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RESEARCH

Practice-level quality improvement interventions in primary care: a review of systematic reviews*

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Aim: To present an overview of effective interventions for quality improvement in primary care at the practice level utilising existing systematic reviews. **Background:** Quality improvement in primary care involves a range of approaches from the system-level to patient-level improvement. One key setting in which quality improvement needs to occur is at the level of the basic unit of primary care – the individual general practice. Therefore, there is a need for practitioners to have access to an overview of the effectiveness of quality improvement interventions available in this setting. **Methods:** *Design:* A tertiary evidence synthesis was conducted (a review of systematic reviews). A systematic approach was used to identify and summarise published literature relevant to understanding primary-care quality improvement at the practice level. Quality assessment was via the Critical Appraisal Skills Programme tool for systematic reviews, with data extraction identifying evidence of effect for the examined interventions. *Scope:* Included reviews had to be relevant to quality improvement at the practice level and relevant to the UK primary-care context. Reviews were excluded if describing system-level interventions. *Outcome measures:* A range of measures across care structure, process and outcomes were defined and interpreted across the quality improvement interventions. **Findings:** Audit and feedback, computerised advice, point-of-care reminders, practice facilitation, educational outreach and processes for patient review and follow-up all demonstrated evidence of a quality improvement effect. Evidence of an improvement effect was higher where baseline performance was low and was particularly demonstrated across process measures and measures related to prescribing. Evidence was not sufficient to suggest that multifaceted approaches were more effective than single interventions. **Conclusion:** Evidence exists for a range of quality improvement interventions at the primary-care practice level. More research is required to determine the use and impact of quality improvement interventions using theoretical frameworks and cost-effectiveness analysis.

Key words: primary care; quality improvement; systematic review

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How this fits in with Primary Healthcare Research and Development

What do we know? Evidence for the effect of quality improvement interventions exists across a

range of healthcare settings and implementation levels; quality improvement interventions can be successful in improving care structure, processes and outcomes.

What does this paper add? This paper reviews systematic reviews of quality improvement interventions, specifically in primary care and at the practice level, highlighting those interventions most likely to produce a positive quality improvement effect and the context in which this effect may be enhanced – for example, through recognising baseline performance and assessing improvement potential, planning quality improvement design and intervention selection and being aware of the improvement opportunity in targeting prescribing behaviours. The paper identifies areas for future research, such as the use of theoretical quality improvement frameworks and cost-effectiveness analysis in analysing primary-care quality improvement interventions.

Background

Primary care occupies a significant and increasing role in healthcare in the United Kingdom and internationally. There is available research literature on quality improvement (QI) across a range of primary-care settings and contexts and these include QI at various levels of care: the individual patient level (e.g., patient self-care promotion), practitioner level (e.g., practitioner audit and feedback), practice level (e.g., practice-based patient review and recall) and the wider national and policy level (e.g., standard setting, accreditation development and financial incentives schemes such as the UK quality and outcomes framework) (Ferlie and Shortell, 2001). 'Quality improvement' is a broad term with a number of different definitions and interpretations. With roots in the early work of W. Edwards Deming and Walter Shewhart in understanding variation, QI is usually described as a continuous effort to improve processes that include identifying a problem, examining and applying solutions and monitoring for improvement (Shewhart, 1931; Deming, 1982; Urowitz *et al.*, 2006; Varkey *et al.*, 2007).

This tertiary evidence synthesis (a review of systematic reviews) identifies and appraises primary-care QI interventions relevant to UK primary care and other healthcare systems at the *practice level.* For the purpose of the review, a 'practice' is described as an organisation including a multidisciplinary primary-care team of a single or multiple general practitioner(s), health professionals, and administrative staff, often based within an ambulatory setting or environment and acting as a gatekeeper, central entry and co-ordination point for healthcare delivery (Moore *et al.*, 2007). Given that systematic reviews usually focus on one type of intervention, there is an increasing need to carry out an overview, also termed a 'review of reviews', of given topics to ensure all relevant systematic reviews are synthesised and presented in a form that is useful to healthcare practitioners and those delivering QI in routine clinical practice (Grimshaw *et al.*, 2003). The specific objective of this review of reviews was to examine and critically appraise the evidence relating to practice-level primary-care QI initiatives relevant to UK primary care.

Methods

This review was informed by available guidance on conducting systematic reviews of systematic reviews and particularly in the context of source identification, study selection, quality assessment, presentation of results and defining the implications of the research conducted (Smith *et al.*, 2011).

Searches

A literature search of the following databases was performed: ATHENS, MEDLINE, EBSCO HOST, EMBASE, CINAHL, the University of Birmingham E-Library and the Cochrane Database (with date search discrimination of papers from June 1994 to June 2014). Use of specified databases was chosen based on reputation and the requirement to use two or more databases to provide a comprehensive search (Ayevard, 2008). In searching for appropriate literature, key terms related to the research objective were utilised. Key terms included examples such as 'quality improvement', 'variation', 'outcome improvement', 'performance improvement' and 'practice improvement'. Using these key terms, related terms, Boolean and phrase searches to focus the search strategy, and in using operators in between key words to combine them, enabled acquisition of literature through the use of databases and journal searching programmes. Where available for bespoke adaptation, electronic searches were targeted by specified inclusion

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Table 1 Results (number) of papers returned by database after applying the search criteria

Source of literature search	Results obtained
ATHENS/EMBASE	61
EBSCO HOST	968
CINAHL (excluding MEDLINE)	5
Cochrane Collaboration (notably EPOC)	15
PubMed/MEDLINE	180
University of Birmingham e-Library	10
Reviews from within review references not otherwise present in literature searches	55
Total	1294

criteria, search modes, expanders and limiters – for example, by ensuring returns of systematic reviews after the application of limited publication dates and Boolean/phrase searches. The reference lists and bibliographies of the included reviews were also searched for relevant reviews.

Table 1 details the number of results obtained from each database source after applying the search criteria.

Selection of systematic reviews

At least two reviewers independently assessed the retrieved studies for inclusion against the inclusion and exclusion criteria and reached agreement through discussion.

Inclusion criteria

Selected studies had to satisfy the following criteria for inclusion based on examination of the full review text: the literature had to be a systematic review (using the key principles and characteristics of systematic reviews as defined by Hemingway and Brereton, 2009: 1), including all relevant Cochrane Effective Practice and Organisation of Care (EPOC) Group reviews working to defined Cochrane review protocols (Cochrane Effective Practice and Organisation of Care Group, 2014); the literature had to be published after 1994 (representing a 20-year search span); the literature had to be relevant to the research questions and include QI and/or understanding variation as included and prioritised aspects of the study; and the literature had to be from the UK primary-care setting and/or a comparable first-contact primary-care settings elsewhere. These were defined through the three-person author group as follows: The United Kingdom, Republic of Ireland, The Netherlands, Finland, Denmark, Sweden, New Zealand, Norway, Spain, Italy and Portugal. This was based on criteria where (a) patients register with a practice that is their usual provider; (b) strong gatekeeping exists – that is, primary care is the first point of contact and non-emergency access to secondary care is via primary care; (c) primary care is delivered through a team rather than a physician alone; (d) primary care is funded via a largely capitation-based payment system (i.e., not fee for service); and (e) the literature had to be focussed at the primary-care practice level or with QI interventions practically implementable at the practice level.

