What works to increase attendance for diabetic retinopathy screening? An evidence synthesis and economic analysis

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Scientific summary

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Background

Diabetic retinopathy is the most common microvascular complication of diabetes mellitus and is one of the leading causes of blindness and visual impairment in the UK and throughout the world. However, despite evidence supporting the effectiveness of diabetic retinopathy screening (DRS) in reducing the risk of sight loss in people with diabetes, screening uptake is below the recommended levels in many screening programmes. Research has highlighted that living in an area of high social deprivation, younger age (< 40 years), having a longer duration of diabetes and belonging to a black, Asian and minority ethnic group are all associated with lower levels of screening attendance. There is a need to identify the most effective and cost-effective quality improvement (QI) interventions that increase attendance for DRS in people with diabetes and to identify the modifiable barriers to/enablers of screening uptake.

Objectives

The specific objectives were as follows.

1. Systematically review the evidence from randomised controlled trials (RCTs) on the effectiveness and cost-effectiveness of QI interventions that seek to increase attendance for DRS and code descriptions of the interventions reported in the included RCTs in terms of the QI components and their constituent behaviour change techniques (BCTs) (with BCTs being the 'active components' of interventions that aim to improve screening attendance).
2. Systematically identify the published and grey literature reporting barriers and facilitators associated with DRS and code barriers/facilitators according to the Theoretical Domains Framework (TDF) of behaviour change and the Consolidated Framework for Implementation Research (CFIR) (with domains being explanatory factors that are proposed to mediate change).
3. Assess BCTs (from objective 1) and barriers and facilitators (from objective 2) in terms of their theoretical coherence (i.e. whether or not the components of existing DRS interventions target important determinants of attendance).
4. Use data from objectives 1–3 to estimate the likely cost-effectiveness of interventions to increase attendance at DRS.

Methods

The study design comprised three phases.

1. Phase 1 (objective 1): a systematic review of RCTs that used any QI intervention to improve attendance for DRS. Interventions could be directed at patients with diabetes, health-care professionals (HCPs), the health-care system or any combination thereof. The primary outcome for this review was attendance for one or more visits for DRS within a 2-year period following randomisation. Secondary outcomes included ongoing adherence to DRS based on attendance following the initial screening event post intervention, resources required to deliver interventions and intervention cost-effectiveness. Intervention content was coded using a classification system to describe the QI components and the BCT taxonomy to identify the specific BCTs present in each intervention and their effectiveness was analysed by subgroup analysis and meta-regression.

2. Phase 2 (objective 2): systematic review of the published and grey literature reporting perceived barriers and enablers associated with DRS attendance and categorisation of barriers/enablers according to validated, theory-informed frameworks (TDF and CFIR).
3. Phase 3 (objectives 3 and 4): exploration of theoretical coherence between component BCTs used in published interventions in the phase 1 review and the TDF domains representing the key barriers to and enablers of DRS attendance identified in the phase 2 review. This was conducted using two validated BCT and domain mapping tools. High coherence was defined as the use of BCTs that target important TDF domains. Low coherence was defined as the use of BCTs that target less important TDF domains. Missed opportunities for intervention design were noted as infrequent use of BCTs that are theoretically coherent. A health economic evaluation was conducted using a Markov economic model to estimate the cost–utility of QI components and BCTs used in interventions. Single BCT components were compared in the model in terms of their cost-effectiveness. The effectiveness of BCT components was estimated using multivariable meta-regressions, utilising the data obtained from the phase 1 systematic review of intervention effectiveness. The costs of BCTs were estimated by assigning a resource use rank to each intervention in each RCT and conducting a multivariable ordered logit regression. Costs were assigned to each expected rank. Imprecision in the model was investigated using sensitivity analyses.

Finally, we conducted a formal 1-day knowledge exchange event with stakeholders and end-users to present the outputs from the evidence synthesis and health economic modelling and discuss the interpretation and service implications of the findings.

