A pharmacist-led IT intervention to reduce PIP: the PINCER trial

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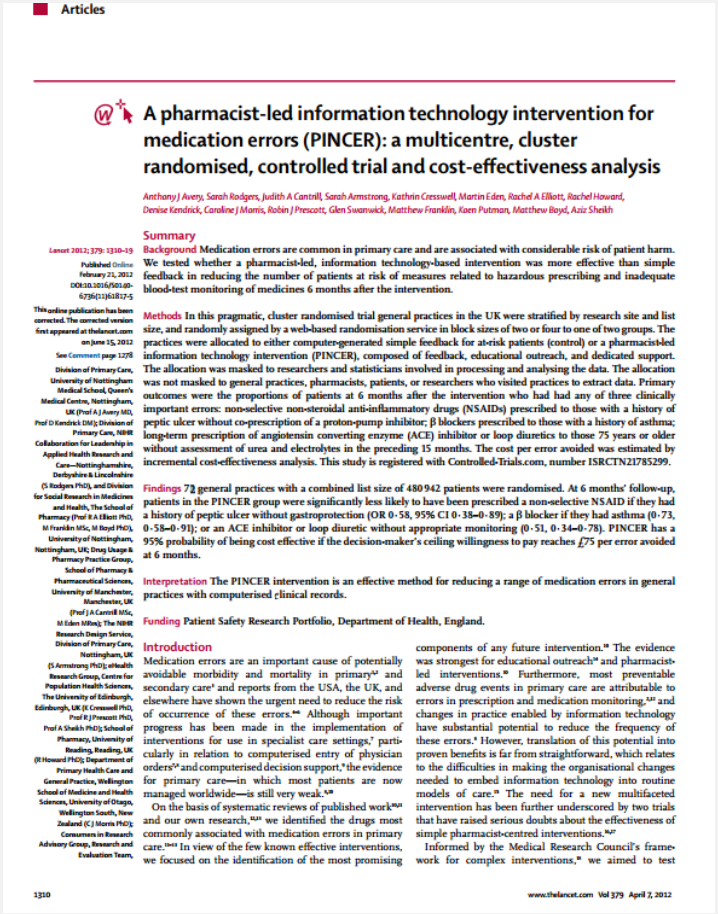
The PINCER Trial

A cluster randomised trial comparing the effectiveness of a **p**harmacist-led **I**T-based **in**tervention with simple feedback in reducing rates of **c**linically important **er**rors in medicines management in general practices



Articles

A pharmacist-led information technology intervention for medication errors (PINCER): a multicentre, cluster randomised, controlled trial and cost-effectiveness analysis

Anthony J Avery, Sarah Rodgers, Judith A Cantrill, Sarah Armstrong, Kathrin Cresswell, Martin Eden, Rachel A Elliott, Rachel Howard, Denise Kendrick, Caroline J Morris, Robin J Prescott, Glen Swanwick, Matthew Franklin, Koen Putman, Matthew Boyd, Aziz Sheikh

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DOI:10.1016/S0140-6736(11)61817-5

Summary

Background Medication errors are common in primary care and are associated with considerable risk of patient harm. We tested whether a pharmacist-led, information technology-based intervention was more effective than simple feedback in reducing the number of patients at risk of measures related to hazardous prescribing and inadequate blood-test monitoring of medicines 6 months after the intervention.

Methods In this pragmatic, cluster randomised trial general practices in the UK were stratified by research site and list size, and randomly assigned by a web-based randomisation service in block sizes of two or four to one of two groups. The practices were allocated to either computer-generated simple feedback for at-risk patients (control) or a pharmacist-led information technology intervention (PINCER), composed of feedback, educational outreach, and dedicated support. The allocation was masked to researchers and statisticians involved in processing and analysing the data. The allocation was not masked to general practices, pharmacists, patients, or researchers who visited practices to extract data. Primary outcomes were the proportions of patients at 6 months after the intervention who had had any of three clinically important errors: non-selective non-steroidal anti-inflammatory drugs (NSAIDs) prescribed to those with a history of peptic ulcer without co-prescription of a proton-pump inhibitor; β blockers prescribed to those with a history of asthma; long-term prescription of angiotensin converting enzyme (ACE) inhibitor or loop diuretics to those 75 years or older without assessment of urea and electrolytes in the preceding 15 months. The cost per error avoided was estimated by incremental cost-effectiveness analysis. This study is registered with Controlled-Trials.com, number ISRCTN21785299.

Findings 72 general practices with a combined list size of 480 942 patients were randomised. At 6 months' follow-up, patients in the PINCER group were significantly less likely to have been prescribed a non-selective NSAID if they had a history of peptic ulcer without gastroprotection (OR 0·58, 95% CI 0·38–0·89); a β blocker if they had asthma (0·73, 0·58–0·91); or an ACE inhibitor or loop diuretic without appropriate monitoring (0·51, 0·34–0·78). PINCER has a 95% probability of being cost effective if the decision-maker's ceiling willingness to pay reaches £75 per error avoided at 6 months.

Interpretation The PINCER intervention is an effective method for reducing a range of medication errors in general practices with computerised clinical records.

Funding Patient Safety Research Portfolio, Department of Health, England.

