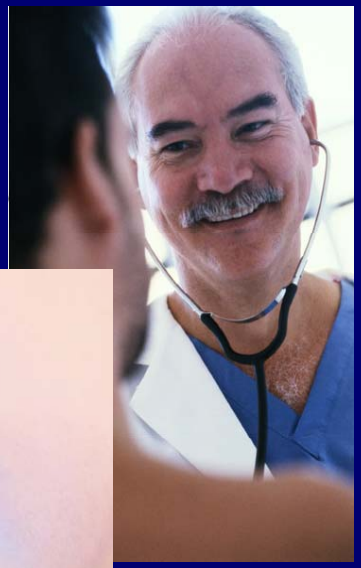


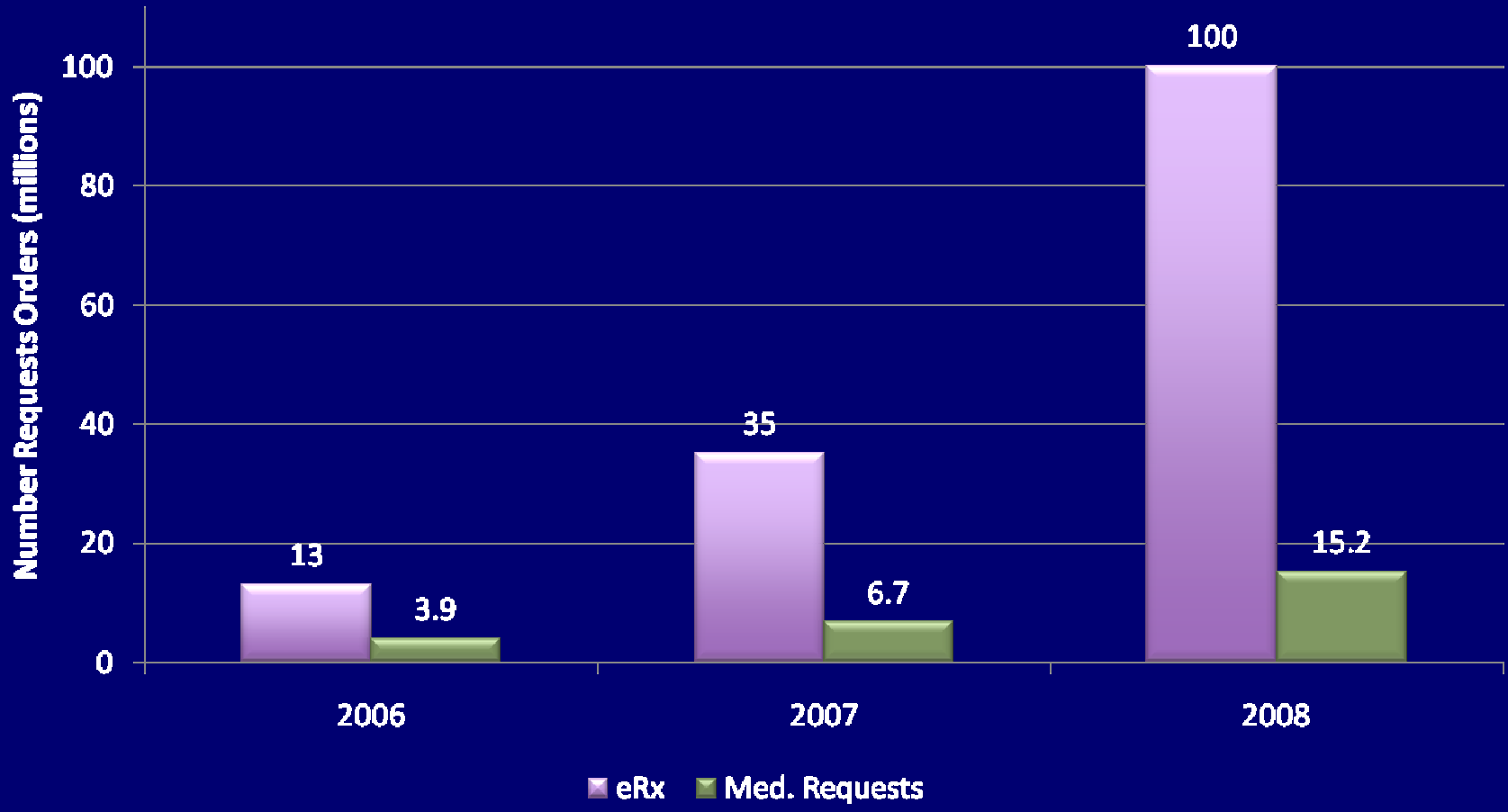
New Opportunities to Improve the Safety and Effectiveness of Prescription Drug Use through Computerized Drug Management

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

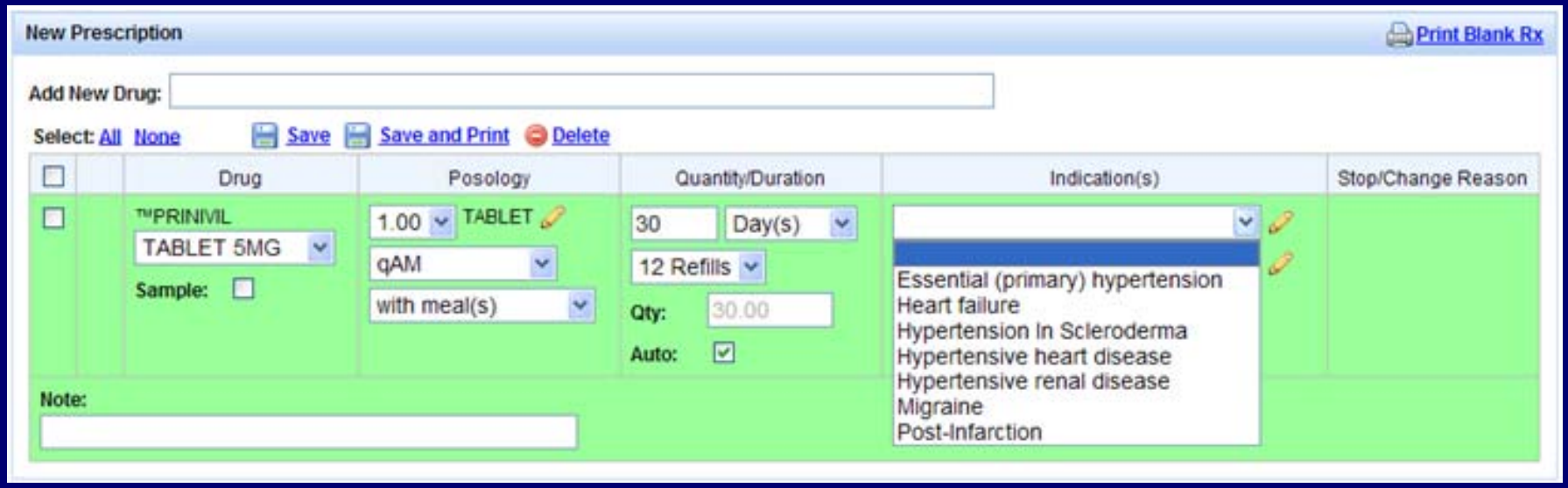
Friedman et al, Health Affairs, Vol 28. no 2. 2009



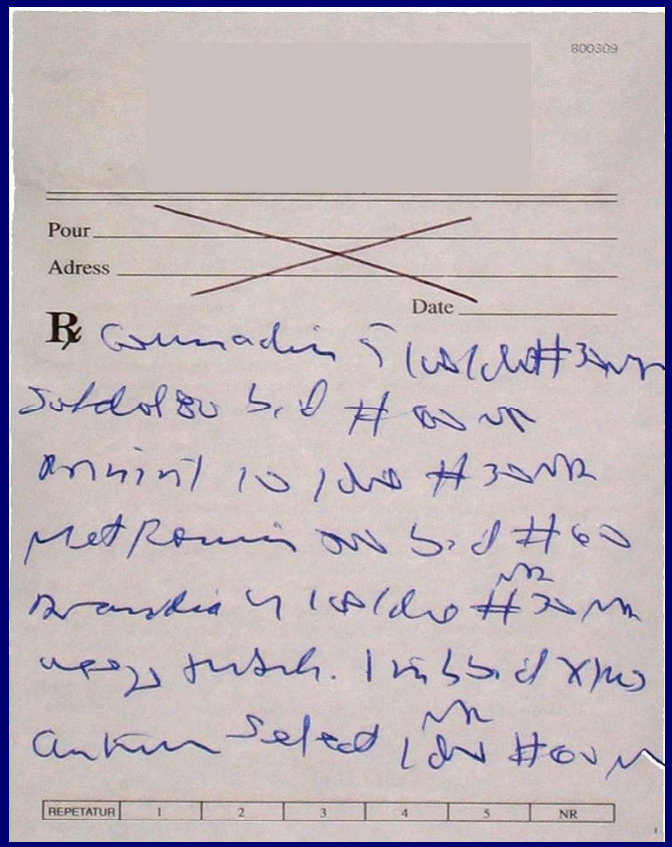
The Good and the Bad News About Computerized Prescribing

The MOXXI System-E-Rx Pad

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



Handwritten vs. Computer-generated Prescriptions



MOXXI Rx no: 28584200 Lundi, 23 février, 2009

Dr. Training User 6 M.D.
Test Establishment for test patients
1140 Pine West, Montreal, Quebec, H3A-1A3

PETRELLI, ANTOINE [PETA47060836, Age: 61]

