

Impact of EHR design and operational procedures on health care data for research

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Medicine

Objectives

- Understand the underlying drivers for Electronic Health Record Design
- Understand the drivers that impact data integrity in the Electronic Health Record
- Understand the limitations of data sets



DISCLOSURE STATEMENT

- None to report



Drexel University College of Medicine: Drexel Medicine

- Multispecialty ambulatory practice
- 250 Physicians
- 17 subspecialties
- 500 Residents/Fellows
- 1000 medical students
- 1000 staff
- 300,000 outpatient visits per year
- Implementation of EHR in 2007

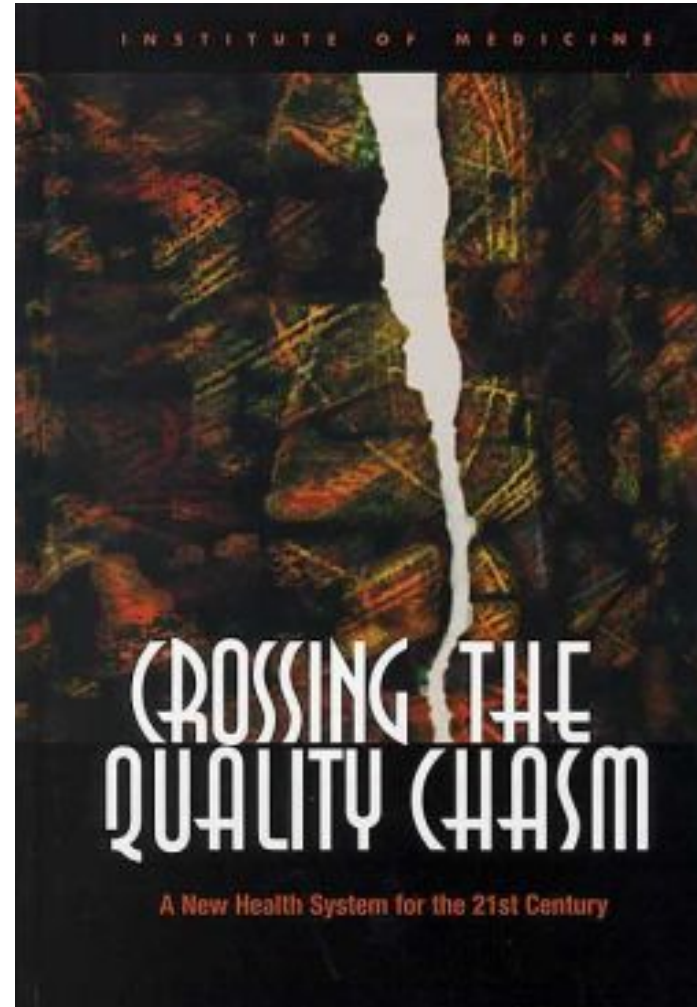


How did we get to this point?



Crossing the Quality Chasm - 2001

- 6 Aims of Health care:
 - Should be:
 - Safe
 - Effective
 - Patient Centered
 - Timely
 - Efficient
 - Equitable



Crossing the Quality Chasm

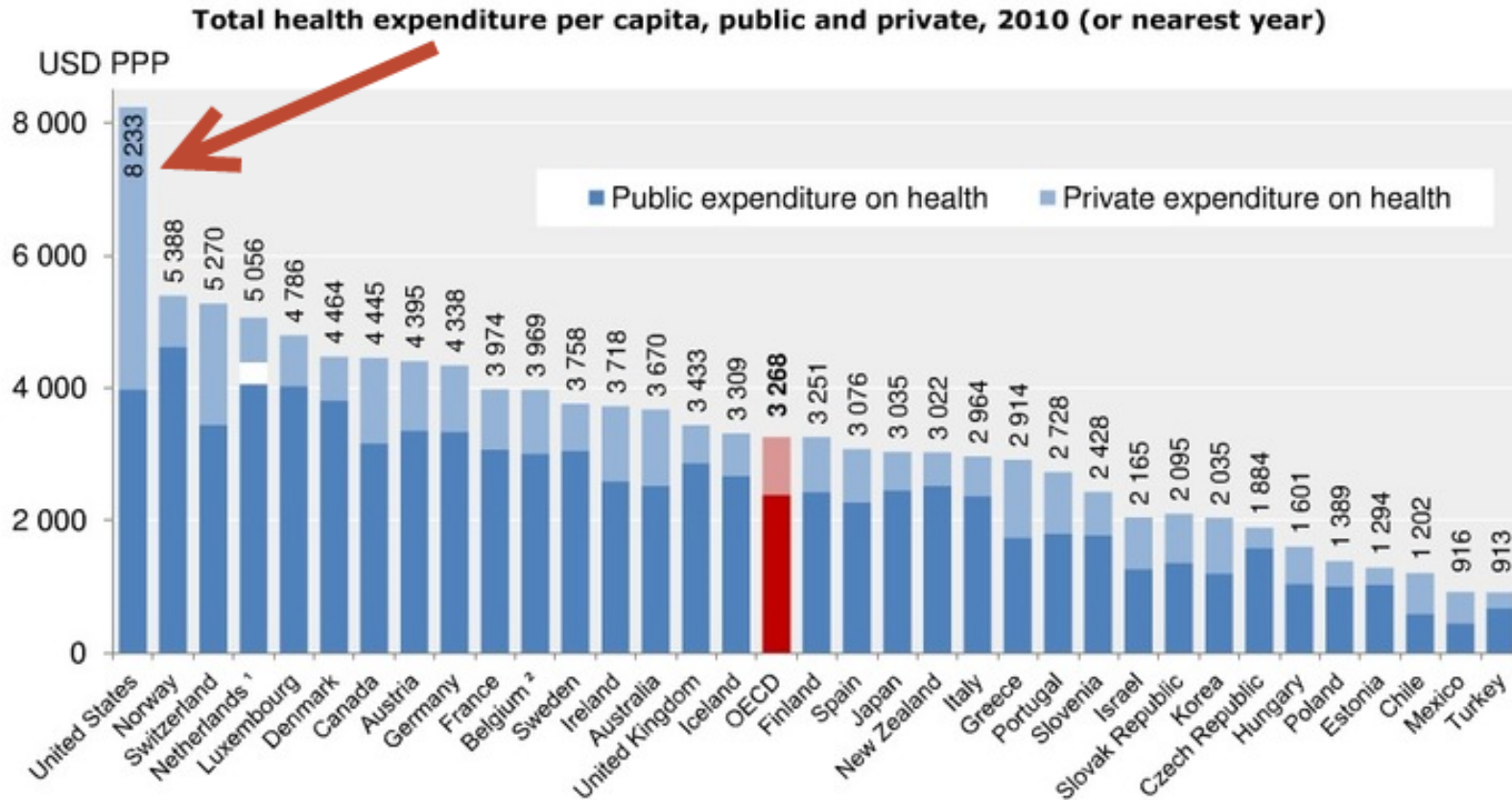
- To be pursued by:
 - Health Care organizations
 - Professional Groups
 - Private Purchasers
 - Public Purchasers
- Goals:
 - Reduce the burden of illness, injury and disability to improve the health and functioning of [our population]