Introduction

Medication errors are an important cause of potentially avoidable morbidity and mortality in primary[1,2] and secondary care[3] and reports from the USA, the UK, and elsewhere have shown the urgent need to reduce the risk of occurrence of these errors.[4–6] Although important progress has been made in the implementation of interventions for use in specialist care settings,[7] particularly in relation to computerised entry of physician orders[8,9] and computerised decision support,[9] the evidence for primary care—in which most patients are now managed worldwide—is still very weak.[9,10]

On the basis of systematic reviews of published work[10,11] and our own research,[12,13] we identified the drugs most commonly associated with medication errors in primary care.[14–16] In view of the few known effective interventions, we focused on the identification of the most promising components of any future intervention.[10] The evidence was strongest for educational outreach[17] and pharmacist-led interventions.[10] Furthermore, most preventable adverse drug events in primary care are attributable to errors in prescription and medication monitoring,[2,12] and changes in practice enabled by information technology have substantial potential to reduce the frequency of these errors.[1] However, translation of this potential into proven benefits is far from straightforward, which relates to the difficulties in making the organisational changes needed to embed information technology into routine models of care.[18] The need for a new multifaceted intervention has been further underscored by two trials that have raised serious doubts about the effectiveness of simple pharmacist-centred interventions.[8,17]

Informed by the Medical Research Council's framework for complex interventions,[19] we aimed to test

Division of Primary Care, University of Nottingham Medical School, Queen's Medical Centre, Nottingham, UK (Prof A J Avery MD, Prof D Kendrick DM); Division of Primary Care, NIHR CoLlaboration for Leadership in Applied Health Research and Care—Nottinghamshire, Derbyshire & Lincolnshire (S Rodgers PhD), and Division for Social Research in Medicines and Health, The School of Pharmacy (Prof R A Elliott PhD, M Franklin MSc, M Boyd PhD), University of Nottingham, Nottingham, UK; Drug Usage & Pharmacy Practice Group, School of Pharmacy & Pharmaceutical Sciences, University of Manchester, Manchester, UK (Prof J A Cantrill MSc, M Eden MBeng); The NIHR Research Design Service, Division of Primary Care, Nottingham, UK (S Armstrong PhD); eHealth Research Group, Centre for Population Health Sciences, The University of Edinburgh, Edinburgh, UK (K Cresswell PhD, Prof R J Prescott PhD, Prof A Sheikh PhD); School of Pharmacy, University of Reading, Reading, UK (R Howard PhD); Department of Primary Health Care and General Practice, Wellington School of Medicine and Health Sciences, University of Otago, Wellington South, New Zealand (C J Morris PhD); Consumers in Research Advisory Group, Research and Evaluation Team,

The Lancet, 2012;379:1310 – 1319 doi:10.1016/S0140-6736(11)61817-5

Main research question

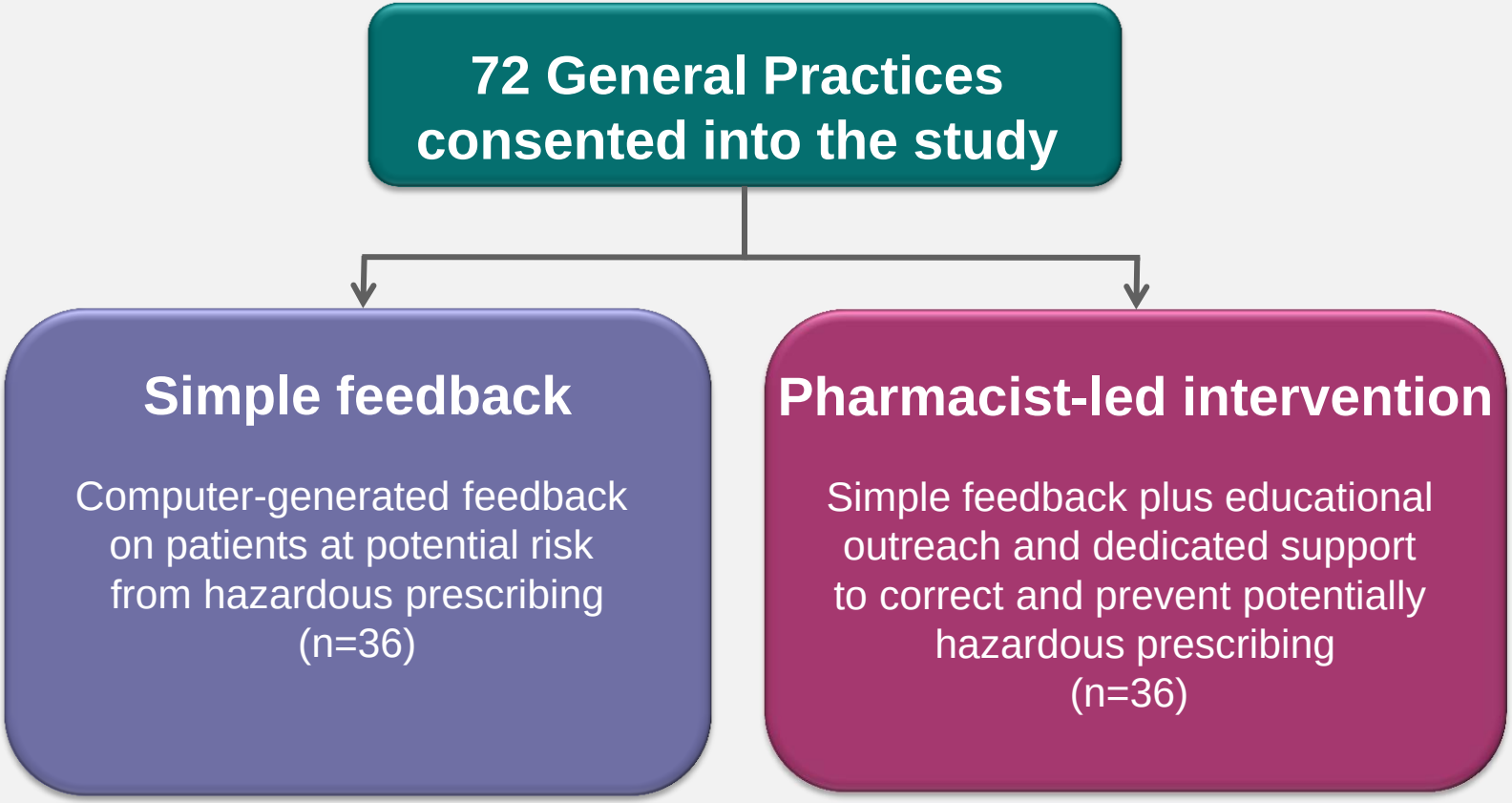
Is a pharmacist-led IT-based complex intervention using educational outreach and practical support more effective than simple feedback in reducing rates of clinically important errors in medicines management in general practice?

