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Clinical prediction rules in practice:

review of clinical guidelines and survey of GPs

Abstract

Background
The publication of clinical prediction rules (CPRs) studies has risen significantly. It is unclear if this reflects increasing usage of these tools in clinical practice or how this may vary across clinical areas.

Aim
To review clinical guidelines in selected areas and survey GPs in order to explore CPR usefulness in the opinion of experts and use at the point of care.

Design and setting
A review of clinical guidelines and survey of UK GPs.

Method
Clinical guidelines in eight clinical domains with published CPRs were reviewed for recommendations to use CPRs including primary prevention of cardiovascular disease, transient ischaemic attack (TIA) and stroke, diabetes mellitus, fracture risk assessment in osteoporosis, lower limb fractures, breast cancer, depression, and acute infections in childhood. An online survey of 401 UK GPs was also conducted.

Results
Guideline review: Of 7637 records screened by title and/or abstract, 243 clinical guidelines met inclusion criteria. CPRs were most commonly recommended in guidelines regarding primary prevention of cardiovascular disease (67%) and depression (67%). There was little consensus across various clinical guidelines as to which CPR to use preferentially. Survey: Of 401 responders to the GP survey, most were aware of and applied named CPRs in the clinical areas of cardiovascular disease and depression. The commonest reasons for using CPRs were to guide management and conform to local policy requirements.

Conclusion
GPs use CPRs to guide management but also to comply with local policy requirements. Future research could focus on which clinical areas clinicians would most benefit from CPRs and promoting the use of robust, externally validated CPRs.

Keywords
clinical prediction rules; clinical guidelines; survey.

INTRODUCTION

Clinical guidelines are developed systematically based on best available evidence to aid clinical decision making.[1] The use of appropriately validated and tested clinical prediction rules (CPRs) is one way of implementing evidence-based medicine (EBM) for diagnosis and prognosis in clinical practice. CPRs are defined as tools that quantify the contributions of history, clinical examination, and diagnostic tests to stratify a patient in terms of the probability of having a target disorder (diagnostic CPR) or a future health outcome (prognostic CPR).[1] An example is the Goldman CPR, which uses a combination of clinical and electrocardiograph findings to risk-stratify patients presenting with chest pain as low, moderate, or high risk of a cardiac cause.[2] Smaller proportions of CPRs go further and recommend management decisions based on their algorithms, for instance, the modified Centor score for streptococcal throat infection stratifies patients based on symptoms and clinical signs and then uses this to direct the need for antibiotic prescription.[3,4]

However, there are well-recognised barriers to implementing CPRs at the point of care.[5,6] One such barrier is a tendency to develop more CPRs for the same clinical situation, rather than validating existing models.[7] The significant increase in the publication of CPRs in recent years suggests an increased interest on the part of researchers at least in such models.[8,9] It is unclear if this reflects increasing usage of these tools in clinical practice or how this may vary across clinical areas.

This study investigated whether published CPRs have been considered useful by expert bodies and at the point of clinical care. To answer the first question, a review of international clinical guidelines produced on behalf of expert bodies was performed, and to answer the second, a well-defined group of UK clinicians, GPs were surveyed about their use of CPRs in selected clinical areas.

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How this fits in

The use of appropriately validated and tested clinical prediction rules (CPRs) is one way of implementing evidence-based medicine for diagnosis and prognosis in clinical practice and publication of CPRs has risen significantly. This study showed that recommendation of CPRs by clinical guidelines varied according to clinical area. Surveyed GPs reported using CPRs most frequently in the clinical domains of cardiovascular disease and depression, primarily to guide management and adhere to local policy requirements. Future efforts could focus on determining in which areas of practice CPRs would be most beneficial for clinicians and patients, and promoting the use of robust, externally validated CPRs.

METHOD

Review of clinical guidelines

The aim was to identify clinical guidelines in eight selected areas in which the authors had prior knowledge that at least one CPR potentially relevant to primary care had been published:

- primary prevention of cardiovascular disease (CVD);
- TIA/stroke diagnosis and management;
- diabetes mellitus screening, diagnosis or risk assessment;
- fracture risk assessment in osteoporosis screening and management;
- lower limb fractures diagnosis;
- breast cancer diagnosis, screening, and risk assessment;
- depression diagnosis and management; and
- acute childhood infections, namely meningitis, influenza, urinary tract infection, gastroenteritis, otitis media, tonsillitis, pneumonia, and bronchiolitis.

