LMR Research Efforts

Tejal Gandhi, MD MPH
Director of Patient Safety
Partners Healthcare

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Brigham and Women's Hospital, and
Harvard Medical School

Acknowledgements

- David Bates
- Lynn Volk
- Michael Matheny
- Rob El-Kareh
- Tom Sequist
- Jeff Schnipper
- Jeff Linder
- Blackford Middleton
- Eric Poon
- Adam Wright
- Pam Neri
- Omar Santiago
- Harley Ramelson

Goals

- Review numerous studies done in LMR of existing and new functionality
  - Caveat: Focus on research from BWH Division of Gen Med, PHS CQA and CIRD
- Provide feedback of results to LMR groups
- Learn from the findings to improve LMR
- Discuss ways to ensure research findings are internally disseminated

Ten Commandments for Effective Clinical Decision Support

1. Speed is everything
2. Anticipate needs and deliver in real time
3. Fit into the user's workflow
4. Little things can make a big difference
5. Physicians resist stopping
6. Changing direction is fine
7. Simple interventions work best
8. Asking for information is OK—but be sure you really need it
9. Monitor impact, get feedback, and respond
10. Knowledge-based systems must be managed and maintained

Bates DW et al, JAMIA 2003

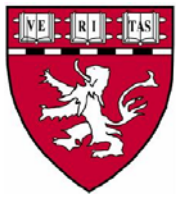
Study Topics

- **Reminders**
- Results Manager
- Medication Decision Support
- Referrals
- Smart Forms
- Discharge Med Reconciliation
- Satisfaction/ROI/Usability

- Note: Not all studies are included, particularly those related to Pt Gateway

The Impact of an Electronic Clinical Reminder System on the Quality of Care

Thomas D. Sequist, MD
Tejal K. Gandhi, MD MPH
Andrew S. Karson, MD MPH
Julie Fiskio, BA
David W. Bates, MD MSc
Funded by AHRQ



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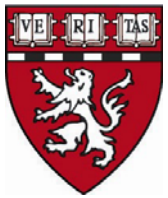
Conclusions

- Reminder system improved care for overall diabetes and coronary artery disease
  - 30% more compliant with diabetes care
  - 25% more compliant with CAD care
- Effect of individual reminders was variable
- PCPs found this reminder system useful

A randomized trial of electronic clinical reminders to improve medication laboratory monitoring

Matheny ME, Sequist TD, Seger AC, Fiskio JM,
Sperling M, Bugbee D, Bates DW, Gandhi TK
Funded by AHRQ



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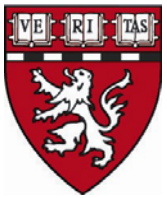
Med-lab reminders study

- Reminders to improve routine med-lab monitoring
  - E.g. check LFTs for patients on statin
- Baseline compliance rates were quite high
- Reminders had no impact on improving compliance

Matheny, M et al. JAMIA 2008

Effect of Actionable Reminders on Performance of Overdue Testing

Robert El-Kareh MD, Tejal K. Gandhi MD MPH,
Eric G. Poon MD MPH, Lisa P. Newmark,
Jonathan Ungar, John Orav PhD,
Thomas D. Sequist MD MPH
Funded by AHRQ



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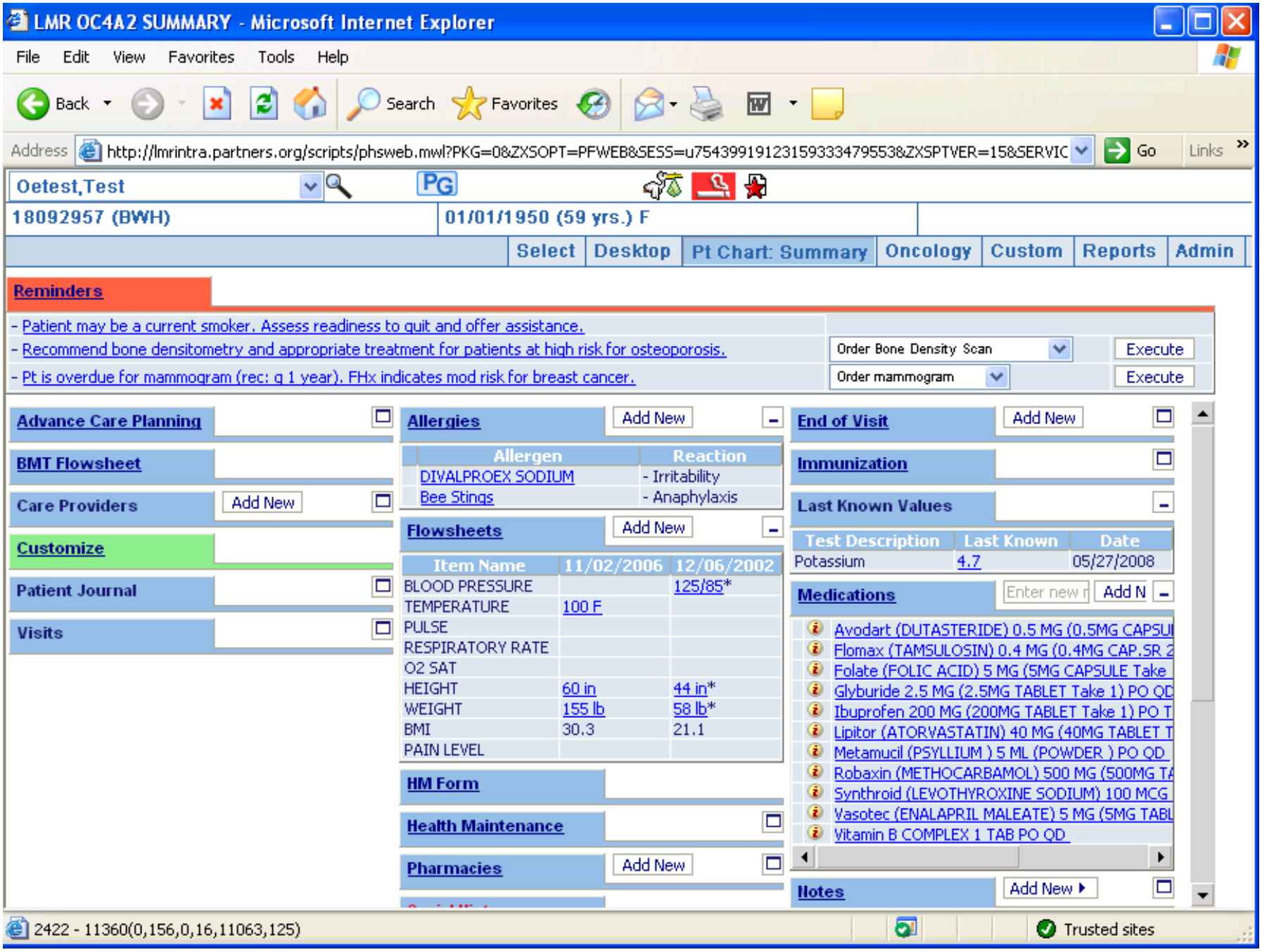
Study Goal