PRESCRIPTION

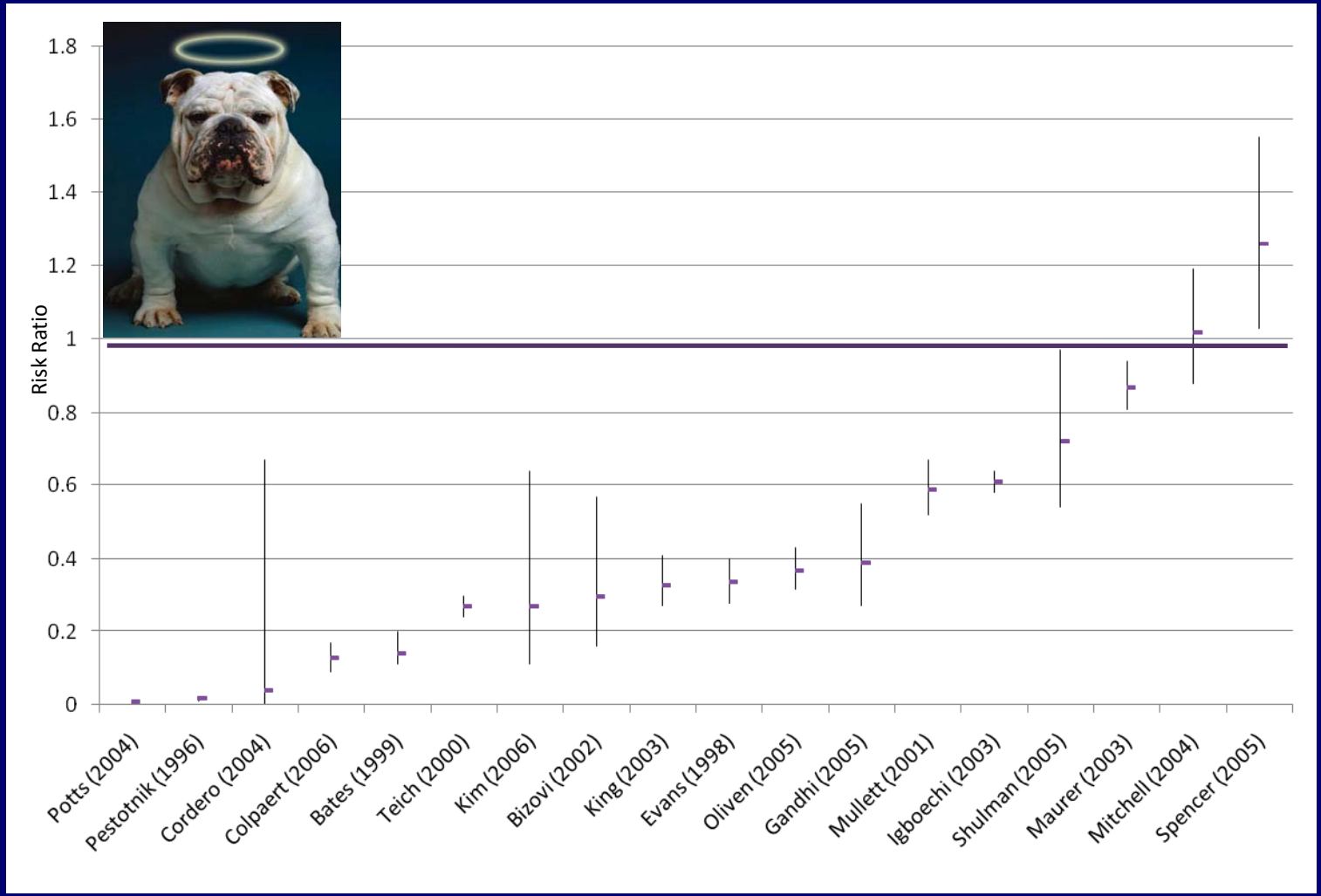
1 / 4 -	**CENTRUM SELECT** COMP.CROQ. #30x30 Jour(s) 1 COMP.CROQ. die Note: --	Rép:6
2 / 4 -	**COUMADIN** 5MG COMPRIME #30x30 Jour(s) 1 COMPRIME die Note: --	Rép:6
3 / 4 -	**HYDROCHLOROTHIAZIDE** 12.5MG COMPRIME #30x30 Jour(s) 1 COMPRIME qAM avec le(s) repas Note: --	Rép:6
4 / 4 -	**METFORMIN** 500MG COMPRIME #90x30 Jour(s) 1 COMPRIME tid avec le(s) repas Note: --	Rép:6

Training User 5
Licence: 55550

Pg. 1

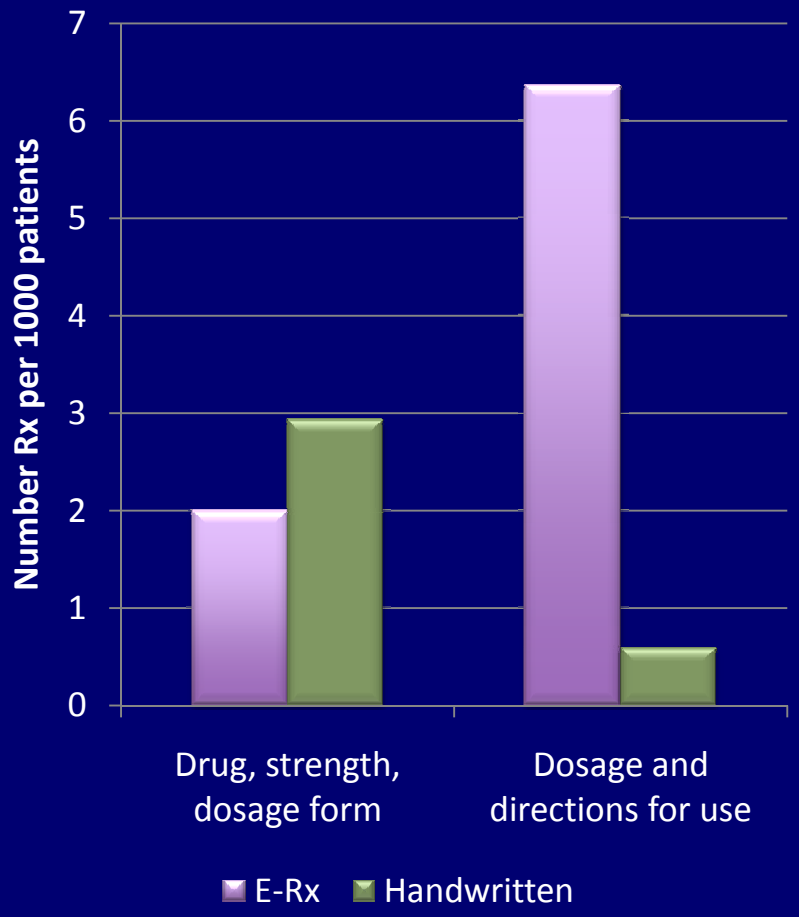
Typed Prescriptions Reduce Prescribing & Transcription Errors

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



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

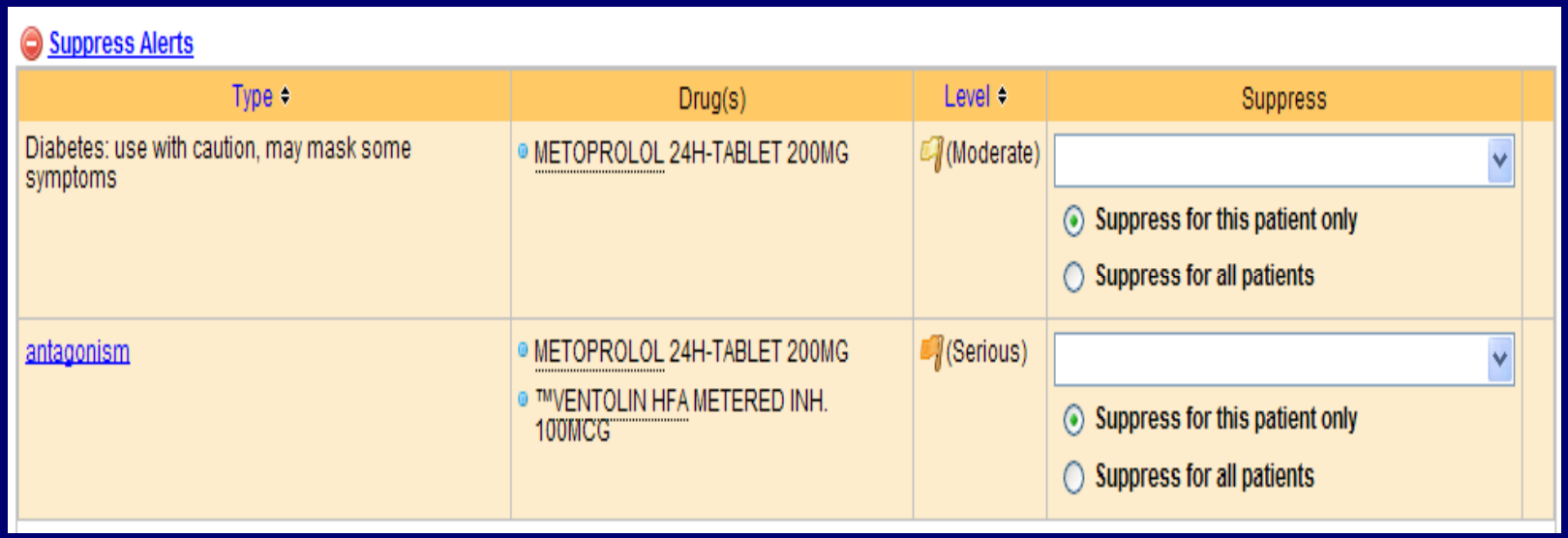
Astrandet.al. BMC Medical Informatics, Jan, 2009



