Clinical prediction rules: A systematic review of healthcare provider opinions and preferences

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ABSTRACT

Objective: The act of predicting clinical endpoints and patient trajectories based on past and current states is on the precipice of a technological revolution. This systematic review summarises the available evidence describing healthcare provider opinions and preferences with respect to the use of clinical prediction rules. The primary goal of this work is to inform the design and implementation of future systems, and secondarily to identify gaps for the development of clinician education programs.

Methods: Five databases were systematically searched in May 2016 for studies collecting empirical opinions of healthcare providers regarding clinical prediction rule usage. Reference lists were scanned for additional eligible materials and an update search was made in August 2017. Data was extracted on high-level study features, before in-depth thematic analysis was performed.

Results: 45 articles were identified from 9 countries. Most studies utilised surveys (28) or interviews (14). Fewer employed focus groups (9) or formal usability testing (4). Three high-level themes were identified, which form the basis of healthcare provider opinions of clinical prediction rules and their implementation — utility, credibility and usability.

Conclusions: Some of the objections and preferences stated by healthcare providers are inherent to the nature of the clinical problem addressed, which may or may not be within the designer's capacity to change; however, others (in particular — actionability, validation, integration and provision of high quality education materials) should be considered by prediction rule designers and implementation teams, in order to increase user acceptance and improve uptake of these tools. We summarise these findings across the clinical prediction rule lifecycle and pose questions for the rule developers, in order to produce tools that are more likely to successfully translate into clinical practice.

1. Introduction

Two patients present to the same hospital, scheduled to undergo identical procedures at the hands of equally skillful and qualified surgeons. One recovers speedily, while the other struggles with major complications requiring complex interventions. The benefit of a reliable method to describe in advance the likelihood of each of these trajectories for a particular patient is clear. Credible foreknowledge of expected outcomes and individual response to treatment can inform decision making of both clinicians and patients, allow for responsive resource allocation to eliminate waste and improve outcomes for high-risk patients, and more accurately benchmark performance of facilities based on their risk-adjusted case-mix than has been possible in the past.

The current technical and infrastructural capacity for predictive analytics seen routinely in other fields exceeds what is implemented in typical clinical practice [1,2], although significant progress is anticipated [3]. Even in institutions with advanced systems, healthcare data are plagued by technical and procedural limitations that inhibit successful big data analysis. This follows a familiar story in clinical information technology projects, which have typically been shaped by slow uptake, reluctant user acceptance, organisational and training issues, decentralised implementation and a piecemeal design approach [4–6]. On the assumption that the data exists and is available in a timely fashion, however, there is evidence for the ability to predict patient outcomes with high accuracy [7].

Informal prediction forms the foundation of clinical practice — patients are continually compared to a physician’s experience and available knowledge base. Likewise, the practice of evidence-based medicine is definitionally predictive in nature [8] — interventions are applied based on their likelihood for success, established through prior
observed outcomes within patient populations. Although more advanced systems have been proposed [2,9], a common way in which prediction is formally applied in a typical clinical setting is through the use of clinical prediction rules\(^1\) (also known as decision models or risk scores — see definition in Table 1) [10]. These rules help clinicians synthesise clinical characteristics with the evidence base and produce a likely diagnosis, risk profile or recommendation for intervention for their patient.

We propose that it is a valuable and timely enterprise to understand the current and future role of CPR in clinical practice, as understood by clinicians. Investment in larger scale predictive analytics projects may be wasteful unless this comparatively simple relationship can be navigated successfully through to translated outcomes. To this end, this paper presents a systematic review of the perspectives of healthcare personnel on CPR. We will use this review to identify characteristics of successfully implemented and broadly used CPRs.

1.1. Outline

The remainder of this article is organised as follows. Section 2 describes the search strategy, data extraction and data synthesis that was performed. Section 3 contains details of specific characteristics of the included papers and their subject CPRs. Section 4 then details the extracted themes and describes the context of these themes within the included papers. Finally Sections 5 and 6 summarise this work and provide conclusions and recommendations.

2. Methods

The protocol for this review was developed in advance, and has been registered as PROSPERO ID 42016039098.

2.1. Search strategy

A systematic search of the literature regarding predictive models is challenging, due to lack of standard terms. Therefore, Ingui and Rogers [11] developed and tested a search strategy to retrieve studies of CPR from MEDLINE (since updated [12]).

After testing these searches, however, it became clear that a high proportion of known eligible papers were missed. This was because primarily papers describing the development of new CPR were returned, rather than the qualitative studies that are the target of this review.