Search strategy. A PubMed search used the 'Practice Guideline' publication type and was expanded to include documents with any of the words; 'Guideline[s]', 'Framework', 'Standards', 'Recommendation[s]', 'Guidance', 'Consensus', 'Statement' or 'Practice Guideline' in the title, producing a highly sensitive search (n = 106 088). To make the search more specific limits were applied: English language; exclusion of publication types News, Randomized Controlled Trial, Meta-Analysis, Clinical Trial, Letter and Comment; published between 1 June 2000 and 31 May 2010, resulting in 41 228 records. This guidelines search was then combined with subject-specific searches designed by researchers familiar with each of the clinical domains.

In addition, the websites of the National Guideline clearing house, the National Institute for Health and Clinical Excellence (NICE) and the Scottish Intercollegiate Guideline Network (SIGN) were accessed and searched (included as additional sources in Appendices 1a and 1b).

Study selection. Documents identified from these subject-specific searches were eligible for inclusion if they met the following criteria: (a) contains systematically developed statements that include recommendations, strategies, or information that assists clinicians and patients to make decisions about appropriate health care for specific clinical presentations; (b) produced by medical speciality associations — relevant professional societies, public or private organisations, government agencies, or healthcare providers at the state, national, or international level; (c) full text freely available in print or electronic format; and (d) current and most recent available version of the guideline available. Documents identified by the search and meeting the above four criteria were considered to be 'clinical guidelines' for the purposes of this review.

The difficulty of formally defining CPRs has been discussed previously.[8] For the purposes of this review, a pre-existing definition[10] was adapted to define a clinical prediction rule as 'a predefined combination of (two or more) questions, symptoms, signs and tests that provides information on risk, diagnosis, or prognosis'. Formal diagnostic criteria were not considered to be CPRs. For the purposes of this review, a CPR was considered to be 'predefined' if the guideline cites an article on the CPR in a peer-reviewed journal.

Data extraction. In each clinical area, one researcher searched through titles and abstracts for their specific search. Each potentially relevant full-text article was independently reviewed in duplicate and relevant data extracted. To be considered to be 'recommended' by the guideline, use of language that recommends, encourages, or promotes the use of the CPR was required. Discrepancies were resolved by consensus or by a third adjudicating reviewer. For each clinical area the total number of guidelines retrieved, the number and proportion recommending use of at least one CPR, and the most commonly recommended CPRs are reported. For the acute infections in

Table 1. List of clinical prediction rules (CPRs) included in the survey

Clinical area	Clinical prediction rule	Description	Reference
Cardiovascular disease	QRISK or QRISK2	10-year risk of heart attack or stroke, based on QRESEARCH database	21
	Joint British Societies (JBS) charts	Based on Framingham risk equation with adjustments	22
	New Zealand (NZ) Tables	Cardiovascular Risk Calculator from the New Zealand Guidelines Group	23
	Sheffield Tables	Based on Framingham risk function	24
	Any Framingham Risk Score	Cardiovascular risk assessment, based on Framingham study	25
	Systematic Coronary Risk Evaluation (SCORE) risk charts	The European cardiovascular disease risk assessment model	26
	PROCAM risk score	Cardiovascular risk assessment, based on Prospective Cardiovascular Münster (PROCAM) Study	27
Anxiety and depression	Patient Health Questionnaire (PHQ)-2	2-item version of PHQ-9	28
	Patient Health Questionnaire (PHQ)-9	9-item depression module of the PHQ	29
	Generalised Anxiety Scale (GAD)-2	2-item subscale of GAD-7	30
	Generalised Anxiety Scale (GAD)-7	7-item anxiety measure	30
	Hospital anxiety and depression scale (HADs)	Self-reported rating instrument for anxiety and depression	31
	Beck Depression Inventory (BDI)	Self-reported items, each correlating to a symptom of major depressive disorder experienced over the preceding 2 weeks	32
Fracture	Ottawa ankle rule	Decision rule for the selective use of radiography in acute ankle injuries	33
	Ottawa knee rule	Decision rule for the selective use of radiography in acute knee injuries	34
	Ottawa foot rule	(Also known as the Ottawa ankle rule)	33
	Pittsburgh knee rule	Decision rule for the selective use of radiography in acute knee injuries	35
Cancer	Gail risk score	Breast cancer risk assessment tool	36
	Risk Assessment in Genetics (RAGs)	Evaluation of genetic risk of cancer	37
Infection	Yale	Observation scales to identify serious illness in febrile children	38
	NICE traffic light system	From the NICE guideline on feverish illness in children	39
	CRB65	Grades severity of community-acquired pneumonia in terms of 30-day mortality	17
	STREP score	Modified Centor Score for Streptococcal Pharyngitis in children and adults	40
	CENTOR score	Diagnosis of Streptococcal Pharyngitis in adults	3
General medical	ABCD or ABCD2 score	Prediction of very early stroke risk after transient ischaemic attack at 7 days	41
	California score	Risk of stroke at 90 days	42
	CHADS or CHADS2	Atrial fibrillation stroke risk	43
	Wells score (DVT)	Risk of deep vein thrombosis	44
	Wells score (PE)	Risk of pulmonary embolism	45

