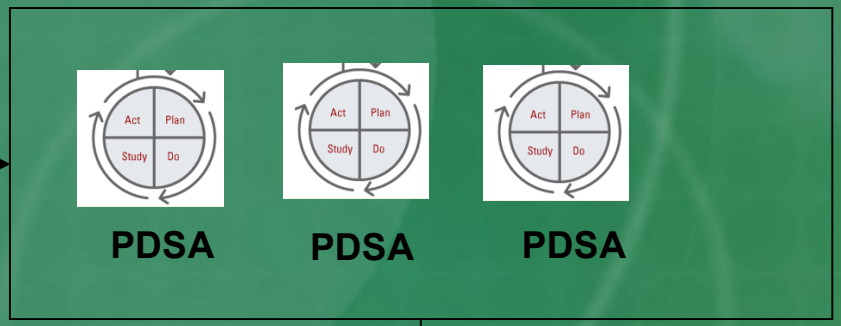


Where is PDSA used within the 100 Day Lean Cycle?

Define the Problem

Baseline Current Processes

Identify Operational Barriers



Develop Future State Process

Process Control Strategy

100 Day Lean Healthcare Training Agenda

- Week #1: Define the Problem
- Week #2: Baseline Current Processes
- Week #3: Identify Operational Barriers
- Week #4: Future State Process: Basic Lean Tools
- Week #5: Future State Process: Advanced Lean Tools
- Week #6: Healthcare Financial Concepts
- Week #7: Pilot Implementation
- Week #8: Process Control Strategy
- Week #9-12: Pilot Plan Implementation

Key Factors for Lean Tool Application to Healthcare

- Focus on enabling the cultural transformation, rather than building technical skills
  - Simplify, Simplify, Simplify
  - Require immediate application
  - Use readily accessible materials
  - Use Healthcare terms and examples rather than those from Lean Manufacturing
- Facilitate through repeated applications of tools for at least 2 additional cycles

Lean Tools

Workflow Analysis

Workflow analysis is used to:

1. Baseline existing clinical processes prior to the improvement cycle
2. Validate process outputs following improvement

- Workflow analysis includes qualitative and quantitative assessments of work processes.

Baseline Current Processes

- What is a baseline?
  - Measurement of output metrics in the current process

- Why?
  - Identify the ‘BIG’ hitters – primary operational barriers
  - Provides reference once improvements are made

Tools for performing workflow analysis…

- Current State Process Maps
- Checksheets
- Process Observation Worksheets
- Spaghetti Diagrams

- Value Stream Map

Current State Process Map

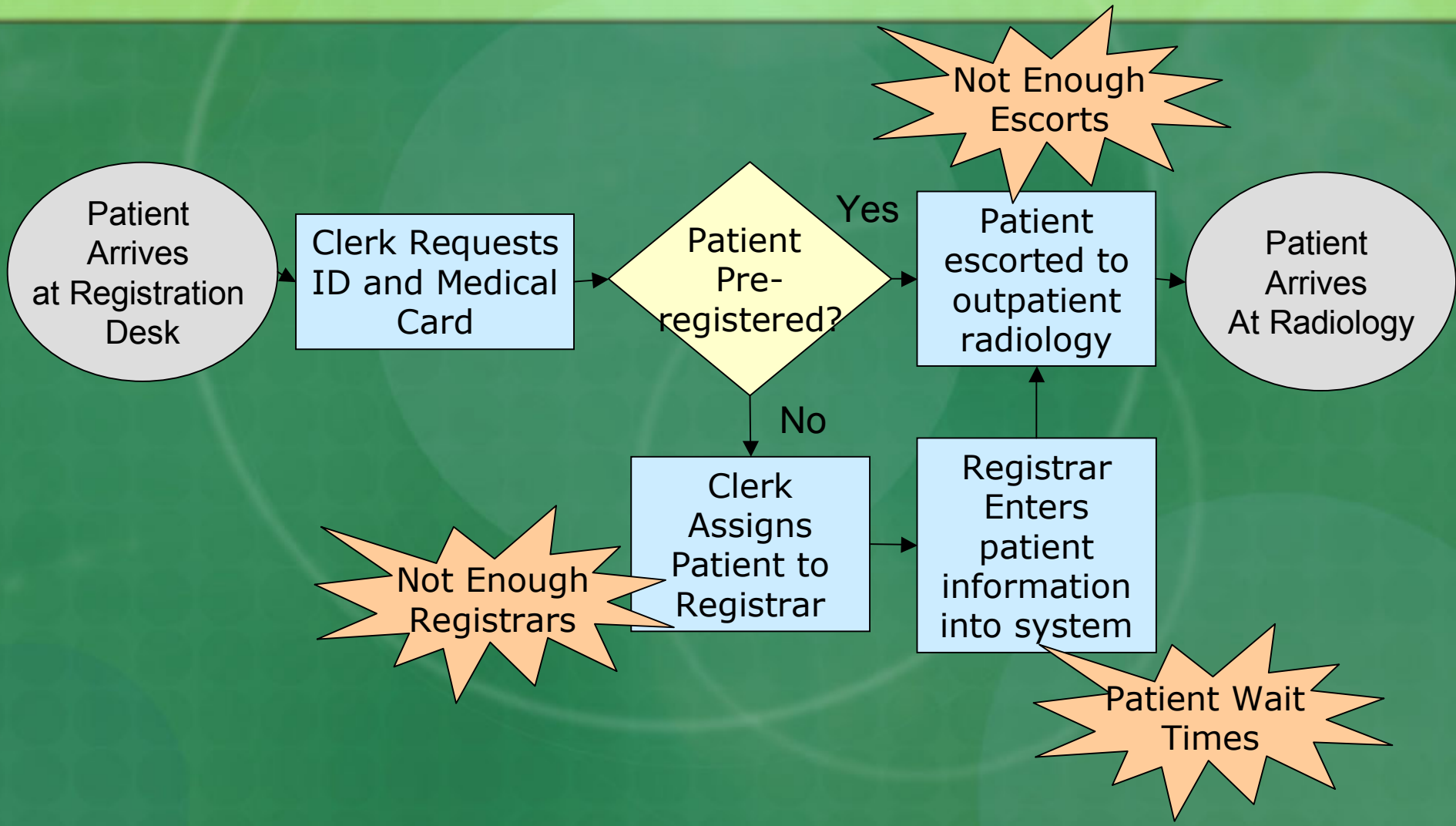
- A diagram that uses graphical symbols to depict the nature and flow of the steps in a process
- Process Maps (a.k.a Flowcharts) provide a visual tool for:
  - Understanding the Process
  - Identifying problem areas that can be targeted for improvement