Further verification of comparable primary-care settings was cross-referenced through the following sources: The Health Systems and Policy Monitor, The Commonwealth Fund International Profiles of Health Care Systems and conference proceedings from the European Forum for Primary Care (European Forum for Primary Care, 2011; The Commonwealth Fund, 2012; European Observatory on Health Systems and Policy, 2014). The qualification of countries representing primary care with relevance to the UK setting is provided, given that within different primary-care settings present in international comparisons, variable factors such as payment method, financial incentives and features of the primary-care system can have an impact on areas as diverse as resource utilisation, compliance, performance target improvement, quality and outcomes (Chaix-Courtier *et al.*, 2000; Atun, 2004; Gosden *et al.*, 2011).

Exclusion criteria

Reviews were excluded where the primary intervention or focus of the research was on primary-care funding, financing and regulatory change, due to these being influenced at the system level as opposed to the practice level. Reviews covering topics already examined through the Cochrane EPOC Group were excluded and were often part of, or referenced within, EPOC review updates.

Assessment of quality

The lead author (R.I.) assessed the quality of each of the included systematic reviews using the

Critical Appraisal Skills Programme (CASP) tool. The other two authors (T.S., T.M.) independently assessed the quality of assessment of a sample of the included studies. The CASP appraisal checklist for systematic reviews was selected for use in the defined literature review in order to provide an economical and structured approach to systematic review appraisal, where the widely recommended and reputable CASP tool in particular promotes understanding about review validity, meaning and applicability (CASP, 2013; McLean *et al.*, 2013; Singh, 2013). Two systematic reviews were excluded after application of the CASP tool due to lack of clarity around defining a clear research question, which resulted in interventions not easily categorised as QI interventions, and where the systematic review was not specifically focussed enough to be relevant to the UK primary-care setting at the practice level. Table 2 provides a summary of the application of the CASP checklist for systematic reviews included for full review.

Figure 1 details the flow chart and results of papers included for the review after application of the inclusion and exclusion criteria, quality check and CASP appraisal.

Data extraction

Data from the included reviews were extracted by one of the authors to record the author(s), date of publication, review purpose, QI intervention, review outcomes and review conclusions.

Data synthesis

The presented review of reviews is a tertiary-level synthesis of secondary-level data – that is, systematic reviews – which were analysed by the overall effect of the intervention examined within each review. The overall effect was determined in different ways across different systematic reviews, as can be seen in Table 3, by review author(s) adopting various quantitative (e.g., meta-analysis) or qualitative (e.g., meta-synthesis) methods for synthesising primary-level data. The overall examined and reported intervention effect within each systematic review and author conclusions were used as the basis for assessing the intervention effect. Clearly, the evidence of overall QI intervention effect in systematic reviews is influenced by the number and quality of the included primary-level studies. However, although individual analysis of the included studies within systematic reviews was not conducted in this review of reviews, quality assessment and application of the CASP tool for systematic review inclusion assessed the appropriateness and rigour of the included studies within reviews. Randomised control trials were the most common study design present in systematic reviews; however, non-randomised controlled clinical trials (CCT), interrupted time series and before and after studies were also present.

Heterogeneity was present in the included reviews across areas such as interventions applied, disease area and primary outcome measures and was not comparable in nature; therefore, purely quantitative statistical approaches to present the findings were deemed inappropriate. Furthermore, numerical and statistical values across both reviews and their included studies were not comparable, sample size discrimination was not always conducted, and therefore the computation of standard error was deemed unfeasible. As such, the included reviews were examined for whether the QI intervention applied demonstrated evidence of an effect for the intervention with reported confidence intervals where stated (Table 3). Furthermore, data synthesis occurred through examining the QI intervention effect by outcome category (Table 4) and the level of change using the framework produced by Ferlie and Shortell (2001), as summarised in Table 5. The Ferlie and Shortell framework was applied to further distinguish whether QI intervention effects were primarily conducted within, and influenced by, a specific level of change – for example, interventions applied at the individual compared with the team level within a practice setting.

A number of included systematic reviews made reference to QI strategies or multiple interventions as part of a wider QI programme. These reviews were analysed with single-intervention reviews as above and assessed for general themes, assessing any impact that individual interventions had within these combined QI strategies and approaches.

Results

A total of 31 systematic reviews were included for further assessment after application of the search strategy, application of the inclusion criteria and

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Table 2 Summary of CASP application to systematic reviews

Study	1	2	3	4	5	6	7	8	9	10
C. Ivers *et al.* (2012)	✓	✓	✓	✓	✓	Utilised risk difference, per centage change and multivariable meta-regression	Precise. Meta-regression using number of health professionals for weighting	✓	✓	✓
C. Gillaizeau *et al.* (2012)	✓	✓	✓	✓	✓	Assumed and corresponding risk noted. Risk ratio, confidence intervals and standardised mean difference all reported	Precise. High risk of performance bias noted. Outcomes varied in terms of precision but built into conclusion	–	✓	✓
C. Forsetlund *et al.* (2009)	✓	–	✓	✓	✓	Utilised risk difference and univariate meta-regression analysis	Precise. However, only extracted the results for the primary outcome	✓	X	✓
C. Thompson *et al.* (2003)	✓	✓	✓	✓	X	Standardised mean differences, sensitivity analysis and funnel plots (to assess effects between larger and smaller studies) used	Results limited and poor quality but noted in overall conclusion. Confidence intervals reported	–	✓	✓
C. O'Brien *et al.* (2007)	✓	✓	✓	✓	✓	Meta-regression and risk differences reported	Precise. Precision supported author conclusions	✓	✓	✓
C. Smith *et al.* (2007)	✓	✓	✓	✓	X	Statistical analysis presented relevant to study type	Significance and results noted but not always clearly statistically defined	–	✓	✓
C. Smith *et al.* (2012)	✓	✓	✓	✓	✓	Meta-analysis was not possible. Study results reported statistically and significance noted	Precise. Overall analysis recognised variable precision between studies. Confidence intervals reported	–	✓	✓
C. Renders *et al.* (2000)	✓	✓	✓	✓	✓	Results were expressed differently in the range of studies but included common statistical methods and were summarised	Heterogeneity meant meta-analysis not possible. Authors described and made sense of effect sizes. Confidence intervals relatively large in individual studies and overall	✓	✓	✓
C. Shojania *et al.* (2009)	✓	✓	✓	✓	✓	Measured process adherence and reported median, confidence intervals and IQR appropriately. Sensitivity analysis also completed	Precise. Clear justification for median improvement use as a statistical measure over meta-regression	✓	✓	✓
C. Laurant *et al.* (2004)	✓	✓	✓	✓	✓	Meta-analysis applied where appropriate and semi-quantitative methods used otherwise. Generally studies not powered to assess equivalence of care	Effects of intervention and significance clearly reported. Due to studies not being powered to measure care equivalence precision of overall findings difficult to assess	–	✓	✓

