



Imaging's Future: Adapting to "Value" Based Care Models

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Today's healthcare challenges



Steady **decline of inpatient volumes** means need for new income sources of revenue and to operating more efficiently

Migration to an **outpatient model** while still needing inpatient volume

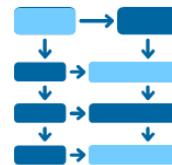


Complexities in building a continuum of care while fostering consistent patient care and service



Pressure to develop best practices for the **patient experience**

A critical need for more **robust data analytics**



Uncertain and dynamic regulatory and political environments

Hospitals and healthcare systems are looking for more than just vendors, consultants, and spot solutions

From Traditional Vendor

- **Sub-optimization** from multiple, diverse, and unconnected solutions
 - Equipment and IT vendors
 - Service vendors
 - Management consultants
- **Transactions** with unplanned, and often ad-hoc, purchasing cycles when client's need and budgets happen to meet
- **Short-lived results** because of difficulty implementing or sustaining changes; consulting recommendations sit on shelf

To Operating Partner

- **Freeing up providers** to focus on the core business of patient care by simplifying all non-clinical operations
- **Reducing costs long-term** through standardization, economies of scale, and pre-planned investment
- **Focusing on outcomes** with aligned incentives, accountability, and user-friendly analytics dashboards
- **Driving change directly** with on-site presence; not “flying away” to next client
- **Supporting client's growth** through strategic design capabilities: new facilities transition and post-merger integration

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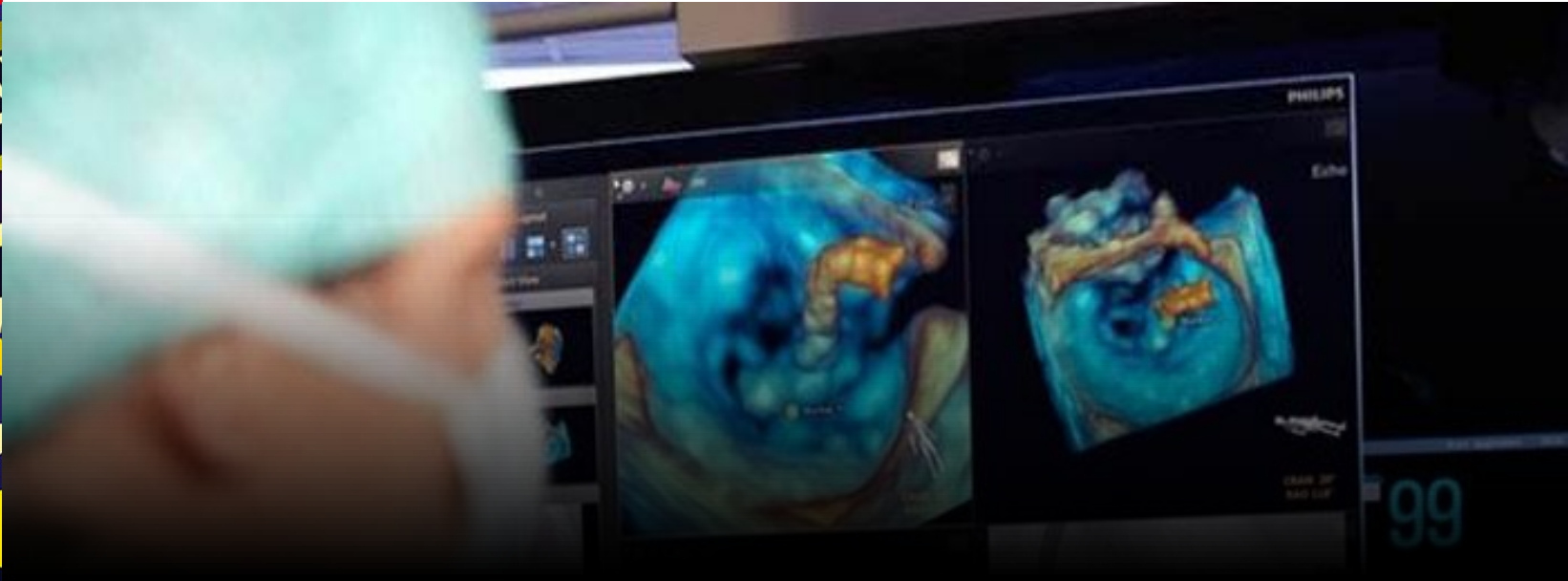
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Value = first time right imaging



In today's environment, the path forward is to deliver highly simplified, comprehensive solutions that enable an efficient, effective definitive decision making process for our customers. This is called **first time right**.