- Evaluate impact on performance of overdue tests of linking electronic reminders to computerized physician order entry

- “Actionable Reminder”
  - Electronic reminder linked to order entry
  - Enabled ordering with single click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Back Search Favorites
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18092957 (BWH)
01/01/1950 (59 yrs.) F
Select Desktop Pt Chart: Summary Oncology Custom Reports Admin
Reminders
- Patient may be a current smoker. Assess readiness to quit and offer assistance.
- Recommend bone densitometry and appropriate treatment for patients at high risk for osteoporosis.
Order Bone Density Scan
Execute
- Pt is overdue for mammogram (rec: q 1 year). FHx indicates mod risk for breast cancer.
Order mammogram
Execute
Advance Care Planning
BMT Flowsheet
Care Providers
Add New
Customize
Patient Journal
Visits
Allergies
Add New
Allergen
Reaction
DIVALPROEX SODIUM
- Irritability
Bee Stings
- Anaphylaxis
Flowsheets
Add New
Item Name
11/02/2006
12/06/2002
BLOOD PRESSURE
125/85*
TEMPERATURE
100 F
PULSE
RESPIRATORY RATE
O2 SAT
HEIGHT
60 in
44 in*
WEIGHT
155 lb
58 lb*
BMI
30.3
21.1
PAIN LEVEL
HM Form
Health Maintenance
Pharmacies
Add New
End of Visit
Add New
Immunization
Last Known Values
Test Description
Last Known
Date
Potassium
4.7
05/27/2008
Medications
Enter new r
Add N
Avodart (DUTASTERIDE) 0.5 MG (0.5MG CAPSUI
Flomax (TAMSULOSIN) 0.4 MG (0.4MG CAP.SR 2
Folate (FOLIC ACID) 5 MG (5MG CAPSULE Take
Glyburide 2.5 MG (2.5MG TABLET Take 1) PO QD
Ibuprofen 200 MG (200MG TABLET Take 1) PO T
Lipitor (ATORVASTATIN) 40 MG (40MG TABLET T
Metamucil (PSYLLIUM) 5 ML (POWDER) PO QD
Robaxin (METHOCARBAMOL) 500 MG (500MG TA
Synthroid (LEVOTHYROXINE SODIUM) 100 MCG
Vasotec (ENALAPRIL MALEATE) 5 MG (5MG TABL
Vitamin B COMPLEX 1 TAB PO QD
Notes
Add New
2422 - 11360(0,156,0,16,11063,125)
Trusted sites

Results

- No difference in rates of ordering of mammograms, bone density, LDL, or HbA1c

Results – MD Survey

- 100% response rate
- 46% almost never placed orders from reminders
- 33% were unaware of capability

Reminders Summary

- Reminders work, but variably
  - Not that effective if start at a high level
  - Users often don’t see them
- Linking to End of Visit did not seem to have additional impact
  - Lack of usage
  - More work needs to be done to better incorporate into workflow

Study Topics

- Reminders
- **Results Manager**
- Medication Decision Support
- Referrals
- Smart Forms
- Discharge Med Reconciliation
- Satisfaction/ROI/Usability

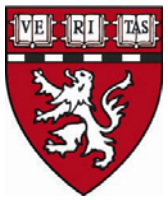
Provider Satisfaction

How Strongly do you agree with the following statements? (1= strong agree, 5=strongly disagree)	Mean
RM improves care quality	1.8
RM decreases malpractice risk	2.1
RM2 is easy to use	2.3
RM2 is useful to me	1.9
RM2 takes more time than before	3.2

N=59, Response rate = 51%

Impact of an automated test results management system on patients' satisfaction about test result communication

