Analytics in Action

Applied Clinical Informatics at Mayo Clinic

CPA HIMSS Presents:
Data Analytics and
Population Health

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Conflict of Interest Disclosure

Tim Miksch, MBA

Has no real or apparent conflict of interest to report

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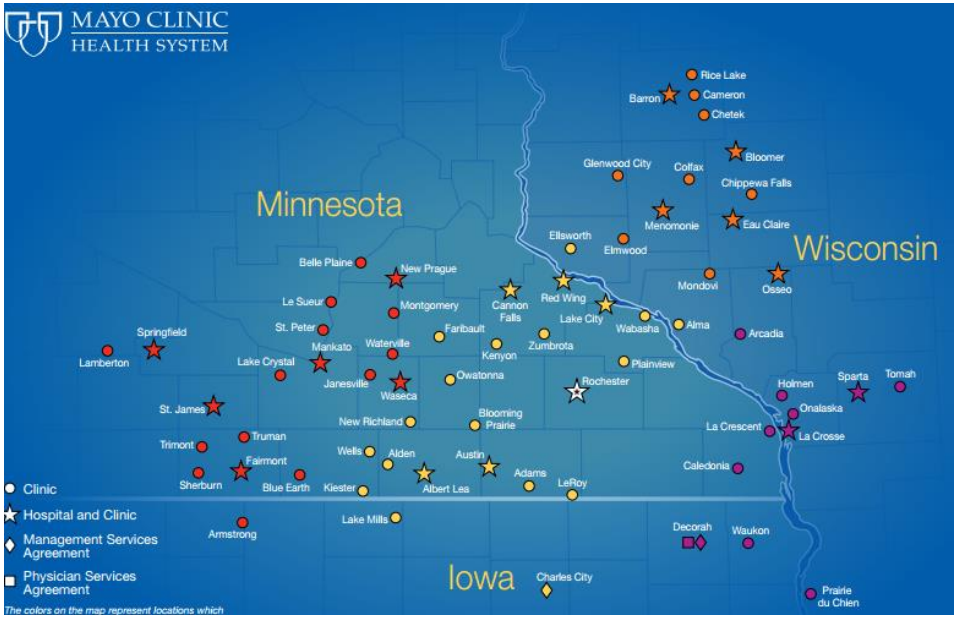
Mayo Clinic

"The best interest of the patient is the only interest to be considered."

William J. Mayo



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Mayo Clinic

Total Clinic Patients – 1,318,300*

Mayo Clinic has a moral responsibility to provide compassionate care to all, and teams of experts deliver seamless, integrated experiences that patients expect.

*Individual patients are counted once annually. Patient numbers are rounded. All figures are from Dec. 31, 2015, unless noted.

http://www.mayoclinic.org/about-mayo-clinic/facts-statistics

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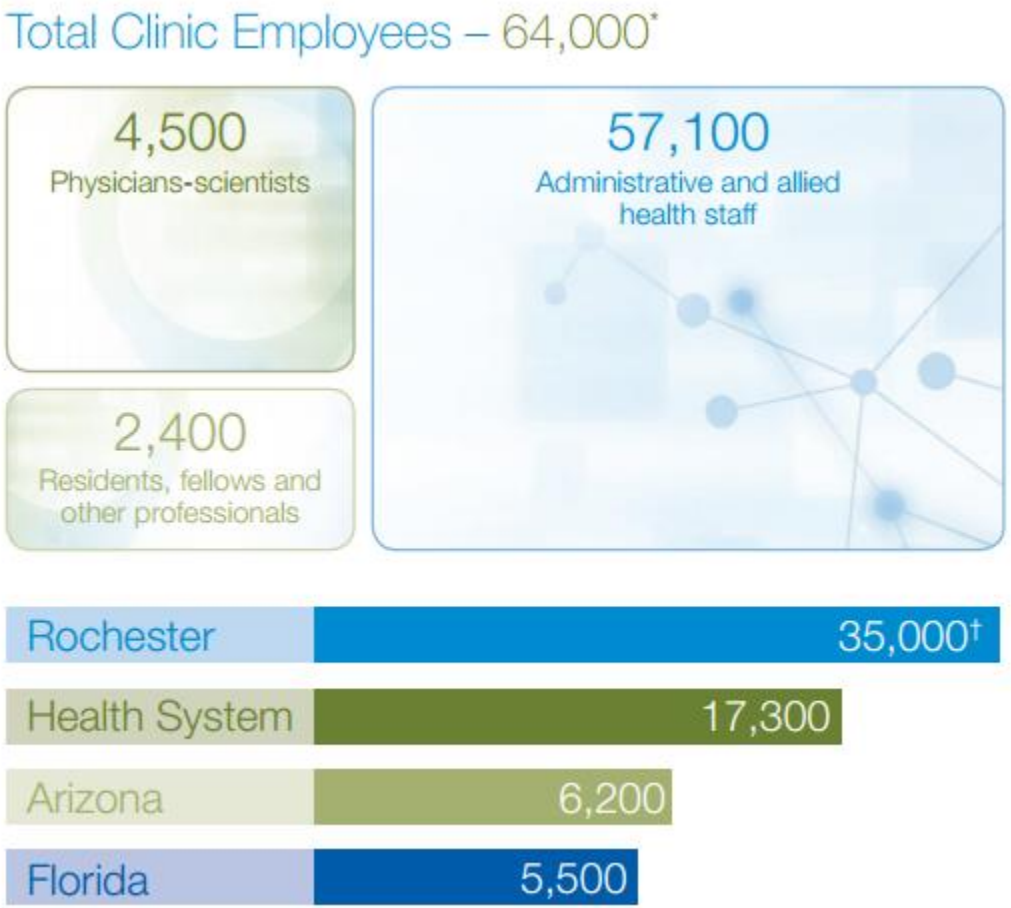
Mayo Clinic



http://www.mayoclinic.org/about-mayo-clinic/facts-statistics

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Personal

- 28+ years at Mayo Clinic
  - 1,200 bed, 60 OR, Catholic Hospital
  - 2,000 Physician Outpatient Practice
  - 100 bed, 50 Physician Community Medical Center
  - 13 site Mayo Clinic Health System
- Human Resources
- Systems & Procedures
- Information Technology
  - Led the implementation of an EHR in MCHS
- BBA, MBA, MS (Biomedical Informatics) in progress

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Mayo Clinic Clinical Systems

Electronic Environment Current State

- Three distinct EMRs from two vendors
- Hundreds of departmental and specialty Systems
- Common data trust

Future State

- Project underway to implement a single EMR
- Developing “Data as a Service” concept
- Practice focus is on standardization across the Enterprise

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History of Informatics at Mayo Clinic

1907

Dr. Henry Plummer invented the modern dossier record system which quickly replaced the ledger system and became the model for medical records worldwide. Each patient is registered and assigned a clinic number. Each patient also has a special envelope -- filed by clinic number -- in which all patient history is placed. That way, no matter how many visits, a full record is maintained.

http://www.mayoclinic.org/tradition-heritage/dr-henry-plummer.html

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10 years ago…..

