

Outline

- Background
- Research on alerts
 - Main findings
 - Drug-drug interaction alerts
 - Creatinine clearance alerts
- Additional Resources

Clinical Decision Support (Alerts)

Order Checking

(1 of 3) SIGNIFICANT drug-drug interaction: WARFARIN TAB 3MG and PRIMIDONE TAB 250MG [PENDING] - Concurrent use may result in decreased anticoagulant effects. Increased anticoagulant effects may occur if the barbiturate is withdrawn. The effect may be dose-related and may continue beyond the dicontinuation of the barbiturate. -Monograph Available

(2 of 3) SIGNIFICANT drug-drug interaction: WARFARIN TAB 3MG and ASPIRIN TAB 81MG [PENDING] - The concurrent use of anticoagulants and salicylates may result in

Accept Order

Cancel Order

Drug Interaction Monograph

Background

Human factors science:

 discovers and applies information about human capabilities, limitations, characteristics to design better technologies, tools, and systems (Gurses 2012)

- <u>Hypothesis</u>: Incorporating human factors engineering principles into alert interface design will:
 - reduce prescribing errors
 - improve usability
 - reduce workload for prescribers

Original alerts:

Order Checking (1 of 1) Previous adverse reaction to: NONSALICYLATE NSAIs, ANTIRHEUMATIC (LOCAL) (1 of 1) SIGNIFICANT drug-drug interaction: IBUPROFEN TAB 800MG and ASPIRIN TAB 81MG [PENDING] - The antiplatelet and cardioprotective effect of aspirin may be decreased if ibuprofen if administered before aspirin. - Monograph Available Accept Order Cancel Order Drug Interaction Monograph

Order Checks

Est CrCl: 28.3 (CREAT: 1.4 mg/dL yesterday 9:01:34 am BUN: 18 mg/dL yesterday 9:01:34 am) [Est. CrCL based on modified Cockcroft-Gault equation using Adjusted Body Weight (if ht >60 in.)]



Original alerts:

Order Checks

Cancel	Order/Order Check Test	
	Renew IBUPROFEN TAB 800MG	
ancer	TID	
	Quantity: 90 Refills: 0 *UNSIGNED*	
	*Order Check requires Reason for Override	
	(1 of 2) Previous adverse reaction to: NONSALICYLATE	
	NSAIs, ANTIRHEUMATIC (LOCAL)	
	(2 of 2) SIGNIFICANT drug-drug interaction: IBUPROFEN TAB 800MG and	
	ASPIRIN TAB 81MG [PENDING] - The antiplatelet and cardioprotective	
		_
	effect of aspirin may be decreased if ibuproten if administered befor aspirin - Monograph Available	e
	effect of aspirin may be decreased if ibuprofen if administered befor aspirin Monograph Available	e
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	effect of aspirin may be decreased if ibuprofen if administered befor aspirin Monograph Available	'e
	aspirin Monograph Available	`e
Cancel (NOTE: The override reason is for tracking purposes	`e
Cancel (Checked Order(s) Checked Order(s) Monograph Available NOTE: The override reason is for tracking purposes and does not change or place new order(s).	'e
Cancel (Checked Order(s) NOTE: The override reason is for tracking purposes and does not change or place new order(s).	è
Cancel (er reas	Checked Order(s) NOTE: The override reason is for tracking purposes and does not change or place new order(s).	è
Cancel (er reas	Checked Order(s) NOTE: The override reason is for tracking purposes and does not change or place new order(s).	'e
Cancel (er reas	Checked Order(s) son for overriding order checks:	'e

Redesigned alerts:

Interactions between ibuprofen tab and: Severity Eviden Drug Risk Gecreased cardioprotection moderate good Low Creatinine Clearance! Risk Lab Results more law Drug Risk Lab Results more law ibuprofen renal failure *Based on modified Cockroft-Gault equation more law	profen Select override justification	5/01/2007	
Low Creatinine Clearance! Drug Risk Lab Results ibuprofen renal failure Est CrCl* 28.3mL/min yesterday *Based on modified Cockroft-Gault equation *Based on modified Cockroft-Gault equation	tions between ibuprofen tab and: Risk rin decreased cardioprotection	Severity moderate	Evidence good
Based on modified Cockroft-Gault equation	atinine Clearance! Risk profen renal failure	Lab Results Est CrCI 28.3mL/min yesterday	more labs
		*Based on modified Cockroft-Gault equation	