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

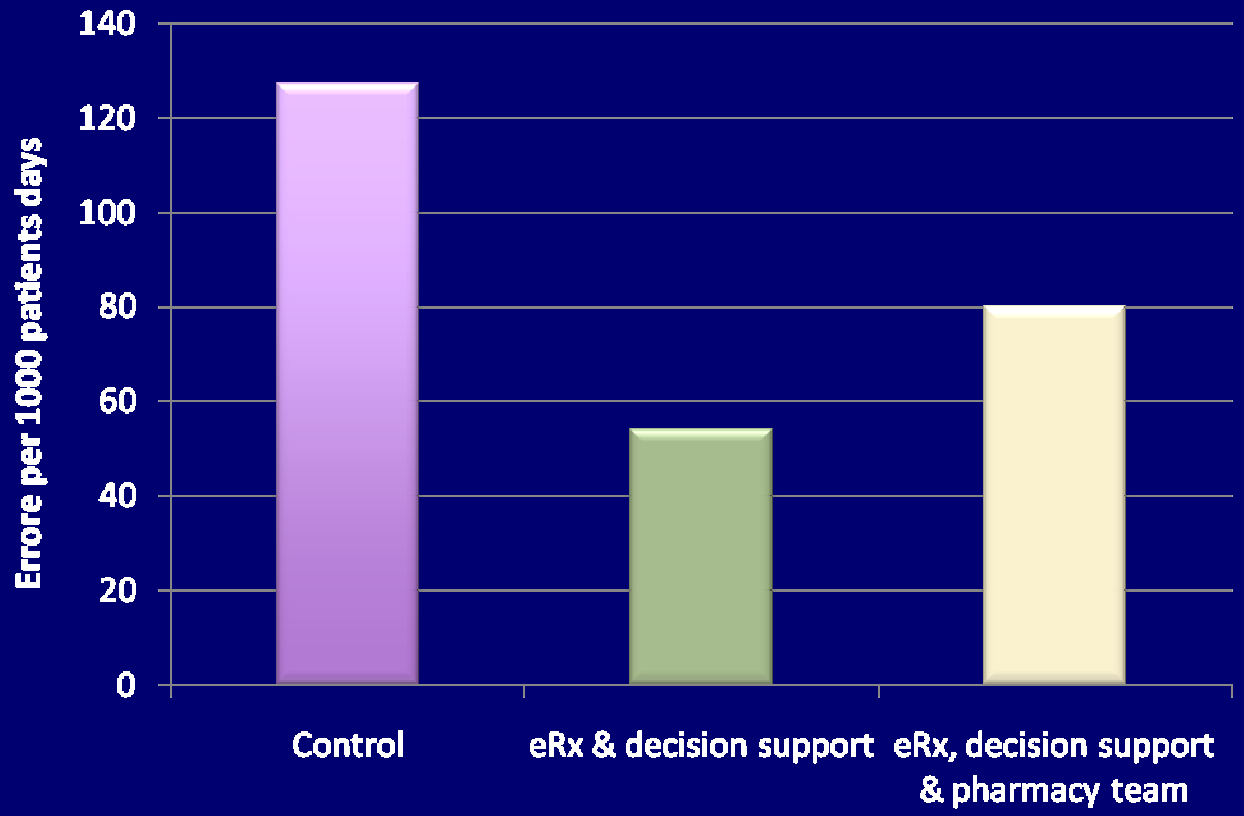
Type of	Percent
Can't or	54,5
System	46,5
Multiple	46,0
Delays in starting antibiotics	39,6
Wrong dose information	38,1
Order for wrong patient	22,5
Delays in stopping drug	22,4

Adding Computerized Decision Support to Provide Automated Alerts for Prescribing Problems



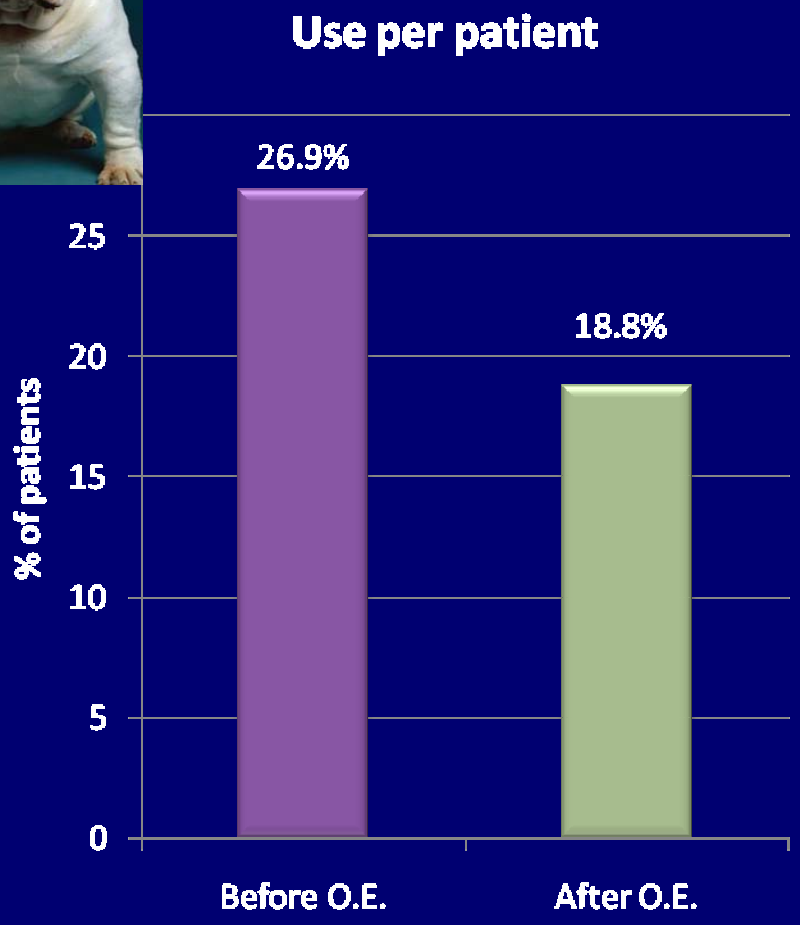
Computerized Hospital E-Rx systems Reduce Medication Errors by > 50%

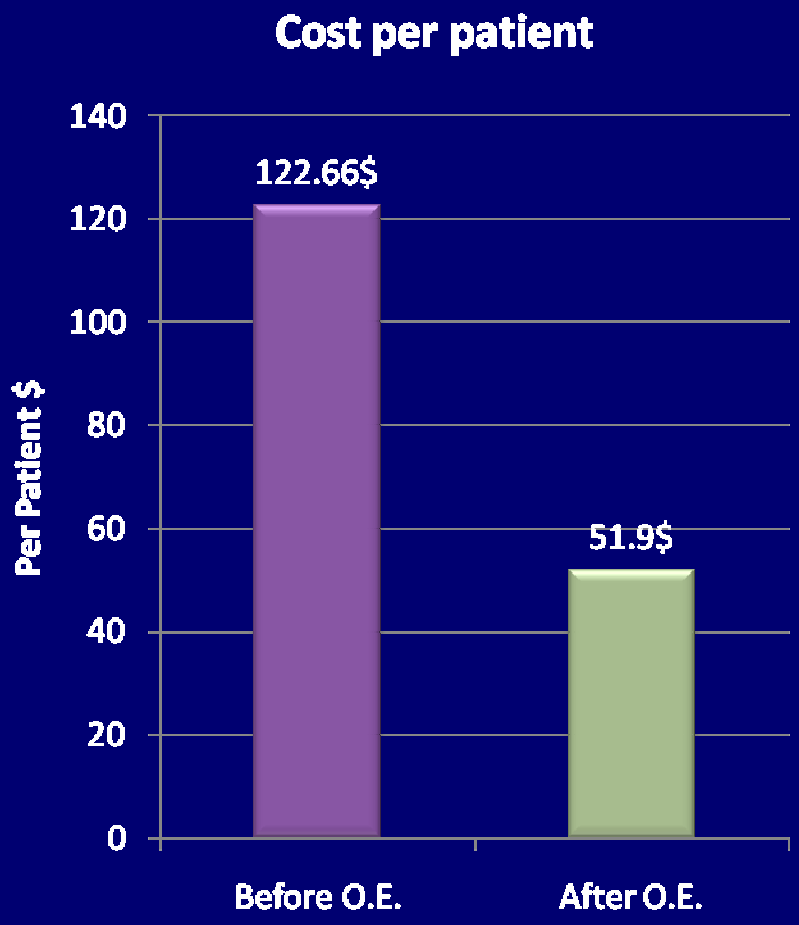
(Bates, JAMA, 1998)



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

Pestotnik, Annals of Internal Medicine, 1996





However Most Drug Alerts from Commercial Systems are Ignored!

Weingartet.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

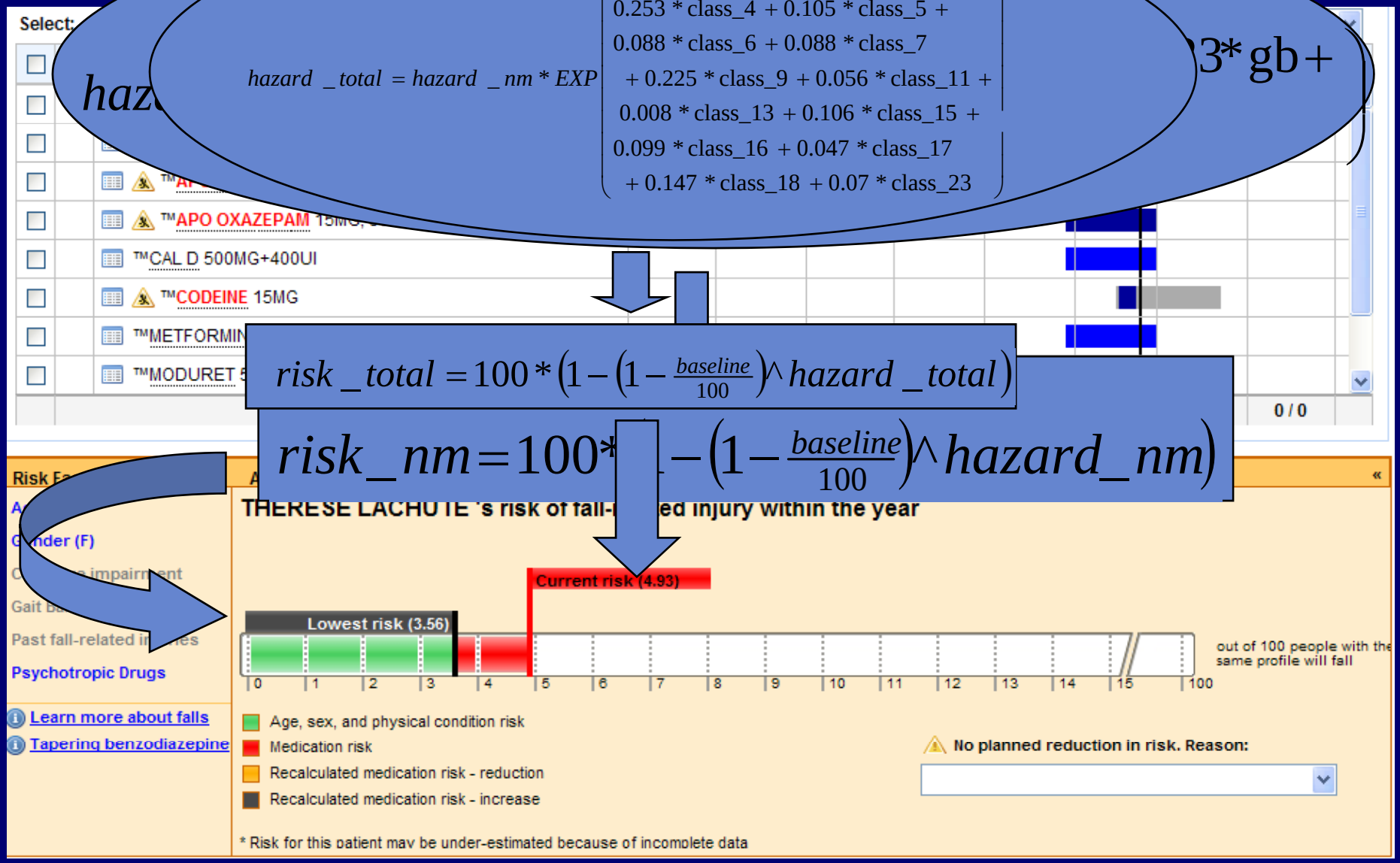
Characteristic	On Demand Alerts	Automated Alerts
Number of Patients	1,550	1,899
Number of Alerts	4,445	6,506
% Seen	0.9%	10.3%
% Revised that were Seen	75.6%	12.1%

