T Dreischulte, A Grant, B Guthrie: Explicit standards to evaluate the quality and safety of medication use in primary care: Expert consensus study

T Dreischulte, S Hudson Evaluating pharmaceutical care: A generic algorithm to operationalise ‘adherence to standards’ as an intermediate outcome measure
Outline

1. The case for explicit standards in the delivery and evaluation of Pharmaceutical care interventions

2. Development and validation of an extensive set of medication use standards for use in primary care

3. An algorithm for evaluating adherence of medication use to standards of best practice

4. Summary and conclusion
Evaluation of medication reviews

• Medication review interventions have shown variable results

• HOMER trial showed an increase in hospitalisation

• Trial designs have been criticised for (among others) not providing insight into how the intervention works (lack of process evaluation)

1. Holland et al. Systematic review
2. Anita Hogg, James McElnay, Christine Clark. Michael G Scott, Chief Pharmacist Antrim Area Hospital BT41 2RL,
Evaluation of medication reviews

Medication reviews are complex interventions, where outcomes may be influenced by a number of factors including how the intervention has been delivered:

- Communication between practitioners and patients
- Communication between practitioners
- (Clinical) experience/ knowledge
- (Systematic) approach
- Access to data

1. Holland et al. Systematic review
2. Anita Hogg, James McElnay, Christine Clark. Michael G Scott, Chief Pharmacist Antrim Area Hospital BT41 2RL,
Complex interventions
Why do they work (or not)?

Intervention

Delivery

Outcomes

Why?

‘effective’ vs ‘ineffective’
Complex interventions
Why do they work (or not)?

Intervention

Delivery

Outcomes

‘effective’ vs ‘ineffective’

- Qualitative
- Quantitative
COMMUNICATION PROBLEMS: HOMER trial

‘I haven’t even phoned my doctor, yet!’

“Review pharmacists in the intervention take every opportunity to give advice and information; advice is often given despite an apparent problem demonstration of patient competence”

“Advice by pharmacists is often rejected by patients”

‘Advice giving role during interventions has the potential to undermine and threaten the patients’ assumed competence, integrity, and self governance”

Salter C, Holland R et al. “I haven’t even called my doctor, yet.” The advice giving role of the pharmacist during consultations for medication review with patients aged 80 or more: qualitative discursive analysis. BMJ Online first doi: 10.1136/bmj.39171.577106.55. 2007
APPARENTLY CLINICALLY SUBOPTIMAL INTERVENTION DELIVERY

Evaluation of MUR’s conducted by community pharmacists \(^1\): Comparison of issues identified intervention pharmacists’ to issues identified by experts:

- Almost all recommendations by CP’s considered appropriate by experts
- CP’s identified only \(~ 30\%\) of potential drug therapy problems identified by experts (\(30\%\) of monitoring issues, \(21\%\) of drug disease interactions, \(44\%\) of unmet indications)

1. Delivery of interventions:
   - Need for standardisation and quality assurance of interventions
   - Explicit standards of best practice of medication use:
     = Minimum of what should be checked in interventions; changed where appropriate

2. Evaluation of interventions
   - Does the intervention reduce non-adherence to standards
Explicit

- Beers/ STOPP: Drugs to be avoided in the elderly
- START: Drugs commonly underprescribed in the elderly
- ACOVE: Prescribing standards for the elderly
- MAT: Disease specific indicators derived from guidelines
Complex interventions

Examples of possible quantitative process measures

Explicit (e.g. Beers, Start/ Stopp, ACOVE, PDRM, MAT)

+ reliably applicable by trained non-experts or computerised (where electronic data available)
+ objective
+ unmet need considered by ‘START’ and ‘MAT’
Data driven quality improvement in primary care (DQIP):
Using informatics to implement new prescribing quality measures integrated with educational interventions and existing quality improvement mechanisms

Bruce Guthrie (PI), Professor of Primary Care medicine, UoD
Tobias Dreischulte, Research pharmacist, NHS Tayside
Aileen Grant, Research fellow, UoD
Aim:

