



Summary of our Sharp activities

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University of Maryland

December 8th, 2010

Houston



Started in September

3 topics:

Medication reconciliation

Lab tracking (missed labs)

Medication interaction (*← discussed yesterday*)



Medication Reconciliation

Sumit Arora
sumitar2@umd.edu

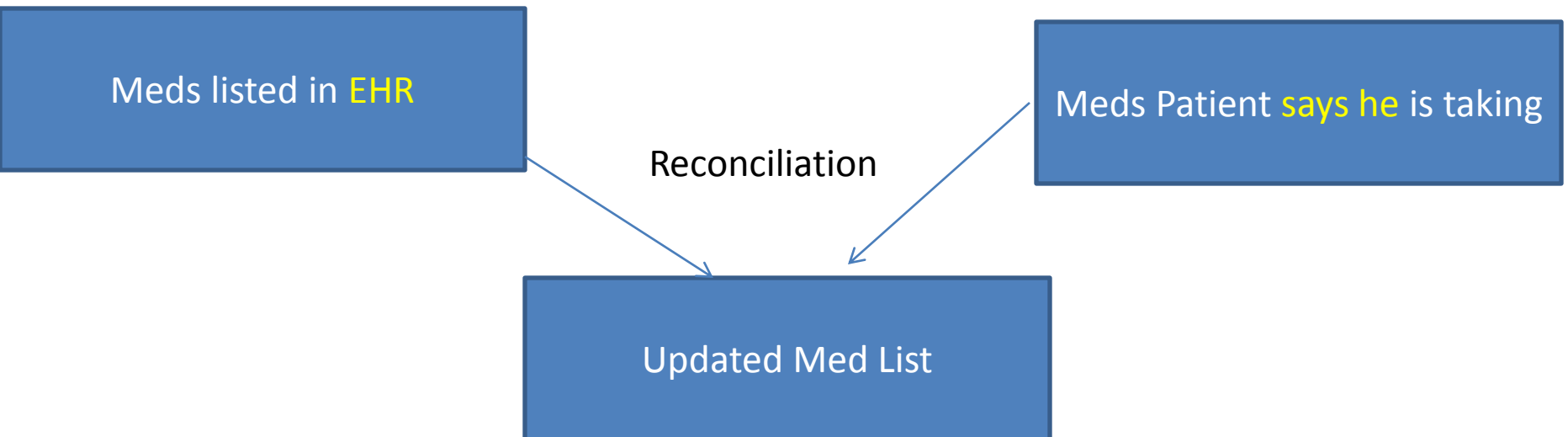


What is Medication Reconciliation?

