Managing Information from Multiple Laboratories in an Integrated Delivery Network

Lab InfoTech Summit

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Managing Information from Multiple Laboratories in an IDN
Outline

- Frame the problem

- Examine options for potential solutions

- Examine EMR as the integrating engine and the challenges for presenting laboratory data from different labs

- Present illustrative examples

The "I" Word

- <u>Integrate</u> – to form, coordinate, or blend into a functioning or unified whole (Merriam-Webster)

- <u>Integrated Delivery Network (IDN)</u> – providers, agencies, and/or institutions that work together to provide coordinated services to a patient population across the spectrum of healthcare

Spectrum of Laboratory Integration in Health Systems with Multiple Labs

Independent lab operations

Some uniformity and intra-system referral work

Standardized and integrated lab operations

Managing Information from Multiple Laboratories in an IDN – Framing the Problem

- Ultimate goal of laboratory is to provide results and interpretations to clinicians in a way that is effective for patient care decision making, BUT…

THE PROBLEMS:

- Clinicians need an integrated, longitudinal view of lab data regardless of data sources

- IDNs have *multiple laboratories* with *disparate legacy systems* and *non-standardized methods* that impact ability to integrate information

- Lab information management follows lab organizational integration – installing a single LIS is not sufficient

Multiple Labs Feed Single EMR

Clinician users

EMR

Lab 1   Lab 2   Lab 3

LIS A   LIS B   LIS C
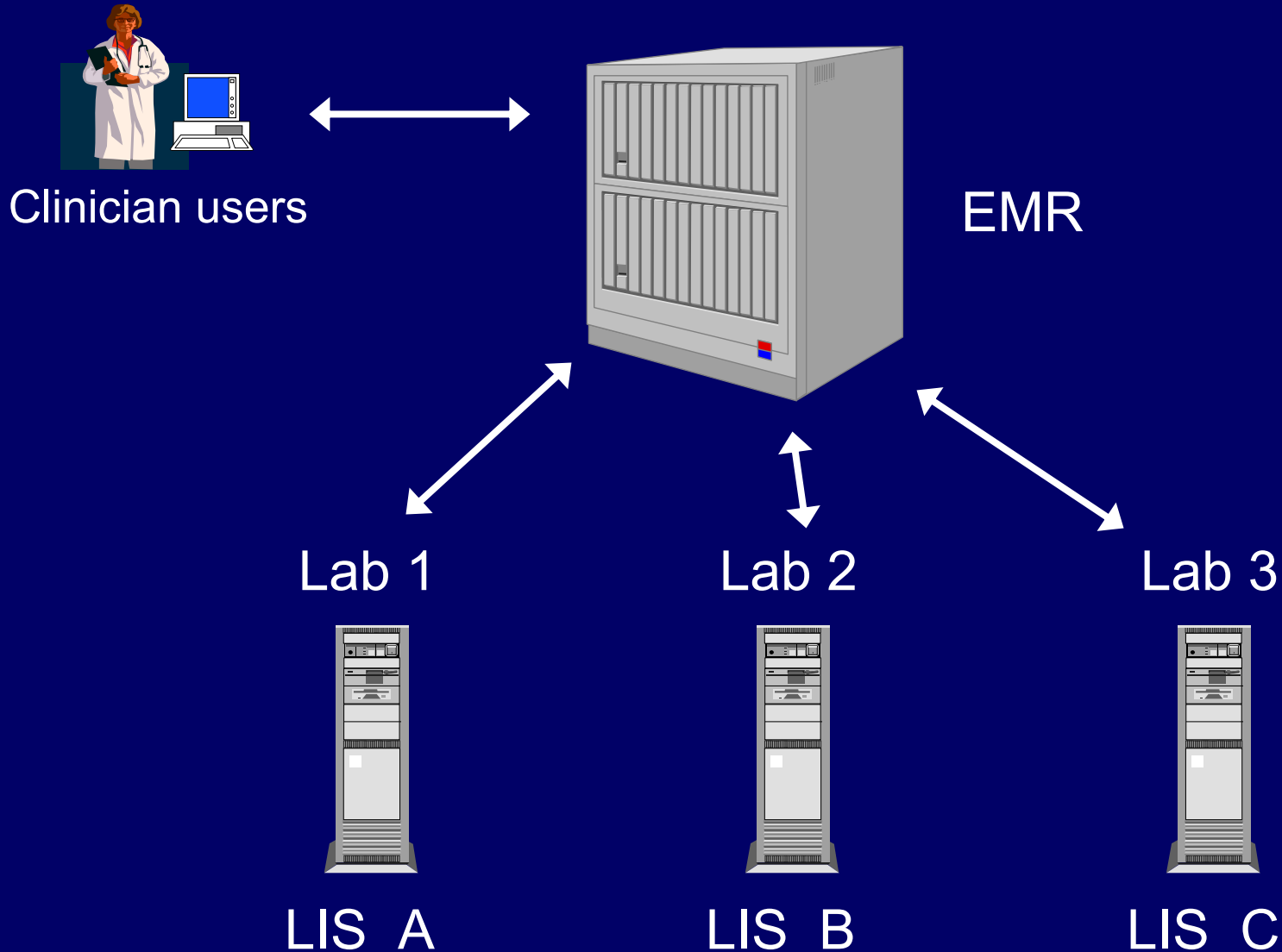
Problems in Integrating Lab Information when Multiple Laboratories Serve an IDN

