Chaos Theory

- Chaos Theory is a mathematical sub-discipline that studies complex systems (http://www.abartm-publications.com/ChaosTheoryIntroduction.html)
- Complex systems are systems that contain so much motion (so many elements that move) that computers are required to calculate all the various possibilities
- Laboratories contain many complex systems
Could your management style be termed as chaos?

For the next 90 minutes we will share ideas of managing a lab with a systems approach to *minimize the chaos*. 
Today’s Goals with a Systems Approach

- Definitions and background
- Systems approach to process management
  - Characteristics
  - A template to follow
  - Role of continuous improvement
- Our experience in the laboratory
  - How applied to specific processes
  - Tools, methods, & examples
  - Take home ideas for you

Definitions

system n.
Organization of functionally interactive units for the achievement of a common goal
Source: Business Dictionary at www.answers.com

systematic adj.
1. Of, characterized by, based on, or constituting a system
2. Carried on using step-by-step procedures
3. Purposefully regular; methodical
Source: www.thefreedictionary.com
Laboratory goal

- Right test
- Right result
- Right patient
- Right time

- ALL processes are part of the system
- Today: how to design SUPPORT processes so that they are systematic and support the overall goals

---

Quality System

- Strategy
- Vision / Mission
- Workflow Management
- Resource Management
- Supply Chain Management
- Staff Recruitment / Development
- New Test Development
- Quality Monitoring

Balanced Scorecard
Characteristics of a Systematic Process

- Designed to meet business requirements
- Clear relationship as a part of the “whole system”
- Active oversight / ownership
- Standardized
  - Well defined
  - Consistent and predictable
  - Easily understood
- Key indicators for success
  - Quantifiable
  - Visible
- Process changes are data driven and purposeful

Continuous Improvement

... is an ongoing effort to improve products, services or processes

When do continuous improvement?
1. When problems arise
2. When management says to
3. Continuously, as it is a part of a systematic process
Systematic Process - Continuous Improvement Tools

- Clear relationship as a part of the “whole system”
  - Balanced scorecard
  - Value stream map
- Standardized process
  - Lean tools to standardize work
  - Six sigma tools to reduce variation
- Key indicators for success
  - Lean visual management
  - Process metrics / dashboards
- Data driven purposeful changes
  - All improvement must be from clear understanding of current situation
  - Continuous improvement cycles
    - Define, Measure, Analyze, Improve, Control
    - Plan, Do, Check, Act

Systems Approach Template

Role of Key Process Owner
- Defines requirements at each process step
- Ensures conformance to process steps
- Utilizes key process indicators for decision-making
Systems Approach Template

Over-Sight

Key Process Owner

What

Step 1  Step 2  Step 3  Step 4  Step 5

How

Tool Box & Support Activities

<table>
<thead>
<tr>
<th>Understanding Business Requirements</th>
<th>System Design Methods</th>
<th>Implementation methods</th>
<th>Measurement tools</th>
<th>Change management</th>
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<tbody>
<tr>
<td>Communication tools</td>
<td>Lean &amp; Six Sigma Tools</td>
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</table>

Quality Planning Tools

Strategy  Vision / Mission

Workflow Management  Resource Management  Supply Chain Management  Staff Recruitment / Development  New Test Development  Quality Monitoring

Balanced Scorecard
Elements of a Systems Approach to Workflow Management

Over-Sight
Lab Supervisor

What
- Define Test Work Flows and Requirements
- Design Process Work Flows
- Daily Workflow Management
- Workflow Performance Monitoring
- Workflow Improvements / Changes

How
Tool Box & Support Activities
- Value Stream Mapping
- Visual management / Dashboards
- Problem Solving
- Define Test Families
- Spaghetti Maps
- Automated management tools
- Waste reduction
- Standardized Work
- Process checkpoints
- Cell Design
- Performance Requirements
- Laboratory Design
- Specimen tracking
- Batch size
- Customer / Supplier Communications
- Planning and Managing Resource Needs: See Resource management