First time right...

... can enable healthcare providers to thrive in the changing healthcare landscape by simplifying the path to clinical decision-making to improve outcomes for patients and reduce burden to the health system.

This approach will drive out variability and hasten the delivery of a clinical “answer” on the path to an optimal outcome for patients.

First time right...

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enables

*the radiologist be an
expert advisor
throughout the health
continuum*



simplifies

*the technology to allow
technicians to achieve the
right image, the first time*



connects

*the information available from
big data with the day-to-day
realities of patient care*

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First time right means understanding KPIs to drive **Productivity & Efficiency**



Metrics

Intelligence

Improvements

Operational

- Repeat imaging
- Low-value imaging
- Follow-up compliance
- Critical findings follow-up
- Staff performance

Clinical

- ACR appropriateness
- Image and report quality
- Diagnostic accuracy



Configured customer data

Operational

- Adjust equipment
- Targeted training
- Targeted education

Clinical

- Adapt guidelines
- Adapt workflow
- Adapt protocols





Data-driven decision making

“... compelled by data, rather than by intuition or personal experience. It is often labeled as business jargon for what scientists call evidence-based decision making”

Source: [Wikipedia](#)

Sample questions in an imaging department

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“How do we standardize our team’s performance across imaging equipment? How can we target trainings only where needed?”

“What are my monthly, weekly, daily and hourly study count?”

“What is my weekly average resource utilization?”

“How can we use data to better inform and direct the management of our department?”

“What are the contributors to our lagging turn around times for screening exams?”

“How am I doing in terms of meeting the budgeted volumes for this month, and year so far?”

“How do we identify and manage imbalances in imaging volumes and determine the root causes?”

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From data analytics towards business intelligence

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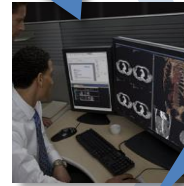
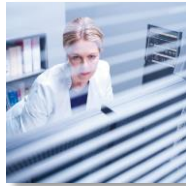
Imaging Utility Analytics

- Rescans
- Device utilization
- Feature utilization
- Optimized scheduling
- Radiation dose (CT Registry)



Imaging Quality Analytics

- Suboptimal imaging studies
- Report quality
- Follow-up adherence (NCCN)
- Automatic metric reporting (PQRS, IMM)
- ACR Appropriateness.



Imaging Workflow Analytics

- Report turn-around time.
- Repeated scans
- Patient follow-up adherence (return on time)
- Predictive resource planning



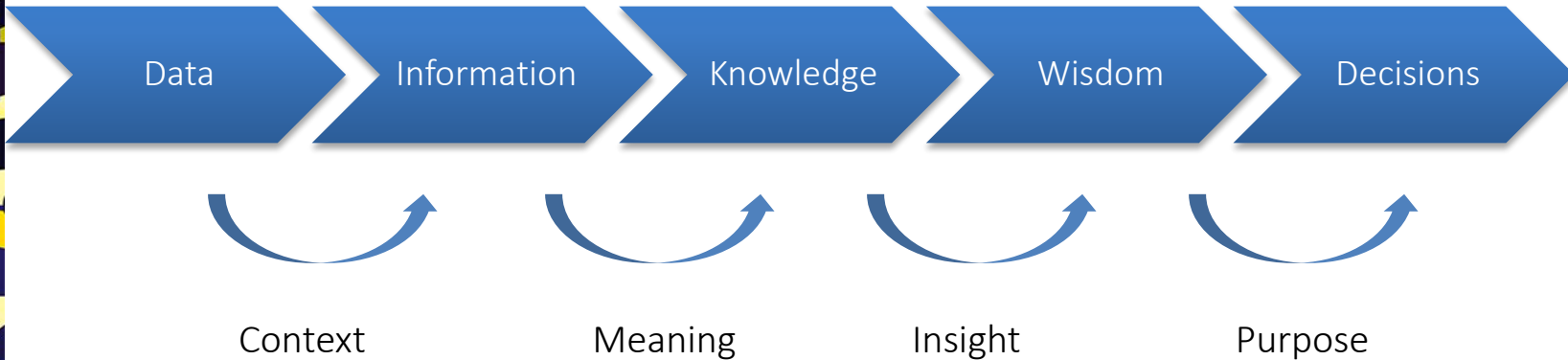
Big Data Imaging Analytics

- Discover new bio-makers with help of multi-dimensional data (Lung Disease)
- Optimized imaging pathway selection in bundled care (patient cohort identification for IGIT)