- Different test methods
  - Different reference ranges for same analyte; each result must carry its reference range
  - Different units of measure for same analyte

- Other report elements
  - Performing lab location information
    - IDN labs
    - Reference laboratories (sendouts)
  - Abnormal result flags; critical value flags
  - Comment/footnote flags

Problems in Integrating Lab Information when Multiple Laboratories Serve an IDN

- Grouping of test results in cumulative result display format

- Test batteries or groups; orphaned components

- Availability of outside reference laboratory reports

- Test name/code conventions

- Definition of "sensitive" test results
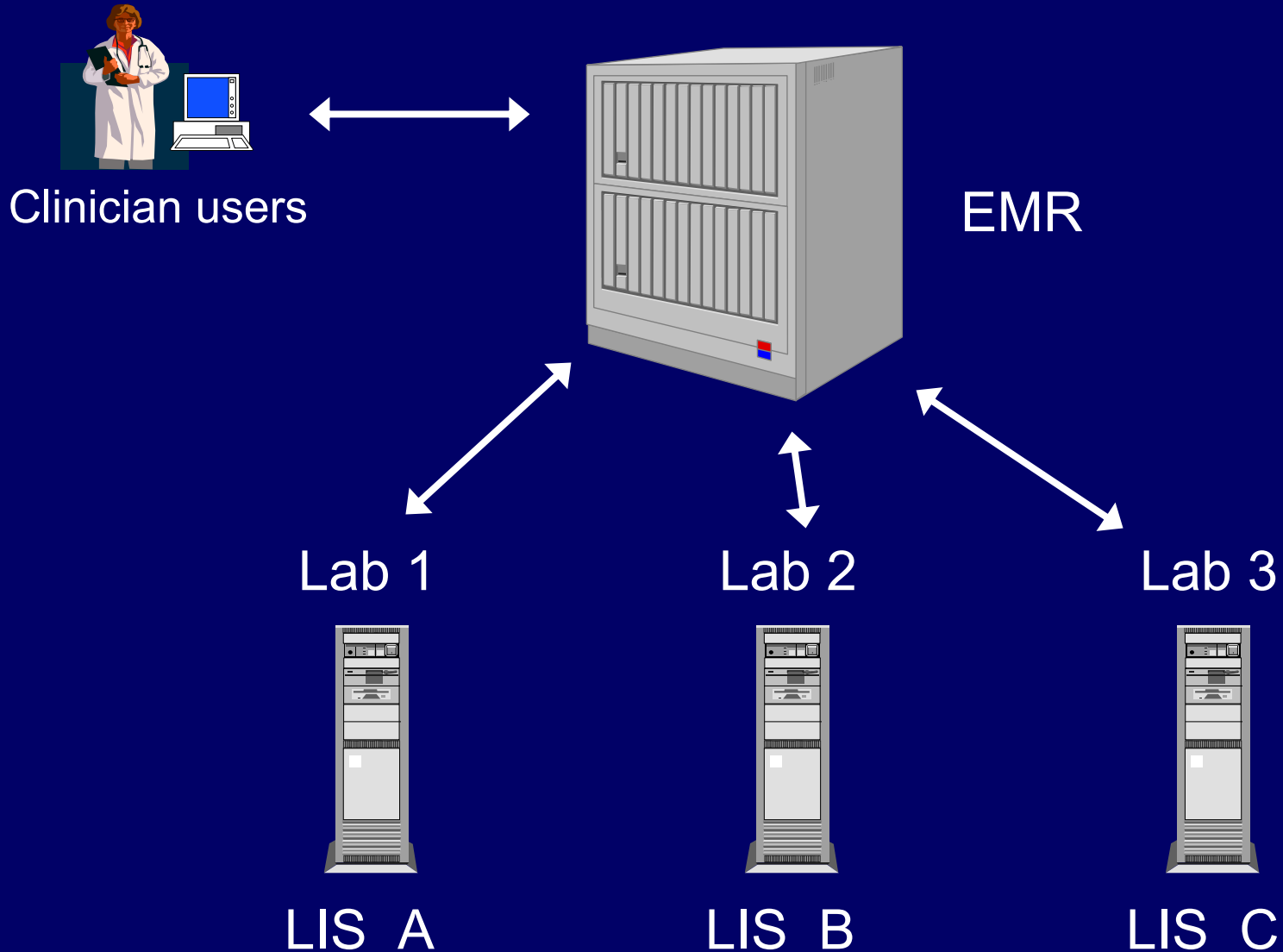
- Uniformity of order sets presented in CPOE