Define Test Workflows and Requirements

- Define test families
  - Group by common process steps, methods
- Performance requirements
  - Customer expectations for turnaround time
  - Industry benchmarking
- Value stream mapping
Value Stream Mapping

End-to-end view of workflow

Process timeline

Design Process Workflows

• Standardized workflow
  • Efficient specimen travel
  • Regular workflow patterns

• Resource requirements
  • FTE needs
  • Equipment needs

• Laboratory design
Laboratory Design

Current State

Future State

Workflow considerations
• Specimen travel
• Personnel travel
• Test family volume
• Shared resources
• Automation & batching requirements
• Space constraints

Daily Workflow Management

• Manage by value streams
• Customer / Supplier communications
  • Communication across process workflow
  • Expectation setting
  • Problem resolution
• Key process checkpoints
• Visual management
• Automated workflow management tools
Visual Management

- Displays key operational information to all lab staff via a large screen in work area
- Information automatically updates
- Tracks orders for four different lab areas
- Notification of urgent requests

Automated Workflow Management
Automated Workflow Management

- Used by lab supervisors and staff to monitor TAT
- Information is automatically refreshed
- Uses color coding to flag areas of concern

Workflow Performance Monitoring

- Test turnaround time reports
- Specimen tracking data
- Manual sampling at key process points
Manual Sampling - Performance to Time Targets

- XR service line
- H&E controls reduction
- Case sort improvements
- Reduction in paperwork
- Staff to demand
- HT students
- Unstained slide focus
- Evening Assist Sup
- Early Derm delivery

Workflow Improvements / Changes

- Cell design
- Batch size analysis / reduction
- Waste reduction
  - Wait time
  - Excessive travel
- Problem solving
  - Reacting to shifting requirements
  - Managing the change

Define Test Work Flows and Requirements
Design Process Work Flows
Daily Workflow Management
Workflow Performance Monitoring
Workflow Improvements / Changes
Elements of a Systems Approach to Resource Management

**Over-Sight**
- Lab Supervisor

**What**
- Define Resource Needs
- Detailed Resource Planning
- Deployment & Management of Resources
- Measuring Resource Effectiveness
- Improve Resource Effectiveness

**How**

<table>
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<th>Tool Box &amp; Support Activities</th>
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<td>Business Requirements</td>
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<td>Staffing to Workload</td>
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<td>Job Definition</td>
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<td>Process targets / Production boards</td>
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<td>Standardize work</td>
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<td>Resource Inventory</td>
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<td>Equipment capacity planning</td>
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<td>Training – Job Instruction</td>
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<td>Staff scheduling</td>
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<td>Overall Equipment Effectiveness</td>
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<td>Process redesign</td>
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<tr>
<td>Resource Request Process</td>
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<td>Visual Management</td>
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<tr>
<td>Increase equipment capacity</td>
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<tr>
<td>Planning and Managing Workflow: See Workflow Management</td>
</tr>
</tbody>
</table>
Define Resource Needs

- Refer to the strategic plan to plan for the business needs:
  - FTE
  - Equipment
  - Space
- Future volume expectations
- Current inventory of resources

Detailed Resource Planning

- Factor in workflow design
- Tools to help you understand and plan for your needs:
  - Workload capacity planning
  - Equipment capacity planning
  - Simulation
Staffing to Workload

Histo staffing vs. requirements by hour

Seeking Approval for Resources
Elements of a Request Process

- Gather data to support the request
- For instruments negotiate the best price and don’t forget the maintenance program
- Make sure the requests tie to the organizational strategy
- Indicate how the resource will be used and highlight benefits, cost savings or FTE reductions
Deployment and Management of Resources

- **Staff resources**
  - Task training – Job Instruction Training
  - Defining job rotations
  - Staff scheduling process
  - Communication and flexibility

- **Equipment resources**
  - Supports workflow – availability, batching rules
  - Visual management / communication

---

Equipment Management
Measuring Resource Effectiveness

- Process targets / production boards
- Competency assessments
- Overall Equipment Effectiveness
  - Availability
  - Performance efficiency
  - Rate of quality results