To define and validate a set of explicit standards of medication use quality and safety in primary care
Development of standards

LITERATURE REVIEW

Identifying topics

- **Guidelines** (SIGN, NICE, ESC etc.)
- **MeRec bulletin** (NPC)
- **Drug safety bulletin** (MHRA)
- **BNF “blue boxes”**
- **Previously developed sets of indicators** (Start/Stop, PDRM, ACOVE)
- **Recent systematic reviews** addressing causes/risk factors for preventable drug related morbidity ¹⁻³

What the literature does NOT tell us (Examples):

Studies of drug related hospital admissions:
- Antiplatelets are among the most common causes of preventable ADE’s involved in drug related hospital admissions, but
  **When is the risk high enough to state that make use of gastro-protection mandatory?**

Unspecific guidance, for example:
- Beta blockers ‘should be avoided’ in asthma (BNF), but:
  **What if a CHD patient has not had an asthma attack for 5 years?**
- Patients with target organ damage ‘should be treated to achieve optimal BP’
  **What if patient is elderly and already on 3 antihypertensive drugs?**

→ Expert/practitioner advice/consensus
RAND APPROPRIATENESS METHOD (RAM)

- RAM combines expert opinion and evidence
- Combines aspects of DELPHI (postal rating) and NGT (face to face meeting and discussion)
- The `only systematic method of combining expert opinion and evidence' ¹

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Development of standards

SAFETY VS QUALITY

QUALITY:
Prescribing behaviour with evidence of patient benefit when conducted
- Targeting underuse

Example: To prescribe a beta-blocker to a patient with a history of MI?

SAFETY:
Prescribing behaviour with evidence of patient harm when conducted
- Targeting inappropriate use/overuse

Example: To prescribe a beta-blocker to a patient with asthma?
# Development of standards

## QUALITY TOPICS

<table>
<thead>
<tr>
<th>Quality Topics</th>
<th>Statements Count</th>
</tr>
</thead>
</table>
| 1. CVD RISK MODIFICATION  
(Antithrombotic prophylaxis, BP lowering, lipid lowering, antidiabetic, other preventative, chronic heart failure, asthma, osteoporosis) | 76 |
| 2. CHRONIC HEART FAILURE  
(Use of ACEI, BB, and dose titration) | 6 |
| 3. ASTHMA  
(Use of inhaled steroids in apparently uncontrolled patients) | 12 |
| 4. OSTEOPOROTIC PROPHYLAXIS  
(Use of bone-sparing agents and calcium/VitD in patients at risk) | 6 |
| **Total** | **100** |

**Example:** To prescribe a beta-blocker to a patient with a history of MI?
# Development of standards

## SAFETY TOPICS

<table>
<thead>
<tr>
<th>SAFETY TOPICS</th>
<th>Statements</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A. GASTROINTESTINAL SYSTEM</strong></td>
<td>(eg Use of NSAIDs/antiplatelets in patients at risk without gastro-protection, use of opioids without laxatives etc)</td>
<td>32</td>
</tr>
<tr>
<td><strong>B. HAEMATOLOGICAL SYSTEM</strong></td>
<td>(eg Warfarin interactions, FBC monitoring)</td>
<td>31</td>
</tr>
<tr>
<td><strong>C. CARDIOVASCULAR SYSTEM</strong></td>
<td>(eg COX IIs in CVD patients; antipsychotics in the elderly)</td>
<td>34</td>
</tr>
<tr>
<td><strong>D. RENAL SYSTEM</strong></td>
<td>(eg U&amp;E monitoring under diuretic therapy, ‘triple whammy’)</td>
<td>60</td>
</tr>
<tr>
<td><strong>E. RESPIRATORY SYSTEM</strong></td>
<td>(eg BB in asthma)</td>
<td>27</td>
</tr>
<tr>
<td><strong>F. ENDOCRINE SYSTEM</strong></td>
<td>(eg sulfonylureas in renal failure or in the elderly)</td>
<td>17</td>
</tr>
<tr>
<td><strong>G. CNS AND MOTOR SYSTEM</strong></td>
<td>(eg benzodiazepines in the elderly, phenothiazines in patients with PD)</td>
<td>59</td>
</tr>
<tr>
<td><strong>H. MUSCULOSCELETAL SYSTEM AND TEETH</strong></td>
<td>(eg statin interactions, tetracyclines in children)</td>
<td>10</td>
</tr>
<tr>
<td><strong>I. MISCELLANEOUS DRUG SPECIFIC ADVERSE EFFECTS</strong></td>
<td>(eg full dose digoxin in the elderly/renal impairment, )</td>
<td>19</td>
</tr>
</tbody>
</table>