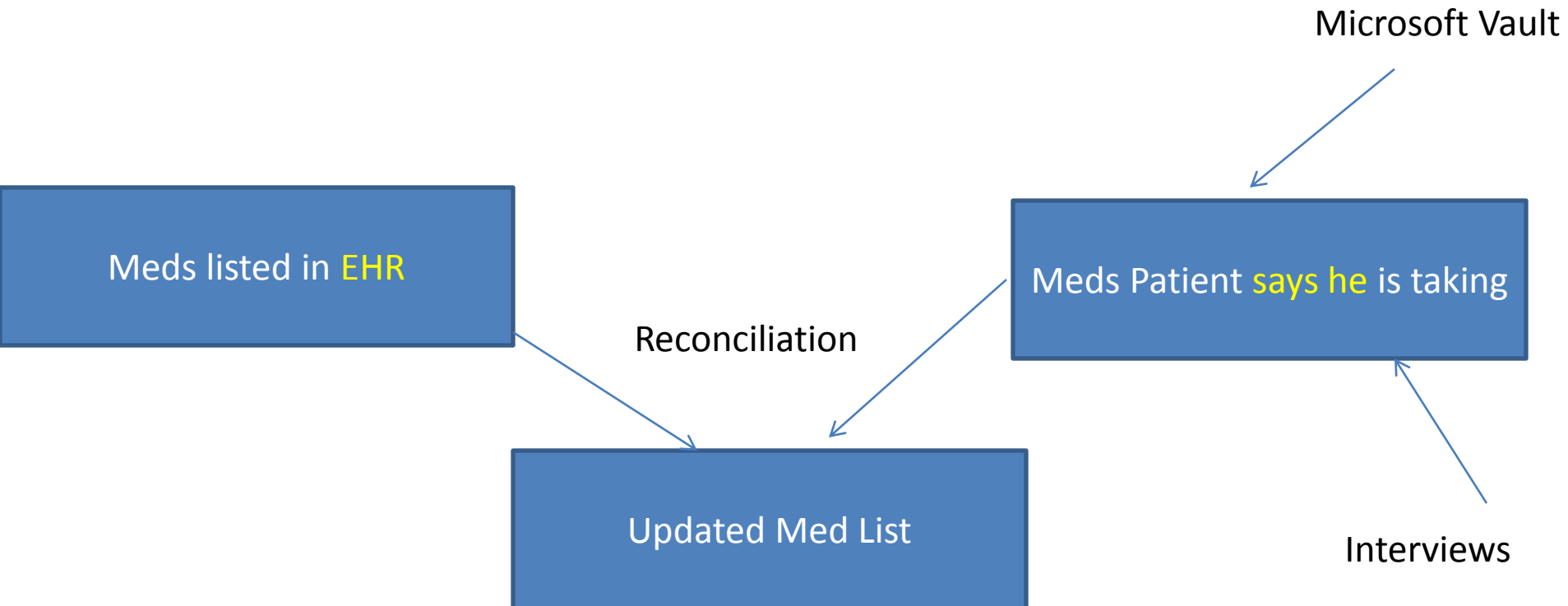
Sumit Arora
sumitar2@umd.edu

In the Physician's Office

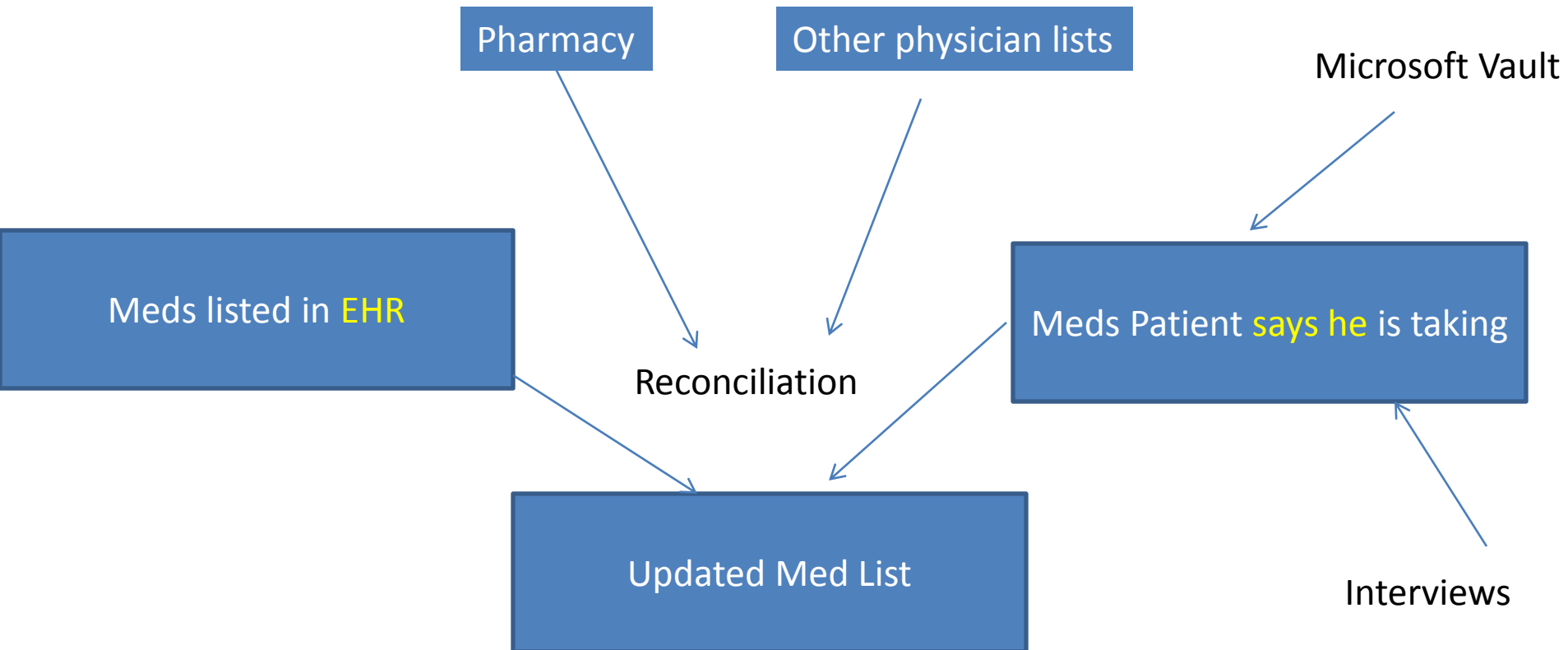
In the Physician's Office



In the Physician's Office

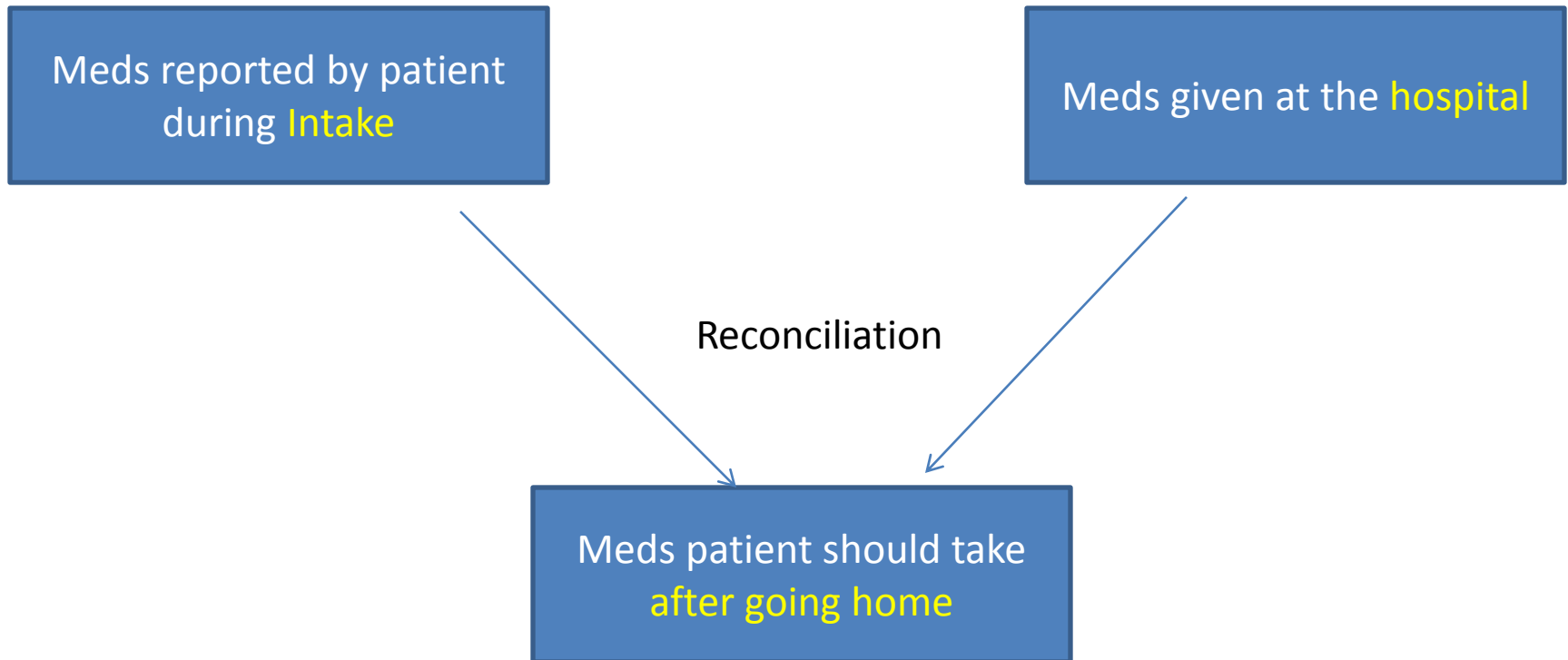


In the Physician's Office



In the Hospital – at discharge

In the Hospital – at discharge



Steps Involved in Medication Reconciliation¹

- **Verification** (collection of medication history);
- **Clarification** (ensuring that medications and doses are appropriate);
- **Reconciliation** (documentation of changes in the orders).

¹Getting Started Kit: Prevent Adverse Drug Events (Medication Reconciliation)

1. Develop a list of current medications;
2. Develop a list of medications to be prescribed
3. Compare the medications on the two lists
4. Make clinical decisions based on the comparison
5. Communicate the new list to appropriate caregivers and to the patient

http://www.ihs.gov/cio/ehr/index.cfm?module=medication_reconciliation

Lots of variation between settings

Data not necessarily correct/complete to start with

Current practices?

