

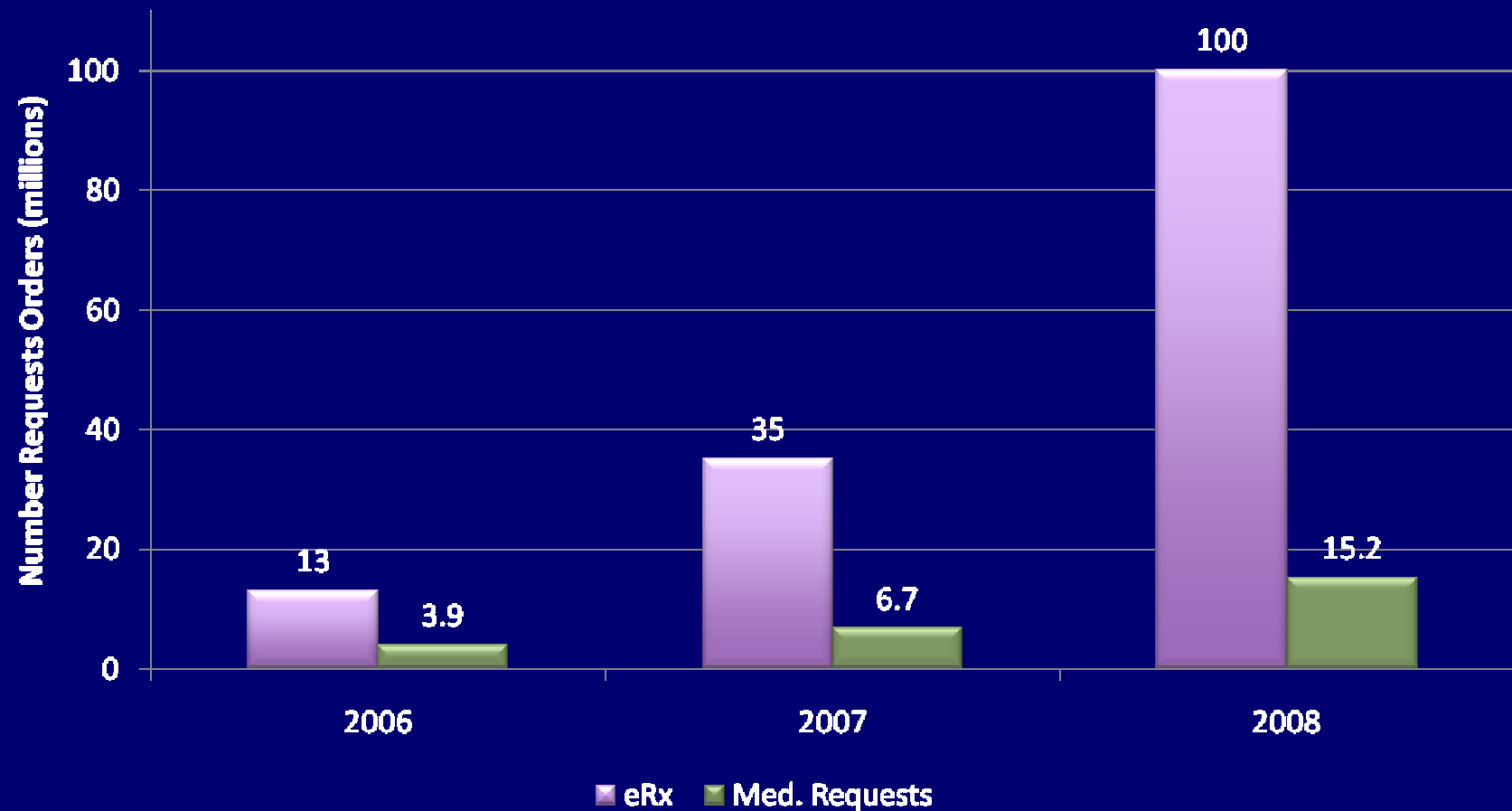
New Opportunities to Improve
the Safety and Effectiveness of
Prescription Drug Use through
Computerized Drug Management

The Expected Benefits of Computerization

- **Safety**
 - Reduce Prescribing + Transcription Errors
 - Improve Follow-up Monitoring
- **Quality**
 - Improve Appropriateness
 - Improve Adherence
- **Drug Costs**
 - Improve Cost-Effective Prescribing
- **Post-Market Surveillance**
 - Provide New Tools for Pharmacosurveillance

Computerized Prescribing is on the Increase

Friedman et al, Health Affairs, Vol 28. no 2. 2009



The Good and the Bad News About Computerized Prescribing



The MOXXI System-E-Rx Pad

Reduce Potential Errors by Providing Menus for Dose Selection
& Treatment Indication

New Prescription Print Blank Rx

Add New Drug:

Select: [All](#) [None](#) Save Save and Print Delete

<input type="checkbox"/>	Drug	Posology	Quantity/Duration	Indication(s)	Stop/Change Reason
<input type="checkbox"/>	<div>TM PRINIVIL</div> <div>TABLET 5MG</div> <div>Sample: <input type="checkbox"/></div>	<div>1.00 TABLET</div> <div>qAM</div> <div>with meal(s)</div>	<div>30 Day(s)</div> <div>12 Refills</div> <div>Qty: 30.00</div> <div>Auto: <input checked="" type="checkbox"/></div>	<div></div> <div>Essential (primary) hypertension</div> <div>Heart failure</div> <div>Hypertension in Scleroderma</div> <div>Hypertensive heart disease</div> <div>Hypertensive renal disease</div> <div>Migraine</div> <div>Post-Infarction</div>	

Note:

Handwritten vs. Computer-generated Prescriptions

800309

Pour _____

Adress _____

Date _____

Rx Gsumadin 5 (10/10/10) #300
 Sotadol 80 5, 10 #100
 Anakin 10 100 #300
 Metformin 500 5, 10 #60
 Brandis 4 10/10 #200
 upo 200 10 5, 10 #100
 Ankin Select 100 #100

REPETATUR	1	2	3	4	5	NR
-----------	---	---	---	---	---	----

MOXXI Rx no: 28584200

Lundi, 29 février, 2006

Dr. Training User 5 M.D.
 Test Establishment for test patients
 1140 Pine West, Montreal, Quebec, H3A-1A3

PETRELLI, ANTOINE [PETA47060836, Age: 61]