children domain, guidelines were included if children were mentioned specifically in the title or if the guideline could be applied to both adults and children.

Survey of GPs

Participants. Participants were GPs in the UK, registered with the General Medical Council, recruited from Doctors.net.uk. To estimate the percentage using each CPR with a standard error of approximately 2.5%, a sample size of 400 GPs stratified by NHS Strategic Health Authority and seniority/position was requested. Doctors.net.uk sent invitations to members followed by reminders until 400 GPs had completed the questionnaire. Participants were asked for their year of qualification, and role in the practice.

Survey. In consultation with academic GP colleagues, 25 CPRs potentially relevant to UK general practice were selected. Modifications made after the in-house pilot included the addition of four CPRs: one of these, the NICE traffic light algorithm for childhood infection, did not meet the criteria for a CPR in the review of guidelines, but was considered a CPR by participants in the pilot survey. The resulting 29 included CPRs were grouped under six clinical areas, for presentation to survey responders, as shown in Table 1. Pragmatic considerations regarding survey length precluded the inclusion of all clinical areas studied in the first part of this study. Responders were asked which CPRs they had heard of and how often they used them. They were asked for reasons why they did or did not use each CPR, using the following options: (a) aid diagnosis; (b) assessing severity; (c) to guide therapy; (d) to guide referral; (e) comply with clinical guidelines/Quality Outcomes Framework (QOF); (f) automatically generated by practice software; and (g) inform or educate patients. A free text field was provided for other reasons for not using CPRs or to indicate any additional CPRs not included in the survey.

RESULTS

Review of clinical guidelines

An overview of the search strategy is presented in Appendix 1a and 1b. A total of 7637 records were screened by title and/or abstract and 243 eligible clinical guidelines in eight clinical areas were identified and included in the review.

A summary of clinical guideline numbers retrieved and named CPRs recommended according to clinical domain is presented in Table 2. Overall, CPRs were most commonly recommended in the clinical domains of primary prevention of cardiovascular disease (67%), depression (67%), TIA/stroke (63%), and breast cancer (51%). For lower limb fractures and fracture risk assessment in osteoporosis, CPRs were recommended in 40% and 38% of reviewed

Table 2. Clinical guidelines review of clinical prediction rules (CPRs) recommendations