Designing New Smart Alerts that Provide

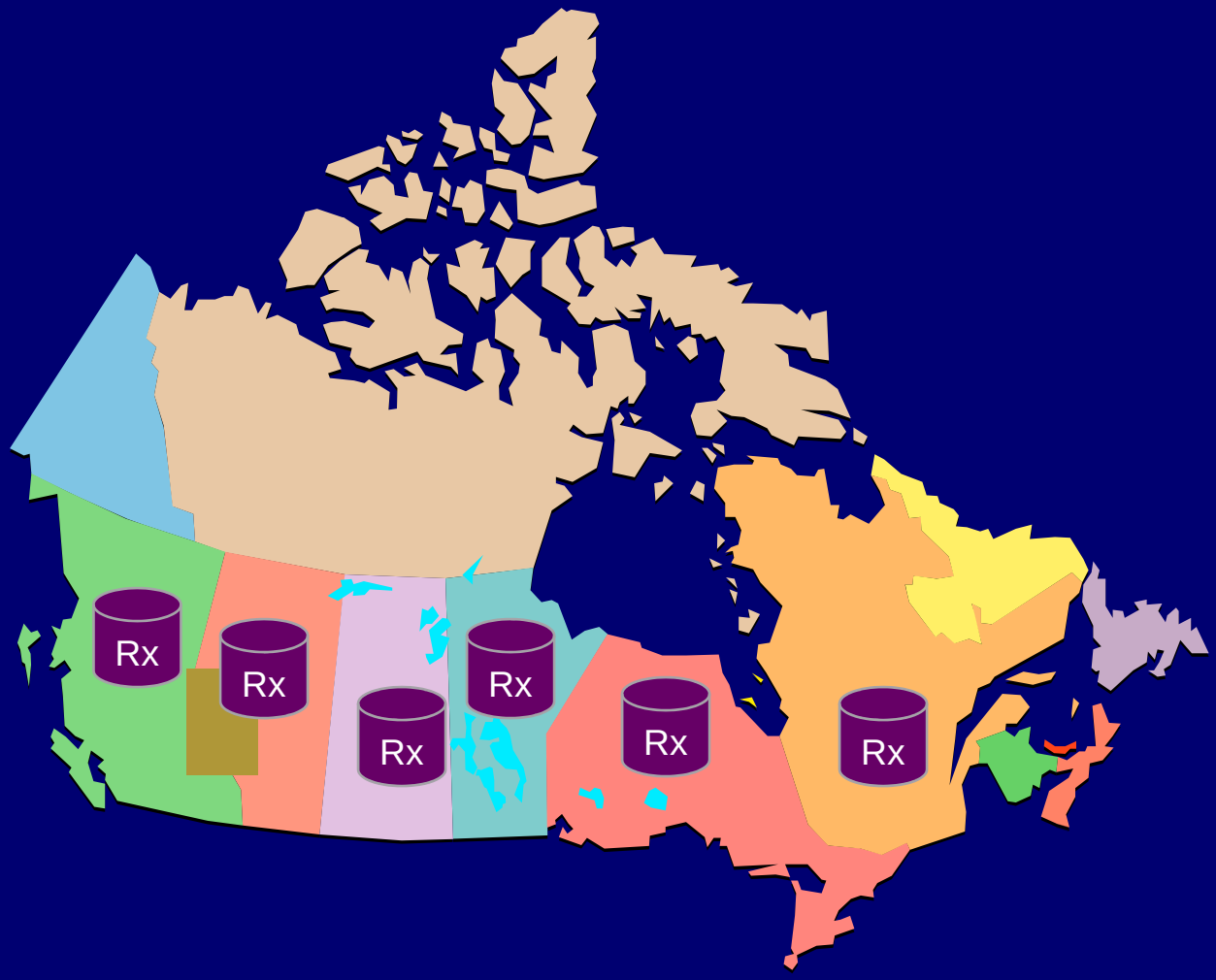
$$hazard\_total = hazard\_nm * EXP\begin{pmatrix} 0.304 * class\_2 + 0.035 * class\_3 + \\ 0.253 * class\_4 + 0.105 * class\_5 + \\ 0.088 * class\_6 + 0.088 * class\_7 \\ + 0.225 * class\_9 + 0.056 * class\_11 + \\ 0.008 * class\_13 + 0.106 * class\_15 + \\ 0.099 * class\_16 + 0.047 * class\_17 \\ + 0.147 * class\_18 + 0.07 * class\_23 \end{pmatrix}$$

$$risk\_total = 100 * \left(1 - \left(1 - \frac{baseline}{100}\right) \wedge hazard\_total\right)$$

$$risk\_nm = 100 * \left(1 - \left(1 - \frac{baseline}{100}\right) \wedge hazard\_nm\right)$$

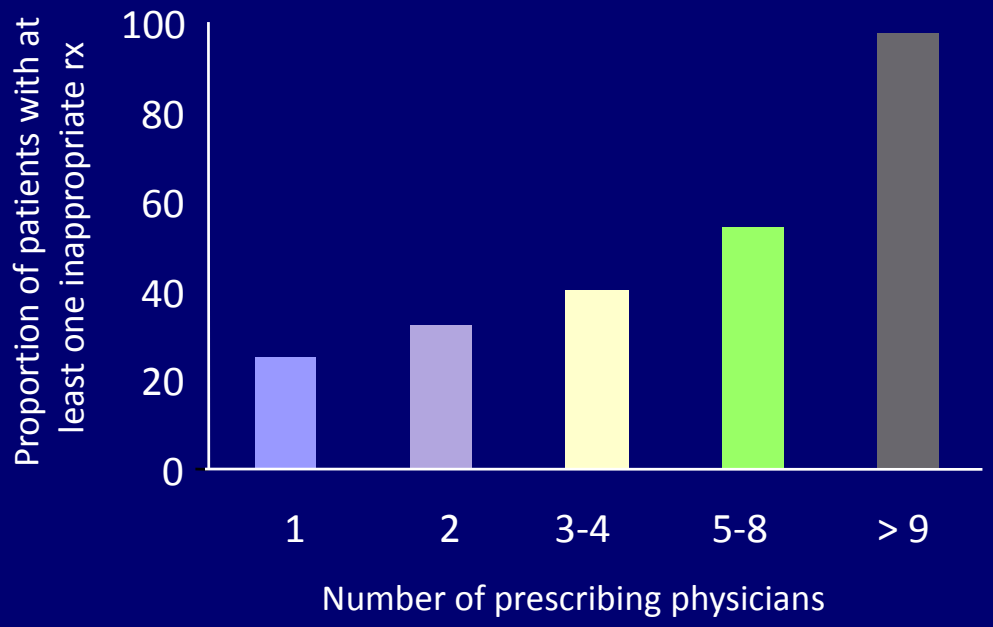


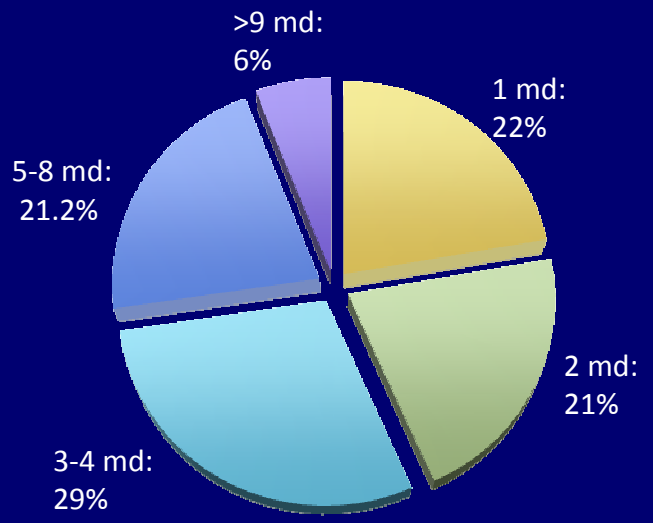
Integrating Computerized Prescribing with Drug Dispensing Information: Coming Soon in Canada