Matheny ME, Gandhi TK, Orav EJ, Ladak-Merchant Z,
Bates DW, Kuperman GJ, Poon EG
Funded by AHRQ



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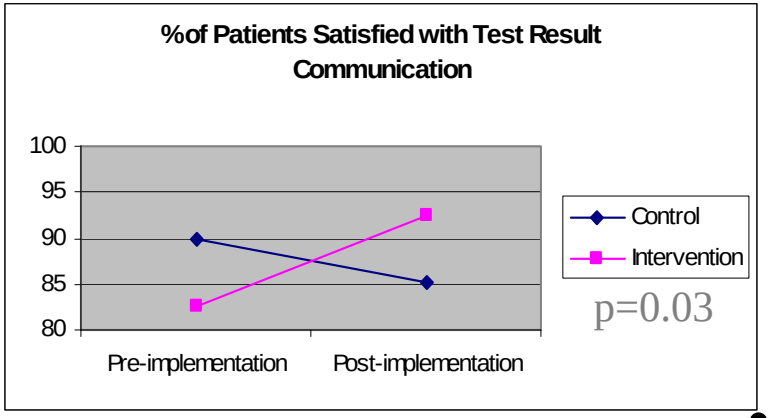
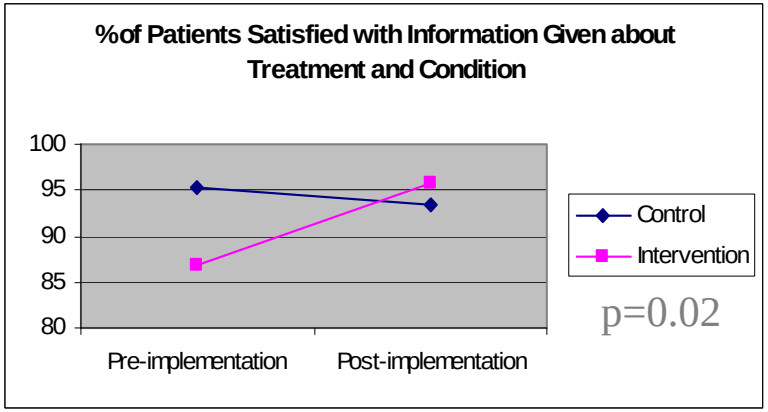
Impact on Patient Satisfaction





- Randomized control trial to assess patient satisfaction
  - ½ practices given RM2 (intervention)
  - ½ usual care (with rest of EMR)
- Patients interviewed via phone before and after implementation of RM2
  - 570 patients interviewed

Matheny et al. Archives of Int Medicine 2007

Study Topics

- Reminders
- Results Manager
- **Medication Decision Support**
- Referrals
- Smart Forms
- Discharge Med Reconciliation
- Problem List
- Satisfaction/ROI/Usability

Improving Acceptance of Alerts in Ambulatory Care

Nidhi Shah, Andy Seger, Diane Seger, Julie Fiskio,
Gil Kuperman*, Barry Blumenfeld, Elaine Recklet,
David Bates, Tejal Gandhi

Funded by AHRQ

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Alert tiers

- Goal was to reduce unecessary interruptions and increase acceptance rates
- Clinical group created tiered alerting system
  - Level 1 – Potentially life-threatening
    - E.g., erythromycin - diltiazem -> V-fib
    - “Hard stop” – couldn’t proceed
  - Level 2 – Potential for serious injury
    - Rizatriptan - linezolid -> serotonin syndrome
    - Interruptive, required a reason
  - Level 3 – Use w/ caution
    - Warfarin – levofloxacin -> increased PT
    - Non-interruptive

Results

- 18,115 alerts
  - 12,933 non-interruptive (71%)
  - 5,182 interruptive (29%)

Interruptive alerts

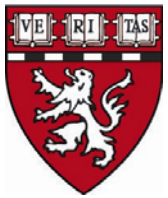
Alert	N	Accepted	Overridden
Duplicate class	3,875	2,695 (77%)	910 (23%)
Drug-drug	1078	451 (42%)	627 (58%)
Drug-disease	19	10 (53%)	9 (47%)
Drug-lab	92	37 (40%)	55 (60%)
Drug-pregnancy	118	12 (10%)	106 (90%)
Total	5182	3,475 (67%)	1,707 (33%)

Conclusions

- Can reduce alert burden by tiering the knowledge base
- Minimizing interruptive alerts improves acceptance of important alerts
- Also positive impact on workflow

Impact of non-interruptive medication laboratory monitoring alerts in ambulatory care

Lo HG, Matheny ME, Seger DL, Bates DW, Gandhi TK
Funded by AHRQ



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Impact of Non-Interruptive Alerts

- Drilled down into the drug-lab alerts
- No difference in lab ordering between control and intervention groups
- Is it a user interface issue or are non-interruptive alerts just not effective?
- Cost- benefit issue
  - Minimize interruptions so higher risk alerts are accepted more often… yet little benefit to the lower risk non-interruptive alerts

Lo, H et al. JAMIA 2009

An Unintended Consequence of Electronic Prescriptions: Prevalence and Impact of Internal Discrepancies

Palchuk MB, Fang EA, Cygielnik JM, Labreche M, Shubina M, Ramelson HZ, Hamann C, Broverman C, Einbinder JS, Turchin A. JAMIA [in press]