Clinical area	Total number of guidelines included	CPR recommended (%)	Named CPRs recommended (number of guidelines)	Other CPRs recommended not in clinical domain
Cardiovascular disease (primary prevention)	45	30 (67)	Risk scores derived from the Framingham Heart Study (21);[25] Systematic Coronary Risk Evaluation (SCORE) tool (5) ;[26] UK Prospective Diabetes Study (UKPDS) Risk Engine (4); [46] Risk stratification system of the 2003 European Society of Cardiology (3); [47] CHADS or $CHADS_2$ score (2);[43] Cardiovascular Life Expectancy model (2); [48] Heartscore (1);[26] Reynolds Risk Score (1); [49]ASSIGN (1); [50] Risk stratification system 1999 World Health Organization guidelines (1).[51]	None
Transient ischaemic attack (TIA) or stroke (diagnosis and management)	16	10 (63)	ABCD or $ABCD_2$ (5);[41,52] Framingham risk score (1);[53] FAST (Facial weakness, Arm weakness, Speech difficulty, Time to act) (6);[54] Rule Out Stroke in the Emergency Room (ROSIER) (5); [55]Melbourne acute stroke scale (MASS) (1).[56]	For depression (GHQ12, PHQ9 and SAD-Q), for malnutrition (MUST) and the Glasgow Coma Scale [19,29,57–59]
Diabetes mellitus (Screening, risk assessment or diagnosis)	20	4 (20)	Finnish Diabetes Risk Score (FINDRISC) (3); [60] Diabetes Risk Calculator (1).[61]	For cardiovascular risk assessment (Framingham risk score) [25]
Osteoporosis (Fracture risk assessment)	25	9 (38)	WHO/FRAX algorithm (5);[62] Osteoporosis Risk Assessment Index (2); [13] Simple Calculated Osteoporosis Risk Estimation questionnaire (1); [63] Two ultrasound indices; the stiffness index and the quantitative ultrasound index (1).	None
Lower limb fractures (Diagnosis and management)	20	8 (40)	Ottawa Ankle Rule (2); [33] Ottawa Knee rule (4);[34] Meniscal Pathology Composite score (1);[64] Function Score of De Bie (1) 4.	None [65]
Acute childhood infections [a] (Diagnosis and management)	73	12 (16)	*Tonsillitis:* Centor score (3);[3] *Pneumonia:* CURB-65 (5);[17] Pneumonia Severity Index/Patient Outcome Research Team (PORT) (5); [66] World Health Organization (WHO) criteria (1); [67] *Meningitis:* Glasgow meningococcal septicaemia prognostic score (2); [68] Bacterial meningitis score (2); [69] Hoen's software (1); [70] Meningitest (1).[71]	Glasgow Coma Scale [19]
Breast cancer (Risk assessment, screening and referral)	32	16 (51)	Original or modified Gail model (5); [72] Claus model (4); [73] BRCAPRO (4); [74] Mammaprint tool (3); [75] Oncotype Diagnosis Recurrence score (3); [76] Adjuvant Risk score (3); [77] Nottingham Prognostic Index (1); [78] Manchester Score (1); [79] Risk Assessment in Genetics (RAGS) Tool (1); [37] Family History Risk Assessment Tool (1); [80] Tyrer Tool (1). [81]	None
Depression (Diagnosis and management)	12	8 (67)	Patient Health Questionnaire (PHQ)-9 (4); [29] Two-item screener (4); [28] Hamilton Rating Scale for Depression (3); [82] Beck Depression Inventory (BDI) (2); [32] Montgomery Asberg Depression Rating Scale (MADRS) (2); [83] Edinburgh Postnatal Depression Inventory (EPDI) (1); [11] Quick Inventory of Depressive Symptomatology (QID-SR) (1); [84] Cornell Scales for Depression in Dementia (CSDD) (1); [85] Bech-Rafaelsen Melancholia Scale (BRMS) (1); [86] Hospital Anxiety and Depression Scale (HADS) (1); [31] Clinical Global Impressions (CGI) scale (1); [87] Geriatric Depression Scale (GDS) (1); [88] Centre for Epidemiological Studies Depression Scale (CES-D) (1).[89]	CAGE-AID [90]

[a]*For the acute childhood infections of otitis media, bronchiolitis, gastroenteritis, urinary tract infection, and influenza, no CPR recommendations were found in reviewed guidelines.*