PRESCRIPTION

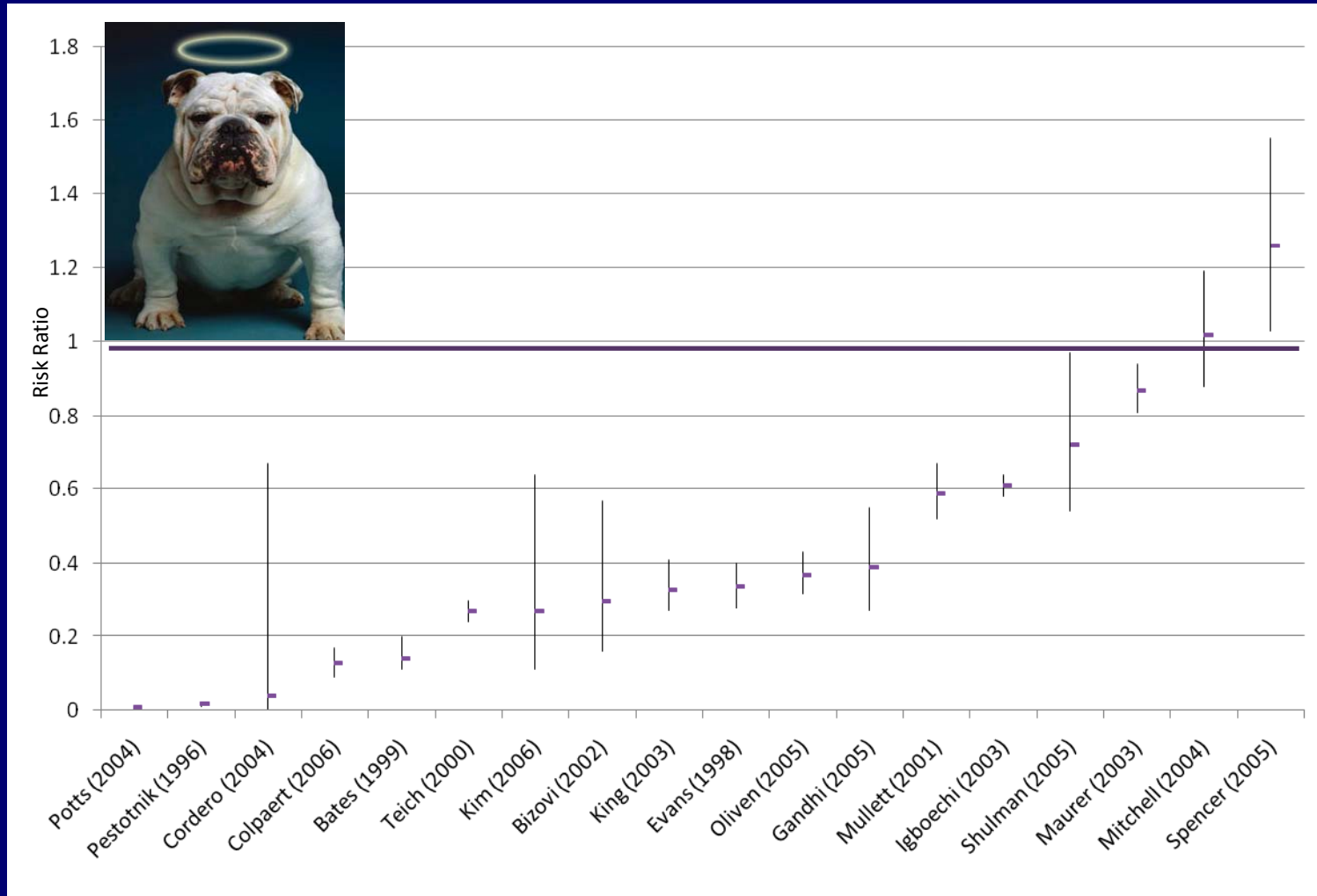
1 / 4 -	CENTRUM SELECT COMP.CROQ. #30x30 Jour(s) 1 COMP.CROQ. die Note: --	Rép:8
2 / 4 -	COUMADIN 5MG COMPRIME #30x30 Jour(s) 1 COMPRIME die Note: --	Rép:8
3 / 4 -	HYDROCHLOROTHIAZIDE 12.5MG COMPRIME #30x30 Jour(s) 1 COMPRIME qAM avec le(s) repas Note: --	Rép:8
4 / 4 -	METFORMIN 500MG COMPRIME #90x30 Jour(s) 1 COMPRIME tid avec le(s) repas Note: --	Rép:8

Training User 5
 Licence: 55550

Pg. 1

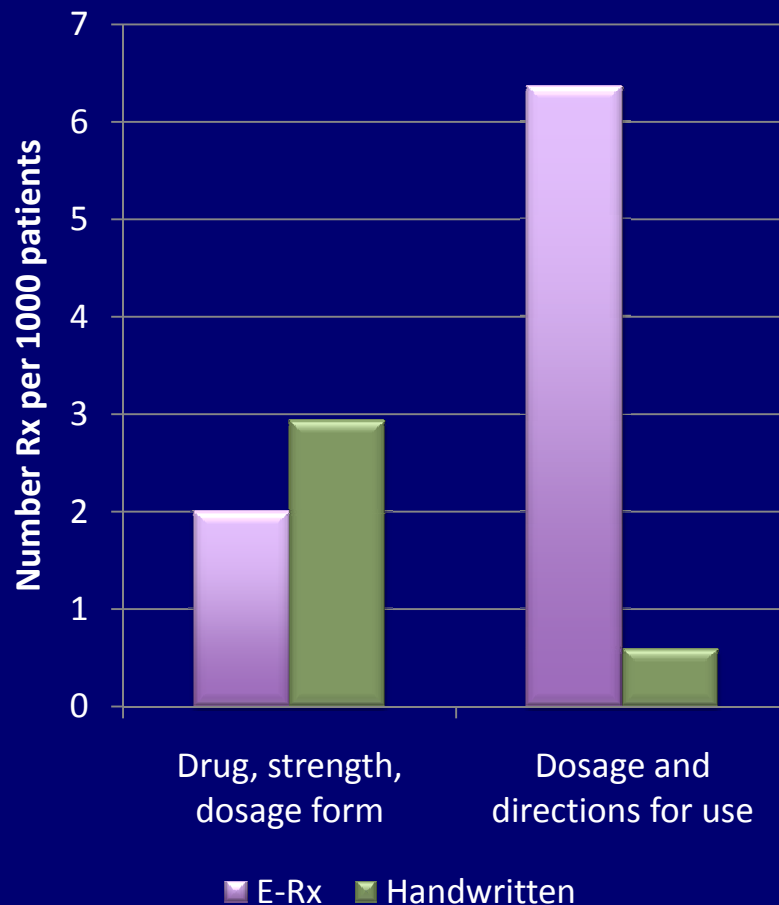
Typed Prescriptions Reduce Prescribing & Transcription Errors

Ammenworthet.al. Vol 15, No 5, JAMIA, 2008 (figure 6)




E-iatrogenesis: Computerized Prescribing Can Produce Prescribing Errors by Dumb-Dumb Design

Astrand et al. BMC Medical Informatics, Jan, 2009






Koppel et al., Vol 293, No 10, JAMA, 2005



Type of	Percent
Can't or	54,5
System c	46,5
Multiple	46,0
Delays in starting antibiotics	39,6
Wrong dose information	38,1
Order for wrong patient	22,5
Delays in stopping drug	22,4

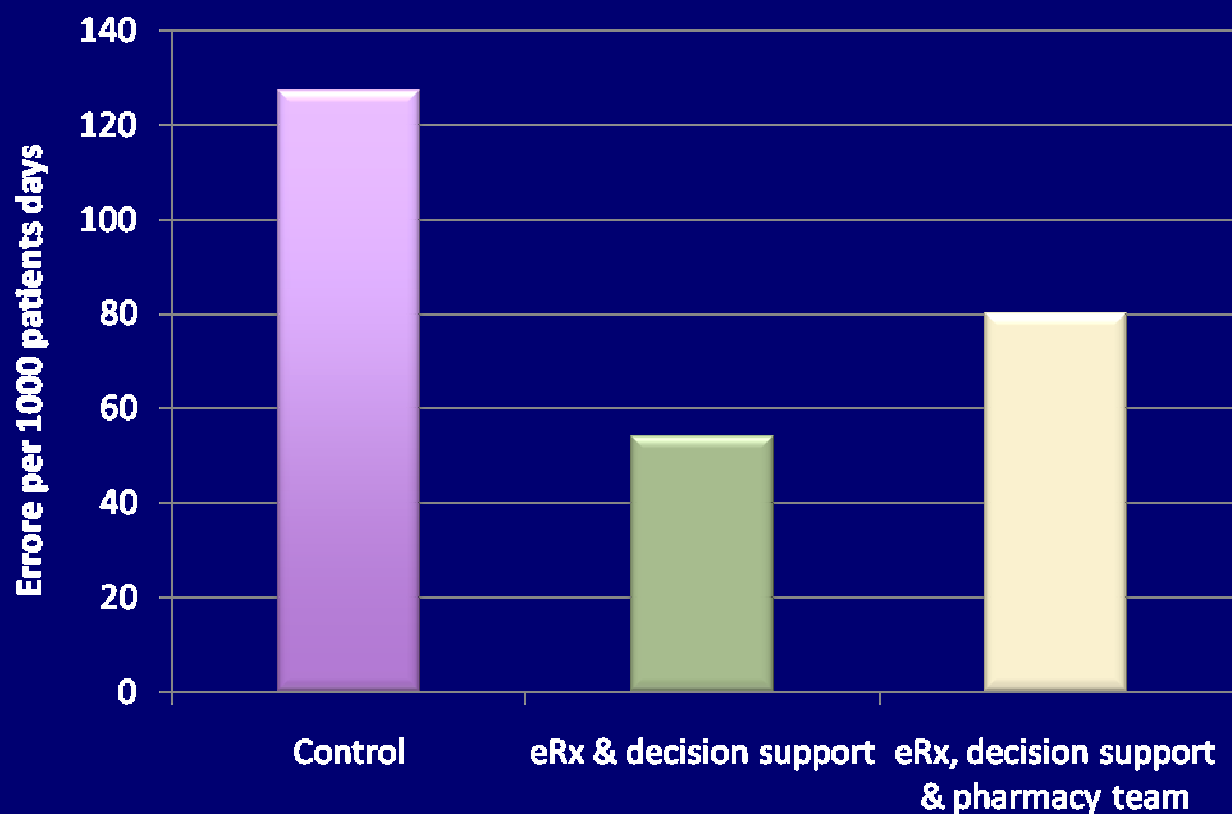
Adding Computerized Decision Support to Provide Automated Alerts for Prescribing Problems

