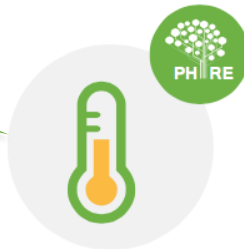# Towards Probabilistic Decision Support

David Buckeridge, MD PhD FRCPC
Associate Professor | McGill University
CIHR Chair | Applied Public Health Research, E-Health Interventions
Medical Consultant | Montreal Public Health, Quebec Public Health Institute
david.buckeridge@mcgill.ca

PH RE

Platform for Health Informatics,
Research and Exploration

Risk Calculator
Risk of Fall Calculator

# Probabilistic Decision Support

- ## 50 to 90% of traditional drug alerts are ignored
  - Generic
  - Clinical implications unclear
- ## Probabilistic alerts can give clear, target message
  - Personalized alert
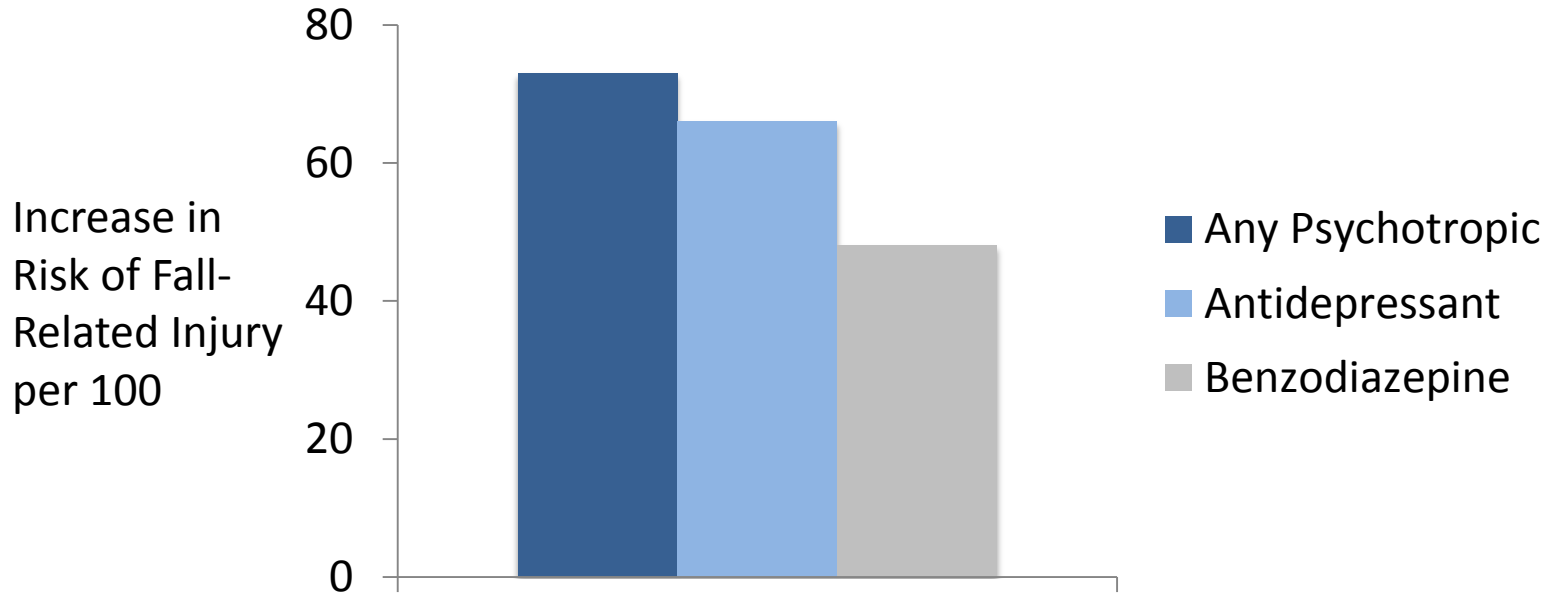  - Tied to important outcome

Traditional

"Level 2 Alert: Age-Drug Interaction with Opiates"

Probabilistic

"15% chance this patient will fall on current dose of codeine"

Taylor & Tamblyn, 2005; Shah, et.al, 2006; Van der Sijs, et.al, 2006; Eslami,et.al, 2007