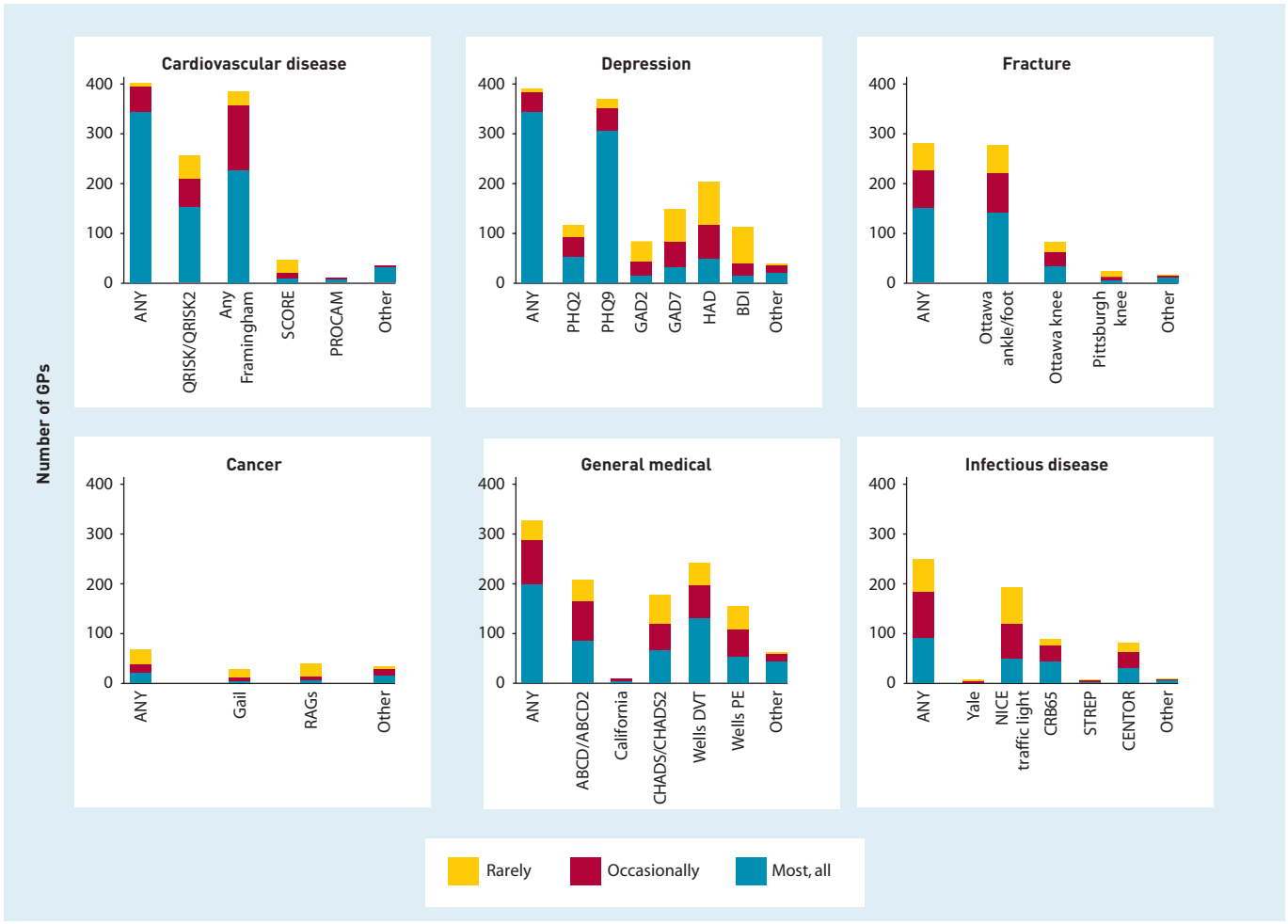

Figure 1. Self-reported use of clinical prediction rules by 401 UK GPs in selected clinical areas.

guidelines respectively. CPRs were least often recommended in the clinical domains of diabetes mellitus (20%) and acute childhood infections (16%). Overall, there was little consensus across reviewed guidelines as to which, if any, CPR to use preferentially.

Survey of UK GPs

A total of 401 responses were collected from Scotland (12%), Northern Ireland (3%), Wales (4.5%), and England (80.5%), spread among each of the 10 English Strategic Health Authority regions. Participants qualified between 1969 and 2005 (median 1995) and most (65%) were GP principals or partners. Figure 1 shows the reported frequency of use of any CPRs in each clinical domain, of specific CPRs indicated by name, and of other CPRs not included in the questionnaire design but named by responders in the free text field. In CVD these other CPRs included ASSIGN (n = 23 GPs, all based in Scotland) and the UKPDS Risk Engine (n = 1). In depression, other CPRs included the Edinburgh Postnatal Depression Scale (24 GPs) and Mini-Mental State Examination for dementia (n = 3).[11,12] In addition to the fracture CPRs listed in the questionnaire, seven used the FRAX tool for osteoporosis.[13] In cancer, additional CPRs mentioned were the Gleason score for prostate cancer staging (n = 13 GPs),[14] Dukes staging for colorectal cancer (n = 5),[15] and the Tumour Nodes Metastases cancer staging system (n = 4).[16] In addition to infection CPRs listed in the survey, five (1%) reported using the CURB65 score[17] and two (0.5%) reported having used the APACHE II score for ICU mortality.[18] In the section entitled general medical, additional CPRs mentioned were the Glasgow Coma Scale (n = 11 GPs), Epworth sleepiness scale (n = 5), and Rockall score for risk of upper gastrointestinal bleeding (n = 3).[19] Responders additionally used the free text to report using the International Prostate Symptom Score for benign prostatic hyperplasia (n = 7),[20] various alcohol use questionnaires (n = 6), and others (all $n \leq 2$). Reported reasons for CPR use are presented in Table 3.