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Partners Healthcare

Unintended Consequences

- Review of 2914 electronic prescriptions with free text fields
  - 16% had internal discrepancies between the sig and special instructions
    - 83% potentially harmful
    - 17% potentially serious harm
- This work (along with site requests) led to the “conflicting sig” project
  - Phase 1 recently implemented

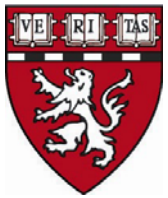
Study Topics

- Reminders
- Results Manager
- Medication Decision Support
- **Referrals**
- Smart Forms
- Discharge Med Reconciliation
- Satisfaction/ROI/Usability

Improving referral communication using a referral tool within an electronic medical record

Gandhi TK, Keating NL, Ditmore M, Kiernan D, Johnson R, Burdick E, Hamann C

Funded by The Commonwealth Fund



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Project Objectives

- Created a structured, electronic referral system in LMR for use by PCPs and specialists
  - Improve the adequacy and timeliness of information exchange between providers
  - Improve PCP ability to track referrals

Research Results

- Studied the Referral Manager at 2 sites
- Intervention site
  - Specialists more likely to receive communication (62% vs 12%)
  - PCPs more often received return communication (69% vs 50%)
  - Patients were more likely to report that the specialist had seen information before the visit (70% vs 43%)

Gandhi, et al. Advances in Pt Safety 2008

Lessons Learned

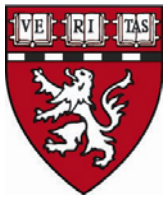
- This application has clinical benefit
- Difficult to get practices to adopt due to varying workflows/impact on workflow
  - Recent increase in practice adoption
- Practices that have adopted it do like it
- Need more work to ensure fits into workflow

Study Topics

- Reminders
- Results Manager
- Medication Decision Support
- Referrals
- **Smart Forms**
- Discharge Med Reconciliation
- Satisfaction/ROI/Usability

Smart Forms & Quality Dashboards

Blackford Middleton, MD, MPH, MSc, Jeffrey Schnipper, MD, MPH
Jeffrey Linder, MD, MPH, Jonathan Einbinder, MD, Matvey Palchuk, MD,
Lynn Volk, Amy Bloom, Lana Tsurikova, Julie Greim, Julie Fiskio, Tony Yu,
Andrea Melnikas, Kerry McColgan, Yelena Kleyner
Funded by AHRQ



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ARI SF Study Conclusions

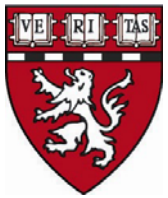
- ARI Smart Form neither reduced overall antibiotic prescribing nor significantly improved the appropriateness of antibiotic prescribing for ARIs, but it was not widely used
- When used, the ARI Smart Form may improve diagnostic accuracy and may reduce antibiotic prescribing for certain diagnoses

CAD Smart Form Results

- Overall CAD Smart Form use was low
- Despite this, patients of Smart Form providers were more likely to have deficiencies in care addressed after a visit
- Deficiencies more often addressed included documentation and measures of clinical inertia

LMR Tobacco Treatment Enhancements

Jeffrey A. Linder, MD, MPH, FACP



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Conclusions

- A multi-faceted tobacco intervention with smart forms, web shell icons, and reminders significantly improved referrals and patient contact with counseling resources

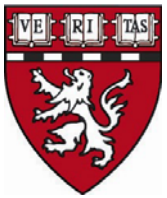
Study Topics

- Reminders
- Results Manager
- Medication Decision Support
- Referrals
- Smart Forms
- **Discharge Med Reconciliation**
- Problem List
- Satisfaction/ROI/Usability

Reconciling Medications After Hospital Discharge:

Development and Evaluation of an Electronic Tool

Jeffrey Schnipper, MD, MPH, FHM
Funded by AHRQ



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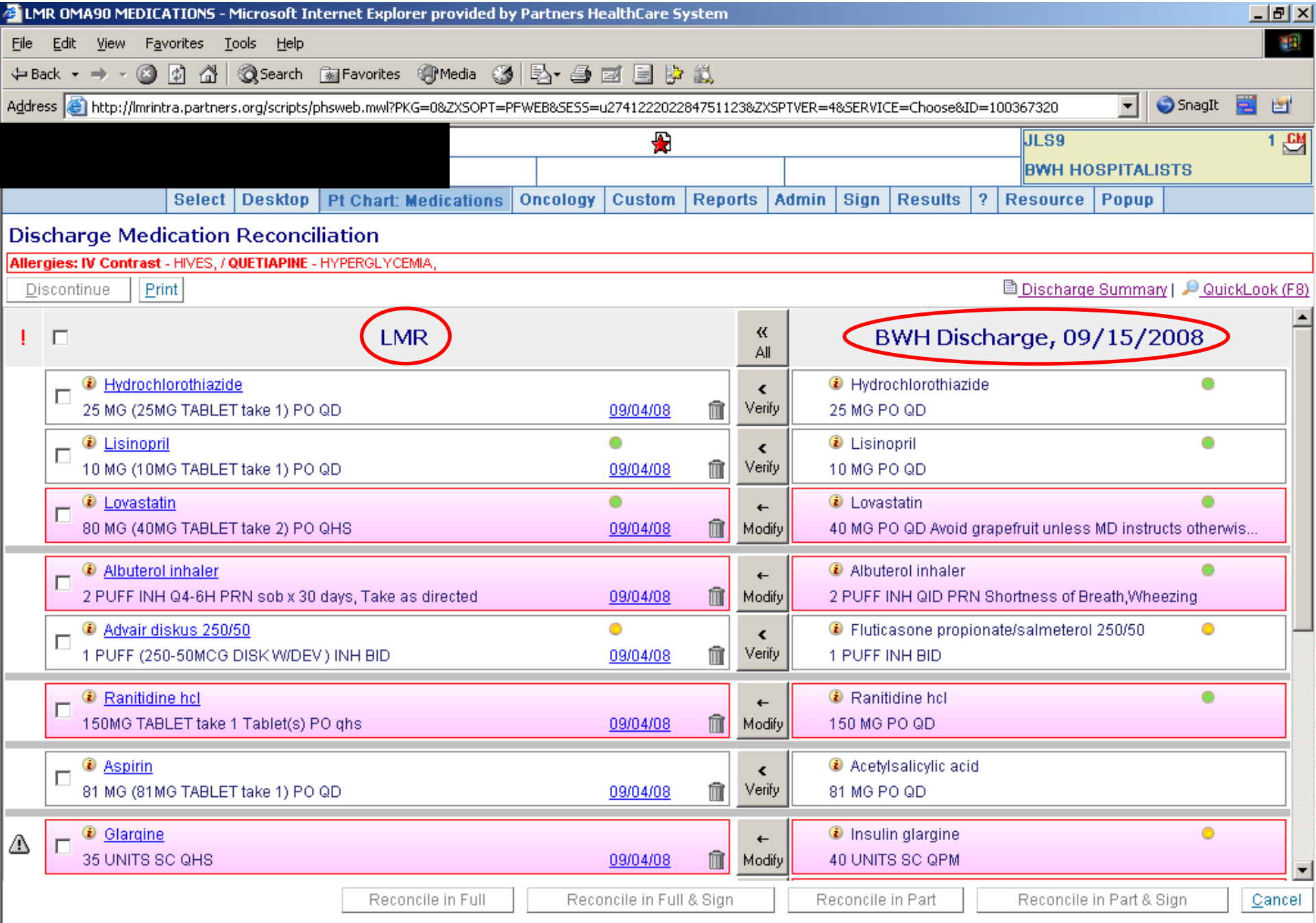
LMR Medication Reconciliation Screen



Lessons Learned

- Use of tool was low at the beginning of the trial
  - Completely new feature
  - Users were not aware of it
  - Users forgot to use it
  - Only to be used in a minority of outpatients
    - Did not get in the habit of using it
  - “Pink button” may not be enough to remind them

Strategies to Increase Use

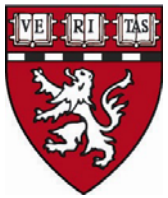
- Forgetting to use it
  - Reminder email to PCPs re: upcoming follow-up appointment with recently discharged patients
  - Passive reminder on summary page

Study Topics

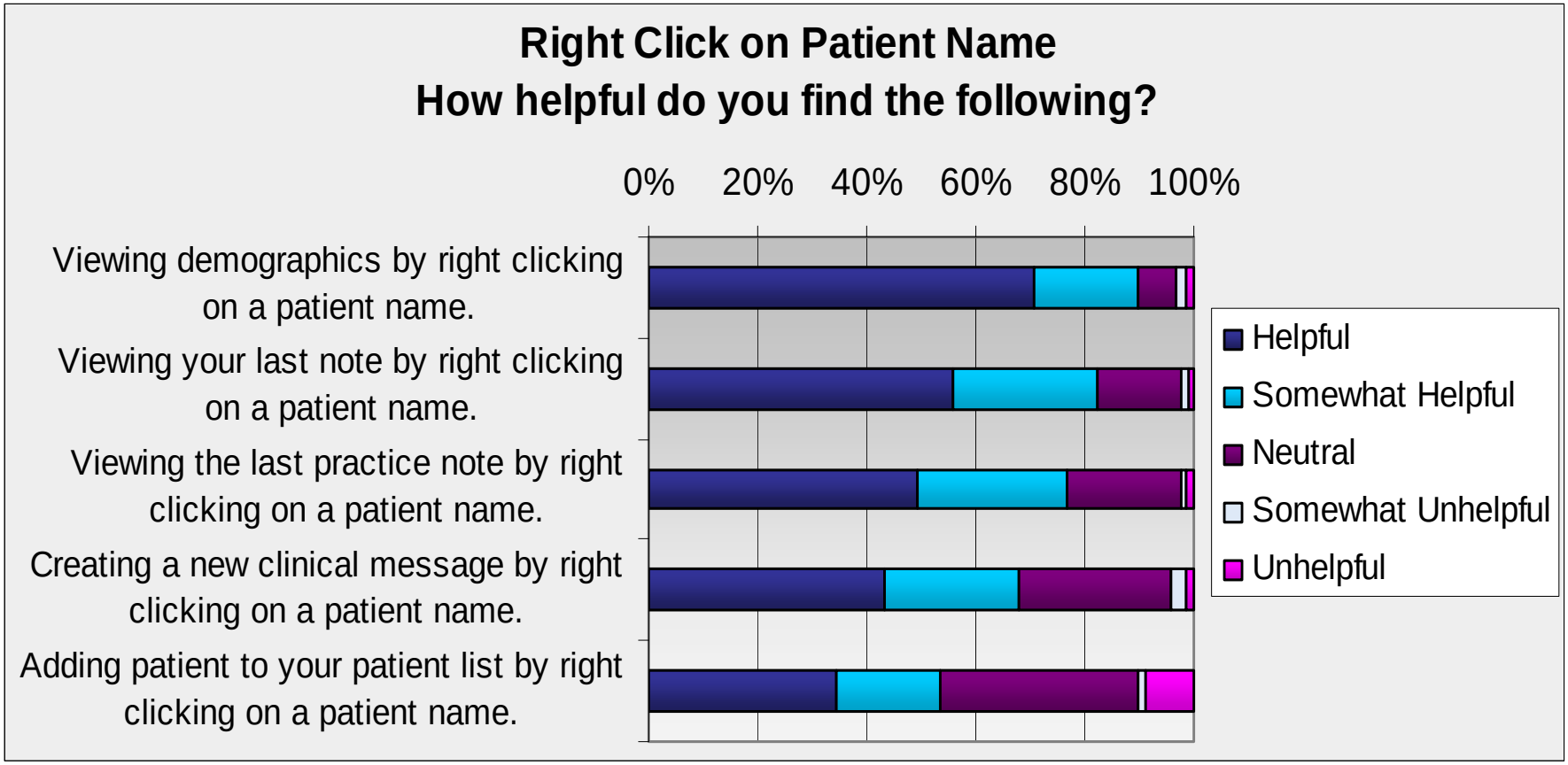
- Reminders
- Results Manager
- Medication Decision Support
- Referrals
- Smart Forms
- Discharge Med Reconciliation
- **Satisfaction/ROI/Usability**