VA HSR&D Human-Computer Interaction & Simulation Lab



Russ et al. Jt Comm J, Dec 2012. Photo is for illustrative purposes only

Summary of Main Findings

- 1. Learnability
- 2. Efficiency
- 3. Low Usability Errors
- 4. Satisfaction

5. [Memorability not measured]

Learnability of Redesign

- Prescribers generally able to use redesign without any training or guidance
 - 3 of 20 needed assistance to move past first alert

Drug	Symptoms	Entered	
ketoprofen	nausea	5/01/2007	
	Select override justification	*	
eractions bei Drug	tween ibuprofen tab and: Risk	Severity	Evidence
aspirin	decreased cardioprotection	moderate	good
w Creatinine Drug ibuprofen	Clearance! Risk renal failure Button cha recommen	nges NOT ded, use error box	tion Cancel Order

Efficiency



Frequency of Prescribing Errors



Frequency of Prescribing Errors



Usability Errors: Scrolling

Original Design

- 19 alerts missed due to scrolling mechanism
 - 6 (30%) of prescribers
 - 2 critical drug-drug interactions



Usability Errors: Session Alert

Original Design

	Order Checks	
2 (10%)	To cancel an order select the order by checking the checkbox and press the "Cancel Checked Order(s)" button.	
prescribers	If the order description is cut short, hover over the test to view the complete description.	
thought how was	Cancel Order/Order Check Test	
	Cancel? TID	
to indicate	Quantity: 90 Refills: 0 *UNSIGNED*	
override	*Order Check requires Reason for Override (1 of 2) Previous adverse reaction to: NONSALICYLATE	
gystificationsentryrs	NSAIs,ANTIRHEUMATIC (LOCAL) (2 of 2) SIGNIFICANT drug-drug interaction: IBUPROFEN TAB 800MG and	
ovprossod	ASPIRIN TAB 81MG [PENDING] - The antiplatelet and cardioprotective effect of aspirin may be decreased if ibuprofen if administered before	
expressed	aspirin Monograph Available	
frustration or		
confusion about		
repeated alerts		
4 (20%) corrected act	ON NOTE: The override reason is for tracking purposes	
3(15%) switched to in	and does not change or place new order(s).	
S(IS/0) SWITCHEU TO INCOMECT order checks:		
action		
Redesign eliminated	Accept Order(s) Return to Order Drug Interaction Monograph	
this session alert		
	15/15	

Prescriber Satisfaction

Score	Original Alerts Mean (SD)	Redesigned Alerts Mean (SD)	p
overall satisfaction (Q1-19)	4.3 (1.2)	5.2 (1.4)	0.033
system usefulness (Q1-8)	4.5 (1.3)	5.2 (1.4)	0.144
information quality (Q9-15)	4.1 (1.2)	5.2 (1.4)	0.013
interface quality (Q16-18)	4.3 (1.3)	5.2 (1.5)	0.005

7 = strongly agree

 $p \le 0.05$ was considered significant

16/15 Russ et al, JAMIA 2014

Key Items for Alert Improvement

Table-like format

- Remove session order check
 - Other aspects of alert system would also need to change if these are removed
- Eliminate scrolling to reduce safety risk

Specific Alert Types

Drug-Drug Interaction Creatinine Clearance

Drug-Drug Interaction (DDI) Alert Findings

DDI Alerts

Original Alert

Order Checking

(1 of 3) SIGNIFICANT drug-drug interaction: WARFARIN TAB 3MG and PRIMIDONE TAB 250MG [PENDING] - Concurrent use may result in decreased anticoagulant effects. Increased anticoagulant effects may occur if the barbiturate is withdrawn. The effect may be dose-related and may continue beyond the dicontinuation of the barbiturate. - Monograph Available

