

Implementation research: Study designs and methods

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Implementation research

- “Research that aims to inform policy decisions about how best to use resources to improve the uptake of research findings by testing approaches to change professional and organisational behaviour.”



Designing a quality improvement intervention: a systematic approach

M A van Bokhoven, G Kok, T van der Weijden

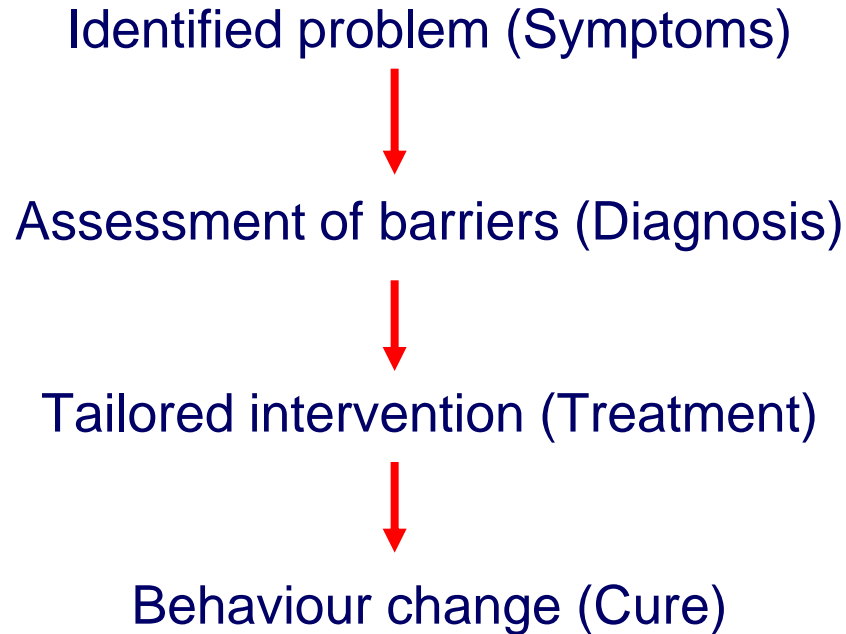
Qual Saf Health Care 2003;12:215–220

Most quality improvement or change management interventions are currently designed intuitively and their results are often disappointing. While improving the effectiveness of interventions requires systematic development, no specific methodology for composing intervention strategies and programmes is available. This paper describes the methodology of systematically designing quality of care improvement interventions, including problem analysis, intervention design and pretests. Several theories on quality improvement and change management are integrated and valuable materials from health promotion are added. One method of health promotion—intervention mapping—is introduced and applied. It describes the translation of knowledge about barriers to and facilitators of change into a concrete intervention programme. Systematic development of interventions, although time consuming, appears to be worthwhile. Decisions that have to be made during the design process of a quality

improvement intervention are discussed. It precedes the choice of its contents. However, it is generally accepted that, to be effective, interventions should be targeted at specific barriers to and facilitators of change.^{4,6,7} Systematic development of interventions and tailoring their content and format to the specific features of a target group and setting seems necessary to improve the effectiveness of patient care.

Steps to improve quality of care have been described as a cyclical process (fig 1).^{6,8,9} While the problem analysis step has been specified in the literature by several authors,^{6,10,11} the literature on quality improvement research so far provides little information on the systematic translation of knowledge about barriers to and facilitators of change into concrete quality improvement interventions. This paper focuses on the methodology of designing and pretesting such interventions. It addresses the question of how to link an intervention to the target problem in a transparent way. Several theories are described, both from the field of quality improvement and change management and from that of health promotion. As an example we use a quality improvement project on the problem of unneces-

Selecting interventions



Bokhoven MA, Kok G, Weijden T van der. Qual Safety Health Care 2003;12:215-20.





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Key messages

- If you focus on effect evaluation
- With quantitative methods
- RCT is golden standard, but
- One size fits all? NO
- Tailor to aim (efficacy vs effectiveness)
- Tailor to stakeholders and resources
- Keep it simple



How to do it?

- Effect evaluation -> Indicators
 - Structure
 - Process
 - Outcome
- Process evaluation
 - Per protocol analysis
- Economic evaluation



How to do it?

Examples of additional CONSORT criteria:

- Intervention: Describe extra resources added to usual settings to implement
- Sample size: use minimally important difference for policy makers

Zwarenstein M et al. Improving the reporting of pragmatic trials: extension of the CONSORT statement. BMJ 2008;337:a2390.



How to do it?

“Can it work?” – “Does it work?”

- Pragmatic – explanatory trials
- Efficacy – effectiveness

Zwarenstein M et al. Improving the reporting of pragmatic trials: extension of the CONSORT statement. BMJ 2008;337:a2390.



Question	Efficacy	Effectiveness
Setting	Ideal setting	
Participants	Highly selected	
Intervention	Strictly enforced, adherence monitored	
Outcomes	Short-term surrogates	
Relevance	Indirect	



Question	Efficacy	Effectiveness
Setting	Ideal setting	Normal practice
Participants	Highly selected	No selection beyond the clinical indication or preference
Intervention	Strictly enforced, adherence monitored	Applied flexibly
Outcomes	Short-term surrogates	Directly relevant to funders, communities
Relevance	Indirect	Directly relevant to practice



Continuum pragmatic - explanatory

- Thorpe et al. J Clin Epidemiol 2009;62:464-475 (PRECIS tool)
- Karanicolos et al. J Clin Epidemiol 2009;62:479-484
- Oxman et al. J Clin Epidemiol 2009;62:485-488
- Oxman et al. J Clin Epidemiol 2009;62:495-498



pragmatic” in this domain. On the other hand, if compliance is part of the intervention (e.g., audit and feedback), this domain would, appropriately, move to a more explanatory approach if audit and feedback could not be similarly applied as part of the intervention in usual circumstances.

Practitioner adherence to study protocol

A pragmatic approach takes account of the fact that practitioners will vary in how they implement an intervention. A purely pragmatic approach therefore, would not be concerned with how practitioners vary or “customize” a trial protocol to suit their setting. By monitoring and (especially) reacting on protocol nonadherence, a trial shifts towards being more explanatory:

- Adherence measured (indirectly) purely for descriptive purposes at the conclusion of the trial
- Adherence data measured and fed back to practitioners
- Uniform adherence-improving strategies are applied to all practitioners
- Adherence-improving strategies applied to practitioners with documented poor adherence.