Current State Process Map

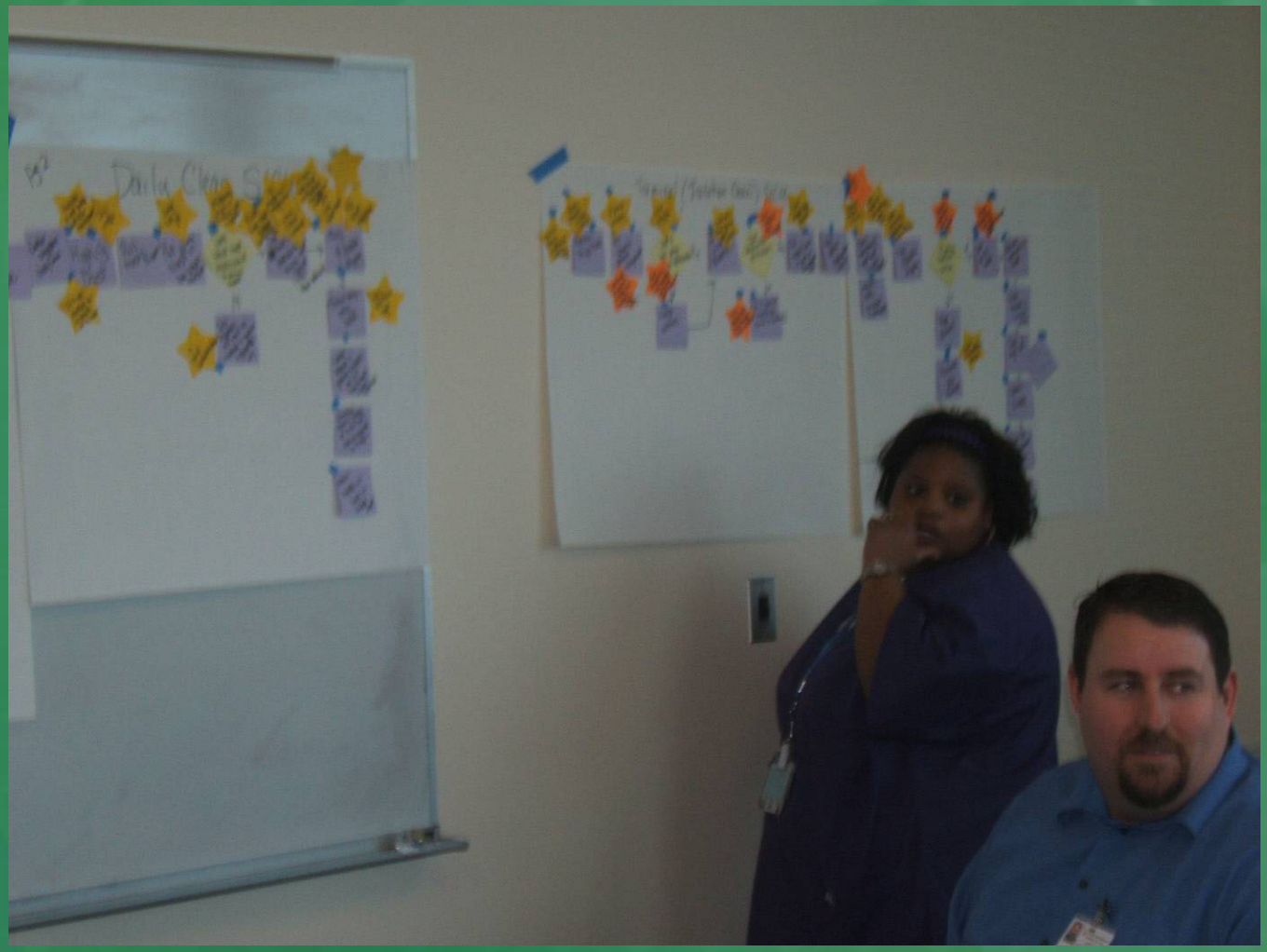
Steps to creating a process map:

1. Review the process under investigation and establish boundaries as outlined in the project charter.
2. Using brainstorming techniques, identify steps in the process.
3. Arrange the processing steps in order.
4. Validate the process flow either by showing the process map to a non-team member involved in the process, or by physically observing the process.

Outpatient Registration Current State Process Map



Process Mapping
Daily/Terminal Cleans



Checksheets

- A worksheet used to collect qualitative process output data, such as compliance and adherence data
- Standardizing forms ensures that data is collected in a reliable, repeatable way.

Checksheets

- Steps to creating/using a checksheet:

1. Select the output variable(s) to be measured.
2. Add columns to collect additional information, such a dates,
   times and shifts.
3. Add columns that may be
   used to indicate categories
   or reasons for
   non-compliance/adherence.
4. Pilot test the form design
   and make changes as required.

Checksheet Example #1

Example #1: Audit Checksheet					
Project Name:					
Output metric:					
Date/Time	Unit	Room #	Compliance against Hand Hygiene protocol (Y/N)	Reason if non-compliant:	Comments:
1/1/2007 10:00AM	ICU	405	Y		
1/1/2007 10:05AM	ICU	405	N	Alcohol dispenser empty	
1/1/2007 10:10AM	ICU	405	N	Nurse carrying items	

Checksheet Example #2

Example #2: Operational Barrier Checksheet					
Project Name:					
Output metric:					
Date/Time	Patient Delay?	Delay Type	Patient Pre-reg'd?	Reason for delay	Comments:
1/1/2007 10:00AM	N		Y		
1/1/2007 10:05AM	Y	DATA	N	Wrong billing info	
1/1/2007 10:10AM	Y	ES	N	Call-off, low staffing	
Reason codes:	DATA: Data Error				
	REG: Waiting on Registrar				
	ES: Waiting on Escort				

Reason or defect code key

Process Observation Worksheet

- A data collection tool used during process observation to collect times and durations for individual process steps.