Improve Resource Effectiveness

- Standardized work
  - Detail out work elements
  - Eliminate non-value added tasks
- Process or workflow redesign
- Leveraging technology
- Increasing equipment effectiveness / capacity
  - Reduce downtime
  - Repeat rate reductions
Elements of a Systems Approach to Management of Laboratory Supplies

Over-Sight: Purchasing / Inventory Management Expert / Lab Supervisor

What
- Introduction of New Supply Item
- Supply Item Process Planning
- Inventory Management System
- Inventory System Performance
- Inventory System Improvement

How

Tool Box & Support Activities

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<td>Supply Item Process Planning</td>
<td>Inventory level planning tool</td>
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<td>Inventory System Performance</td>
<td>Supply Chain Dashboard</td>
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<td>Inventory System Improvement</td>
<td>Inventory Level Optimization</td>
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<td>Supplier Assessment</td>
<td>Quality Assurance</td>
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<td>Automated Inventory System</td>
<td>Automated inventory System</td>
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<td>Operational Metrics and Indicators</td>
<td>Vendor Management</td>
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<td>Quotation Process</td>
<td>Bench Requirements &amp; Stock Locations (5S)</td>
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<td>Item Creation Process</td>
<td>Supply Chain Analysis Tools</td>
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<td>Supply Waste Reduction</td>
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<td>Contract Negotiation</td>
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<td>Supply Item Database</td>
<td>Supply Quality Cost Tools</td>
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</table>
Introduction of New Supply Item

- Laboratory / Purchasing Collaboration
  - Partnering with procurement support
  - Joint development of supply chain processes
- Vendor assessment - Preferred vendor list
- Quotation process
  - Price, volume, lead time
  - Contracts
- Creation of orderable item
  - Purchasing system
  - Inventory management system

Supply Item Process Planning

- Quality assurance processes
  - Regulatory needs
  - Lot control tracking / management
  - QC requirements
- Planning inventory levels
  - Usage forecast
  - Defined min / max levels
Setting Inventory Levels

**Safety Stock** - planned minimum level of inventory, extra inventory used to cover variation

**Reorder Point (ROP)** – level of inventory when an order is placed

**Max** - the highest level of inventory after order fulfillment

---

**Inventory Management System**

- **Organizing stock locations**
- **Supply ordering system**
  - **Manual**
  - **Automated**
Supplies – Stock Locations
Figure out what you have and get organized

• Excellent use for lean 5S tool:
  • Sort – Set in Order – Shine – Standardize - Sustain

Inventory System Development

A Manual Inventory System can bring improved control and stability to supply management:
• Can be used in a variety of applications
• Eliminates need to “keep an eye on” levels of numerous items
• Improves communication
• Simple and visual
• Low cost
Manual System in Action

Re-order Point

Item Description
ROP
Item ID Number
Re-Order Qty
Source

Supplies Arrive

Automated Inventory System

• Most of our labs now use the PAR Excellence automated inventory system
Inventory System Performance

- Inventory operational metrics and indicators
- Analysis tools
  - planned usage vs. actual usage
  - quality costs - scrap
- Supply chain dashboards

Inventory Metrics Dashboard Example

- Chose six key metrics
- Business and operational
- Designed with the “customer” in mind
- Sent out regularly each month

Note: Charts do not show actual data, for demonstration purposes only.
Inventory System Improvement

• Inventory level optimization
• Supply waste reduction
• Vendor management / partnering
  • Sequestering programs
  • Supplier quality improvement
• Formulary / value analysis
  • New test development

Inventory Level Optimization

• Find opportunities for reducing inventory maximum levels and re-order points
• Drives reduction in on-hand inventory or increase in inventory turns

• Inventory Turns
• If we assume $50M annual supply spend, improvement from 5.3 to 6.3 would equal $1.5M cost avoidance

Note: Charts do not show actual data, for demonstration purposes only.
Systems Approach to Staff Recruitment, Orientation and Training