Crossing the Quality Chasm

- Patient as source of control
- Shared knowledge and free flow of information
- Evidence based decision making
- Safety as a system property
- Need for transparency
- Anticipation of needs
- Decrease in waste
- Cooperation amongst clinicians

Slic

US spends two-and-a-half times the OECD average



1. In the Netherlands, it is not possible to clearly distinguish the public and private share related to investments.

2. Total expenditure excluding investments.

Information on data for Israel: <http://dx.doi.org/10.1787/888932315602>.

Source: OECD Health Data 2012.

OECD = Organization for Economic Co-operation and Development (international organization of 34 countries founded in 1961 to stimulate economic progress and world trade)

“Once again, U.S. has most expensive, least effective health care system in survey” – The Washington Post, June 16, 2014

	AUS	CAN	FRA	GER	NETH	NZ	NOR	SWE	SWIZ	UK	US
OVERALL RANKING (2013)	4	10	9	5	5	7	7	3	2	1	11
Quality Care	2	9	8	7	5	4	11	10	3	1	5
Effective Care	4	7	9	6	5	2	11	10	8	1	3
Safe Care	3	10	2	6	7	9	11	5	4	1	7
Coordinated Care	4	8	9	10	5	2	7	11	3	1	6
Patient-Centered Care	5	8	10	7	3	6	11	9	2	1	4
Access	8	9	11	2	4	7	6	4	2	1	9
Cost-Related Problem	9	5	10	4	8	6	3	1	7	1	11
Timeliness of Care	6	11	10	4	2	7	8	9	1	3	5
Efficiency	4	10	8	9	7	3	4	2	6	1	11
Equity	5	9	7	4	8	10	6	1	2	2	11
Healthy Lives	4	8	1	7	5	9	6	2	3	10	11
Health Expenditures/Capita, 2011**	\$3,800	\$4,522	\$4,118	\$4,495	\$5,099	\$3,182	\$5,669	\$3,925	\$5,643	\$3,405	\$8,508

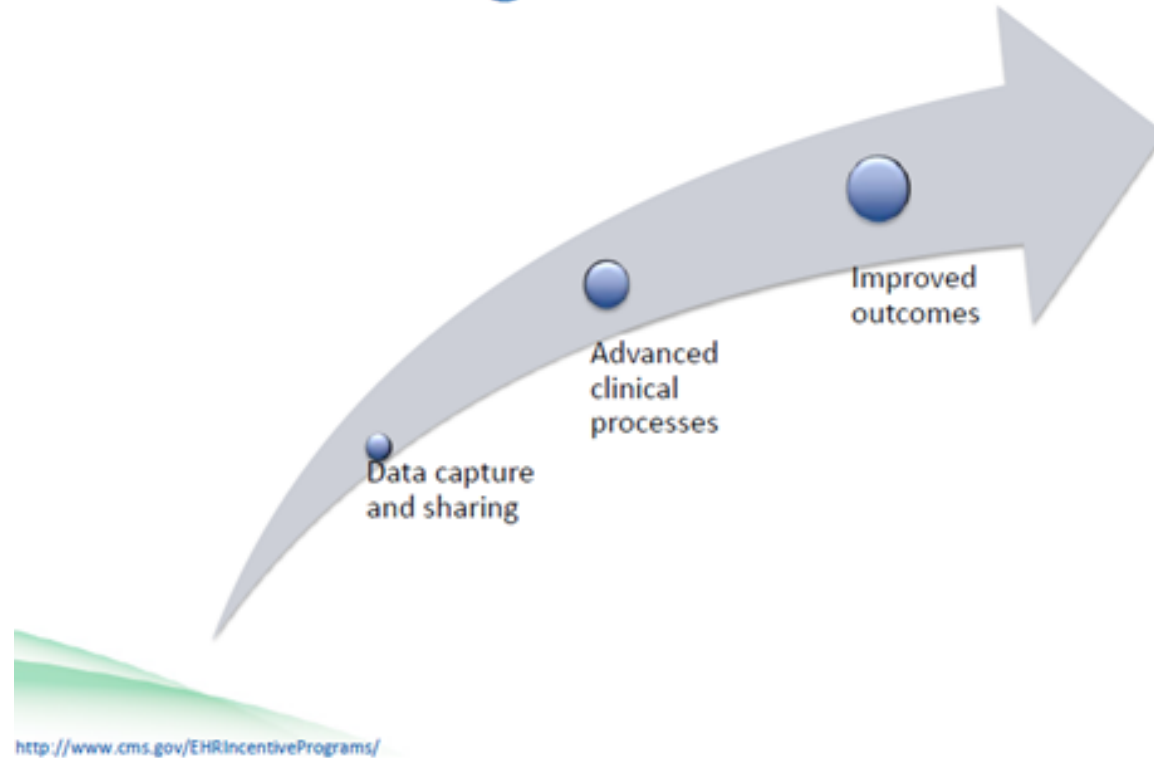
Notes: * Includes ties. ** Expenditures shown in \$US PPP (purchasing power parity); Australian \$ data are from 2010.

Source: Calculated by The Commonwealth Fund based on 2011 International Health Policy Survey of Sicker Adults; 2012 International Health Policy Survey of Primary Care Physicians; 2013 International Health Policy Survey; Commonwealth Fund *National Scorecard 2011*; World Health Organization; and Organization for Economic Cooperation and Development, *OECD Health Data, 2013* (Paris: OECD, Nov. 2013).