 [Suppress Alerts](#)

Type ▾	Drug(s)	Level ▾	Suppress
Diabetes: use with caution, may mask some symptoms	<ul style="list-style-type: none">METOPROLOL 24H-TABLET 200MG	 (Moderate)	<div><input type="text" value=""/></div> <div><input checked="" type="radio"/> Suppress for this patient only</div> <div><input type="radio"/> Suppress for all patients</div>
antagonism	<ul style="list-style-type: none">METOPROLOL 24H-TABLET 200MGTM VENTOLIN HFA METERED INH. 100MCG	 (Serious)	<div><input type="text" value=""/></div> <div><input checked="" type="radio"/> Suppress for this patient only</div> <div><input type="radio"/> Suppress for all patients</div>

Computerized Hospital E-Rx systems Reduce Medication Errors by > 50%

(Bates, JAMA, 1998)

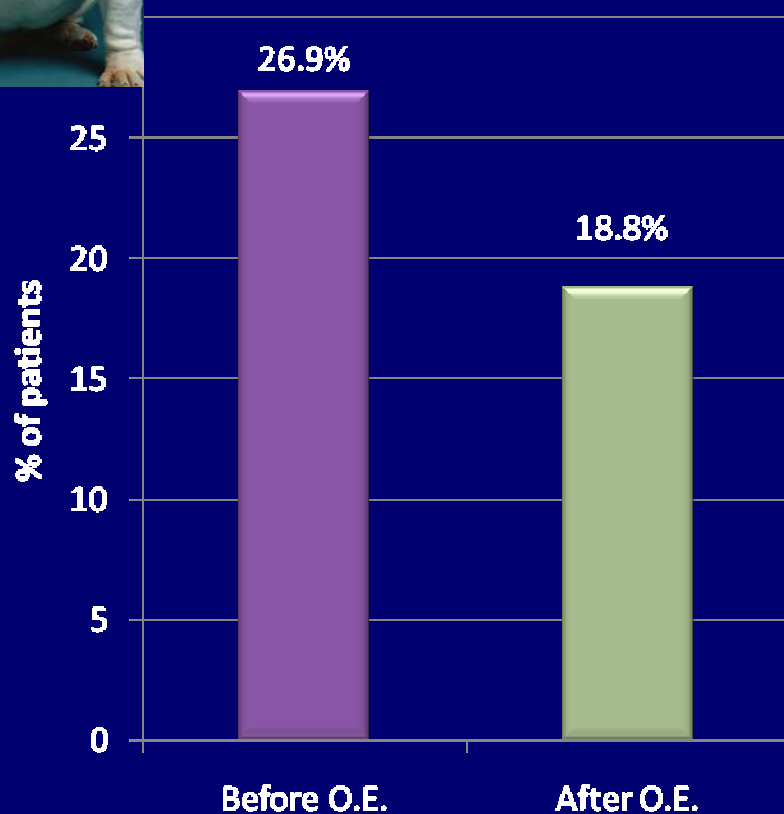


Computerized Hospital Order-Entry systems Reduce Use and Cost of Antibiotics

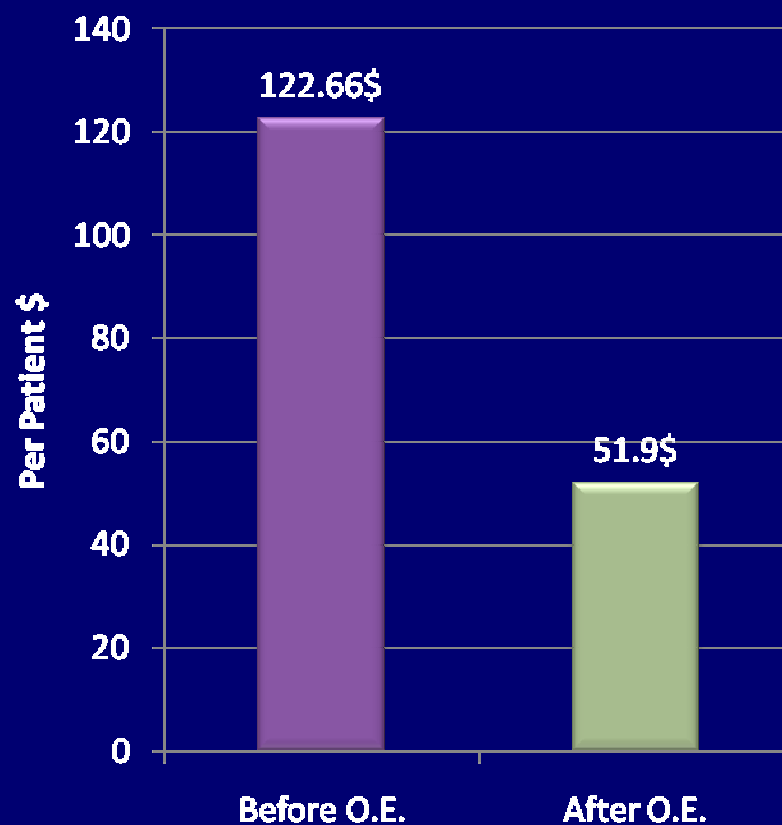
Pestotnik, Annals of Internal Medicine, 1996



Use per patient



Cost per patient



However Most Drug Alerts from Commercial Systems are Ignored!

Weingart et al. Archives Int Med, 2003

- Physicians over-ride 49% to 96% of alerts for drug-allergy, drug-drug and drug-disease contraindications
- Drug renewals more likely to be overridden than new drug prescriptions
- Experienced physicians more likely to over-ride alerts than trainees
- Incorrect data explains most allergy and pregnancy alerts
- Benefit greater than risk reason for most over-rides
- Control over severity and viewing of alerts by physicians

On Demand vs. Automated Drug Alerts

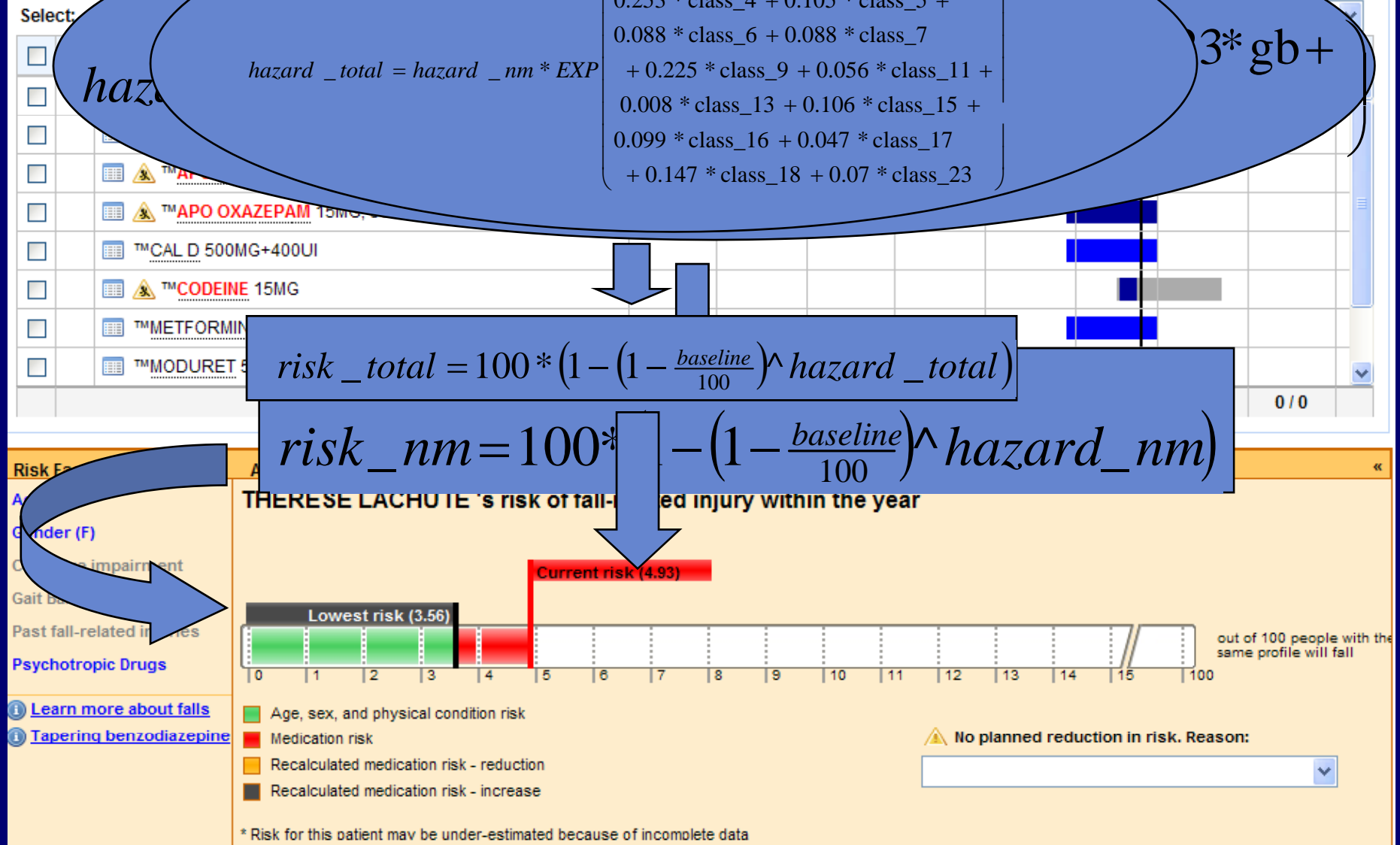
Percent Seen and Revised in 3,449 Patients