Results

Phase 1: diabetic retinopathy screening intervention effectiveness review

We screened 7277 studies, of which 66 RCTs ($n = 352{,}879$ participants) were included in the review (The Cochrane Library, MEDLINE, EMBASE and trials registers; search date February 2017). Of the included studies, 50 (75.8%) were of general QI interventions that evaluated their impact across a range of outcomes (including DRS uptake) and 16 (24.2%) were of interventions that had a primary target of improving attendance for DRS. The studies were conducted primarily (66.7%) in North America between 1988 and 2013. Thirty-five studies (53%) were parallel-group patient RCTs and 31 (47%) were cluster RCTs in which the HCP or the health-care setting was the unit of randomisation. Interventions were multifaceted and incorporated multiple QI components/BCTs targeting patients and HCPs. Fifty studies compared a variety of QI interventions with usual care. A random-effects meta-analysis of these studies found a 12% [risk difference (RD) 0.12, 95% confidence interval (CI) 0.10 to 0.14] absolute increase in DRS attendance for the interventions compared with usual care. Although the pooled effect estimate was larger for DRS-targeted interventions (RD 0.17, 95% CI 0.11 to 0.22) than for non-targeted interventions, this difference was not statistically significant. Ten studies compared a less intensive intervention ('active' control) with a more intensive intervention. The aim of these studies was to determine whether stepping up the intensity of an intervention component, or introducing further components, would increase DRS. The pooled effect estimate for these studies was smaller (RD 0.05, 95% CI 0.02 to 0.09), in favour of the more intensive intervention, suggesting that it is possible to further enhance the effect size by increasing intervention intensity. The main comparison in this review (any QI intervention vs. usual care) was associated with substantial heterogeneity. Heterogeneity was explored using subgroup analysis and univariate meta-regression. Sufficient studies were available to investigate the impact of 17 BCTs targeting patients or HCPs. All BCTs were effective in subgroup analysis, with pooled RDs ranging from 0.11 to 0.26. A meta-regression found that certain BCTs were more effective at improving DRS attendance, including 'goal-setting (in relation to outcomes or consequences of attending, not attendance itself)' (regression coefficient 0.162, 95% CI 0.070 to 0.254; $p = 0.001$), 'credible source' (e.g. persuasive communication from a respected person) (regression coefficient 0.097, 95% CI –0016 to 0.211; $p = 0.092$) and 'restructuring the social environment' (e.g. introduce diabetes link workers) (regression coefficient 0.085, 95% CI –0.001 to 0.172; $p = 0.053$). There was some evidence for larger effect sizes in populations with lower baseline DRS attendance (regression coefficient –0.208, 95% CI –0.419 to 0.004;

$p = 0.054$); however, much of the observed heterogeneity was unexplained. We found no studies reporting our secondary outcome measure of ongoing adherence to DRS following the initial screening appointment post intervention and no data on the relative effectiveness of interventions in particular population subgroups, for example according to socioeconomic characteristics.

Phase 2: barriers/enablers review

We screened 3457 studies, of which 65 were included in the review (MEDLINE, EMBASE, PsycINFO and sources of grey literature; search date March 2016). Of these, 41 (63%) used quantitative methods only (e.g. questionnaires, surveys), 18 (28%) used qualitative methods only (e.g. interviews/focus groups) and six (9%) used mixed methods. The majority (79%) of studies that used quantitative methods in full or as part of a mixed-method design used a cross-sectional survey design. The majority of studies (79%) that used qualitative methods in full or as part of a mixed-method design were descriptive and used no specific analytical or theoretical approach. The studies were conducted primarily in North America (60%), with only 12 studies (18%) conducted in the UK. Fifty studies (77%) reported barriers/enablers from the perspective of the patients only, 14 studies (21%) reported barriers/enablers from the perspective of both patients and HCPs and one study (2%) reported barriers/enablers from the perspective of HCPs who were diagnosed with diabetes. The TDF domains 'environmental context and resources', 'social influences', 'knowledge', 'memory, attention and decision processes', 'beliefs about consequences' and 'emotions' were identified as representing the most important factors potentially influencing screening attendance. Thematic synthesis within these six domains resulted in specific content themes at multiple levels, including at the patient (e.g. fear/anxiety about vision loss, confusion between screening and routine eye care), HCP (e.g. recommendation to screen, or lack of such recommendation, by the HCP), health-care system (e.g. inaccurate registers) and wider community (e.g. lack of media coverage) levels. Overall, there were almost three times as many content themes identified as barriers than as enablers (60 vs. 22). Many of the themes/subthemes identified within the six TDF domains related to four broad areas: (1) perceptions of convenience (e.g. transportation, scheduling appointment issues), (2) (lack of) awareness (e.g. of diabetic retinopathy, screening importance/frequency), (3) comfort and support (e.g. trust in doctors, social support, negative emotions) and (4) misconceptions that need to be addressed through improved message content (e.g. DRS not necessary, confusion between attendance at retinopathy screening and routine eye tests). Recoding the themes from the TDF domains into CFIR constructs did not offer any further insights as the barriers and enablers reported in the studies were predominantly from the perspective of the patient rather than the perspective of the organisation or HCP.