Problems in Integrating Lab Information when Multiple Laboratories Serve an IDN – Administrative Aspects

- Managing multiple platforms and vendors – IVD and LIS

- Congruence of LIS and EMR strategies with lab operational strategy

- Decision making process and authority – where does the buck stop?

- Outreach testing strategy and revenue flow – are IDN labs "clients" of one another?
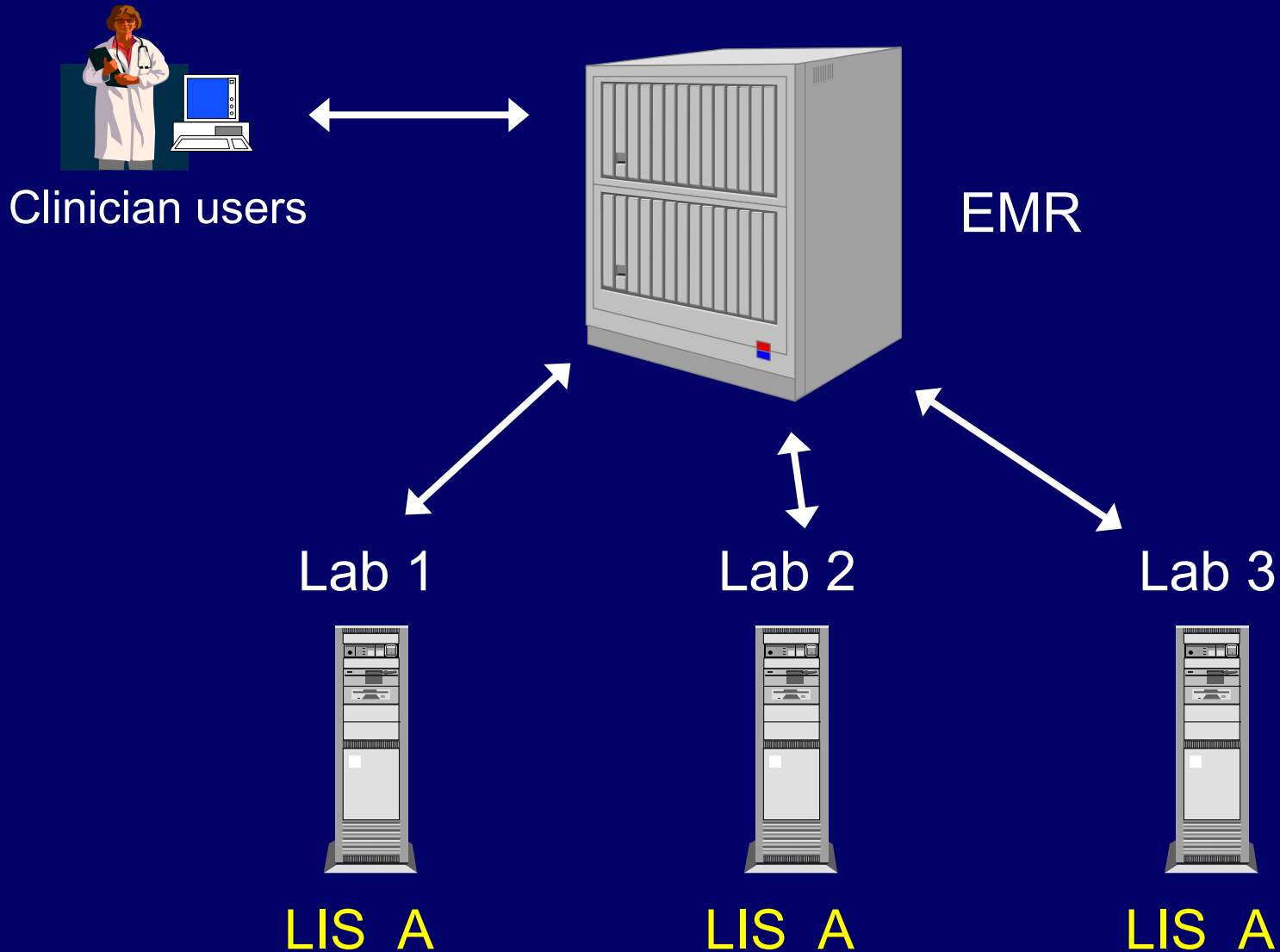
Potential Solutions Target Different Problems