Tamblyn et al, JAMIA, July/August, 2008

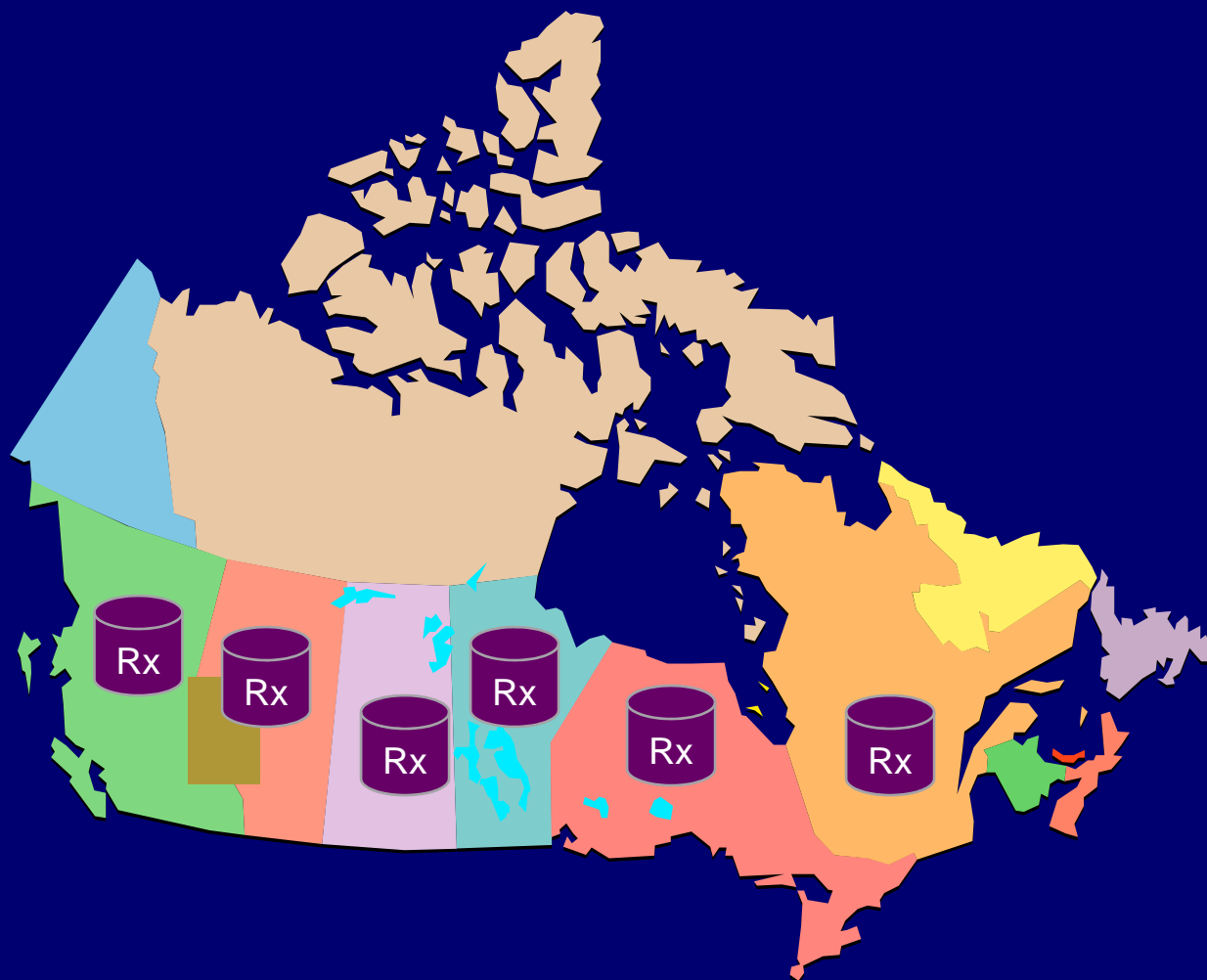


Characteristic	On Demand Alerts	Automated Alerts
Number of Patients	1,550	1,899
Number of Alerts	4,445	6,506
% Seen	0.9%	10.3%
% Revised that were Seen	75.6%	12.1%

Designing New Smart Alerts that Provide

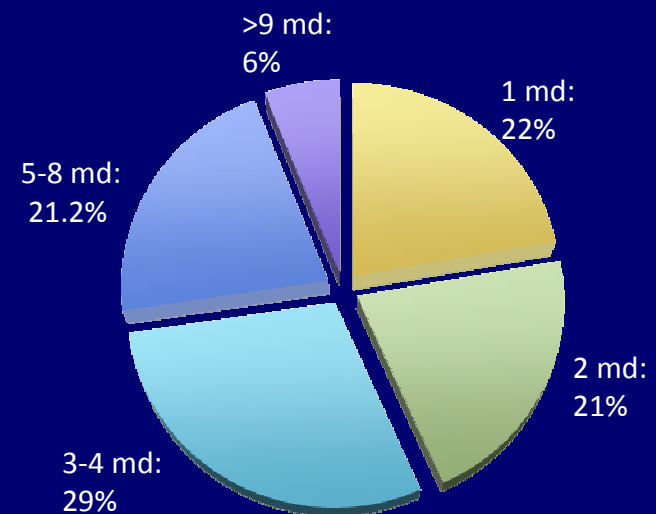
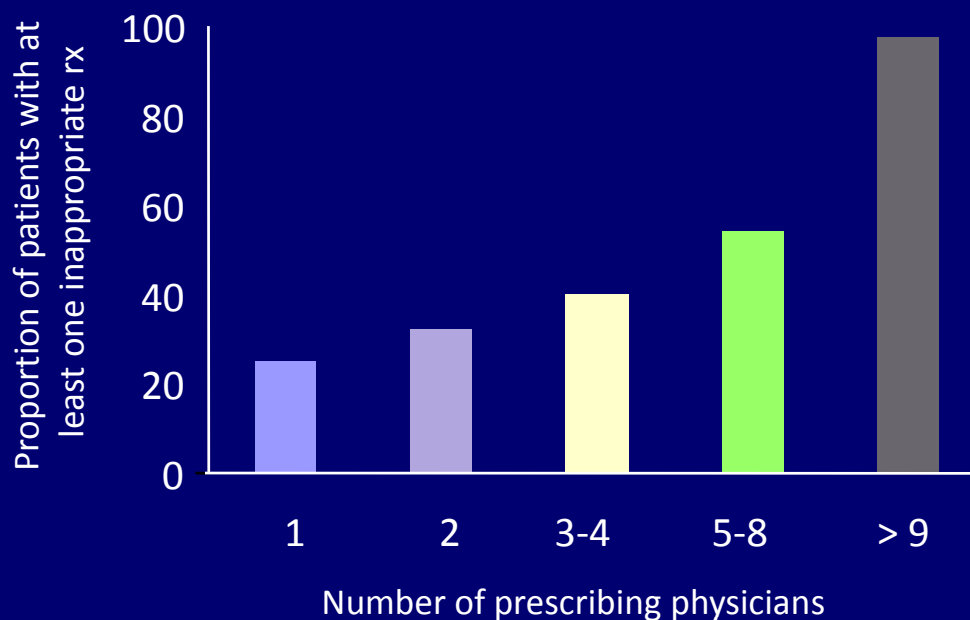


Integrating Computerized Prescribing with Drug Dispensing Information: Coming Soon in Canada