# Psychotropic Medications Cause Fall-Related Injuries

Increase in Risk of Fall-Related Injury per 100



- Any Psychotropic
- Antidepressant
- Benzodiazepine

# Adverse Drug Events in Community are Preventable at Time of Prescribing



**Proportion of Adverse Drug Events that are Preventable**

- Psychotropic Medications: 41% (N=181)
- All Other Classes: 26% (N=1342)
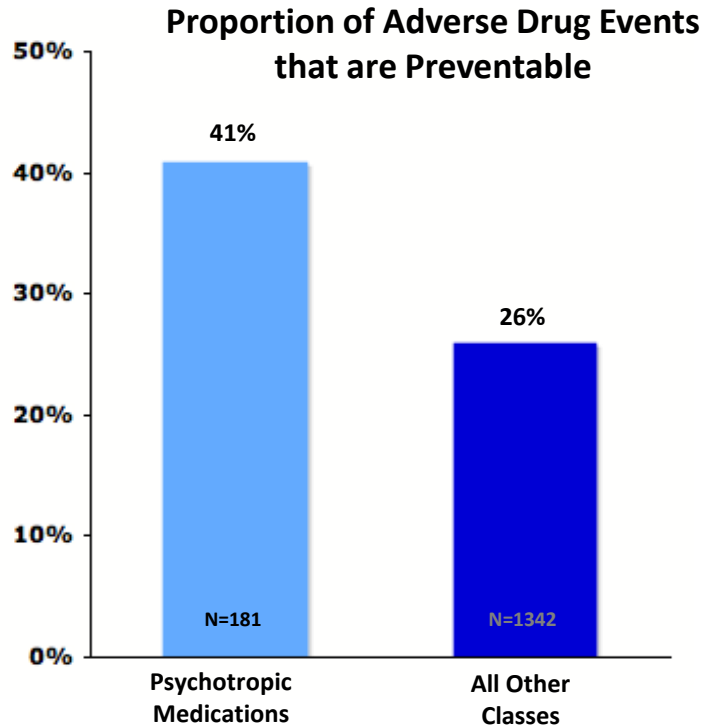
**Timing of Error Leading to a Preventable Adverse Drug Event**

- Time of Prescribing 58%
- N=421
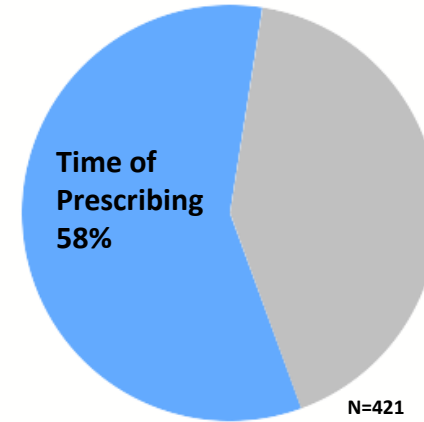
Gurwitz JH, Field TS, Harrold LR, Rothschild J, Debellis K, Seger AC, Cadoret C, Fish LS, Garber L, Kelleher M, Bates DW. Incidence and preventability of adverse drug events among older persons in the ambulatory setting. JAMA. 2003 Mar 5;289(9):1107-16.