Overview

- The study involved at-risk patients in 72 general practices who were being prescribed drugs that are commonly and consistently associated with medication errors

- These included the prescription of NSAIDs and beta blockers, and the monitoring of ACE inhibitors or loop diuretics, methotrexate, lithium, warfarin, and amiodarone

Cluster randomised trial



PINCER findings

- At 6-months follow-up patients in the PINCER group were
  - 42% less likely to have been prescribed a nonselective NSAID if they had a history of peptic ulcer without gastroprotection
  - 27% less likely to be given a beta blocker if they had asthma
  - Almost 50 % less likely to be prescribed an ACE inhibitor or loop diuretic without appropriate monitoring
  - The intervention also improved composite prescribing and monitoring outcomes
- Using GP computer systems to identify patients at risk, combined with a pharmacist intervention, can substantially reduce medication errors
- There was evidence that the intervention was cost-effective
- The intervention could be rolled out across NHS at low cost to reduce prescribing errors

What next after PINCER?

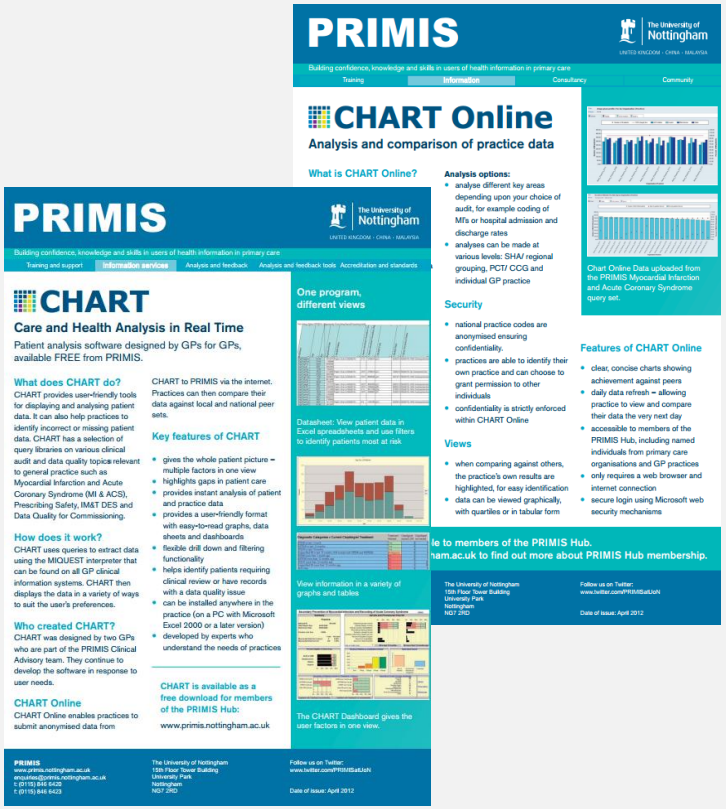
- We are involved in a substantial body of research that is having an influence on policy and practice
- We now have a great opportunity to develop things further through current opportunities
- PINCER was “proof of principle”
- In terms of taking the PINCER work forward, we now want to focus on:
  - Rollout of the PINCER prescribing safety indicators
  - Which prescribing safety indicators are the most important/most cost-effective
  - Whether the PINCER approach reduces morbidity