Table 2 (*Continued*)

Study	1	2	3	4	5	6	7	8	9	10
Royal *et al.* (2006)	✓	✓	✓	✓	✓	Used random effects meta-analysis due to study heterogeneity. Forest plot used to clearly display analyses	Confidence intervals relatively large in individual studies and overall	–	✓	✓
Gallagher *et al.* (2010)	✓	✓	✓	✓	✓	Appropriate statistical analysis used. Clear presentation of analysis	Only three RCTs included. One of the three RCTs demonstrates no clear effect and forest plot analysis possibly not precise enough to draw conclusions. Combined effect reduction in systolic BP of 10.50 mmHg reported	–	✓	✓
Grimshaw and Eccles (2004)	✓	✓	✓	✓	✓	Single estimates of dichotomous process variables were derived for each study comparison based upon the primary end-point or the median measure across several reported end-points	Precise. Clear analysis of results across a range of outcome areas and interventions. Additional analysis of single versus multifaceted interventions and effects of number of interventions	✓	✓	✓
Faulkner *et al.* (2003)	X	–	Study not included for discussion after applying CASP screening questions. Systematic review focus and paper inclusion were used to present a more narrative approach of service innovations where authors note a difficulty in the interpretation of findings. The paper content was not clear in relation to what constituted 'innovation' and outcomes measured were difficult to interpret as related to different aspects of referral activity, from referral volume to referral outcome. A diversity of included studies presented an extremely heterogeneous mix of studies (e.g., some focussed on financial/regulatory interventions where as others focussed on patient-level) which, after review, were not easily applied to the objectives for the current review								
Lau *et al.* (2012)	✓	✓	✓	✓	✓	Clear meta-analysis presented with pooled odds ratio for appropriate studies. Confidence intervals and significance clearly displayed	As a number of interventions were analysed, precision varied between intervention. Author conclusions based on precision	–	✓	✓
Rhydderch *et al.* (2005)	✓	✓	✓	✓	✓	Review 'bottom line' results not absolutely clear. Description and narrative presented with assessment of development, validity and reliability of organisational assessments	Result precision clear through analysis of organisational assessment tools. Authors acknowledge recall may be limited	✓	✓	✓

Table 2 (*Continued*)

Study	1	2	3	4	5	6	7	8	9	10
Holden (2003)	✓	–	–	–	✓	Subjective and objective interpretation of results provided	Precision generally reported in individual studies. No clear author reference to overall precision from a statistical perspective	✓	X	✓
Baskerville *et al.* (2012)	✓	✓	✓	✓	✓	Review results clearly expressed through overall combined effect size. Meta-regression, publication bias, influence bias and sub-group bias were all conducted	Precise. Confidence intervals given and explained	–	✓	✓
Fahey *et al.* (2005)	✓	✓	✓	✓	✓	Clear outcomes and weighted mean difference use with both statistical and clinical significance recorded	Precise. Pooled data not always possible due to heterogeneity. Conclusions around organisational interventions based primarily on a single, large RCT	✓	✓	✓
De Belvis *et al.* (2009)	✓	✓	✓	✓	✓	Forest plots used for comparisons of similar interventions and assessment of statistical significance of results included	Precise. Cumulative meta-analysis utilised appropriately where possible. Statistical justification for conclusions could have been made clearer as was primarily analysed through narrative	✓	✓	✓
Hulscher *et al.* (1999)	✓	✓	✓	✓	✓	Statistical significance and included study results presented in tabular format, with extensive comparison of interventions. No statistical pooling or meta-analysis	Descriptive and extensive narrative however lack of clear bottom line statistical justification of conclusions, however authors explain this in review weaknesses	–	✓	✓
Tricco *et al.* (2012)	✓	✓	✓	✓	✓	Mean differences, pooled effects and forest plots were combined with very clear statistical analyses	Precise. Confidence intervals reported and examined	–	✓	✓
Grimshaw and Eccles (2004)	X	–	Study not included for discussion as it was difficult to identify the specific criteria and detail around the population of study, intervenion and outcomes and how included studies were justified for inclusion against these criteria. Although the review clearly provides valuable information, it was not suitable for inclusion as it was not specific or focussed enough on the aims of the current review and parallel inclusion criteria applciation with more scurtiny			

CASP = critical appraisal skills programme; IQR = interquartile range; RCTs = randomised control trials; BP = blood pressure.
C. denotes Cochrane EPOC review.
Key: ✓ = Yes (also indicates not applicable); X = No; – = Can't tell

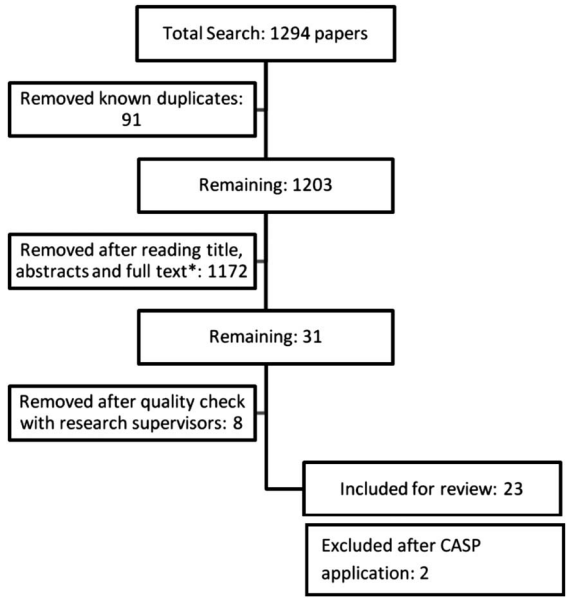

Figure 1 Flow chart of paper selection – inclusion and exclusion process. CASP = critical appraisal skills programme.

full paper review. Eight systematic reviews were excluded by the three-person review group; common reasons for exclusion included systematic reviews with a published date before 1994, reviews with a focus on primary-care settings either not comparable with the UK setting (e.g., research based exclusively in the United States) or not relevant to the practice setting and reviews not clearly demonstrating a QI intervention.

