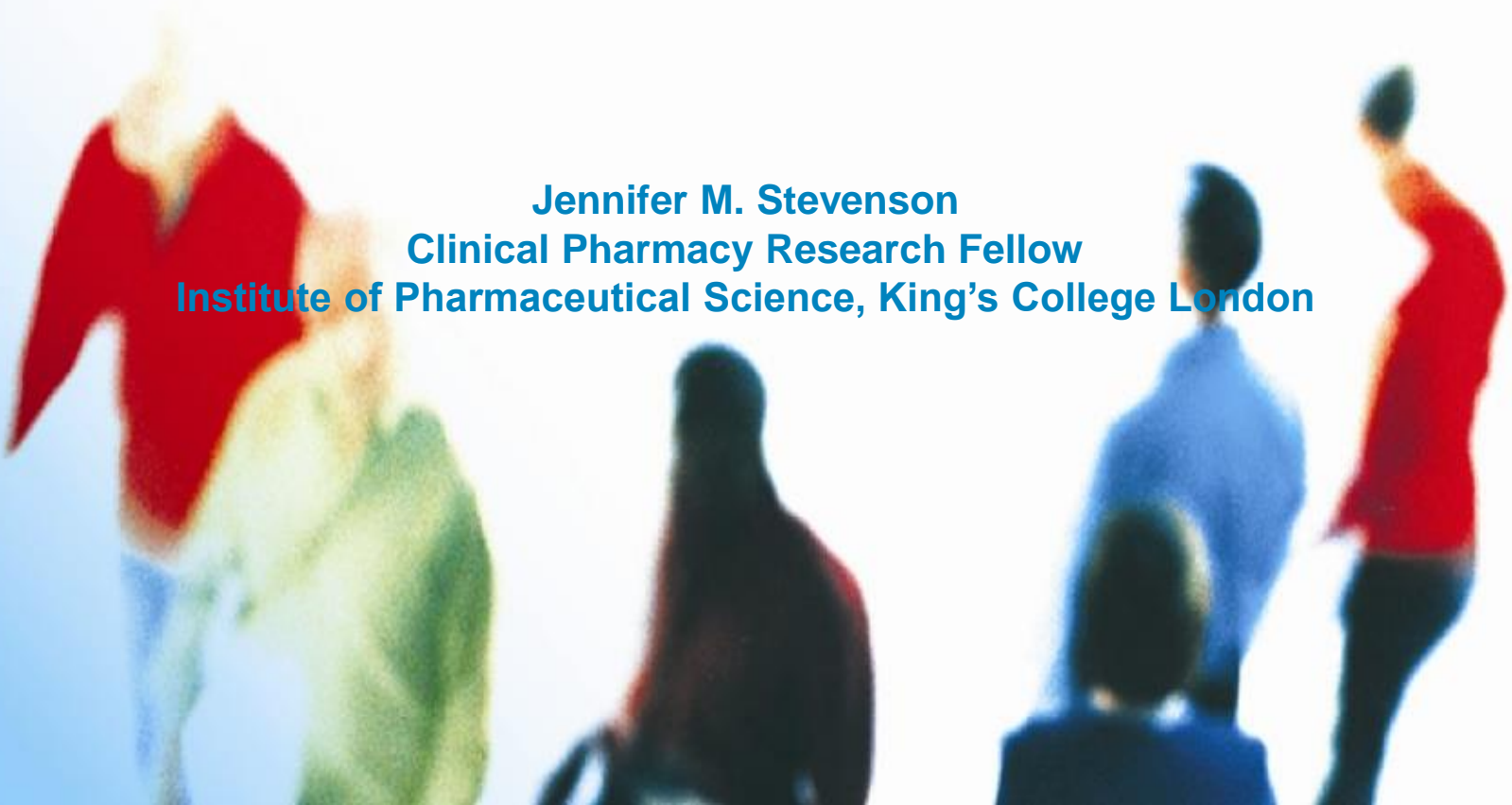


Predicting medication related harm in older adults – a review of the validated models



Jennifer M. Stevenson
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Lily Case Study: A predictable return journey?