Meaningful Use



A Conceptual Approach to Meaningful Use



Meaningful Use Summary

Meaningful Use Stage 1 Objectives and Measures					Meaningful Use Final Stage 2 – 2014 Edition Objectives and Measures										2014 Edition Final Certification Language				2014 Edition Final Certification Language	
Meaningful Use Core Function	Meaningful Use Core Function	Meaningful Use Core Function	Meaningful Use Core Function	Meaningful Use Core Function	Stage 1 Objectives (Effective 2014 and Forward)		Stage 1 Measures (Effective 2014 and Forward)		Stage 2 Final Objectives			Numerator / Denominator / Exclusions for % Based Measures				2014 Edition Final Certification Language	2014 Edition Final Certification Language	2014 Edition Final Certification Language	2014 Edition Final Certification Language	
					Eligible Professionals	Eligible Hospitals	Meaningful Use Core Function	High-Precision	High-Priority	Numerator	Denominator	Threshold	Exclusions							

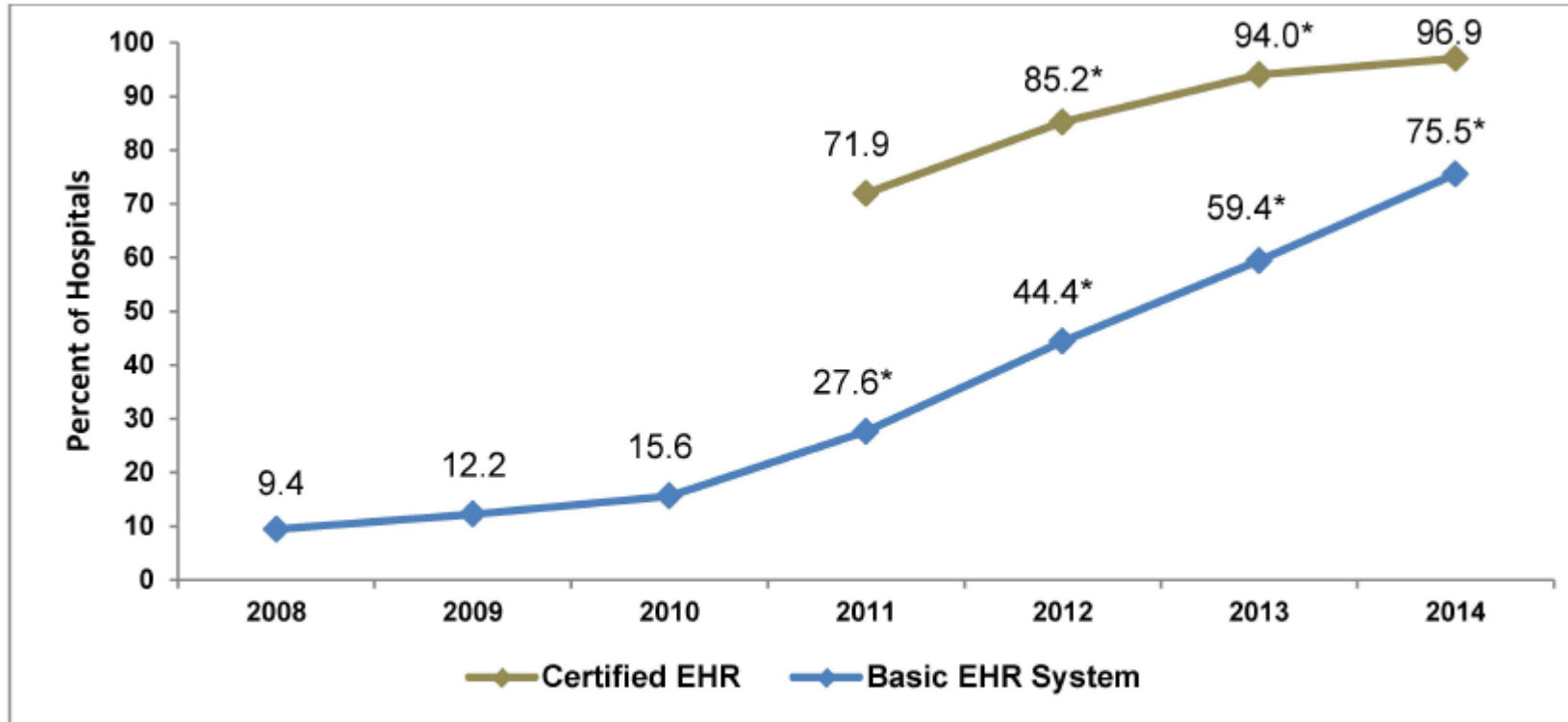
Information Sources for this Infographic from the Federal Register documents posted September 4, 2012

Meaningful Use – The Whiteboard Story – Stage 1 Final Rule Meaningful Use Objectives and Measures Compared to Stage 2 Final Objectives and Measures from the The CMS Electronic Health Record Incentive Program Stage 2 and the ONC 2014 Edition Final Rules Posted to the Federal Register on 9-4-12

Meaningful Use – The Whiteboard Story – Stage 1 Final Rule Meaningful Use Objectives and Measures Compared to Stage 2 Final Objectives and Measures from the The CMS Electronic Health Record Incentive Program Stage 2 and the ONC 2014 Edition Final Rules Posted to the Federal Register on 9-4-12

Adoption of Electronic Health Records

Figure 1: Percent of non-Federal acute care hospitals with adoption of at least a Basic EHR with notes system and possession of a certified EHR: 2008-2014



NOTES: Basic EHR adoption requires the EHR system to have a set of EHR functions defined in Table A1. A certified EHR is EHR technology that meets the technological capability, functionality, and security requirements adopted by the Department of Health and Human Services. Possession means that the hospital has a legal agreement with the EHR vendor, but is not equivalent to adoption.

*Significantly different from previous year ($p < 0.05$).