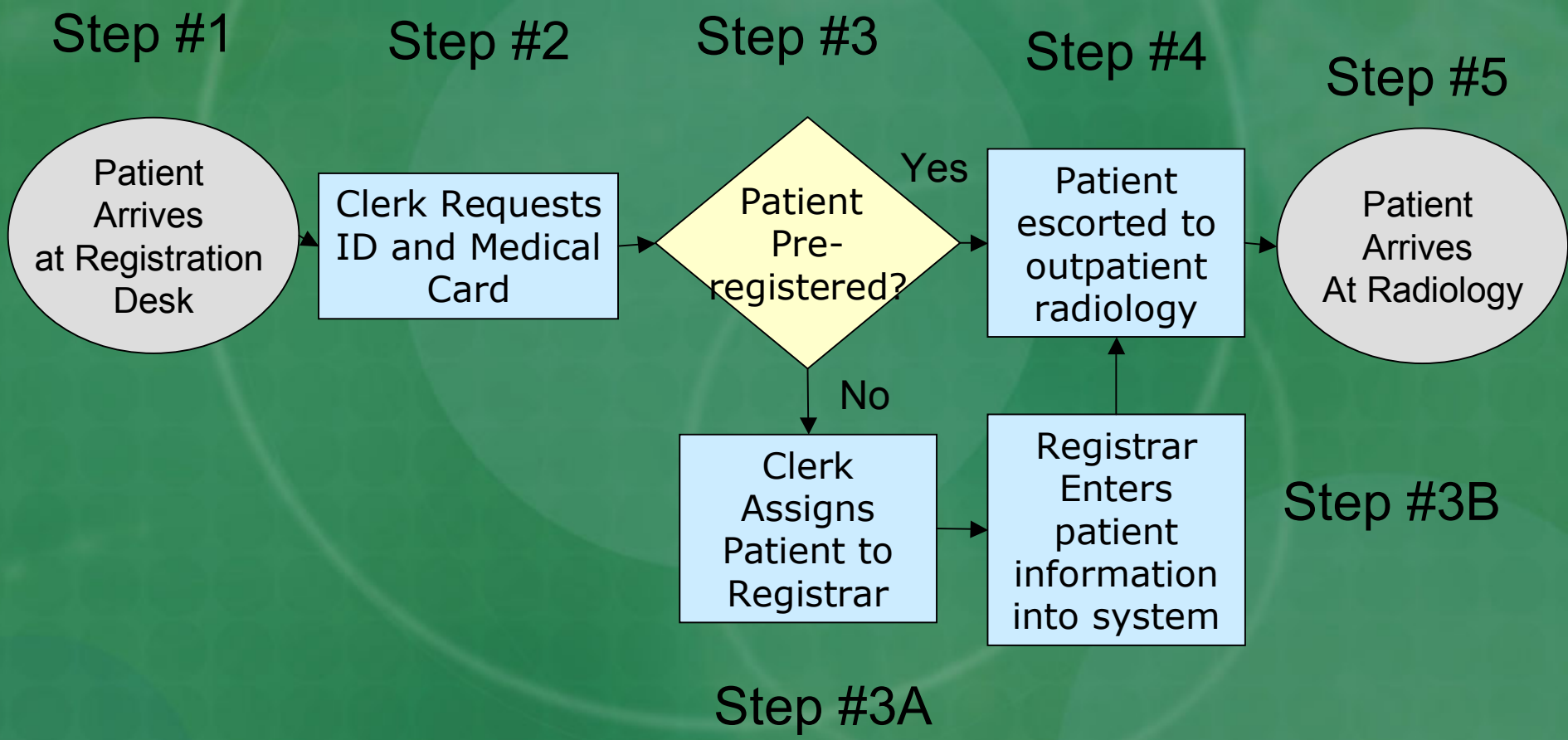
- Using a standardization process observation worksheet allows for reliable, repeatable data collection.

Process Observation Worksheet

- Steps to creating/using a process observation worksheet:

1. List the steps from the process map in sequential order.
2. Observe the process and collect information on process step durations, wait times, and travel distances.
3. Multiple observations should be done in order to determine range of variation in processing steps/times.

Outpatient Registration Current State Process Map



Process Observation Worksheet

Process Observation Worksheet		Process:	Outpatient Registration		Name:	Jane
Step #	Description	Distance	Clock Time	Task Time	Wait Time	Observations
			0:00			
1	Patient Arrives at the Registration Desk		0:10	0:10		Long line at desk
2	Clerk Requests ID + Medical Card		0:13	0:03		
3	Patient Pre-registered? (Y/N)		N			
3A	- Clerk Assigns patient to Registrar		0:15	0:02		
3B	- Registrar enters patient information into system	100	0:25	0:10	0:03	wait for registrar
4	Patient escorted to Outpatient Radiology	200	0:33	0:08	0:05	wait for escort
5	Patient Arrives at Outpatient Radiology		0:45	0:12		

Process Observation Worksheet

Task time calculated later…

Process Observation Worksheet		Process:	Outpatient Registration		Name:	Jane
Step #	Description	Distance	Clock Time	Task Time	Wait Time	Observations
			0:00			
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4	Patient escorted to Outpatient Radiology	200	0:33	0:08	0:05	wait for escort
5	Patient Arrives at Outpatient Radiology		0:45	0:12		

Distance traveled In steps

Enter time that step was completed.

Waste Worksheet Example

Process Observation Worksheet
Process:

Types of Waste	Observations During Process Walk-through
Processing Unnecessary processes and activities traditionally accepted as necessary. More steps than necessary. Unnecessary effort ("friction").	
Motion (Search Time) Unnecessary movement that does not add value. Movement that is too slow or too fast. Time spent looking for information, people, supplies and equipment.	
Defects Cost of inspection for defects; customer complaints; passing on defects to others rather than fixing the problem when detected; work-arounds	
Transportation Conveying, transferring, picking-up/setting down, piling up, and otherwise moving unnecessary items.	
Inventory Anything – materials, parts, implants, supplies – that are retained for any length of time that could be ordered just-in-time. Work in progress waiting for action	
Overproduction Producing what is unnecessary, when it is unnecessary, and in unnecessary amounts; "just-in-case" work	
Time Waiting for people or services to proceed; idle time rather than "just-in-time" or "pull production." Delays and queues.	
Complexity Complex process flows. Product choices that confuse customers. Organizational boundaries that introduce inefficiency and frustrate customers.	