- If someone told you to use a phone to get to Jack's Stack in Kansas City, you'd need:

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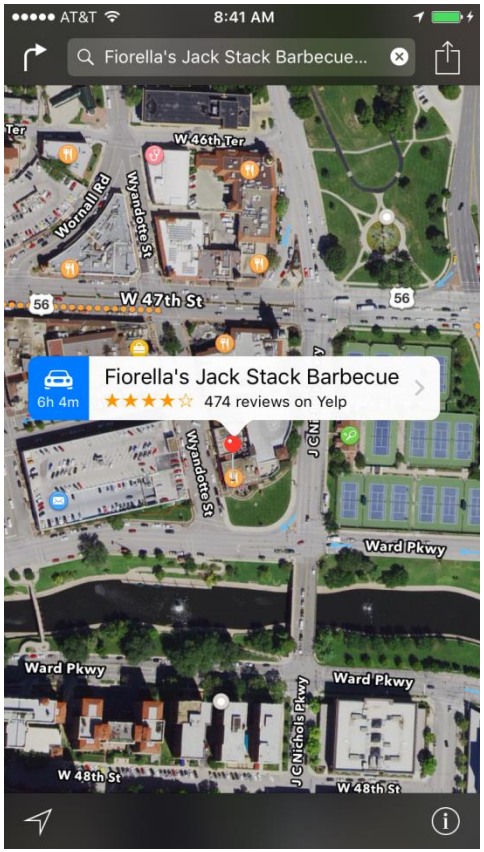
Now

- “Hey Siri!”



Apps use location data for many purposes, ranging from social networking to turn-by-turn navigation services. They get location data through the classes of the Core Location framework. This framework provides several services that you can use to get and monitor the device's current location:

- The standard location service offers a highly configurable way to get the current location and track changes.

https://developer.apple.com/library/ios/documentation/UserExperience/Conceptual/LocationAwarenessPG/CoreLocation/CoreLocation.html

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What's the Connection?

- Wayfinding apps inform the driver of the constantly changing environment, providing guidance along the way
  - Direct and Alternate Routes (with time & distance)
  - Traffic patterns
  - Suggested routes based on preference
  - Even accident and police locations
- They are proactive and adjust on the fly
- They supplement with potentially relevant information
  - Web link to menu, Tap-able phone number for reservations
  - Reviews on best menu items, Suggested alternative venues
- So why can't we (or why don't we) design clinical applications to act in a similar fashion?

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Clinical Decision Support

- Frequently interpreted as “rules” to fire after a provider has taken an action, typically an order
- If the system detects a potential problem with the order, such as a drug-drug interaction, an alert window pops up on the screen
- “Alert Fatigue” is a legitimate concern
- Imagine a GPS system that waits until you miss a turn before giving you any feedback… or sends monthly report of all your missed turns
- Or having to bypass 5 useless window alerts when ordering books on Amazon…Every time

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Informatics AND Analytics

- **Clinical informaticians** transform health care by analyzing, designing, implementing, and evaluating information and communication systems that enhance individual and population health outcomes, improve patient care, and strengthen the clinician-patient relationship. [1]

- While a universal definition of clinical data analytics has not yet been established, within the industry, **clinical analytics** refers to the capture and use of discrete clinical data to identify and measure quality, patient safety, or service line efficiencies and improvements[2]

[1] Gardner RM, Overhage JM, Steen EB, Munger BS, Holmes JH, Williamson JJ, et al. Core content for the subspecialty of clinical informatics. J Am Med Inform Assoc. 2009 Mar-Apr;16(2):153-7.

[2] Womack DM, Kennedy R, Bria B. Current Practices in Clinical Analytics: A Hospital Survey Report. NI 2012: Proceedings of the 11th International Congress on Nursing Informatics. 2012;2012:458.

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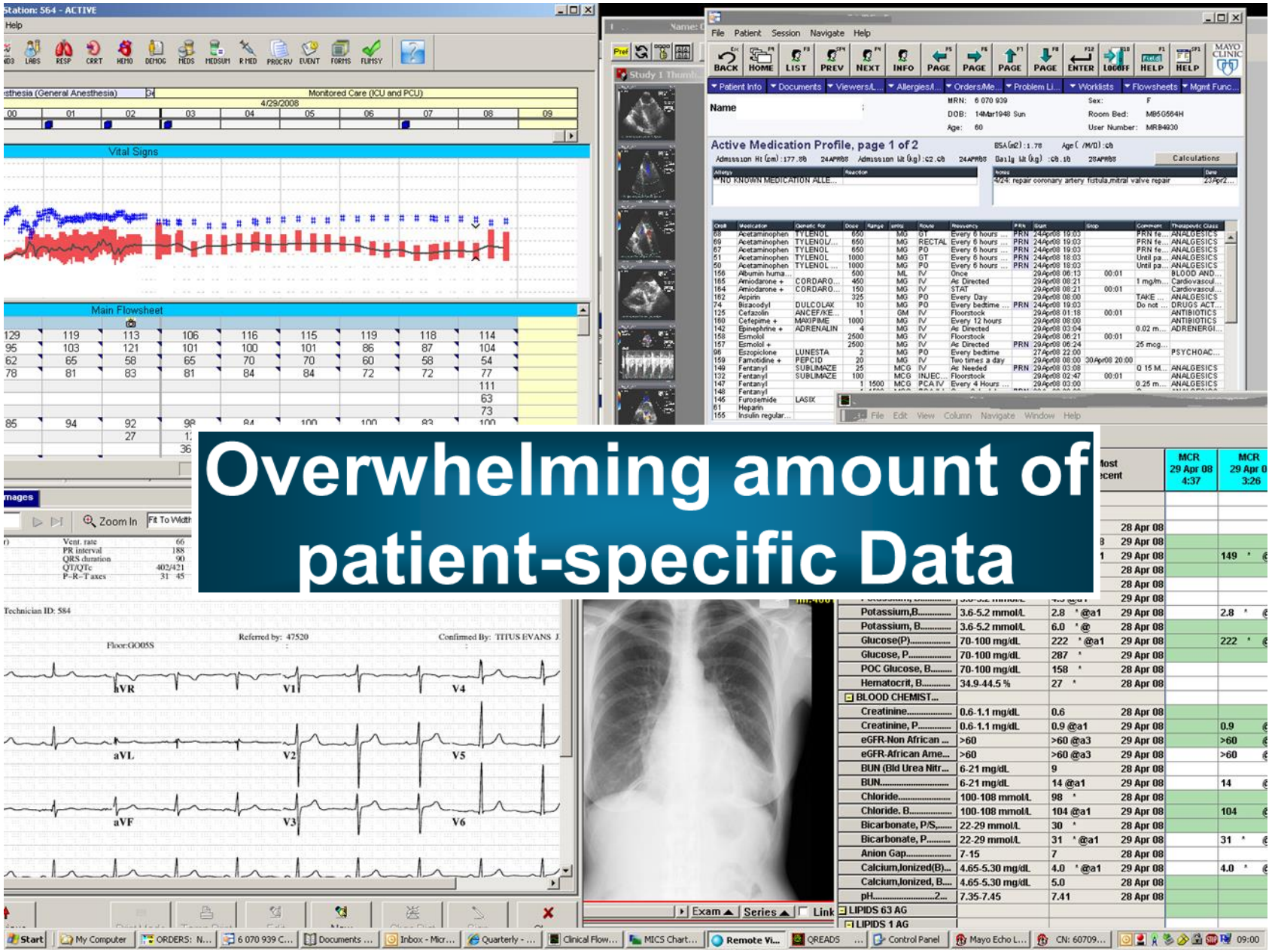
Overwhelming amount of patient-specific Data

