Key Performance Indicators in Radiology

The Future of Medical Imaging: Trends and Perspectives
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Business Intelligence

Entails assembling financial and non-financial metrics that help guide an organization in achieving its mission and goals

Critical to managing a practice or department

Turning Data Into Business Intelligence

- What metrics are most important in managing and measuring success?

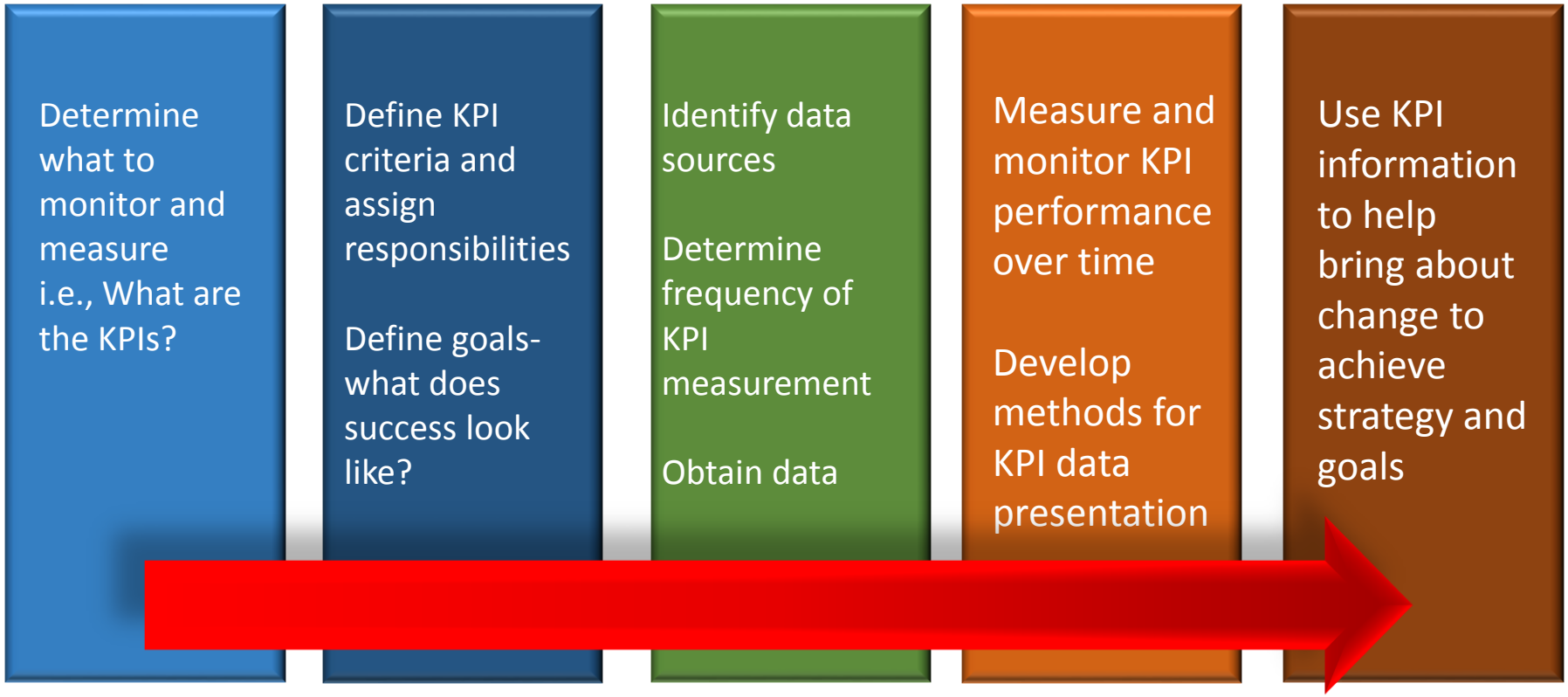
- I.e., what are the *Key Performance Indicators* (KPIs) for the organization?

- How are these metrics best presented ?

- How can these KPIs be used to help close the gap between the current state and organizational goals?

Q#1: Are the terms “Business Intelligence” and “KPIs” used in your organization?

KPI Process Steps



Step #1: Determine What To Measure--Key Performance Indicators (KPIs)

- KPIs should reflect what is important to the organization
- Engage stakeholders to identify KPIs
- Focus on areas where there are:
  - Known gaps between performance and strategic goals
  - Ongoing compliance requirements
  - Clear organizational expectations
    - Financial performance
    - Service
    - Quality and safety
    - …
- Recognize that it is impractical, if not impossible, to measure everything or even too many things simultaneously

Step #1: Typical Categories Of Indictors

- **Quality and safety**
- **Stakeholder satisfaction**– patients, employees, referring physicians
- **Operations**– efficiency, utilization, timeliness
- **Finance**

Step #1: Functional Types Of Indicators

- **Structure** (context)—physical facilities, equipment, staffing levels, staff training
- **Process** (transactions) – steps in the care process: diagnostic and therapeutic
- **Outcome** (effects) – change in health status, complications, stakeholder satisfaction

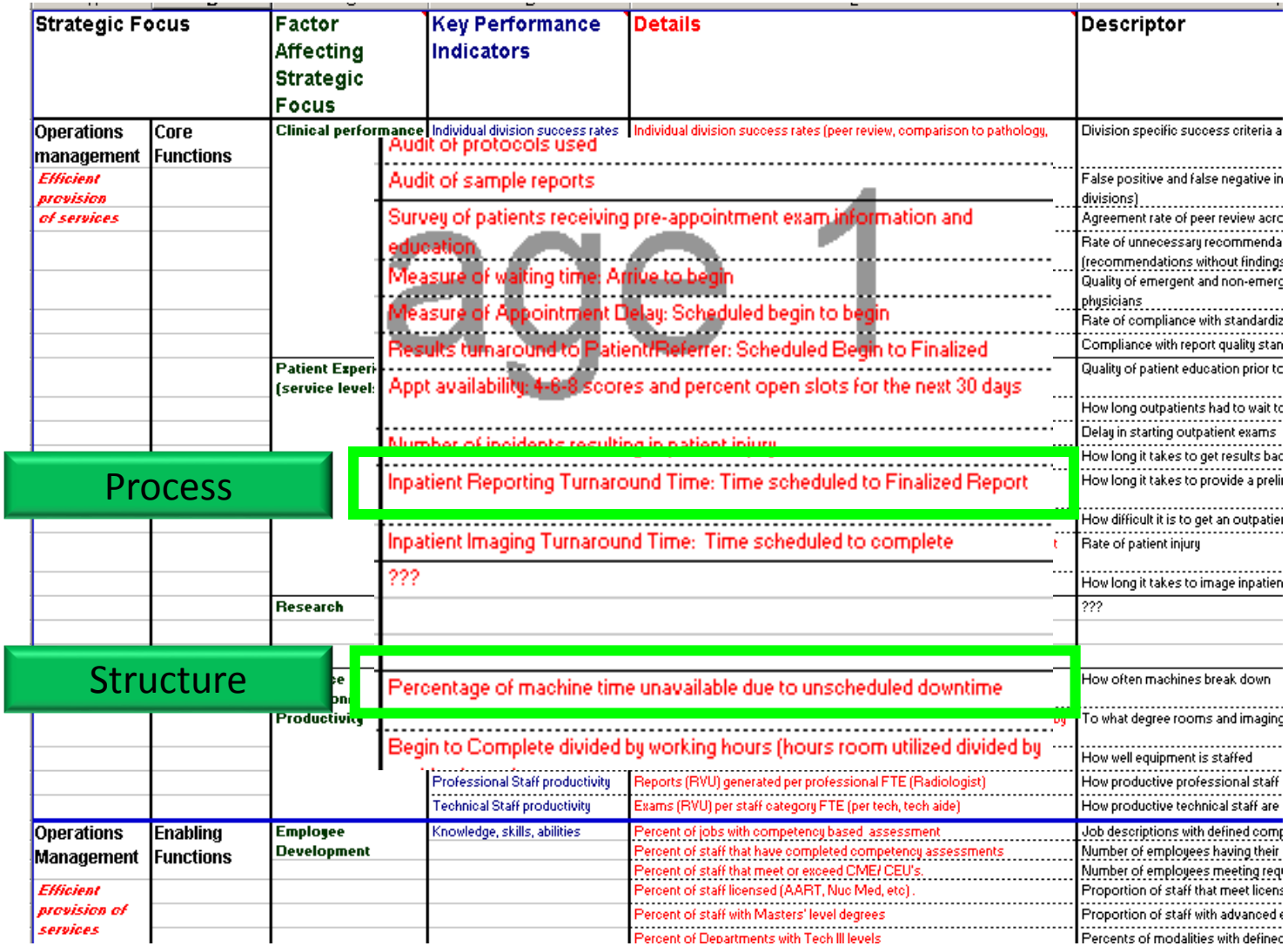
The Donabedian Model of Care Evaluation

Donabedian, A. The quality of care: How can it be assessed? JAMA 1988; **260** (12): 1743–8

Examples of Functional KPIs For Radiology

- **Structure**
  - Installed equipment base by type
  - Age of equipment
  - Number of FTEs
  - Level of specialization
  - Licensure and certification
- **Process**
  - Incident reporting rates
  - Equipment utilization rates
  - Report turnaround times
  - Compliance with hand hygiene policies
  - Procedure volume
    - By day, week, month
    - Trended over time by month, year
  - Billed charges versus budget
    - MTD
    - YTD
- **Outcome**
  - Operating margin
  - Error rates
  - Complication rates, accidents
  - Patient satisfaction
  - Employee satisfaction