- Standardize LIS using multi-facility software

- Standardize lab operations and methods

- Standardize EMR across IDN sites

Multiple Labs Feed Single EMR

Clinician users

EMR

Lab 1   Lab 2   Lab 3

LIS A   LIS B   LIS C

Solution: Standardize LIS using Multi-facility Software

Clinician users

EMR

Lab 1

Lab 2

Lab 3

LIS A

LIS A

LIS A

Standardizing LIS across IDN Improves Lab Financial Performance

- Implemented multi-facility LIS as key component of IDN-wide lab service redesign

- Established metrics for quantifying value of LIS (cumulative return >$3M over 3 yrs.)

- Contrasted other IDS lab consolidation projects that did not realize full savings due to failure of integrated LIS implementation

- "A fully implemented LIS is considered the major enabler of positive change when combined with a genuine commitment from all levels of staff and leadership"

Solution: Standardize LIS Using Multi-Facility Software

- Solves:
  - Different LIS vendors, systems, databases, interface specs

- Does not solve:
  - Different test methods, test codes, reference ranges, units, performing lab locations, instrument interfaces, fee schedules
  - Independence of operations and culture in labs
  - Different EMRs (non-integrated view of lab results and order options to clinicians)

Solution: Standardize Lab Operations and Methods

- Goal is to establish uniform testing methodologies and administrative oversight

- Consolidation into centralized lab(s) may or may not be a component

Presenting Unified View of Lab Data as a Driver of Test Platform Standardization

Hernandez JS, et al. Clin Lab Med Rev Nov/Dec 2005;19

- Standardization and integration of chemistry and immunochemistry testing platforms across diverse labs of Mayo IDN

- Driving forces cited:
  - Assure uniform quality
  - *Compare results across entire system*

- "As patients transfer between Mayo facilities… Physicians can track, trend, and interpret patient results, which also decreases the need for repeat testing"

Importance of Organizational Culture in Integration Projects
Hernandez JS, et al. Clin Lab Med Rev Nov/Dec 2005;19

- Team philosophy, trust, and recognition of differences in complexity and culture cited as success factors

- "[The project]…requires skills that are not taught in most medical schools, residencies, fellowships, or medical technology schools."
 - Change management, team building, conflict resolution, negotiation, and strategic planning

Solution: Standardize Lab Operations and Methods

- Solves:
  - Different test methods, test codes, reference ranges, units, instrument interfaces
  - Independence of operations and culture in labs

- Does not solve:
  - Different performing lab locations
  - Different EMRs (non-integrated view of lab results and order options to clinicians)

Solution: Standardize EMR across IDN sites

- Goal is to provide uniform, integrated medical record information to clinicians across multiple sites in IDN

Master Patient Index Enables Data Sharing Across IDN in Absence of Common Patient Identifier