Search terms were defined to capture study purposes which jointly address two high level concepts (1) clinician attitudes, preferences and practices and (2) prediction of risk via a model or decision rule. See Table 1 for the PICOS strategy and Appendix A for final searches used after extensive piloting.

The literature was searched in May 2016 and an update search performed in August 2017. After screening for duplicates and eligibility, and adding references obtained from reference mining, 45 eligible papers were included in the final review (Fig. 1).

Studies were screened independently by authors GK and BG, with discrepancies resolved via consensus. The inter-rater agreement was excellent, with a Cohen's kappa statistic of \(\kappa = 0.84\) and \(\kappa = 0.88\) for abstract and full-text phases respectively.

Quality screening was completed by author GK using the CASP qualitative checklist, with two references removed due to not meeting an appropriate standard of research design.

2.2. Data extraction

A data extraction form was developed a priori to capture high-level study characteristics. The results of this extraction can be seen in Tables 2–4.

2.3. Data synthesis

Thematic coding was performed using the NVivo qualitative research software (version 11.3) by author GK. This inductive coding was reviewed iteratively with feedback by BG until saturation was achieved, and a meaningful hierarchy of codes was developed.

3. Results

3.1. Characteristics of included studies

3.1.1. Publication dates

As seen in Fig. 2, the rate at which studies meeting the inclusion criteria have been published has increased over time. Using the updated MEDLINE search string as a baseline [12], the rate that CPRs are studied for acceptability or usability is found to slightly outpace the rate of general CPR publications. This proportion remains extremely low, but does indicate a relative increase in interest in the qualitative analysis of CPRs over time.

3.1.2. Methods

A majority of included studies (28, 62%) employed a survey, with a significant minority (14, 31%) performing semi-structured interviews. Usability tests and focus groups were performed more rarely (4, 9%) due to the higher resources required. 9 studies used mixed methods, typically an initial survey with follow-up interviews and/or focus groups.

The most common recruitment strategy was through primary care network membership (16, 36%) followed by contacting members of a professional body (14, 31%). Response rate was provided in 23 studies, with an average of 51.3% (s.d. 22.5%).\(^2\) For recruitment directly via medical practice, network or hospital(s), there were more studies targeting health-care providers within non-academic than academic institutions (16 and 8 respectively).

3.1.3. Uptake of CPRs

More than half of the included studies (24, 53%) do not report usage or uptake of the CPRs in question. Amongst the remaining 21 studies, only two report observed uptake in an experimental setting [31,57]. One reports uptake (acceptance when triggered) by encounter and the other by clinician. The rest describe the self-reported use. Direct comparisons are not possible due to heterogeneity in the reporting and quantification of CPR use.

The only measure that could be directly compared was clinicians’ awareness of a specific named rule — this was reported in 6 studies, covering 5 named rules, and one group of domain-related rules — see Fig. 3. Note in particular that the Low Risk Ankle Rule (LRAR) is far less familiar than the Ottawa Ankle Rule (OAR), which is likely due to the overwhelming popularity of the OAR, despite the LRAR’s higher sensitivity and specificity.

3.1.4. Health provider perspectives

Overall, three high level categories emerged in the themes of included studies — utility, credibility and usability — which reflect the three distinct phases in the lifecycle of a CPR — development, validation and implementation — respectively.

These findings have been summarised in Fig. 4, along with questions that reflect the thematic analysis results, that CPR designers can use to interrogate the design and architecture of new tools in order to bring

\(^1\) CPR: Clinical Prediction Rules

\(^2\) Where more than one response rate reported, the most general was used for aggregation.
them inline with the stated health provider perspectives.

4. Results in context

4.1. Utility

4.1.1. Specialty

General practice and emergency medicine are by far the most CPR- and CVD specialists, represented in 31 of 45 included studies. This is consistent with the most commonly observed role domains — cardiovascular disease (CVD) (12, 27%), cancer (6, 13%) and trauma (7, 16%) — and study participants — GPs and emergency physicians (21 and 10 respectively). These specialties require practitioners to be generalists; to recognise, support and treat a variety of conditions, and it is not practicable to expect consistent knowledge across a broad domain without flexible and accessible decision aids. Additionally, general practice is the specialty where physicians are likely to have an ongoing relationship with patients, following up progress over time. As such, a focus on helping patients to understand their personal risks, suggested behaviour changes and treatment pathways is valued [25,44]. In hospital settings, emergency physicians also rate CPRs as more aligned with their workflow and thought processes than internists do [43].