See-Think-Act

- Present the information they need in a meaningful way
- Avoid the information they don’t need
- Make it easy to take the next best step

- Some examples of how Mayo is attempting this follow…

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Inpatient surgical practice

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The CRS Plan

	Goal	Presurgical visit	Preoperative: day of surgery	Intraoperative	PACU	Postoperative day 0 (day of surgery)	Postoperative day 1 - dismissal (order set)	Dismissal
Pain management	Pain score <4 or patient pain goal	Patient Education	Celecoxib (oral) Gabapentin (oral) Acetaminophen (oral) Adjustments for renal failure, age	Single-injection intrathecal	Maximize multimodal pain management	Acetaminophen NSAIDS Adjustments for hepatic, renal disease respectively	Oxycodone for pain score >4 (rare needs) Maximize non-pharmacologic	–
Diet	General diet within 4 hours of surgery end time	–	Nothing by mouth 6 hours prior	–	Start liquids	General diet Adjustment to diabetic for diabetic patients	General diet Adjustment to diabetic for diabetic patients	–
Fluids	Euvolemia	–	Oral clears up until 2 hours prior	Euvolemia goals	IV fluid rate to 40mL/hr	Oral intake at least 800 not to exceed 2000	IV fluids stop at 8 AM day after surgery	–
Activity	Rapid return to baseline	–	Baseline (continued normal daily activities)	–	–	Up in chair for meals Out of bed >2 hours, 1 or more walks	Up in chair for meals Out of bed >8 hours, 6 or more walks	–
Dismissal planning	Anticipate a 2-3 day stay. Many patients will be eligible to leave the hospital day 2.	Ensure dismissal plan in place	Ensure dismissal plan in place and patient has transportation following procedure	–	–	–	–	Follow dismissal instructions

It was difficult to ensure everyone on the care team not only knew the plan, but where the patient was **in relation to the plan**.

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Analytics Can Directly Influence Behavior
("You manage what you measure")

	Count of Mayo Clinic Number	Average of Procedure LOS	Average of Surgical Op Time	Count of Pain Score Return to Room	% Pts w/Pain Score
CTRS	**6,758**	**5.92**	**314.91**	**6,656**	**98.5%**
B. G.	337	4.82	155.19	335	99.4%
D. W	905	4.91	252.02	890	98.3%
E. J.	714	6.58	228.55	699	97.9%
H. K.	931	5.40	207.17	919	98.7%
H. N	283	5.79	261.26	283	100.0%
J. H.	715	7.17	172.83	706	98.7%
K. L.	470	6.07	173.89	452	96.2%
R. M	1,028	5.43	378.81	1,025	99.7%
R. R.	1,229	6.59	649.03	1,203	97.9%
S. Y.	146	6.23	172.38	144	98.6%

Averaged 62% prior to data transparency

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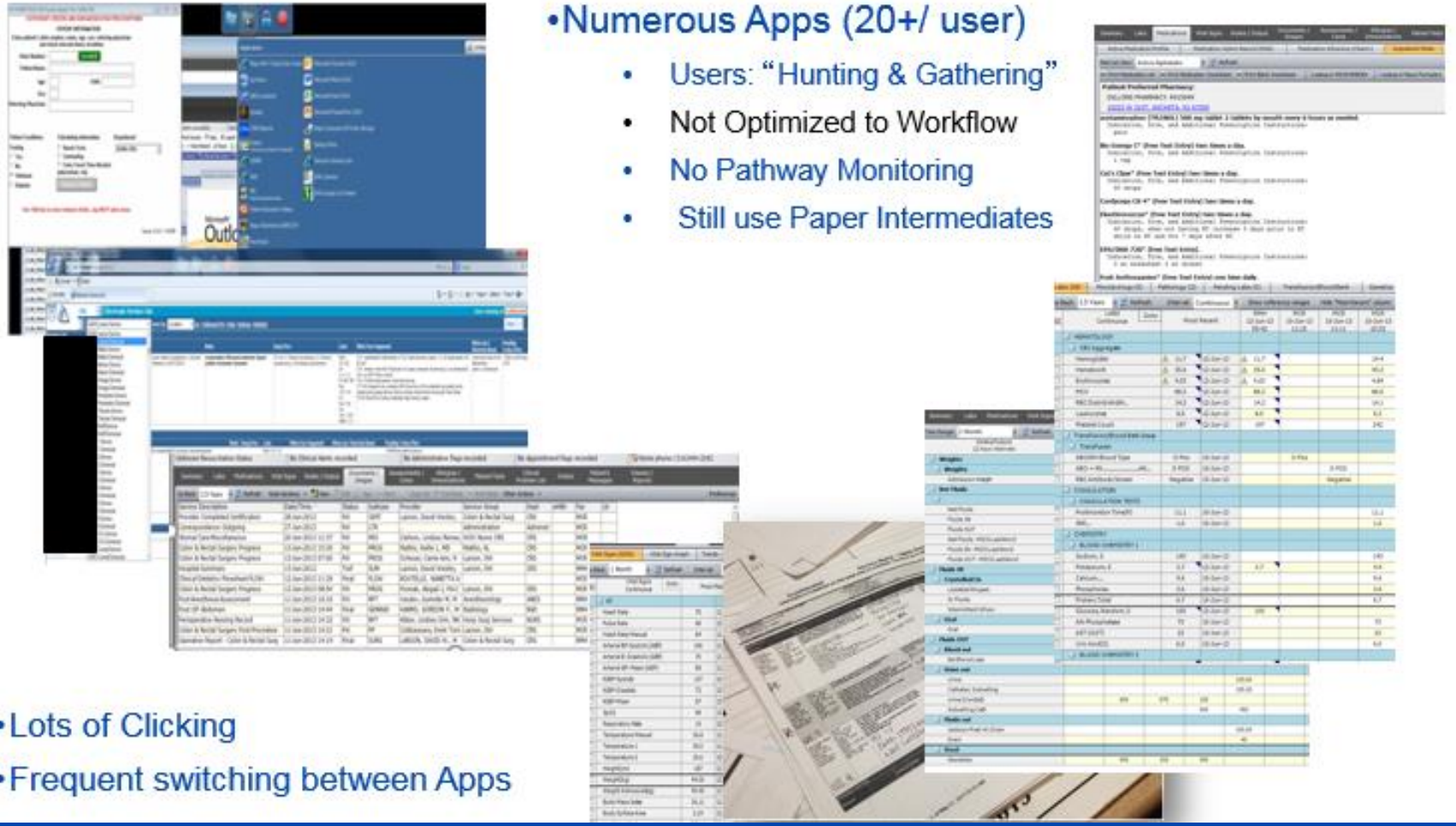
Point of Care (PoC) Tools
Current State of Electronic Environment