MGH KPI Stakeholder Brainstorming



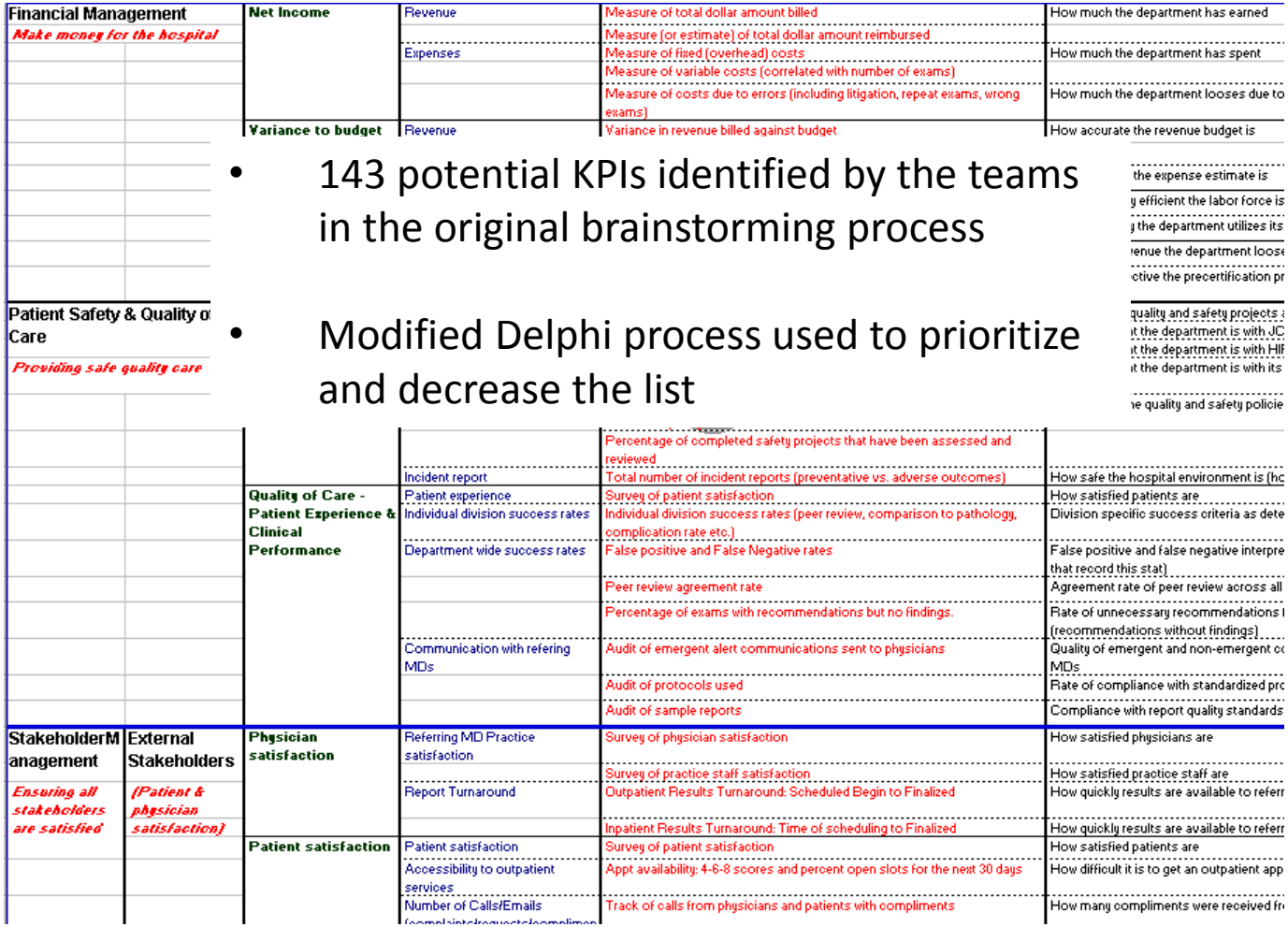
Strategic Focus		Factor Affecting Strategic Focus	Key Performance Indicators	Details	Descriptor
Operations management	Core Functions	Clinical performance	Individual division success rates	Individual division success rates (peer review, comparison to pathology,	Division specific success criteria a
Efficient provision of services				Audit of protocols used	
				Audit of sample reports	False positive and false negative in divisions)
				Survey of patients receiving pre-appointment exam information and education	Agreement rate of peer review acrc
				Measure of waiting time: Arrive to begin	Rate of unnecessary recommenda (recommendations without findings
				Measure of Appointment Delay: Scheduled begin to begin	Quality of emergent and non-emerg physicians
				Results turnaround to Patient/Referrer: Scheduled Begin to Finalized	Rate of compliance with standardiz
		Patient Experi (service level:		Appt availability: 4-6-8 scores and percent open slots for the next 30 days	Compliance with report quality stan
				Number of incidents resulting in patient injury	Quality of patient education prior to
					How long outpatients had to wait to
					Delay in starting outpatient exams
				Inpatient Reporting Turnaround Time: Time scheduled to Finalized Report	How long it takes to get results bac
					How long it takes to provide a preli
				Inpatient Imaging Turnaround Time: Time scheduled to complete	How difficult it is to get an outpatie
				???	Rate of patient injury
		Research			How long it takes to image inpatien
					???
				Percentage of machine time unavailable due to unscheduled downtime	How often machines break down
		Productivity			To what degree rooms and imaging
				Begin to Complete divided by working hours (hours room utilized divided by	How well equipment is staffed
			Professional Staff productivity	Reports (RVU) generated per professional FTE (Radiologist)	How productive professional staff
			Technical Staff productivity	Exams (RVU) per staff category FTE (per tech, tech aide)	How productive technical staff are
Operations Management	Enabling Functions	Employee Development	Knowledge, skills, abilities	Percent of jobs with competency based assessment	Job descriptions with defined comp
				Percent of staff that have completed competency assessments	Number of employees having their
				Percent of staff that meet or exceed CME/ CEU's.	Number of employees meeting requ
Efficient provision of services				Percent of staff licensed (AART, Nuc Med, etc)	Proportion of staff that meet licens
				Percent of staff with Masters' level degrees	Proportion of staff with advanced
				Percent of Departments with Tech III levels	Percents of modalities with definec

Process

Structure

Multi-functional teams asked to identify KPIs in each important area of activity

MGH KPI Stakeholder Brainstorming



Financial Management *Make money for the hospital*	**Net Income**	Revenue	Measure of total dollar amount billed	How much the department has earned
			Measure (or estimate) of total dollar amount reimbursed	
		Expenses	Measure of fixed (overhead) costs	How much the department has spent
			Measure of variable costs (correlated with number of exams)	
			Measure of costs due to errors (including litigation, repeat exams, wrong exams)	How much the department looses due to
	Variance to budget	Revenue	Variance in revenue billed against budget	How accurate the revenue budget is
Patient Safety & Quality of Care *Providing safe quality care*			Percentage of completed safety projects that have been assessed and reviewed	
		Incident report	Total number of incident reports (preventative vs. adverse outcomes)	How safe the hospital environment is (hc
	Quality of Care - Patient Experience & Clinical Performance	Patient experience	Survey of patient satisfaction	How satisfied patients are
		Individual division success rates	Individual division success rates (peer review, comparison to pathology, complication rate etc.)	Division specific success criteria as dete
		Department wide success rates	False positive and False Negative rates	False positive and false negative interpre that record this stat)
			Peer review agreement rate	Agreement rate of peer review across all
			Percentage of exams with recommendations but no findings.	Rate of unnecessary recommendations (recommendations without findings)
		Communication with refering MDs	Audit of emergent alert communications sent to physicians	Quality of emergent and non-emergent c MDs
			Audit of protocols used	Rate of compliance with standardized pro
			Audit of sample reports	Compliance with report quality standards
StakeholderManagement *Ensuring all stakeholders are satisfied*	**External Stakeholders** *(Patient & physician satisfaction)*	**Physician satisfaction**	Referring MD Practice satisfaction	Survey of physician satisfaction	How satisfied physicians are
				Survey of practice staff satisfaction	How satisfied practice staff are
			Report Turnaround	Outpatient Results Turnaround: Scheduled Begin to Finalized	How quickly results are available to referr
				Inpatient Results Turnaround: Time of scheduling to Finalized	How quickly results are available to referr
		Patient satisfaction	Patient satisfaction	Survey of patient satisfaction	How satisfied patients are
			Accessibility to outpatient services	Appt availability: 4-6-8 scores and percent open slots for the next 30 days	How difficult it is to get an outpatient app
			Number of Calls/Emails (complaints/requests/compliment	Track of calls from physicians and patients with compliments	How many compliments were received fr

- 143 potential KPIs identified by the teams in the original brainstorming process
- Modified Delphi process used to prioritize and decrease the list

Q#2: What is an example of an important KPI in your practice or company?