Lives alone
Carers twice a day
Carers administer medications
Monthly dosette box delivery

Constipation
Anaemia
Hypothyroidism
Hypercholesterolaemia
Chronic back pain
Non-insulin dependent diabetic



Levothyroxine 100mcg OM
Paracetamol 1g QDS
Metformin 1g BD
Gliclazide 40mg OM
Multivitamins 1 OM
Nicotine Patch 21mg OD
Senna 15mg ON PRN

Lily Case Study: The journey



- Treated for UTI
- Poor appetite and weight loss
- New suspected lung cancer
- Metformin and gliclazide stopped

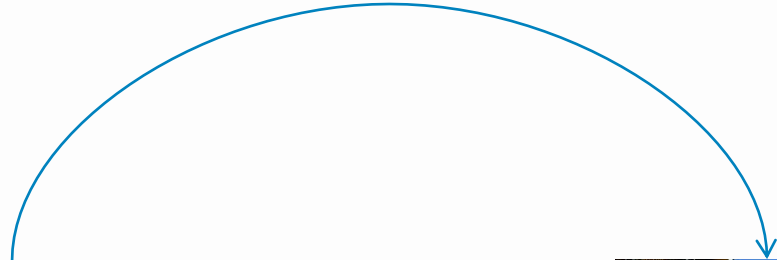
Lily Case Study: The journey

- Treated for UTI
- Poor appetite & weight loss
- New lung cancer
- Metformin & gliclazide stopped



- Discharged home
- Increased care package
- GP informed of medication changes
- One week dosette supplied

Lily Case Study: The journey



- Treated for UTI
- Poor appetite & weight loss
- New lung cancer
- Metformin & gliclazide stopped

- Discharged home
- Increased care package
- GP informed of medication changes
- One week dosette supplied



- **2 weeks after discharge**
- **Found on floor**
- **Blood sugars 1.8**

Lily Case Study: The journey



- Discharged home
- Increased care package
- GP informed of medication changes
- One week dosette supplied



- 2 weeks after discharge
- Found on floor
- Blood sugars 1.8

- Re-admitted
- Severe hypoglycaemia
- Discharge dosette finished
- Carers re-order medications

Lily Case Study: The journey

- Re-admitted within 2 weeks
- Severe hypoglycaemia
- Discharge dosette finished
- Carers re-order medications