Single interventions

The specific QI interventions reviewed that the demonstrated strongest effect (whether on care structure, process or outcomes) included audit and feedback, point-of-care reminders, computerised advice, practice facilitation and interventions for evidence-based guideline adoption, adherence to clear practice structures and processes for patient review, continuing education and educational outreach, as presented in Tables 3 and 4 (Renders *et al.*, 2000; Grimshaw *et al.*, 2003; Holden, 2003; Fahey *et al.*, 2005; O'Brien *et al.*, 2007; Smith *et al.*, 2007; 2012; De Belvis *et al.*, 2009; Forsetlund *et al.*, 2009; Shojania *et al.*, 2009; Gallagher *et al.*, 2010; Baskerville *et al.*, 2012; Gillaizeau *et al.*, 2012; Ivers *et al.*, 2012; Lau *et al.*, 2012; Tricco *et al.*, 2012). The evidence of effect for these interventions was also replicated in reviews of broader QI approaches comprising several interventions. For example, in their review of interventions for improving vaccination rates, Lau *et al.* (2012) observed many of the described interventions (audit and feedback, point-of-care reminders and practice outreach) as having a particularly large individual and combined effect for improvements in disease-specific vaccination rates as measured through statistical analysis of odds ratios. Audit (whether individual, single practice or multi-practice), feedback and continuing education are cited as having the greatest direct effect on patient outcomes, with other interventions primarily affecting process improvement. Where baseline performance or achievement was low for the measured outcome, the resultant effect size was larger (Ivers *et al.*, 2012). For those reviews that did not measure outcomes directly, it must be recognised that care structure and process improvement can also be correlated with improved outcomes (The King's Fund, 2012).

In categorising evidence of the QI effect against three outcome areas of process improvement/adherence with desired practice, improvement in physiological/biological outcomes and other

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Table 3 Quality improvement interventions and effect

Intervention	Evidence of effect	Data synthesis approach/statistics and key results	Studies included for outcome	Outcome	References
Audit and feedback	Yes	Median adjusted RD = 4.3%, IQR 0.5%–16% (dichotomous outcomes) Weighted median adjusted per cent change relative to control = 1.3%, IQR 1.3%–28.9% (continuous outcomes)	49 21	Healthcare professional compliance with practice	Ivers *et al.* (2012)
Audit and feedback	Yes	Weighted median RD = −0.4%, IQR −1.3%–1.6% (dichotomous outcomes) Weighted median per cent change = 17%, IQR 1.5%–17% (continuous outcomes)	6 5	Patient outcomes	Ivers *et al.* (2012)
Computerised advice	Yes	Increased target peak serum concentrations – aminoglycoside antibiotics: peak concentration SMD = 0.79 (95% CI 0.46–1.13); Increased target peak serum concentrations – theophylline SMD = 0.41 (95% CI −0.2–1.02) Proportion of people within therapeutic range for aminoglycoside antibiotics pooled RR = 4.44 (1.94–10.13); Improved desired range for oral anticoagulants SMD = 0.19 (95% CI 0.06–0.33) and insulin SMD = 1.27 (95% CI 0.56–1.98) Decreased thromboembolism events for anticoagulants, rate ratio = 0.68 (95% CI 0.49–0.94)	8 12 4	Drug dosage	Gillaizeau *et al.* (2012)
Computerised advice	No	No effect based on pooled RRs relating to decision support for drug dosages	2	Mortality	Gillaizeau *et al.* (2012)
Continuing education meetings and workshops	Yes	Median adjusted risk difference = 6% (1.8%–15.9%)	30	Healthcare professional compliance with practice	Forsetlund *et al.* (2009)
Continuing education meetings and workshops	Yes	Median adjusted risk difference = 3.0% (0.1%–4.0%)	5	Patient outcomes; achievement of treatment goals	Forsetlund *et al.* (2009)
Dietary advice given by dietician compared with self-help resources	No	Standardised and un-standardised mean differences and reported CI; no statistically significant effect	3	Blood cholesterol and secondary outcomes	Thompson *et al.* (2003)
Dietary advice given by dietician compared with GP	Not clear	Standardised and un-standardised mean differences and reported CI; not clear – primary care settings had different results for measured blood cholesterol with no significant differences for secondary outcome measures	1	Blood cholesterol and secondary outcomes	Thompson *et al.* (2003)

Table 3 (*Continued*)

Intervention	Evidence of effect	Data synthesis approach/statistics and key results	Studies included for outcome	Outcome	References
Educational outreach visits	Yes	Median adjusted RD = 5.6% (IQR 3%–9%)	69	Compliance with desired practice	O'Brien *et al.* (2007)
Educational outreach visits	Yes	Median = 4.8% (IQR 3%–6.5%)	28	Improved prescribing	O'Brien *et al.* (2007)
Shared care	No	Mean difference and RR with reported CI; no evidence of effect	15	Physical and mental health outcomes	Smith *et al.* (2007)
Shared care	Yes	Medication prescribing improvement; RR = 1.21% (95% CI 1.01, 1.44); medication use improvement; RR = 1.29% (95% CI 1.21, 1.36)	11	Appropriate medication prescribing and use	Smith *et al.* (2007)
Targeted multimorbidity improvement in primary and community care	Yes	Improvement using RCT unit of analyses; narrative synthesis	2	Prescribing and medication adherence	Smith *et al.* (2012)
Targeted multimorbidity improvement in primary and community care	Not clear	Improvement using RCT unit of analyses; narrative synthesis	4	Physical and mental health outcomes	Smith *et al.* (2012)
Diabetes management interventions in primary care	Yes	Analysis through various RCT units due to heterogeneity	28	Process outcomes	Renders *et al.* (2000)
Diabetes management interventions in primary care	Yes	Analysis through various RCT units due to heterogeneity. Result when using patient education	27	Patient outcomes	Renders *et al.* (2000)
Point-of-care reminders	Yes	Median improvement = 4.2% (IQR 0.8%–18.8%)	32	Process adherence	Shojania *et al.* (2009)
Doctor–nurse substitution	No	No difference; Narrative synthesis	16	Patient outcomes, process of care, resource utilisation, cost	Laurant *et al.* (2004)
Primary care interventions to reduce medication-related adverse events	No	No significant effects from pooled analysis and pharmacist led intervention RCTs (OR = 0.91, 95% CI 0.80, 1.04)	38	Preventable drug-related morbidity and admissions.	Royal *et al.* (2006)
QI for the management of hypertension in CKD	Yes	Combined effect of a reduction in systolic blood pressure of 10.50 mmHg (95% CI 5.34–18.41 mmHg)	4	Blood pressure	Gallagher *et al.* (2010)
Clinical practice guideline implementation	Yes	Overall, interventions to implement clinical guideline recommendations are effective, with median effect size of 9% (IQR 7%–14%) in improving healthcare compliance with desired practice reported for single interventions	235	Compliance with practice and improvements in care	Grimshaw and Eccles (2004)

Table 3 (*Continued*)