Rollout of PINCER indicators

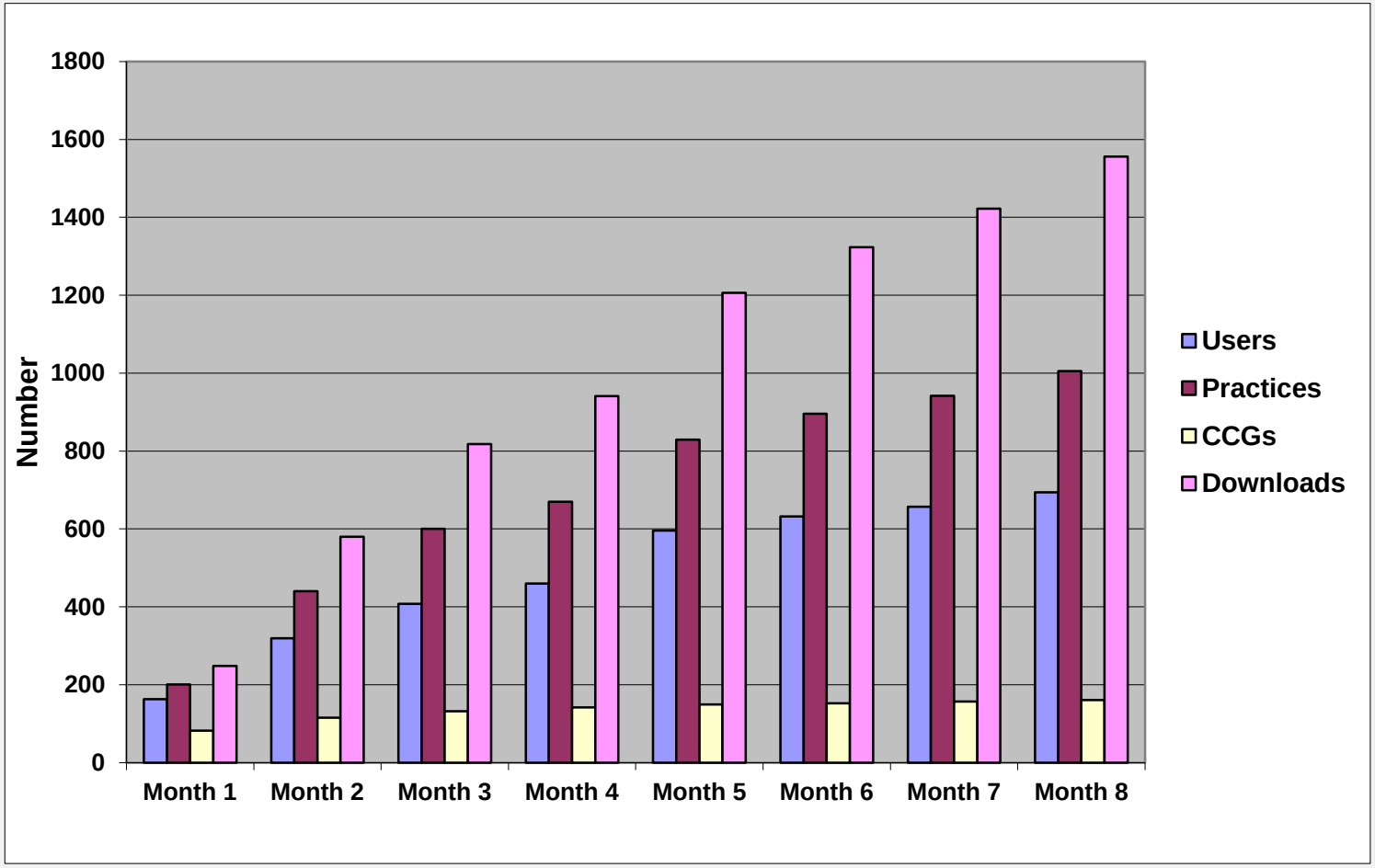
Stage 1: Update PINCER indicators and make them available to general practices in England

- We have worked with Primary Care Information Services (PRIMIS) to update the MIQUEST computer queries used in the PINCER trial and have made them available to general practices in England through the PRIMIS Query Library

- We have developed web-based general practice/CCG views of aggregated anonymised patient level data using CHART online



PINCER Query Library downloads



General Practice view

Data extracted on 27/01/13 using Reference date 30/11/12

PRIMIS **CHART** care and health analysis in real time — The University of Nottingham

PINCER QUERY SET

PEPTIC ULCER, NSAID AND PPI

PATIENTS AT RISK *(hover over figure for full description)*	3

FURTHER DETAILS

			Prescribed NSAID in the last 6 months		Not prescribed NSAID in last 6 months
Patients aged 18 or over with a Peptic Ulcer Read code that is dated over 6 months ago (All these patients can be seen on the datasheet)	339	equals	7	plus	332
	100.00%		2.06%		97.94%
			OF WHICH		
	equals		equals		equals
Prescription of PPI dated within the last 6 months	83	equals	4	plus	79
	100.00%		4.82%		95.18%
	plus		plus		plus
No prescription of PPI dated within the last 6 months	256	equals	3	plus	253
	100.00%		1.17%		98.83%

These patients can be indentified by using preset filter 1 on the datasheet

Patients with Peptic Ulcer AND who have no prescription of PPI in the last 6 months	256
Of which have a prescription for NSAID in the last 6 months.	3
Percentage	1.17%

MIQUEST response file PEPREPA.CSV was created on 30/11/12 using Refdate 30/11/12
PINCER PEPREPA: Peptic Ulcer REPORT (Pseudonymised)