Courtesy of Peter Woodbridge

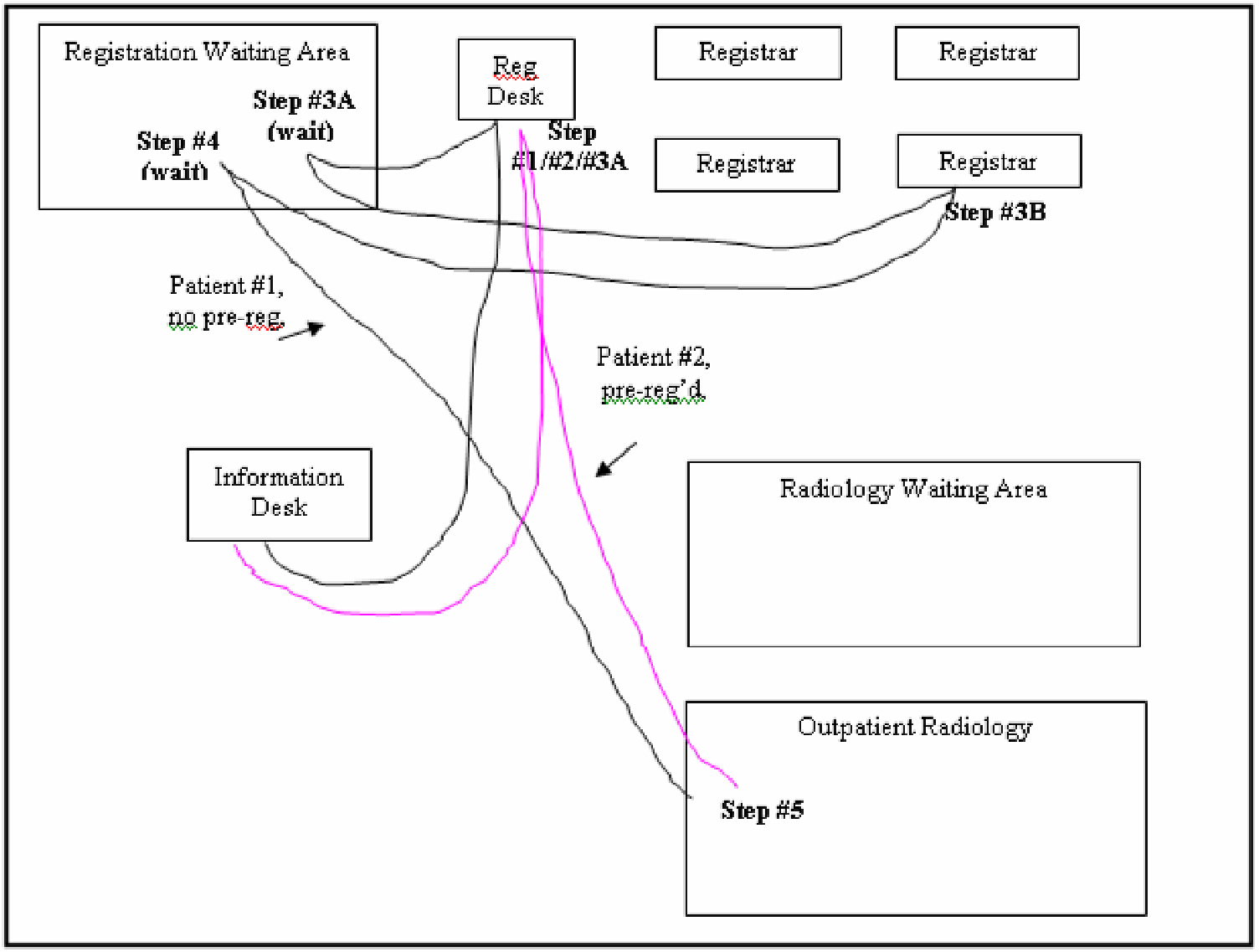
Spaghetti Diagram

- Spaghetti Diagrams:
  - Also known as a transportation or workforce diagram
  - Is used to visually represent the physical flow of work for a process

Spaghetti Diagram

- Steps for creating a spaghetti diagram:
  1. Find or create a diagram of the workspace.
  2. Observe the process:
     - Note the physical location of the worker at the beginning of the process.
  3. Draw lines that follow the path that the worker takes as they complete the process.
     - Lines may be numbered to reflect the steps on the process map.

Spaghetti Diagram



Value Stream Map

- A Value Stream Map is used to summarize the information collected by the other process observation tools.

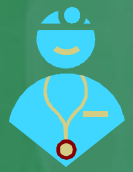
- Information and material flow may be added to provide a complete snapshot of the process.

Value Stream Symbols

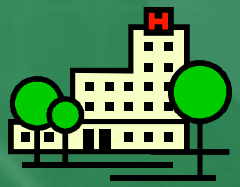
Process Box

Data Box

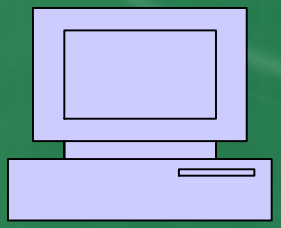
Physician



Hospital



Information /Computer System



Pull System Flow

Information Flow

Physical Flow

Electronic Information Flow

Queue/ Inventory

Value Stream Map

- Steps to creating a Value Stream Map:
  1. Flow Chart the Process from the Perspective of the Patient
  2. Add Suppliers and Customers
  3. Map the Information flow
  4. Map the Material Flow
  5. Collect/Add information about process times, wait times and queues.