- Numerous Apps (20+/ user)
  - Users: "Hunting & Gathering"
  - Not Optimized to Workflow
  - No Pathway Monitoring
  - Still use Paper Intermediates

- Lots of Clicking
- Frequent switching between Apps

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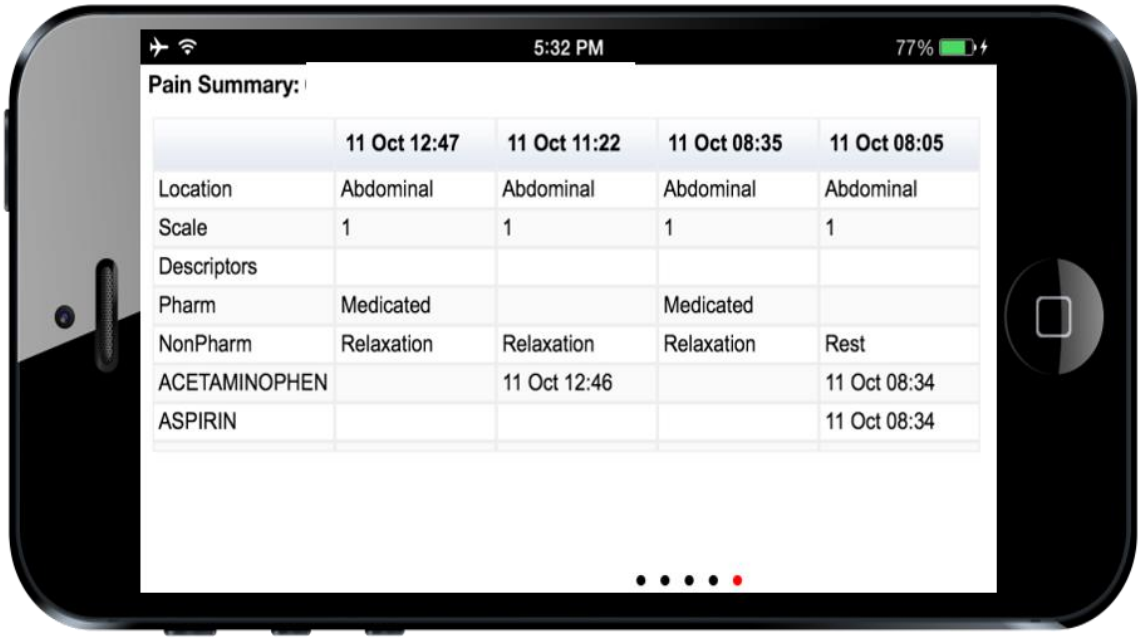
Presentation

- What opportunities are there to create “views” for specific needs?
- A LOT!



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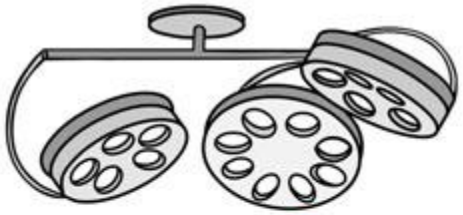

13 g/dl

9 g/dl

A drop of more than 3!

Enriching the data through Real Time analytics

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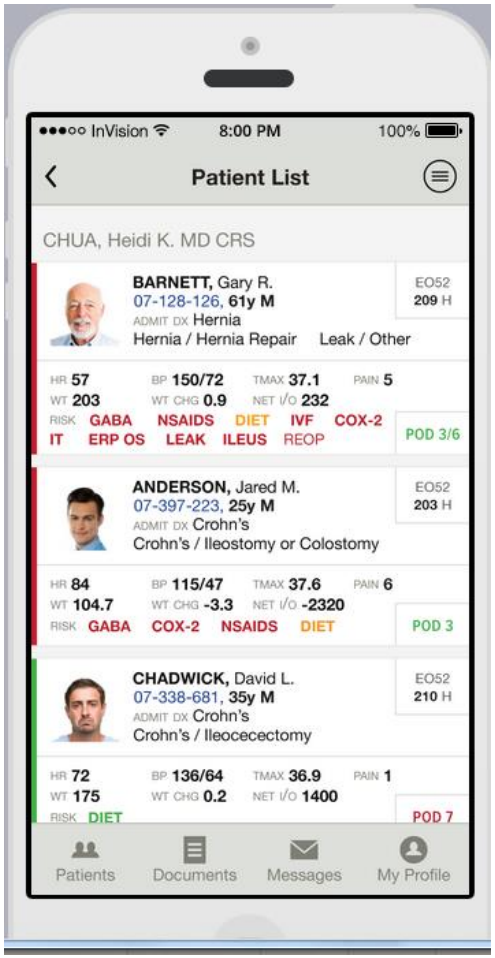
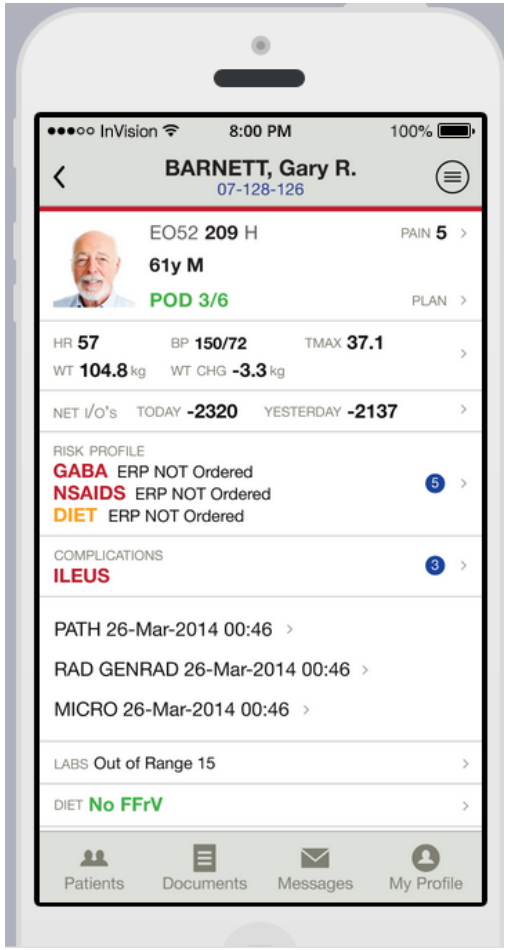
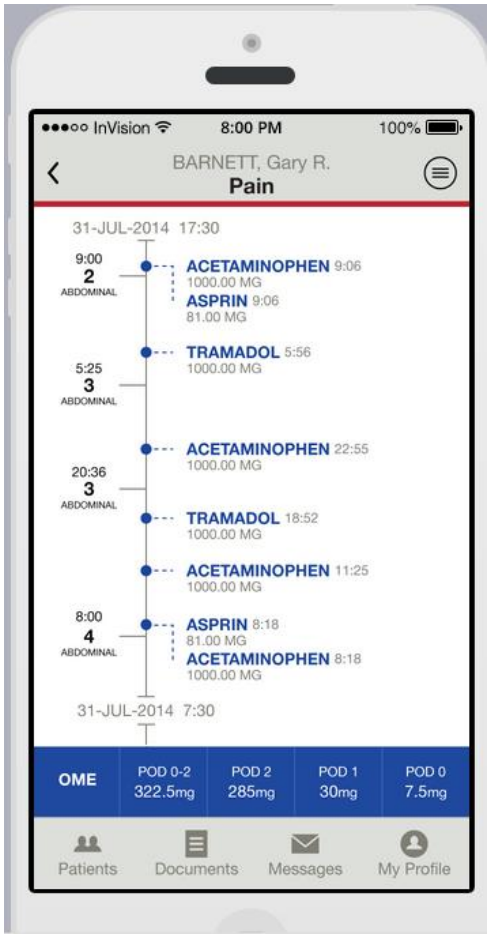
Point of Care Tool Prototypes