(2 of 3) SIGNIFICANT drug-drug interaction: WARFARIN TAB 3MG and ASPIRIN TAB 81MG [PENDING] - The concurrent use of anticoagulants and salicylates may result in

Cancel Order

Drug Interaction Monograph

Redesigned Alert



Accept Order

Frequency of Prescribing Errors for Individual Alerts



21/15

DDI Alert Prescribing Error

Redesign only allows cancellation of one medication at alert interface

ATTAC AND A DECEMBER OF A

Or	dering fluoxetine cap,o	pral		~
	Interactions between f	luoxetine cap,oral and:		
	Drug	Risk	Severity	Evidence
	phenelzine sulfate	serotonin syndrome	major	tair
		Select override justification		
			- M	
	Accent Order			ancel Order
1	l justification required			~

DDI Alert Prescribing Error

	Cancel Order/Order Check Test	
	Cancel? DAILY Quantity: 90 Refills: 0 *UNSIGNED*	
ering fluoxe nteractions	*Order Check requires Reason for Override (1 of 1) CRITICAL drug-drug interaction: PHENELZINE SULFATE TAB 15MG and FLUOXETINE CAP,ORAL 20MG [UNRELEASED] - Concurrent use or switching between agents without a sufficient washout period may	
phenelzin	result in serotonin syndrome. Symptoms of serotonin syndrome may include irritability, altered consciousness, double vision, nausea, confusion, anxiety, hyperthermia, increased muscle tone, rigidity, myoclonus, rapid fluctuations in vital signs, and coma. Serotonin syndrome may result in death Monograph Available	nce
Accept O	Cancel: DAILY Quantity: 90 Refills: 1 *UNSIGNED*	
justification (Cancel Checked Order(s) NOTE: The override reason is for tracking purposes and does not change or place new order(s).	
	Enter reason for overriding order checks:	_

Efficiency

- Redesigned alerts took about ¹/₂ the time (52 vs. 97 sec; p < .001).
- Conservative estimate of saving 5 sec/alert could save 10,270 clinical work hrs/yr across U.S. VAMCs

Russ et al., 2015

DDI Alert Recommendations

- Allow cancellation of multiple interacting medications
- DDI alerts should display more lab info or provide easy access (e.g., links) to lab results
- Efficiency likely improved by:
 - Reduced number of alerts (session order check removed)
 - Reduced text/table-like format

Creatinine Clearance (CrCL) Alert Findings

CrCL Alerts

Original Alert

Drder Checks	×
Est CrC1: 29.5 (CREAT: 2.4 mg/dL today 10:09:14 am BUN: 40 mg/dL today 10:09:14 am) [Est. CrC1 based on modified Cockcroft-Gault equation using Adjusted Body Weight (if ht >60 in.)]	7
ок	

Redesigned Alert

Ordering spironolactone tab			
Low Creatinine Clearance!			<u>^</u>
Drug	Risk	Lab Results	
spironolactone	hyperkalemia	Est CrCI* 29.5mL/min today	more labs
		*Based on modified Cockroft-Gault equation	
Accept Order			Cancel Order

Prescribing Errors



CrCL Alert Recommendations

- Present alert at time of decision
- Allow access to lab results from alert
- Minimize information presented initially
- Consider adding dosing guidelines

Summary

Cautions:

- Not tested during patient care
- Still need to pilot any alert design changes in clinical setting

Conclusions

- One of 1st scenario-based studies of alerts
- Incorporating human factors principles:
 - Reduced prescribing errors, improved usability
- Evidence that alert interface can influence prescribing errors

Future work:

 Cognitive task analysis to understand decisionmaking processes

Additional Resources

Alerts Research	Publication
Main Results	Russ et al., JAMIA, Oct 2014
CrCL Alerts	Melton et al. The American Journal of Medicine, Oct 2015
DDI Alerts	Russ et al. The Joint Commission Journal on Quality and Patient Safety, Sept 2015
Override Justification Entry	Russ et al., Annals of Pharmacotherapy, April 8, 2015
DDI Panel Recommendations (Sponsored by AHRQ)	Payne et al., JAMIA, March 30, 2015.

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mmmm

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Thank you!

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