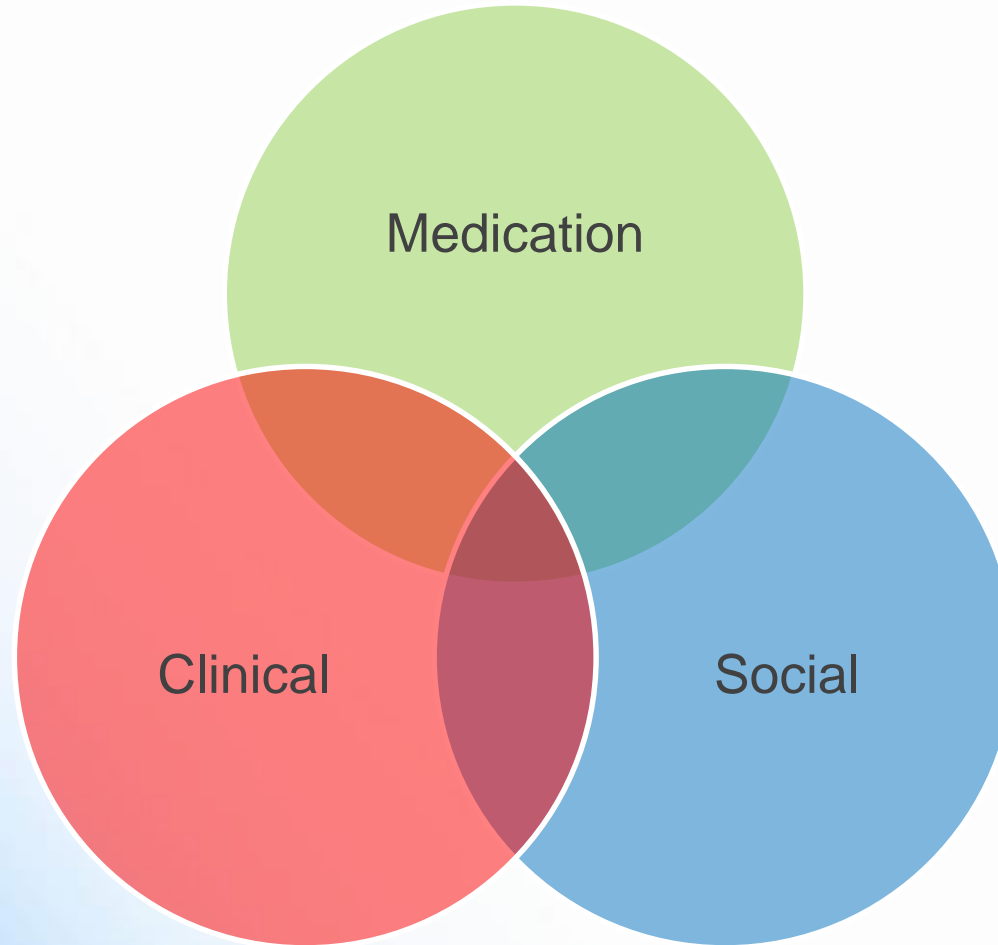


- Discharged home
- Increased care package
- GP informed of medication changes
- One week dosette supplied

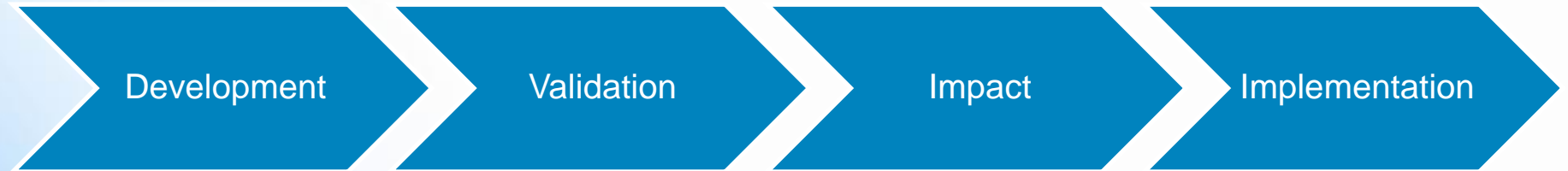


- 2 weeks after discharge
- Found on floor
- Blood sugars 1.8

Predictors of harm



Risk prediction modelling



Risk prediction modelling



1. Identification of variables
2. Univariate analysis
3. Multivariate analysis

Risk prediction modelling



1. Identification of variables
2. Univariate analysis
3. Multivariate analysis

- 1. Application of model**
- 2. Discrimination**
- 3. Calibration**

Risk prediction modelling



1. Identification of variables
2. Univariate analysis
3. Multivariate analysis

1. Application of model
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1. Comparison to routine care
2. Value in practice

Risk prediction modelling



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- 1. Comparison to routine care
- 2. Value in practice

- 1. Usability
- 2. Face validity

Risk prediction modelling



1. Identification of variables

2. Univariate analysis

3. Multivariate analysis

1. Application of model

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1. Comparison to routine care

2. Value in practice

1. Usability

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Systematic review of the risk prediction models

Aim:

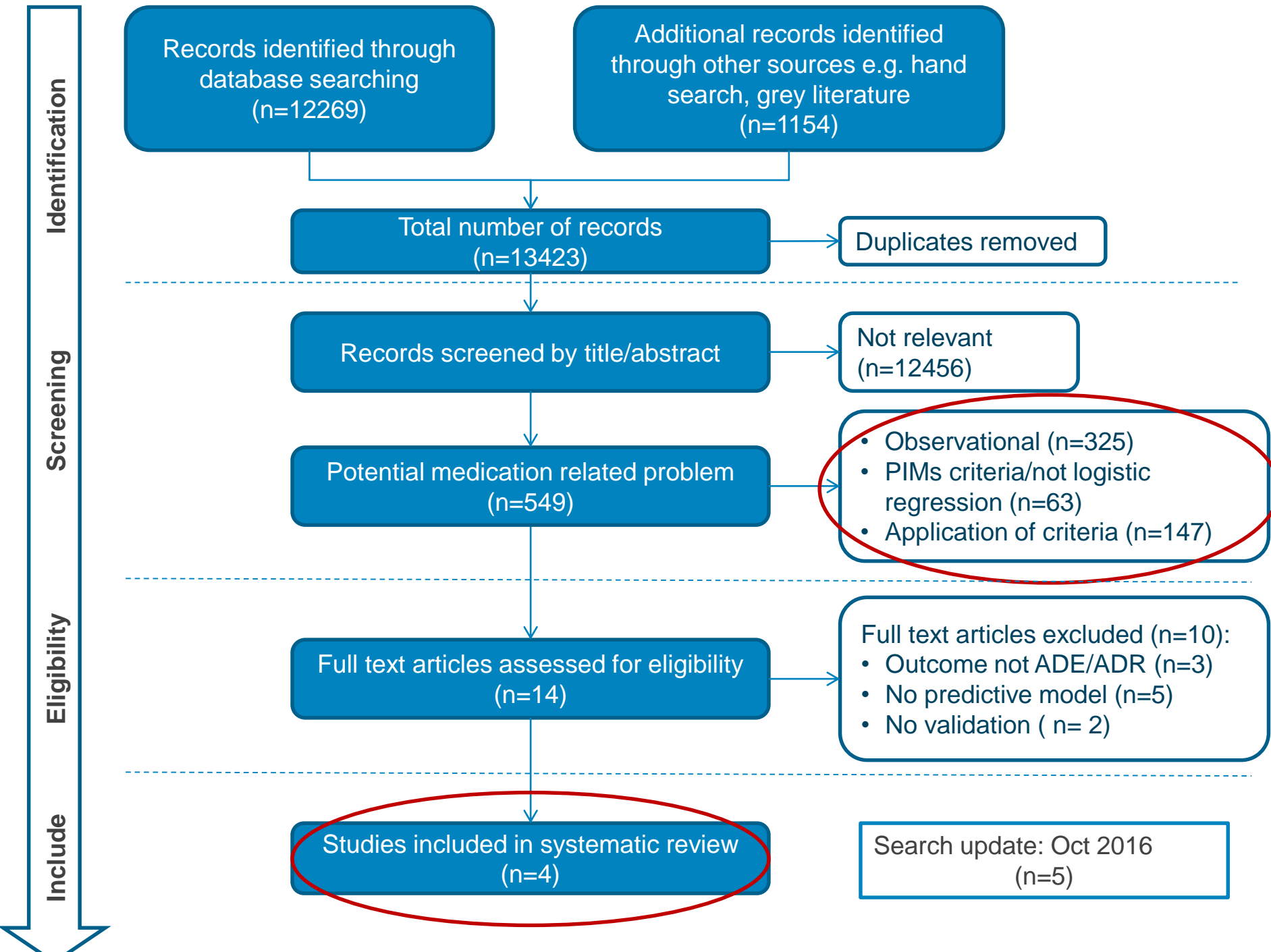
- Identify validated medication risk prediction models
- Assess quality

Inclusion criteria:

- Included a majority of patients over the age of 65 years
- Outcome measure was patients had experienced an ADE or ADR, but excluding prescription errors
- Model development followed a multivariable approach in design and analysis
- The model had been validated, externally or internal

Stevenson JM et al. Predicting Adverse Drug Reactions; A Systematic Review of the Risk Prediction Models. *Clinical Interventions in Aging*. 2014, Vol. 9, p1581-1593.

Stevenson JM et al. Predicting Medication Related Risk in the Elderly; A Review of the Validated Tools. *European Geriatric Medicine* 2012;3:S129 Doi : 10.1016/j.eurger.2012.07.319