**Oversight**
- Institutional Operations Coordinating Group (OCG)

**What**
- Position posted and recruitment initiated
- Candidates selected and interviewed
- Position offered to candidate
- Orientation and Training initiated
- Competency assessed

**How**
- Tool Box
  - Regulatory requirements for positions
  - Standardized Job Descriptions
  - Behavioral Interview Questions and Panel
  - Lab Tour and testing (if needed)
  - Human Resources Tracking Database
  - Salary Benchmarking
  - Competitive Benefit Package
  - Relocation assistance
  - Standardized Job offer process
  - Institutional Orientation
  - Department Orientation
  - Work unit Orientation
  - Standard Operating Procedures
  - Training & Competency Tools
  - Data Collection
  - Feedback Process
  - Performance Management
  - Formal Performance Assessment

Lab Tour and testing (if needed)
Appealing to the Operations Coordinating Group for approval

- Identify the need for the position and how it will be used
- Workload data should accompany the request and demonstrate need
  - Volumes
  - Units of service performed
  - Productivity indicators (ie. RVU’s)
  - Turnaround time
  - Available staff vs. hours of operation

Position is posted and recruitment initiated

- Understand the regulatory requirements and post the appropriate job
- A standardized job description makes it easy for candidates to understand the requirement and responsibilities
- A database to manage and track applications simplifies the process for Human Resources and the hiring manager
Position is posted and recruitment initiated

- Recruitment can take a number of forms:
  - On-line advertisement and job posting sites
  - Professional societies
  - Conferences
  - Social networking - facebook, Twitter
  - Journal advertisement

Candidates selected and interviewed

- Do they meet minimum requirements?
- Does a transcript support their education?
- Examine the employment history. Are there flags?
- Consider a phone pre-interview and/or a video interview (especially for a long distance recruit)
Candidates selected and interviewed

- What kinds of questions will you ask?
- How will you conduct the interview?
  - Individual session with the manager
  - Several 1 on 1 sessions with key leadership
  - Interview Panel
- Will you require a skills test?
- What criteria will be used to make your selection?

Position offered

- What are unique points that can be used to sell your position?
- How competitive is your salary and benefit package? Consider benchmarking to ensure your offer is competitive
- Will you offer relocation assistance? Sign on bonus?
Orientation and training initiated

- How will you help your new staff member adjust to their new surroundings?
  - Orient them to the history and culture of the institution
  - Help them understand their new department
  - Develop a training plan

Orientation and training initiated

What kind of things does a new team member need to be trained on?

- Patient confidentiality
- Compliance
- SOP’s
- Computer processes
- Lab safety
- Timekeeping
- Work unit expectations
Competency assessment

• How do you know if new staff are performing to expectations?

• Develop competency assessment tools
  • Simulations
  • Direct observation
  • Written tests
  • Problem solving
  • Peer review

• Provide feedback and coaching. Reinforce positive behaviors. Offer helpful advice.

Measuring success and linking it back to the system

• Collect metrics to ensure your efforts are on track:
  • Staff turnover
  • Training events
  • Completed competency assessments
  • Completed performance appraisals
Systems Approach to Staff Development

Who

Departmental Leadership

What

- Leadership develops strategic vision of the future
- Work unit needs identified
- Gap Analysis conducted
- Promising performers identified
- Training, mentoring and coaching
- Leadership opportunities explored and tested

Tool Box

- Strategic Planning
  - Perform skills assessment for all staff
- Regulatory Requirements
  - Sort available skills vs. needed skills
  - Develop tools to grow needed skills
- Evaluation of new processes and equipment that may require unique skills
- Match employee potential to needed skills
  - Visit with the employee to understand their career goals
- In-house training
  - Formalized training programs and courses
  - Project opportunities
  - 1 on 1 mentoring
- Competency Development Tools
  - Feedback Process
  - Performance Management
  - Formal Performance Assessment

Leadership develops strategic vision for the future

- SWOT Analysis
- Economic environment (Salary)
- Competitive environment (Recruitment)
- Regulatory needs and restrictions (Educational needs)
- New technologies and processes
- Develops plan to grow future leaders
**Work unit needs identified; Gap analysis conducted**