Imaging Outcome Analytics

- Correlate imaging and pathological outcomes (e.g. MQSA)
- Correlate imaging and therapeutic outcomes

Stages of data sophistication





Data-driven practice management



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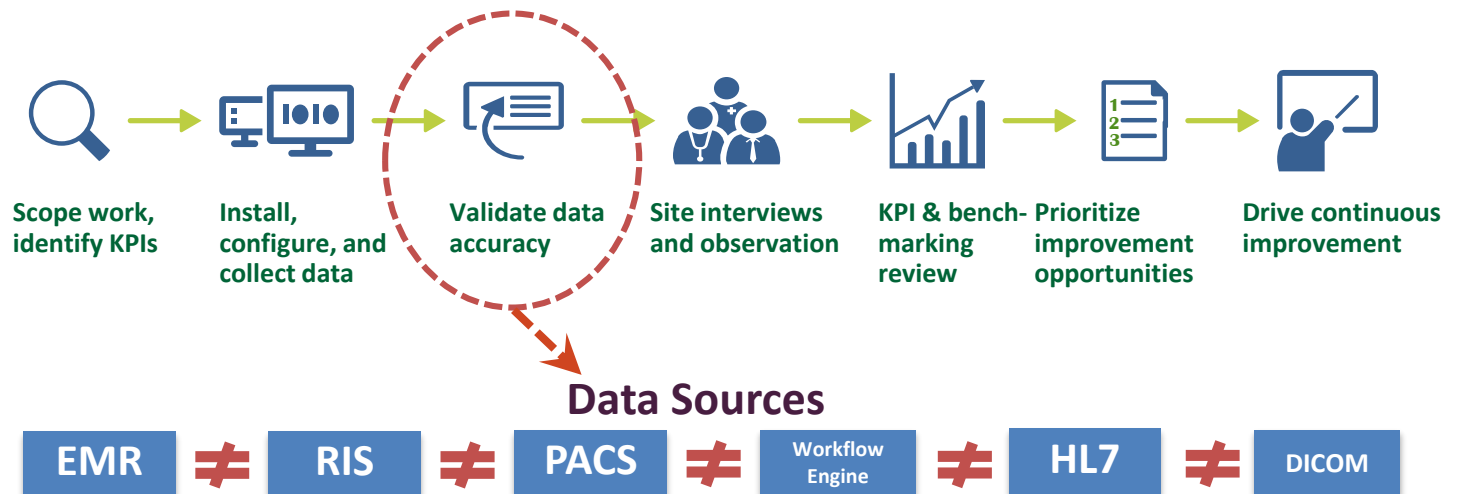


Image related data sources

Data Source	Advantages	Disadvantages
EMR/RIS	<ul style="list-style-type: none"> - Contains all data except for images, including scheduling and billing information 	<ul style="list-style-type: none"> - Not all data can be easily queried - Manually entered data resulting in poor quality
PACS	<ul style="list-style-type: none"> - System timestamps from modalities resulting in accurate reporting of resource utilization and TATs - PACS administrators have significant control 	<ul style="list-style-type: none"> - Contains only imaging related data - Not easy to export aggregate study information
Workflow Engine	<ul style="list-style-type: none"> - Closest interface to capturing workflow related data 	<ul style="list-style-type: none"> - Contains only data related to specific user activities, such as finalizing a report
HL7	<ul style="list-style-type: none"> - Multiple system timestamps 	<ul style="list-style-type: none"> - Requires specialized knowledge to process messages - May not necessarily be the data used for operational reporting, such as study completion
DICOM (meta data)	<ul style="list-style-type: none"> - System timestamps from modalities resulting in accurate reporting of resource utilization and TATs 	<ul style="list-style-type: none"> - Requires specialized knowledge to process messages - May not necessarily be the data used for operational purposes