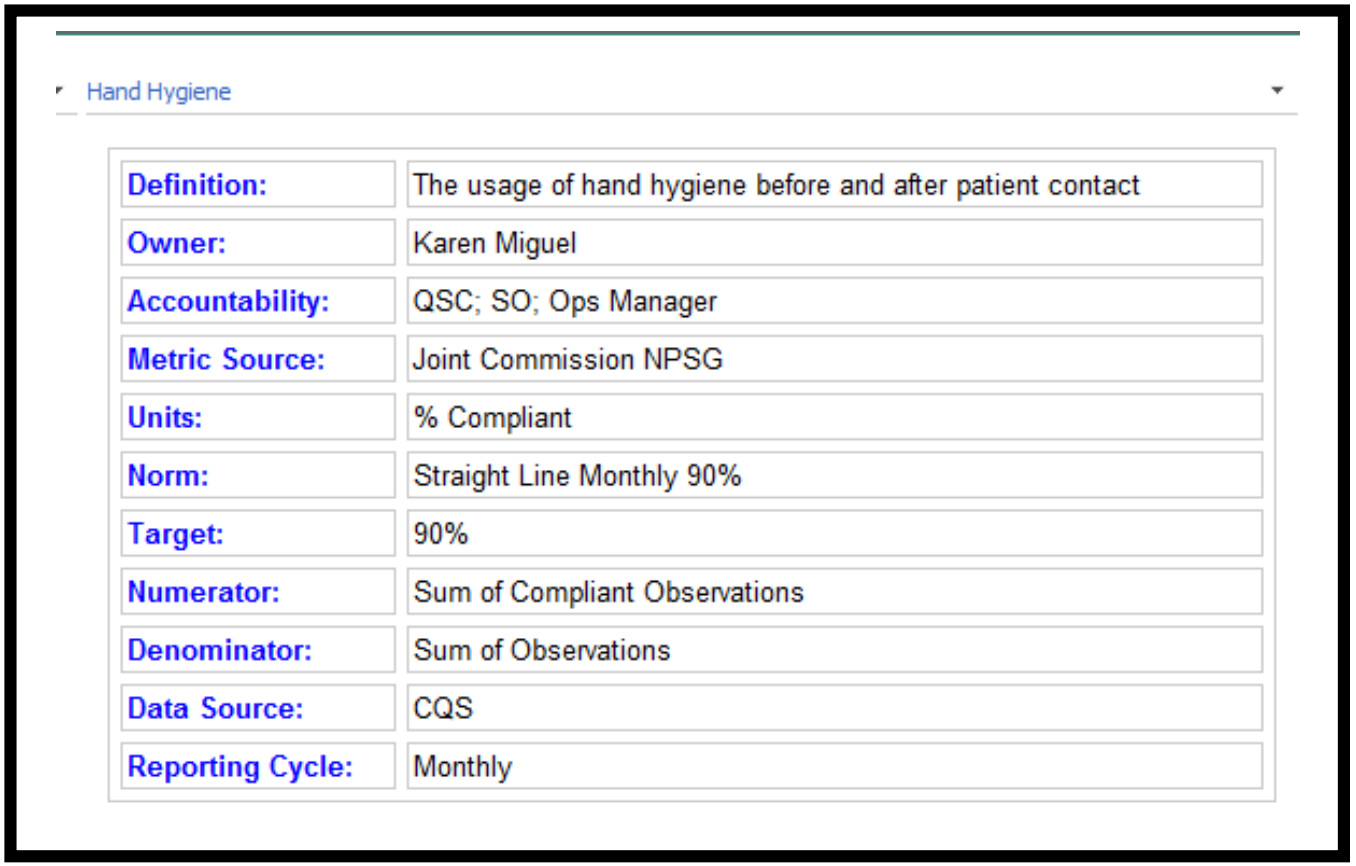
Step #2: Define KPIs And Goals: Assign Responsibilities

- Define all terms
  - All percentages must have a defined numerator and denominator
- Identify person responsible for the curation and validation of each KPI
- Assign each KPI to a major category—Finance, stakeholders, operations, Q&S
- Identify end users accountable for each KPI E.g.:
  - Financial—Hospital Executives, Department Chair, Department Administrators, Operations managers
  - Physician productivity– Division or Section Heads, Chairman
  - Equipment utilization– Modality lead physician, Department administrators, Operations managers, Service engineers

Step #2: Goals and Benchmarks

- Identify/ establish goals related to each KPI– what constitutes success?
  - Financial– do better than plan
  - Hand hygiene >90% compliance, Universal protocol compliance—100%
  - Stakeholder satisfaction– positive trend
  - Complications– do better than bench marks with decreasing trend

- Identify benchmark sources for comparison, if available
  - Society of Chairmen of Academic Radiology Departments surveys for physician productivity
  - Literature reports
  - Joint Commission standard
  - Industry standards—computer up time



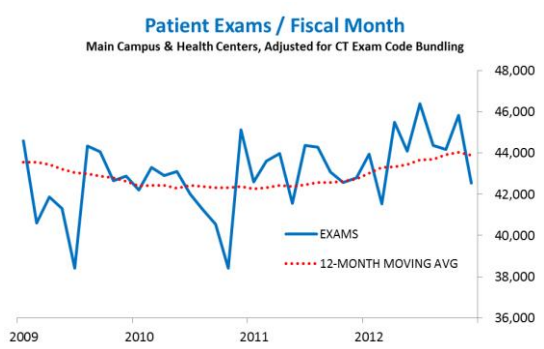
Massachusetts General Hospital template for defining KPIs, setting goals and assigning responsibilities

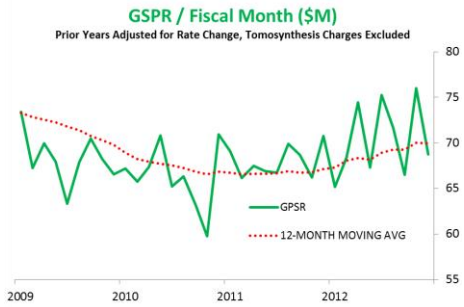
Q#3: Is there a standard process in your organization for defining KPIs and assigning responsibility?

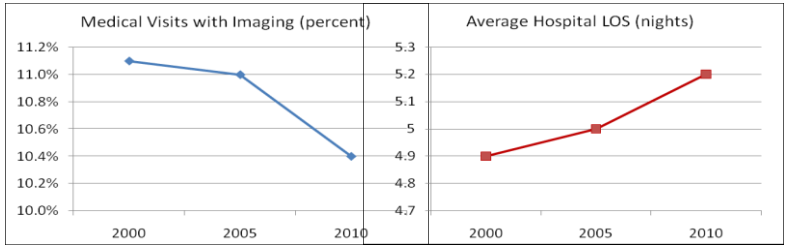
Q#4: Does your organization have a template for defining KPIs?

Step #3: Identify Sources Of Data

- EHR
  - Patient demographics
  - Patient diagnoses
- RIS
  - Appointment availability
  - Procedure volume
  - Report turn-around times
  - Equipment utilization rates
  - Patient waiting times
  - Physician productivity
  - Unread case volumes
- PACS
  - Images/case
- Per event reporting
  - Morbidity and mortality conference
  - Complications
  - Deaths
- Direct observation
  - Hand hygiene







Step #3: Identify Sources Of Data

- Surveys
  - Patient satisfaction
  - Employee satisfaction
  - Referring physician satisfaction
- Hospital safety reporting system
  - Incident reporting– slips and falls
- Administrative compliance record reviews
  - Universal protocol adherence
  - Standardized reporting issues
- Hospital administrative and Human Resource systems
  - Educational module compliance
  - Licensure
  - CME compliance
  - Vaccination compliance
- Financial systems
  - Billings and collections
  - Resource utilization by category
  - Operating margin

Step4: Develop Presentation Methods

- Charts, spreadsheets, graphs
- Heatmaps
- Dashboards
- Balanced Scorecards
    - Summary of multiple parameters
- Trend indicators
    - Arrows for short term versus goal
    - Graphs for long term
- Color coding
    - Green- meets goal
    - Yellow- close to goal
    - Red- not meeting goal
- Drill down/Roll up capability

Use of KPIs is most effective when users can see what they need to know at a glance and easily drill down

Step #3 Determine Frequency of Measurement (Reporting Cycle) and Trending

- Real-time
  - Unread case volume by division, by modality
  - Time to next exam
- Daily
  - Case volume by type,
  - Appointment availability
- Monthly
  - Financial indicators
  - Compliance with hand hygiene and universal protocol
  - Case complications
- Yearly
  - Annual financial results
  - Physician productivity
  - Patient satisfaction

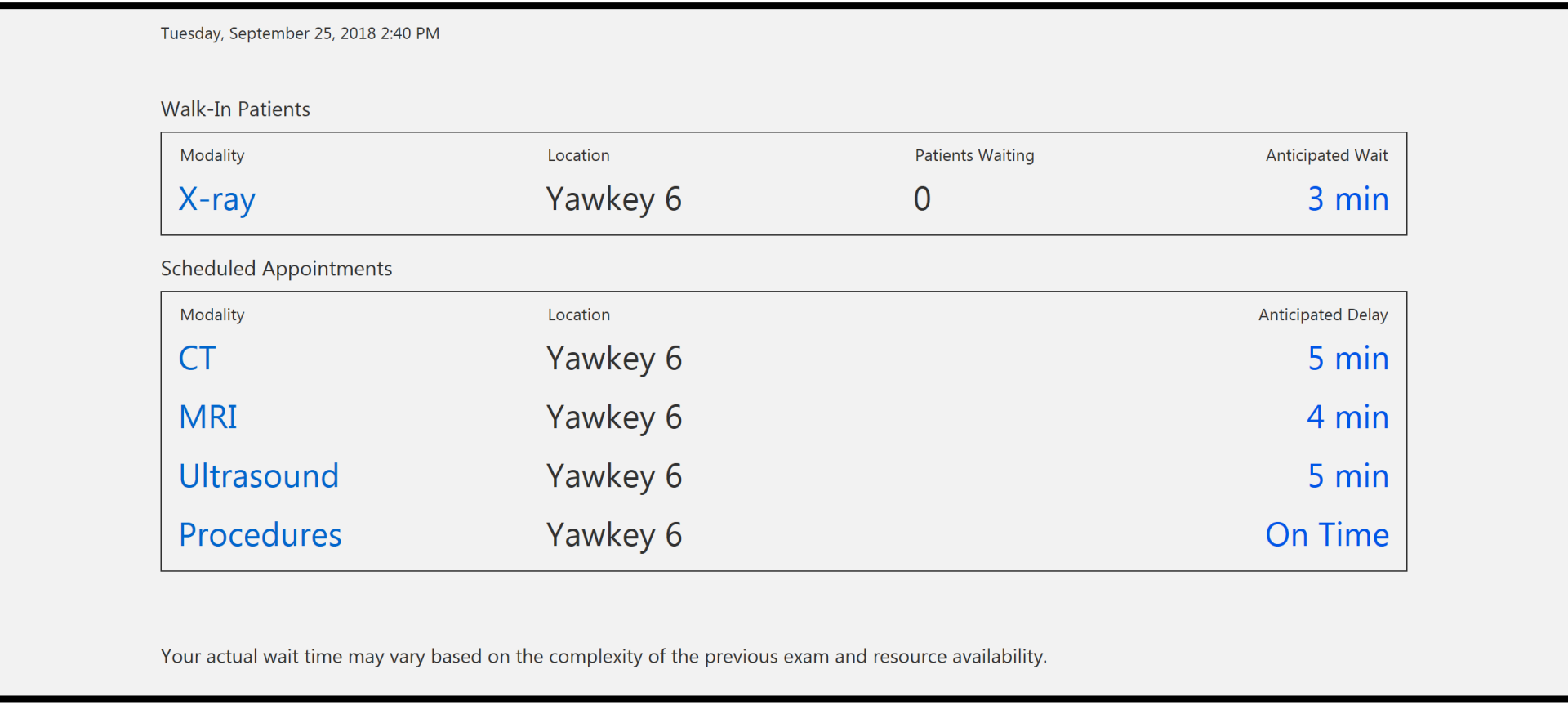
The value and use of data are highly influenced by the timing of its availability