Table 3. Number (%) of GPs reporting respective reasons for using clinical prediction rules

	Cardiovascular disease, *n* (%)	Anxiety and depression *n* (%)	Fracture *n* (%)	Cancer *n* (%)	Infection *n* (%)	General medical *n* (%)
Aid diagnosis	143 (36)	217 (54)	225 (56)	48 (12)	92 (23)	219 (55)
Assessing severity	191 (48)	279 (70)	66 (16)	39 (10)	168 (42)	142 (35)
To guide therapy	336 (84)	207 (52)	64 (16)	30 (7)	118 (29)	188 (47)
To guide referral	89 (22)	134 (33)	146 (36)	59 (15)	106 (26)	218 (54)
Comply with clinical guidelines/QOF	267 (67)	313 (78)	17 (4)	21 (5)	37 (9)	106 (26)
Automatically generated by practice software	106 (26)	31 (8)	4 (1)	4 (1)	1 (0.002)	19 (5)
Inform or educate patients	220 (55)	123 (31)	50 (12)	30 (7)	44 (11)	75 (19)
Other	1 (0.002)	8 (2)	8 (2)	2 (0.005)	1 (0.002)	3 (1)

QOF = Quality and Outcomes Framework.

The main reason for not using named CPRs related to lack of familiarity (Table 4). Other reasons, reported in free text fields, included preference for own clinical judgement (for CPRs listed under depression, infection, and general medical), greater relevance to secondary care settings (fracture and cancer), and perceived lack of utility (depression and cancer).

Table 4. Number (%) of GPs who do not use the respective clinical prediction rules and of these, the number (%) who had never heard of them

Clinical area	CPR	Do not use *n* (%)	Never heard of it, *n* (%)
Cardiovascular disease	QRISK or QRISK2	140 (35)	88 (22)
	Joint British Societies (JBS) risk charts	78 (19)	33 (8)
	JBS risk calculator	152 (38)	96 (24)
	New Zealand tables	355 (89)	313 (78)
	Framingham risk score	58 (14)	6 (1)
	Systematic Coronary Risk Evaluation (SCORE)	364 (91)	332 (83)
	PROCAM	98 (393)	94 (378)
Anxiety and depression	Patient Health Questionnaire (PHQ)-2	292 (73)	251 (63)
	PHQ9	33 (8)	17 (4)
	Generalised Anxiety Scale (GAD)-2	318 (79)	246 (61)
	GAD7	247 (62)	152 (38)
	Hospital and Anxiety Depression scale (HADs)	198 (49)	54 (13)
	Beck Depression Inventory (BDI)	287 (72)	108 (27)
Fracture	Ottawa ankle	125 (31)	83 (21)
	Ottawa knee	315 (79)	284 (71)
	Ottawa foot	312 (78)	289 (72)
	Pittsburgh knee	390 (97)	378 (94)
Cancer	Gail risk score	377 (94)	363 (91)
	Risk Assessment in Genetics (RAGs)	365 (91)	346 (86)
Infection	Yale	391 (98)	387 (97)
	NICE traffic light	213 (53)	172 (43)
	CRB65	320 (80)	313 (78)
	STREP score	390 (97)	386 (96)
	Centor score	323 (81)	305 (76)
General medical	ABCD or ABCD2	194 (48)	173 (43)
	California score	394 (98)	386 (96)
	CHADS or $CHADS_2$	230 (57)	208 (52)
	Wells score for DVT	163 (41)	139 (35)
	Wells score for PE	247 (62)	228 (57)