Cancer and CVD were both highly represented domains, however it is noteworthy that there is no correspondingly high prevalence of studies targeting cancer specialists or cardiologists (1 study reporting on each). Most of these rules were instead defined in the general practice setting, targeting early diagnosis and management of patient risk over time.

4.1.2. Audience

Numerous papers report higher acceptability and knowledge of CPR amongst clinicians with fewer years of experience [30,40,44,48,49,51]. In these instances, it is assumed that CPRs function as a substitute for clinical experience and reassure younger clinicians of their judgment, and may even help teach clinical reasoning [42]. This perception can extend to the point that CPRs are seen as a ‘crutch’ (contributing to negative views) [15]. This may also be impacted by a reluctance of clinicians to change long-held beliefs, leaving younger participants more open to statistical tools [51], and a lower overall comfort level with technology and/or evidence-based medicine in older respondents [18].

The most effective CPR users were clinicians who worked full-time and reported using rules frequently [48] — underscoring the benefit seen with frequent usage.

4.1.3. Added value

Multiple studies reported that the way in which cancer [21,55] and CVD [39] CPRs most added value to primary care was by distinguishing patients who had a slightly elevated risk, as opposed to identifying those with a greatly increased risk (who should be readily identifiable). A side-effect of this observation is that outside controlled validation study settings, clinicians may not apply CPRs uniformly [38,44]. This is important, since a rule that is in practice used only in low-certainty cases will necessarily underperform its theoretical accuracy.

Critical care is identified by advanced practice nurses as a specialty with a large degree of uncertainty [17] and thus should have a proliferation of CPR, due to the high potential to add value through confidence in treatment decisions. This is not borne out by this review, which includes only one such study, although study participants report a reduction in anxiety at end of life when the decision to remove life-
support systems is supported by objective data [17].

This desire for reassurance and objectivity is also seen in EM, where there was a positive correlation between likelihood to use a rule and severity of outcome [22,30]. A rule to identify patients for prophylactic treatment against post operative nausea and vomiting is one of the most poorly received CPRs in the review [32], which is attributed by anaesthetists to the low burden that this issue has on patients, compared to the side-effects of available treatments.

CPR for common complaints are perceived to be beneficial [18,49], likely due to the increase in memorability and a decrease in the time to apply a given rule with more frequent use.

### 4.1.4. Actionability

Healthcare providers consistently prefer CPR where results are actionable or directive, as opposed to strictly numerical [32,44,47,49] due to challenges interpreting risk-based recommendations in isolation.

This requirement for actionability is also seen with respect to rules that attempt to diagnose patients or classify them into sub-types. If treatment decisions are not different between groups, further detail is not important in a clinical (i.e. not research) context [56].

Other actionable outcomes favourably viewed by clinicians avoid time-consuming, invasive or costly procedures [49], identify risk factors that will have the highest impact on patient outcomes [23], prioritise tests or referrals in the face of non-specific symptoms [51] and systematically assess combinations of symptoms instead of in isolation [21].

### 4.1.5. Medico-legal and regulatory environment

There is evidence that US physicians are more likely to believe CPRs increase the risk of being sued [15,34,47], whereas the converse is generally true in other English-speaking countries, where they are viewed as protective against such suits [47,49] by providing documented evidence of a rationale to forming certain decisions. A corollary to this, however, is the concern that in the instance that a CPR disagrees with the clinical judgment of a physician, they may order procedures they believe are unnecessary if there is a paper trail indicating that they were prompted that this was necessary [20].

Physician autonomy is an important factor for participants in many of the included studies, although the level of concern varied greatly. One study reported a global pattern which closely reflected the pattern by which physicians from each country viewed their increased risk of being sued when using CPRs [47] — a higher perception of loss of physician control correlating with a greater fear of litigation.

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**Table 2**

<table>
<thead>
<tr>
<th>Country</th>
<th>Recruitment setting</th>
<th>Study methods</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia</td>
<td>Academic hospital(s)</td>
<td>Focus group</td>
</tr>
<tr>
<td>Canada</td>
<td>Academic primary care network</td>
<td>Semi-structured interview</td>
</tr>
<tr>
<td>France</td>
<td>Educational institution</td>
<td>Survey</td>
</tr>
<tr>
<td>Germany</td>
<td>Non-academic hospital(s)</td>
<td>Usability testing</td>
</tr>
<tr>
<td>Netherlands</td>
<td>Non-academic primary care network</td>
<td></td>
</tr>
<tr>
<td>Spain</td>
<td>Professional body membership</td>
<td></td>
</tr>
<tr>
<td>Switzerland</td>
<td>Targeted approach</td>
<td></td>
</tr>
<tr>
<td>UK</td>
<td>Enrolment in an existing RCT</td>
<td></td>
</tr>
<tr>
<td>USA</td>
<td>Other</td>
<td></td>
</tr>
</tbody>
</table>