EMR Site 1

EMR Site 2

EMR Site 3

Master Patient Index
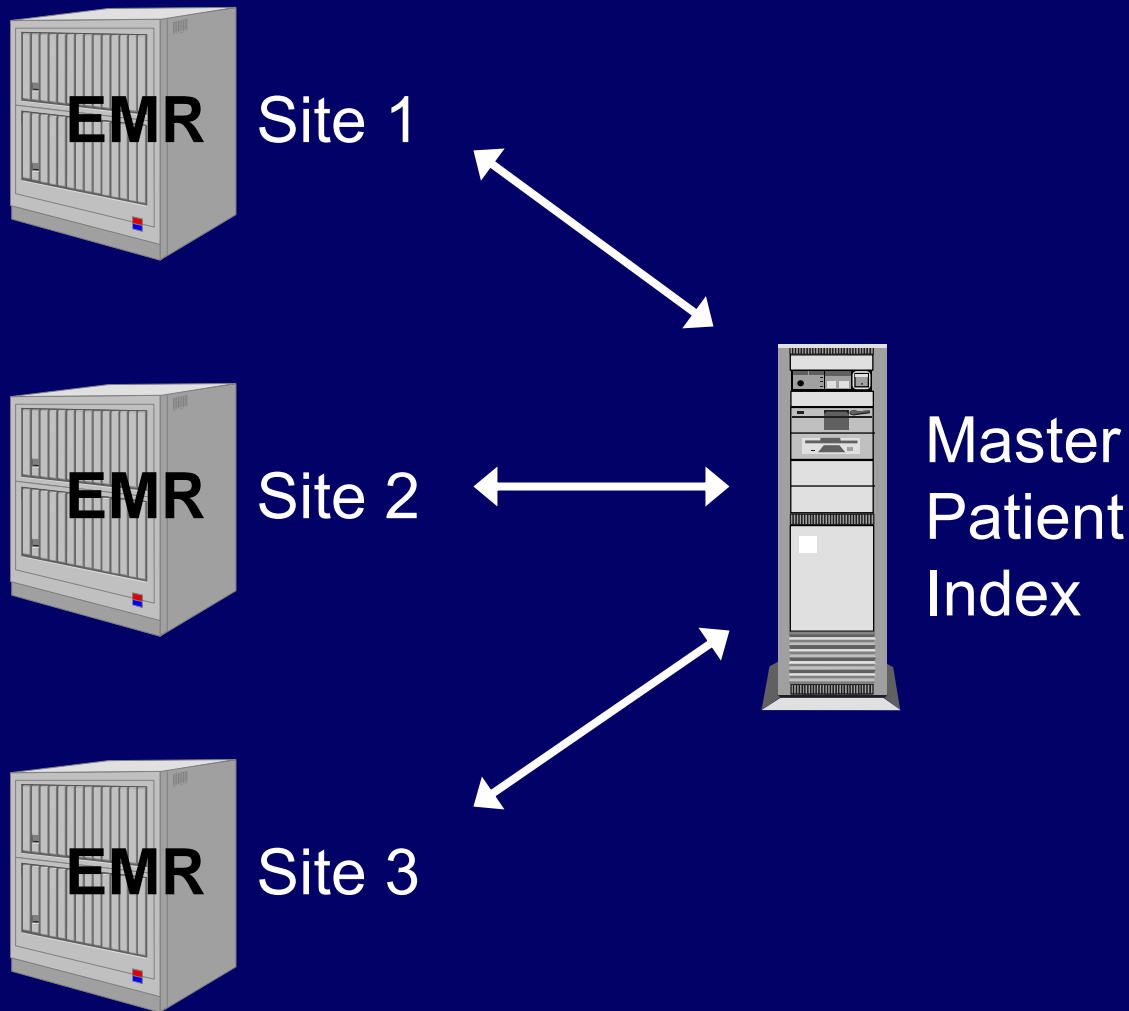
- Different legacy medical record numbers in use at different IDN sites can be cross-referenced through the master index

- An integrated view of patient data across all sites can be presented using the same EMR at all sites

Solution: Standardize EMR across IDN sites

- Solves:
  - Different EMRs – presents unified, integrated view of lab information to clinicians, but…

- Does not solve:
  - Different LIS vendors, systems, databases, interface specs
  - Different test methods, test codes, reference ranges, units, lab locations, instrument interfaces, fee schedules
  - Independence of operations and culture in labs

Results Tree – Cumulative Display

Search: [▼]

☑ Hide data prior to: 12/13/2004 [...]   [Use Date Range Wizard]

ALL TOPICS

- LAB GENERAL
  - CHEMISTRY
  - HEMATOLOGY
  - COAGULATION
  - URINE ANALYSIS
- MICROBIOLOGY
  - MICRO
- BLOOD BANK
  - BLOOD BANK
- PATHOLOGY
  - SURGICAL PATHOLOGY
- RESPIRATORY THERAPY
  - ADULT
- OTHERS
  - O2 Oxygen Device
  - Preabumin
  - TRANSCRIPTION

	1 12/12/05 0600		2 12/11/05 0500		3 12/10/05 1900	4 12/10/05 0600		1
GENERAL CHEMISTRY								
Calcium	8.4	❗	7.9	❗		7.1	❗	
Magnesium	1.5	❗	1.7			1.4	❗	
Glucose	113	❗	120	❗		112	❗	
BUN	8		8			9		
Creatinine	1.5	❗	1.2			1.2		
Sodium	141		144			140		
Potassium	3.6		3.3	❗		3.7		
Chloride	110		111	❗		108		
CO2	21	❗	22	❗		21	❗	
Anion Gap	10		11			11		
BLOOD COUNTS								
WBC			6.89			7.54		
RBC			3.55	❗		3.79	❗	
Hemoglobin			9.3	❗		10.0	❗	
Hematocrit			30.5	❗		32.5	❗	
Platelet Count			259			217 *		
MCV			85.9			85.8		
MCHC			30.5	❗		30.8	❗	
MCH			26.2	❗		26.4	❗	