Phase 3.1: mapping

Published interventions included a median of four BCTs targeting patients (range 0–16) and three targeting HCPs (range 0–14). Ten BCTs were frequently identified in intervention arms targeting patients and seven were frequently identified in intervention arms targeting HCPs. The majority (80%) of frequently used BCTs in patient intervention arms, and all (100%) frequently used BCTs in HCP intervention arms, were paired with at least one of the six domains that were identified as important in the review in phase 2, representing high theoretical coherence. Only two BCTs in the patient intervention arms had a low level of coherence (i.e. they were paired only with domains of lesser importance): 'goal-setting (outcome, i.e. consequences)' and 'problem-solving (involving personalised barrier identification together with finding solutions)'. All frequently used BCTs were effective, regardless of whether they had low or high theoretical coherence. However, the majority (88%) of effective BCTs were highly coherent. Missed opportunities for intervention design were identified for all six important theoretical domains, that is, at least one coherent BCT was not frequently identified in the interventions. Opportunity seized was highest for 'memory, attention, and decision processes' (50% of the theoretically coherent BCTs were frequently used in interventions), followed by 'knowledge' (42% of the theoretically coherent BCTs were frequently used in interventions). The most missed opportunities were observed for the 'emotions' domain; none of the coherent BCTs paired with this domain were frequently used in existing DRS interventions (range 0–3 intervention arms).

Phase 3.2: economic modelling

The probability of an intervention being cost-effective at a societal willingness-to-pay threshold of £20,000 per quality-adjusted life-year was determined using economic modelling that considered the situation of annual screening, age at screening of 64 years and likelihood of attending screening without any additional intervention of 70%. The QI component with the highest probability of being cost-effective was patient education, but in general QI components were unlikely to be considered cost-effective. The patient-targeted BCTs of 'goal-setting', 'feedback on outcomes of behaviour' (such as timely treatment), 'social support' and 'information about health consequences' had extremely high probabilities of being cost-effective compared with no BCT intervention (≥ 0.975). For the HCP-targeted BCTs, adding objects to the environment (e.g. reminder systems) had a probability of being cost-effective of > 0.9. The sensitivity analyses showed that the probability of being cost-effective increased with lower baseline DRS attendance levels and when the screening interval was increased to biennially or every 3 years.

Conclusions

The results of this study suggest that a number of strategies are likely to improve attendance for DRS. QI interventions targeted at the person with diabetes, HCPs or the health-care system improve attendance by 12% on average compared with usual care. There was some evidence to indicate that a larger effect size could be anticipated in poor attenders. Current interventions are generally using appropriate BCTs that mediate change in screening behaviour, with a high probability of being cost-effective.

Implications for practice

Including behavioural interventions to support the uptake of DRS services could improve the uptake of DRS. Such interventions included providing feedback on the consequences of attendance or non-attendance; encouraging social (interpersonal) support to attend; providing more information on diabetic eye disease, including information about its health consequences and the process of screening; and introducing reminder systems or ensuring that patient information is provided by a credible source, such as national clinical guidelines. These interventions can be delivered at a patient level and at the level of the health system, including health-care professionals. We identified that these interventions are effective, potentially cost-effective and also likely to target the important factors associated with attendance at DRS.

For services with lower levels of uptake, the cost-effectiveness evidence and evidence on the effectiveness of BCTs suggest that providing 'feedback' and 'information about health consequences' could be worthwhile. Examples of possible approaches include providing information on diabetic retinopathy, the consequences and benefits of DRS and explaining the difference between DRS and attendance for regular eye tests. Other possible approaches include introducing processes to facilitate attendance and improvements in the screening environment, for example processes to improve convenience for patients such as online management/ booking systems or monitoring tools such as diabetes passports.

Implications for research

The evidence from this study can be used to inform the development of a future RCT to evaluate the effectiveness and cost-effectiveness of multifaceted interventions for DRS attendance. Intervention components that target the emotional barriers to and enablers of screening attendance, such as anxiety regarding the process or outcome of screening, should be considered. Usual care should be specified in sufficient detail such that BCTs present in the control arm can be identified. Outcome assessment at a minimum of 24 months is suggested to capture attendance and ongoing attendance at DRS. The evidence suggests that the target participants should be those who do not regularly attend for DRS. Before carrying out a trial, a programme of preliminary research is recommended to identify the population with a low

DRS attendance rate. A qualitative exploration of key determinants of attendance in subgroups of low attendees and the feasibility of and ethical concerns around targeting population subgroups is needed.

Study registration

This study is registered as PROSPERO CRD42016044157 and PROSPERO CRD42016032990.

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