Analysis of the primary outcome

While the pragmatic trial is concerned with the question, “Does the intervention work under usual conditions? Assuming other aspects of a trial have been treated in a pragmatic fashion, an analysis that makes no special allowance for noncompliance, nonadherence, practice

restrictions should have very little impact. A purely pragmatic approach would not consider these restricted analyses.

5. Examples

To demonstrate the use of the tool, we have applied the instrument to four trials exhibiting varying degrees of pragmatic and explanatory approaches. Table 2 describes how these trials addressed the 10 domains previously described. As we have stated previously, PRECIS is intended to be

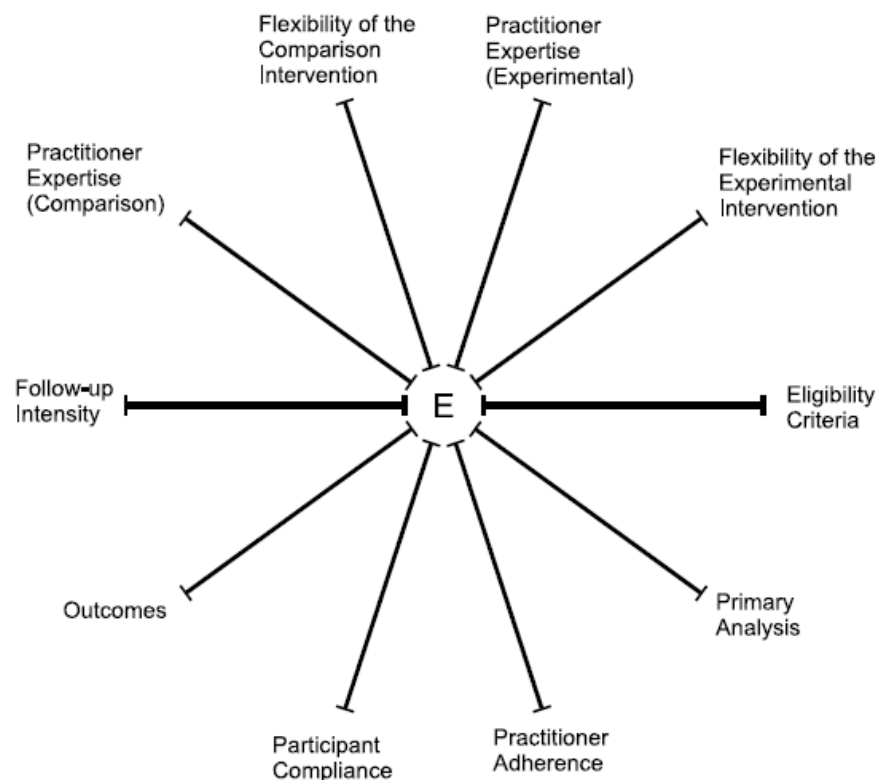


Fig. 1. The blank pragmatic–explanatory continuum indicator summary (PRECIS) “wheel.”

How to do it?

Randomised vs non-randomised?

“Poorly controlled studies more likely to show effect than well controlled studies in review of interventions to improve prescribing.”

Soumerai et al. Improving drug prescribing in primary care: a critical analysis of the experimental literature. Milbank Quarterly 1989;67:268-317.

Craig P et al. Developing and evaluating complex interventions: the new Medical Research Council guidance. BMJ 2008;337:a21655.



Clustered trials

Unit of:

randomisation

data collection

analysis

1 professional

- professional

- professional

2 professional

- patient

- professional

3 professional

- patient

- patient

4 group of prof.

- patient

- professional



How to do it?

Why not patient randomised trials?

- This may be less valid for behavioural change studies.
- Danger that treatment given to control patients will be contaminated by professionals' experience of applying the guideline to patients in the experimental group.



A few examples

- Case 1 Non-controlled cluster trial
- Case 2 Clustered RCT
- Case 3 Complex clustered RCT
- Case 4 Complex clustered RCT



Study protocol

Open Access

Introduction of a breast cancer care programme including ultra short hospital stay in 4 early adopter centres: framework for an implementation study

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Involving patients in cardiovascular risk management with nurse-led clinics: a cluster randomized controlled trial

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ABSTRACT

Background: Preventive guidelines on cardiovascular risk management recommend lifestyle changes. Support for lifestyle changes may be a useful task for practice nurses, but the effect of such interventions in primary prevention is not clear. We examined the effect of involving patients in nurse-led cardiovascular risk management on lifestyle adherence and cardiovascular risk.

Methods: We performed a cluster randomized controlled trial in 25 practices that included 615 patients. The intervention consisted of nurse-led cardiovascular risk management, including risk assessment, risk communication, a decision aid and adapted motivational interviewing. The control group received a minimal nurse-led intervention. The self-reported

know whether the delivery of primary prevention programs by practice nurses is effective. We also do not know the effect of nurse-led prevention, including shared decision making and risk communication, on cardiovascular risk.

Because an unhealthy lifestyle plays an important role in the development of cardiovascular disease,^{9,10} preventive guidelines on cardiovascular disease and diabetes recommend education and counselling about smoking, diet, physical exercise and alcohol consumption for patients with moderate and highly increased risk.^{6,11} These patients are usually monitored in primary care practices. The adherence to lifestyle advice ranges from 20% to 90%,¹²⁻¹⁵ and improving adherence requires effective interventions, comprising cognitive, behavioural and affective components (strategies to influence

Table 1: Characteristics of the general practices, nurses and patients included in the study of nurse-led interventions for cardiovascular risk management