Results Display With Too Many Flags

	5		6		7	
	04/14/01 1840		04/14/01 1840		04/03/01 0455	
GENERAL CHEM...						
Protein, Total	6.00 *	▼	6.10 *	▼		
Albumin	3.3 *	▼	3.2 *	▼		
Calcium			8.60 *		9.40 *	
Magnesium						
Bilirubin, Total	.7 *		.7 *			
Alkaline Phosph...	234.0 *	▲	236.0 *	▲		
ALT	27.0 *		27.0 *			
AST	23.0 *		22.0 *			
Glucose			160.0 *	▲	120.0 *	▲
BUN			35.00 *	▲	20.00 *	
Sodium			145.00 *		136.00 *	
Potassium			3.70 *		4.20 *	
Chloride			112.00 *	▲	100.00 *	
CO2			25.00 *		30.00 *	
WSR						
Phenytoin			2.90 *	▼	7.40 *	▼
Bilirubin,Conjug			.2 *			
Creatinine Urine			1.1 *		1.1 *	
Nitrogen Ur						

Search:

ALL TOPICS
- LAB GENERAL
  - CHEMISTRY
  - HEMATOLOGY
  - COAGULATION
  - URINE ANALYSIS
- OTHERS
  - BLOOD, URINE
  - Culture Collect Date
  - Culture Name
  - Culture Plate Date
  - Culture Report
  - Culture Source
  - Culture Spec NO
  - Culture Status
  - Epithelial/LPF
  - Culture Volume
  - Mucous
  - TRANSCRIPTION

New results (No timemark set)

ALL TOPICS
- LAB GENERAL
  - CHEMISTRY
  - HEMATOLOGY
  - COAGULATION
  - URINE ANALYSIS
- OTHERS
  - BLOOD, URINE
  - Culture Collect Date
  - Culture Name
  - Culture Plate Date
  - Culture Report
  - Culture Source
  - Culture Spec NO
  - Culture Status

	5	6
	04/14/01 1840	04/14/01 1840
GENERAL CHEM...		
Protein, Total	6.00 ▼	6.10 ▼
Albumin	3.3 ▼	3.2 ▼
Calcium		8.60
Magnesium		
Bilirubin, Total	.7	.7
Alkaline Phosph...	234.0	236.0 ▲
ALT	27.0	27.0
AST	23	22.0
Glucose		160.0 ▲
BUN		35.00 ▲
		145.00
		3.70
		112.00 ▲
		25.00

Result Detail

Order #: 39897038
Description: CHEMISTRY FLORIDA BACKLOAD
Component: Albumin
Collection: 04/14/2001 1840   Ref. Range: 3.5 - 5.0 G/dl

3.2 G/dl (Low)

Result   Comment   Narrative   Impression   Notes

Order Report   OK
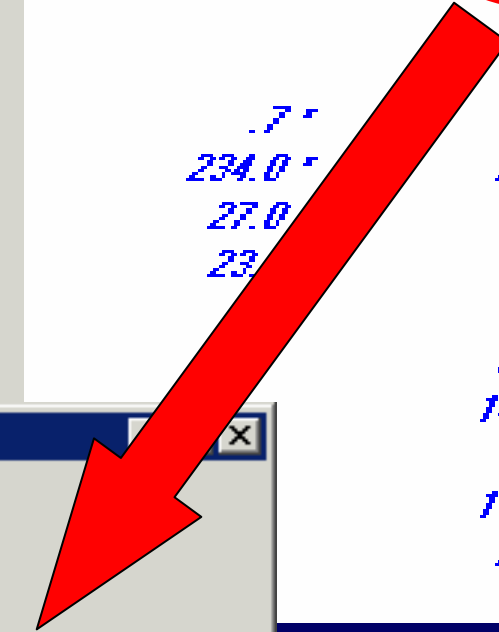
Reference Range and Other Information