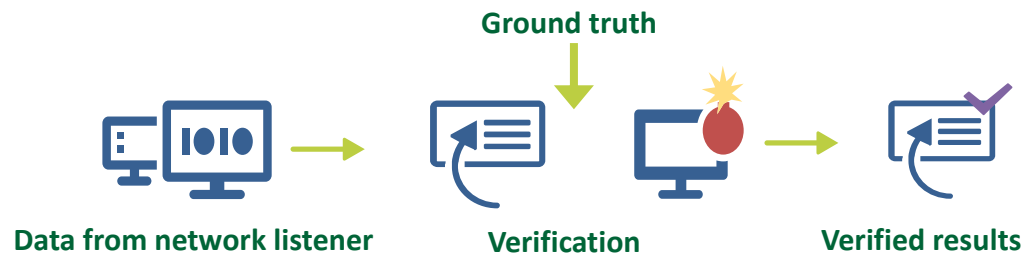
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Data verification strategy

- Extract 'ground truth' data from existing clinical systems and verify against these results



- Verification criteria
 - Verify study volumes by:
 - Modality, exam code, AE title, location
 - Verify timings
 - Procedure time, prep time, scan time, idle time



Establishing ground truth - challenges

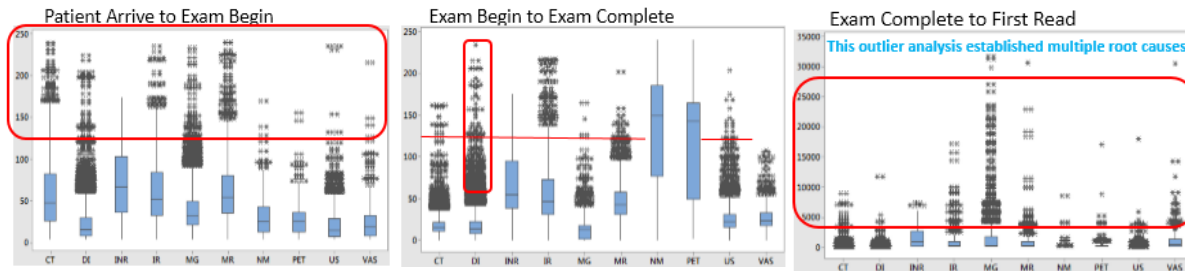
- Extract data from Epic:
 - Epic has two reporting mechanisms:
 - “Clarity” for analytics reporting
 - “Workbench” for operational reporting (for up to 30 days)
 - Exam count in Clarity \neq count in Workbench: Clarity report default queries were incorrect
- Data quality issues due to staff compliance and new terminology
 - Studies not properly completed which affect daily exam volumes
 - Complexity of patient class (IP, OP, ED) : 24 different patient classes in Epic
 - New exam codes in Radiology
- Epic ‘ground truth’ is based on manual data entry
 - Exam start and end times are entered manually, often at end of shift

Improvements in report turnaround time analysis

Analyzed turnaround time by splitting into 3 categories by each modality

- Patient check-in to exam start
- Exam start to exam complete
- Exam complete to first read and made the analysis

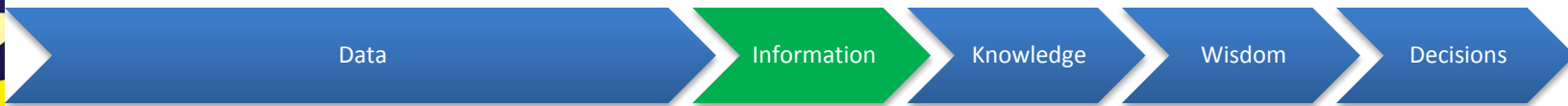
TAT analysis- Patient arrive to exam read by radiologist



Quick Win : Team initiated the proactive weekly analysis to detect as well as reduce these outliers. Leadership decided to implement these countermeasures across the enterprise



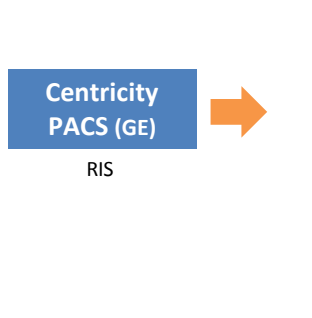
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Context