Group; baseline characteristic	Mean (SD)*	
	Intervention	Control
Practice	<i>n</i> = 13	<i>n</i> = 11
No. of patients per practice	7894 (6642)	6729 (3076)
No. of general practitioners per practice	4 (3)	4 (1)
Practice nurses	<i>n</i> = 13	<i>n</i> = 11
Age, yr	38 (7)	39 (9)
Sex, female, no. (%) of nurses	13 (100)	11 (100)
Work experience as a practice nurse focused on:		
Diabetes		
Yes, no. (%) of nurses	8 (53)	9 (82)
No. of years	3.4 (1.3)	3.8 (1.4)
Cardiovascular risk		
Yes, no. (%) of nurses	12 (80)	9 (82)
No. of years	1.8 (1.3)	1.6 (1.0)
Hypertension		
Yes, no. (%) of nurses	12 (80)	8 (73)
No. of years	3.7 (5.3)	2.7 (1.3)
General or other		
Yes, no. (%) of nurses	11 (73)	8 (73)
No. of years	4.4 (5.0)	5.1 (4.5)
Full-time equivalent	0.46 (0.2)	0.64 (0.2)
Patients	<i>n</i> = 304	<i>n</i> = 285
Age, yr	56 (10)	58 (10)
Sex, male, no. (%)	130 (43)	134 (47)
Socio-economic status, no. (%)		
High	76 (26)	58 (21)
Intermediate	123 (42)	105 (38)
Low	92 (32)	112 (41)
Smokers, no. (%)	100 (34)	53 (19)‡
Systolic blood pressure (mm Hg)	144 (19)	150 (19)‡
Hypertension, † no. (%)	186 (62)	198 (71)§
Cholesterol ratio	4.5 (1.4)	4.6 (1.4)
LDL cholesterol, mmol/L	3.7 (1.0)	3.8 (1.0)
Hypercholesterolemia, † no. (%)	151 (51)	104 (37)‡
Glucose, mmol/L	5.8 (1.0)	6.0 (1.6)
Diabetes, no. (%)	34 (11)	49 (17)§
Family history of cardiovascular disease, no. (%)	138 (45)	95 (33)
Body mass index	29 (4.9)	29 (5.3)
Obesity, no. (%)	117 (39)	95 (33)
10-year risk of cardiovascular mortality	4.3 (4.9)	5.4 (6.3)§
High risk patients, no. (%)	85 (28)	112 (39)‡

Note: LDL = low-density lipoprotein; SD = standard deviation.

size calculation assumed an intraclass correlation coefficient of 0.02, α of 0.05 and a power of 0.80. Thus, a total of 450 patients (225 per group) were needed. To compensate for 20% loss to follow-up, we required a total of 580 patients (29 patients per practice, assuming 20 participating practices).

Statistical analysis

We examined the differences between the groups by use of the *t* test for continuous variables (composite adherence score, consumption of fat, fruit and vegetables, and physical activity) and 10-year mortality risk from cardiovascular disease. We used a χ^2 test for dichotomous variables (smoking and alcohol consumption).

The 6 lifestyle factors (smoking, consumption of alcohol, fat, fruit and vegetables, and physical activity) were further explored by multilevel regression analyses (backward procedure) in 6 models, with each lifestyle factor as a dependent variable. We controlled for group allocation, preintervention scores, patients' age, sex and socio-economic status, hypertension, hypercholesterolemia, diabetes and obesity. A random intercept was included in each model to account for the intraclass correlation. We adjusted for skewed distribution of data for certain outcomes, such as fruit and vegetables, by means of log-transformation. To avoid zero values, we first added 1 to the data before log-transforming.

The 6 lifestyle factors were combined in a composite standardized adherence score expressing the agreement between a patient's lifestyle and the national recommendations. Meeting the national recommendation was scored as 1, and not meeting it was scored as 0. We used a *t* test to compare the sum of the scores (0–6) of the intervention group with that of the control group.

We explored cardiovascular risk by use of a multilevel regression analysis, with cardiovascular risk as a dependent variable. We controlled for group allocation and preintervention score.

Finally, we examined differences between baseline and after 1 year by a

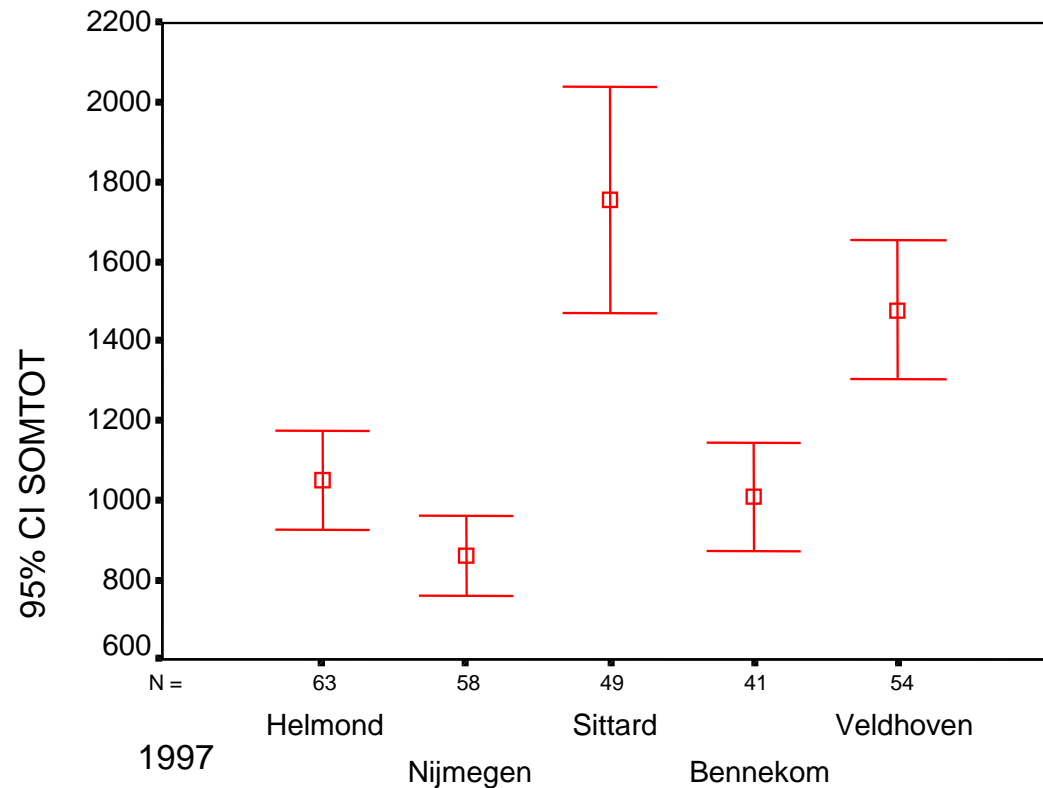
Case 2

- Post randomisation selection bias
- Zelen design (Vierhout 1995)
- M'trecht Self Management trial

Campbell et al. CONSORT statement: extension to cluster randomised trial. BMJ 2004;328:702-8



Verstappen WHJM, et al. Variation in test ordering behaviour of general practitioners: professional or context-related factors? *Fam Pract* 2004;21:387-95.