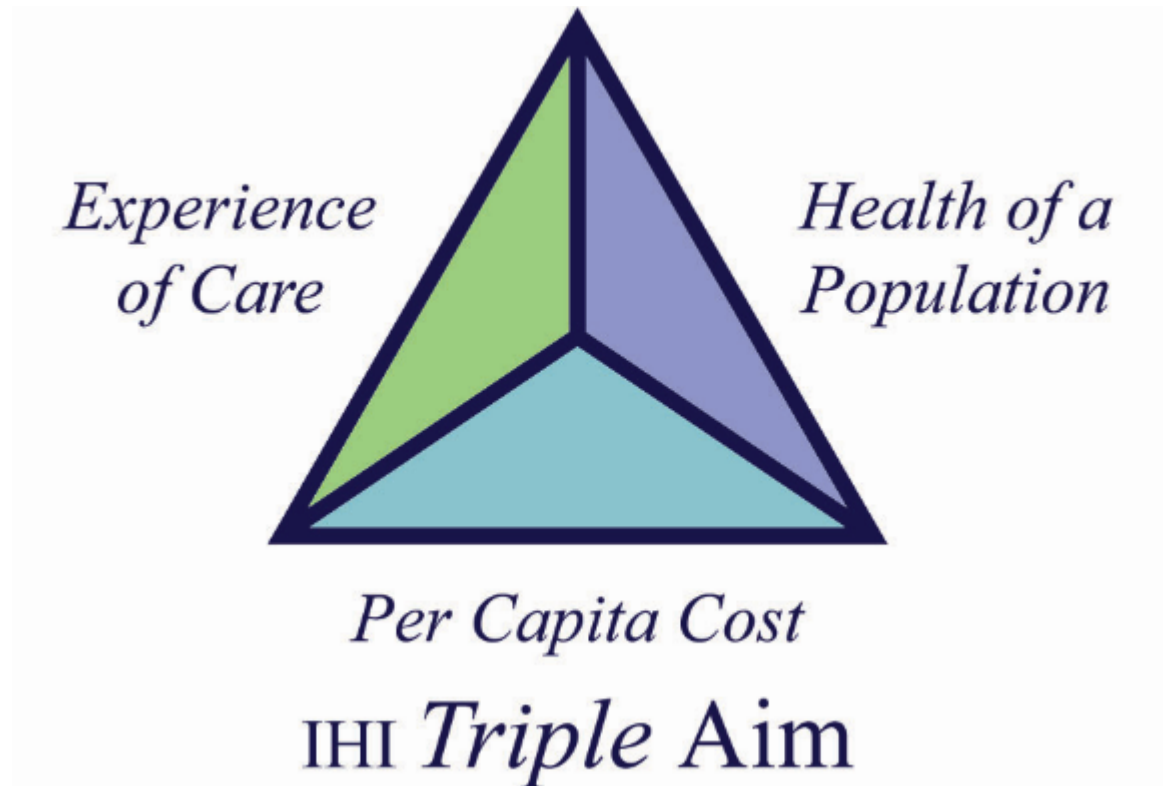
SOURCE: ONC/American Hospital Association (AHA), AHA Annual Survey Information Technology Supplement

<https://www.healthit.gov/sites/default/files/data-brief/2014HospitalAdoptionDataBrief.pdf>, last accessed September 13, 2016



~~Triple Aim~~ → Quadruple Aim

- “improving the experience of care, improving the health of populations, and reducing per capita costs of health care” – The Institute for HealthCare Improvement, 2012



Health of the Provider

Quality Payment Program: Merit Incentive Payment System (MIPS)

Element	Was...	Weight	Future Weight	Reporting Method
Quality	Patient Quality Reporting System (PQRS)	50%	30%	Registry/QCQR/Web Interface (248 patients)
Resource	Physician Value-PQRS (PV-PQRS)/ Value Modifier (VM)	10%	30%	Claims
Clinical Practice Improvement Activity (CPIA)	Didn't exist before	15%	15%	Registry/QCQR
Advancing Care Information (ACI)	Meaningful Use (MU)	25%	25%	Registry/QCQR

<https://www.gpo.gov/fdsys/pkg/FR-2016-05-09/pdf/2016-10032.pdf> , last accessed July 12, 2016



Time in the EHR measured

- For every 1 hour of clinical care delivered, 2 additional hours of clerical/documentation work in the office
- An additional 1-2 hours of work occur at home
- Increased risk for physician burnout
- Increased risk for lower quality care (and documentation...)



<http://annals.org/article.aspx?articleid=2546704>, last accessed September 14, 2016

Medical Education

- One just needs to look at how physicians are trained in further understanding the data collected in EHRs
 - “90% of diagnoses come from a detailed history”
 - Identify the reason for visit (Chief Complaint)
 - Discuss the details regarding the complaint (e.g. timing, severity, associated signs and symptoms)
 - Contributory Family, Medical, Social History, Surgical History
 - Review of Organ Systems to identify other related issues
 - Physical Exam
 - Assessment (synthesis of the information gathered)
 - Plan



Documentation and Billing

- Complete documentation reflects the performance of the physician with the patient and follows a regimented set of guidelines
 - 1995 Evaluation and Management guidelines
 - Chief Complaint (CC)
 - History of Present Illness (HPI)
 - Past Family, Medical, Social History
 - Review of Systems (ROS)
 - Physical Exam
 - Assessment
 - Plan

https://www.cms.gov/Outreach-and-Education/Medicare-Learning-Network-MLN/MLNProducts/Download/eval_mgmt_serv_guide-ICN006764TextOnly.pdf, Last accessed 8/13/16



Evaluation and Management Guidelines

- Documentation may either be in HPI or specific sections: Duplication!

The guidelines recognize three areas of **Past, Family and/or Social History**:

Past History

A review of current medications, prior illnesses and injuries, operations and hospitalizations, allergies and age-appropriate immunization status.

Family History

A review of significant medical information about the patient's family, including information about the health status or cause of death of parents, siblings and children; specific diseases related to problems identified in the CC, HPI or ROS.

Social History

An age-appropriate review of significant activities that may include information such as marital status, living arrangements, occupational history, use of drugs, alcohol or tobacco, extent of education and sexual history.

<http://www.aafp.org/fpm/2010/0300/p22.html>, last accessed 9/6/16



Electronic Progress Notes

- Benefits:
 - Legible
 - Better quality notes

J Am Med Inform Assoc. 2014 Oct 23. pii: amiajnl-2014-002726. doi: 10.1136/amiajnl-2014-002726. [Epub ahead of print]

Electronic health records improve clinical note quality.