Initial approach to Performance Reporting



DOJ	WEEKDAY	Dept	ExamCode	PatientType	PatientLocationCode	Resource	Test	OrderEnteredTime	ArrivalDTM	BeginDTM	CompletedDTM	DepartDTM	Referrer
1	1/25/2015	118	A	4	8	8	ULTRAS	1/25/2015 10:38	1/25/2015 10:38	1/25/2015 11:00	1/25/2015 11:00	GORDON, FRIEDRICH	
2	1/25/2015	118	A	4	8	8	ULTRAS	1/25/2015 10:38	1/25/2015 10:38	1/25/2015 11:00	1/25/2015 11:00	GORDON, FRIEDRICH	
3	1/25/2015	118	A	4	8	8	ULTRAS	1/25/2015 10:38	1/25/2015 10:38	1/25/2015 11:00	1/25/2015 11:00	GORDON, FRIEDRICH	

WEEKDAY	(Multiple Items)
HOUR	(Multiple Items)
Row Labels	Count of ExamCode
Jan	1543
Feb	1341
Mar	1506
Apr	1647
May	1470
Jun	1460
Jul	1561
Aug	1461
Grand Total	11989

PivotTable Fields

Choose fields to add to report:

- DOS
- WEEKDAY
- Dept
- ExamCode
- Accession
- PatientType
- PatientStatus
- LocationCode
- Resource
- Tech
- OrderEnteredTime
- ArrivalDTM
- Referrer

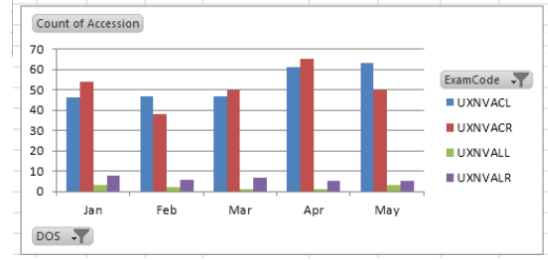
Drag fields between areas below:

FILTERS
WEEKDAY
HOUR

ROWS
DOS

VALUES
Count of ExamCode

Count of Accession	Column Labels				
Row Labels	UXXNVACL	UXXNVACR	UXXNVALL	UXXNVALR	Grand Total
Jan	46	54	3	8	111
Feb	47	38	2	6	93
Mar	47	50	1	7	105
Apr	61	65	1	5	132
May	63	50	3	5	121
Grand Total	264	257	10	31	562



- Takes a lot of time**
- Data extraction
 - Data import
 - Formatting
 - Context switching
- Error prone**
- Lot of copy-pasting
 - Manual calculations
- Aesthetics**
- Drill-down capabilities
 - Trend identification
 - Hard to 'merge' graphs

PivotTable Fields

Choose fields to add to report:

- DOS
- WEEKDAY
- Dept
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Drag fields between areas below:

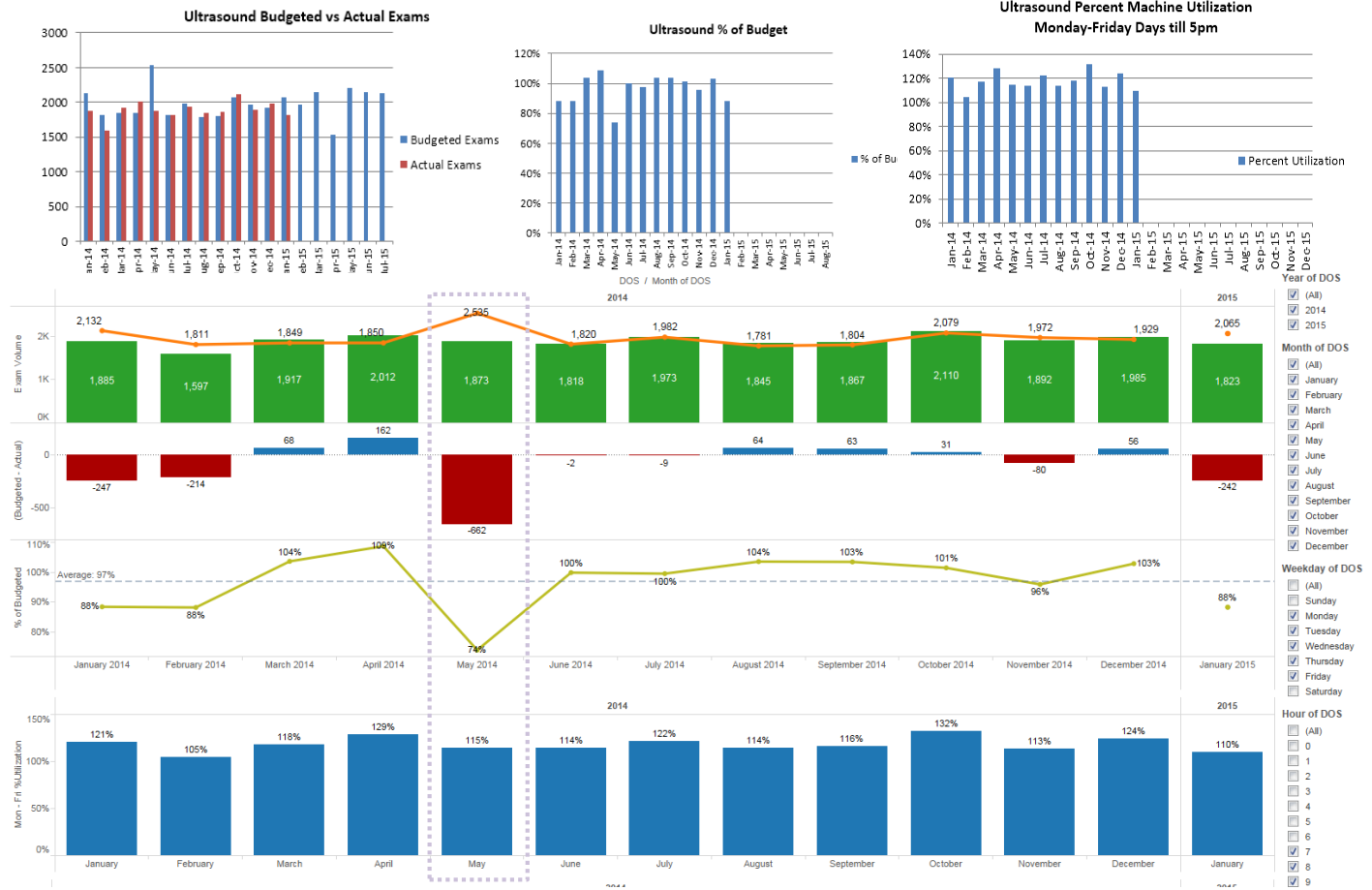
FILTERS
DOS

COLUMNS
ExamCode


ROWS
DOS

VALUES
Count of Accession

Interactive dashboards for Reporting and Exploration



Establishing data confidence to drive continuous improvement



The challenge

- Imaging departments have a wealth of data sources, yet each give differing views; this makes it difficult to derive meaningful information without establishing a ground truth and data consistency

Our objective

- Establish confidence based on two specific criteria critical for data integrity and confidence: volumes and timings

Method

- Deploy a network listener to capture HL7 and DICOM
- Aggregate and reconcile data from RIS, PACS, EMR, and workflow engine with triangulated output

Outcome

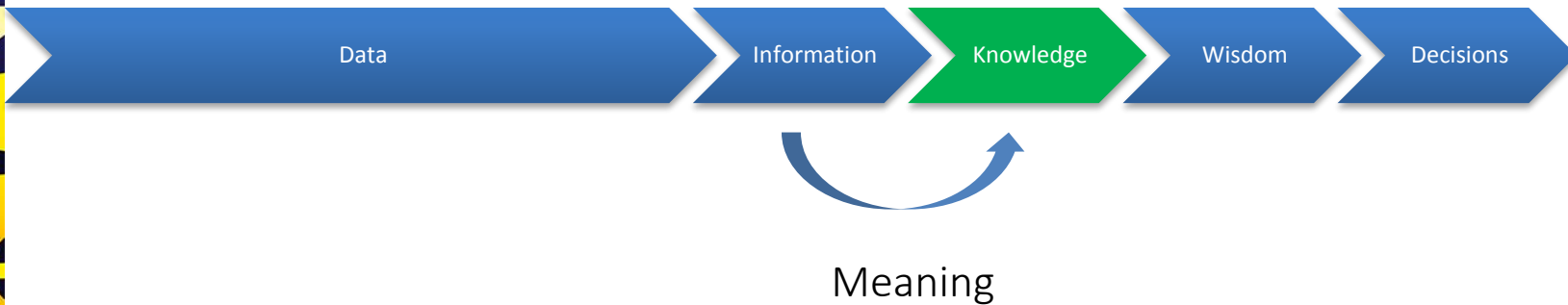
- Reconciled scans, accession numbers, images, medical record numbers, etc., in order to establish foundational operational and financial data that are consistent and can be correlated