- Perform skills assessment (formal education, certifications, internal and external training, leadership activities, community exposure)
- Assess current skills vs. future needs
- Develop tools or seek external resources to build needed skills

**Promising performers identified**

- Review the skills assessment and match employee skills to needs of the work unit
- Visit with promising performers to understand their career aspirations and craft a roadmap for their career development
- Develop the future!
Training, mentoring, and coaching

- Develop in-house training opportunities
- Investigate external training programs and coursework
- Consider potential projects that allow employees to gain experience and additional skills
- Provide 1 on 1 mentoring and group coaching

Leadership opportunities explored and tested

- Establish competency standards to set expectations
- Provide opportunities for the developing leader to work independently and stretch their wings
- Provide frequent feedback, positively reinforce desired behaviors. Talk through trouble spots.
- Provide a formal assessment of progress at least once every year and more frequently if desired or needed
Elements of a Systems Approach to New Test Development & Implementation

**Oversight**
- Departmental Development Oversight Group (APDOG)

**What**
- Request Submission & Approval
- Laboratory Development Activities
- Laboratory & IT Test Validation
- Pre-Clinical & Clinical Test Implementation
- Post Implementation Follow-up

**How**
- Tool Box & Support Activities
  - Standardized Web-based Tools
  - Gantt Charts
  - Document Templates
  - Workload Effort Analysis Tool
  - Supply Chain Tools
  - Tracking Database
  - Resource Metrics Collection
  - Standardized Review
  - Regulatory Tools
  - Communication Tools
  - Approval for Test Implementation
  - Coding/Billing Assessment
  - Feedback Process
  - Post-Implementation Maintenance
  - Training & Competency Development Tools
  - Intellectual Property & Business Assessment
  - Laboratory Operations Assessment

**Balanced Scorecard**
- Strategy
  - Vision / Mission
New Test Request Submission & Approval

Process and Tools:

• Project requests submitted via web-form
• Development Oversight Group (DOG) review (Pathologists, Development Technologists, Supervisors, and other technical experts)
• Project team assigned consisting of Test Champion, Medical Expert, and Dev Technologist(s)
• Project documented in database (status and business case metrics)
• Business assessment conducted (intellectual property rights/opportunities, financial impact, etc.)

Laboratory Development Activities

Process and Tools:

• Scientific test & instrumentation development activities documented in database
• Information Sharing
• Updates provided to the DOG
• Documents supporting validation and clinical implementation are prepared
• Activities supporting the test process are initiated:
  • Procedures
  • Equipment
  • Inventory
Laboratory & IT Test Validation

Process and Tools:
- Test validation plan is approved, validation conducted and data summarized
- Quality and Regulatory reviews performed
- Test reviewed by DOG and approved for implementation
- Validation and related documents filed
- New test configured within the laboratory information system (LIS)

Pre-Clinical & Clinical Test Implementation

Process and Tools:
- Validated test information handed-over to clinical laboratory for implementation
- Workload effort, capacity, and test cost analysis performed
- Reagents/Supplies for test acquired into laboratory inventory
- Test reporting validated in LIS
- Training and document revision completed and staff trained to processes
- Test “Go-Live” is communicated to customers
Post Implementation Follow-up

Process and Tools:

- Test performance data collected and monitored with occasional reports to DOG
- Test changes are performed as required, revalidated, and documented
- Test vitality tracked for 12 months or longer
- Low-volume tests are examined for clinical utility and made obsolete if no longer needed

New Test Development
Systems-Based Benefits

- Systems-based design incorporates best practices of multiple areas
- Improved interaction leads to reduced redundancy and better use of resources
- Improved access to development resources
- Transparency with projects
- Improved external contribution and peer review
- Operations, education, quality, and regulatory elements are woven throughout the framework
Elements of a Systems Approach to Development of Quality Monitors