Current Electronic Environment vs. New CRS Tool

Eliminating waste, Improving Quality

Provider Workflow/Effort	Current EMR Needs to Round	New PoC Tool (mobile) Needs to Round
Information Systems	11+	1
Use of Paper Intermediates	5+	0
Manual Pathway/ Complication Calculations	>36	**0**
Screen Transitions (Inter-application)	237 (43)	**25 (0)**
Mouse Clicks	619	**25**
Estimated Cognitive Load Index	1,623	**75 (<5% of current)**
Time (minutes)	30:14 (95% on navigation)	**< 4:30 (95% on Clinical)**

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Primary care

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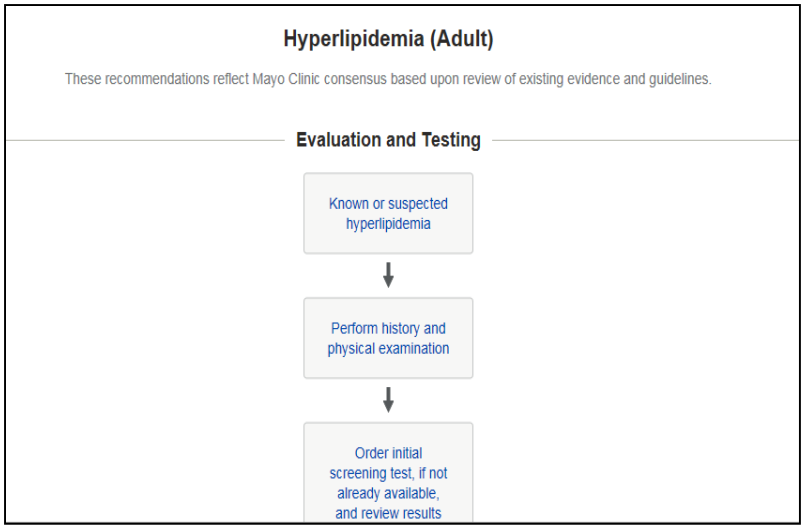
AskMayoExpert: Care Process Models (CPMs)

- CPMs are interactive algorithms that illustrate evidence and expert opinion-based core knowledge about a disease or condition, and represent the consensus of colleagues from all sites



- MayoExpertAdvisor translates care process models into computable code to better deliver knowledge to care givers.