LMR Evaluation Survey Results

Pamela Neri, Stephanie Pollard,
Lynn Volk, Allison Wilcox, Deborah Williams,
Harley Ramelson,
Gordon Schiff, David Bates



New Feature:
Right Click on Patient Name



More than half of the responders to the above question answered **"do not know yet/do not use feature"** for all but the first item (viewing demographics). These respondents have been excluded from the denominator.

Health Maintenance

- For approximately half of the 13 tasks available to do for Health Maintenance, the majority of the providers who responded to the question answered that they have never done the task or that the option is not currently available.

- Of those providers who were familiar with the tasks:
  - More than 25% of them said that the task was fairly difficult/difficult to do for each of the HM tasks listed
  - Less than 50% of providers said that the task was fairly easy/easy to do for each of the HM tasks listed.

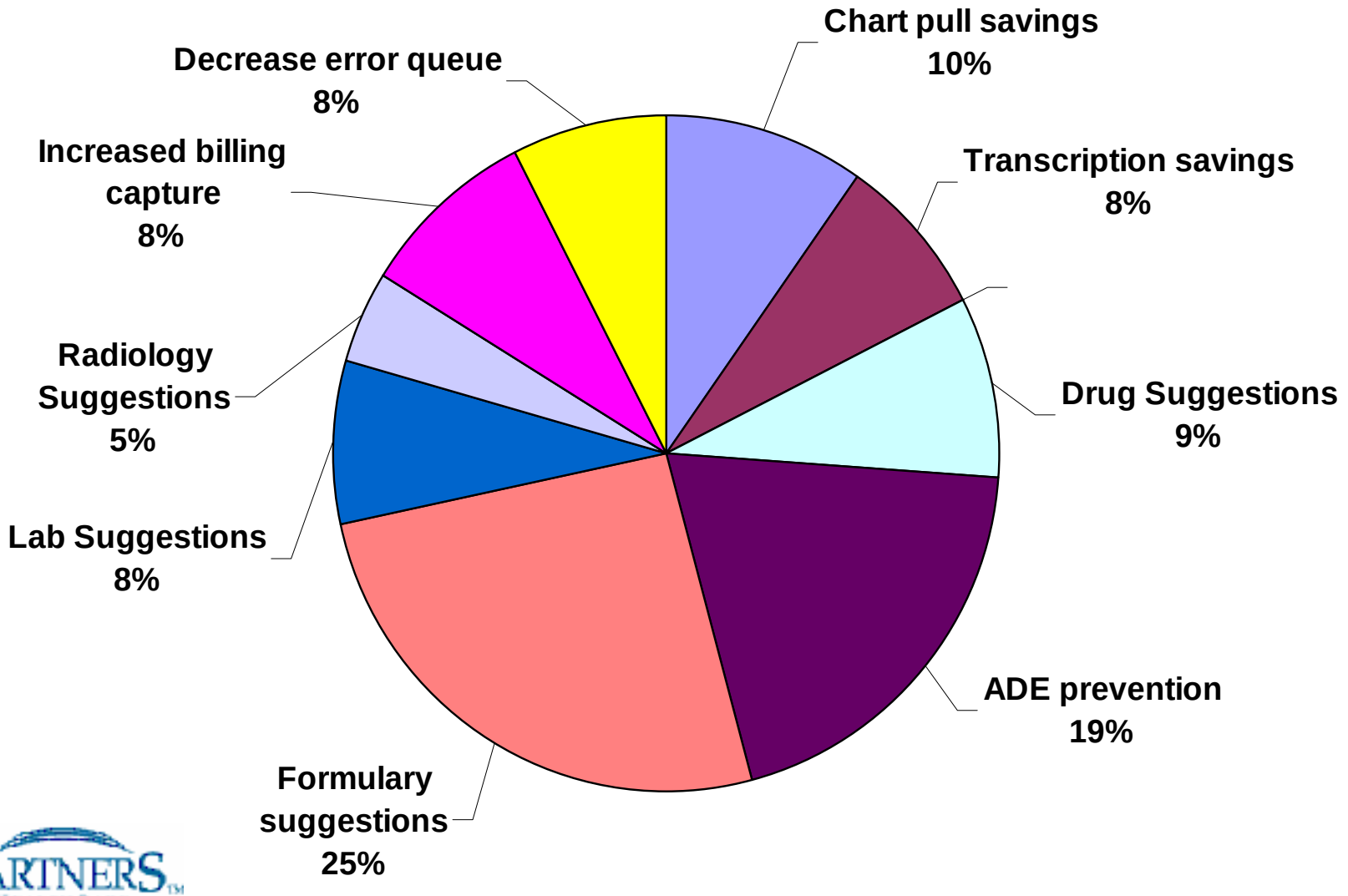
- LMR 2010 Spring Release has new HM functionality and next LMR survey will provide comparative results