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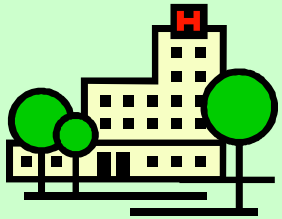
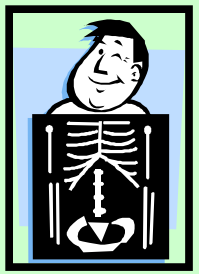
Value Stream Map Step #1/#2



Scheduling

Referring Physician



Radiology

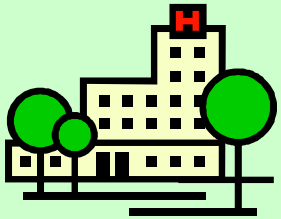
Verify Information

Assign to Registrar

Enter information

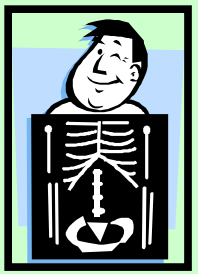
Escort to Radiology

Value Stream Map Step #2/#3

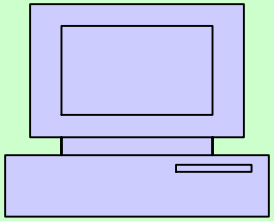


Scheduling

Referring Physician



Radiology



Registration System

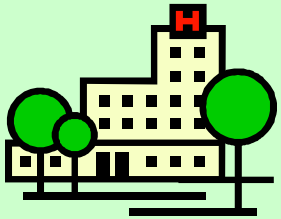
Verify Information

Assign to Registrar

Enter information

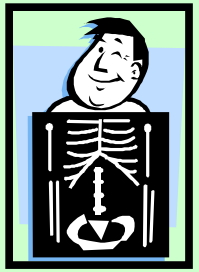
Escort to Radiology

Value Stream Map Step #5

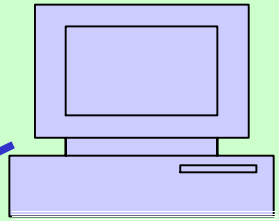


Scheduling

Referring Physician

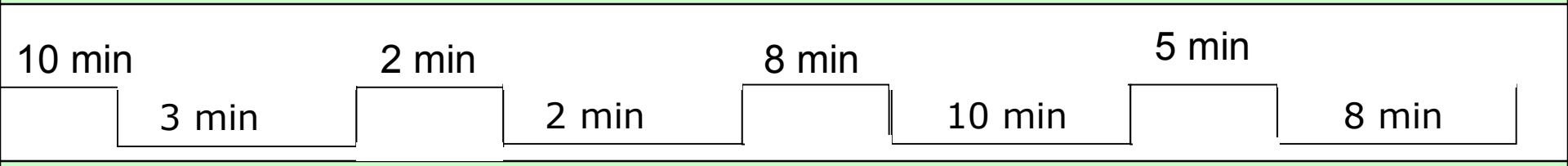


Radiology



Registration System

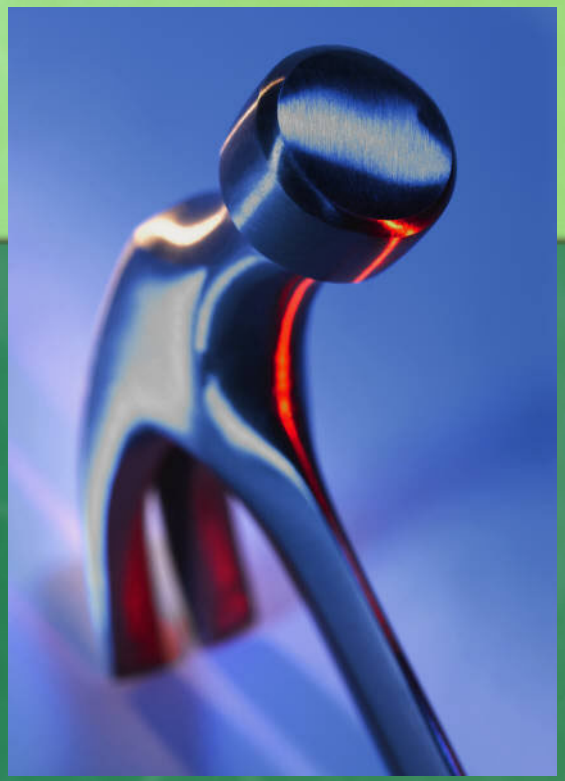
Verify Information	1	Assign to Registrar	8	Enter information	2	Escort to Radiology
PT = 3 min		PT = 2 min		PT =10min		PT =8 min



Total Process Time = 23 minutes

Total Lead Time = 48 minutes

Apply Lean Tools



- Apply Lean Tools to reduce or eliminate waste
  - 5S
  - Visual Controls
  - Visual Workplace rules
  - Workstation Design
  - Setup Reduction

5S Workplace Organization

S1: Sort

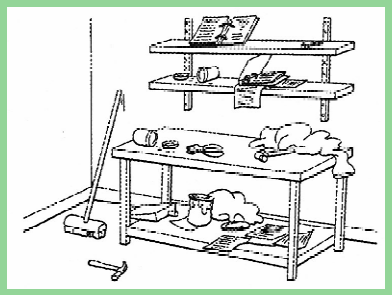
S2: Set in Order

S3: Shine

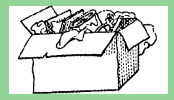
S4: Simplify and Standardize

S5: Sustain

Before 5S

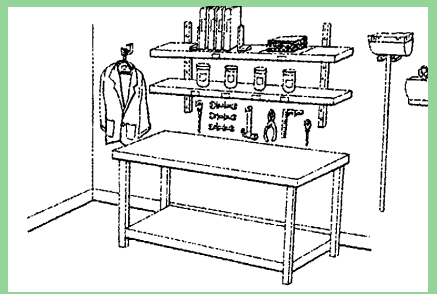


Not Needed



Needed

After 5S



A place for everything and everything in its place

Before 5S

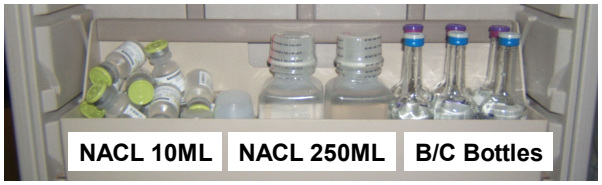
S1: Sort

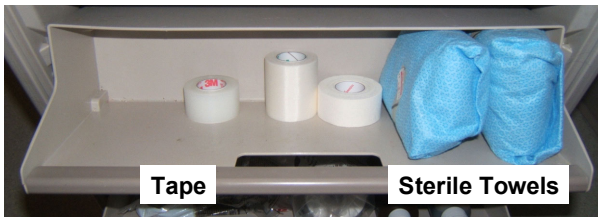
- Remove and Red Tag Items not used or excess supplies