Multiple Prescribing Physicians Increase the Risk of Inappropriate Prescriptions

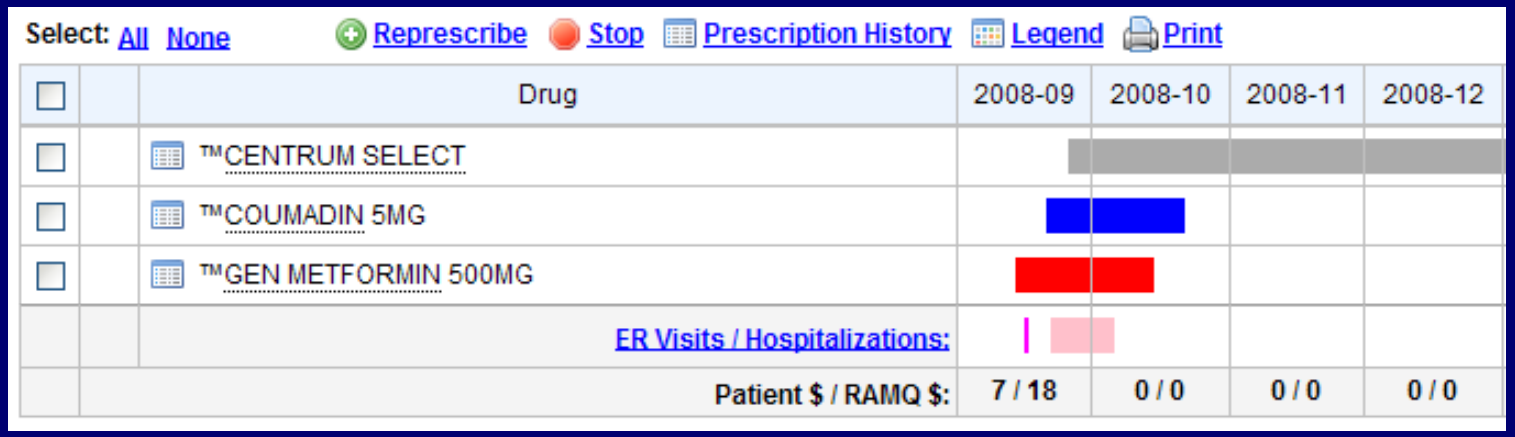
(Tamblyn et. al., CMAJ, 1993)

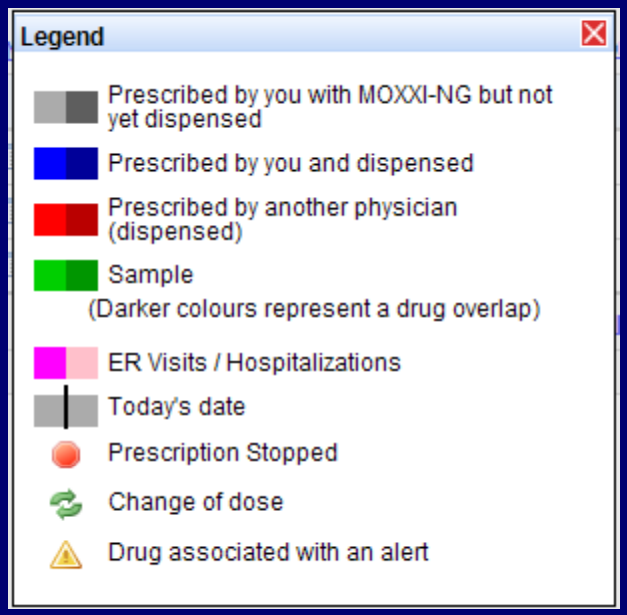




MOXXI: 198,051 eligible patients insured by the RAMQ drug insurance from Jan. 2006 to Jan. 2007

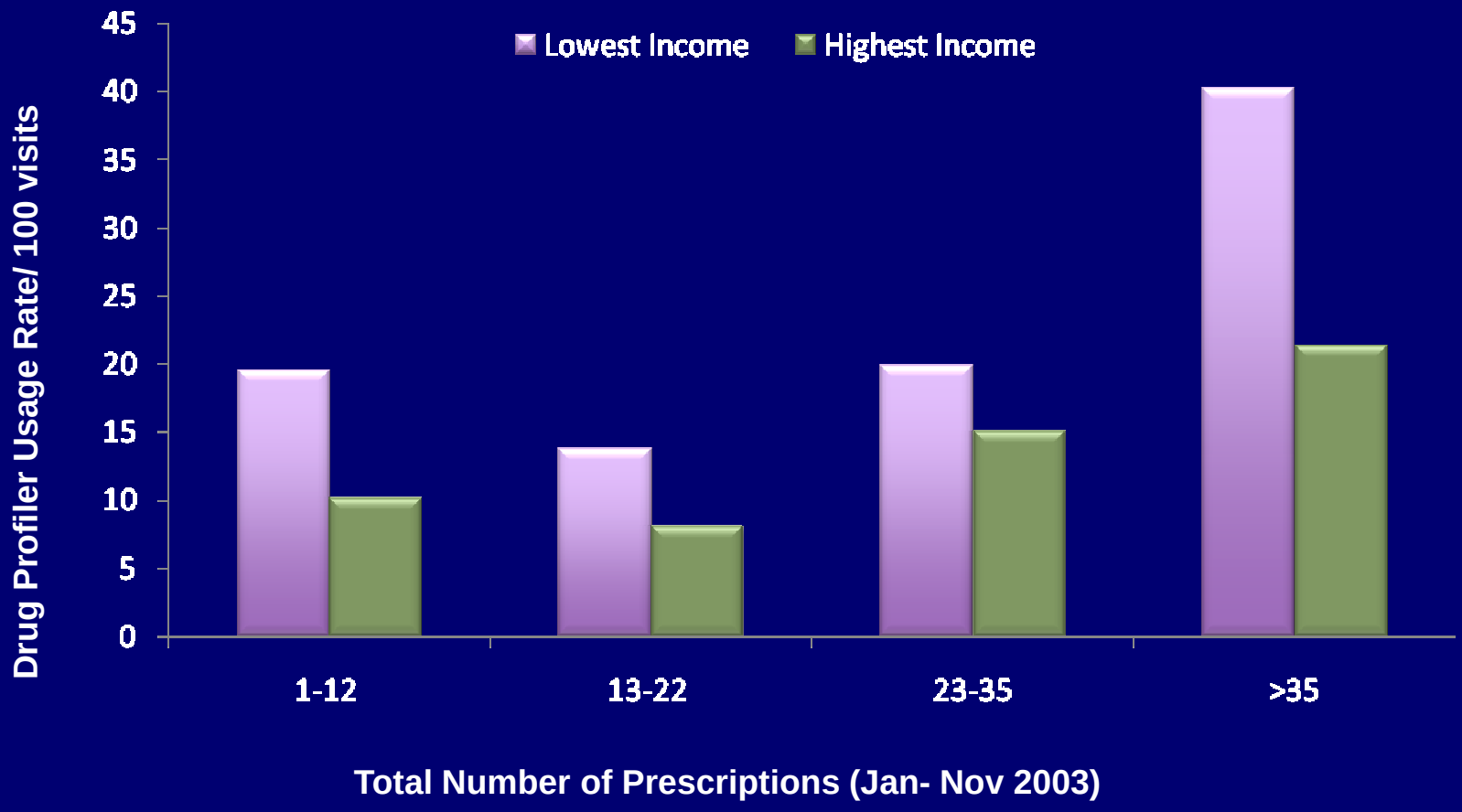
Improving Safety by Retrieving the Complete Drug Profile from an Integrated Drug Management System





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

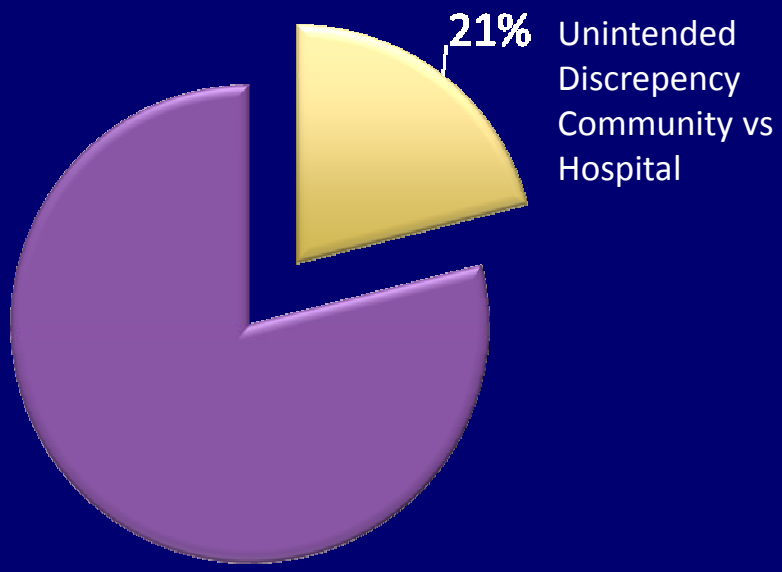
Yuko Kawasamiet.al. International Journal of Medical Informatics, 2007