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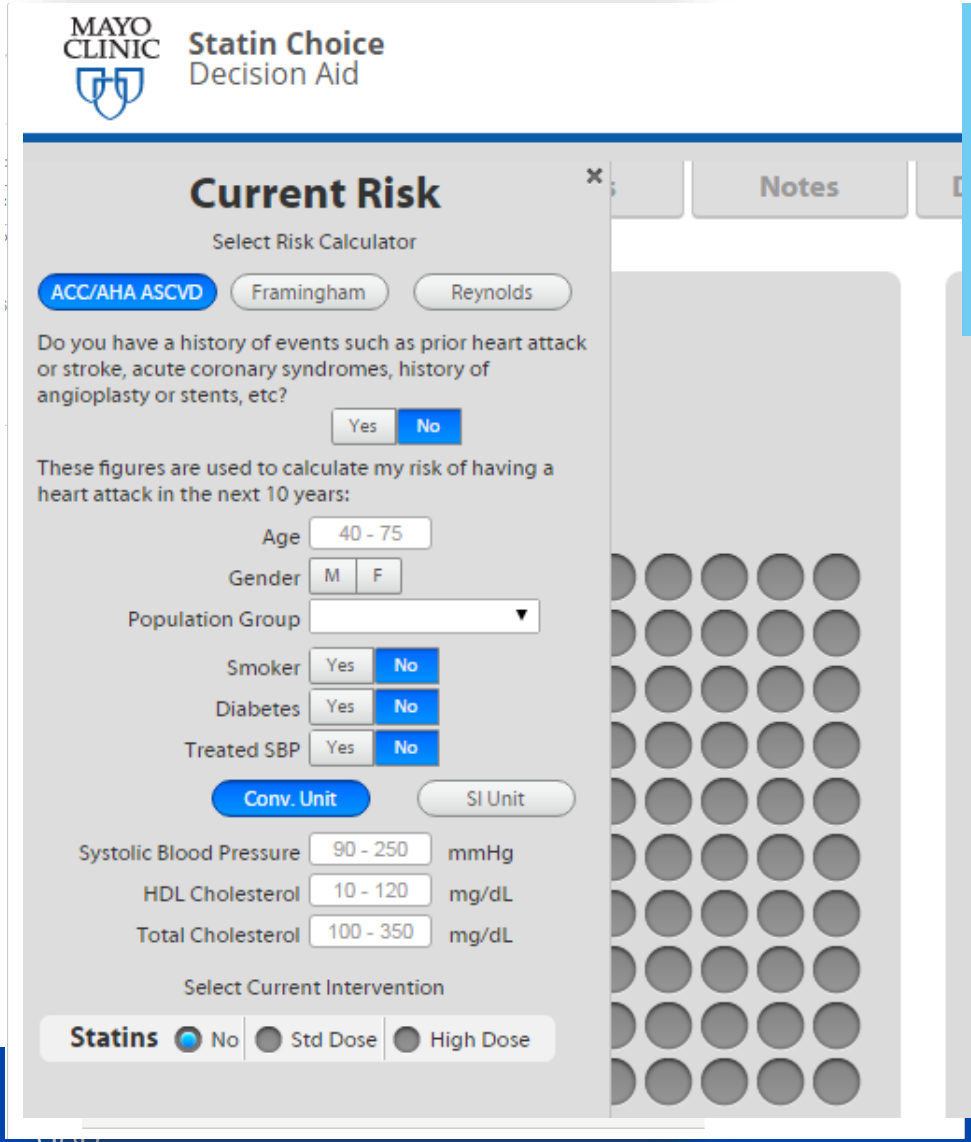
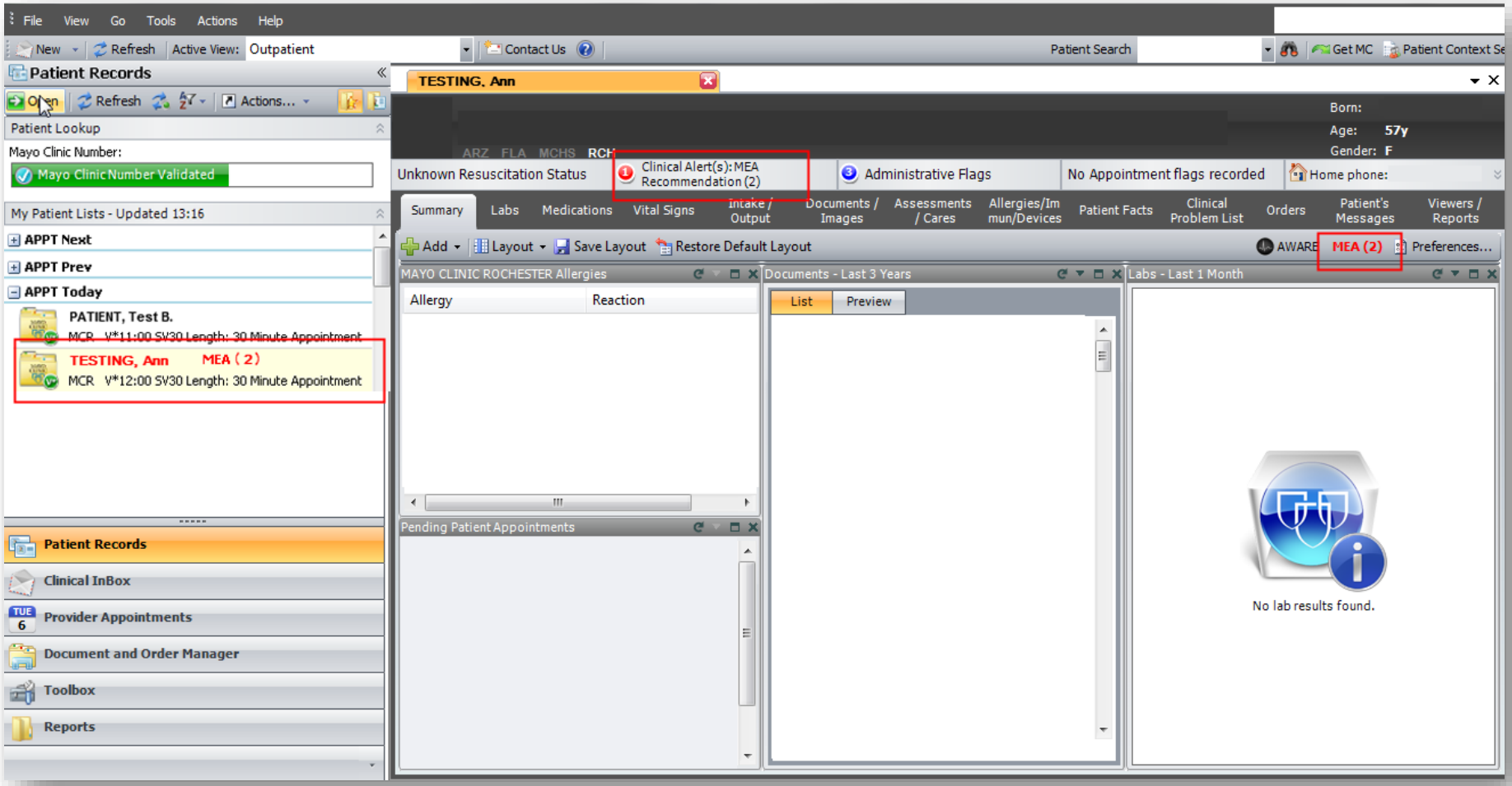
Current Process for Providers



Statin Patient Decision Aid:

1. Provider has to locate the statin decision aid within AME
2. After clicking on link, directed to the statin decision aid
3. The provider has to manually enter the patient's vitals, lab values, and history