# Fall-Related Injuries in Older Adults are Common and Costly
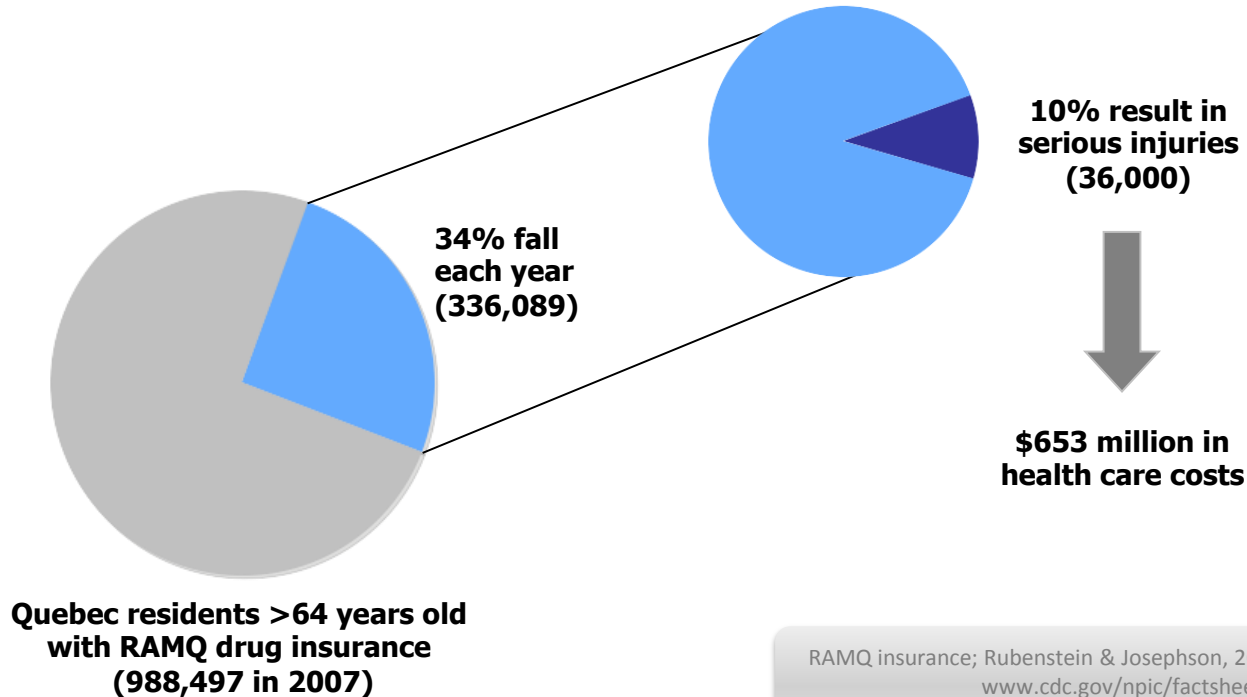


34% fall each year (336,089)

10% result in serious injuries (36,000)

$653 million in health care costs

Quebec residents >64 years old with RAMQ drug insurance (988,497 in 2007)

# Adjusted Risk Factors for Fall Related Injury

| ☐ | | Drug | 2008-09 | 2008-10 | 2008-11 | 2008-12 | 2009-01 | 2009-02 | 2009-03 | 2009-04 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ☐ | ▦ | ™ACTONEL 35MG | | | | | | ██ | | |
| ☐ | ▦ | ™APO CYCLOBENZAPRINE 10MG | | | | | | █ | | |
| ☐ | ▦ ⚠ | ™APO FLURAZEPAM 30MG | | | | | | ██ | | |
| ☐ | ▦ ⚠ | ™APO OXAZEPAM 15MG, 30MG | | | | | | ██ | | |
| ☐ | ▦ | ™CAL D 500MG+400UI | | | | | | ██ | | |
| ☐ | ▦ ⚠ | ™CODEINE 15MG | | | | | | █▓▓ | | |
| ☐ | ▦ | ™METFORMIN 500MG | | | | | | ██ | | |
| ☐ | ▦ | ™MODURET 50+5MG | | | | | | ██ | | |
| | | Patient $ / RAMQ $: | 0 / 0 | 0 / 0 | 0 / 0 | 0 / 0 | 57 / 101 | 6 / 14 | 0 / 0 | 0 / 0 |

| Risk Factors | Alert: increased risk of fall | « |
|---|---|---|

**Age: 78**

**Gender (F)**

Cognitive impairment

Gait Balance

Past fall-related injuries

**Psychotropic Drugs**

ⓘ Learn more about falls

ⓘ Tapering benzodiazepine

**THÉRÈSE LACHUTE 's risk of fall-related injury within the year**

Current risk (4.93)

Lowest risk (3.56)

| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 100 |

out of 100 people with the same profile will fall

🟩 Age, sex, and physical condition risk

🟥 Medication risk

🟧 Recalculated medication risk - reduction

⬛ Recalculated medication risk - increase

⚠ No planned reduction in risk. Reason:

[                                    ▾]