Real-time Monitoring of Work

Unread exams in MSK division- for different modalities

Allows on-line rebalancing of radiologists deployment

Real-time monitoring of predicted outpatient wait times



Tuesday, September 25, 2018 2:40 PM

Walk-In Patients

Modality	Location	Patients Waiting	Anticipated Wait
X-ray	Yawkey 6	0	3 min

Scheduled Appointments

Modality	Location	Anticipated Delay
CT	Yawkey 6	5 min
MRI	Yawkey 6	4 min
Ultrasound	Yawkey 6	5 min
Procedures	Yawkey 6	On Time

Your actual wait time may vary based on the complexity of the previous exam and resource availability.

Information provided to patients on monitors in waiting rooms

Available in real-time to managers throughout department via intranet

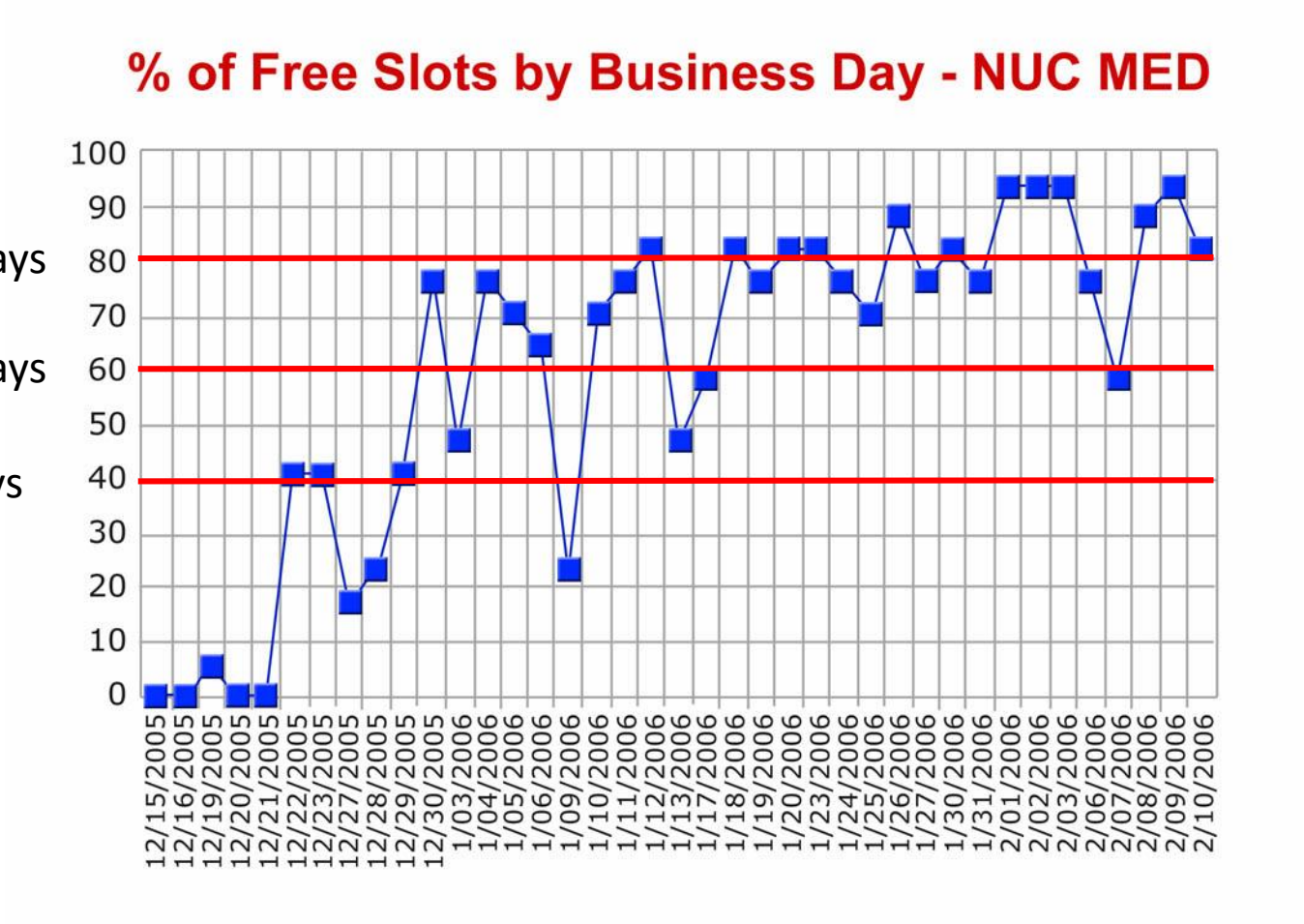
Powered by an AI program that takes into account multiple parameters

Daily Reporting of Outpatient Appointment Availability; Days to 40%, 60%, 80%

80%= 19 days

60%= 10 days

40%= 6 days



View By: Heat Calendar | Finalized | Completed

Division: NUCMED

Final Signer: Total

Massachusetts General Hospital Imaging

Heat Calendar

Jan

Sun Day	Mon Day	Tue Day	Wed Day	Thu Day	Fri Day	Sat Day
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

Feb

Sun Day	Mon Day	Tue Day	Wed Day	Thu Day	Fri Day	Sat Day
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Mar

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26	27	28	29	30		

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24	25	26	27	28	29	30
31						

Jun

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21	22	23	24	25	26	27
28	29	30				

Jul

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Aug

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25	26	27	28	29	30	31

Nov

Sun Day	Mon Day	Tue Day	Wed Day	Thu Day	Fri Day	Sat Day
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Dec

Sun Day	Mon Day	Tue Day	Wed Day	Thu Day	Fri Day	Sat Day
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6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

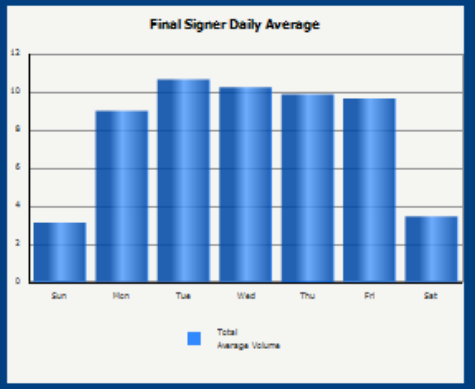
Less than 10 exams | Between 10 and 25 exams | between 25 and 75 exams | More than 75 exams