**Example:** To prescribe a beta-blocker to a patient with asthma?
Study 1
Rating procedure – QI SCALES

For all statements:

**QUESTION 1:
Is the prescribing behaviour *appropriate*?**

1 2 3 4 5 6 7 8 9

Inappropriate Uncertain Appropriate

For **safety** statements:

Is it *necessary to avoid* the described prescribing procedure?

1 2 3 4 5 6 7 8 9

Necessary to avoid Uncertain Not necessary to avoid

For **quality** statements:

**QUESTION 2:
Is it *necessary to do* the described prescribing procedure?**

1 2 3 4 5 6 7 8 9

Not necessary to do Uncertain Necessary to do
Example: To prescribe a beta-blocker to a patient with a history of MI

Definition of ‘appropriate’:

- Expected benefits exceed the expected risks
- Expected benefit is large enough to be worthwhile doing (irrespective of cost)

Definition of ‘necessary to do’:

It would be considered ‘improper’ care not to prescribe as stated, because
- strong evidence makes benefits likely
- benefits are likely to be clinically significant
Development of standards
Rating procedure – QI CONCEPTS

Example: To prescribe a beta-blocker to a patient with a history of MI

Definition of ‘inappropriate’:
- Expected risks exceed the expected benefit
- Expected risk is large enough to be NOT worthwhile doing (irrespective of cost)

Definition of ‘necessary to avoid’:
It would be considered ‘improper’ care not to prescribe as stated, because
- patient harm is likely
- harms are likely to be clinically significant
# Development of standards

## Questionnaire – example

### A. GASTROINTESTINAL SYSTEM

#### 1. RISK OF GASTROINTESTINAL ULCERATION/BLEEDING

**USE OF POTENTIALLY GASTROTOXIC DRUGS WITHOUT CO-PRESCRIPTION OF GASTROPROTECTION**

1. **PATIENTS AGED 66 TO 75 YEARS WITHOUT A HISTORY OF PEPTIC ULCER**
   
   To prescribe the drugs below without co-prescription of a gastro-protective agent to a patient without a history of peptic ulcer, aged 65-74 years:

<table>
<thead>
<tr>
<th>Drug Description</th>
<th>Appropriateness</th>
<th>Necessary to avoid</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Low dose aspirin (alone)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b) Oral NSAID (alone)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c) Low dose aspirin and clopidogrel</td>
<td></td>
<td></td>
</tr>
<tr>
<td>d) Low dose aspirin and warfarin</td>
<td></td>
<td></td>
</tr>
<tr>
<td>e) Low dose aspirin and oral NSAID</td>
<td></td>
<td></td>
</tr>
<tr>
<td>f) Warfarin and oral NSAID</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Rating</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 2 3 4 5 6 7 8 9</td>
<td>1 2 3 4 5 6 7 8 9</td>
</tr>
</tbody>
</table>
Study 1
Rating procedure – QI SCALES

For all statements:

**Question 1:**
Is the prescribing behaviour *appropriate*?

- 1, 2, 3: Inappropriate
- 4, 5, 6: Uncertain
- 7, 8, 9: Appropriate

For **safety** statements

Is it *necessary to avoid* the described prescribing procedure?

- 1, 2, 3: Necessary to avoid
- 4, 5, 6: Uncertain
- 7, 8, 9: Not necessary to avoid

For **quality** statements

Is it *necessary to do* the described prescribing procedure?