Burke HB¹, Sessums LL¹, Hoang A¹, Becher DA¹, Fontelo P², Liu F², Stephens M³, Pangaro LN¹, O'Malley PG¹, Baxi NS⁴, Bunt CW³, Capaldi VF 2nd⁴, Chen JM⁴, Cooper BA⁴, Djuric DA⁵, Hodge JA⁵, Kane S⁴, Magede C¹, Makary ZR⁴, Mallory RM⁴, Miller T³, Saperstein A³, Servey J³, Gimbel RW⁶.

- Shortfalls
 - Note Bloat
 - Improper use of “Cut and Paste” with duplication without updating
 - Single Click templates “All normal”



Documentation approaches vary...

Note Authoring

PT, II 86 YO M DOB: 23Feb1930 Chart Update 9/19/2016

Primary Care Note View

Commit Pat Loc Status

Patient needs HCV Confirmatory testing

Note Documents Problem Meds Meds Flowsheet Allergies Immun Vitals Flowsheets Orders HMP Orders by Enc Growth Chart Results - Diag/Imaging Results - Lab

New Patient Visit CHOU, EDGAR Status: Needs Input

Chief Complaint

- Reason For Visit
 - DUCM - Reason For Visit
- Transition of Care
 - DUCM - Transition of Care
 - DUCM - Provider TCM
- History of Present Illness
 - DUCM - Chronic Disease**
 - DUCM - Depression Screeni
 - DUCM - Substance Abuse E
 - DUCM - Diet and Exercise
 - DUCM - Free Text HPI
 - DUCM - Preventative Scree
- Self-Management
 - DUCM - Self-Management A
 - DUCM - Medication Adheren
- Advanced Directives
 - DUCM - Advanced Directive
- Current Meds
- Allergies
- Active Problems
- Past Medical History
- Surgical History
- Family History

Interval Events (recent hospitalization(s), ER visit(s), new problem(s), status of existing condition(s), etc)

FREE TEXT GOES HERE

Problem Focused Review of Systems:

- Wt Loss ___ Lbs Wt Gain ___ Lbs
- Headache___ Dyspnea Edema___
- Lightheadedness___ Orthopnea___ Claudication___
- Blurry Vision___ Paroxysmal Nocturnal Dyspnea___ Muscle Pain___
- Polyuria___ Chest Pain___ Muscle Weakness___
- Polydipsia___ Abdominal Pain___ Numbness of Hands___
- Melena Foot Ulcer___
- Bright Red Blood Per Rectum___ Foot Pain___
- Other: ___

Glucose Monitoring:

- Checks Regularly___ Checks Sporadically Does not check

Output Template CC

- New Patient Visit
- Care Plan

DUCM - Chronic Disease Mgmt HPI: |
DUCM - Depression Screening: |
DUCM - Substance Abuse Evaluation: |
DUCM - Diet and Exercise: |
DUCM - Free Text HPI: |
DUCM - Preventative Screening Male: |
Preventative Screening and Risk Assessment

View Recompile Sign Spell Check Copy Forward Security Codes Audit eReply Save & Close Save Close

SINGLE CLICK OPTIONS

Data Integrity

- Data integrity refers to the overall completeness, accuracy and consistency of data.

Data input: If you've seen one physician...

- you've seen one physician...