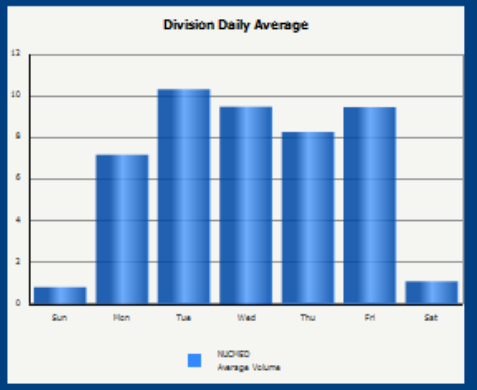
Exam Volume

Definition: Total # of Exams

Source: IDXRad

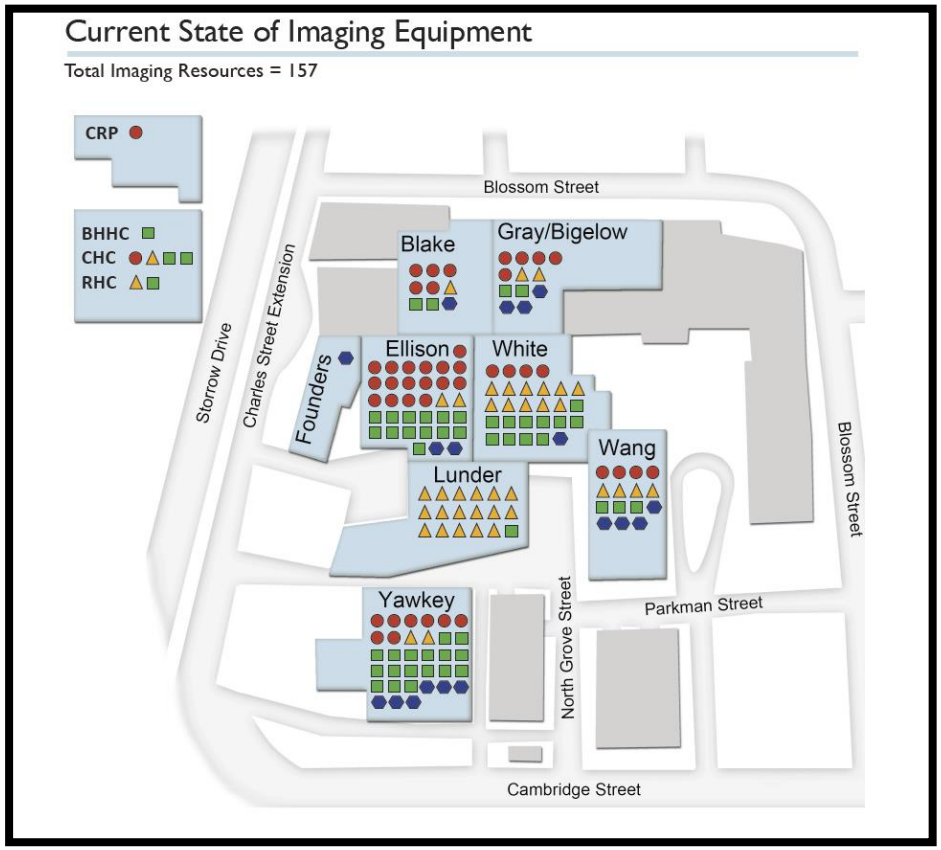
Reporting Cycle: Daily





“Heat” Calendar-- Division

Heat Map of Equipment Age/Useful Life Annual Summary In Departmental Capital Request



More than 3 years of useful life 53/157

Will be beyond useful life guidelines within 3 years 41/157

Beyond useful life per guidelines 43/157

18/157 approved replacements

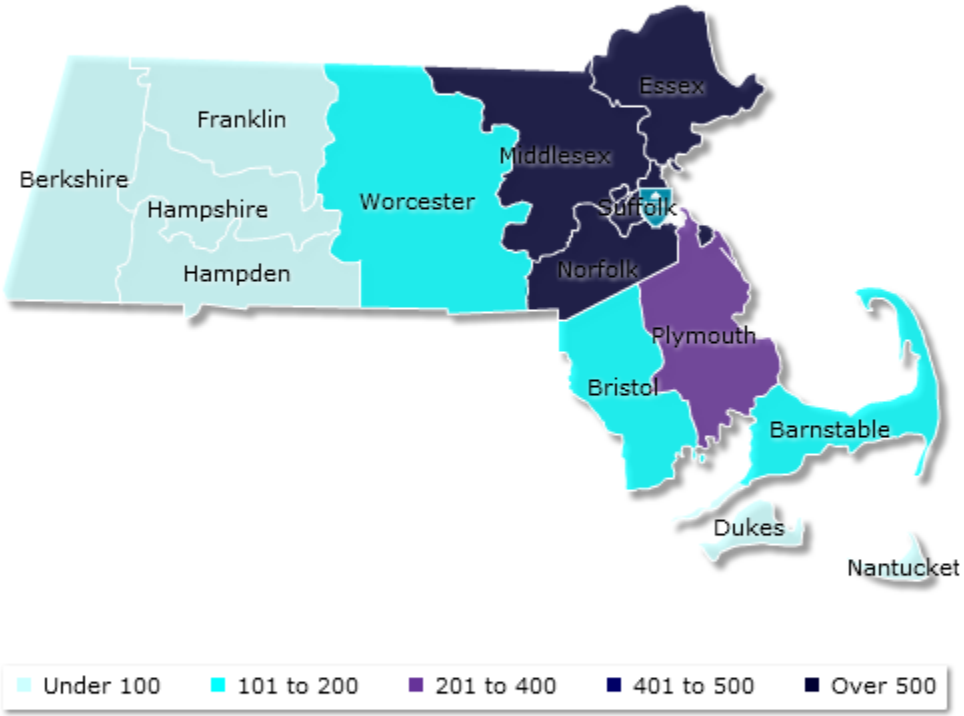
Radiology Heat Map

Radiology Heatmap

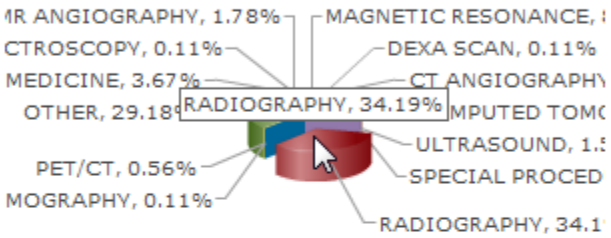
MGH Radiology Heatmap - Patient Volume Last Week

Patient Exams | Doctor Refe

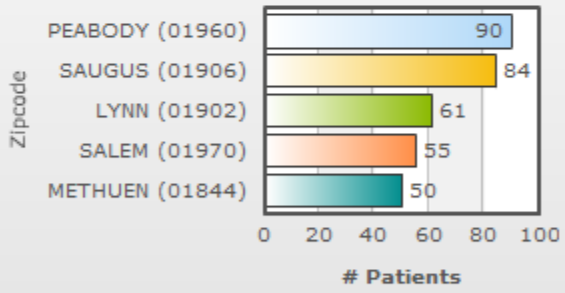
[Show All MGH Centers]



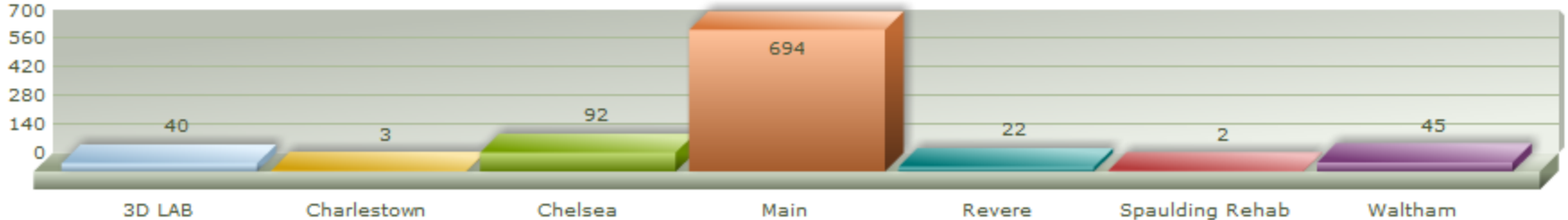
Exams By Type - Essex County



Patients By Top Zip

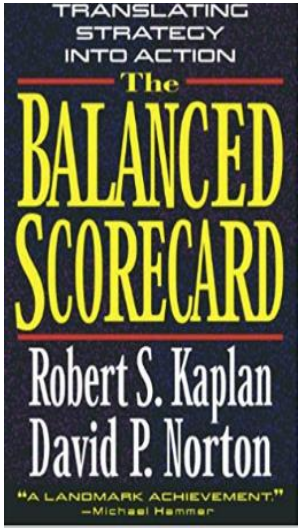


Patient Volume By Center - Essex County



Balanced Scorecards

- Both a management concept and a data presentation method
- Designed to link data presentation to strategy and goals
- Hierarchical presentation with “drill down” capability—summary level to granular detail
- Should be tailored to each organization’s needs
  - KPIs that reflect success factors for the business that link to strategic direction
  - “Gap-to-goal” data at a glance



Kaplan and Norton. *The Balanced Scorecard.* Harvard Business Review Press, Boston, MA 1996