Author/Study Design	Variables	Score	Total score (% risk)	
McElnay Prospective n = 929 No. drugs = 4.3 ADR = 16%	Prescribed antidepressants	No score developed	No score developed	
	Prescribed digoxin			
	GI problems			
	Abnormal potassium			
	Thinks drugs responsible			
	Experiences angina			
	Experiences COPD			
Tangiisuran (BADRI) Prospective n = 690 No. drugs = 7 ADR = 12.5%	Hyperlipidaemia	1	0	(3%)
	Number of drugs ≥8	1	1	(5%)
	Length of stay ≥12 days	1	2	(9%)
	Use of hypoglycaemic agent	1	3	(18%)
	High WBC on admission	1	4	(32%)
			5	(38%)
Onder (GerontoNet) Retrospective/prospective n = 5936 No. drugs = 6.3 ADR = 6.5%	≥4 comorbidities	1	0-1	(5%)
	Heart failure	1	2-3	(4%)
	Liver disease	1	4-5	(7%)
	Number of drugs 5-7	1	6-7	(12%)
	Number of drugs ≥8	4	≥8	(28%)
	Previous ADR	2		
	Renal failure	1		
Trivalle (Trivalle Geriatric Score) Prospective/retrospective n = 576 No. drugs = 9.4 ADE = 39%	Number of drugs 0-6	0	0-6	(12%)
	Number of drugs 7-9	6	7-12	(28%)
	Number of drugs 10-12	12	13-18	(35%)
	Number of drugs ≥13	18	>18	(52%)
	Antipsychotic treatment	9		
	Recent anticoagulant	7		

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Results: Quality Assessment

Standard criteria	McElnay	Tangiisuran	Onder	Trivalle	
Overall Quality	<i>Development</i>	Yes	Yes	Yes	Yes
	<i>Validation</i>	Yes	Yes	Yes	Yes
	<i>Impact</i>	No	No	No	No
	<i>Implementation</i>	No	No	No	No



Results: Model Performance

Standard criteria		McElnay	Tangiisuran	Onder	Trivalle
Model performance	<i>Development phase reported</i>	No	Yes	Partly	No
	<i>Validation</i>	Internal	External	External	Internal (bootstrap)