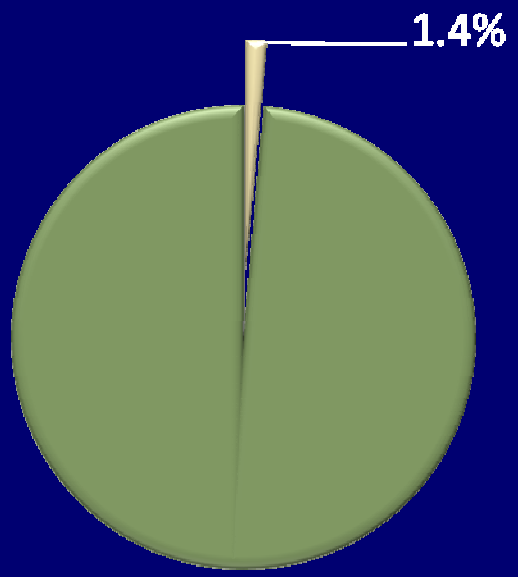
Medication Reconciliation Made Easy

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

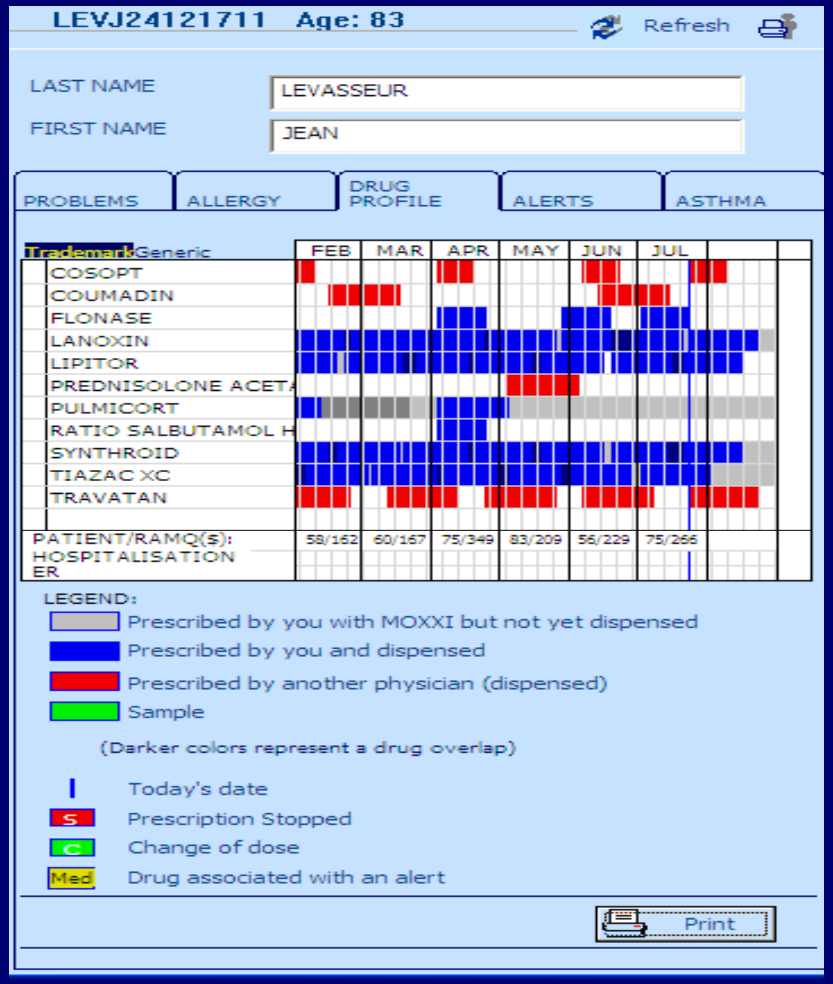
Discrepencies Before Automated MedRec (n=120 admissions)

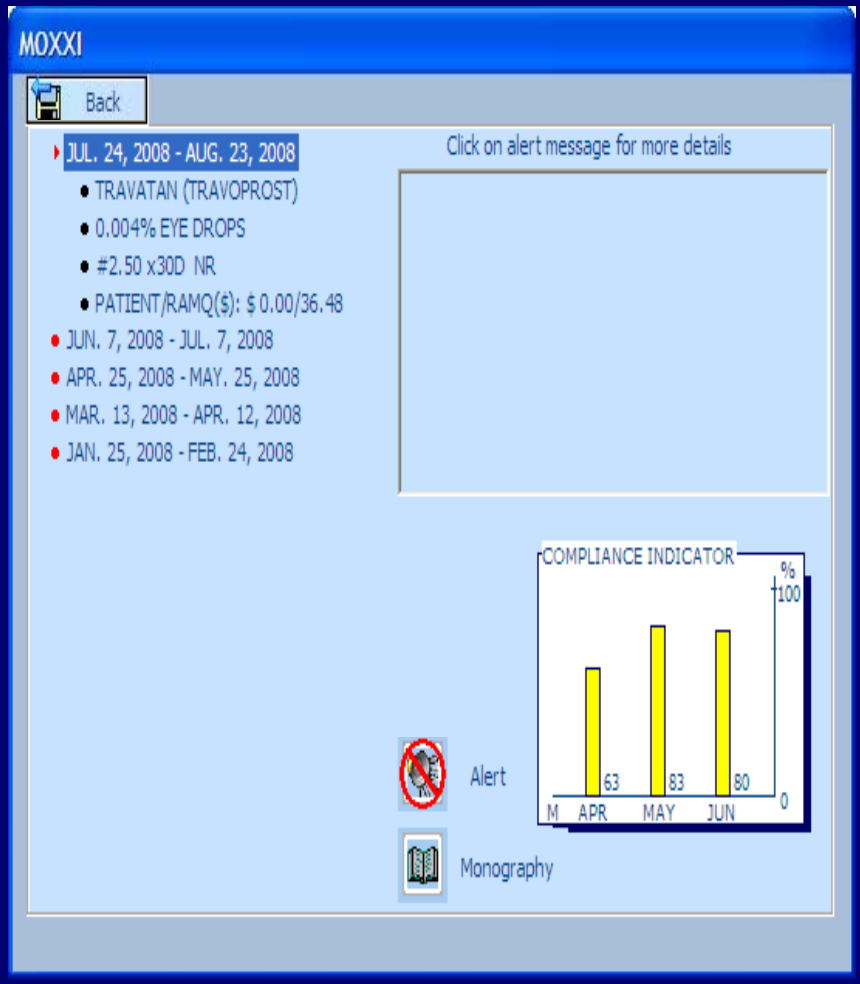


Discrepencies After Automated MedRec (n=19,356 admissions)



Improve Follow-Up and Medication Adherence





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	

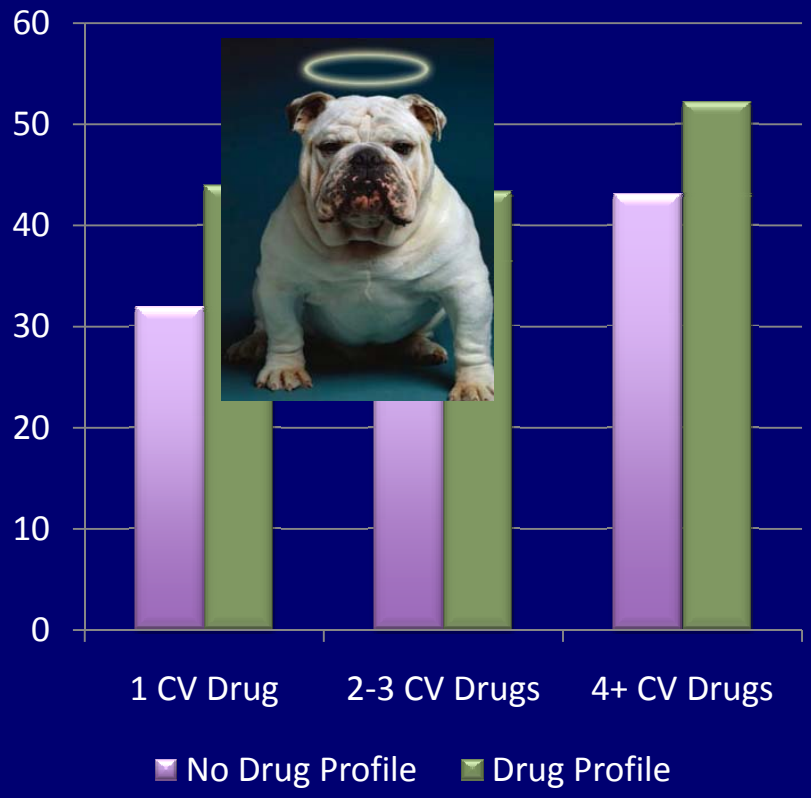
Hypertension

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



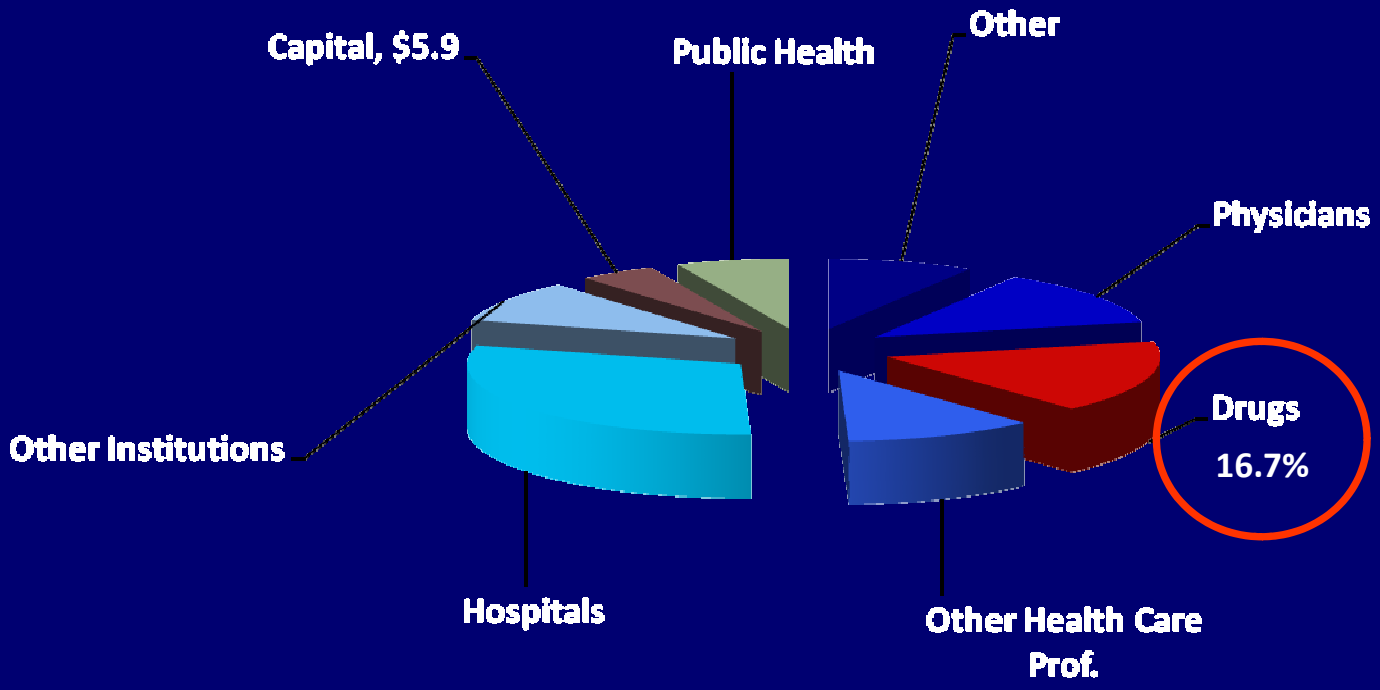
Patient Reminders via Interactive Voice Response Systems: Feasibility Study