A break-through method for change

- personalised feedback, 6 x year :
 - comparative graphical feedback, data derived from existing sources
 - guidelines
- 2 weeks later: small group peer review, chaired by opinion leader



Clinical problems

1. Cardiovascular diseases/ Hypertension

Cholesterol, subfractions,
sodium, serum creatinine, BUN,
(exercise-)ECG, potassium

2. Gastro-ental complaints

SGPT/SGOT/LDH, amylase,
 γ -glutamyltransferase, bilirubin,
alk.phosphate, ultrasound of
hepatobiliary tract

3. Urogenital complaints

Prostate specific amino acid,
Ultrasound of kidneys, IVP,
renal ultrasound, IVP, double
contrast barium enema,
sigmoidoscopy

1. COPD/asthma

pulmonary function test,
immunoglobulin E, chest X-ray, allergic
screening test

2. General malaise/ fatigue /vague complaints

ESR, Hb + -indices, Ht, leucocytes +
differential count, TSH, monospot

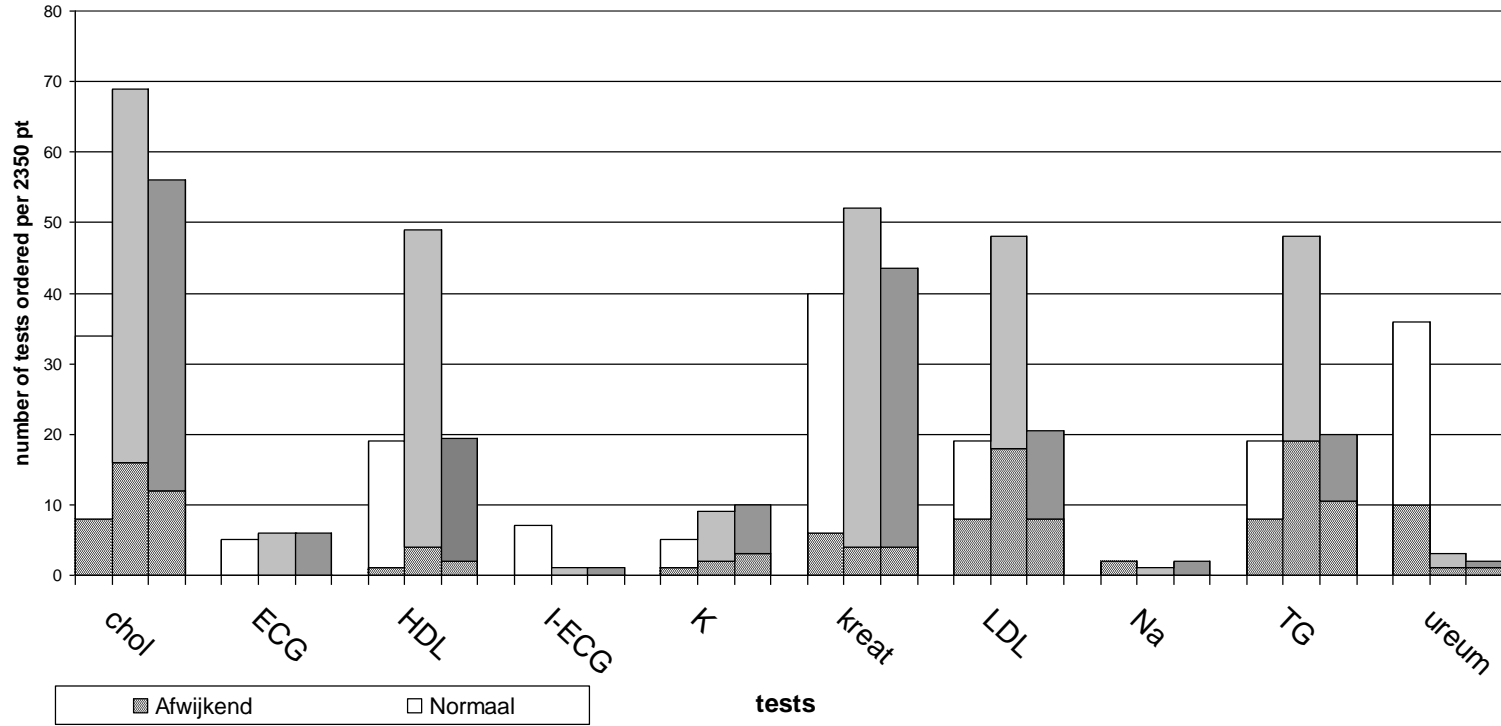
3. Joint degeneration/joint complaints

ESR, uric acid, rheumatoid factors (latex
fixation test, Rose-Waaler test), X-ray of
lumbar spine, -shoulder, -cervical spine, -
knee, -hip

Cardiovascular Disease

Period: 07/1999 t/m 12/1999 GP: XXXX

(GP - GPgroup - Region)



Case 2 Small group peer review

- 5 min agenda setting
- 5 min critical look at own numbers
- 5 min pair-wise talk
- 60 min plenary discussion
 - relate behaviour to guidelines
 - discuss resistance to change, learn from each other
- 15 min making work agreements



Case 2 Effect evaluation

- number of tests
- number of 'redundant' tests

per GP/ per 2300 patients/ per 6 months



clinical problems
block A:

cardiovascular

upper abdominal

uro-genital

clinical problems
block B:

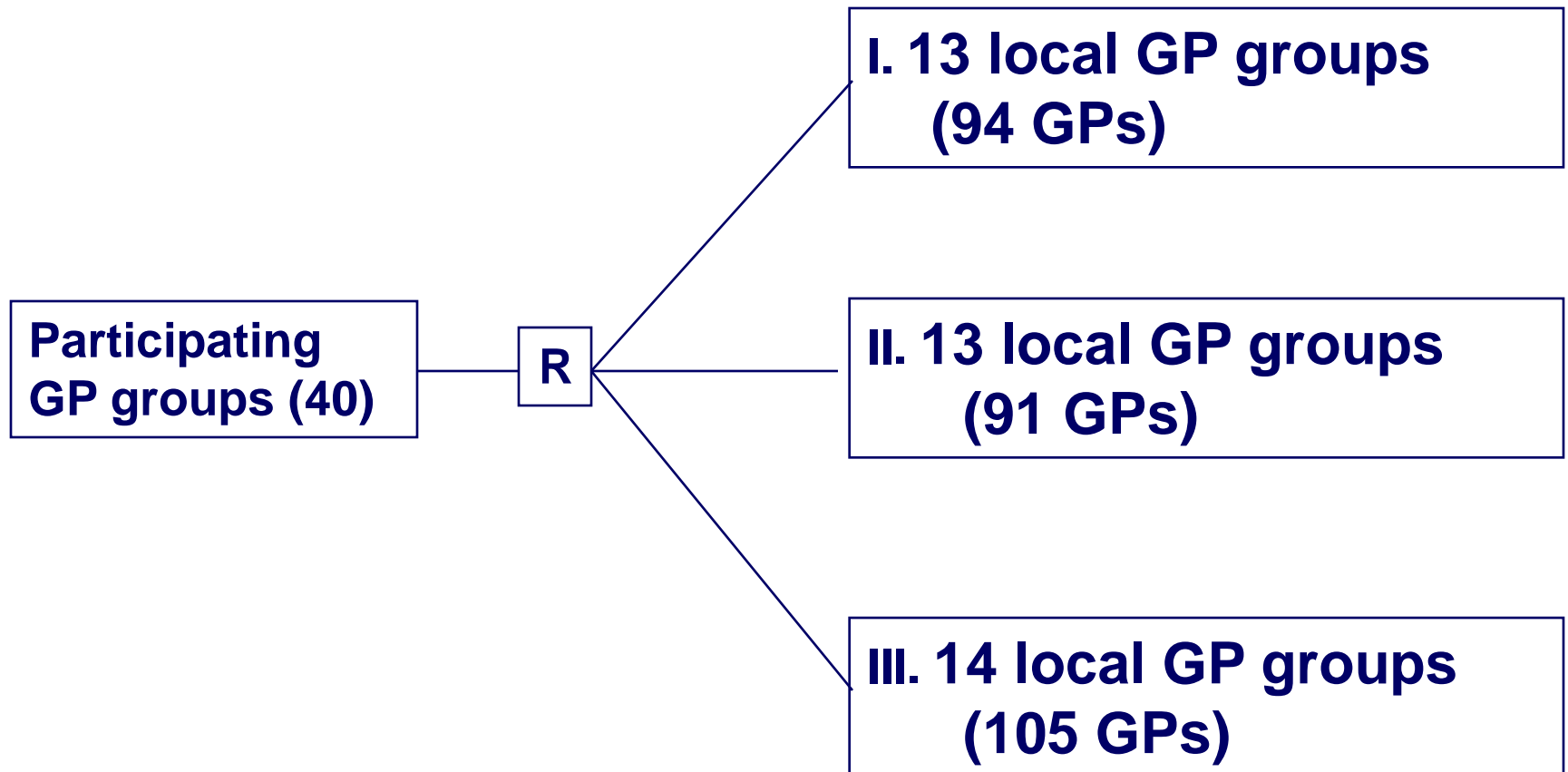
COPD/asthma

fatigue

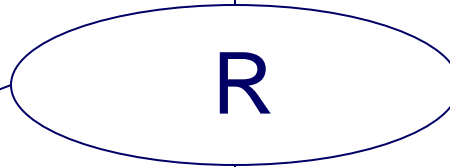
musculoskeletal



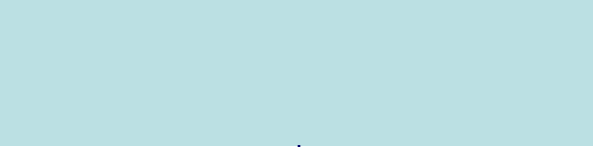
Study population



GP groups
N = 40 283 GPs



baseline
A + B tests



meetings on A
no intervention on B

meetings on B
no intervention on A

feedback on A
no intervention on B

follow-up
A + B tests



GP groups

N = 40 283 GPs

R

```
graph TD; R([R]) --> B[baseline  
A + B tests]; R --> C[meetings on B  
no intervention on A]; B --> D[meetings on A  
no intervention on B]; C --> E[meetings on A  
no intervention on B]; D --> F[follow-up  
A + B tests]; E --> G[follow-up  
A + B tests];
```

The diagram illustrates a study design for GP groups. It starts with a central node 'R' in an oval, representing the initial group of 40 GP groups (283 GPs). From 'R', the study branches into two parallel paths. The left path (highlighted in red) consists of three stages: 'baseline' (A + B tests), 'meetings on A' (no intervention on B), and 'follow-up' (A + B tests). The right path (highlighted in light blue) consists of three stages: 'meetings on B' (no intervention on A), 'meetings on A' (no intervention on B), and 'follow-up' (A + B tests). Arrows indicate the flow from top to bottom in each path.