A Cost-Benefit Analysis for Electronic Medical Record Systems in Primary Care

Wang SJ. Middleton B. Prosser LA. Bardon CG. Spurr CD. Carchidi PJ. Kittler AF. Goldszer RC. Fairchild DG. Sussman AJ.

Kuperman GJ. Bates DW.

Breakdown of Benefit Areas for Base Case: $31,300 benefit/provider



PARTNERS HEALTHCARE

Improving EHR Usability Based on Human Factors

A presentation for:

HIMSS07 Annual Conference & Exhibition

By:

Qi Li, MD, MBA

Clinical Informatics Research & Development, Partners Healthcare System, Boston, MA

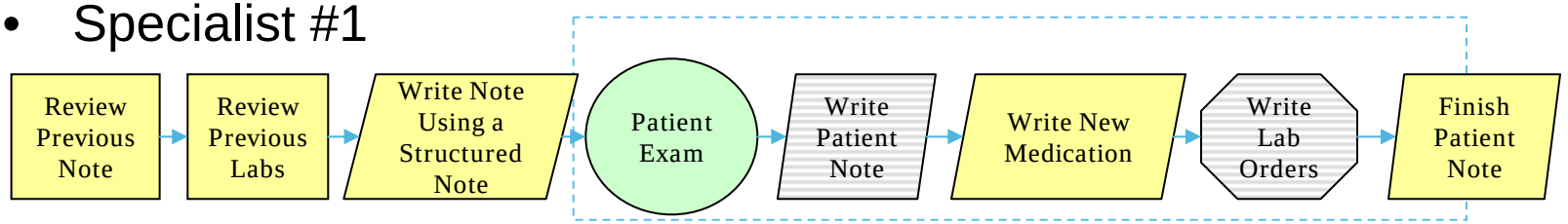
&

Omar Santiago, MSc, MBA

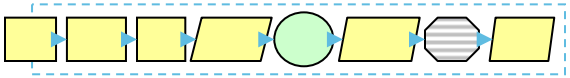
Massachusetts General Hospital, Boston, MA

Audits: Understanding Work

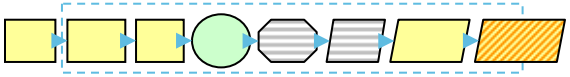
- Specialist #1



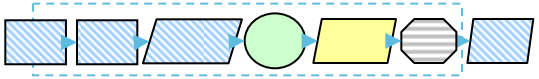
- PCP 1



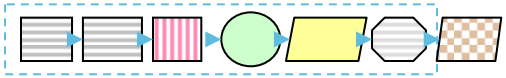
- PCP 2



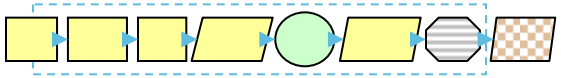
- PCP 3



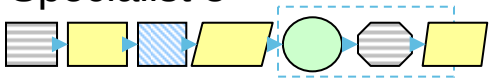
- PCP 4



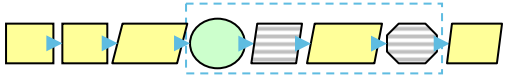
- Specialist 2



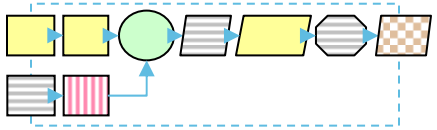
- Specialist 3

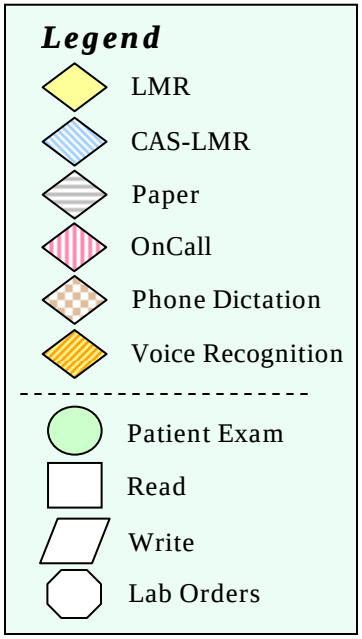


- Specialist 4



- Specialist 5





Audit Results: A Scarcity of Time

Assumption: Most clinicians would like to complete their clinical documentation either during or shortly after an encounter

Hypothesis: Clinicians have little time available for documentation.