- *Note: your help needed*
- Separate lists on separate screens
 - See list A, See list B, enter final list on blank screen
 - List A and B side by side
- Combined lists
 - No meaningful grouping (e.g. use alphabetical order)
 - Lots of scrolling and searching

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EARLY PROTOTYPE

Medication Reconciliation

Patient's Name: [Mr. Alan Smith](#)

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Consolidated Record

Source	Medication	Dosage	Start Date	End Date	Comments	Actions
Physician	Codeine	1 Pill/Day	2/4/2010	4/4/2011	Mild	<input type="button" value="Keep"/> <input type="button" value="Edit"/> <input type="button" value="Delete"/>
Patient	Ibuprofen	2 Pills/Day	7/1/2009	1/1/2011	Regular Usage	Reconciled
Physician		2 Pills/Day	7/1/2009	1/1/2011	For Pain	
Patient	Oxycodone	3 Pills/Day	6/12/2010	10/12/2011	Irregular Usage	<input type="button" value="Keep"/> <input type="button" value="Edit"/> <input type="button" value="Delete"/>
Patient	Paracetamol	2 Pills/Day	6/2/2010	9/29/2011	Irregular Usage	<input type="button" value="Keep"/> <input type="button" value="Edit"/> <input type="button" value="Delete"/>
Patient	Tylenol	3 Pills/Day	2/2/2010	7/10/2011	Regular Usage	Reconciled
Physician		3 Pills/Day	2/2/2010	7/10/2011	For Fever	
Physician	Warfarin	1 Pill/Day	3/19/2010	12/10/2011	Important	<input type="button" value="Keep"/> <input type="button" value="Edit"/> <input type="button" value="Delete"/>

Medication Reconciliation

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Medication Reconciliation

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Grouped by similarity
- today only exact match

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Next: also partial match

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Actions to reconcile:
[Continue] [Stop]

Actions in reconciled list
[Modify]?
[Add new med]?

Medication Reconciliation

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LOG of reconciliation decisions

Medication Reconciliation

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BETTER WAYS OF GROUPING MEDS ?

Medication Reconciliation

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Consolidated Record

Issue	Source	Medication	Dosage	Start Date	End Date	Comments	Actions
Pain	Physician	Codeine	1 Pill/Day	2/4/2010	4/4/2011	Mild	Keep Edit Delete
	Patient	Ibuprofen	2 Pills/Day	7/1/2009	1/1/2011	Regular Usage	Reconciled
	Physician		2 Pills/Day	7/1/2009	1/1/2011	For Pain	
	Patient	Oxycodone	3 Pills/Day	6/12/2010	10/12/2011	Irregular Usage	Keep Edit Delete
Fever	Patient	Paracetamol	2 Pills/Day	6/2/2010	9/29/2011	Irregular Usage	Keep Edit Delete
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	Physician		3 Pills/Day	2/2/2010	7/10/2011	For Fever	
Blood Clots	Physician	Warfarin	1 Pill/Day	3/19/2010	12/10/2011	Important	Keep Edit Delete

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BETTER WAYS OF GROUPING MEDS ?



Missed Test Results

Sureyya Tarkan

HCIL

sureyya@cs.umd.edu

March 15, 2011

What are Missed Results?

- Mishandling of abnormal test results (Wahls, 2007)
- No follow-up
- Physicians order many tests (29-38%) (Elder, 2009)
- Sent to outside facilities (laboratories, hospitals, etc.)
- The complexity of the process, separation of lab from clinic location and lack of quality control systems in outpatient setting make testing error-prone (Hickner et. al., 2007).

Test Processing Steps

(McEwen; Hickner, 2005-8)

1 Pre-analytic

- Ordering the test
- Implementing the test

Specify the test
& when to do it

2 Analytic

- Performing the test

Lab technicians

3 Post-analytic

- Reporting results to the clinician
- Responding to the results
- Notifying the patient of the results
- Following-up to ensure the patient took the appropriate action based on test results