Mission
Why we exist

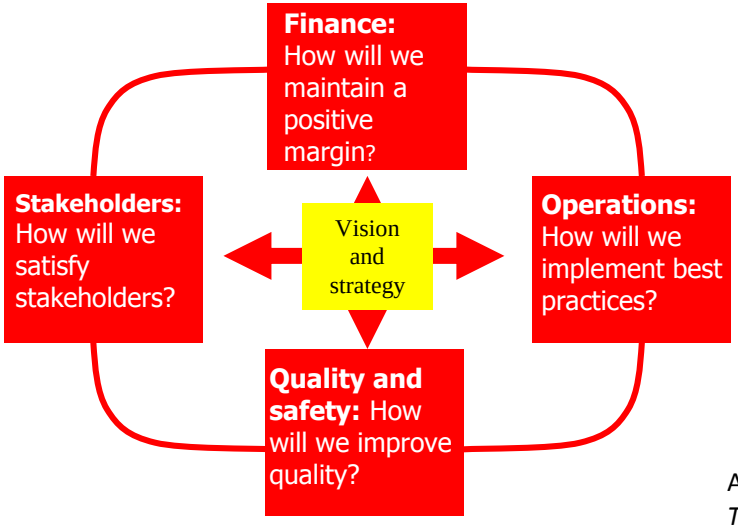
Values
What is important to us

Vision
What we want to be

Strategy
Our game plan

Strategy Map
Translate the strategy to action

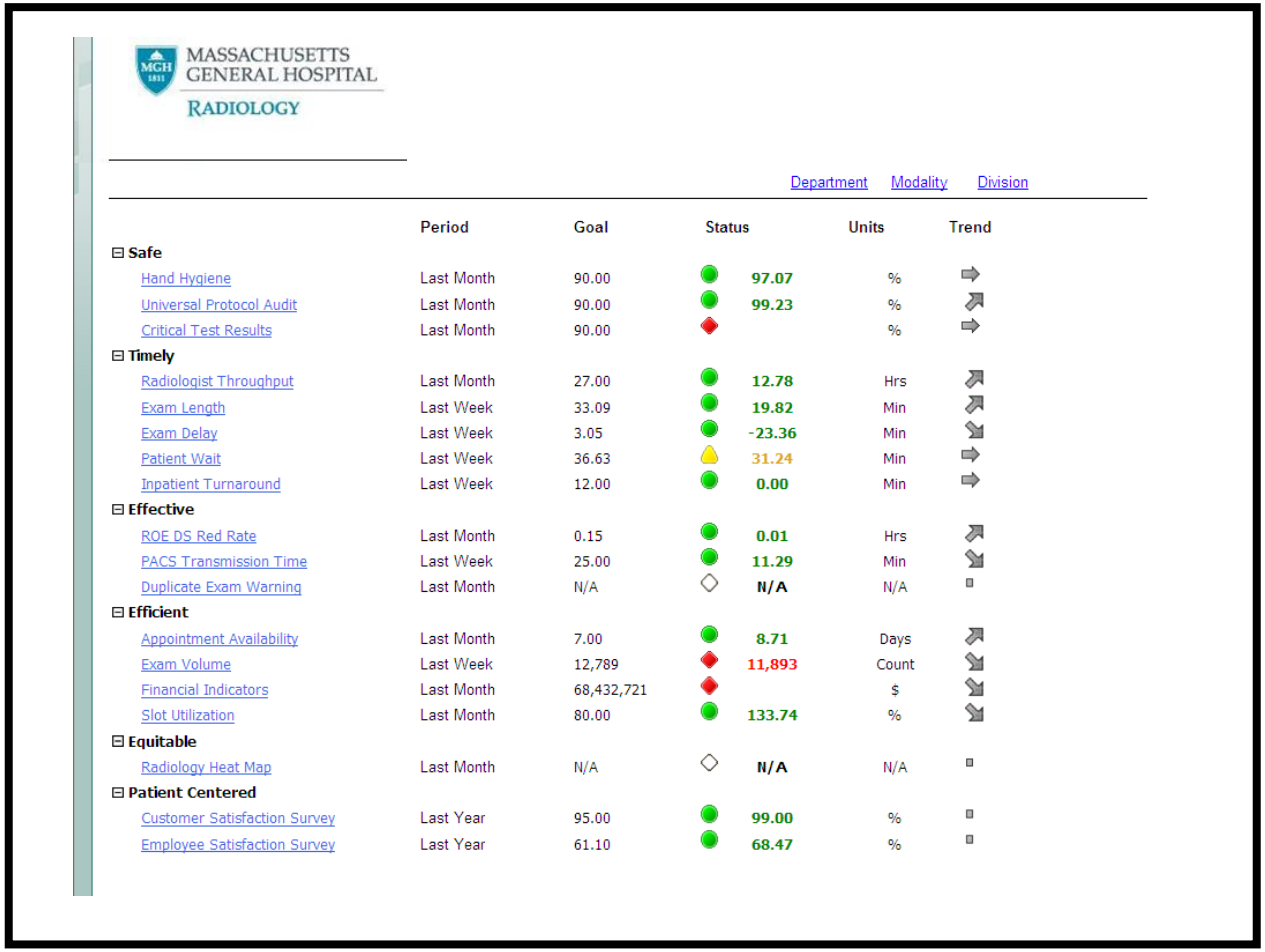
Balanced Scorecard
Measure and focus



Adapted and modified from Kaplan and Norton. *The Balanced Scorecard* and *Strategy Maps*, Harvard Business Review Press, Boston, MA

Q#5: Does your organization have a business intelligence dashboard or Balanced Scorecard?

MGH Departmental Primary Dashboard (Balanced Scorecard) Using The 6 US National Academy of Medicine Categories of Quality And 18 Roll Up KPIs