Coronary Artery Disease

CAD

Heart Failure

Heart Disease

HF

CHF

Congestive Heart Failure

Low Ejection Fraction

ASCVD

Myocardial infarction

MI

MI s/p stent

MI s/p PTCA

MI s/p balloon angioplasty

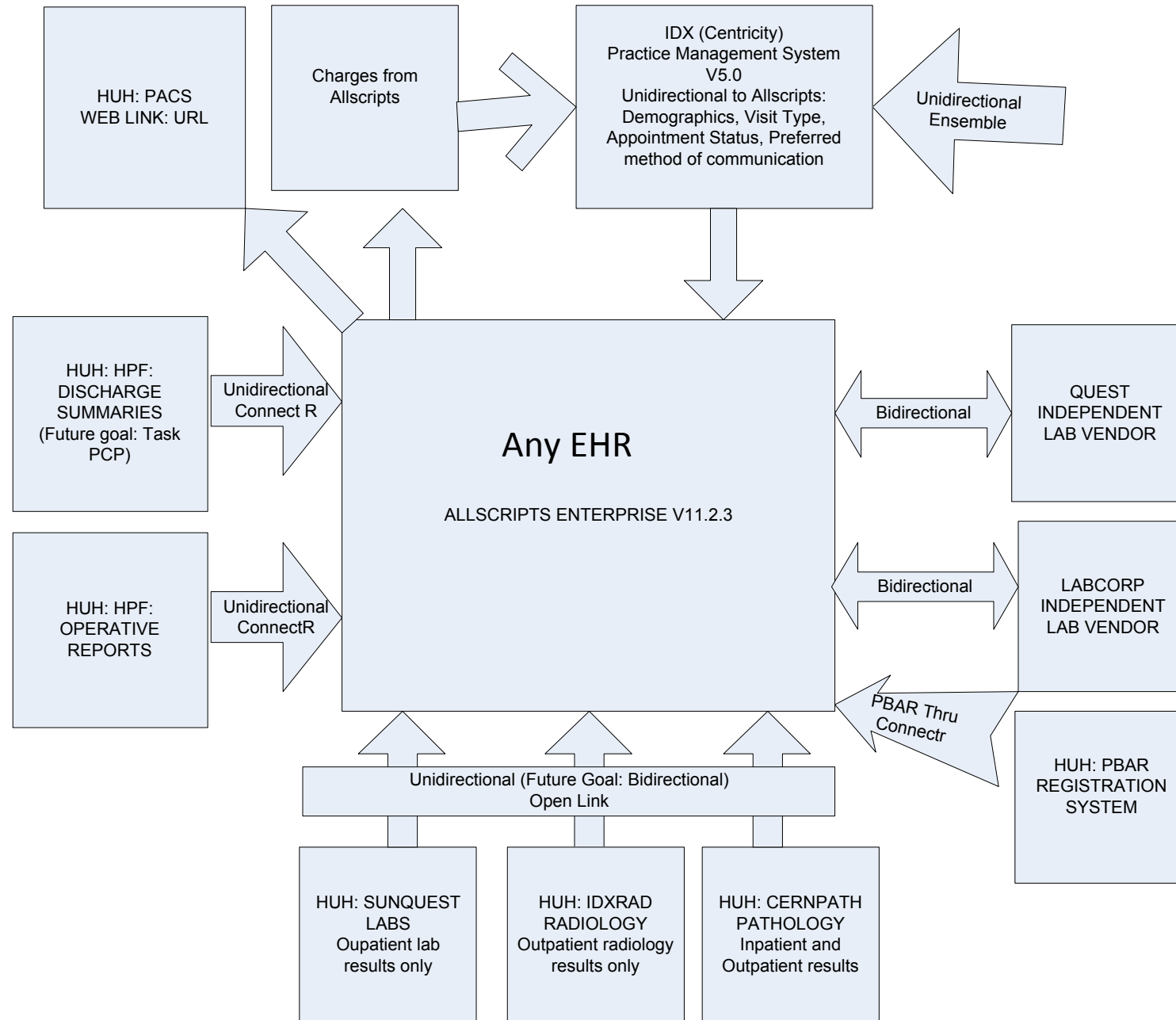
CABG

Coronary Artery Bypass Graft

CHF with EF<55%

CHFpEF

Ischemic Cardiomyopathy



Most organizations are not like Kaiser Permanente...

- Data sources come from disparate sources
 - Payers
 - Hospitals
 - Other health care systems
 - Ancillary Services
 - Home Health
 - Nursing Homes
 - Skilled Nursing Facilities
 - Lab Vendors

Data Integrity

- Inaccurate Reporting
 - Sensitivity of reporting ranging from 46-98% per measure

Table 2. Absolute Rates of Recommended Care, as Measured by Automated Report and Manual Review

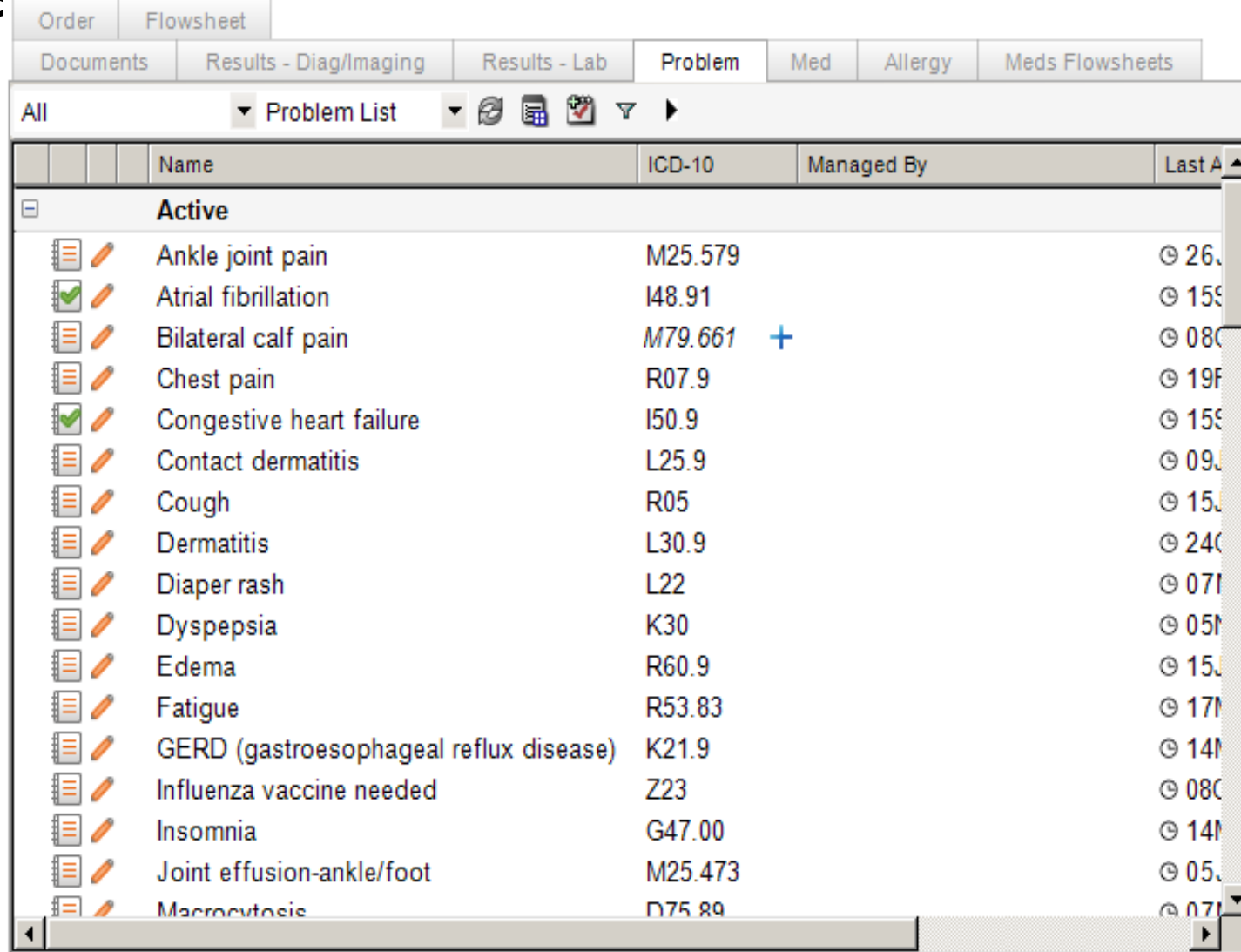
Measure	Electronic Report	Manual Review	Difference (95% CI)
Appropriate asthma medication	0.38 (0.30 to 0.46)	0.77 (0.70 to 0.84)	-0.39 (-0.50 to -0.29)
Cancer screening			
Breast cancer	0.26 (0.19 to 0.34)	0.33 (0.25 to 0.41)	-0.07 (-0.17 to 0.04)
Cervical cancer	0.23 (0.16 to 0.30)	0.20 (0.14 to 0.27)	0.03 (-0.07 to 0.12)
Colorectal cancer	0.20 (0.14 to 0.27)	0.21 (0.14 to 0.28)	-0.01 (-0.10 to 0.08)
Diabetes			
Hemoglobin A _{1c} test done	0.77 (0.69 to 0.83)	0.75 (0.68 to 0.82)	0.01 (-0.08 to 0.11)
Hemoglobin A _{1c} level <7%	0.43 (0.35 to 0.51)	0.43 (0.35 to 0.52)	-0.01 (-0.12 to 0.11)
Hemoglobin A _{1c} level >9% or no test	0.35 (0.27 to 0.43)	0.35 (0.28 to 0.44)	-0.01 (-0.11 to 0.10)
LDL cholesterol level <2.59 mmol/L (<100 mg/dL)	0.57 (0.49 to 0.65)	0.37 (0.30 to 0.46)	0.20 (0.09 to 0.31)
Influenza vaccine, age ≥50 y	0.35 (0.28 to 0.44)	0.30 (0.23 to 0.38)	0.05 (-0.05 to 0.16)
IVD			
Appropriate antithrombotic medication	0.75 (0.68 to 0.82)	0.65 (0.57 to 0.73)	0.10 (0.00 to 0.20)
LDL cholesterol level <2.59 mmol/L (<100 mg/dL)	0.53 (0.44 to 0.61)	0.43 (0.35 to 0.52)	0.09 (-0.02 to 0.21)
Pneumococcal vaccination	0.27 (0.20 to 0.34)	0.48 (0.40 to 0.56)	-0.21 (-0.32 to -0.11)