Reference	Age	Sex	Active	Registered Date	Earliest PU Code to 6M ago	Earliest PU Date to 6M ago	Latest PU Code to 6M ago	Latest PU Date to 6M ago	Latest NSAID Code 6M-0M	Latest NSAID Date 6M-0M	Latest PPI Code 6M-0M	Latest PPI Date 6M-0M	Category	denominator	enumerator
64725898CD	81	M	R	06/10/98	J12	09/07/01	J12	01/08/01			a6b1	07/11/12	NSAID not prescribed and PPI prescribed		
D3207A5971	78	M	R	01/03/99	J12	21/12/76	J12	21/12/76					NSAID not prescribed and PPI not prescribed	1	
E5EFAF886E	73	M	R	20/04/99	J13	01/10/65	J13	01/10/65			a6b7	09/10/12	NSAID not prescribed and PPI prescribed		
6985970E3E	76	M	L	23/06/10	J1210	01/05/99	J1210	01/05/99					NSAID not prescribed and PPI not prescribed	1	
09CF9D9E94	69	M	L	19/02/09	J11	01/01/62	J11	01/01/62					NSAID not prescribed and PPI not prescribed	1	
C487D710EA	61	M	L	02/12/99	J11z	24/02/09	J11z	23/11/09					NSAID not prescribed and PPI not prescribed	1	
3A54091579	89	M	R	09/12/99	J1202	05/03/47	J1202	05/03/47					NSAID not prescribed and PPI not prescribed	1	
2D20158743	85	F	R	09/12/99	J13	08/05/52	J121z	09/02/67					NSAID not prescribed and PPI not prescribed	1	
29E0A658FC	83	M	R	10/07/00	J12	01/01/88	J12	01/01/88			a6hz	19/10/12	NSAID not prescribed and PPI prescribed		
4AA86CC852	54	F	R	12/10/00	J12	29/04/09	J12	29/04/09			a6c2	22/10/12	NSAID not prescribed and PPI prescribed		
DCCA249407	81	F	R	20/11/00	J12	04/07/63	J12	04/07/63			a6b1	05/09/12	NSAID not prescribed and PPI prescribed		
B696907C06	69	M	R	05/03/01	J1212	01/01/75	J1212	01/01/75					NSAID not prescribed and PPI not prescribed	1	
8197041D56	47	M	R	16/05/01	J13	30/06/11	J13	24/01/12			a6b1	29/10/12	NSAID not prescribed and PPI prescribed		
6A0E220D7F	92	F	R	28/08/01	J11	01/01/03	J11y	17/05/04			a6b1	05/11/12	NSAID not prescribed and PPI prescribed		
1DA12F4845	92	F	R	24/04/02	J121y	10/07/81	14C1	12/03/02			a6c2	12/11/12	NSAID not prescribed and PPI prescribed		
5E479C1016	62	M	R	20/12/01	J12	01/01/79	J12	01/01/79			a6c2	27/11/12	NSAID not prescribed and PPI prescribed		
B15A81CF36	85	F	R	09/01/02	J12	15/07/11	J12	15/07/11			a6c2	08/10/12	NSAID not prescribed and PPI prescribed		
7A8DA856FA	36	M	L	29/01/02	J123	08/01/04	J123	08/01/04					NSAID not prescribed and PPI not prescribed	1	
66FDE559CA	39	M	R	23/05/02	J13z	09/08/00	J13z	09/08/00	j2ck	10/09/12			NSAID prescribed but PPI not prescribed	1	1
DD19099DF4	73	M	L	10/06/02	J11z-1	08/02/94	J11z-1	11/07/94					NSAID not prescribed and PPI not prescribed	1	
ADED58E61D	96	F	D	23/07/02	J12	01/01/63	J12	01/01/63					NSAID not prescribed and PPI not prescribed	1	
CDD1B9D098	61	M	R	07/08/02	J1202	01/01/82	J1202	01/01/82			a6c3	17/10/12	NSAID not prescribed and PPI prescribed		
C45C464AA9	85	F	D	15/08/02	J11	05/02/08	J11	05/10/10					NSAID not prescribed and PPI not prescribed	1	

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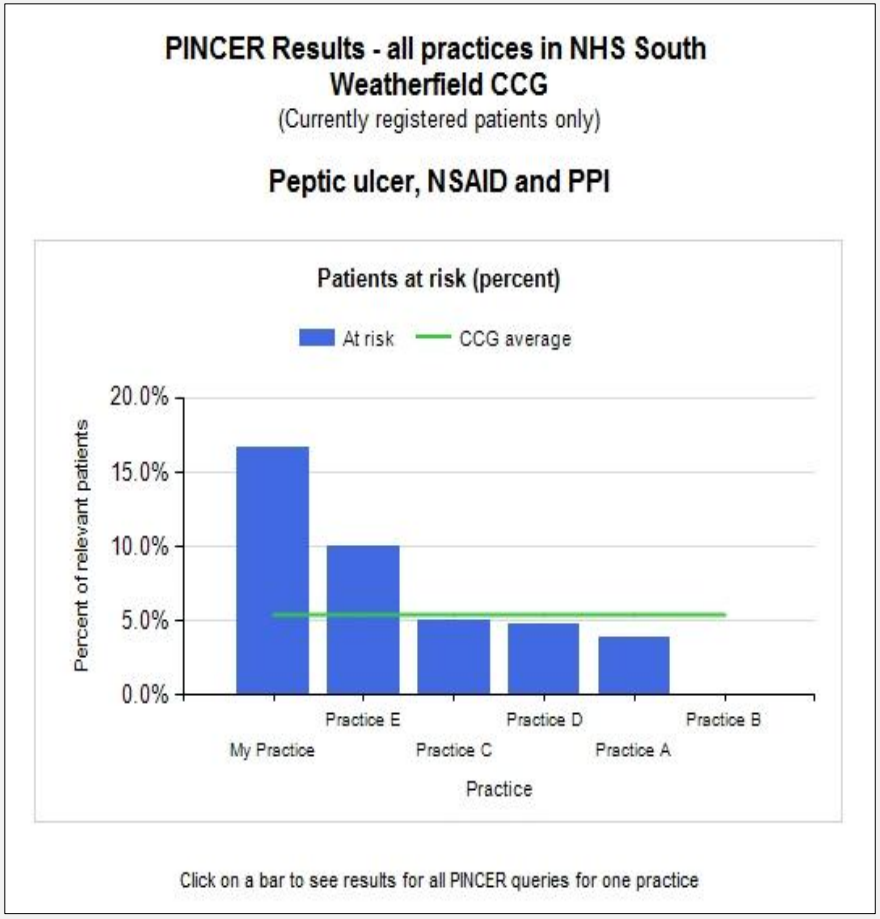
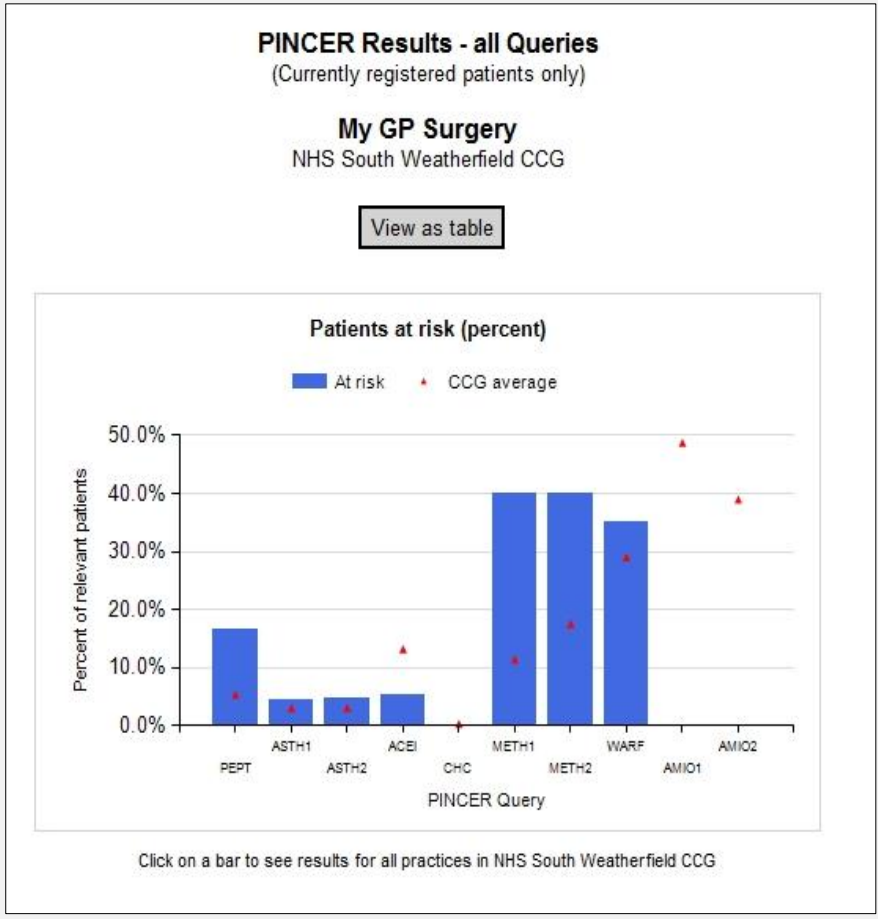
66FDE559CA	39	M	R	23/05/02	J13z	09/08/00	J13z	09/08/00	j2ck	10/09/12			NSAID prescribed but PPI not prescribed	1	1
A1EB2EBAE8	52	M	R	02/03/12	J11	01/01/84	J11	01/01/84	j202	14/11/12			NSAID prescribed but PPI not prescribed	1	1
580D37D359	53	M	R	25/01/11	J12z	01/01/05	J12z	01/01/05	j202	25/06/12			NSAID prescribed but PPI not prescribed	1	1