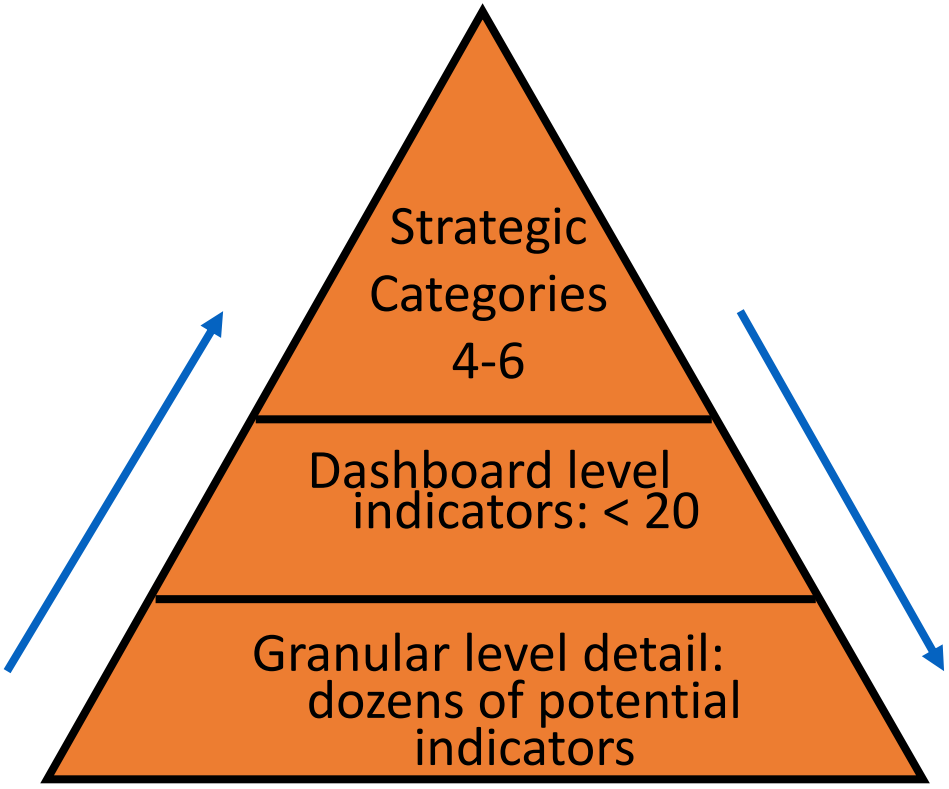


MASSACHUSETTS GENERAL HOSPITAL
RADIOLOGY

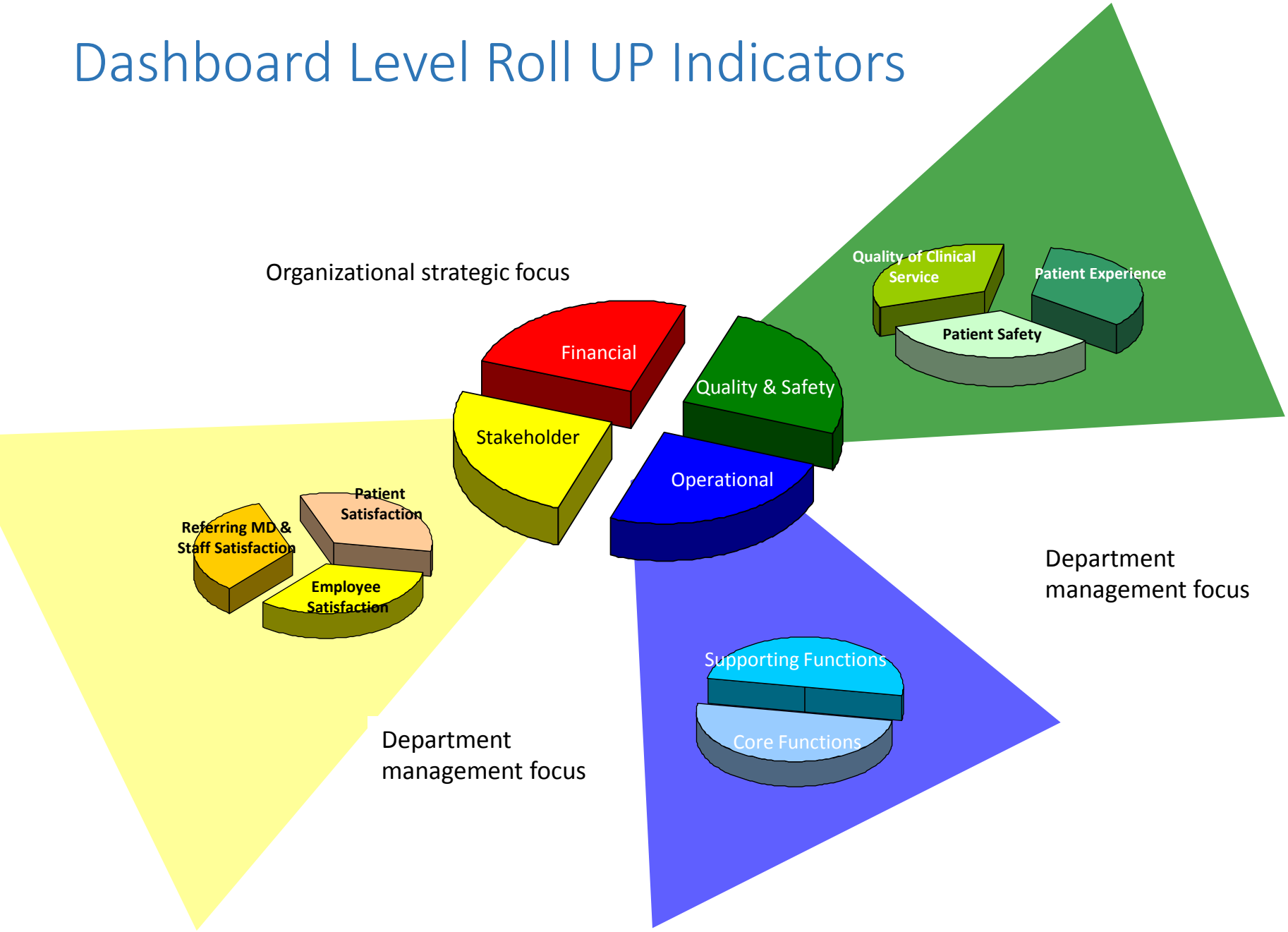
Department Modality Division

	Period	Goal	Status		Units	Trend
Safe						
Hand Hygiene	Last Month	90.00		97.07	%	
Universal Protocol Audit	Last Month	90.00		99.23	%	
Critical Test Results	Last Month	90.00			%	
Timely						
Radiologist Throughput	Last Month	27.00		12.78	Hrs	
Exam Length	Last Week	33.09		19.82	Min	
Exam Delay	Last Week	3.05		-23.36	Min	
Patient Wait	Last Week	36.63		31.24	Min	
Inpatient Turnaround	Last Week	12.00		0.00	Min	
Effective						
ROE DS Red Rate	Last Month	0.15		0.01	Hrs	
PACS Transmission Time	Last Week	25.00		11.29	Min	
Duplicate Exam Warning	Last Month	N/A		N/A	N/A	
Efficient						
Appointment Availability	Last Month	7.00		8.71	Days	
Exam Volume	Last Week	12,789		11,893	Count	
Financial Indicators	Last Month	68,432,721			$	
Slot Utilization	Last Month	80.00		133.74	%	
Equitable						
Radiology Heat Map	Last Month	N/A		N/A	N/A	
Patient Centered						
Customer Satisfaction Survey	Last Year	95.00		99.00	%	
Employee Satisfaction Survey	Last Year	61.10		68.47	%	

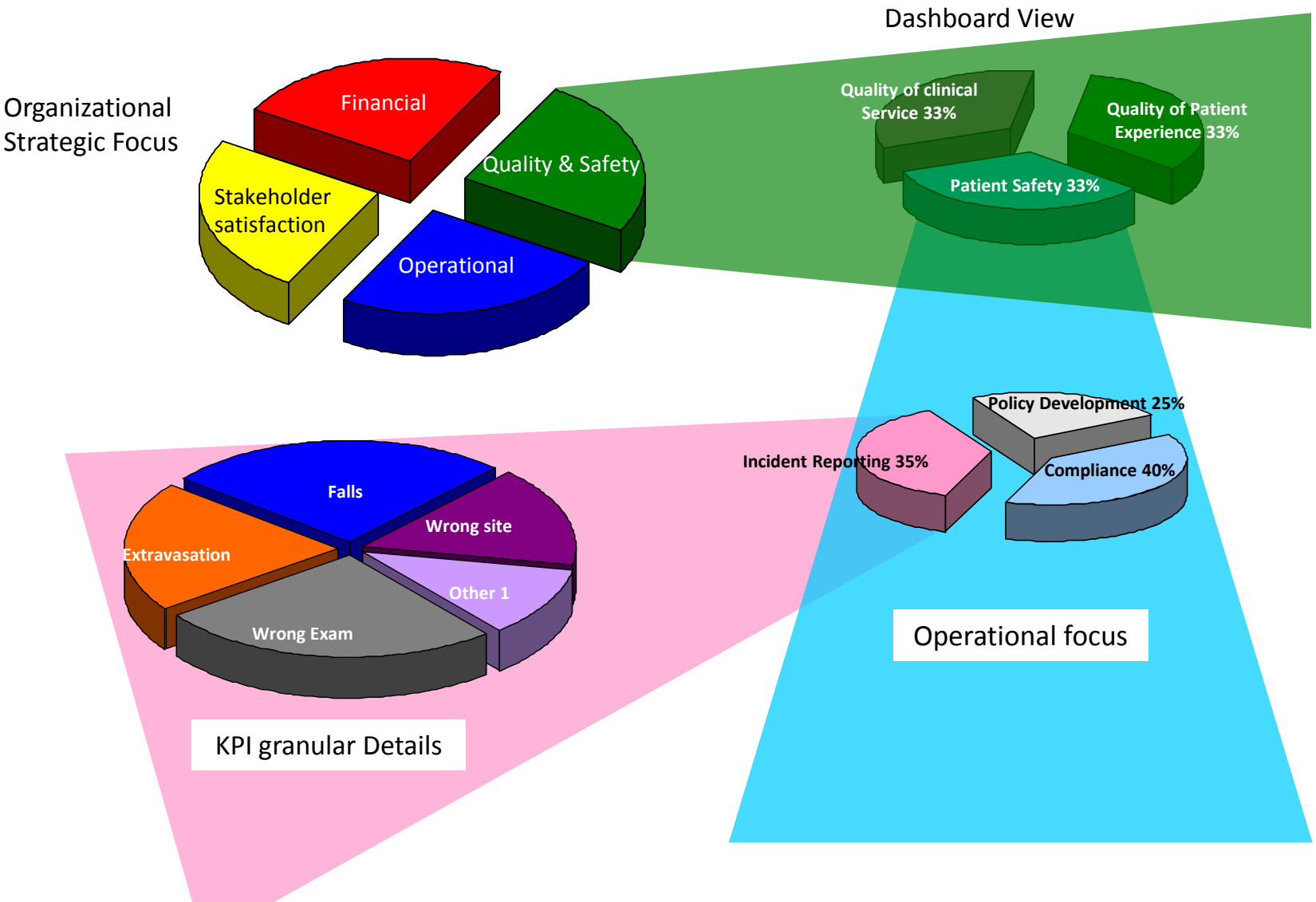
Hierarchical Presentation Of Business Intelligence Data: Role Up And Drill Down



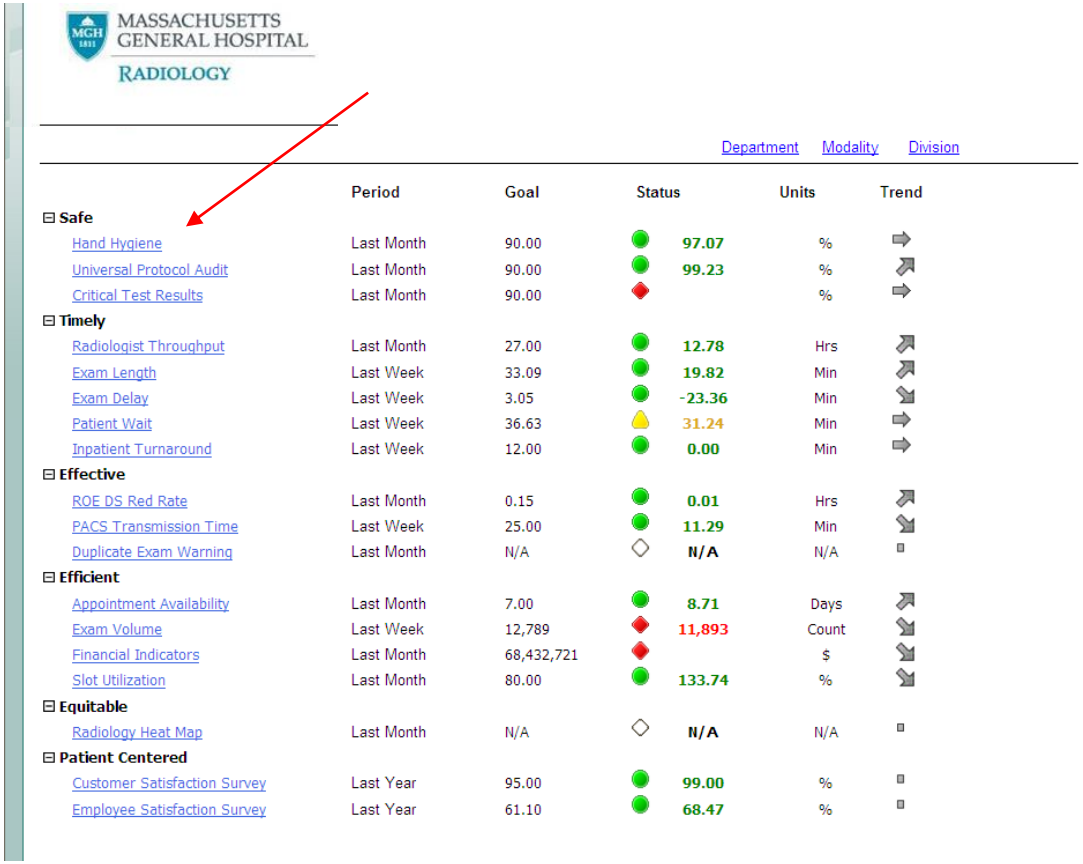
Dashboard Level Roll UP Indicators



KPI Granular Level Indicators



Drill Down Example: Hand Hygiene



MASSACHUSETTS GENERAL HOSPITAL
RADIOLOGY

Department Modality Division

	Period	Goal	Status	Units	Trend
Safe					
Hand Hygiene	Last Month	90.00	97.07	%	
Universal Protocol Audit	Last Month	90.00	99.23	%	
Critical Test Results	Last Month	90.00		%	
Timely					
Radiologist Throughput	Last Month	27.00	12.78	Hrs	
Exam Length	Last Week	33.09	19.82	Min	
Exam Delay	Last Week	3.05	-23.36	Min	
Patient Wait	Last Week	36.63	31.24	Min	
Inpatient Turnaround	Last Week	12.00	0.00	Min	
Effective					
ROE DS Red Rate	Last Month	0.15	0.01	Hrs	
PACS Transmission Time	Last Week	25.00	11.29	Min	
Duplicate Exam Warning	Last Month	N/A	N/A	N/A	
Efficient					
Appointment Availability	Last Month	7.00	8.71	Days	
Exam Volume	Last Week	12,789	11,893	Count	
Financial Indicators	Last Month	68,432,721		$	
Slot Utilization	Last Month	80.00	133.74	%	
Equitable					
Radiology Heat Map	Last Month	N/A	N/A	N/A	
Patient Centered					
Customer Satisfaction Survey	Last Year	95.00	99.00	%	
Employee Satisfaction Survey	Last Year	61.10	68.47	%	