Review results
& Decide what to do

Existing System: Partners Healthcare Results Manager

Select Desktop: Result Mgr Patient Chart Custom Reports Admin Sign Results Resource									
View Options		Open Visits Only	44 Prev Next >>		Provider			Poon, Eric Gon-Chee, M.D.	
Print Letters		Close Visits		View Ticklers 0 Overdue, 3 Pending		View To Do 0 Overdue, 50 Pending		Add PI to WatchList	Customize
Visit Date	Patient Name / MRN	CDR Results	Abn	Ack	Visit Note	Patient Letter	User Flags/Comments		
<input type="checkbox"/> 02/18/2003	P	C	!!!	✓	p	P	---		
<input type="checkbox"/> 02/18/2003	S	C,H	!!	✓	p	P	---		
<input type="checkbox"/> 02/13/2003	T	C,H	!!	✓	p	P	---		
<input type="checkbox"/> 02/13/2003	H	C,H,R	!!	✓	p	P	---		
<input type="checkbox"/> 02/13/2003	A	C,H	!!	✓	F/P		---		
<input type="checkbox"/> 02/04/2003	R	C,H	!!	✓	p		---		
<input type="checkbox"/> 02/13/2003	L	C,H	!	✓	p	P	---		
<input type="checkbox"/> 02/13/2003	P	C,H	!	✓	F	p	dobutamin echo		
<input type="checkbox"/> 02/04/2003	P	C,H	!	✓	p	P	---		
<input type="checkbox"/> 02/18/2003	C	C			F/P		---		



Order Tracking Prototype (and simulation)

MSTART MSTART File

Provider: Brown, Joe
Current Time: Wed Nov 03 16:05:00 EDT 2010

Order **Track** Retrospective Analysis

Options

- All Tests
 - Pending Tests
 - Lateness
 - Patient
 - Test
 - Ordered By
 - Brown, Joe
 - Johnson, Alice
 - Williams, Mary
 - Jones, Andrew
 - Davis, Michael
 - Abnormality
 - Arrived Results

Enter to search: Search

Arrived Results

Late	Seen	A...	Patient	Test	Ordered By	Expected Dur...	Elapsed Time
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Lee, Justin	X-Ray	Williams, Mary	13-75 hours	23 hours

Pending Tests

Late	Patient	Test	Ordered By	Expected Du...	Elapsed...	Responsible
<input type="checkbox"/>	Smith, Kathy	Test	Brown, Joe	130 hours	27 hours	Smith, Kathy
<input type="checkbox"/>	Thompson,...	Mammograp...	Johnson, Alice	81 hours	26 hours	Robinson, Eric
<input type="checkbox"/>	Carter, Jenni...	Colonoscopy	Williams, Mary	30-119 hours	27 hours	Harris, Charl...
<input type="checkbox"/>	Adams, Kevin	Test	Jones, Andrew	130 hours	25 hours	Black, Sue
<input type="checkbox"/>	Baker, Eliza...	Colonoscopy	Brown, Joe	30-119 hours	24 hours	Edwards, Ra...
<input type="checkbox"/>	Young, Arthur	Blood	Jones, Andrew	17-43 hours	20 hours	Young, Arthur
<input checked="" type="checkbox"/>	Anderson, T...	EKG	Williams, Mary	16 hours	19 hours	Walker, Ryan
<input checked="" type="checkbox"/>	King, Peter	EKG	Davis, Michael	16 hours	17 hours	Howard, Am...
<input type="checkbox"/>	Wilson, Robert	Blood	Johnson, Alice	17-43 hours	16 hours	Moore, Sharon
<input type="checkbox"/>	Jackson, Paul	Urinalysis	Jones, Andrew	52 hours	13 hours	Jackson, Paul
<input type="checkbox"/>	Doe, John	X-Ray	Brown, Joe	13-75 hours	7 hours	Doe, John

Order Tracking Prototype (and simulation)

The screenshot shows the MSTART application window. The title bar reads "MSTART". The menu bar includes "MSTART" and "File". In the top right corner, it displays "Provider: Brown, Joe" and "Current Time: Wed Nov 03 16:05:00 EDT 2010". A red oval highlights the "Track" button in the top navigation bar, which also includes "Order" and "Retrospective Analysis".