Multiple Prescribing Physicians Increase the Risk of Inappropriate Prescriptions

(Tamblyn et. al., CMAJ, 1993)



MOXXI: 198,051 eligible patients insured by the RAMQ drug insurance from Jan. 2006 to Jan. 2007

Improving Safety by Retrieving the Complete Drug Profile from an Integrated Drug Management System

Select: [All](#) [None](#) [Represcribe](#) [Stop](#) [Prescription History](#) [Legend](#) [Print](#)

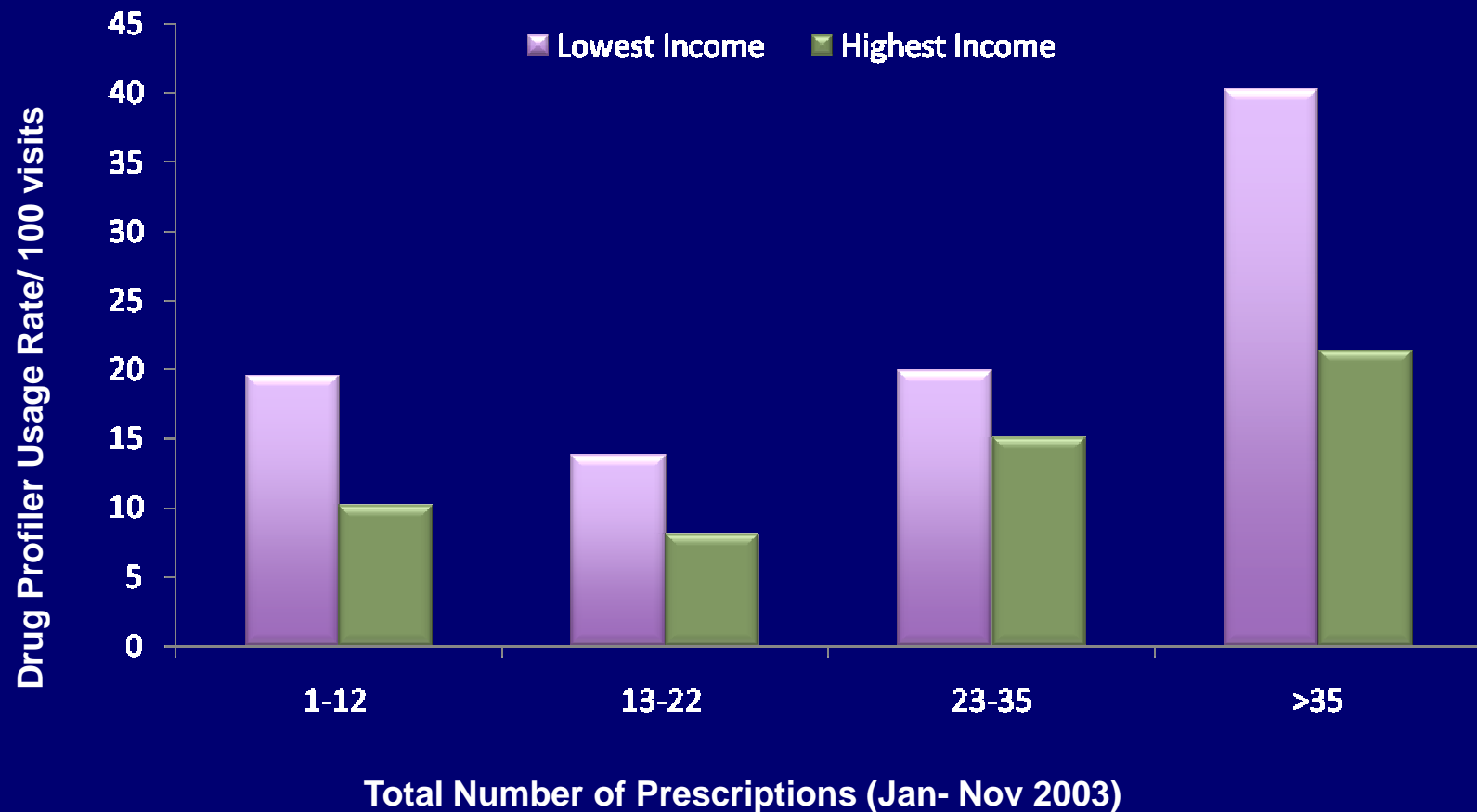
<input type="checkbox"/>	Drug	2008-09	2008-10	2008-11	2008-12
<input type="checkbox"/>	TM CENTRUM SELECT				
<input type="checkbox"/>	TM COUMADIN 5MG				
<input type="checkbox"/>	TM GEN METFORMIN 500MG				
	ER Visits / Hospitalizations:				
	Patient \$ / RAMQ \$:	7 / 18	0 / 0	0 / 0	0 / 0

Legend

- Prescribed by you with MOXXI-NG but not yet dispensed
- Prescribed by you and dispensed
- Prescribed by another physician (dispensed)
- Sample
(Darker colours represent a drug overlap)
- ER Visits / Hospitalizations
- Today's date
- Prescription Stopped
- Change of dose
- Drug associated with an alert

Physicians Use the Integrated Drug Profiler for Patients with Multiple Drugs and Lower Income

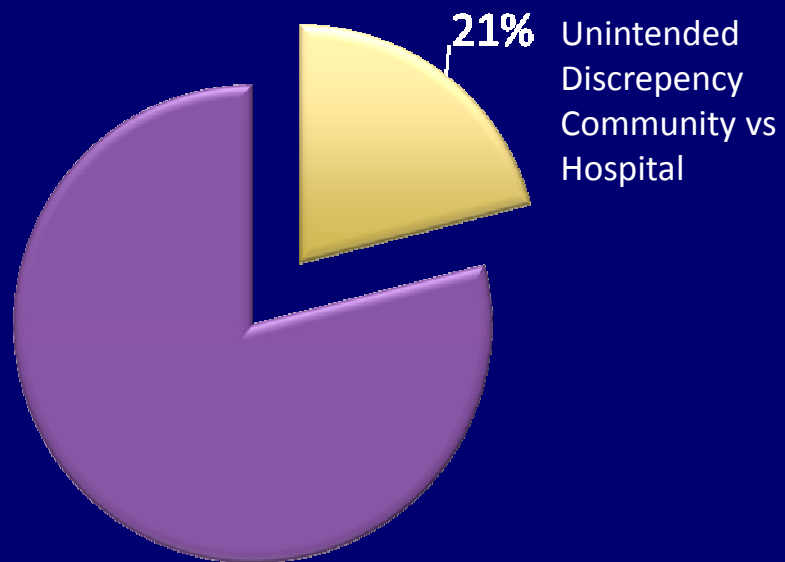
Yuko Kawasamiet.al. International Journal of Medical Informatics, 2007



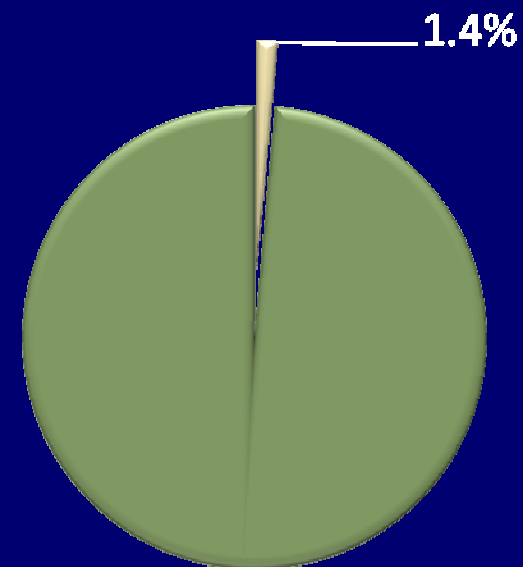
Medication Reconciliation Made Easy

Agrawalet.al. Joint Commission Journal on Quality and Patient Safety, Vol 35, No 2, 2009

Discrepancies Before Automated MedRec
(n=120 admissions)



Discrepancies After Automated MedRec
(n=19,356 admissions)



Improve Follow-Up and Medication Adherence

LEVJ24121711 Age: 83 Refresh

LAST NAME: LEVASSEUR
FIRST NAME: JEAN

PROBLEMS ALLERGY DRUG PROFILE ALERTS ASTHMA

Trademark/Generic	FEB	MAR	APR	MAY	JUN	JUL
COSOPT						
COUMADIN						
FLONASE						
LANOXIN						
LIPITOR						
PREDNISOLONE ACETA						
PULMICORT						
RATIO SALBUTAMOL H						
SYNTHROID						
TIAZAC XC						
TRAVATAN						
PATIENT/RAMQ(\$):	58/162	60/167	75/349	83/209	56/229	75/266
HOSPITALISATION						
ER						