IVD = ischemic vascular disease; LDL = low-density lipoprotein.

EHR Data more complete than claims

- Analysis of diabetics using claims data vs data extracted from the EHR
- Claims data only identified 75% of existing diabetics
- EHR data identified 97% of existing diabetics

83yo with PMHx CAD, atrial fibrillation, MR s/p MVR, DM, HTN, CHF with EF=45%, urinary incontinence presents for follow up



The screenshot shows a medical software interface with a 'Problem List' tab selected. The list contains 18 active problems, each with a name, ICD-10 code, and a date. The problems are:

Name	ICD-10	Managed By	Last A
Active			
Ankle joint pain	M25.579		26.
Atrial fibrillation	I48.91		159
Bilateral calf pain	M79.661 +		080
Chest pain	R07.9		19F
Congestive heart failure	I50.9		159
Contact dermatitis	L25.9		09.
Cough	R05		15.
Dermatitis	L30.9		240
Diaper rash	L22		071
Dyspepsia	K30		05M
Edema	R60.9		15.
Fatigue	R53.83		17M
GERD (gastroesophageal reflux disease)	K21.9		14M
Influenza vaccine needed	Z23		080
Insomnia	G47.00		14M
Joint effusion-ankle/foot	M25.473		05.
Macrocytosis	D75.89		071

83yo with PMHx CAD, atrial fibrillation, MR s/p MVR, DM, HTN, CHF with EF=45%, urinary incontinence presents for followup.

	Name	ICD-10	Managed By	Last A
	Macrocytosis	D75.89		071
	Mitral regurgitation	I34.0		080
	Need for diphtheria-tetanus-pertussis...	Z23		
	Need for pneumococcal vaccination	Z23		12J
	Numbness	R20.0		080
	Obstructive chronic bronchitis with...	J44.1		151
	Osteochondral Lesion Of The Left Talus			26.
	Pain in joint of right shoulder	M25.511		171
	Proptosis	H05.20		010
	Prostate cancer	C61		071
	Rhinorrhea	J34.89		080
	Seizure	R56.9		110
	Subdural hematoma	I62.00		080
	Transient ischemic attack	G45.9		12.
	Trigger thumb of left hand	M65.312		011
	Type 2 diabetes mellitus without...	E11.9		159
	Type 2 diabetes mellitus, uncontrolled	E11.65		159
	Viral syndrome	B34.9		30.

New Edit Resolve View Details Print Problem List

SUMMARY:

34 problems

Limit of 10 submissions for Medicare Claims (used to be 4)

Diagnoses need to be submitted annually for patients (impacts risk scores)

Documented Plan

Plan: #1 Diabetes

Check hgbA1c
Consult Podiatry and Ophthalmology
Check BMP as had elevated Creatinine at last visit
Start Glipizide
Start Statin

#2 HTN- controlled

Continue current regimen

#3 Prostatic obstruction

Followup with Urology

#4 CHF- compensated

Continue current regimen

#5 Health maintenance

Flu and Prevnar today

#6 Atrial fibrillation

Continue to monitor

Charge Capture

Visit Charge Selector (Sorted by Code)

[Select Encounter](#) [Audit Log](#) [Personalize](#)

View:

- ANTICOAGULANT
- Atria Visit Char...
- Care Plan Oversi...
- Established Pati...
- Home Visits - Es...
- Home Visits - Ne...
- MC Annual Prev/G...
- MC Cert / Recert
- MNT/DSMT
- New Patient
- Office Consultat...
- Preventive - Est...