S2: Set in Order
S3: Shine

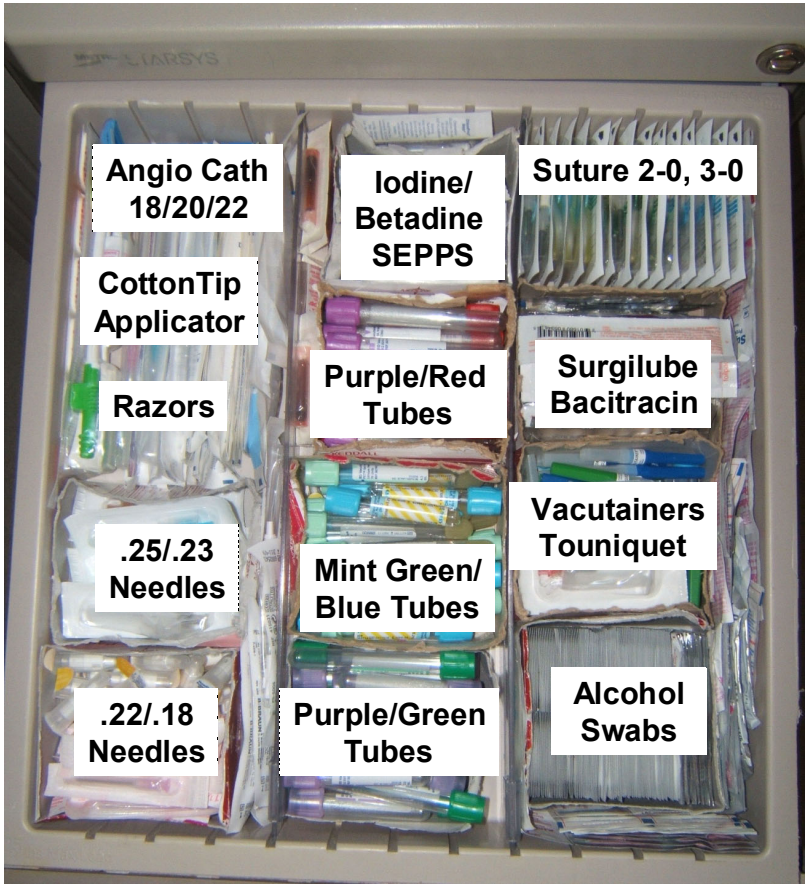
S4: Simplify/Standardize
S5: Sustain

Right Side





Drawer 1



Visual Controls

- Key Principle: Make It Visible
  - Everyone, including outsiders, can see and understand the status of the process at all times
  - See
    - Flow
    - Performance
    - Problems
    - Opportunities for improvement

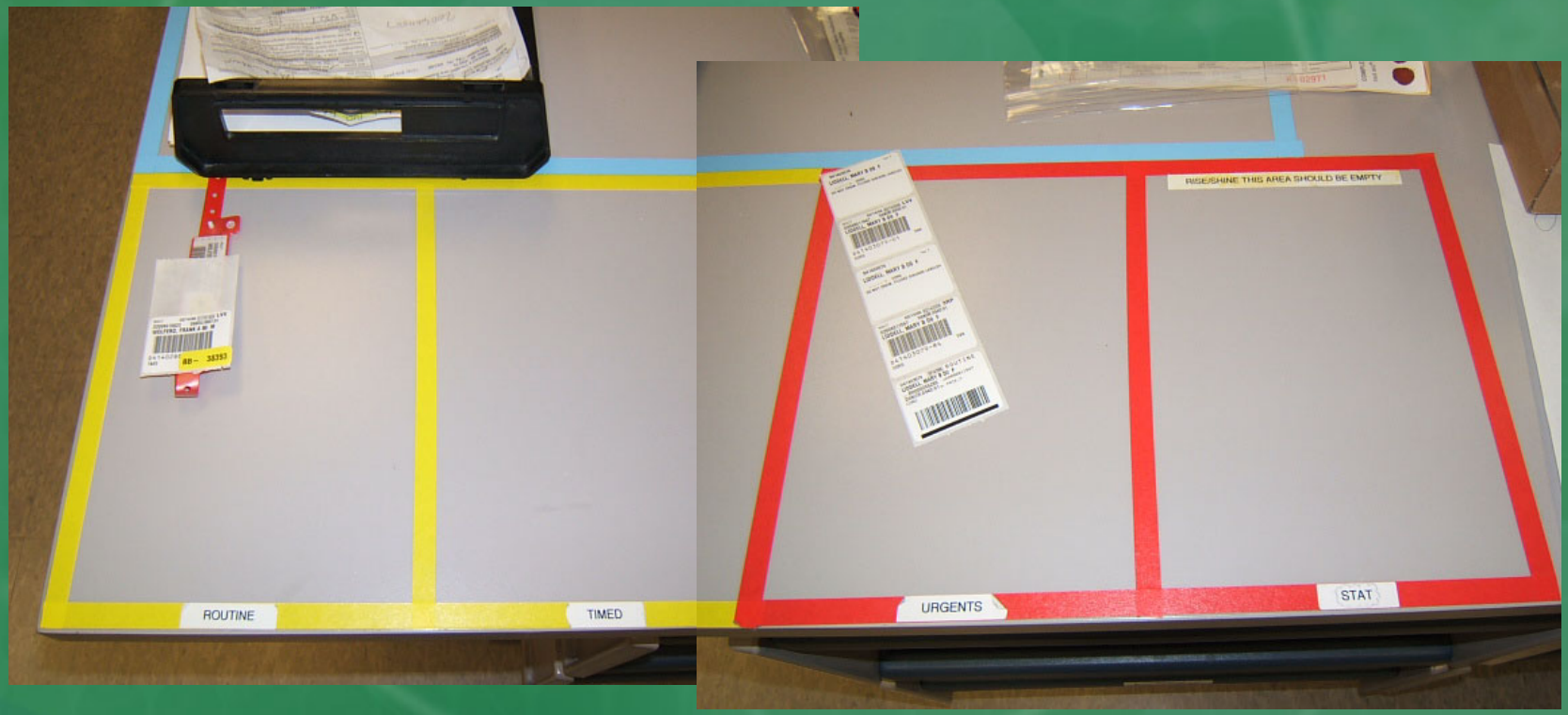
Visual Workplace Rules

- Tools, supplies, and equipment must be:
  - Easy to see
  - Easy to use
  - Easy to return
- 30-second rule:
  - Items accessed at least once a month should be located within 30-seconds
    - Supplies
    - Tools, equipment
    - Information