LEGEND:

- Prescribed by you with MOXXI but not yet dispensed
- Prescribed by you and dispensed
- Prescribed by another physician (dispensed)
- Sample

(Darker colors represent a drug overlap)

| Today's date

S Prescription Stopped

C Change of dose

Med Drug associated with an alert

Print

MOXXI

Back

JUL. 24, 2008 - AUG. 23, 2008

- TRAVATAN (TRAVOPROST)
- 0.004% EYE DROPS
- #2.50 x30D NR
- PATIENT/RAMQ(\$): \$ 0.00/36.48

JUN. 7, 2008 - JUL. 7, 2008

APR. 25, 2008 - MAY. 25, 2008

MAR. 13, 2008 - APR. 12, 2008

JAN. 25, 2008 - FEB. 24, 2008

Click on alert message for more details

COMPLIANCE INDICATOR

Month	Compliance (%)
APR	63
MAY	83
JUN	80

Alert

Monography

New Opportunities to Investigate Reasons for Primary Non-Adherence

Diabetes

Niravet.al, JGIM, Dec., 2008

Predictor of Non-Adherence	OR	P-value
Initial Drug		
Biguanide	ref	0.03
Sulfonylurea	1.14	
Insulin	1.89	
Multiple	2.28	
A1c<9%	ref	0.02
≥9%	0.38	
Co-pay ≥\$10	ref	<0.0001
<\$10	0.45	

Hypertension

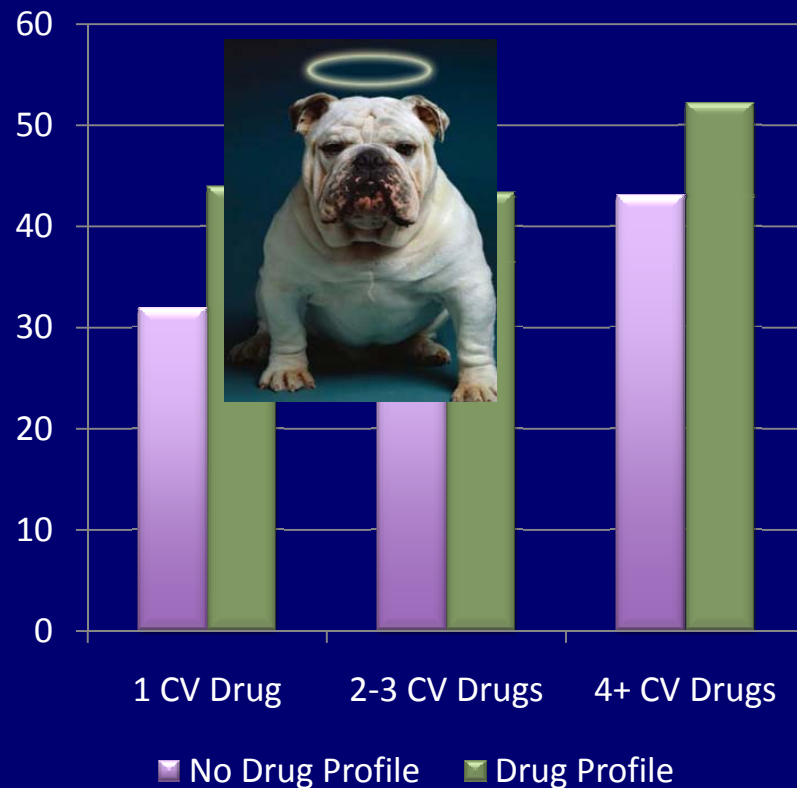
Niravet.al. Am J Hypertension, Vol22, No. 4, 2009

Predictor of Non-Adherence	OR	P-Value
Age (per 10 yrs)	1.10	0.02
Diastolic BP (per 10mm Hg)	0.74	<0.001
Co-pay ≥\$10	ref	
< \$10	0.40	<0.0001

New Opportunities to Improve Adherence

Physician Review of Compliance: RCT (N=59 MDs, 2,293 patients)

Tamblyn et.al Medical Decision-Making, under review



Patient Reminders via Interactive Voice Response Systems: Feasibility Study

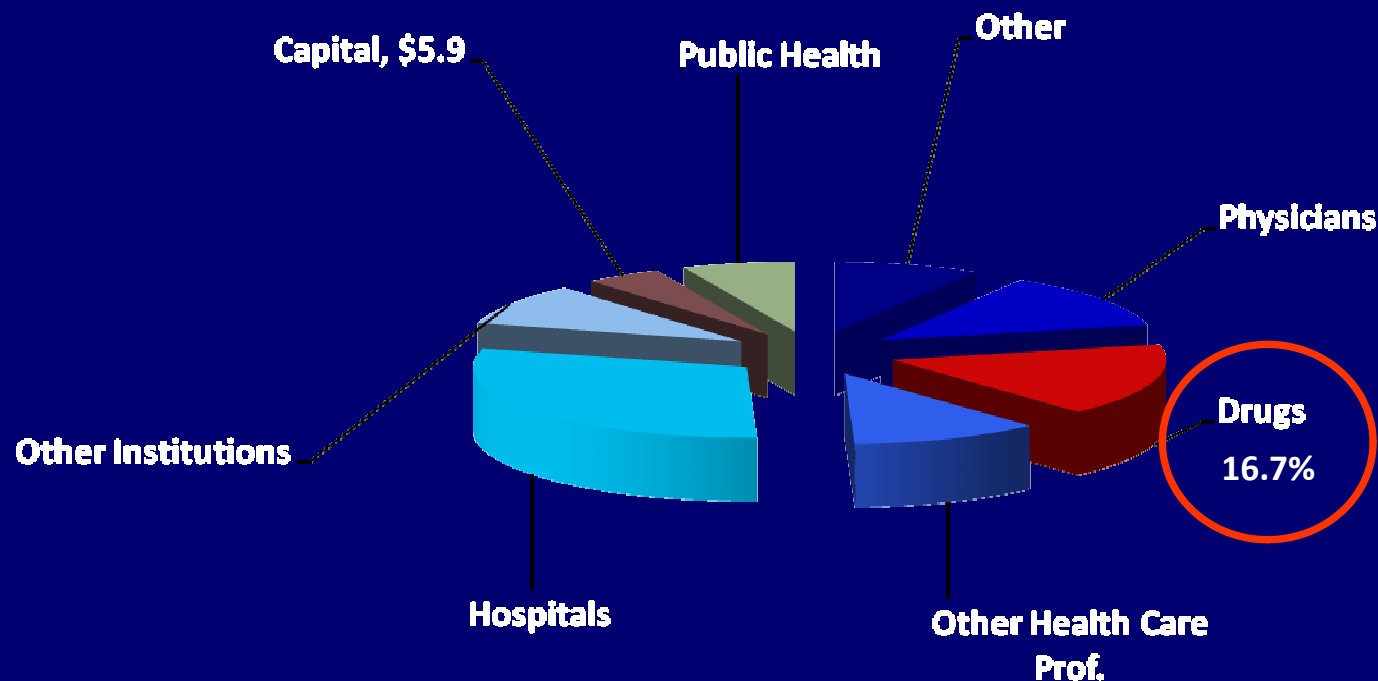
Reidelet.al., BMC Medical Informatics, Vol 8, No 46, 2008

Feasibility Assessment Item	% Agree
Understood purpose of reminder	44.7
Difficulty with setting reminders	14.3
Reminder calls can be ignored	29.0
Name of medication	78.3
Already refilled before reminder	71.4
System helpful as a refill reminder	14.3