Department level summary

Scorecard - Hand Hygiene

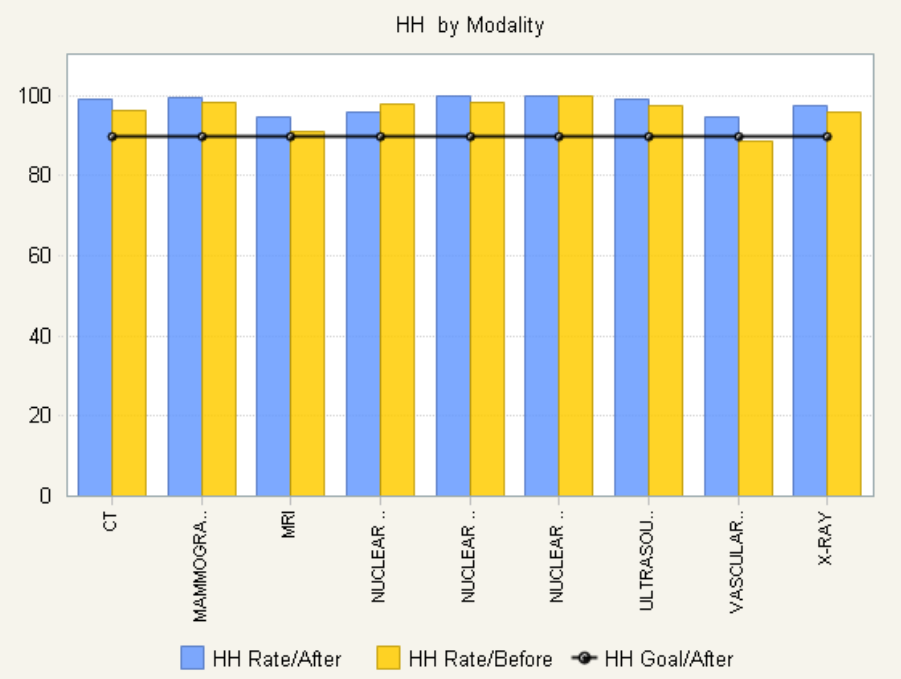
	Value	Target/Status	Trend
3D LAB		90 ◇	▫
CT	97.79	90 ●	→
MAMMOGRAPHY	99.03	90 ●	→
MRI	93.00	90 ●	→
NUCLEAR CARDIOLOGY	96.81	90 ●	→
NUCLEAR MEDICINE	99.22	90 ●	→
NUCLEAR MEDICINE-PET	99.87	90 ●	→
ULTRASOUND	98.41	90 ●	→
VASCULAR RADIOLOGY	91.66	90 ●	→
X-Ray	96.71	90 ●	→

Hand Hygiene

Definition:	The usage of hand hygiene before and after patient contact
Owner:	Karen Miguel
Accountability:	QSC; SO; Ops Manager
Metric Source:	Joint Commission NPSG
Units:	% Compliant
Norm:	Straight Line Monthly 90%
Target:	90%
Numerator:	Sum of Compliant Observations
Denominator:	Sum of Observations
Data Source:	CQS
Reporting Cycle:	Monthly

Hand Hygiene Bar by Modality Group

MEM Time Month: All



Hand Hygiene Grid by Title and Group

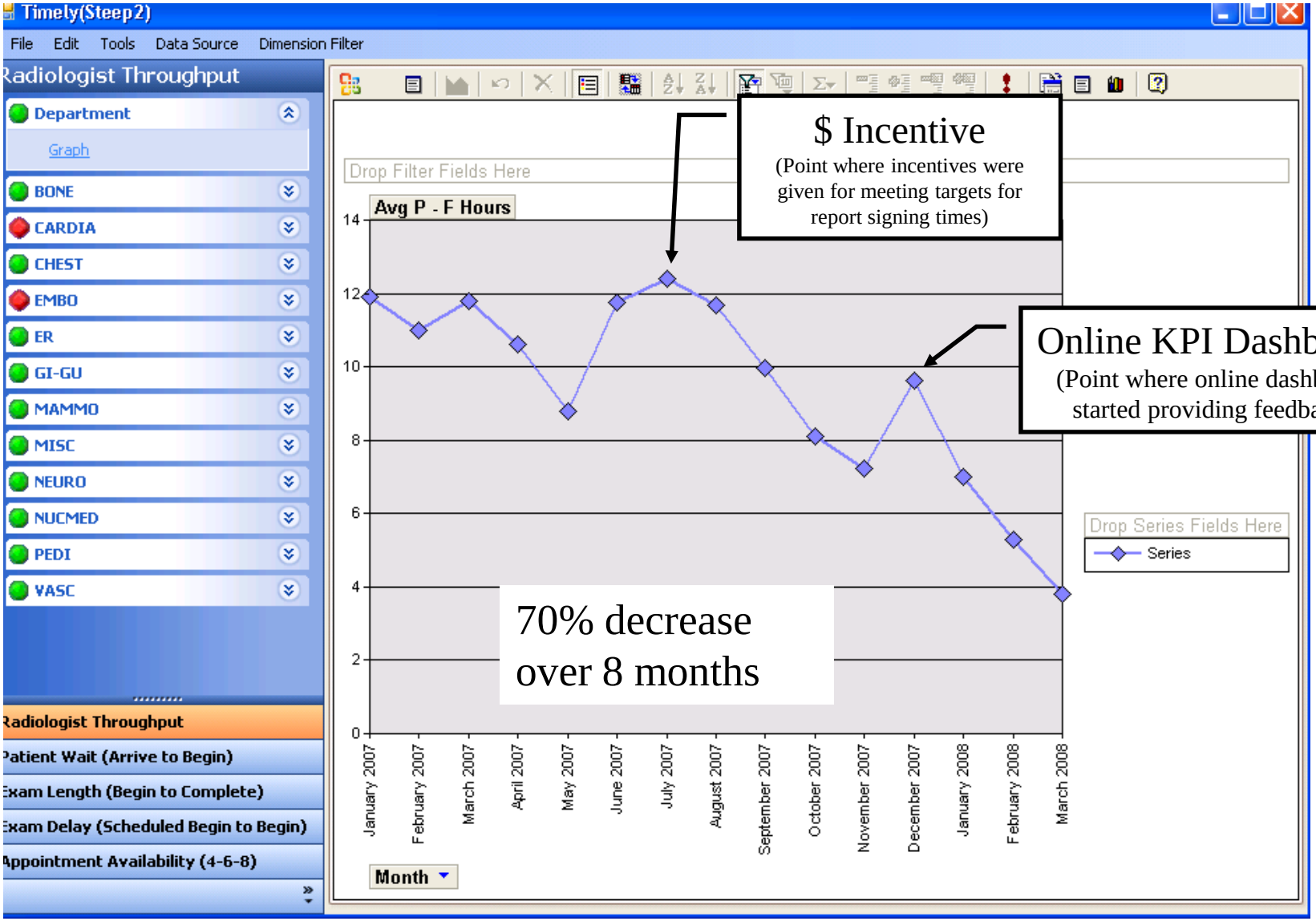
MEM Time Month: All

	Rate Before	N Before	Rate After	N After	HH Goal
					90.0
MD	85.5	553.0	95.1	732.0	90.0
Nurse	95.9	997.0	96.3	1069.0	90.0
Other	81.4	92.0	92.0	149.0	90.0
RSR	86.6	304.0	97.9	417.0	90.0
Tech	97.9	6636.0	98.7	7104.0	90.0
Tech Asst	97.3	587.0	99.2	623.0	90.0
Transporter	87.9	211.0	97.8	480.0	90.0

Drill Down Example: Hand Hygiene Compliance KPI In Each Practice Unit

Steps 5: Use KPIs To Improve Performance

Report Turn-Around-Time



Q7: Have you improved a process through use of KPIs?

Share and example…

Dos and Don’ts

Do

- Prioritize the most important KPIs
- Use KPIs to obtain *actionable* business intelligence
- Periodically review the importance of each KPI
  - Areas needing attention change over time
- Try to mitigate the burden of data collection
  - automate data collection as much as possible
- Hold people accountable for them and to them
  - Training is key
    - Interpretation
    - Cause and effect relationships

Don’t

- Try to measure everything all the time
- Overwhelm the organization with too many KPIs
- Create an overly expensive and time wasting system for KPIs
- Rely on KPIs out of larger context
  - Common sense trumps numbers every time

Pitfalls

- KPI process becomes regarded as just another pro forma administrative burden and not used for intended purposes

- Missing what's important to measure what is easy to measure
  - "Not everything that counts can be counted, and not everything that can be counted counts" Sociologist, William Bruce Cameron-- 1963

- Misinterpreting KPI results
  - Productivity between high RVU versus low RVU subspecialties--pediatrics versus neuroradiology
  - Not correcting costs to reflect variances in volume

Pitfalls

- Failure to understand balance between KPIs
  - Patient satisfaction versus quality of care – on line mammography versus accuracy of interpretations

- Reliance on KPIs can result in unintended consequences
  - Physician productivity and performance,
    - Cherry picking of easier cases
    - Avoidance of risky procedures to reduce incidents requiring reporting
  - Adverse resource management to meet expense budget
    - Understocking with “stock outs”

Conclusions

- Used correctly KPIs can help in achieving organizational goals
- KPIs should be adapted to each organization's situation
- The benefits of KPI use must be balanced against the time and cost to acquire and analyze them
- Leaders and managers should be trained in how to turn KPI based business intelligence into action but…
- KPIs are ultimately just another management tool and should be placed in context