Intervention	Evidence of effect	Data synthesis approach/statistics and key results	Studies included for outcome	Outcome	References
Interventions for improved pneumococcal and influenza vaccination	Yes	Increased influenza vaccination rates, OR = 1.46 (95% CI 1.35–1.57); pneumococcal vaccination rates, OR = 2.01 (95% CI 1.72–2.3)	106	Vaccination rates	Lau *et al.* (2012)
Multi-practice audit	Yes	48% of audited parameters had improved significantly ($P<0.05$) post-audit	48	Performance improvement	Holden (2003)
Practice facilitation of evidence-based guideline use	Yes	Practice facilitation was commensurate with effect size of 0.56 (95% CI 0.43–0.68)	23	Practice compliance and improvement	Baskerville *et al.* (2012)
Educational and organisational interventions for hypertension management	Yes	System of regular patient review with antihypertensive drug therapy was shown to reduce blood pressure (weighted mean difference –8.2/–4.2 mmHg, –11.7/6.5 mmHg, –10.6/–7.6 mmHg for three strata of entry blood pressure) and all-cause mortality at five years follow-up (6.4% versus 7.8%, difference 1.4%) in a single large RCT (the Hypertension Detection and Follow-up Study)	56 (results dominated by single RCT noted)	Blood pressure (mmHg) and blood pressure control	Fahey *et al.* (2005)
EBM adherence for Type II Diabetes Management	Yes	Improvement demonstrated through narrative and conclusions drawing on statistical analysis of heterogeneous studies	6	Process of Diabetes Care	De Belvis *et al.* (2009)
EBM adherence for Type II Diabetes Management	No	Narrative synthesis, however, studies limited in both number and quality	7	Outcomes of Diabetes Care	De Belvis *et al.* (2009)
Disease prevention interventions	Not clear	The examination of which interventions are most effective is not clearly displayed (partly due to differing study characteristics) or discussed comparatively. There is at least some evidence for the following interventions based on mean reported scores before and after intervention: Information transfer Learning through social influence (local opinion leaders, outreach visits and others) Feedback Physician reminders Organisational interventions (primarily screening and referral on) Multifaceted/combination interventions including at least one of the above	58 8 3 3 13 4	Outcomes of preventative services on primary care practice performance	Hulscher *et al.* (1999)

Table 3 (*Continued*)

Intervention	Evidence of effect	Data synthesis approach/statistics and key results	Studies included for outcome	Outcome	References
QI strategies for Diabetes Management	Yes	QI strategies had the following effect on biological markers; reduction in HbA1c by a mean difference of 0·37% (95% CI 0·28–0·45; 120 trials), LDL cholesterol by 0·10 mmol/L (0·05–0.14; 47 trials), systolic blood pressure by 3·13 mmHg (2·19–4·06, 65 trials), and diastolic blood pressure by 1·55 mmHg (0·95–2·15, 61 trials). All trails compared the intervention against usual care	As noted; 47–120 based on marker	Biological markers	Tricco *et al.* (2012)
QI strategies for Diabetes Management	Variable	QI strategies increased the likelihood that patients received aspirin [11 trials; relative risk (RR) 1·33, 95% CI 1·21–1·45], antihypertensive drugs (10 trials; RR 1·17, 1·01–1·37), and screening for retinopathy (23 trials; RR 1·22, 1·13–1·32), renal function (14 trials; RR 128, 1·13–1·44), and foot abnormalities (22 trials; RR 1·27, 1·16–1·39). However, statin use (10 trials; RR 1·12, 0·99–1·28), hypertension control (18 trials; RR 1·01, 0·96–1·07), and smoking cessation (13 trials; RR 1·13, 0·99–1·29) were not significantly increased	As noted; 10–23 based on treatment	Treatment uptake	Tricco *et al.* (2012: 2252)

RD = risk difference; IQR = interquartile range; SMD = standardised mean difference; 95% CI = 95% confidence interval; GP = general practioner; RCT = randomised control trial; RR = risk ratio; OR = odds ratio; EBM = evidence-based medicine; QI = quality improvement; LDL = low-density lipoprotein.

Table 4 Quality improvement interventions by outcome category

Outcome category	QI intervention reporting evidence of effect within systematic reviews (where data is analysed, effect is statistically significant)
Process improvement/ compliance with desired practice	16/16
Physiological/biological marker improvement	4/7
Other patient outcome	3/8

QI = quality improvement.

Table 5 Four levels of change for improving quality

Levels	Examples
Individual	Education; academic detailing; data feedback; benchmarking; guideline, protocol, pathway implementation; leadership development
Group/team	Team development; task re-design; clinical audits; breakthrough collaboratives; guideline, protocol, pathway implementation
Organisation	Quality assurance; continuous quality improvement; quality management; organisation development; organisation culture; organisation learning; knowledge management/ transfer
Larger system/ environment	National bodies (NICE, CHI, AHRQ); evidence-based practice centres; accrediting/licensing agencies (NCQA, Joint Commission); public disclosure ('report cards', etc.); payment policies; legal systems

patient outcomes, the QI intervention effect was more consistently successful in improving process and/or adherence with the desired practice compared with other outcomes. However, it must be stated that categorisation of outcomes in this way is not necessarily sensitive or scientific enough to draw conclusions on QI success across these areas.

Prescribing

A number of reviews sought to improve prescribing or prescribing behaviour as the key outcome. Ivers *et al.* (2012: 10) describe prescribing behaviours as 'important but not complex'. Of those reviews aiming to affect prescribing behaviour, point-of-care reminders, computerised advice and educational outreach visits had the greatest impact (O'Brien *et al.*, 2007; Shojania *et al.*, 2009; Gillaizeau *et al.*, 2012). There was also evidence that QI interventions produced improvements in prescribing behaviour that were greater than the effects from other measured outcomes, such as patient-level physical and mental health outcomes (Smith *et al.*, 2007; 2012). In these cases, QI interventions that affected prescribing behaviour and practice were more effective than other interventions and particularly when the intention was to improve care for patients with multi-morbidity, where disease management above improving prescribing behaviour may be more complex (Smith *et al.*, 2007; 2012; Ivers *et al.*, 2012). The effects on noted QI interventions for prescribing also produced improvement across a range of prescribing-related outcomes, from increased appropriate prescribing volume, improved prescribing compliance, improved prescribing accuracy and dosage and reduced adverse prescribing incidents (O'Brien *et al.*, 2007; Smith *et al.*, 2007; 2012; Shojania *et al.*, 2009; Gillaizeau *et al.*, 2012; Ivers *et al.*, 2012).

Multifaceted interventions

A number of reviews looked at combined or multifaceted interventions (defined as more than one intervention) as part of a QI approach, where multifaceted interventions were sometimes used as comparative arms to single-intervention systematic reviews. The effects on the outcomes of multifaceted interventions was seen across a range of review areas, from condition-specific reviews, such as multifaceted interventions for primary-care management of diabetes, to single-measurement areas, such as reductions in hypertension (Renders *et al.*, 2000; Fahey *et al.*, 2005; O'Brien *et al.*, 2007; De Belvis *et al.*, 2009; Baskerville *et al.*, 2012; Ivers *et al.*, 2012). Multifaceted interventions achieved positive outcomes compared with no intervention or single-intervention in both single practice and multiple-practice QI initiatives (Renders *et al.*, 2000; Fahey *et al.*, 2005; O'Brien *et al.*, 2007; De Belvis *et al.*, 2009; Baskerville *et al.*, 2012; Ivers *et al.*, 2012). Hulscher *et al.* (1999) provide a sensible hypothesis for explaining the multifaceted

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Table 6 Summary of improvement effects for multifaceted interventions