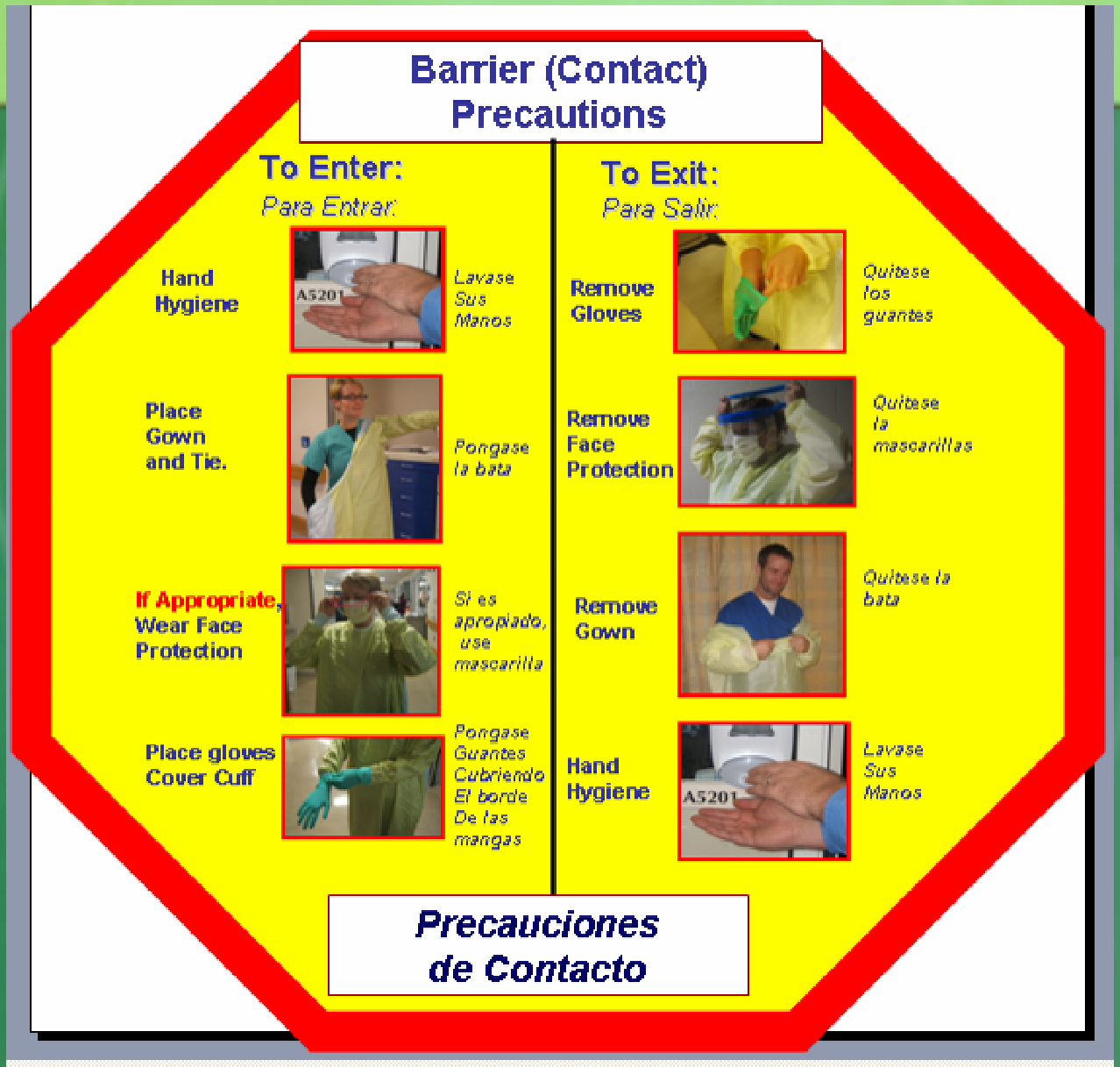
5S Examples

Visual Controls + 5S

Visual Control Examples….