Impact

- Identified and addressed root causes for data discrepancies
- Established meaningful metrics for specific departmental KPIs
- **Streamlined reporting approach across managers and reduced reporting time**



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Imaging assessments: sample outputs

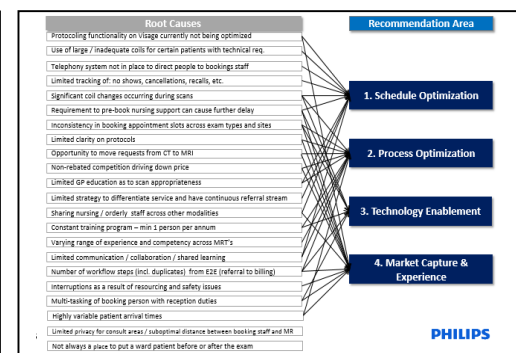
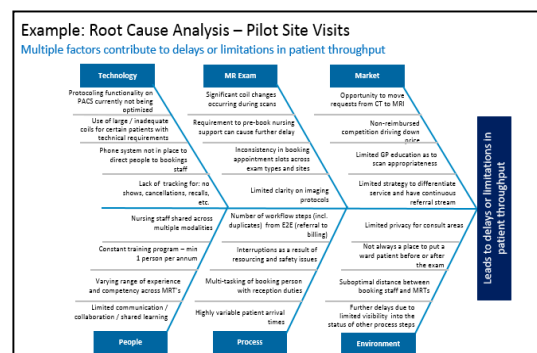
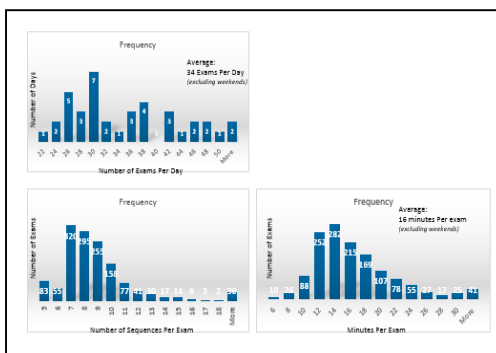
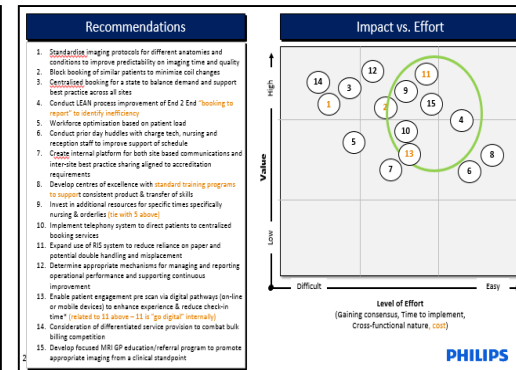
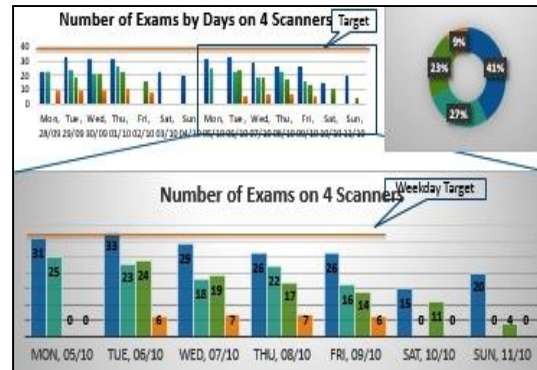
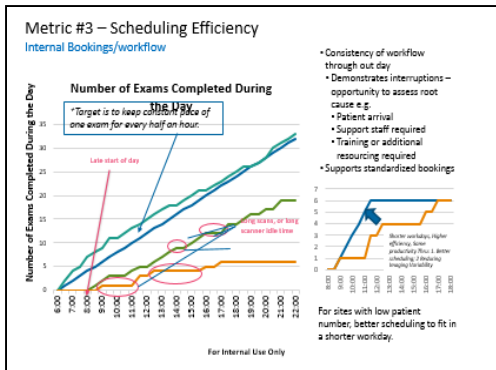
Benchmarking, root cause analysis, prioritized KPIs