DISCUSSION

Summary

Of the eight clinical domains studied, guidelines most commonly recommended CPRs for primary prevention of CVD and depression. For CVD, a total of 10 different cardiovascular risk assessment models were recommended, most commonly those derived from the Framingham Heart Study. Surveyed GPs reported using these tools in practice also, with most using Framingham derived scores, the Joint British Societies risk score, or QRISK, primarily to guide therapy. Other reported reasons for use of these CPRs were to inform or educate patients, comply with guidelines/Quality and Outcomes Framework (QOF), and to assess disease severity. For depression, a total of 13 different models were recommended in eight reviewed guidelines, most commonly the PHQ-9. This was also utilised by most of the surveyed GPs who indicated that guideline or QOF conformance was the most common reason for use, followed by assessing severity and as a diagnostic aid. The Ottawa ankle rule for ankle fracture assessment, although infrequently recommended by reviewed guidelines, was used by most of the surveyed GPs, primarily to aid diagnosis. For breast cancer, although about half of reviewed guidelines recommended the use of a CPR model for risk assessment, these tools were very infrequently utilised by surveyed GPs. Most were either unaware of these tools or preferred to use UK referral guidelines, which dictate that suspected cancer cases need specialist review within 2 weeks.

Both the survey and review suggest that there are varying influences regarding use of CPRs in clinical practice. Use of these tools may vary geographically as illustrated by the guidelines review, where the QRISK2 score was recommended by UK guidelines only, and within the UK by the survey, with the ASSIGN algorithm being used exclusively by Scottish GPs. As already mentioned, national policy requirements in UK general practice also have an impact on CPR uptake. Overall, a lack of familiarity, preference for their own clinical judgement, or considering the CPR to be unnecessary were highlighted by surveyed GPs as the main impediments for use of these tools at the point of care. Examining

the level of evidence for all CPRs included in this review was beyond the scope of this study. However, it is interesting to note that the Centor score for streptococcal throat infection, which has been broadly validated for use in general practice, was not used by most GPs (81%), with 76% of these reporting they had never heard of it, whereas the NICE traffic light system for the assessing childhood fever, which was developed for the purposes of the guideline, was used by almost half of the surveyed GPs. CPR use also varied according to clinical area, for example the CHADS and CHADS2 score for the prediction stroke risk in patients with atrial fibrillation and the Well's score for DVT were not utilised by most surveyed GPs, although most were familiar with these CPRs.

Clinical guidelines offer scope to critically appraise published CPRs, which could help clinicians in making an informed decision regarding their use. However, in this review there was little such evaluation of CPRs evident and little consensus between guidelines as to which, if any, of these tools should be used preferentially.

Strengths and limitations

This study reviews wide-ranging international literature supplemented by a detailed survey of actual clinical practice in UK general practice. Each review was designed by a researcher with experience in the relevant area. The pre-selection of clinical domains in which CPRs exist allows comparison in terms of guideline recommendations and use in practice.

There are several limitations. First, for the purpose of rigorous review it was necessary to adopt a single, objective definition of a CPR. As there is no internationally agreed definition of a CPR, the definition used should be considered a working definition for a specific project rather than definitive for all purposes. Second, the literature review, of international scale and across eight clinical areas, is supplemented by a survey of primary care in a single national setting. The authors did not have the resources to conduct an international survey of primary, secondary, and tertiary care, and this led to a UK survey that looked at fewer CPRs than the literature review. Finally, the electronic survey mechanism used for this study gives no known denominator and represents a partially self-selecting population.

Comparison with existing literature

Previous studies of clinical prediction rules across multiple domains have assessed the properties of the rules, such as validity and impact, rather than their uptake by practicing clinicians[7,9] Surveys of the uptake of CPRs have usually been restricted to single clinical domains.[91–94] To the author's knowledge this is the first large survey to compare the uptake of CPRs across multiple clinical domains and to relate this to a systematic evaluation of guideline recommendations.

Implications for research and practice

From a clinical perspective, CPRs were applied by surveyed GPs most frequently in the clinical domains of CVD and depression mainly to guide management and adhere to local policy requirements. Lack of awareness was cited as one of the reasons for not using CPRs in practice. Future efforts could focus on determining in which areas of practice CPRs would be most beneficial to clinicians and patients, for example, referral guidance at the primary–secondary care interface for high stakes diagnoses such as myocardial infarction and cancer. In addition, the implementation of poorly validated CPRs should be resisted. Research should instead be directed to developing robust, externally validated CPRs that have been shown to have a positive impact on the process and outcome of clinical care. It is these CPRs that should be promoted in clinical guidelines.

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Ethical approval

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Provenance

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Competing interests

Richard Stevens is an author of the UKPDS Risk Engine, one of the clinical prediction rules studied in this manuscript. He has no financial stake in the Risk Engine.

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Appendices 1a and 1b. Literature search for clinical practice guidelines.