On the left, the "Options" panel is expanded to show a tree view of filters:

- All Tests
 - Pending Tests
 - Lateness
 - Patient
 - Test
 - Ordered By
 - Brown, Joe
 - Johnson, Alice
 - Williams, Mary
 - Jones, Andrew
 - Davis, Michael
 - Abnormality
 - Arrived Results

The main area contains a search bar with the text "Enter to search." and a "Search" button. Below this are two tables:

Arrived Results

Late	Seen	A...	Patient	Test	Ordered By	Expected Dur...	Elapsed Time
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Lee, Justin	X-Ray	Williams, Mary	13-75 hours	23 hours

Pending Tests

Late	Patient	Test	Ordered By	Expected Du...	Elapsed...	Responsible
<input type="checkbox"/>	Smith, Kathy	Test	Brown, Joe	130 hours	27 hours	Smith, Kathy
<input type="checkbox"/>	Thompson,...	Mammograp...	Johnson, Alice	81 hours	26 hours	Robinson, Eric
<input type="checkbox"/>	Carter, Jenni...	Colonoscopy	Williams, Mary	30-119 hours	27 hours	Harris, Charl...
<input type="checkbox"/>	Adams, Kevin	Test	Jones, Andrew	130 hours	25 hours	Black, Sue
<input type="checkbox"/>	Baker, Eliza...	Colonoscopy	Brown, Joe	30-119 hours	24 hours	Edwards, Ra...
<input type="checkbox"/>	Young, Arthur	Blood	Jones, Andrew	17-43 hours	20 hours	Young, Arthur
<input checked="" type="checkbox"/>	Anderson, T...	EKG	Williams, Mary	16 hours	19 hours	Walker, Ryan
<input checked="" type="checkbox"/>	King, Peter	EKG	Davis, Michael	16 hours	17 hours	Howard, Am...
<input type="checkbox"/>	Wilson, Robert	Blood	Johnson, Alice	17-43 hours	16 hours	Moore, Sharon
<input type="checkbox"/>	Jackson, Paul	Urinalysis	Jones, Andrew	52 hours	13 hours	Jackson, Paul
<input type="checkbox"/>	Doe, John	X-Ray	Brown, Joe	13-75 hours	7 hours	Doe, John

Tracking

Arrived Results

Late	Seen	A...	Patient	Test	Ordered By	Expected Dur...	Elapsed Time
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Lee, Justin	X-Ray	Williams, Mary	13-75 hours	63 hours
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Wilson, Robert	Blood	Johnson, Alice	17-43 hours	56 hours
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Smith, Kathy	Test	Brown, Joe	130 hours	59 hours
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Baker, Elizab...	Colonoscopy	Brown, Joe	30-119 hours	63 hours
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	King, Peter	EKG	Davis, Michael	16 hours	57 hours

Pending Tests

Late	Patient	Test	Ordered By	Expected Dur...	Elapsed...	Responsible
<input type="checkbox"/>	Thompson,...	Mammography	Johnson, Alice	81 hours	66 hours	Robinson, Eric
<input type="checkbox"/>	Carter, Jenni...	Colonoscopy	Williams, Mary	30-119 hours	67 hours	Harris, Charles
<input type="checkbox"/>	Adams, Kevin	Test	Jones, Andrew	130 hours	65 hours	Black, Sue
<input checked="" type="checkbox"/>	Young, Arthur	Blood	Jones, Andrew	17-43 hours	60 hours	Young, Arthur
<input checked="" type="checkbox"/>	Anderson, T...	EKG	Williams, Mary	16 hours	59 hours	Lewis, Jack
<input checked="" type="checkbox"/>	Jackson, Paul	Urinalysis	Jones, Andrew	52 hours	53 hours	Bailey, Isabel
<input type="checkbox"/>	Doe, John	X-Ray	Brown, Joe	13-75 hours	47 hours	Taylor, Richa...
<input type="checkbox"/>	Clark, George	Test	Davis, Michael	130 hours	46 hours	Clark, George
<input type="checkbox"/>	Hill, Jeffrey	Mammography	Johnson, Alice	81 hours	46 hours	Cook, Lisa
<input type="checkbox"/>	Wright, Patrick	Urinalysis	Davis, Michael	52 hours	41 hours	Brooks, Caitlyn

Tracking

Arrived Results

Late	Seen	A...	Patient	Test	Ordered By	Expected Dur...	Elapsed Time
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Lee, Justin	X-Ray	Williams, Mary	13-75 hours	63 hours
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Wilson, Robert	Blood	Johnson, Alice	17-43 hours	56 hours
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<input type="checkbox"/>	Wright, Patrick	Urinalysis	Davis, Michael	52 hours	41 hours	Brooks, Caitlyn