Reference	Supports improvement effect for multifaceted approach?
C. Ivers *et al.* (2012)	Yes: intervention effect sizes for continuous outcomes were larger where audit and feedback were part of a multifaceted approach (no difference for dichotomous outcomes)
C. Gillaizeau *et al.* (2012)	N/A: no overall analysis of multifaceted intervention compared with single intervention
C. Forsetlund *et al.* (2009)	N/A: no significant difference in the effects of multifaceted interventions
C. Thompson *et al.* (2003)	N/A: no overall analysis of multifaceted intervention compared with single intervention
C. O'Brien *et al.* (2007)	Yes: multifaceted interventions had a median effect size of 8.8%, compared with educational outreach visits alone with a median effect size of 5%
C. Smith *et al.* (2007)	N/A: no overall analysis of multifaceted intervention compared with single intervention
C. Smith *et al.* (2012)	N/A: no overall analysis of multifaceted intervention compared with single intervention
C. Renders *et al.* (2000)	Yes: multifaceted interventions can enhance QI in the management of Diabetics by healthcare professionals; Not compared with single interventions
C. Shojania *et al.* (2009)	No: median improvement of multifaceted interventions in adherence of 1.9% compared with single intervention of 5.7%
C. Laurant *et al.* (2004)	N/A: no overall analysis of multifaceted intervention compared with single intervention
Royal *et al.* (2006)	N/A: no overall analysis of multifaceted intervention compared with single intervention
Gallagher *et al.* (2010)	N/A: no overall analysis of multifaceted intervention compared with single intervention
Grimshaw and Eccles (2004)	N/A: multifaceted interventions did not appear to be more effective than single interventions; no relationship between number of interventions and effect size
Lau *et al.* (2012)	N/A: no overall analysis of multifaceted intervention compared with single intervention
Rhydderch *et al.* (2005)	N/A: no overall analysis of multifaceted intervention compared with single intervention
Holden (2003)	N/A: no overall analysis of multifaceted intervention compared to single intervention
Baskerville *et al.* (2012)	Yes: outreach as a multifaceted intervention is effective in evidence-based guideline adoption
Fahey *et al.* (2005)	Yes: multifaceted approach was successful in the QI study, which dominated review findings. However, this was not compared with single intervention
De Belvis *et al.* (2009)	Yes: multifaceted interventions more likely to be effective in adherence to evidence-based practice; Not statistically compared with single intervention
Hulscher *et al.* (1999)	N/A: no clear comparison between multifaceted versus single interventions
Tricco *et al.* (2012)	N/A: QI strategies targeting system of chronic disease management more effectively than targeting healthcare professionals alone. No clear comparison between multifaceted versus single *interventions*

QI = quality improvement.
C. denotes Cochrane EPOC review.

effect applied to primary and preventive care, stating that the high number of influencing factors involved in this care area are more likely to be affected by a greater number of interventions. Table 6 summarises the impact of multifaceted interventions by the included systematic review. In one review, however, completed by Shojania *et al.* (2009), examining point-of-care reminders and other interventions, single interventions realised a higher median improvement compared with multifaceted interventions, and previous authors have also indicated no significant effect of multifaceted approaches to QI through guideline dissemination (Grimshaw and Eccles, 2004; Squires *et al.*, 2014). For these reasons, the evidence is not conclusive to suggest that multifaceted approaches are more effective than single interventions.

Organisational level interventions

Reviews by Fahey *et al.* (2005) and Rhydderch *et al.* (2005) focussed their aims on organisational elements of QI in primary care with some important findings. On QI intervention at the organisational level, Fahey *et al.* (2005) observed that QI programmes addressing primary-care structure, management, organisation and systematic process implementation had a statistically significant effect on blood pressure control and hypertension outcomes. Particularly referenced is the 'Hypertension detection and follow-up programme', which, although based on some data from trials over 20-years old, demonstrated that organisation-focussed QI intervention that included hypertension detection and regular review, including addressing medication adherence and blood pressure goal

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achievement, had a significant impact on hypertension outcomes (Davis and Ford, 2001). Hulscher *et al.* (1999) also cite organisational patient identification and follow-up referral as an effective strategy for included reviews, that focus on screening and referral for breast and cervical cancers and alcohol-related problems. The authors additionally note from an included study that when targeting health promotion behaviour change, extended length of GP appointment by just over 1 min (7.16 min in control versus 8.25 min in intervention arm) meant that GPs were more likely to offer screening and provide or elaborate on health promotion advice that could have a positive impact on disease outcomes.

Ferlie and Shortell (2001) cited four levels of change for improving quality of healthcare – namely, QI at the individual, group/team, organisation and system/environment levels – reference to this framework in the present review was made when analysing results, although recognising the exclusion of system-level QI interventions for the present review. Comparing the different levels of QI intervention from individual to organisational level, all levels contained a mixture of evidence for an effect and evidence of no effect, whether relating to care structure, process or outcomes. In this respect, it did not become immediately apparent that any single level of intervention realised greater QI outcomes than another.

Discussion

Summary of findings

Audit and feedback, point-of-care reminders, computerised advice, practice facilitation and interventions for evidence-based guideline adoption, adherence to clear practice structures and processes for patient review, continuing education and educational outreach all demonstrated evidence of QI effect. Wider QI strategies, which included these interventions such as clinical practice guideline implementation strategies, also demonstrated evidence of effect (Grimshaw and Eccles, 2004). The evidence of an effect for QI was higher where baseline performance was low. Prescribing was a healthcare process commonly targeted and improved by QI interventions. Multifaceted interventions achieved positive outcomes compared with no intervention across a range of disease areas in both single-practice and multiple-practice QI initiatives. However, this finding was not present in the review conducted by Shojania *et al.* (2009) and has not been replicated in the wider literature reviewed here (Grimshaw and Eccles, 2004). We also note that a recent review of reviews addressing this question also concluded that there is no compelling evidence that multifaceted interventions are more effective than single-component interventions in affecting healthcare professional behaviours (Squires *et al.*, 2014). The reason for this may be because multifaceted interventions are usually adopted when there is a need to affect change for an outcome or outcomes that are inherently more difficult to improve (Shojania *et al.*, 2009). Equally, in examining the literature around the impact of multifaceted interventions, the primary outcome measure is important. In this review, multifaceted interventions predominantly aimed to affect change through structured QI programmes or QI interventions aimed at whole-care areas and appeared to show a positive effect of multifaceted approaches compared with no intervention or single intervention. This is compared with other available literature using multifaceted approaches to affect individual healthcare professional behaviour change or compliance to practice which appears to demonstrate that multifaceted interventions are no more effective than single interventions (Grimshaw and Eccles, 2004; Squires *et al.*, 2014). Recognising this, from the reviews examined, multifaceted approaches delivered measured QIs across a range of research areas and outcomes and could lead to greater compounded gains when implemented successfully. It must be noted that challenges also exist in discriminating multifaceted interventions from single interventions (e.g., where interventions such as educational outreach are inherently multifaceted).