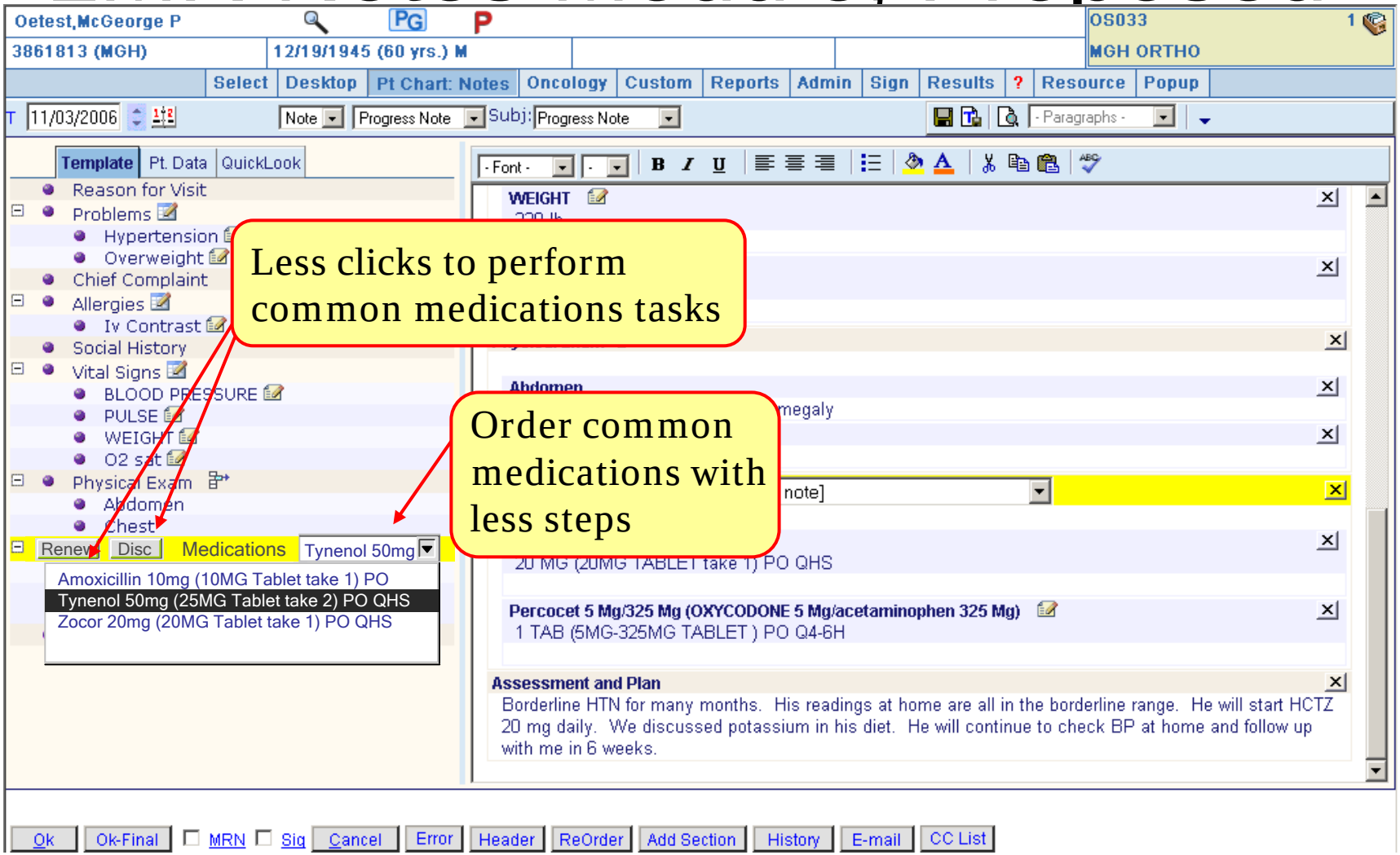
Evidence:

Avg. scheduled encounter time	23 mins.
Avg. time spent in patient interview/exam	- 14 mins.
Avg. time spent on needed paper work (lab orders, encounter forms, routing forms)	- 2 mins.

Deduction: Residual time left for documentation work 7 mins.

Recommendation: EHR's performance be measured by its ability to both review and update notes, labs and meds in 7 minutes or less.

LMR Notes Module, Proposed



Conclusions

- EHR usability can be improved by both IT design and workflow reengineering
  - Focus on gaining efficiencies in common tasks
- Workflow analyses are essential towards continuously enhancing EHR usability

Summary 1

- Many enhancements to LMR from research with proven benefits
- Implementation key to realizing full value of IT investment
  - Leadership buy-in
  - Process redesign
  - Ongoing support
- Major limitations to effectiveness/size of benefit is lack of use by end users
  - But degree of benefit comparable to literature norm—need decision support, registries AND team care to get to high quality
- PHS IS in conjunction with research needs to have more of a focus on:
  - End users' workflow
  - Usability
  - Training
    - Many features that users are unaware of

Summary 2

- Also need to continue cutting edge nationally recognized research on LMR decision support and enhancements
- How do we maintain an inventory of this work/results?
  - Putting together this deck was very challenging
  - Lots missing!
- How can we ensure that research findings are communicated and can provide feedback/input to LMR future development?
  - Annual updates to key committees?

Next Directions?

- Workflow
- Usability/systems engineering
- Training
- Ongoing monitoring of usage
- Development of medical home/chronic disease functionality
- Patient engagement/empowerment
  - PHR (much research underway)
  - Adherence interventions