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**Table 3**

<table>
<thead>
<tr>
<th>Rule type</th>
<th>Rule domain</th>
<th>Clinical specialty</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diagnostic</td>
<td>All-cause mortality</td>
<td>Breast surgery</td>
</tr>
<tr>
<td>Prognostic</td>
<td>Back pain</td>
<td>Dentistry</td>
</tr>
<tr>
<td>Therapeutic</td>
<td>Cancer</td>
<td>Diabetes Management</td>
</tr>
<tr>
<td></td>
<td>Cardiovascular disease</td>
<td>Emergency</td>
</tr>
</tbody>
</table>

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**Support systems is supported by objective data [17].**
4.1.6. Psychosocial factors

Due to this desire for autonomy, multiple studies found that clinicians would augment or replace the CPRs with other factors [30,31,48,51], or apply in a manner that was contrary to the tool design such as restricting the applicable patient population [17,38,44]. This explains discrepancies between results in validation and impact studies.

A perceived result of loss of autonomy is the imposition of external control or reduction in services for patients predicted not to respond to treatment [17,32,40] if insurers have access to CPR results. Physicians feel threatened by this as an artefact of a rigid framework that is not suitable for all patients [17], and that it may result in ‘intellectual sloppiness’, as providers become dependent on these tools cannot form...
judgments independently [40,42].

It is possible to argue that some loss of autonomy is a positive outcome of CPR usage, with authorities able to benchmark performance of multiple clinicians and ensure standardised care is provided to all patients. There is evidence, however, that this is perceived as a threatening or overbearing action by some clinicians [50], which may affect their successful implementation.

4.1.7. Patient/clinician interaction

Consultation time is a finite and valuable resource. CPR use requires additional effort from the clinician, and may interrupt the consultation flow, prompting concerns that CPR use may cause longer consultations, or cause other important issues to be de-emphasised [20,21,24,25,29,33,51,57]. This is particularly problematic in instances requiring double data entry or context switching [29,52], where computer usage gets in the way of more relational interactions [33]. Some papers suggest that carefully selected trigger points, responding to and better reflecting the true nature of the consultation, would address this issue [25,57].

Emergency physicians report less concern regarding time taken to apply CPRs, and are more likely to feel that they are time saving devices [34,46]. This may be due to the high representation of the Ottawa Ankle and Knee Rules, which are not only simple to apply, requiring no data entry, but also have demonstrably decreased unnecessary tests, which directly affects the emergency physician workflow — unlike specialist and primary care contexts, where tests fall outside consultation time so any time saved is decoupled from the main patient care phase.

Some physicians are reluctant to initiate CPRs in front of a patient if they cannot anticipate results, especially if these results are potentially confronting, as in the case of a high-risk cancer prognosis [51] or if they feel that patients will have trouble contextualising the risk [33].

Fig. 3. Physician awareness of included CPR: Ottawa Ankle Rule [34,47,48]; Adjuvant! Online & MammaPrint [16]; PECARN [49]; LRAR [34].

Fig. 4. Identified themes by development phase.
4.2. Credibility

4.2.1. Face validity
This review found that rules that do not have clear face validity are rarely acceptable to clinicians. Studies report that tools with conspicuously missing risk factors will be viewed skeptically [15-17,24,36,55], whereas those that reflect current best practice clinical reasoning have good credibility [21,31,40,42]. This skepticism holds, largely regardless of the verified performance of the rule in practice.

This disadvantages machine learning models with complex feature engineering and hidden layers, at least partially explaining the gap between what is technically feasible and that which is actually observed. This call for biological plausibility is reported directly by clinicians [40], and also observable in use. Physicians feel that weight bearing ability is relevant to diagnosis of ankle fractures, and manually include it in their calculations, despite the 100% sensitivity of the LRAR. The outcome of this is a reduction in specificity, with no additional instances of fracture diagnosed.

This is linked to the desire for actionability — with a premium on time and resources, there is a preference to only use tools that will have an impact on patient care. For prognostic models, this requires that identifiable risk factors can be discerned and modified. Diagnostically and therapeutically this makes less sense, however clinicians do not seem to discriminate, requiring face validity in all circumstances. Similarly, without a discernible causative pathway some clinicians do not view the results as truly personalised, crediting only applicability at the group level [32].