Other areas of the literature review demonstrated considerations around QI programmes or interventions that showed negative findings, little or no effect of QI interventions. Both the examples relating to role substitution (e.g., between doctors and nurses) demonstrated relatively weak evidence for any impact on improved outcomes (Thompson *et al.*, 2003; Royal *et al.*, 2006). In examining all reviews, there were also less-clear impacts of QI initiatives on areas such as mortality and morbidity, but this was mostly due to the lack of appropriate follow-up or indeed primary measure of these areas (Thompson *et al.*, 2003;

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Royal *et al.*, 2006). In respect of this, it is important not to discount QI interventions as having an effect on morbidity and mortality outcomes, where the wider literature highlights a relationship here, particularly in showing that QI for effective prescribing and drug treatment has a clear impact on mortality and morbidity (Turnbull, 2003; Fahey *et al.*, 2005). Smith *et al.* (2012) also found mixed effects of interventions (most commonly care co-ordination and enhanced multidisciplinary team care approaches) for improving outcomes related to multimorbidity, other than an indication of improved prescribing, medication adherence and patient satisfaction following intervention, there was mixed evidence that interventions had effects on a wider range of patient health outcomes, care utilisation and patient behaviours.

Strengths and limitations of this study

A key strength of this review and the methodology adopted is that it allows the findings of individual systematic reviews on QI interventions in general practice to be compared, contrasted and summarised (Smith *et al.*, 2011). We also sought to ensure relevance by explicitly identifying QI research in primary healthcare settings where first-contact primary care is the norm, such as UK primary care. As a consequence, some potentially relevant systematic reviews that did not meet these criteria were excluded (e.g., reviews exclusively including studies set in the United States). The justification provided for this inclusion criteria is that it may be difficult to draw firm conclusions regarding QI intervention impact from other primary-care settings that could be influenced by significant external factors such as the political, regulatory or other contexts that primary care operates within (Chaix-Courtier *et al.*, 2000; Atun, 2004; Gosden *et al.*, 2011). In addition, there are other considerations to note, where the variation in primary-care delivery in the United States, for example, makes differentiation of a first-contact primary-care research setting difficult to identify – for example, where primary care operates within an accountable care system, purely corporate arena, demographically biased insurance market or other contexts (Starfield *et al.*, 2005; Kringos *et al.*, 2010). It is suggested, however, that review findings are still likely to be relevant to those operating in other primary-care settings for two reasons. First, due to research summaries and systematic reviews from other settings – for example, the United States and Australia – identifying and promoting similar improvement effects for the key QI interventions examined, such as audit and feedback, practice facilitation and point-of-care reminders (Garg *et al.*, 2005; Taylor *et al.*, 2014). Second, because, although reviews *exclusively* from settings outside the defined inclusion criteria were excluded, many reviews included contained a mix of research settings, including those such as North America and Australasia. One of the key limitations to this study is the possibility of omission of QI research that was not captured through the targeted search strategy; however, a broad search strategy was deployed that generated a high number of systematic reviews in primary care, which were subsequently reviewed for relevance to primary-care QI. A potential limitation also arises where the same individual study or studies could be included in more than one review. Although this is possible given the high total number of overall studies, it was not felt that the impact of this would be significant based on assessing the occurrence of this in reviews of similar topics. The systematic reviews included were analysed as the unit of analysis and therefore lack of primary study applicability within reviews to UK primary care could be seen as a limitation of the review. In terms of the methodological quality of the review of reviews it is noted that we did not rigorously apply dual author study appraisal and data extraction. The fact that a single author led on these steps may have introduced bias, although we attempted to minimise these by ensuring that the other two authors quality assured the appraisal process.

Other considerations

Financial and economic considerations

From an economic and financial analysis perspective, cost-effectiveness was not explored in the present review and this is primarily because, as is common in QI literature, data around cost and cost-effectiveness were lacking and limited to evaluation of specific areas identified under health technology assessment as opposed to QI initiatives (NHS Quality Improvement Scotland, 2009). For the included reviews, although cost-effectiveness

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Table 7 Theories of change in healthcare

Theory category	Theory sub-grouping examples
Individual professionals	Cognitive theories; educational theories; motivational theories
Social context	Theories of communication; social learning theory; social network and influence theories; theories related to teamwork; theories of professional development; theories of leadership
Organisational context	Theory of innovative organisations; theory of quality management; theories of integrated care; complexity theory; organisational learning theory; theories of organisational culture
Political and economic context	Reimbursement theories; theory of contracting

Adapted from Grol *et al.* (2007: 105–06).

analysis was limited, for reviews that did make a reference to cost-effectiveness, the impact was either cost neutral or cost saving compared with usual care. However, it must be stated that comprehensive cost-effectiveness analysis was not completed and was usually based on a small number of studies (Thompson *et al.*, 2003; O'Brien *et al.*, 2007; Gillaizeau *et al.*, 2012). Furthermore, some authors comment that cost-effectiveness is highly dependent on the manner in which a QI intervention is delivered and the variation present in this respect could be difficult to examine (Thompson *et al.*, 2003; O'Brien *et al.*, 2007; Gillaizeau *et al.*, 2012).

The importance of cost-effectiveness, although not examined in this review, is recognised as central to supporting effective decision making for the health economy in application of health research.

Implementation and change science and theory

Other combined areas of importance not specifically explored or indeed present in the included reviews are that of theoretical and scientific perspectives of and on change, implementation science, knowledge translation and addressing barriers to change in QI. Grol *et al.* (2007) describe the importance of using theoretical and scientific perspectives in planning and studying improvement in patient care. Within their paper, the authors describe the complexity of healthcare and indeed QI in healthcare that is influenced by contextual factors not always considered in healthcare improvement interventions, which typically target individual professionals as opposed to the wider, complex environment of change. The authors argue for an increasing need for improvement research to use theoretical perspectives to plan and study for improvement that helps create understanding of the obstacles, success criteria and incentives of change in the healthcare setting (Grol *et al.*, 2007). The authors continue to comprehensively review the range of impact and process theories present in change implementation (summarised in Table 7), stating that, although no single theoretical framework appears superior, evidence exists for their use and application depending on the change intervention, and therefore these frameworks should be applied to improve QI understanding and implementation (Grol *et al.*, 2007). Furthermore, there is a large and growing body of research that suggests that implementation of improvement initiatives is as important as the evidence-based QI initiative itself (Cheater *et al.*, 2009; May *et al.*, 2009; Dixon-Woods *et al.*, 2011).

Sustainability

As a final note on implementation, the topic of sustainability deserves attention. Keller and Aiken (2009) note that one of the key problems in QI and change management is that of sustainability and draw attention to the findings by John Kotter in 1995 that change programmes typically only have around a 30% success rate; a rate that was mirrored in examining the change programmes of a large, global management consultancy firm in 2008 (Keller and Aiken, 2009). Among the reasons for lack of sustainability, areas such as leadership commitment, organisational capacity and capability, reinforcement and motivational alignment are cited (Keller and Aiken, 2009). Models for improving sustainability exist; however, the application of theoretical frameworks in this context is further underlined to understand the issues surrounding sustainability (Feldstein and Glasgow, 2008).