Surgical Pathology Report in EMR

Result Information

Result Date and Time	Status	Provider
11/6/2002 4:14 PM	Final result	Ordered

Collection Information

Collection Date	Collection Time
11/6/2002	4:14 PM

Results

```
SURGICAL PATHOLOGY REPORT
Accession #:
Final Pathologic Diagnosis
A) ASCENDING COLON, POLYP, BIOPSY:
- FRAGMENTS OF HYPERPLASTIC POLYP.
B) COLON, HEPATIC FLEXURE POLYP, BIOPSY:
- FRAGMENTS OF COLONIC MUCOSA WITH MILD EDEMA OF THE LAMINA
PROPRIA.
        ***Electronically Signed Out***
emb/11/7/02                            UPIN #G81426
Specimen(s) Received
A: Colon, ascending,  biopsy
B: Colon, hepatic flexure,  biopsy
Gross Description
A. Received in formalin and labeled with the patient's name and
"polyp ascending colon" is an irregular soft tissue segment that
measures 1.2 x 0.3 x 0.2 cm.  Entirely submitted in one cassette.
B. Received in formalin and labeled with the patient's name and
"polyp hepatic flexure" is a ran soft tissue segment that
```

Differences in Abnormal Flags

Search: [▼]

☑ Hide data prior to: 11/14/2005 [···]   Use Date Range Wizard

ALL TOPICS
- LAB GENERAL
  - CHEMISTRY
  - **HEMATOLOGY**
  - COAGULATION
  - URINE ANALYSIS
- MICROBIOLOGY
  - MICRO
- BLOOD BANK
  - BLOOD BANK
- PATHOLOGY
  - SURGICAL PATHOLOGY
  - CYTOPATHOLOGY
- RESPIRATORY THERAPY
  - ADULT
- OTHERS
  - O2 Oxygen Device
  - TRANSCRIPTION

	1 11/24/05 0400		2 11/22/05 0609		3 11/20/05 0400		4 11/19/05 0430	
BLOOD COUNTS								
WBC	15.19	▲	13.08	▲	10.61		15.22	!
RBC	3.87	▼	3.90	▼	4.07	!	4.17	!
Hemoglobin	10.8	▼	11.0	▼	11.5	!	11.7	!
Hematocrit	32.2	▼	32.4	▼	34.3	!	34.2	!
Platelet Count	408	▲	333		289		315	
MCV	83.2		83.1		84.3		82.0	
MCHC	33.5		34.0		33.5		34.2	
MCH	27.9		28.2		28.3		28.1	
MPV	10.3		10.3		10.2		9.8	
RDW-CV	13.7		13.6		13.4		13.1	
Neut%			76.3	▲	74.8	!		
Abs Neut			9.98	▲	7.94	!		
Lymph%			11.2	▼	12.6	!		
Abs Lymph			1.46		1.34			
Mono%			8.7	▲	9.1	!		
Abs Mono			1.14	▲	0.97	!		
Eosin%			3.4		3.1			
Baso%			0.4		0.4			

Legacy System Abnormal Flag Conventions

Site 1
   High ↑, Low ↓, Critical High/Low ↑↑/↓↓
   Abnormal non-numeric !

Site 2
   All abnormal results !

Site 3
   All abnormal results *

Site 4
   High H, Low L, Critical High/Low HY/LY

Site 5
   High >, Low <, Abnormal *

Web access
    High H, Low L , Critical High/Low *H/*L

Abnormal Flag Conventions

Abnormal Flag	Region 1	Region 2	Region 3
High	▲	❗	▲
Low	▼	❗	▼
Critical High	⚡	❗	⚡
Critical Low	⚡	❗	⚡
Non-numeric	❗	❗	❗

EMR Results Display

Hematology (Up to 25 latest results)

	2005 22 Nov 10:00
All **Graph**	
☐ RBC (4.2-5.4) M/uL	2.69 L
☐ HGB (12.0-16.0) g/dL	5.8 *L 📄
☐ HCT (36.0-48.0) %	18.6 *L 📄
☐ MCV (80-100) fL	69.4 L
☐ MCH (27-34) pg	21.6 L
☐ MCHC (32-36) g/dL	31.1 L
☐ RDW (11.5-14.5) %	17.0 H
☐ Platelet Count (150-400) k/uL	195

```
                                                    11/22/05
     HEMATOLOGY                                         10:00
         WBC Count      4.0-11.0      k/uL       5.2   T
         RBC Count      4.2-5.4       M/uL         2.69L
         Hemoglobin     12.0-16.0     g/dL        5.8LYT
         Hematocrit     36.0-48.0     %          18.6LYT
         MCV            80-100        fL           69.4L
         MCH            27-34         pg           21.6L
```