baseline
A + B tests

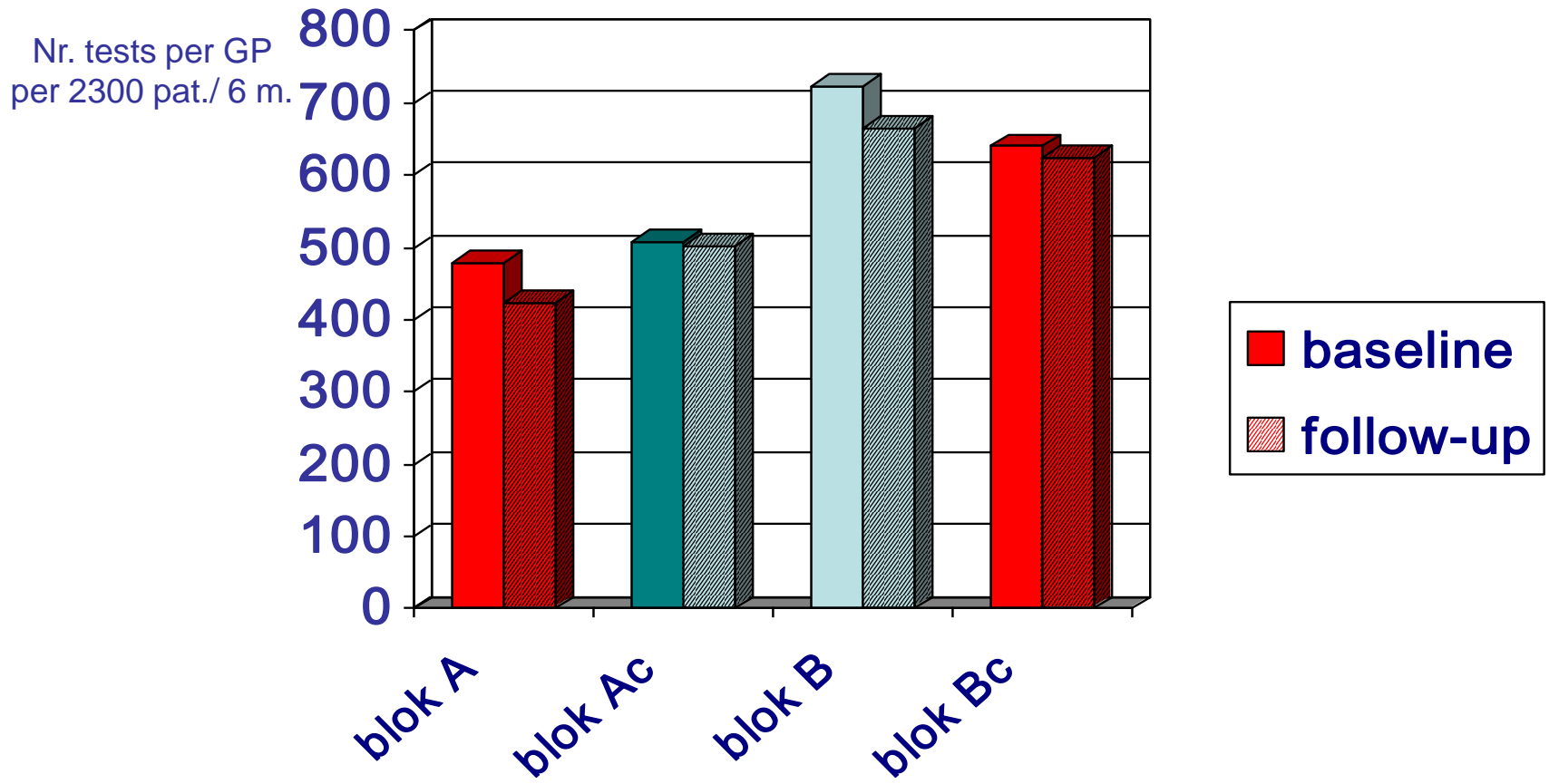
meetings on A
no intervention on B

follow-up
A + B tests

meetings on B
no intervention on A

follow-up
A + B tests

Case 3 Results



Verstappen W et al. Effect of a practice-based strategy on test ordering performance of primary care physicians. JAMA 2003;289:2407-12.

Block designs

Advantages

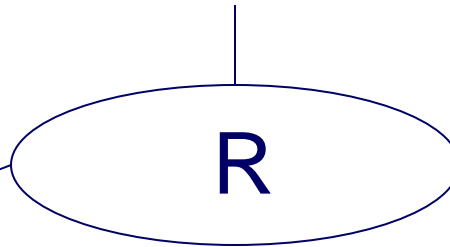
- Equalises Hawthorne and other non-specific effects
- Maximise power
- Efficient
- Potentially greater generalisability

Disadvantages

- Complex to design (especially if want to test multiple interventions or levels of interventions)
- Complex to run
- Complex to analyse



GP groups
N = 40 283 GPs



baseline
A + B tests



meetings on A
no intervention on B



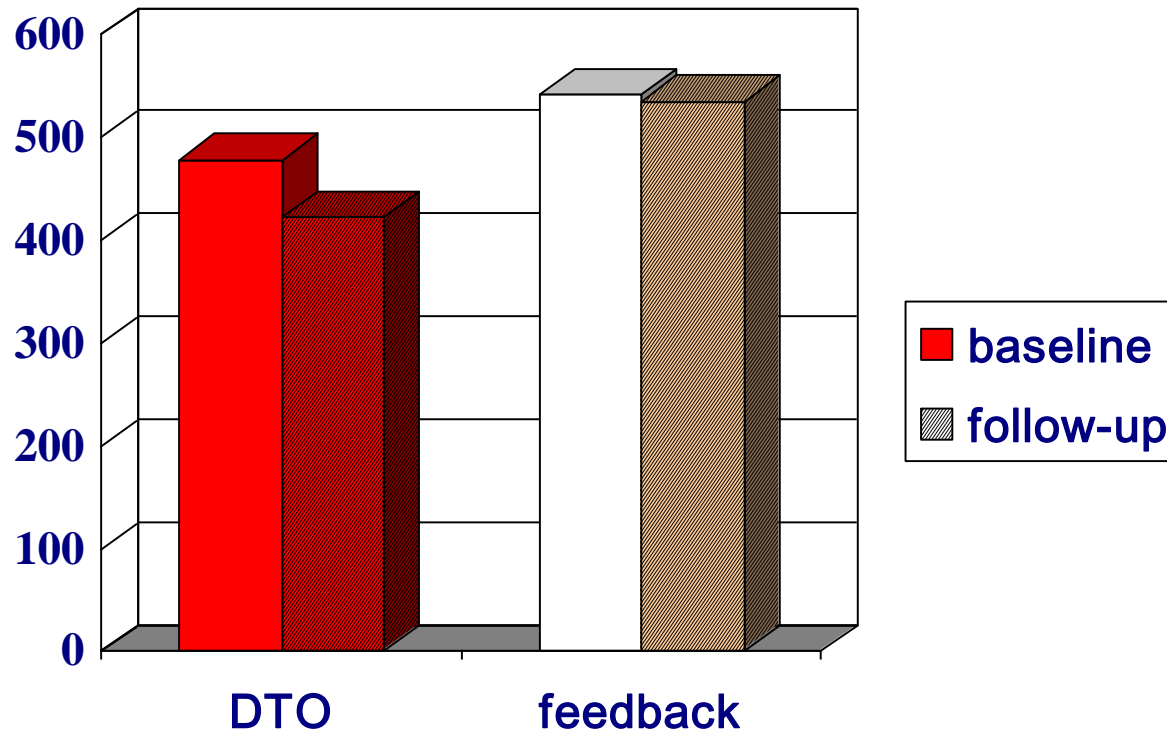
follow-up
A + B tests



feedback on A
no intervention on B



Case 3 Results



Case 3 Results

- Running costs
 - feedback reports
 - quality meetings
 - opportunity costs
- Development costs
- Research costs

Verstappen W. Comparing cost effects of two quality strategies to improve test ordering in primary care. A RCT. Int J Qual Health Care 2004;16:391-8.