General practice/CCG view





General practice/CCG view

PRIMIS **CHART Online** The University of Nottingham

PINCER Results - all queries
(Currently registered patients only)

GP Surgery 1
NHS South Weatherfield CCG

View as chart | Up to all practices

PINCER Query Click on query to view evidence base	Patients at risk	Percent at risk	Trend	CCG Average	Quartile
Peptic ulcer, NSAID and no PPI	3	3.8	↓	5.4	1
Asthma (all) and β-blockers	47	2.9	↓	3.1	1
Asthma (unresolved) and β-blockers	47	2.9	↓	3.1	1
ACEI, loop diuretics and no monitoring	8	2.2	↓	13.2	1
Thrombosis and CHC	1	0.4	–	0.3	3
Methotrexate and no FBC	0	0.0	–	11.5	1
Methotrexate and no LFTs	2	6.5	↓	17.6	1
Warfarin and no INR	1	0.8	–	29.1	1
Lithium and no level recording	5	29.4	↑	34.0	1
Amiodarone and no TFTs, no thyroxine	2	40.0	↓	48.8	2
Amiodarone and no TFTs, with thyroxine	2	40.0	↓	39.0	2

Rollout of PINCER indicators

Stage 2: Develop further query libraries

- We are working with PRIMIS to develop further query libraries based on 56 RAND approved prescribing safety indicators developed for the RCGP
- We have conducted an E-Delphi exercise to identify potential harm and likelihood of hazardous prescribing for the 56 indicators
- We have identified 15 of the most important indicators (in terms of severity and frequency) from this exercise (PINCER+)

Rollout of PINCER indicators

Stage 3: Pilot the prescribing safety indicator query libraries

- We are about to start piloting the acceptability, technical feasibility, reliability, and validity of the prescribing safety indicators in one Clinical Commissioning Group (CCG)
- We plan to explore the prevalence of “at-risk” patients for the 15 most important RCGP indicators using an analysis of the QResearch database
- We are collaborating with the University of Manchester to apply the prescribing safety indicators in the Salford integrated (primary & secondary care) healthcare dataset and Clinical Practice Research Datalink (CPRD)
- We are working with PRIMIS to facilitate a PINCER rollout in N. Ireland

Rollout of PINCER indicators

Stage 4: Economic modelling

- We have just received further funding from the NIHR School for Primary Care Research to model the cost effectiveness of different prescribing safety indicators to identify those indicators that are likely to be the most cost-effective