4.2.2. Validation study design and availability
Practitioners must be confident in the evidence supporting a tool before they are willing to overcome other barriers to implementation, however there are few included studies that spell out what validation is required to meet this bar. The OAR is cited as an example of rigorous development standards [46,48], but only in a general sense, not detailing by which factors this is defined.

Out of 29 studies that look at named included rules (not including theoretical, in-house or unrestricted sets of rules discussed in the abstract), 23 refer to contemporaneous validation studies in external populations.

The endorsement and/or mandate by professional bodies is a valuable strategy in dissemination and successful uptake of a new CPR [44,46,55], and is given great weight by clinicians.

4.3. Usability and implementation

4.3.1. Usage and usability
In a number of papers, usability is equated with memorability [48,56], with some clinicians only willing to use tools that can be applied without referring to the computer at all. Similarly, high value is placed model simplicity and low variable count [31], which should be easily measurable and available without elaborate equipment and testing. Benefits of a simple tool are realised by both clinicians and patients, as patients can be involved in the decision making process [56], and the benefits of CPR usage are readily understood [51].

Simplicity in both variable selection and interface extends into the learnability and accurate application of the tool. Even tools that have eventually high usability demonstrate a period of familiarisation where error rates are higher while clinicians become accustomed to the system [23].

Few papers (4) apply any usability testing methods directly; however even in a low-resource and low-experience setting, this is shown to be an effective tool in increasing satisfaction [23], and simple tests can expose usability flaws [56,57].

4.3.2. Information technology and integration
40% of CPRs as implemented in the studies of this review were fully or partially integrated (patient data populated directly from the EHR), 20% offline, 11% online but not integrated (requiring double data entry) and 29% unclear or hypothetical implementations only. For CPR requiring data input, the clear preference is for the system to be integrated with patient data [22,24,25,29,51,52,55,57], with the importance of this requirement increasing in recent years. This preference for integration puts additional value on CPR designs that rely on relatively few commonly available data points, ideally in their most generic form, to allow effective integration across diverse systems. Integration into the health record can also provide additional context to filter CPRs to only those applicable to the patient under review.

Physicians in the included studies do not demonstrate a sophisticated concern about data security or persistence [58] however they are sensitive to any technological failures or outages, and perceived delays [52,20,17].

4.3.3. Results presentation and visualisation
Interpretation of risk-based outputs presents a challenge to clinicians, particularly differences between absolute and relative risks [33], and even when output can be correctly interpreted, this does not necessarily translate into consistent treatment [23]. Visual representation is beneficial in accurate interpretation of risks [24,58], particularly consistent use of traffic-lights for risk-based information, which evoke an emotional response [20,24,51], helping clinicians understand when to treat, and patients understand physician recommendations. Visual representation is also found to speed up review of results, allowing rapid interpretation whilst remaining patient-focused [20] and avoiding presenting too much information, which may be confrontational [24].

Other presentation factors preferred by clinicians are the option to print out results and tailored supporting documentation for patients to take home and digest in their own time [29], comparative displays to show the impact of modifying risk factors [29] and multiple formats to improve understanding [28,55].

4.3.4. Education and dissemination
One way in which clinicians express frustration with CPRs is with the lack of training and support for them to apply rules accurately and consistently [17,20,33]. The lack of simple and accessible training materials is a highly impactful barrier to implementation [17,21].

An effective roll-out will be situationally dependent, however the following desirable characteristics were identified by users included in this review: integration into the patient flow at the appropriate time [49], convincing evidence of effectiveness above current accepted practice [34], materials that address correct usage, including how to combine the tool with clinical acumen and characteristics that may appear to be erroneously omitted [34,48], patient communication strategies [34], quick-reference materials and memory aids [48], publication in high-profile journals [46], endorsement by professional organisations [46], continued support and interaction post roll-out [21], information on CPR development methodology and standards of evidence [26,46], and short and well-planned training sessions or materials with key information clearly highlighted [20,17].

5. Discussion

5.1. Limitations
It is clear that few CPRs are studied for usability or utility — consequently there is little to no evidence of how they are used in practice. Our search was intentionally restricted to qualitative studies, which significantly limited the result set.

There are no commonly accepted variables available for aggregation, which limits reviews to qualitative synthesis. Physician awareness of CPRs and intended versus actual uptake would be useful data points
in future work. Without summary statistics, it is not possible to precisely track trends over time, and the overall conclusions of the review are more susceptible to bias.