* Risk for this patient may be under-estimated because of incomplete data

## Drug Profile  «

⊕ Represcribe  ● Stop  ▦ Prescription History  ▦ Legend  🖨 Print          ◀◀ ▶ ▶▶  Go to: 2008-12 ▾

| ☐ | | Drug | 2008-07 | 2008-08 | 2008-09 | 2008-10 | 2008-11 | 2008-12 | 2009-01 | 2009-02 |
|---|---|---|---|---|---|---|---|---|---|---|
| ☐ | ▦ | ™ACTONEL 35MG | | | | | | | | |
| ☐ | ▦ | ™APO CYCLOBENZAPRINE 10MG | | | | | | | | |
| ☐ | ▦ ⚠ | ™APO FLURAZEPAM 30MG | | | | | | | | |
| ☐ | ▦ ⚠ | ™APO OXAZEPAM 15MG, 30MG | | | | | | | | |
| ☐ | ▦ | ™CAL D 500MG+400UI | | | | | | | | |
| ☐ ⟳ | ▦ ⚠ | ™CODEINE 15MG | | | | | | | | |
| ☐ | ▦ | ™METFORMIN 500MG | | | | | | | | |
| ☐ | ▦ | ™MODURET 50+5MG | | | | | | | | |

### Risk Factors        Alert: increased risk of fall
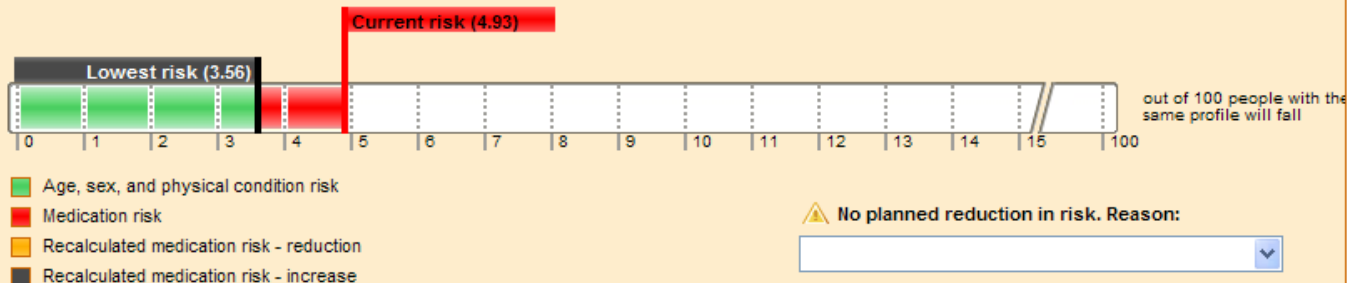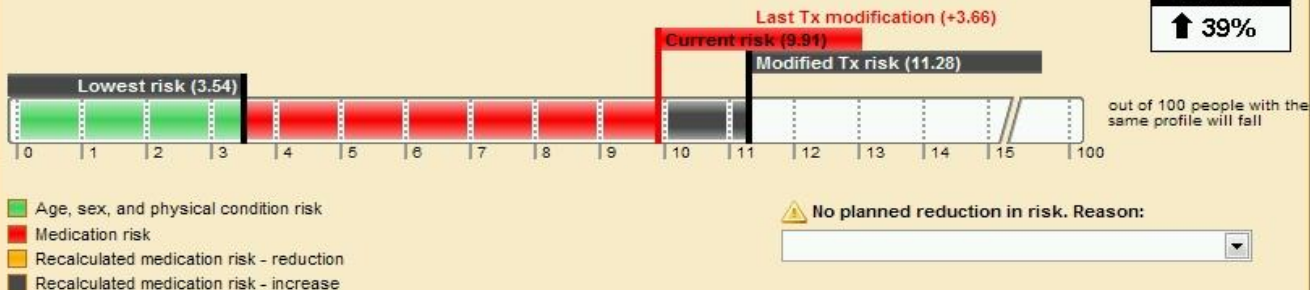
Age: 78
Gender (F)
Cognitive impairment
Gait Balance
Past fall-related injuries
Psychotropic Drugs

ⓘ Learn more about falls
ⓘ Tapering benzodiazepine

**THÉRÈSE LACHUTE 's risk of fall-related injury within the year**

Relative Risk Increase
⬆ 39%

Last Tx modification (+3.66)
Current risk (9.91)
Modified Tx risk (11.28)
Lowest risk (3.54)