Related to this, two areas perhaps the most closely related to organisational QI that are interestingly absent from the literature review are features of leadership and the role of leaders in creating a QI

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culture. In their paper about improving quality of healthcare in the United Kingdom and in previously referencing and utilising their levels of change for QI, Ferlie and Shortell (2001) discuss leadership and culture extensively in relationship with QI. Leadership may not necessarily present as an individual, but may take the form of a network or group leadership, including clinical leadership, and is cited as being of central importance in creating and working within a culture that facilitates QI through learning, collaboration and a patient focus (Ferlie and Shortell, 2001). It may perhaps be the conceptual levels of terms such as leadership and culture that create their absence in the literature, which is biased to discussing clinical QI interventions.

Implications for policy and practice

The review of reviews presented has many potential implications for policy and practice. Most notably, it highlights key interventions that may be most suitable for designing QI interventions in primary care at the practice level including audit and feedback, point-of-care reminders, computerised advice, practice facilitation and interventions for evidence-based guideline adoption, adherence to clear practice structures and processes for patient review, continuing education and educational outreach. Development of QI interventions should recognise that a larger improvement opportunity may exist where baseline performance is low. Clinicians and non-clinicians alike involved in QI at the primary-care practice level should also recognise the importance of effective QI implementation in parallel with evidence-based interventions, evaluating any QI approaches through a clear framework to support future learning and development.

Areas for future research

Areas for future research identified within the review process were identified as the following:

- Understanding the role of group/team development in primary-care QI.
- Understanding the evidence base around leadership and culture in primary-care development; exploring the types and impact of leadership and culture.
- Understanding the cost-effectiveness of QI interventions in primary care.
- Identifying the characteristics of successful QI in primary care and successful practices in terms of quality outcomes.
- Identifying the common barriers to change in primary-care QI.
- Evaluating the impact of primary-care QI interventions using theoretical frameworks.

Conclusion

There is evidence of effectiveness for a range of primary-care QI initiatives relevant to UK primary care at the practice level. Particularly effective interventions include audit and feedback, point-of-care reminders (computerised and other), practice facilitation and interventions for evidence-based guideline adoption, adherence to clear practice structures and processes for patient review, continuing education and educational outreach.

Multifaceted interventions and interventions aiming to affect prescribing practice appear particularly successful, and QI implementers can enhance success through focussing on effective QI implementation, addressing barriers to change, while recognising that QI will be more effective when baseline performance is low.

More research is required to determine the use and impact of QI interventions using theoretical frameworks and cost-effectiveness analysis.

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Conflicts of Interest

No competing interests or conflicts of interest declared.

Ethical Standards

Ethics committee approval was not required for this review.

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Appendix

Table A1 Quality improvement intervention definitions and descriptions

Intervention	Definition
Audit and feedback	Ivers *et al.* (2012: 7), define audit and feedback as 'Any summary of clinical performance of healthcare over a specified period of time … One may alternatively describe an audit and feedback intervention as clinical performance feedback … The feedback may include recommendations for clinical action and may be delivered in a written, electronic or verbal format.'
Computerised advice	Gillaizeau *et al.* (2012) describe computerised advice (sometimes referred to as clinical decision support systems, which may or may not be computerised) as a recommendation, alert, advice, decision support interface or reminder delivered via a computer or electronic display unit, which is most often integrated within the medical record at the point-of-care and delivered or used in real time. Computerised advice may be defined slightly separately from point-of-care reminders, where the advice requires a computer-based calculation or input to inform the advice provided – for example, computerised drug dosage advice tailored to an individual patient, which was the primary intervention analysed by Gillaizeau *et al.* (2012)
Continuing education meetings and workshops	Forsetlund *et al.* (2009) described educational meetings in terms of their delivery approach and state: 'Educational meetings include courses, conferences, lectures, workshops, seminars and symposia.' (Forsetlund *et al.*, 2009: 2). The authors go on to suggest that educational meetings may be delivered through interactive, didactic or mixed approaches. The authors used investigators' research objective, question or study focus to differentiate between educational meetings compared with other interventions such as audit and feedback or continuous quality improvement
Educational outreach visits	O'Brien *et al.* describe an educational outreach visit as 'a personal visit by a trained person to healthcare professionals in their own settings to provide information with the intent of changing their performance'. This intervention may also include feedback with tailored intervention depending on assessed barriers to change, where the trained person delivering the intervention is not from the same practice site (2007: 1). In this respect, educational outreach differs from continuing education meetings through the personalised approach and site of intervention, although differing from audit and feedback where the visit is delivered by a trained individual often without an audit component measuring performance over time (Forestlund *et al.*, 2009)

Table A1 (*Continued*)

Intervention	Definition
Shared care	Smith *et al.* (2007) defined shared care as 'the joint participation of primary care physicians and specialty care physicians in the planned delivery of care, informed by an enhanced information exchange over and above routine discharge and referral notices' (Smith *et al.*, 2007: 1). Shared care is described in parallel with available shared care taxonomies, describing specific interventions such as joint primary care and specialist liaison meetings with discussion and planning of ongoing patient management, shared care records and shared and circulated electronic data sets and communication (Smith *et al.*, 2007)
Point-of-care reminders	See differentiation from computerised advice in 'Computerised advice' definition. Point-of-care reminders are defined as 'Patient or encounter-specific information that is provided via a computer console (either visually or audibly) and intended to prompt a healthcare professional to recall information usually encountered through their general medical education, in the medical records or through interaction with peers, and so remind them to perform or avoid some action to aid individual patient care' (Gordon, 1998 in Shojania *et al.*, 2009: 3). There is a differentiation from computerised advice, which infers some calculated computerised input to the electronic output; however, both may occur at the point-of-care
Doctor–nurse substitution	In the included review, doctor–nurse substitution is defined as 'The situation where task(s) formerly performed by one type of professional (i.e., doctor) are transferred to a different type of professional (i.e., nurse), usually with the intention of reducing cost or addressing workforce shortages.' (Laurant *et al.*, 2004: 9). The emphasis is on interventions usually and perhaps, expected to be, delivered by a doctor where the example of a nurse-led diabetes clinic replacing a doctor-led clinic is given. This is different to supplementation, where a nurse would provide care alongside a doctor, for example
Clinical practice guidelines implementation	Grimshaw and Eccles (2004) examine a number of interventions related to guideline dissemination. The authors cite common interventions as reminders, dissemination of educational materials and audit and feedback, in addition to other interventions such as educational outreach. As such, this intervention is not independent from other that have been previously defined
Multi-practice audit	Multi-practice audit in the review completed by Holden (2003) is described in relation to the audit cycle, where there is an initial analysis/survey, consideration by those audited, standard setting or improvement identification following audit and re-audit. Within the review, primary studies included a mix of internal and external audit
Practice facilitation of evidence-based guideline use	Similar to the review by Grimshaw and Eccles (2004), Baskerville *et al.* (2012) examine a number of strategies primarily related to improved compliance with evidence-based guideline adoption. The authors, however, explicitly define the intervention as a multifaceted approach, which simultaneously addresses barriers to change. The intervention is also analysed from the perspective of the multifaceted primary studies utilised

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