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

Feasibility Assess	% Agree
Understood purp	44.7
Difficulty with set lls	14.3
Reminder calls ca ed	29.0
Name of medicati	78.3
Already refilled before reminder	71.4
System helpful as a refill reminder	14.3

New Opportunities to Enhance Cost-Effectiveness

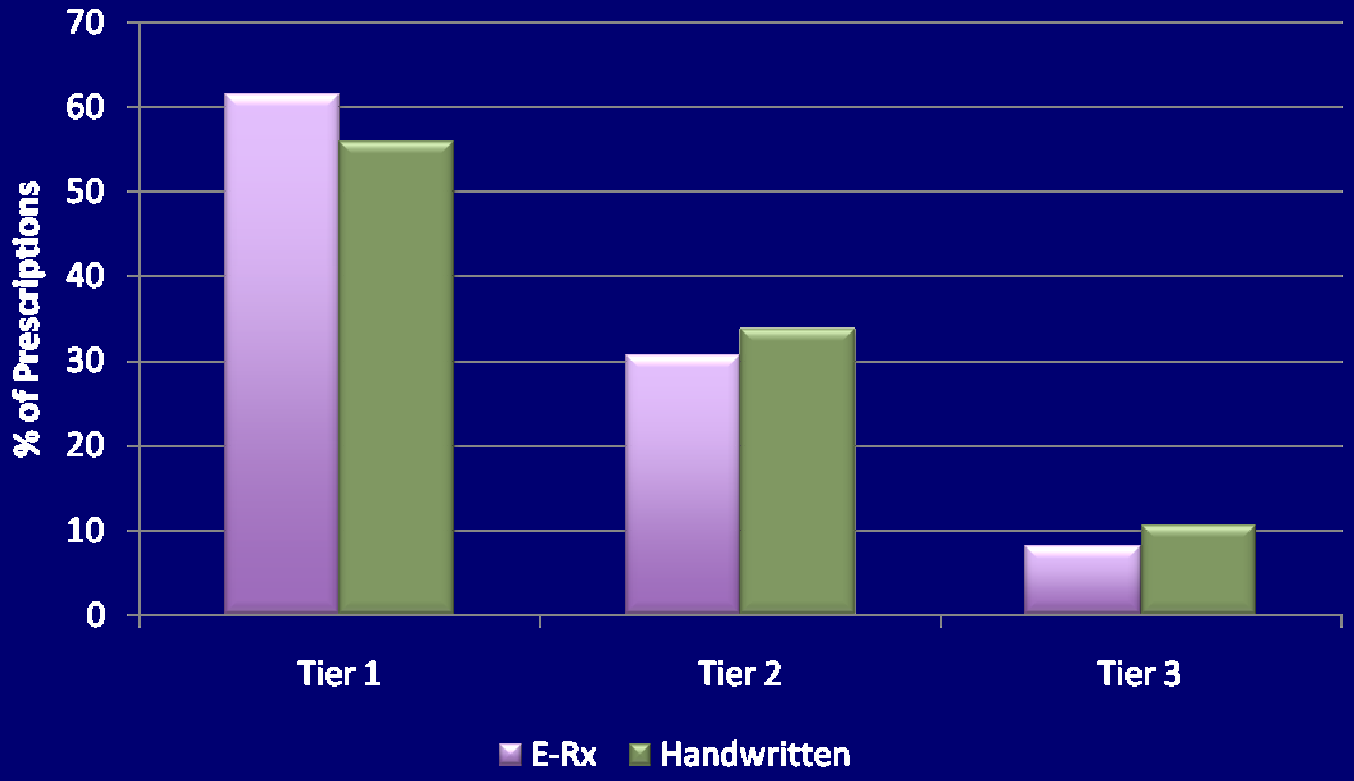
Drug Costs in Canada, 2004: $130 Billion



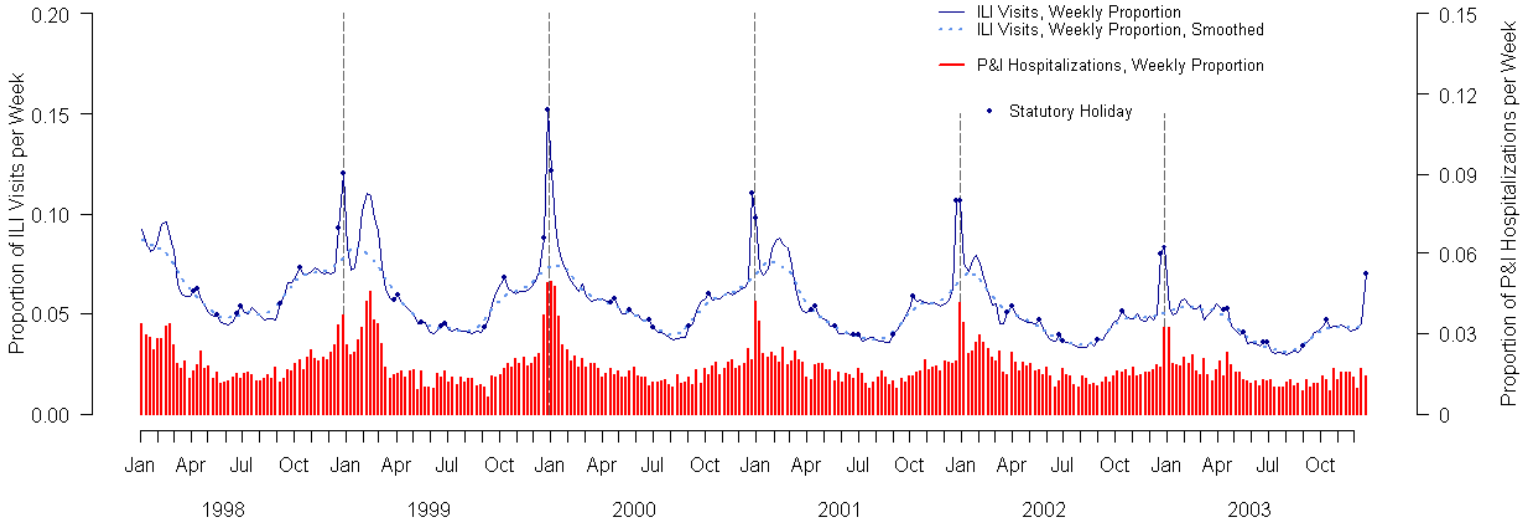
The Impact of Cost and Formulary Reminders at the Time of E-Rx

National Council for Prescription Drug Programs Standard: Script 8.1

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



Surveillance

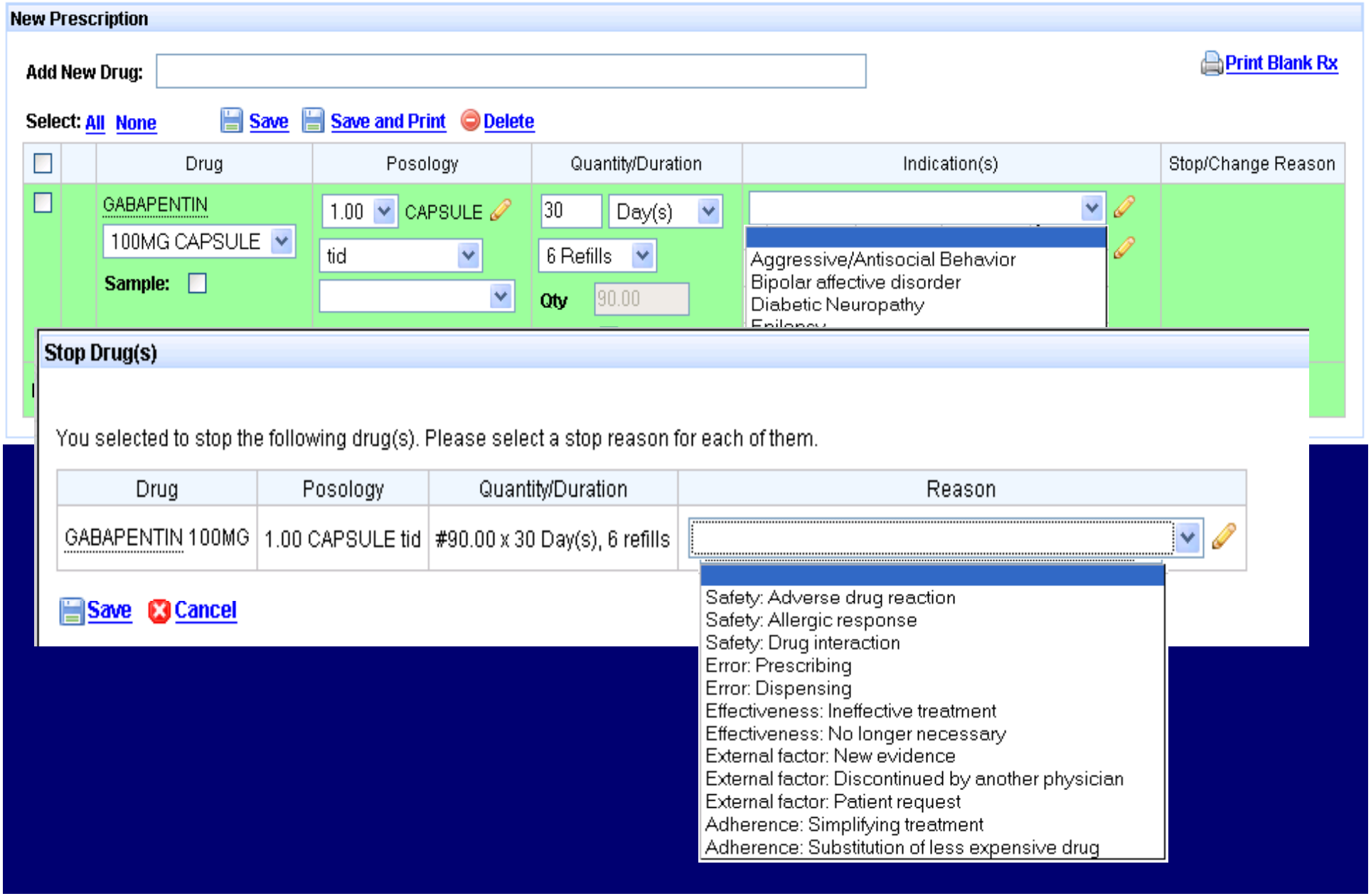


Notes: -P&I ICD-9 codes 480-487
-Maximum of 1 visit per patient to each physician at each establishment per day
-Statutory Holidays: New Year's Day, Good Friday, Easter Monday, Victoria Day, St-Jean-Baptiste Day, Canada Day, Labour Day, Thanksgiving Day, Christmas Day, Boxing Day

