



Probabilistic Prediction: the FRAT-up approach

*L. Cattelani, P. Palumbo, L. Palmerini, S. Bandinelli,
C. Becker, F. Chesani, L. Chiari*





FRAT-up in short



- Assessment tool for evaluating the fall risk within a year
- Aimed to general practitioners and health organisations
 - per-subject evaluation vs. population wide
- Focused on elder (65+), community-dwelling
- Based on risk factors available in the literature
- Exploits available clinical information about the subject
 - It does not require the execution of any test
- Freely available as a web-based application
 - Simple web questionnaire to be filled-up by experts



FRAT-up – how it looks like...

Computed risk

Current risk of the subject: 0.461



Form to be filled with subject's data

Health profile of the subject:

Fear of falling (Deshpande)?	<input checked="" type="radio"/> Yes	<input type="radio"/> No	<input type="radio"/> Use prevalence	physical activity level:	<input type="text" value="1"/>	<input type="checkbox"/> Use prevalence
Urinary incontinence last year?	<input type="radio"/> Yes	<input checked="" type="radio"/> No	<input type="radio"/> Use prevalence	MMSE score:	<input type="text"/>	<input checked="" type="checkbox"/> Use prevalence
History of previous strokes?	<input checked="" type="radio"/> Yes	<input type="radio"/> No	<input type="radio"/> Use prevalence	How does the subject feel:	<input type="text" value="1"/>	<input type="checkbox"/> Use prevalence
Does the subject suffer Parkinson?	<input type="radio"/> Yes	<input type="radio"/> No	<input checked="" type="radio"/> Use prevalence	Hearing impairment?:	<input type="text" value="3"/>	<input type="checkbox"/> Use prevalence
Does the subject use antiepileptics?	<input type="radio"/> Yes	<input type="radio"/> No	<input checked="" type="radio"/> Use prevalence	CESD:	<input type="text"/>	<input checked="" type="checkbox"/> Use prevalence
History of previous falls?	<input checked="" type="radio"/> Yes	<input type="radio"/> No	<input type="radio"/> Use prevalence	Subject's number of IADL:	<input type="text"/>	<input checked="" type="checkbox"/> Use prevalence
Does the subject use a walking aid?	<input type="radio"/> Yes	<input type="radio"/> No	<input checked="" type="radio"/> Use prevalence	Age:	<input type="text" value="76"/>	<input type="checkbox"/> Use prevalence
Dizziness or unsteadiness last year?	<input type="radio"/> Yes	<input type="radio"/> No	<input checked="" type="radio"/> Use prevalence	Visual acuity (3 meter):	<input type="text"/>	<input checked="" type="checkbox"/> Use prevalence
Does the subject use sedatives?	<input type="radio"/> Yes	<input type="radio"/> No	<input checked="" type="radio"/> Use prevalence	Visual stereognosis:	<input type="text"/>	<input checked="" type="checkbox"/> Use prevalence
Diabetes blood glucose 126?	<input type="radio"/> Yes	<input type="radio"/> No	<input checked="" type="radio"/> Use prevalence			

- A huge number of scientific medical papers identifies:
 - which are the risk factors
 - the statistical relation between risk factors and observed falls, in terms of Odds Ratio
 - E.g.: "*Subjects with or without a history of stroke differ by an OR of 1.61 (CI 95%: 1.31–1.98) w.r.t. the fall event*"
- Scientific literature provides also:
 - Reviews, i.e. collection of studies about the same risk factor
 - Meta-reviews



Main assumption

Intuition: a subject exposed to more risk factors should have a higher risk than subjects exposed to less RFs...

The total fall risk of a subject is given by the contribution of all risk factors to which the subject is exposed.





Research question #1



How to evaluate and combine the contribution of each risk factor?

FRAT-up approach:

1. convert ORs in probabilities
2. compute the total risk through an LPAD program



Research question #2

How to determine if a subject is exposed to a risk factor?

FRAT-up approach:

A. Distinguish between risk factors and "estimators"

- E.g., risk factor: "vision impairment"
- Estimators: any of the outcomes of clinical tests "visual acuity at 3mt.", "visual stereognosis", "contrast sensitivity"

B. When uncertain, allows the use of statistical prevalence of the risk factor

C. Support for dichotomic, scalar and synergy risk factors



Current Implementation



FRAT-up is implemented and available as a freely accessible application at the url:

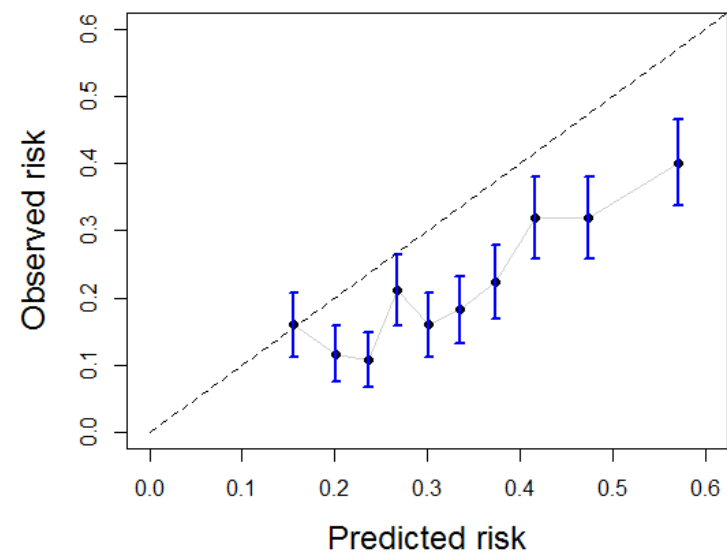
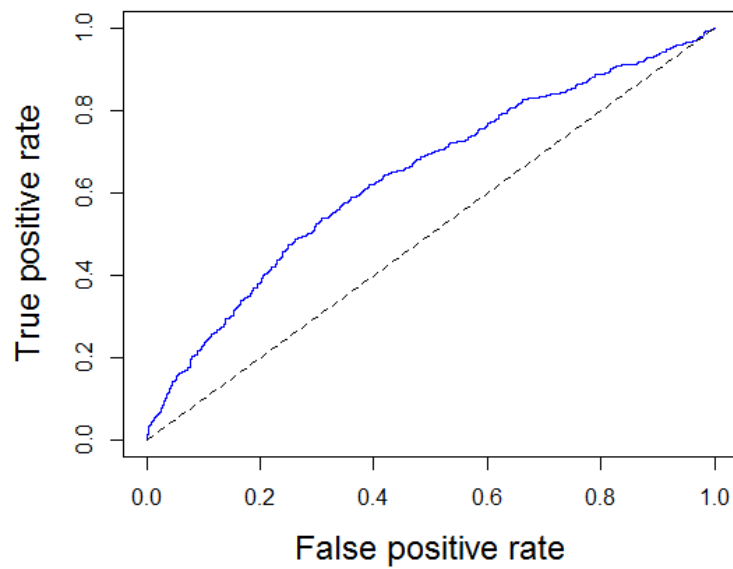
ffrat.farseeingresearch.eu

- Web-based interface for inputting the clinical profile of a subject
- Focused on community-dwelling elders (65+)
- 26 different risk factors (RFs and ORs taken by meta-review Deandrea et al., 2010, *Risk Factors for Falls in Community-dwelling Older People.*)
 - sociodemographic, medical and psychological factors
 - Boolean, scalar and synergic risk factors supported
 - Allows for use of prevalence, when in doubt about the subject
- 28 different estimators



Validation

- FRAT-up has been **validated** using the **InCHIANTI DB** in a purely prospective manner
- FRAT-up performs similarly to the state of the art approaches (e.g., Tinetti Balance Scale, or the “Timed Up and Go Test”)





Scenarios #1 and #2



#1: FRAT-up as a Decision Support System for GPs

- Per-subject evaluation
- Monitoring/logging of the risk along time
- Risk factors ranked on the base of each contribution to the overall risk
 - identify which risk factor should be addressed first, on the basis of the expected results
 - (available in the near future)

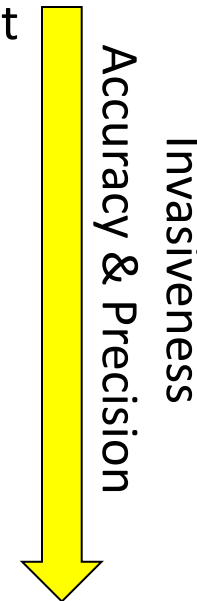
#2: FRAT-up as a population-wide screening tool – DSS for health policy makers

- automatically fed with EPRs
- Analysis and optimization of cost-vs-expected results at the population level (future extension)



Integration with diagnostic tests

1. FRAT-up as a first-level assessment of the risk per-subject
2. If appropriate, second level assessment: "Timed Up-and-GO" test with a commercial smartphone
 - Diagnostic test executed in a controlled environment
 - Farseeing app developed on purpose
3. Third level assessment: activity day life monitoring with commercial smartphone
 - One week observation
 - Farseeing app developed on purpose



Prototype available at:

<http://ffrat.farseeingresearch.eu/bruxelles/>



Scenario #4



What if literature results about risk factors do not fit your target population?

- FRAT-up directly supports the learning of the probabilities (parameters) over a set of example data
 - different algorithms available: EMBLEM, feature selection, regression logistic, etc.
 - currently validating, partial results are good





European Commission
Information Society and Media



Thank you for the attention

Questions?

Please stop at the Farseeing booth and play with the demo