Case 3 Results

<i>Costs per GP per 6 months (€)</i>	Total strategy	Feedback only
All costs	701	58
running costs only	554	17
Running costs, - opp. costs	93	17
Cost reductions	301	161



Case 4

- Maastricht – Cardiff (UK) collaboration
- Netherlands organisation of health care research
- Improving management of patients with acute cough by CRP point of care testing and communication training (IMPAC³T)

Cals JWL et al. BMC Family Practice 2007



Assessed for eligibility:
54 group practices from the Zuid Oost Brabant region

Excluded (34):
Not meeting inclusion criteria (9)
Refused to participate (25)

20 group practices randomised twice
(2 GPs per group practice consented to participate)

CRP

10/10 GPs completed study

110 patients

100% data on Antibiotics

89% returned diary

Communication

7/10 GPs completed study

84 patients

100% data on Antibiotics

88% returned diary

CRP + Comm.

10/10 GPs completed study

117 patients

100% data on Antibiotics

94% returned diary

Usual Care

10/10 GPs completed study

120 patients

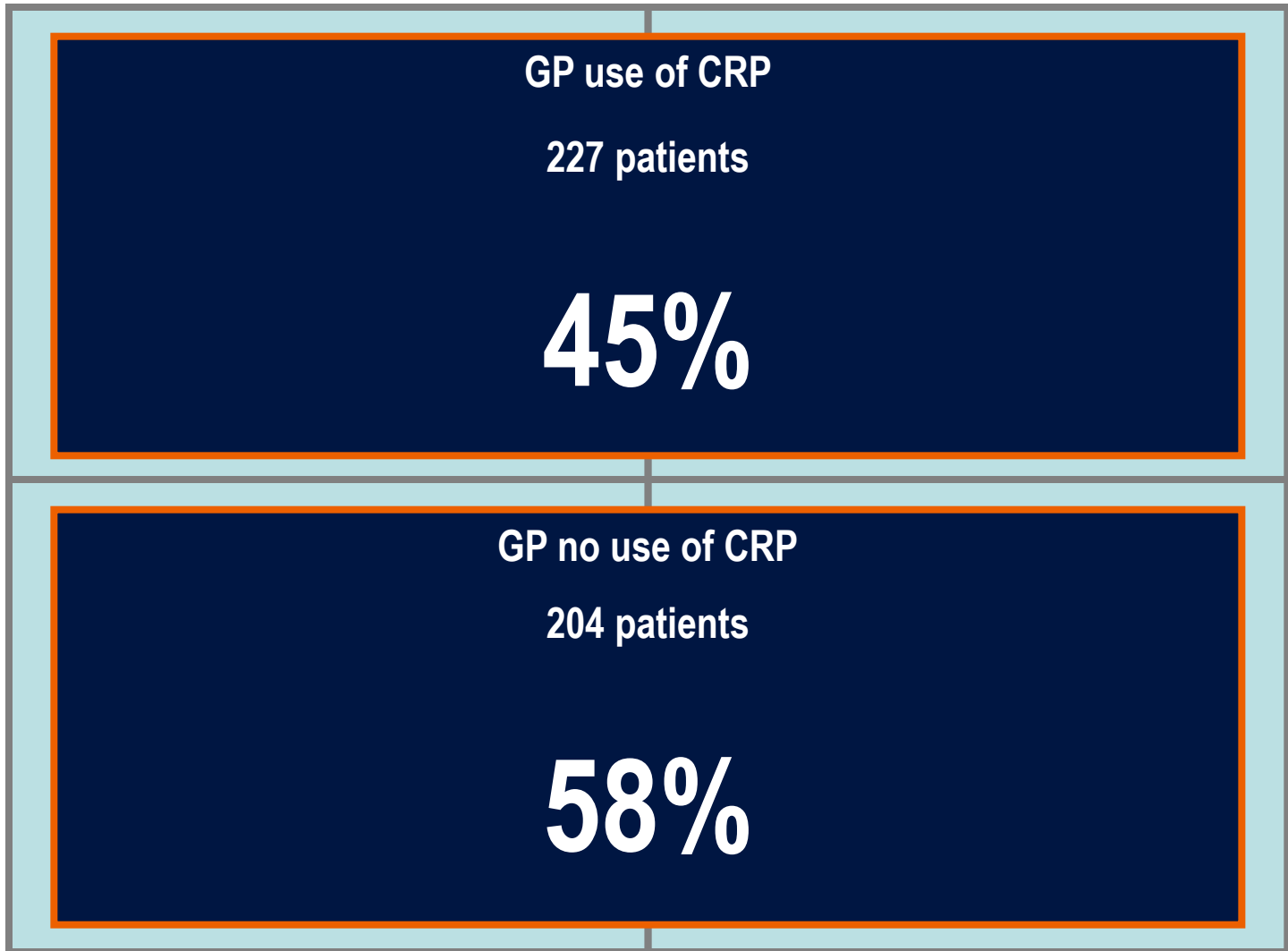
100% data on Antibiotics

87% returned diary

431 patients

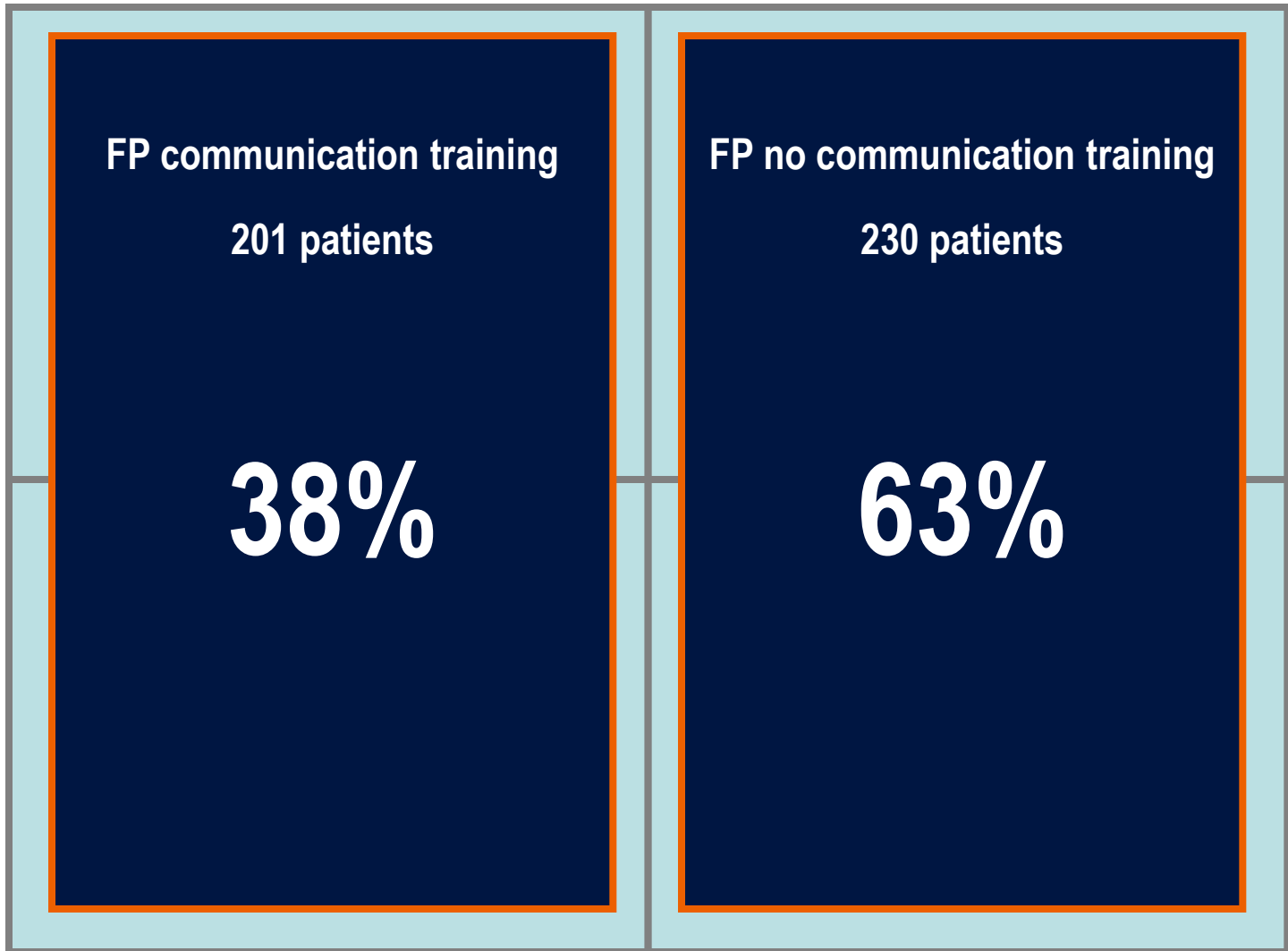
100% follow-up for AB and reconsultation
89% follow-up for diary data (symptom scores)