Testflow Process

```
<process id="101" name="X-Ray">
  <actor name="Patient">
    <task id="1002" name="Schedule appointment" start="0" end="2"
      unit="days"/>
  </actor>

  <actor name="Laboratory">
    <task id="1003" name="Take X-Ray" start="1" end="2" unit="hours"/>
  </actor>

  <actor name="Radiologist">
    <task id="1004" name="Write report" start="12" end="20" unit="hours"/>
  </actor>

  <actor name="Provider">
    <task id="1005" name="Analyze result" end="5" unit="hours"/>
  </actor>
</process>
```



Tracking



Arrived Results

Late	Seen	A...	Patient	Test	Ordered By	Expected Dur...	Elapsed Time
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Lee, Justin	X-Ray	Williams, Mary	13-75 hours	63 hours
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Tracking



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Actions combined with Review of Results

Act on Result

Here is more information on this test:
...
...
...
...
...
...
What is the next action to be taken?

Ask assistant to

Inform Patient Name: Lee, Justin Tel: 438

Schedule Visit days

Order

Repeat Test days



Drug Interactions

Darya Filippova

Nov 2010

HCIL



Alerts: Drug Interactions

- Doctors prescribing meds
- Pharmacists filling the prescriptions
- Self-monitoring (MS Health Vault, Google Health)

Statistics (Buurma 06)

- 2006 study in Dutch pharmacies: 153 days, 43K prescriptions, 2.5K alerts (6%).
- 72.3% alerts – recurrent, no action was taken

Statistics (Indermitte 07)

- 2007 study in Switzerland pharmacies
- 600 patients taking 2+ drugs
- Most pharmacies: “severe” and “moderate” alerts only
- 79% of all DDI alerts – overridden

Why?

- Incorrect alert (clinical data)
- Acceptable interaction
- Irrelevant (meds not taken)
- Multiple alerting
- Patient tolerated drugs before

Surveyor Health

Selected: Example - Celebrity Medlist - Heath Ledger

Celebrity Medlist Save As

Side Effects Risk Map 140 Identified (58 Major, 82 Minor)

View: All Side Effects

Search side effects for my symptoms:

Hint: "Surround search phrases with quotes"

Severity **Side Effect**

Severity	Side Effect	All	Alpr	Diaz	Doxy	Hydr	Oxyc	Tema
Minor	Dizzy - Dizziness	High	High	High	High	High	High	High
Minor	Drowsiness - Drowsy	High	High	High	High	High	High	High
Minor	Abnormally Low Blood Pressure - Hypotension	High	Low	Low	Low	High	High	High
Major	Confused - Impaired Cognition	High	High	High	High	High	High	High
Minor	Feel Like Throwing Up - Nausea	High	High	High	High	High	High	High
Minor	Feeling Faint - Fainting	High	Low	Low	Low	High	High	High
Minor	Feeling Weak - General Weakness	High	High	High	High	High	High	High
Minor	Not Feeling Well - Malaise	High	Low	Low	Low	High	High	High
Minor	Slurred Speech	High	High	High	High	High	High	High
Minor	Throwing Up - Vomiting	High	High	High	High	High	High	High
Minor	An Increase in the Thickness of Lung Secretions - Thick Bronchial Secretions	High	Low	Low	High	Low	Low	Low
Minor	Blurred Vision	High	High	High	High	High	High	High
Major	Depression	High	High	High	High	High	High	High
Minor	Diarrhea	High	High	High	High	High	High	High
Minor	Dry Mouth - Xerostomia	High	High	High	High	High	High	High

Display 15 rows per page row(s) 1 - 15 of 140 Next >

Selected: Basic Medlist

Basic Medlist Mapped: 5 of 7 Save As

Side Effects Risk Map 123 Identified (88 Major, 35 Minor)

Interactions Risk Map 5 Identified (3 Serious, 2 Moderate)