0  1  2  3  4  5  6  7  8  9  10  11  12  13  14  15  100

out of 100 people with the same profile will fall

🟩 Age, sex, and physical condition risk
🟥 Medication risk
🟧 Recalculated medication risk - reduction
⬛ Recalculated medication risk - increase

⚠ No planned reduction in risk. Reason: ▾

* Risk for this patient may be under-estimated because of incomplete data

# Randomized Controlled Trial Quantifies Risk Reduction



Change of -0.17 (-0.32 to -0.02) in risk of injury per 1000

Greatest change for patients at highest risk

Risk of injury per 1000

N=2,741   N=2,887
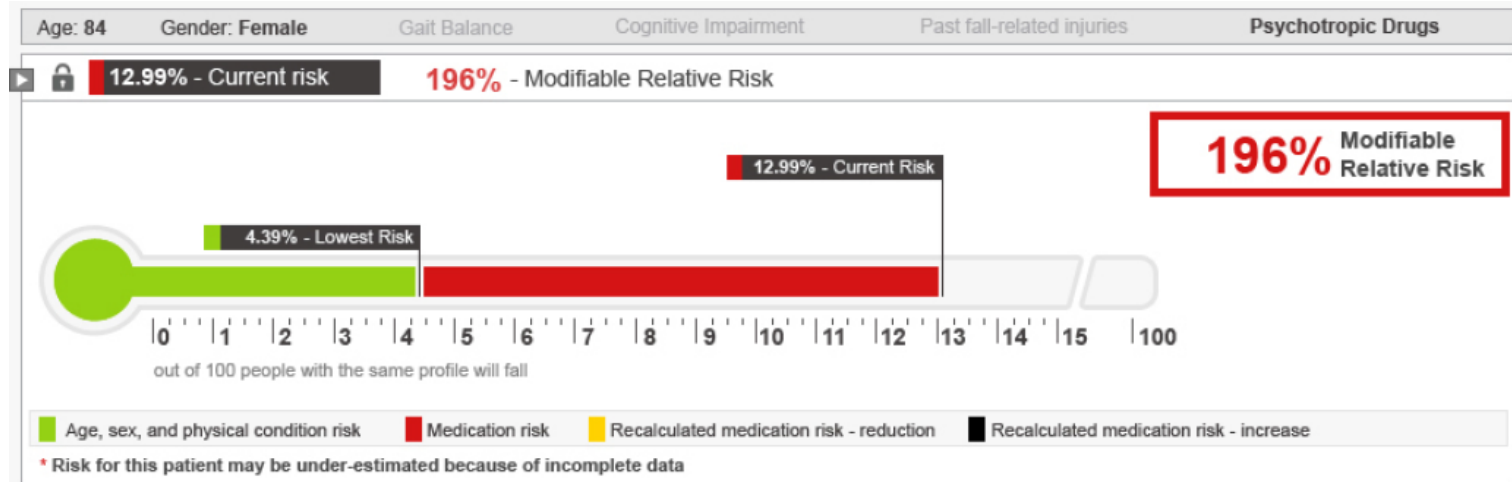
Control   TRIPP

Risk at the end of follow-up (% probability of in

3.71 is the point where the effect of the risk of injury alert is the same as the conventional alert

Risk at baseline (% probability of injury in the next year)