- 1, 2, 3: Not necessary to do
- 4, 5, 6: Uncertain
- 7, 8, 9: Necessary to do
RESULTS

RECRUITMENT FRAMING:
- Mix of academia and clinical practice
- Mix of pharmacy and medical profession

PANELLISTS (n=10):
- 2 pharmacy academics with special interest in prescribing in primary care
- 2 health board level pharmacists working in medicines governance
- 2 pharmacists working in general practice
- 1 GP working in clinical practice but also member of SMC
- 3 GPs working in clinical practice
Development of standards

Results - Quality statements

- Disagreement = 1 (1%)
- ‘Appropriate’ median ≥ 7 = 91/100 (91%)
- ‘Necessary’ median ≥ 7 = 73/100 (73%)
Development of standards

Results- safety medians

- Disagreement = 12 statements
- ‘Appropriate’ median $\leq 3 = \frac{225}{288}$ (78%)
- ‘Necessary’ median $\leq 3 = \frac{202}{288}$ (70%)
## Development of standards

### Results

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Quality Statements</th>
<th>Safety Statements</th>
<th>SI's</th>
<th>QI's</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. RISK OF GASTROINTESTINAL ULCERATION/BLEEDING</td>
<td>73</td>
<td>202</td>
<td>35</td>
<td>17</td>
</tr>
<tr>
<td>1. PATIENTS AGED 66 TO 75 YEARS WITHOUT A HISTORY OF PEPTIC ULCER</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>To prescribe the drugs below without co-prescription of a gastro-protective</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a) Low dose aspirin (alone)</td>
<td>5</td>
<td>5.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b) Oral non-selective NSAID (alone) long term (&gt;3 months)</td>
<td>3</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c) Low dose aspirin and clopidogrel</td>
<td>2.5</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>d) Low dose aspirin and warfarin</td>
<td>1</td>
<td>1.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>e) Low dose aspirin and oral NSAID long term (&gt;3 months)</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>f) Warfarin and oral NSAID</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. PATIENTS AGED 76 YEARS OR OLDER WITHOUT A HISTORY OF PEPTIC ULCER</td>
<td></td>
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<td></td>
<td></td>
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<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b) Oral non-selective NSAID (alone) long term (&gt;3 months)</td>
<td>1.5</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c) Low dose aspirin and clopidogrel</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>d) Low dose aspirin and warfarin</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>e) Low dose aspirin and oral NSAID long term (&gt;3 months)</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>f) Warfarin and oral NSAID</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. PATIENTS WITH A HISTORY OF PEPTIC ULCER</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>To prescribe the drugs below without co-prescription of a gastro-protective</td>
<td></td>
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<td></td>
</tr>
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<td>2.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b) Oral non-selective NSAID (alone) long term (&gt;3 months)</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c) Low dose aspirin and clopidogrel</td>
<td>1</td>
<td>1</td>
<td></td>
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<td>d) Low dose aspirin and warfarin</td>
<td>1</td>
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<td></td>
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</tr>
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<td>1</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>f) Warfarin and oral NSAID</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Example:**

18 statements

1 Indicator

**SI 1: Patients at risk of gastro-intestinal toxicity from taking the drugs specified below, who are NOT prescribed a gastro-protective agent**

**SPECIFICATIONS:**

a) Prescribed an NSAID (long term) AND at least one of: History of peptic ulcer, aged >75, co-prescribed an NSAID

b) Prescribed aspirin and at least one of: Co-prescribed clopidogrel, warfarin or NSAID
How to measure adherence to standards?
All adults over the age of 40 years who are assessed as having a ten year risk of having a first cardiovascular event $\geq 20\%$ should be considered for treatment with simvastatin 40 mg/day following an informed discussion of risks and benefits between the individual and responsible clinician.