Severity **Interaction**

Severity	Interaction	Colc	Nizo	Phen	Vera	Warf
Serious	Colcrlys Oral - Nizoral Oral Interaction: Concurrent use of itraconazole or ketoconazole may result in elevated levels of and toxicity from colchicine. Symptoms of colchicine toxicity include muscle weakness or pain; numbness or tingling in the fingers or toes; unusual bleeding or bruising; abdominal pain; nausea; severe diarrhea or vomiting; feeling weak or tired; increased infections; and pale or gray color of the lips, tongue, or palms of hands.(1,2)	✓	✓			
Serious	Nizoral Oral - Phenytoin Oral Interaction: The pharmacological and adverse effects of phenytoin may be increased during fluconazole, itraconazole, miconazole, or voriconazole therapy. The pharmacological effects of itraconazole and voriconazole may be decreased during concurrent therapy with phenytoin.		✓	✓		
Serious	Nizoral Oral - Warfarin Oral Interaction: The anticoagulant effect of warfarin may be increased.		✓			✓
Moderate	Colcrlys Oral - Verapamil Oral Interaction: Concurrent use of diltiazem or verapamil may result in elevated levels of and toxicity from colchicine. Symptoms of colchicine toxicity include muscle weakness or pain; numbness or tingling in the fingers or toes; unusual bleeding or bruising; abdominal pain; nausea; severe diarrhea or vomiting; feeling weak or tired; increased infections; and pale or gray color of the lips, tongue, or palms of hands.(1,2)	✓			✓	
Moderate	Phenytoin Oral - Warfarin Oral Interaction: Multiple effects may be seen: 1) Increased bleeding may be observed. 2) Elevated plasma levels of hydantoin, with possible toxicity, may be seen.			✓		✓

ePocrates



CARE Clinical Research

Drugs That May Lengthen PT		Drugs That May Shorten PT	
(higher INR; increased warfarin effect)		(lower INR; decreased warfarin effect)	
Antibiotics	Anti-inflammatories	Alcohol	Penicillin
Carbenicillin	Allopurinol	Antacids	Rifampin
Erythromycin	Fenoprofen	Antihistamines	Spirolactone
Fluconazole	Ibuprofen	Barbiturates	Sucralfate
Isoniazid	Indomethacin	Carbamazepine	Trazodone
Ketoconazole	Naproxen	Cholestyramine	Vitamin C (large doses)
Metronidazole	Phenylbutazone	Griseofulvin	
Moxalactam	Piroxicam	Haloperidol	
and other cephalosporins	Sulfinpyrazone	Oral contraceptives	
Trimethoprim-sulfa	Zileuton		
Antiarrhythmics			
Amiodarone			
Quinidine			
Others			
Anabolic steroids	Omeprazole		
Cimetidine	Phenytoin		
Clofibrate	Tamoxifen		
Disulfiram	Thyroxine		
Lovastatin	Vitamin E (large doses)		

Desired features

- Decrease number of alerts
- Resolving alerts
 - Patient
 - User/physician
- Record DDI resolution
- Immediate OR significant harm

Ordering system

Login as:

Patient:

Patient

Batman 30

Current medications

- warfarin
- erythromycin
- colcrys
- amiodarone

Drug interactions: need resolution

warfarin interacts with **erythromycin** Severity: **SERIOUS**

Details:

The pharmacological and adverse effects of phenytoin may be increased during fluconazole, itraconazole, miconazole, or voriconazole therapy. The pharmacological effects of itraconazole and voriconazole may be decreased during concurrent therapy with phenytoin

amiodarone interacts with **alcohol** Severity: **SEVERE**

Details:

Concurrent use of diltiazem or verapamil may result in elevated levels of and toxicity from colchicine. Symptoms of colchicine toxicity include muscle weakness or pain; numbness or tingling in the fingers or toes; unusual bleeding or bruising; abdominal pain; nausea; severe diarrhea or vomiting; feeling weak or tired; increased infections; and pale or gray color of the lips, tongue, or palms of hands

Drug interactions: resolved

Drug name	Drug name	Severity	Status	Resolution
warfarin	erythromycin	severe	<input checked="" type="checkbox"/> Resolved	No evidence
amiodarone	alcohol	serious	<input checked="" type="checkbox"/> Resolved	Low dosage

Ordering system

Login as: Bob Kane

Patient: Batman

Patient
 Batman, 30

Current medications

- warfarin
- erythromycin
- colcrys
- amiodarone

New order Renew Cancel

Drug interactions: need resolution

No unresolved interactions

Drug interactions: resolved

Drug name	Drug name	Severity	Status	Resolution
warfarin	alcohol	serious	Resolved	Low dosage
warfarin	erythromycin	severe	Resolved	No evidence
amiodarone	alcohol	serious	Resolved	Low dosage
warfarin	amiodarone	severe	Resolved	Tolerated before

Issues

- Should we allow “enabling” resolved alerts?
- How do we elevate alert’s importance?
- Patients with similar profiles
 - What is similar?

Thank You

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ben@cs.umd.edu