Intervention   Control
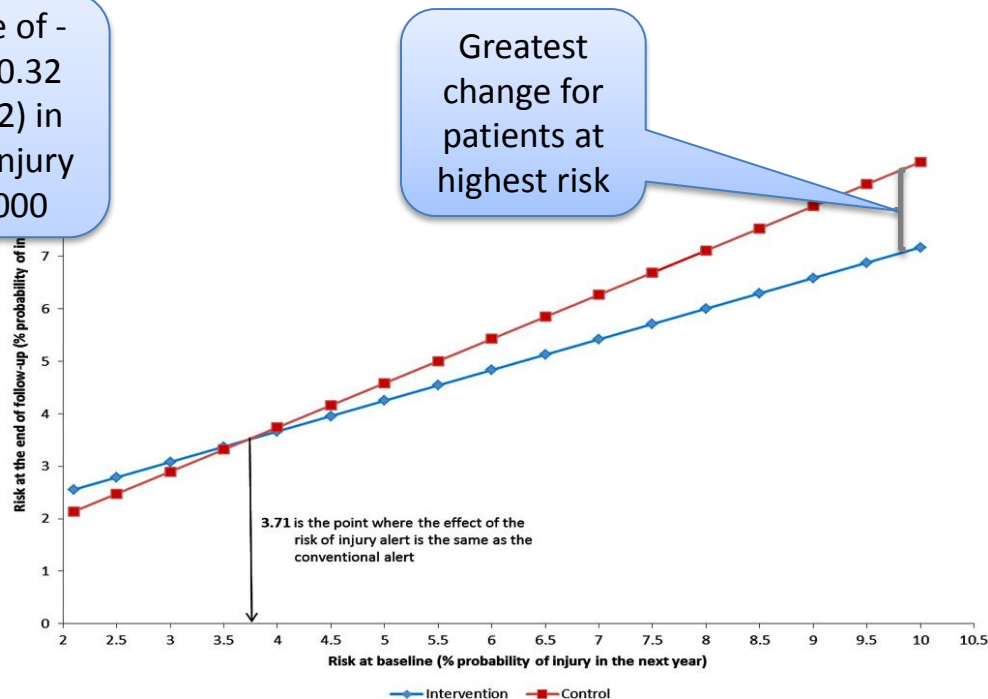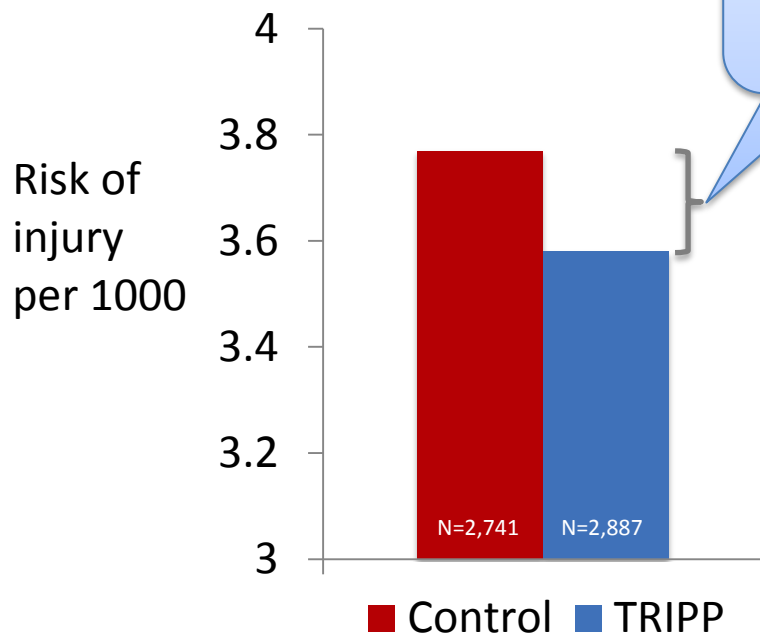
Tamblyn R, Eguale T, Buckeridge DL, Huang A, Hanley J, Reidel K, Shi S, Winslade N. The effectiveness of a new generation of computerized drug alerts in reducing the risk of injury from drug side effects: a cluster randomized trial. J Am Med Inform Assoc. 2012 Jul-Aug;19(4):635-43.

# Ongoing Implementation



| Age: 84 | Gender: Female | Gait Balance | Cognitive Impairment | Past fall-related injuries | Psychotropic Drugs |

12.99% - Current risk    196% - Modifiable Relative Risk

196% Modifiable Relative Risk

12.99% - Current Risk

4.39% - Lowest Risk

0  1  2  3  4  5  6  7  8  9  10  11  12  13  14  15  100

out of 100 people with the same profile will fall

Age, sex, and physical condition risk    Medication risk    Recalculated medication risk - reduction    Recalculated medication risk - increase

* Risk for this patient may be under-estimated because of incomplete data

- Implementation as SaaS with EMR vendor in Quebec and Multi-centered NIH-funded trial in the US
- Validating algorithm in Ontario and US

David Buckeridge
david.buckeridge@mcgill.ca
@davidbuckeridge