Clinical Viewer Screen



*Notifications only show for actionable recommendations

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MayoExpertAdvisor

A. Care Recommendation
Depending on the individual patient's data in the EHR, MEA makes a recommendation.

B. Vitals
Most recent outpatient vitals.

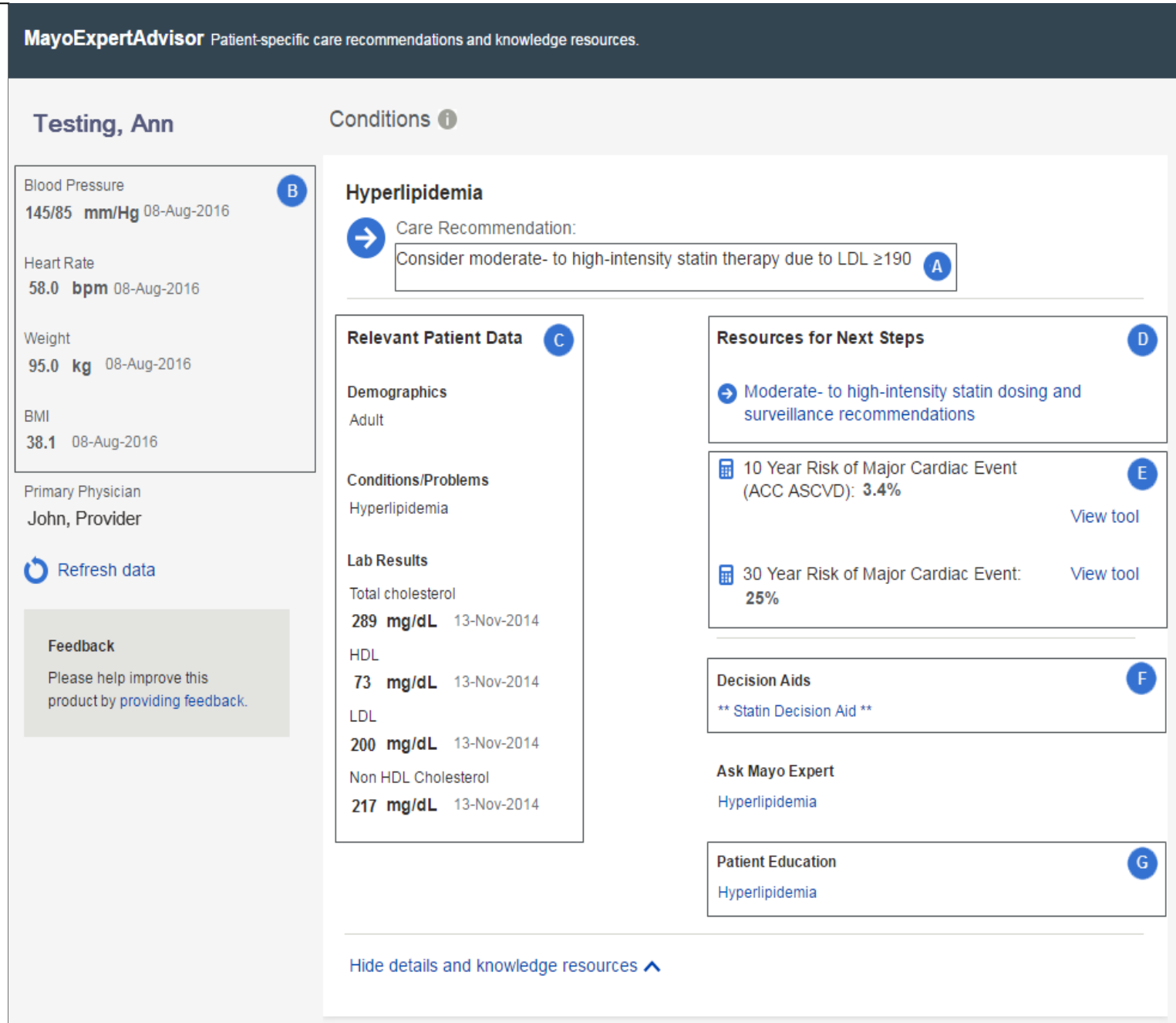
C. Relevant Patient Data
The most relevant demographics, conditions, medications and labs for managing the given condition.

D. Resources for Next Steps
Additional condition-specific tools (e.g. titration schedules) to assist in recommendations.

E. Risk Calculators
Condition-specific risk calculators with patient's data prefilled for real-time calculations.

F. Decision Aids
Mayo-vetted shared decision making tools. Field values are prefilled with patient data.

G. Patient Education
Links to relevant patient education material in AME.



Hyperlipidemia

Care Recommendation:

Consider moderate- to high-intensity statin therapy due to ASCVD

Relevant Patient Data

Demographics

Adult

Conditions/Problems

ASCVD

Hyperlipidemia

Diabetic

Hypertension

Lab Results

Total cholesterol

HDL

LDL

Non HDL Cholesterol

Resources for Next Steps

Moderate- to high-intensity statin dosing and surveillance recommendations

10 Year Risk of Major Cardiac Event (ACC ASCVD): 65.1% View tool

Decision Aids

** Statin Decision Aid **

Ask Mayo Expert

Hyperlipidemia

Screening Recommendations for Asymptomatic Men

Patient Education

Lowering High Triglycerides Through Diet

Managing Cholesterol, Sodium and Triglycerides

Alternative Therapies for Managing or Lowering Cholesterol

Your Cardiovascular Health Risk Assessment

Mayo Clinic Healthy Weight Pyramid

CV - Cardiovascular Risk Reduction Program

Blood Pressure and Weight Record

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10 Year Risk of Major Cardiac Event (ACC ASCVD)

Patient Data

Pre-filled values are pulled from the patient record. Adjusting the values will not affect the patient's record.

Age:	71.83	(40-79)
Sex:	◉ Female ○ Male	
Race:	White	
Total Cholesterol (mg/dL):	246	(130-320)
Hdl - Cholesterol (mg/dL):	83	(20-100)
Systolic Blood Pressure:	125	(90-200)
Diabetes:	◉ Yes ○ No	
Hypertension:	◉ Yes ○ No	
Smoker:	○ Yes ◉ No	

Risk Score

11.2%

Original score based on current data from the patient record.

26.8%

Based on adjusted patient data values.

Adjust the values and click recalculate to model interventions. Adjusting the values will not effect the patient's record.

Recalculate Reset to patient record values

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Congestive Heart Failure with Reduced Ejection Fraction

Care Recommendation:

Consider increasing dose of Losartan to target dose for heart failure, monitor creatinine and potassium levels

Relevant Patient Data

Demographics

Adult

Conditions/Problems

CHF

Diabetic

Hypertension

Lab Results

Creatinine

0.8 mg/dL 18-Jan-2016

Potassium

4.3 mmol/L 18-Jan-2016

Ejection Fraction

0.49 20-May-2014

Resources for Next Steps

ARB titration schedule

Seattle Heart Failure 2 Year Survival: View tool

Decision Aids

** Statin Decision Aid **

Ask Mayo Expert

Heart Failure Reduced Ejection Fraction (HFrEF)