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Data-driven performance improvement to optimize imaging volumes across MR scanners

The challenge

- Imaging department observed significant variation in exam count across MRI systems within the department

Our objective

- Identify opportunities to reduce variability in exam count across systems

Method

A department's modality team deployed a data-driven improvement approach to analyze variation in machine utilization of three adjacent MRI systems

Outcome

- Identified significant variation in machine utilization
- Determined root cause was varying levels of comfort with specific machine operation due to inconsistent and inadequate personnel training

Impact

Deployed targeted application training for technologists

Achieved machine utilization balancing across 3 MR systems within 3 months regardless of operator

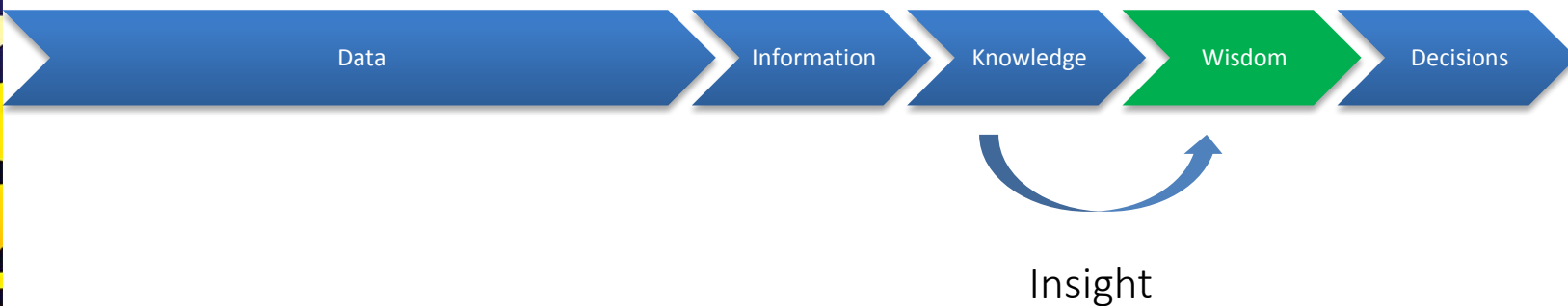
MR2 MR3 MR4

MR2 MR3 MR4

MR2 MR3 MR4

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Per capita cost reduction



The challenge

- Highly variable exam durations make optimal scheduling problematic
- Longer exams increase operational costs

Our objective

- To automatically identify which imaging exams take longer and have higher variability

Method

- Identified target protocols by looking at volume and durations
- Utilized machine log files to obtain accurate information

Outcome

- Three classes of protocols
- Clinical change to protocols
- Reduction in exam duration

Impact

- **Reduction in time per exam of ~20%**
- Created tools to integrate changes into standard way of working

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Practice management



Improvements

Operational and Financial

- Adjust equipment mix to properly serve patient population
- Detect workflow inefficiencies and apply Lean improvement concepts
- Target training for technologists, staff, and radiologists
- Suggest continuing education
- Optimal patient scheduling
- Referral patterns
- Reimbursement

Clinical

- Ensure adherence to guidelines
- Identify and apply best practices
- Minimize variation in application of protocols
- Ensure follow up adherence

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Conclusions and future work

- Measurement tools enable continuous improvement -- but it is important to...
 - Ensure the **decisions** are made **based on trusted data**
 - **Integrate metrics** into the daily **way of working**
 - Explore novel solutions but **always measure** their **impact**
- In order to
 - **Drive Value (Cost, Quality, Access) for the Patient**
- Through
 - **Adoption of a continuous improvement *culture***

Acknowledgments

- We would like to thank
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Thank you for your attention

Questions?