**MAT criterion**

| Qualifier (Q): | Patient with a 10 year risk of having a first cardiovascular event of $\geq 20\%$ ...
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard (S):</td>
<td>... is prescribed <strong>simvastatin 40mg</strong></td>
</tr>
<tr>
<td>Exceptions:</td>
<td>Explicitly documented or apparent history of statin intolerance, etc.</td>
</tr>
<tr>
<td>Operation rules:</td>
<td>For CVD risk estimation the most current blood pressure (BP) and total cholesterol (TC) readings within last 60 months are considered</td>
</tr>
</tbody>
</table>
Algorithm for adherence assessment
1. Delivery / 2. Evaluation

Data to decide applicability?
- NO: \(\text{ID}_Q\)
- YES

Is standard applicable?
- NO: \(\text{N/A}\)
- YES

Data to decide adherence?
- NO: \(\text{ID}_S\)
- YES

Is standard adhered to?
- YES
- NO

Are exceptions present?
- NO
- YES

Example

MAT criterion
Qualifier (Q): Patient with a 10 year risk of having a first cardiovascular event \(\geq 20\%\) should be considered for treatment with simvastatin 40 mg/day following an informed discussion of risks and benefits between the individual and responsible clinician.

Standard (S): ... is prescribed simvastatin 40mg

Exceptions: Explicitly documented or apparent history of statin intolerance, etc.

Operation rules: For CVD risk estimation the most current blood pressure (BP) and total cholesterol (TC) readings within last 60 months are considered.
Explicit standards
Delivery of interventions

Data to decide applicability?
- NO: ID_Q
  - YES

Is standard applicable?
- NO: N/A
  - YES

Data to decide adherence?
- NO: ID_S
  - YES

Is standard adhered to?
- YES
- NO

Are exceptions present?
- NO
  - YES: NO_EXC

eg TC for CVD risk assessment is not available

Patients CVD risk is < 20%

Simvastatin dose is unknown

Standard is met

Standard is not met without an apparent reason

Standard is not met but an explicitly documented reason
Explicit standards
Delivery of interventions

Data to decide applicability?

YES

NO

IDQ

Is standard applicable?

NO

N/A

YES

Data to decide adherence?

NO

ID_S

YES

Are exceptions present?

NO

NO

YES

NO_EXC

YES

Standard is met

Standard is not met without an apparent reason

Care issues

Standard is not met but an explicitly documented or validated reason

eg TC for CVD risk assessment is not available

Patients CVD risk is < 20%

Simvastatin dose is unknown
Adherence to explicit standards
Evaluation of interventions

Data to decide applicability?
- NO: ID_Q
- YES: Monitoring/document. improved

Is standard applicable?
- NO: N/A
- YES: Monitoring/document. improved

Data to decide adherence?
- NO: ID_S
- YES: Monitoring/document. improved

Is standard adhered to?
- YES: YES
- NO: NO EXC

Are exceptions present?
- NO: NO EXC
- YES: NO EXC
Adherence to explicit standards
Evaluation of interventions

1. Data to decide applicability?
   - NO: ID_Q
   - YES: Monitoring/document. improved
     - NO: NO_EXC

2. Is standard applicable?
   - NO: N/A
   - YES: Monitoring/document. improved
     - NO: NO_EXC

3. Data to decide adherence?
   - NO: ID_S
   - YES: Monitoring/document. improved
     - NO: NO_EXC

4. Is standard adhered to?
   - YES: YES
   - NO: NO_EXC

5. Are exceptions present?
   - NO: NO_EXC
   - YES: Adherence improved
     - Exc. Identified and documented
     - NO: NO_EXC

Adherence improved

YES
Adherence to explicit standards
Evaluation of interventions

- Data to decide applicability?
  - NO: IDQ
  - YES
    - Is standard applicable?
      - NO: N/A
      - YES
        - Data to decide adherence?
          - NO: ID_S
          - YES
            - Is standard adhered to?
              - YES
                - Are exceptions present?
                  - NO: NO_EXC
                  - YES
                    - Monitoring/document. improved
                      - YES
                      - Monitoring/document. improved
                        - NO: NO_EXC
            - Are exceptions present?
              - NO: NO_EXC
              - YES
                - Monitoring/document. improved
                  - YES
                  - Monitoring/document. improved
                    - NO: NO_EXC