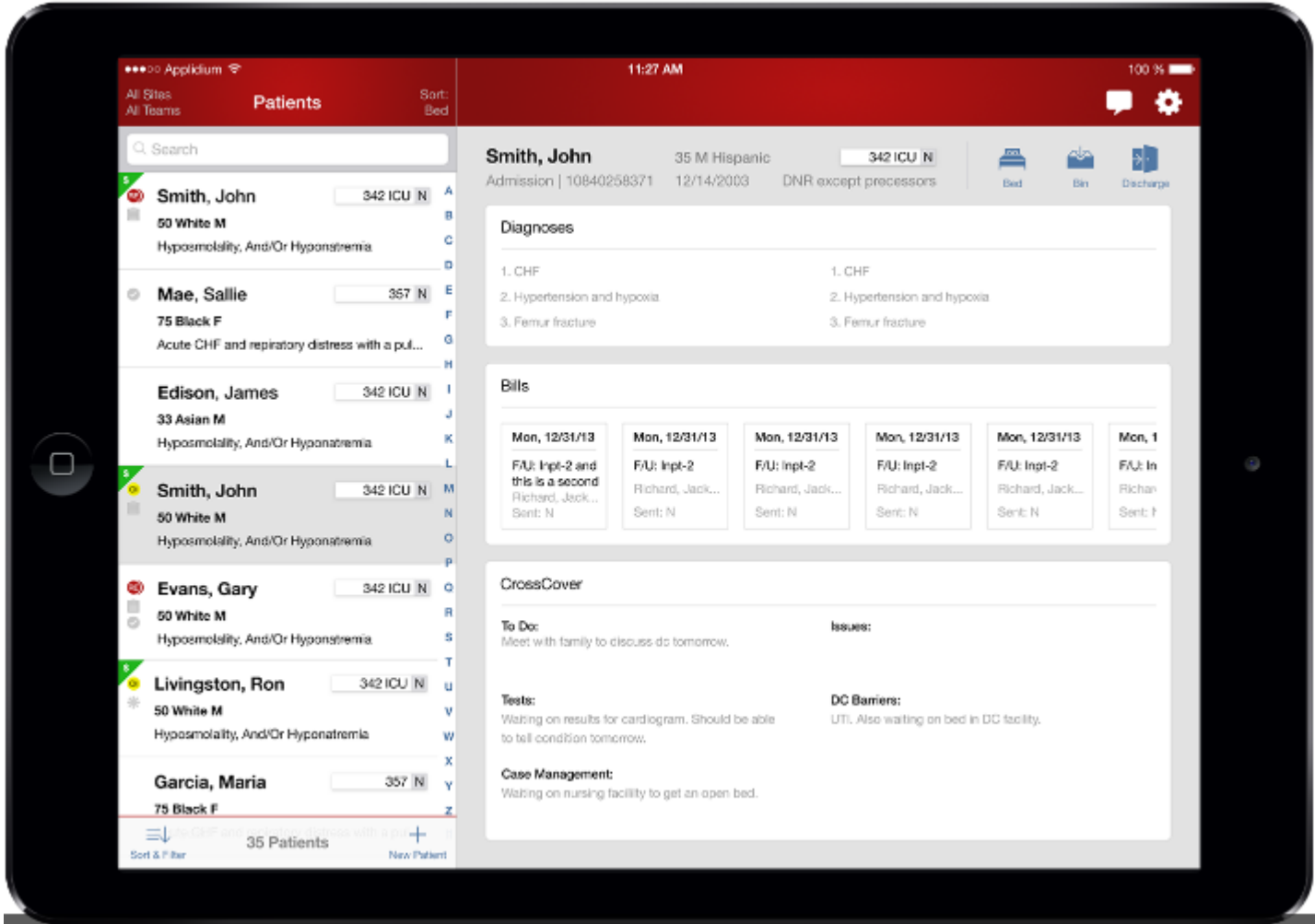
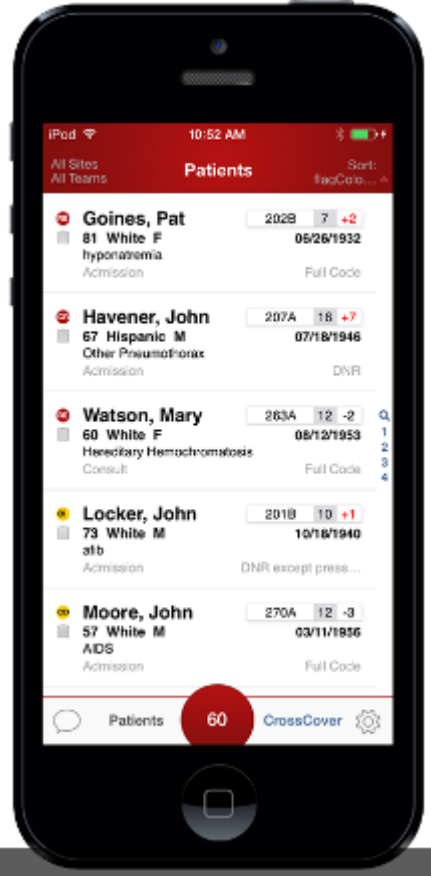
No entries in list

- Modifier Group:**
- 25 SAME PHYSICIAN/SEPARATE PROCEDURE
 - GC THIS SERVICE HAS BEEN PERFORMED IN ...
 - WA INTERNAL AUDITING

#	ICD-10	Diagnosis
<input type="checkbox"/> 1	I50.9	Congestive heart failure
<input type="checkbox"/> 2	I48.91	Atrial fibrillation
<input type="checkbox"/> 3	E11.9	Type 2 diabetes mellitus without complication
<input type="checkbox"/> 4	E11.65	Type 2 diabetes mellitus, uncontrolled
<input type="checkbox"/> 5	Z23	Need for pneumococcal vaccination

CPT Code®	Modifier	Visit Charge	Linked Dx
99214	25,GC	OFC/OUTPT E&M ESTAB MOD-HI 25 MIN	1,2,3,4,5

Additional means of data capture



Improving the Health of a Population: Data and Patient Quality Reporting System (PQRS)

- Case Study:
 - PQRS Measure #7: Beta blocker therapy for Prior Myocardial Infarction or Left Ventricular Systolic Dysfunction (LVEF <40%)
- How would you find this information?
 - PQRS relies on billing codes (ICD-10- formerly ICD-9)
- Additional background:
 - Left Ventricular Systolic Dysfunction does not have a billing code
 - Requires additional billing code: G8694
 - Patient Quality Reporting System results reported nationally in 2014 for consumers to allow comparison with other organizations
 - Value Based Modifier program – Payment to the organization will be based on performance on quality measures
- What concerns would you have for your organization?
 - Potential risk for 1) poor outcomes falsely attributed solely based on extraction technique; 2) lower reimbursements

Data and Predictive Analytics



https://upload.wikimedia.org/wikipedia/commons/f/f9/Poland_Trash_002.JPG; last accessed 9/14/16



<http://www.ghmcblog.org/blog1-wp/wp-content/uploads/2013/05/lemonade.jpg>; last accessed 9/18/16



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What's happening?

Cleveland Clinic, IBM launch new Watson project to find new treatment options for cancer patients

http://www.cleveland.com/healthfit/index.ssf/2014/10/cleveland_clinic_ibm_to_begin.html, Accessed November 1, 2014



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How to improve?

- Understand the data sources and methods of data entry to understand the limitations of the data requested
- Less focus on programs that do not necessarily improve quality



Additional Sources of Data and Future Applications

- Health Share Exchanges
- Precision Medicine
- Advancements in Artificial Intelligence