PINCER resources

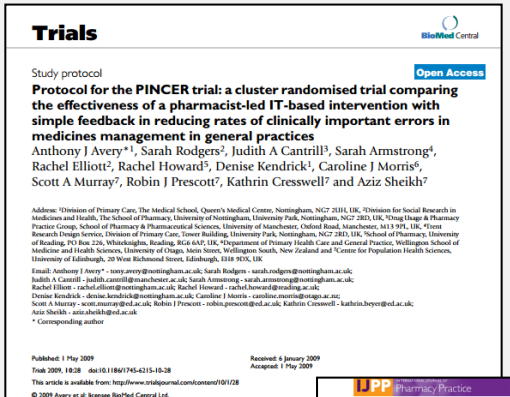
- eLearning materials developed as a result of the PINCER study: http://www.pulse-learning.co.uk/commissioning-modules/commissioning/how-we-reduced-prescribing-errors-with-pharmacists-support

- Details showing how general practices can download the computer queries used in the PINCER trial: Rodgers S. *New PINCER Query Library Tool to support safer prescribing.* Prescriber 2013; 24(6): 11-14 (19 March 2013) DOI: 10.1002/psb.1027 http://onlinelibrary.wiley.com/doi/10.1002/psb.1027/pdf

- Rodgers S. Five steps to reducing prescribing errors using PINCER. Pulse Today 12 February 2013 http://www.pulsetoday.co.uk/your-practice/practice-topics/it/-five-steps-to-reducing-prescribing-errors-using-pincer/20001835.article

- To download queries go to:
  http://www.primis.nottingham.ac.uk/index.php/news/hot-news/813

PINCER publications



Trials

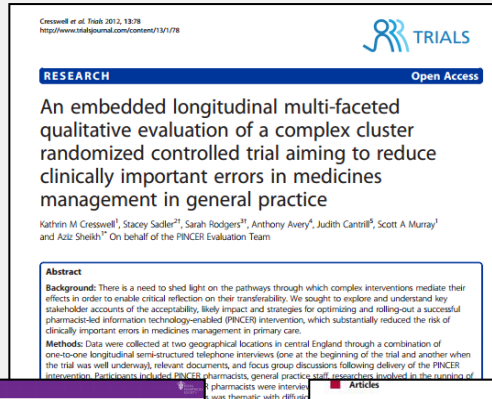
BioMed Central

Study protocol

Open Access

Protocol for the PINCER trial: a cluster randomised trial comparing the effectiveness of a pharmacist-led IT-based intervention with simple feedback in reducing rates of clinically important errors in medicines management in general practices

Anthony J Avery*[1], Sarah Rodgers[2], Judith A Cantrill[3], Sarah Armstrong[4], Rachel Elliott[2], Rachel Howard[5], Denise Kendrick[1], Caroline J Morris[6], Scott A Murray[7], Robin J Prescott[7], Kathrin Cresswell[7] and Aziz Sheikh[7]



Cresswell et al. Trials 2012, 13:78
http://www.trialsjournal.com/content/13/1/78

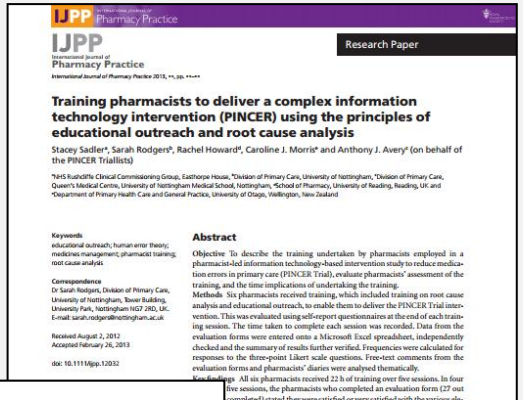
TRIALS

RESEARCH

Open Access

An embedded longitudinal multi-faceted qualitative evaluation of a complex cluster randomized controlled trial aiming to reduce clinically important errors in medicines management in general practice

Kathrin M Cresswell[1], Stacey Sadler[2†], Sarah Rodgers[3†], Anthony Avery[4], Judith Cantrill[5], Scott A Murray[1] and Aziz Sheikh[1*] On behalf of the PINCER Evaluation Team

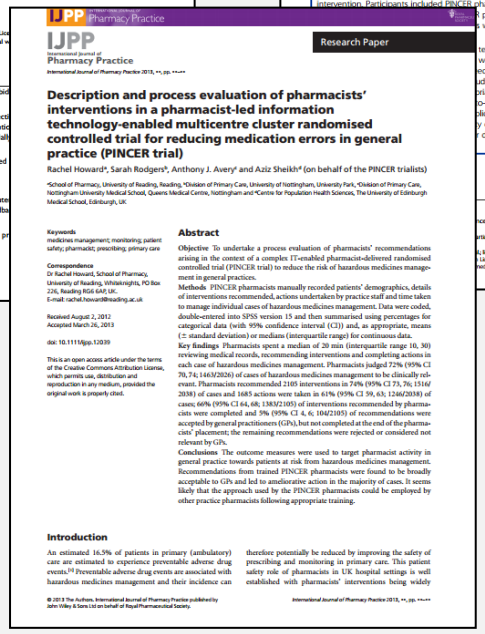


IJPP International Journal of Pharmacy Practice

Research Paper

Training pharmacists to deliver a complex information technology intervention (PINCER) using the principles of educational outreach and root cause analysis

Stacey Sadler[a], Sarah Rodgers[b], Rachel Howard[a], Caroline J. Morris[a] and Anthony J. Avery[a] (on behalf of the PINCER Triallists)