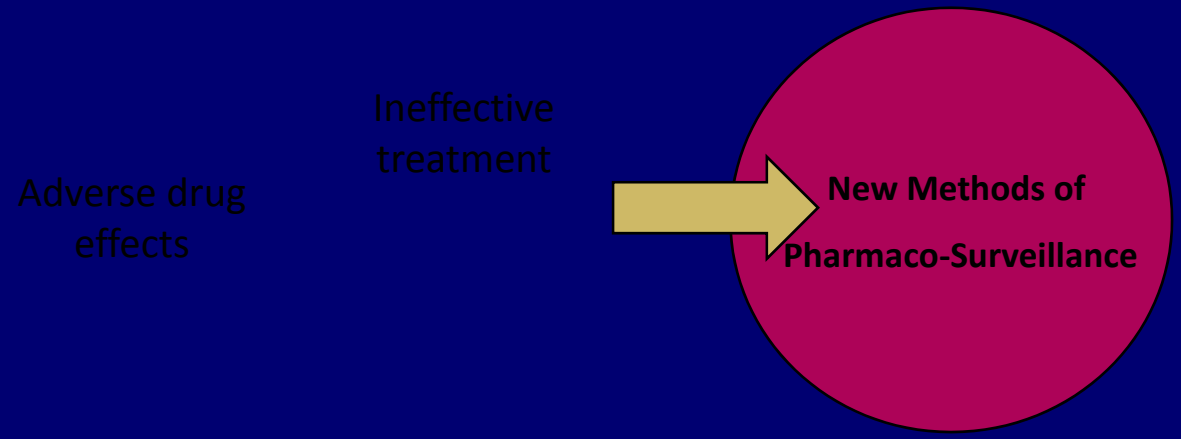
Methods of Pharmacosurveillance

- 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)



Why do Physicians Stop Medications?
Reasons for Stop Orders written for 857 of 3889 MOXXI Patients Seen Between Nov, 2005- Jan, 2006



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

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

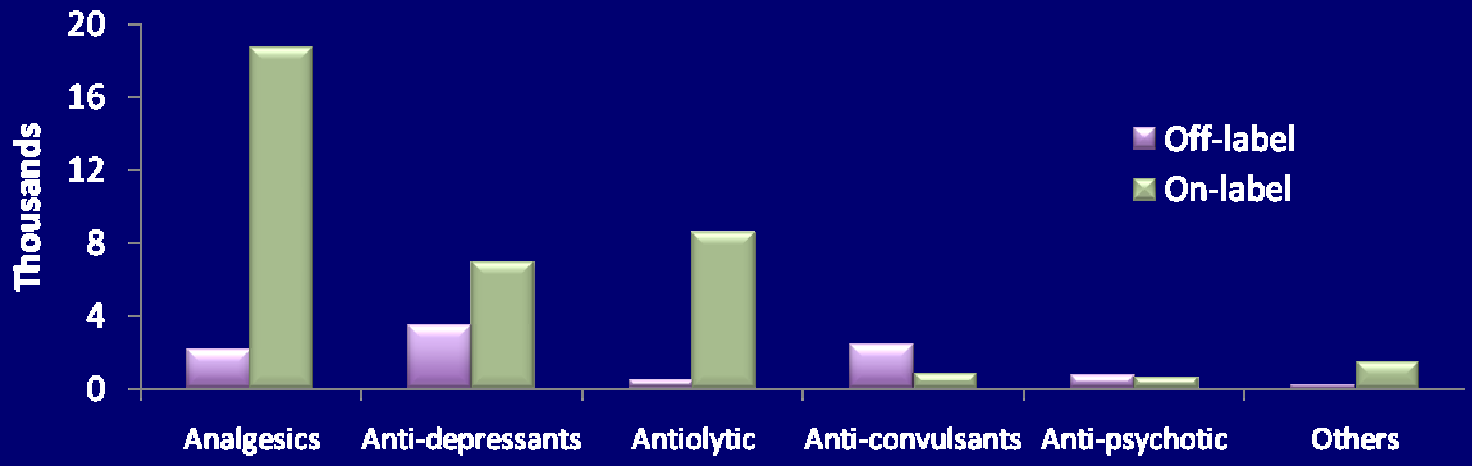
E-Rx Stop/Change	Adverse Effects/ Ineffective Treatment Documented in Medical Chart		Total
	Present	Absent	
Present	325	9	334
Absent	13	298	311
	338	307	645
	Naive	Adjusted for Sampling	
Sensitivity	96.2%	67%	
Specificity	97.1%	99.7%	

New Methods of Assessing Off-Label Use

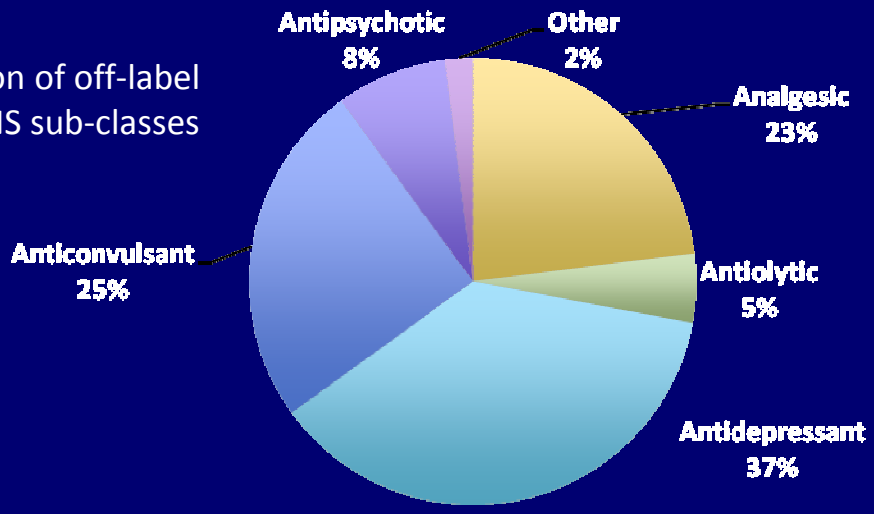
Study	NDTI (2001)	NDTI (1978)	Family Practice (1978)
Drugs & conditions	100 most frequent + 60 randomly selected	100 most frequent drug uses	500 drug uses
Off-label	21%	31%	9.2%
Other findings	Cardiac (46%) Gabapentin (83%)	44% - ineffective	Off-label indication often mistaken as being on-label
Recommendation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

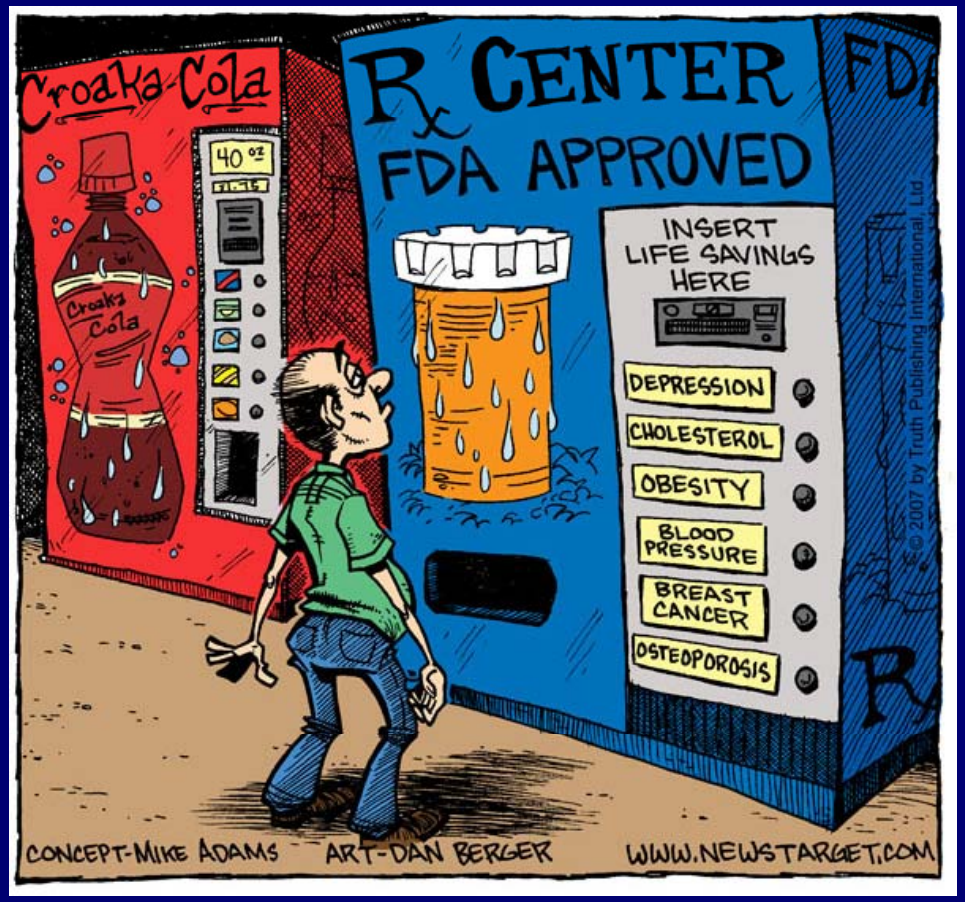


Percentage distribution of off-label Prescribing among CNS sub-classes



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

robyn.tamblyn@mcgill.ca