**Over-Sight**
- Anatomic Pathology Executive Team/Quality Oversight Group

**What**
- Plan – Selection of Quality Indicators
- Develop
- Implement
- Interpret
- Act

**How**
- Tool Box & Support Activities
  - Organizational Direction
  - Strategic Prioritization
  - Resource Availability
  - Risk Assessment
  - Non-conforming Event Analysis
  - Data Collection Strategies
  - Benchmarking
  - Pilot trials
  - Baseline Data
  - Histograms
  - Pareto Charts
  - Control Charts
  - Remedial Action
  - Root Cause Analysis
  - Corrective Action
  - Quality Improvement

- Balanced Scorecard
- Quality Monitoring

**Strategy**
- Vision / Mission

**Quality System**
- Workflow Management
- Resource Management
- Supply Chain Management
- Staff Recruitment/Development
- New Test Development

**Process Flow**
- Plan
- Develop
- Implement
- Interpret
- Act
**Development of Quality Monitors - PLAN**

**Considerations**
- Organizational Direction
- Strategic Prioritization
- Risks to the organization
- Resource availability
- Customer concerns, sentinel events
- Patient centered
- Safety

**Development of Quality Monitors - DEVELOP**

- Develop the strategy for data collection
  - Individuals responsible
  - Data Source
  - Frequency of measurement
  - Set thresholds
  - Manipulation
  - Form of presentation
Development of Quality Monitors - DEVELOP

Develop best practices and set thresholds

- Baseline data
- Industry standards/benchmarks
- Published data
- Risk assessment

Development of Quality Monitors - IMPLEMENT

- Collect actual data
- Use pilots to test the data
- Adjust after a few months
- Review at least annually; what is relevant this year may be of minimal value next year
**Development of Quality Monitors - INTERPRET**

**Tools for data analysis**
- Pareto charts
- Control charts
- Histograms

**Identify trends/patterns**

**Amendment Rate**

- Proportion for Amendment pct
- Date
- UCL
- LCL

- μ0=0.82%
- Sep-08 Dec-08 Mar-09 Jun-09 Sep-09
Development of Quality Monitors - ACT

• Act on non conforming events and exceeded thresholds
• Root cause analysis
• Remedial actions
• Identify opportunities for improvement
• Continue or Stop monitoring?

Plan – Selection of Quality Indicators
Develop
Implement
Interpret
Act

Strategy
Vision / Mission

Quality System

Workflow Management
Resource Management
Supply Chain Management
Staff Recruitment / Development
New Test Development
Quality Monitoring

Balanced Scorecard
We launched the “Rockets” but how to bring it all together?

- Balanced Scorecard - A well-rounded set of quantifiable measures derived from an organization’s strategy
- Originated from research on how managers measure operational performance Kaplan and Norton, 1992
- Includes a number of different perspectives such including: customer, financial, operational, organizational

Balanced Scorecard in Healthcare

- Applicable to all types/levels of healthcare organizations
  - Henry Ford Healthcare System
  - Duke Children’s Hospital
  - Department of Anesthesiology, Yale University
  - Nursing units, operating rooms, long-term care centers
- Connects practices, outcomes, quality, values, and costs in a healthcare organization Castenada-Mendez, 1998
- BSC adopters have improved quality of care and financial results Park Huber, 2007
AP Division Scorecard – Focus Areas

Clinical Practice (Workflow management)

Finance (Supply chain)

Operations (Resource management)

Quality measures (internal / external)

Growth and Learning (Staff recruitment and development)

Test development

Strategy
Vision / Mission

Quality System

Workflow Management
Resource Management
Supply Chain Management
Staff Recruitment / Development
New Test Development
Quality Monitoring

Balanced Scorecard
"The same kind of management which permits a factory to give the fullest service will permit a hospital to give the fullest service, and at a price so low as to be within the reach of everyone."


Questions???

- Email us:
  - Bridgeman.Andrew@mayo.edu
  - Colborn.Lisa@mayo.edu
References


• CLSI Document GP35. Development and use of quality Indications for Process Improvement and Monitoring of Laboratory Quality – Proposed Guideline


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