New Opportunities to Enhance Cost-Effectiveness

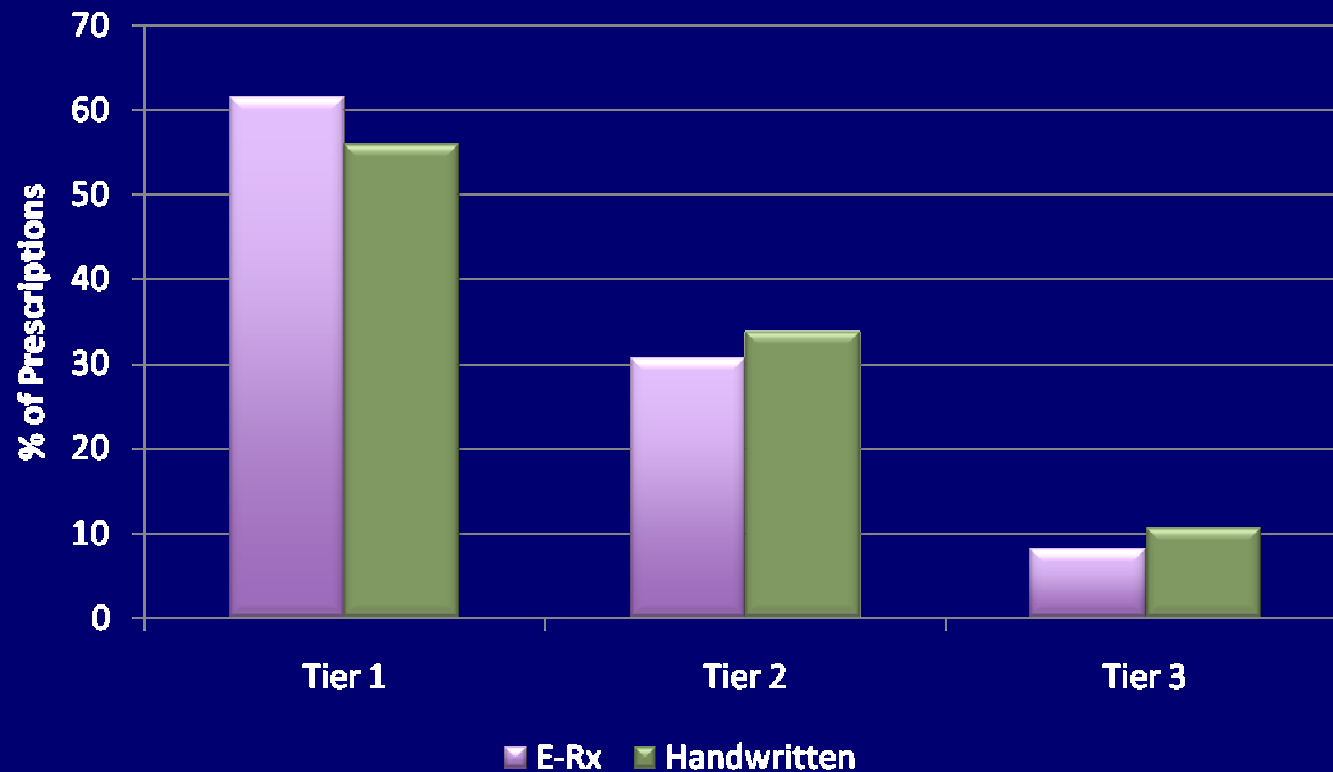
Drug Costs in Canada, 2004: \$130 Billion



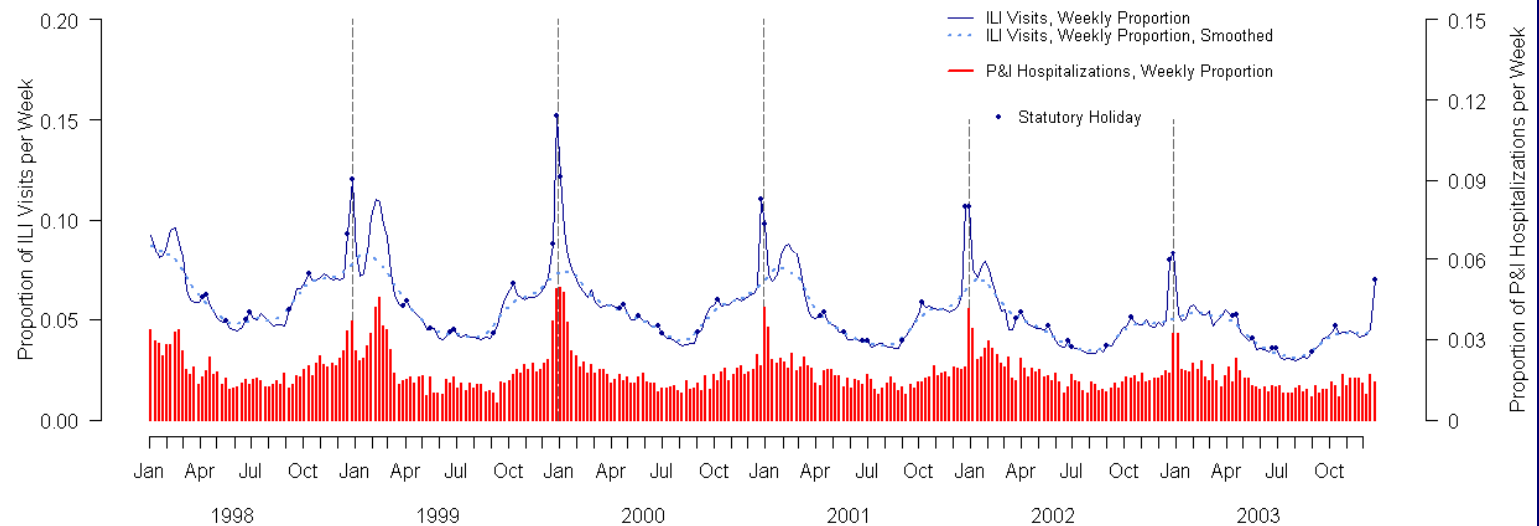
The Impact of Cost and Formulary Reminders at the Time of E-Rx

National Council for Prescription Drug Programs Standard: Script 8.1

Fischer et.al., Arch Int Med, April, 2009



Surveillance



Notes: -P&I ICD-9 codes 480-487

-Maximum of 1 visit per patient to each physician at each establishment per day

-Statutory Holidays: New Year's Day, Good Friday, Easter Monday, Victoria Day, St-Jean-Baptiste Day, Canada Day, Labour Day, Thanksgiving Day, Christmas Day, Boxing Day

Methods of Pharmacosurveillance

- Spontaneous reporting of adverse drug reactions (Canada Vigilance Program, MedWatch)
- Prescription-event monitoring (PEM) - UK, NZ
- Computerized administrative data - Canada
- Stand-alone electronic health records (GPRD)
- Integrated electronic health records

Using electronic prescribing to collect drug indication and treatment outcome (MOXXI)

New Prescription

Add New Drug:

 [Print Blank Rx](#)

Select: [All](#) [None](#)











[Save](#)



[Save and Print](#)





[Delete](#)

<input type="checkbox"/>	Drug	Posology	Quantity/Duration	Indication(s)	Stop/Change Reason
<input type="checkbox"/>	GABAPENTIN 100MG CAPSULE  Sample: <input type="checkbox"/>	1.00  CAPSULE  tid  	30 Day(s)  6 Refills  Qty 90.00	 Aggressive/Antisocial Behavior Bipolar affective disorder Diabetic Neuropathy Epilepsy	

Stop Drug(s)

You selected to stop the following drug(s). Please select a stop reason for each of them.

Drug	Posology	Quantity/Duration	Reason
GABAPENTIN 100MG	1.00 CAPSULE tid	#90.00 x 30 Day(s), 6 refills	 



[Save](#)



[Cancel](#)

Safety: Adverse drug reaction
 Safety: Allergic response
 Safety: Drug interaction
 Error: Prescribing
 Error: Dispensing
 Effectiveness: Ineffective treatment
 Effectiveness: No longer necessary
 External factor: New evidence
 External factor: Discontinued by another physician
 External factor: Patient request
 Adherence: Simplifying treatment
 Adherence: Substitution of less expensive drug

Why do Physicians Stop Medications?