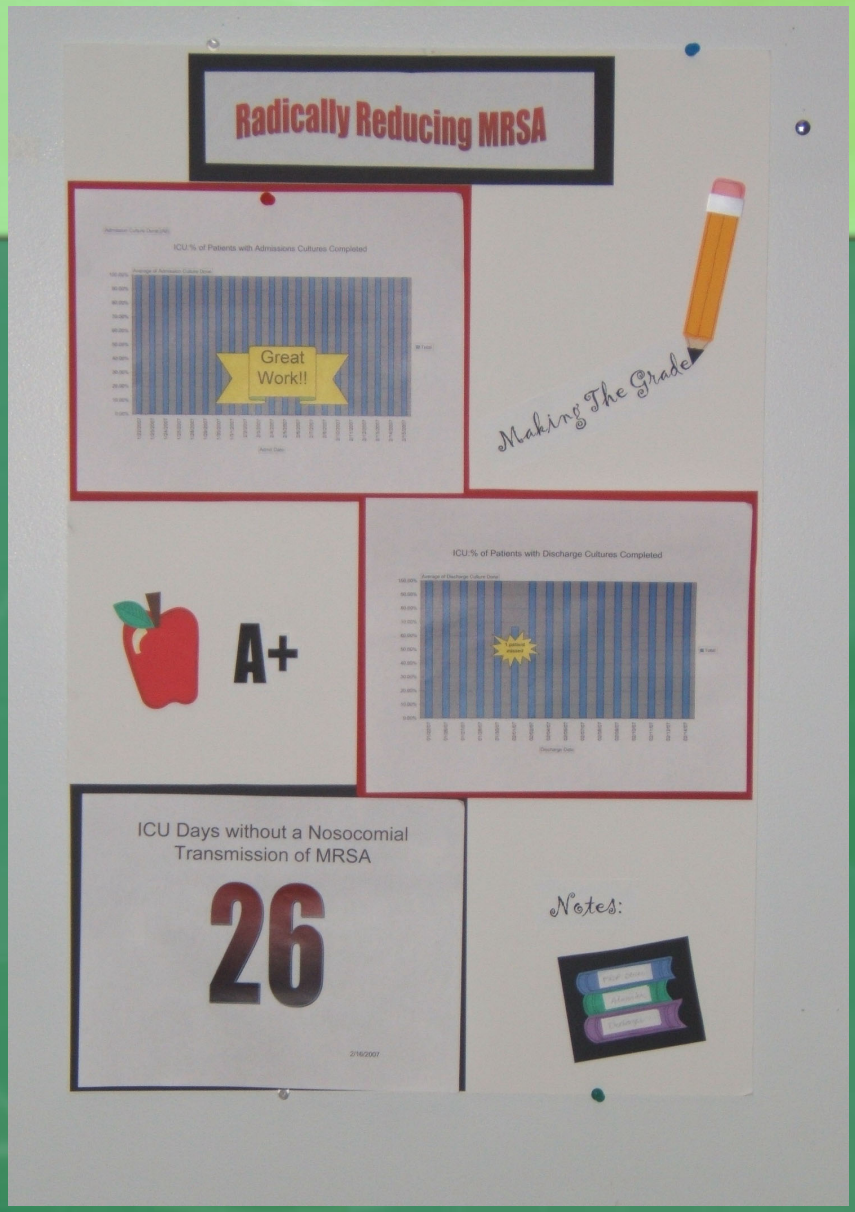


Isolation Sign



Contact Isolation Visual Controls

MRSA Project Visual Controls



Lean Healthcare

Project Example

courtesy of Joe Swartz

Lean Simulation Exercises

Woodward-Hagg, H., Scachitti, S., Workman-Germann, J., Suskovich, D., Vanni, C., Schwartz, J., Hudson, B., (2007). Adaptation of Lean Methodologies for Healthcare Applications. *Proceedings of the 2007 Society for Health Systems Conference, IIE*, New Orleans, LA, February 2007.

Lean Simulation Exercise

- What is a Lean Simulation Exercise?
  - Hands-on Activity or Event that provides:
    - Opportunity for immediate application of Lean tools
    - Greater understanding of the processes under investigation
    - Ability to test change in no-risk environment

Developing Effective Healthcare Based Lean Exercises

1. Consider your audience
2. Introduce basic Lean tools first
3. Baseline current processes
4. Require immediate application
5. Quantify improvements
6. Recognize the team(s) accomplishments.

Basic Lean Exercise

- Goals:
  - Provide Hands-On application of basic Lean Tools:
    - Process Mapping
    - Checksheets
    - Process Observation Worksheets
    - Spaghetti Diagrams
    - 5S
    - Visual Controls

Basic Lean Exercise

1. Participants are divided into teams of 5-6.
   - One team member → 'doctor'.
   - Other team members → observe the process and collect process data using Lean Tools.

2. The 'doctor':
   1. Examines the patient
   2. Determines the supplies necessary to treat the patient.
   3. Goes to the supply area to find supplies

Basic Lean Exercise

Basic Lean Exercise

3. The Team goes through multiple iterations of collecting data, identifying waste in the process and applying Lean tools to reduce the time to obtain supplies.

Round #1:	9 minutes	Disorganized supply area, far from patient rooms
Round #2:	4 minutes	More organized supply area, closer to patient rooms
Round #3:	2 minutes	'Leaned' supply area, easy access to both units

Basic Lean Exercise

Advanced Lean Exercise

- Goals:
  - Provide Hands-On application of advanced Lean Tools:
    - Value Stream Mapping
    - Flow
    - Constraint Identification
    - Constraint Management
  - Based on Patient Flow through an ER

Advanced Lean Exercise

1. Participants are assigned roles (Triage Nurse, ED nurse, Registrar, Transporter, ED Physician, Lab Tech, Radiology Tech)

2. Roles are defined to perform a specific service for the 'patient' and send the patient onto the next provider.
   - 'Patients' are colored coded to receive specific services

3. The 'patient' is evaluated upon 'discharge' to insure that they have received the required services.

Advanced Lean Role Example

STATION: ER Doctor

1. ER Doctor rolls die and counts to the average # of seconds to simulate treatment time.

2. Patients must see ancillary services and/or specialist as outlined in the table below prior to moving patient to next unit.
   a. NOTE: Patient Bed must be held during any ancillary or specialist services.
   b. NOTE: Purple Patients must be held over in the ER for the duration of the exercise.

3. After ancillary services requirements are met, the ER Doctor must contact the ER Nurse and arrange for patient move as outlined below.

4. ER Doctor may only communicate with an ER Nurse or Charge Nurse.

Patient Requirements Example

Gingerbread Color	Ancillary Services/Specialist Requirements			Move to:
	Lab	Radiology	Specialist	
Brown	X	X	X	ICU
Light Blue			X	Unit Bed
Tan		X		Discharge
Pink	X	X		Unit Bed
Blue		X	X	Unit Bed
Green	X		X	Discharge

Advanced Lean Exercise

1. Participants:
   - Receive the patient into their unit/area
   - Roll dice and count to number displayed on die.
   - Call the transporter (or otherwise coordinate) to transport the patient to the next provider.

2. Multiple iterations are used to:
   - Create a current and future state value stream map
   - Identify constraint areas in the process
   - Streamline processes to remove waste and/or add value

Lean Simulation Exercises

- Lean Simulation Exercises can be customized for specific projects:
  - 5S Exercise:
    - Nursing Station Design
    - Central Line Insertion
  - ED Flow Exercise
    - Outpatient Registration
    - Cath Lab Processes
    - Outpatient Hypertension Assessment

Questions?