+ CRP -



AB prescribing day 1-28

p < 0.01*



AB prescribing day 1-28

$p < 0.001^*$

Factorial designs

Advantages

- **Comparison of multiple interventions or levels of intervention under similar circumstances**
- **Possibility of detecting interaction effects**
- **Maximises power**
- **Efficient (two RCTs for the price of one)**

Disadvantages

- **Complex to conduct and analyse**
- **Rarely sufficient power to detect interaction effects**
- **Power diminished if interaction between the interventions**



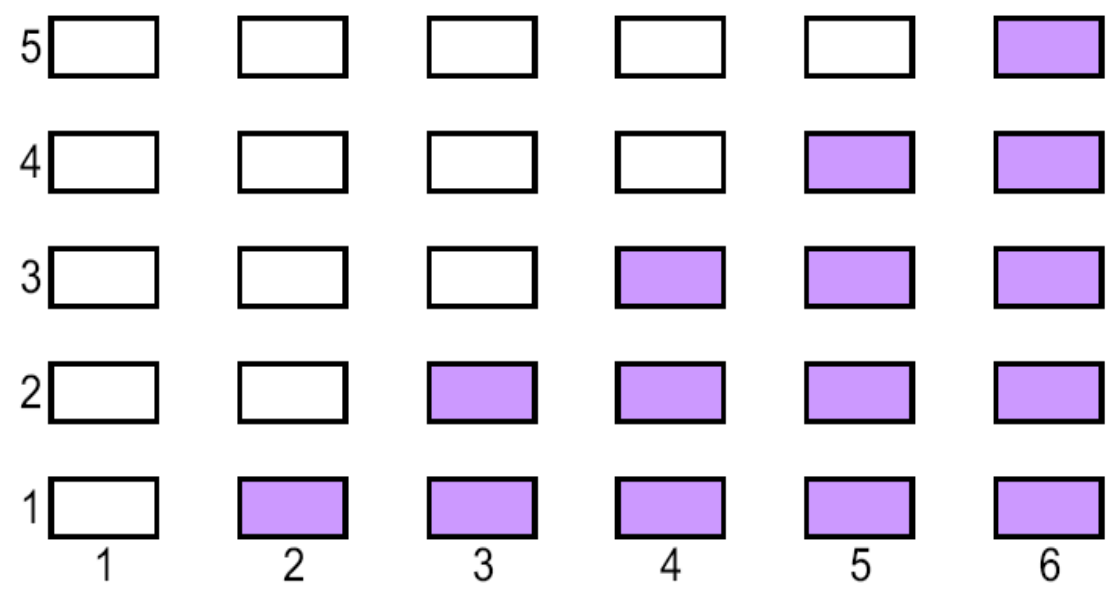
Some considerations

- Preference trials and randomised consent designs
- Stepped wedge design
- N=1 designs

Craig et al. Developing and evaluating complex interventions. The new MRC guidance. BMJ 2008;337:979.



Participants/Clusters



Time periods

Shaded cells represent intervention periods
Blank cells represent control periods
Each cell represents a data collection point

Brown et al. The stepped wedge trial design: a systematic review. BMC Med Res Methodology 2006;6:54

Key messages

- If you focus on effect evaluation
- With quantitative methods
- RCT is golden standard, but
- One size fits all? NO
- Tailor to aim (efficacy vs effectiveness)
- Tailor to stakeholders and resources
- Keep it simple