Adherence improved
- Exc. Identified and documented
  - YES
  - NO_EXC

Adherence improved
  - YES
Adherence to explicit standards
Evaluation of interventions

- Data to decide applicability?
  - NO: **ID_Q**
    - Monitoring/document. improved
      - YES: **NO_EXC**
  - YES: NO

- Is standard applicable?
  - NO: N/A
  - YES: NO

- Data to decide adherence?
  - NO: **ID_S**
    - Monitoring/document. improved
      - YES: **NO_EXC**
  - YES: NO

- Is standard adhered to?
  - YES: YES
  - NO: NO

- Are exceptions present?
  - NO: **NO_EXC**
    - Adherence improved
      - YES: YES
    - Exc. Identified and documented
      - NO: **NO_EXC**
    - Adherence improved
      - YES: YES

Monitoring/document. improved
Adherence improved
Exc. Identified and documented
Adherence to explicit standards
Evaluation of interventions

- Data to decide applicability?
  - NO
    - ID_Q
  - YES
    - Are exceptions present?
      - NO
        - NO_EXC
      - YES
        - Ex. Identified and documented

- Is standard applicable?
  - NO
    - N/A
  - YES
    - Is standard adhered to?
      - YES
        - Adherence improved
      - NO
        - NO_EXC

- Data to decide adherence?
  - NO
    - ID_S
  - YES
    - Monitoring/document. improved

- Monitoring/document. improved
  - YES
  - NO
  - NO_EXC

- 'Apparent' adherence gap (%):
  \[
  \frac{\Sigma (NO, ID_S)}{\Sigma (Applicable)}
  \]

- Adherence improved
  - YES
  - NO
  - NO_EXC

- Exc. Identified and documented
  - YES
  - NO
  - NO_EXC

- Adherence improved
  - YES
• Explicit standards play an important role in the delivery and evaluation of Pharmaceutical Care Interventions

• An extensive set of medication use standards has been developed and validated by a panel of UK experts/practitioners

• Improvements in the ‘Adherence to standards’ of medication use may be a useful intermediate outcome for pharmaceutical care interventions

• A **generic** algorithm to use explicit standards as a means of quantifying improvements in the adherence to standards has been suggested
Thank you
t.dreischulte@cpse.dundee.ac.uk
Data presentation formats

Figure 1  Simple league table and regional mean for glycated haemoglobin control in type 2 diabetes in Tayside practices.

Figure 2  League table and 95% confidence intervals for glycated haemoglobin control in type 2 diabetes in Tayside practices.

Data presentation formats

Figure 4  Cross sectional control chart for percentage of patients with type 2 diabetes with HBA1c ≤7.4% in Tayside practices.
Data presentation formats

<table>
<thead>
<tr>
<th>Tayside average</th>
<th>Indicator</th>
<th>Practice 1</th>
<th>Practice 2</th>
<th>Practice 3</th>
<th>Practice 4</th>
<th>Practice 5</th>
<th>Practice 6</th>
<th>Practice 7</th>
<th>Practice 8</th>
<th>Practice 9</th>
<th>Practice 10</th>
<th>Practice 11</th>
<th>Practice 12</th>
<th>Practice 13</th>
<th>Practice 14</th>
</tr>
</thead>
<tbody>
<tr>
<td>81.7%</td>
<td>BMI recorded</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
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<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>92.6%</td>
<td>Smoking recorded</td>
<td>●</td>
<td>●</td>
<td>●</td>
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<td>92.7%</td>
<td>HBA1c measured</td>
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<td>55.7%</td>
<td>HBA1c ≤7.4%</td>
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<td>86.8%</td>
<td>HBA1c ≤10%</td>
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<td>69.3%</td>
<td>Pulses screening</td>
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<td>70.4%</td>
<td>Neuropathy screening</td>
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<td>85.5%</td>
<td>BP measured</td>
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<td>46.4%</td>
<td>BP ≤145/85</td>
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<td>Microalbuminuria screening</td>
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<td>Creatinine measured</td>
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</table>

Figure 5  Control chart signals for 13 measures in 17 practices in one locality (practices compared with Tayside regional mean).