EMR Results Display

HEMATOLOGY	11/07/05 0450	11/06/05 0600	11/05/05 1230	11/04/05 1810	1400
WBC 4.8-10.8 k/uL	6.42	5.94	5.93		5.54
RBC 4.7-6.1 M/uL	4.76	4.21 *	4.38 *		2.96 *
HGB 12-16 g/dL	9.7 *	7.9 *	8.3 *		4.1 * T
HCT 37-47 %	30.5 *	25.6 *	26.6 * T		14.9 * T
MCV 81-99 fL	64.1 *	60.8 *	60.7 *		50.3 *
MCH 27-31 pG	20.4 *	18.8 *	18.9 *		13.9 *
MCHC 33-37 %	31.8 *	30.9 *	31.2 *		27.5 *
RDW 11.5-14.5 %		34.1 *	33.7 *		23.9 *
Plt Estimate					

EMR Results Display

Chart

All Available

Since

○ Received ● Performed

Nov-20-2005

☐ Retain for next patient

Result Selection

All

☑ Display Category Headers

☐ Abnormal ☐ Show Pending

New Results...

Display Format

Report by Order
Summary
Trend View

☐ Graph

	Nov2005 05:10	Nov2105 06:25
Anion Gap	11	7
Calcium Level	8.7	8.8
Magnesium Level	1.9	
Hematology		
HEMATOLOGY		
White Blood Cell Count	↑ 19.1	↑ 11.6
Red Blood Cell Count	3.82	↓ 3.58
Hemoglobin.	↓ 9.8	↓ 9.0
Hematocrit.	↓ 30.7	↓ 28.9
MCV	↓ 80.4	↓ 80.7
MCH	↓ 25.7	↓ 25.1
MCHC	31.9	↓ 31.1
Red Cell Distribution Width	15.7	15.6
Platelet Cnt	↑ 498	↑ 490
Mean Platelet Volume	10.0	10.1
Hem Path Review to Follow	NO	
Smear?	NO	

Results

COMPLETE BLOOD COUNT (Order# 185496)

Result Information

Result Date	Status	Provider Status
2/2/1996	Final result	Reviewed

Component Results

Component	Value	Flag	Low	High	Units	Stat
HGB	14.4		13.5	17.5	g/dL	
HCT	42.9		38.8	50.0	%	
RBCS	4.67		4.32	5.72	X 10E12/l	
MCV	89.9		81.2	95.1	fL	
WBC	7.7		3.5	10.5	X 10E9/l	
NEUTROPHILS	5.6		1.7	7.0	X 10E9/l	
LYMPHOCYTES	1.5		0.9	2.9	X 10E9/L	
MONOCYTES	0.6		0.3	0.9	X 10E9/L	
EOSINOPHILS	0.2		0.05	0.50	X 10E9/L	
PLT	399		150	450	X 10E9/L	

Lab and Collection

COMPLETE BLOOD COUNT (Order#185496) on 2/2/1996 - Lab and Collection Information

Performing Lab Location

Order

COMPLETE BLOOD COUNT [85001]

Lab Information

Lab	Resulting Physician
WEST SIDE INTERNAL LAB	

Lab Collection Information

Specimen	Collection Date
Capillary blood	2/2/1996

Handling of Outside Reference Laboratory Reports in EMR

- Clinicians require access sendout test reports, and laboratories are responsible for getting these results to clinicians

- For interfaced labs, these flow through LIS to EMR

- BUT, interfaces to all referral labs is not possible

- Simple results can be manually entered into LIS, then sent to EMR

- Many such reports are long and complex and may have charts, tables, graphs.

- Scanning into EMR may be a solution

Considerations for Scanning Outside Lab Reports into EMR

- Method of indexing – by patient, date, report type, etc.

- Method of access in EMR – how will the clinicians know the result exists, and how do they access it?

- Multiple page reports

- QA of scanning process – image acceptability; no cut-offs

- Corrected/amended report handling

- Identity of scanning person

Manual Entry of Structured Lab Data from Multiple Sources into EMR

Staes CJ, Bennett ST, et al. J Am Med Inform Assoc 2006;13

- System for manual entry of transplant patient lab data from Intermountain and into EMR

- In addition to availability of results across IDN and permanence of results in EMR, additional benefits of discrete data elements compared to scanned documents:
  - amenable to arranging data in different views
  - available for use in rule-based decision support

Tactics for Working with EMR Staff

- Build ties to EMR administrator responsible for lab data handling – they won't look for you

- Provide specific examples and explanation of problems when they arise

- Engage interested physicians and work with them to influence EMR changes

- Demonstrate value to EMR IT staff of having lab subject matter experts – prevent problems for them and improve patient care

Managing Information from Multiple Laboratories in an IDN
Summary

- Disparate legacy systems and non-standardized methods challenge the ability to provide clinicians an integrated view of lab information.

- Standardization of the LIS, of lab operations, and of EMR address overlapping but different issues.

- Laboratory must raise institutional awareness of lab information handling issues in EMR