Internal: Testing model using original dataset

External: Testing model in new data from a different centre

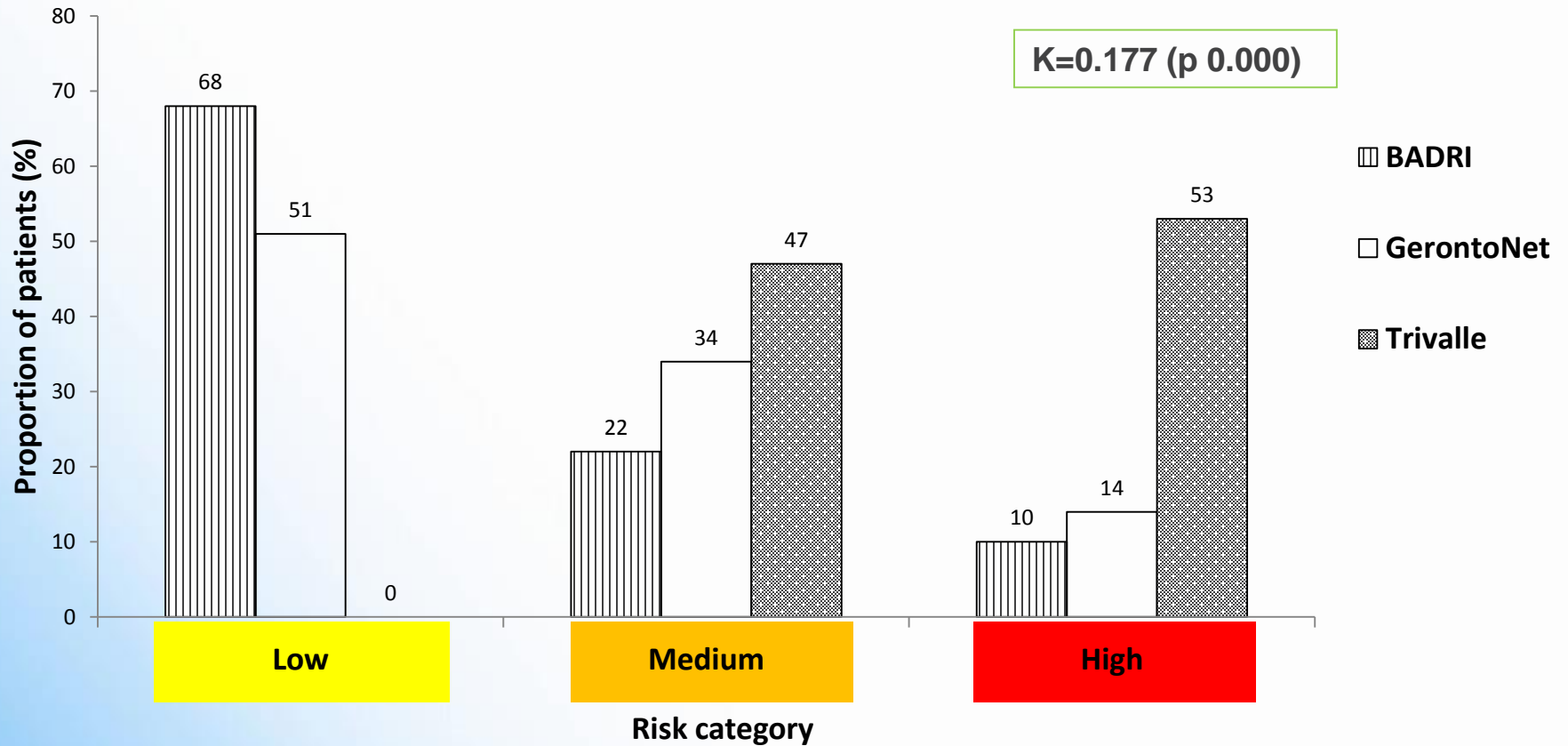
Results: Model Performance

Standard criteria		McElnay	Tangiisuran	Onder	Trivalle
Model performance	<i>Development phase reported</i>	No	Yes	Partly	No
	<i>Validation</i>	Internal	External	External	Internal (bootstrap)
		Sensitivity 40.5% Specificity 69% Accuracy 63%	Sensitivity 80% Specificity 55% AUROC 0.73	Sensitivity 68% Specificity 65% AUROC 0.70	Sensitivity not reported Specificity not reported AUROC 0.70

Sensitivity: predict patients will suffer harm, and they do

Specificity: predict patient will not suffer harm, and they do not

Model agreement



Percentage of patients stratified to low (<10%), medium (10-20%) and high (>20%) risk (n=270).

Search update: October 2016

Author/Study Design	Variables	Score	Model performance	
Nair (PADR-EC) Prospective n = 768 No. drugs = 10.8 ADR = 15%	Drug changes in preceding 3 months	2	Development phase reported	Partly
	Renal failure	2	Validation	External Sensitivity = 63% Specificity = 63% AUROC = 0.67
	Dementia	2		
	No. of antihypertensives: 1-2	- 3		
	≥3	5		
Anticholinergics	2			

The TRIPOD Statement: Reporting guidelines for prediction model studies

Predicting Risk of Medication related harm in the Elderly (PRIME)

<http://bmcgeriatr.biomedcentral.com/articles/10.1186/s12877-016-0191-8>

Acknowledgments

- King's College London
- Guy's and St. Thomas' NHS Foundation Trust
- PRIME Study Research Team



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-

Results: Model Performance

Standard criteria		McElnay	Tangiisuran	Onder	Trivalle
Participant recruitment	<i>Clear inclusion criteria</i>	Yes	Yes	Yes	Yes
	<i>No selection bias</i>	Unsure	Yes	Unsure	Unsure
	<i>Low loss to follow up</i>	Yes	Yes	Yes	Yes
Candidate predictor variables	<i>Clear predictor measurement</i>	Partly	Mostly	Partly	Partly
	<i>Blind to outcome</i>	Yes	Yes	Partly	Yes
	<i>Linear gradient</i>	Not reported	Not reported	Not reported	Yes
	<i>Collinearity test</i>	Partly	Partly	Not reported	Yes
Out-come	<i>Appropriate method</i>	Partly	Partly	Partly	Partly
Power	<i>> 10 EPVs</i>	No	No	Yes	Unsure
Variable selection	<i>Method of selection</i>	Partly	Yes	Yes	Yes
	<i>Fitting procedure reported</i>	Yes	Yes	Partly	Partly