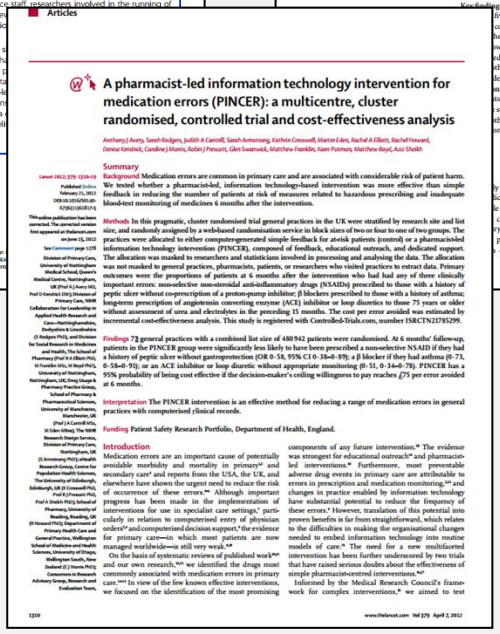


IJPP International Journal of Pharmacy Practice

Research Paper

Description and process evaluation of pharmacists' interventions in a pharmacist-led information technology-enabled multicentre cluster randomised controlled trial for reducing medication errors in general practice (PINCER trial)

Rachel Howard[a], Sarah Rodgers[b], Anthony J. Avery[a] and Aziz Sheikh[a] (on behalf of the PINCER trialists)



Articles

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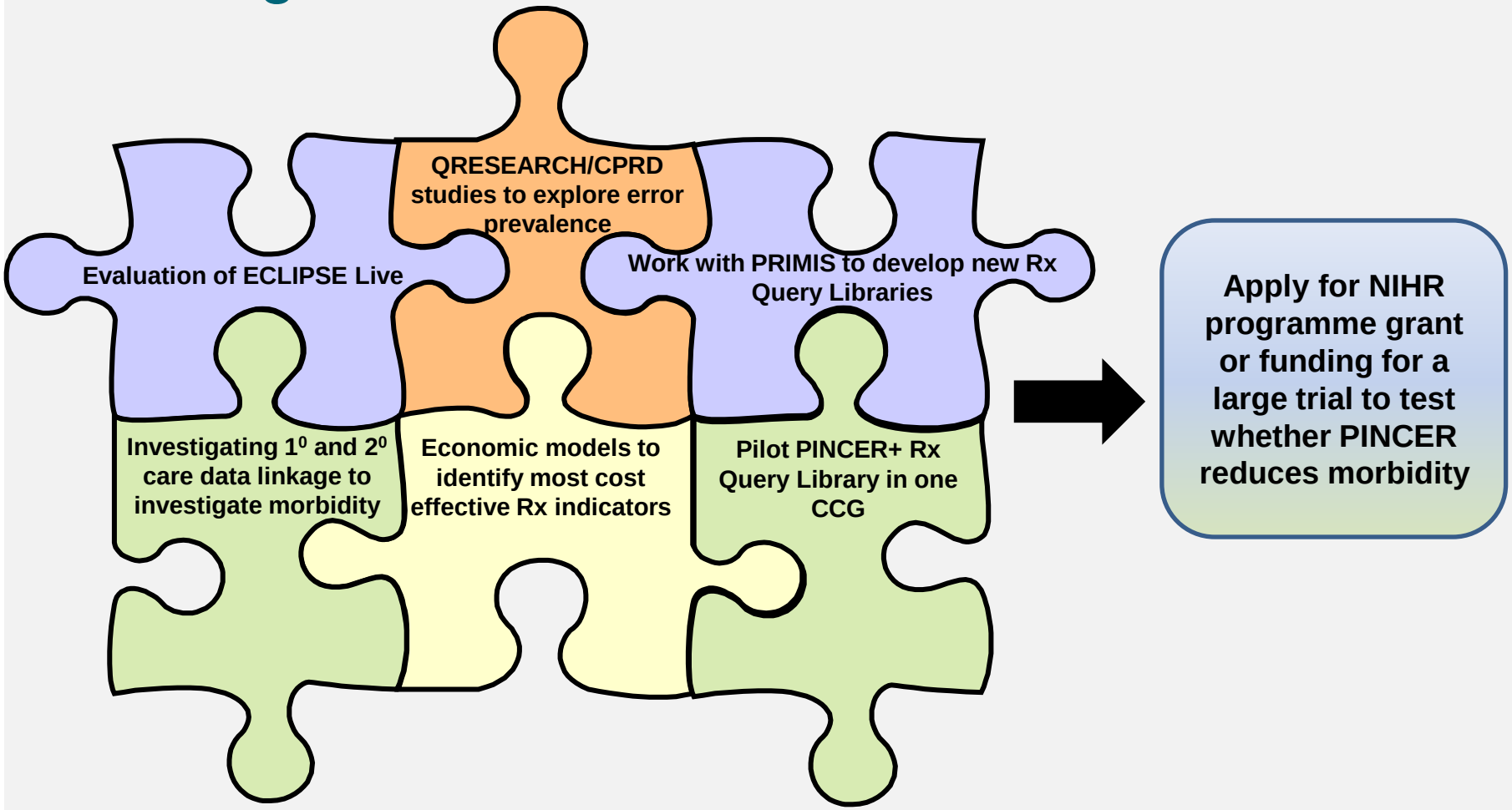
Further work

- PINCER indicators embedded into the ECLIPSE Live software

- Draws uploads from GP systems overnight
- Stores anonymised data on eclipse
- Allows medicines management to get live prescribing data
- Allows feedback on hazardous prescribing
- Has the ability to link primary and secondary care data
- We have just been successful in obtaining funding to carry out an evaluation of ECLIPSE software in 1 CCG

Programme of work for next 6-12 months



Thank you for listening

For further information please visit our website:
http://www.nottingham.ac.uk/research/groups/medicinesafetyeffectivehealthcare/index.aspx

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Professor Tony Avery
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