Screening Recommendations for Asymptomatic Women

Patient Education

Heart Failure Self-Care Plan

Circulation of the Heart

Mediterranean Diet

CV - Cardiovascular Risk Reduction Program

Blood Pressure and Weight Record

Mayo Clinic Healthy Weight Pyramid

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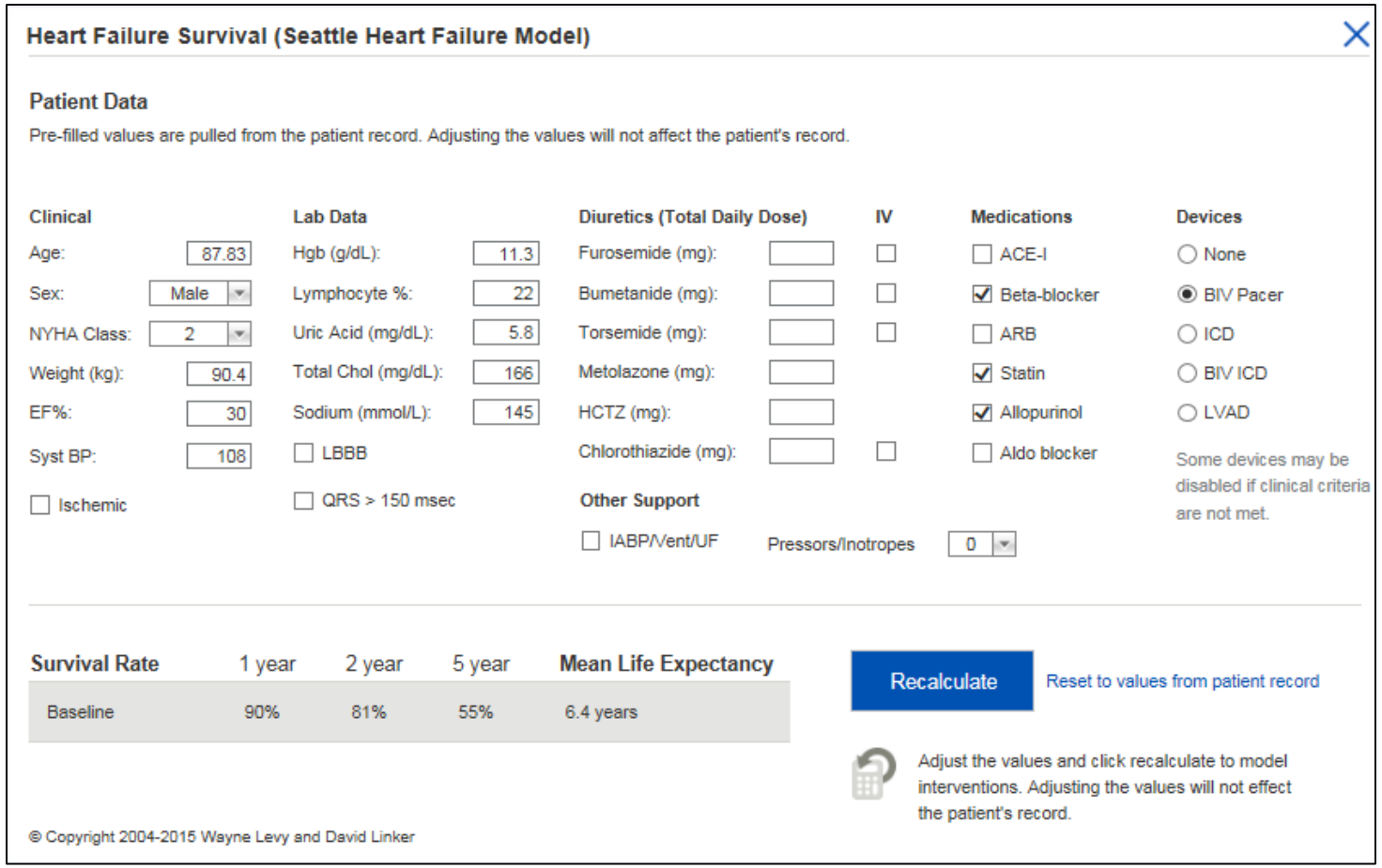
Heart Failure Survival (Seattle Heart Failure Model)
Patient Data
Pre-filled values are pulled from the patient record. Adjusting the values will not affect the patient's record.
Clinical
Age: 87.83
Sex: Male
NYHA Class: 2
Weight (kg): 90.4
EF%: 30
Syst BP: 108
Ischemic
Lab Data
Hgb (g/dL): 11.3
Lymphocyte %: 22
Uric Acid (mg/dL): 5.8
Total Chol (mg/dL): 166
Sodium (mmol/L): 145
LBBB
QRS > 150 msec
Diuretics (Total Daily Dose)
Furosemide (mg):
Bumetanide (mg):
Torsemide (mg):
Metolazone (mg):
HCTZ (mg):
Chlorothiazide (mg):
IV
Other Support
IABP/Vent/UF
Pressors/Inotropes 0
Medications
ACE-I
Beta-blocker
ARB
Statin
Allopurinol
Aldo blocker
Devices
None
BIV Pacer
ICD
BIV ICD
LVAD
Some devices may be disabled if clinical criteria are not met.
Survival Rate 1 year 2 year 5 year Mean Life Expectancy
Baseline 90% 81% 55% 6.4 years
Recalculate
Reset to values from patient record
Adjust the values and click recalculate to model interventions. Adjusting the values will not effect the patient's record.
© Copyright 2004-2015 Wayne Levy and David Linker

Atrial Fibrillation

Care Recommendation:

Consider anticoagulation therapy, if HAS-BLED score <3, due to CHA2DS2-VASc score 2 or greater

Relevant Patient Data

Demographics

Adult

Conditions/Problems

Atrial fibrillation

Diabetic

Hypertension

Resources for Next Steps

Review HAS-BLED bleeding risk score, consider anticoagulant

CHADS2-VASc Score: **6 points** View tool

Ask Mayo Expert

Heart Failure With Reduced Ejection Fraction (HFrEF)

Patient Education

Mediterranean Diet

Lowering High Cholesterol

Hide details and knowledge resources

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CHA2DS2VASc Risk Score

The CHA2DS2VASc score is a clinical perdiction tool for estimating stroke risk in patients with non-rheumatic atrial fibrillation and to identify candidates for anticoagulation or antiplatelet therapy.

Patient Data

Pre-filled values are pulled from the patient record. Adjusting the values will not affect the patient's record.

Age:	○ <65	◉ 65-74 ○ ≥75
Sex:	○ Female	◉ Male
Congestive Heart Failure History:	◉ Yes	○ No
Hypertension History:	◉ Yes	○ No
Stroke/TIA/ Thromboembolism History:	◉ Yes	○ No
Vascular Disease History:	○ Yes	◉ No
Diabetes:	◉ Yes	○ No

Risk Score

6 points

Original score based on current data from the patient record.

A score of 0 is "low" risk and may not require anticoagulation; a 1 score is "low-moderate" risk and should consider antiplatelet or anticoagulation, and score 2 or greater is "moderate-high" risk and should otherwise be an anticoagulation candidate.

Adjust the values and click recalculate to model interventions. Adjusting the values will not effect the patient's record.

Recalculate Reset to patient record values

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Sample Results

Metric	Without MEA	With MEA	Percent Improvement
Click Count	284	84	338 %
Elapsed Time to Calculate	9:02	1:34	673 %
Keystrokes	73	28	260 %
Page Changes	15	4	375 %

	# of Individuals	Percent
Very likely to recommend	6	42.9%
Somewhat likely to recommend	7	50.0%
Neither likely nor unlikely to recommend	1	7.1%
Somewhat unlikely to recommend	0	0.0%
Very unlikely to recommend	0	0.0%
Total	14	100.0%

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Thank you

Questions?

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