Reasons for Stop Orders written for 857 of 3889 MOXXI Patients Seen Between Nov, 2005- Jan, 2006

Adverse drug
effects

Ineffective
treatment



New Methods of
Pharmaco-Surveillance

Validity of Prescription Stop Change Orders to Detect Adverse Drug Events and Ineffective Treatment

Equaleet.al. Drug Safety, Vol 31, No 11, 2008

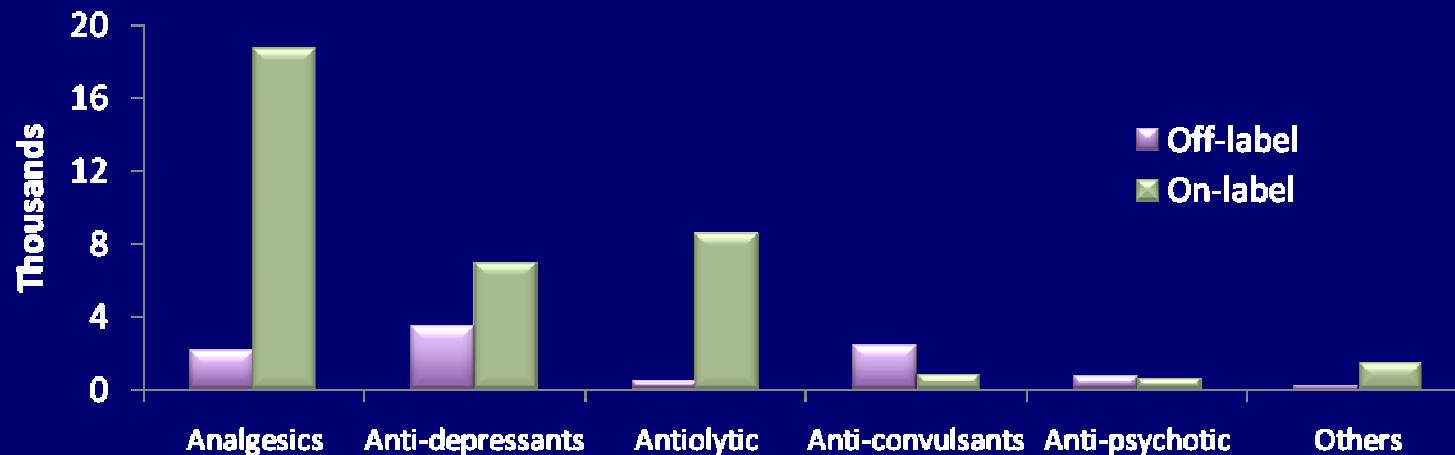
E-Rx Stop/Change	Adverse Effects/ Ineffective Treatment Documented in Medical Chart		Total
	Present	Absent	
Present	325	9	334
Absent	13	298	311
	338	307	645
	Naive	Adjusted for Sampling	
Sensitivity	96.2%	67%	
Specificity	97.1%	99.7%	

New Methods of Assessing Off-Label Use

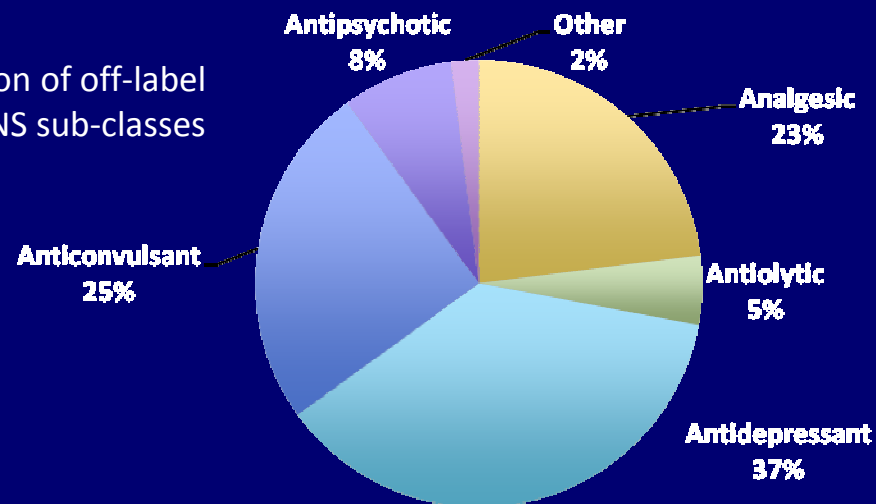
Study	NDTI (2001)	NDTI (1978)	Family Practice (1978)
Drugs & conditions	100 most frequent + 60 randomly selected	100 most frequent drug uses	500 drug uses
Off-label	21%	31%	9.2%
Other findings	Cardiac (46%) Gabapentin (83%)	44% - ineffective	Off-label indication often mistaken as being on-label
Recommendation	Safety, cost, effectiveness	Post-marketing drug efficacy	

On- and off-label prescribing: Psychotropic Drugs

202,210 E-Rx; Januray 2005-March, 2008: MOXXI Research Program

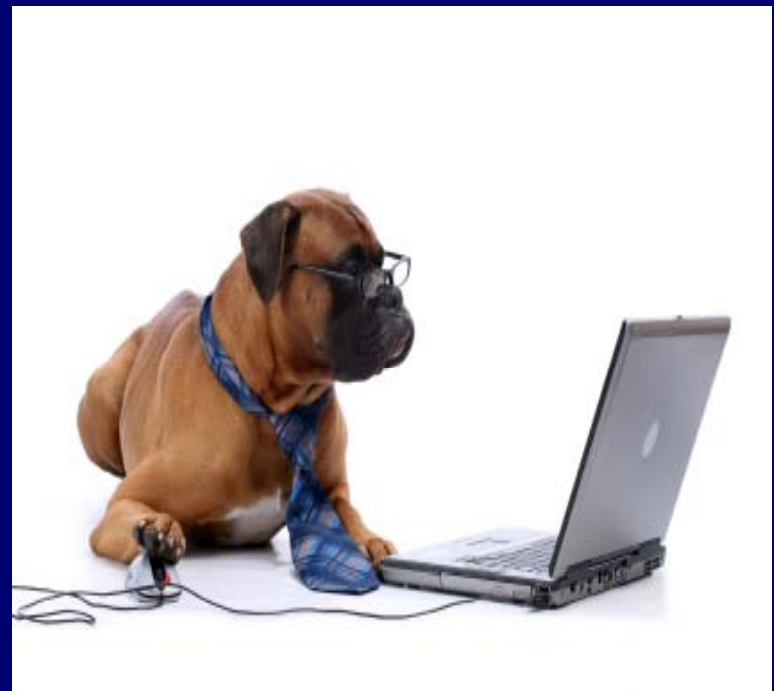


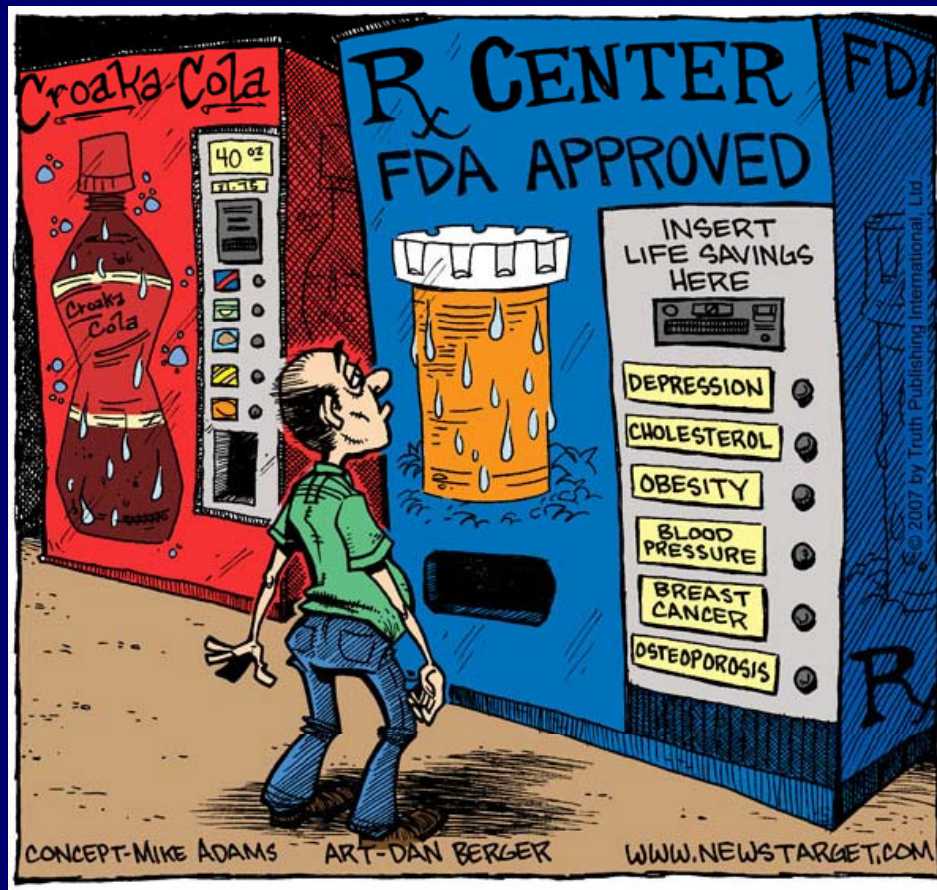
Percentage distribution of off-label Prescribing among CNS sub-classes



In Brief

- Computerized drug management provides:
 - New tools to improve the safety and effectiveness of prescription drug use
 - New opportunities to incorporate epidemiological predictive models into decision-support
 - New sources of information for pharmacosurveillance
 - New sources of information for drug research





Thank-You

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