Due to the unavailability of directly comparable and aggregatable variables, it is difficult to make clear distinctions of trends over time. It is possible to see an increase in demand for integration into health records, with all studies stating this as a high-priority item published since 2009, however few of the emerging themes show such a distinct trend.

5.1.3. Correlation of opinions to real-world experience

Physician opinions are an important predictor of the success of a new CPR in clinical practice, but they are of course not the only factor required for well-received implementations. This review addresses the perceptions of CPRs across a diverse set of paradigms, covering the nature of clinical practice alongside human factors and implementation strategies, which will, when followed, increase the likelihood of successful implementation and uptake. This does not address the question of impact and true, measurable benefits to patient populations.

6. Conclusions and recommendations

Holding constant factors that relate only to the nature of the clinical problem addressed, for broad acceptance of a new CPR, developers should prioritise the utility, credibility and usability of their models. These goals are reflected primarily in the rule’s actionability, face validity and simplicity (respectively).

Fig. 4 presents a summary of the findings of this review that allow CPR developers to interrogate their methods and goals in order to produce a model that is highly translatable and will be viewed favourably by clinicians.

6.1. Utility

The most commonly observed utility of CPRs relates to assisting GPs with diagnosis and risk management of cancer and CVD patients. This is followed by providing emergency physicians with rapid reassurance in the face of uncertainty.

The utility of CPRs decrease if the predicted outcome does not have significant impact to the patient (severe condition or serious potential side effects), or if the outcome is numerical and not clearly actionable. CPRs should include directive outcomes and causal pathways, with attention paid to the discriminative performance and calibration of patients in the ‘yellow’ zone (slightly elevated risk).

6.2. Credibility

Clinician’s perception can be more important for translatability than proven performance. GPs in particular do not generally report knowledge of CPR performance, while some emergency physicians and specialists pay attention to the discriminative power (in particular, sensitivity) of CPRs.

Face validity can be improved by:

- Performing feature engineering steps to ensure biological plausibility;
- Complexity reduction;
- Clear direction on modifiable risk factors;
- Where the above are not possible, directly addressing any potential concerns in educational materials.

Additionally, the roll-out phase should include steps to educate professional organisations and comply with their requirements for validation and training. Ideally a validation phase should include an impact assessment, which will address potential inconsistency in application across patient groups.

6.3. Usability

Simplicity must be preserved to improve both the technical implementation and integratability. This facilitates a smooth fit within the clinician/patient interaction by limiting data entry, disruption in communication and unnecessary context switching.

Clinicians report misuse of CPRs when attempting to add features or inconsistently apply rules. Where risk factors are modifiable, or any output is actionable, the CPR and associated materials should communicate this clearly.

6.4. Future work

A review of education and usability testing strategies and their ability to improve CPR uptake and correct usage is a valuable next step after this work. Jointly they could form the basis for a CPR rollout checklist, which could provide a streamlined process for ensuring that the implementation phase is performed effectively. A framework for quantifying and grading the evidence base of CPRs is already underway.

Appendix A

A.1 Search strings

MEDLINE: 1. Practice Patterns, Physicians/; 2. Practice Patterns, Nurses/; 3. Attitude of Health Personnel/; 4. 1 or 2 or 3; 5. Decision Support Techniques/; 6. Decision Support Systems, Clinical/; 7. prediction model*.mp.; 8. risk predict*.mp.; 9. clinical predict*.mp.; 10. decision rule*.mp.; 11. prediction rule*.mp.; 12. prediction tool*.mp.; 13. 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12; 14. 4 and 13

Scopus: (KEY(practice patterns, physicians) or KEY(practice patterns, nurses) or KEY(attitude of health personnel)) and (KEY(decision support techniques) or KEY(decision support systems, clinical) or TITLE-ABS(prediction model) or TITLE-ABS(risk predict) or TITLE-ABS (clinical predict) or TITLE-ABS(decision rule) or TITLE-ABS(prediction rule) or TITLE-ABS(prediction tool))

CINAHL: (practice pattern+ or attitudes of health*) AND (decision support+ or prediction model+ or risk predict+ or clinical predict+ or decision rule+ or prediction rule+ or prediction tool+)

References


[9] C.A. Longhurst, R.A. Harrington, N.H.A. Shah, Increasingly, clinicians desire fully integrated risk-score calculators; Face validity is important for translation of risk scores; Consistency is necessary for acceptance of CPR.


