

Features Predicting the Success of Computerized Decision Support for Prescribing: A Systematic Review

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Abstract

This systematic review evaluated whether certain features of prescribing decision support systems (RxCDSS) predict successful outcomes. A systematic literature search was conducted to identify randomized controlled trials involving RxCDSS, which were independently assessed by two reviewers for study outcomes and the presence of 28 system features. These outcomes were then modeled using univariate binary logistic regression. Our analysis suggested that features related to system integration, ease of use and adequate justification of decision support were more prevalent in successful systems that alter physician behaviour relative to those that did not.

Background

Prescribing Computerized Decision Support Systems (RxCDSS) provide patient-specific advice to clinicians in hopes of optimizing therapy and reducing prescribing errors.¹ Despite an impact on clinician behaviour, improvements in patient outcomes are still lacking.²⁻⁴ To facilitate improvements in this technology, we conducted a systematic review aimed at determining if 28 previously noted features of system design or implementation^{2,3,5-7} (Table 1) were associated with a multi-level definition of RxCDSS success.

Table 1 – RxCDSS Features Under Review

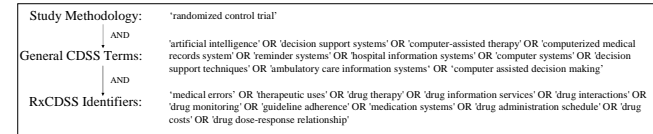
Pure Technical Features	Logic of Decision Support
Integration with charting order entry system to support workflow efficiency	Provision of a recommendation, not just an assessment
The computer generates the decision support	Justification of decision support via provision of reasoning
The system is fast	Justification of decision support via provision of research evidence
System uses data standards that support integration with EHRs, legacy systems	Assessment and recommendations are accurate and reliable
CDSS could be readily transported to another site (generalizability)	
System always up and running	
Technical/User Interactions	Development/Administrative Environment
Computers are readily available in convenient locations for users	Local user involvement in development process
The CDSS supports the user's task at hand	Clear incentive for users to use system
Automatic provision of decision support as part of clinician workflow	User's is/are early adopters
No need for additional clinician data entry	Active involvement of local opinion leaders
Request documentation for the reason for not following CDSS recommendations	Organization fosters and acts on improvement suggestions
Provision of decision support at time and location of decision making	CDSS launch supported by educational campaign
Recommendations executed by noting agreement	Interested users have the freedom to embrace the CDSS without waiting for multiple colleagues or staff to approve
Saves clinicians time or requires minimal time to use	CDSS developers also evaluators
Clear and intuitive user interface with prominent display of advice	Setting has learners involved
Provision of decision support goes to patients as well as providers	

Methods

This review included randomized controlled trials (RCT) published in English. An RxCDSS was defined as an electronic program that analyzes patient-specific information to advise a prescriber or pharmacist when writing or filling a prescription. Studies focused on diagnosis, vaccination, nutrition or 'fine-tuning' medications were excluded.

We searched the databases Medline, EMBASE, INSPEC and CINAHL for articles published between the earliest entry to the first week of June 2005 using a search strategy tailored to each database (Figure 1). The titles and abstracts of returned citations were independently assessed by two reviewers, with discrepancies resolved by a third reviewer.

Figure 1 – Internet Search Algorithm



Studies reviewed in full were independently assessed for success on three different levels: implementation (i.e. system used by clinician), change in provider behaviour (i.e. decrease in inappropriate prescribing), and change in patient outcomes. Here, the absence of success was considered failure. Each study was then scanned to determine the presence/absence of each of the system features under study, with an option of being 'unable to assess' the features presence. Lastly, methodological quality was established using an 8 point scale described elsewhere.²

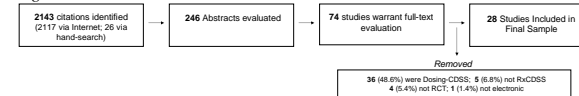
Results

2143 citations contained 74 studies warranting full review. 28 of these were RCTs which met all inclusion criteria (electronic CDSS on prescribing).⁸ Reviewer agreement (kappa) for the measures: successful implementation, change in process, change in patient outcomes were 1.0 (95% CI: 1.0; 1.0), 0.4091 (0.0115; 0.8067), and 0.7487 (0.586; 0.9887), respectively.

Characteristics of the 28 RCTs identified by the literature search:

- 99000 patients (study n=21, mean reported: 4742, range: 169; 41870) and 1800 providers (study n=21, mean reported: 89, range: 17; 300) involved (note: studies with unclear reporting of patient/provider numbers were excluded).
- Mean methodological score: 5.75 (with possible minimum of 2 and maximum of 8).
- 25 (89.3%) were successful at implementing their systems, 14 (50.0%) changed provider behaviour, and 3 (10.7%) reported improvements in patient outcomes.
- Studies reported on a mean of 21.3 features (95% CI 16.1; 26.5), both those present and those absent.
- One study⁹, which found no benefit for adding symptom information to RxCDSS output, was excluded from the features analysis for lacking a true control group.

Figure 2 – Citation Inclusion Flow-Chart



The most frequent features reported in the 25 studies that successfully implemented (i.e. installed and used) their RxCDSS included: 'the CDSS supports the task at hand' (92.6%), 'integration with charting order entry system to support workflow efficiency' (81.5%), 'provision of decision support at time/location of decision making' (81.5%), 'provision of a recommendation, not just an assessment' (81.5%), 'computers readily available in convenient locations for users' (77.8%), and 'active involvement of local opinion leaders' (77.8%).

Results for the features found to be more prevalent in the 14 studies which successfully impacted provider behaviour when compared to the 13 studies that did not are summarized in Table 2. Statistically, 'engaging users in recommendation rationale' (p=0.034) appears to be associated with a change in provider behaviour, while 'CDSS launch supported by educational campaign' (p=0.029), and 'provision of decision support goes to patients as well as providers' (p=0.01) appears to be associated with failure to impact provider behaviour.

Table 2 – RxCDSS Features More Prevalent in Successful Provider Behaviour Change

Engaging users in recommendation rationale (p=0.034)
59.3% of studies list feature;
78.6% of successful studies have feature; 38.5% unsuccessful have feature
Saves clinicians time or requires minimal time to use (p=0.085)
55.6% of studies list feature
71.4% of successful studies have feature; 38.5% unsuccessful have feature
No need for additional clinician data entry (p=0.182)
59.3% of studies list feature
71.4% of successful studies have feature; 46.2% unsuccessful have feature
Setting with learners involved (p=0.152)
74.1% of studies list feature
85.7% of successful studies have feature; 61.5% unsuccessful have feature
Integration with charting order entry system (p=0.114)
81.5% of studies list feature
92.9% of successful studies have feature; 69.2% unsuccessful have feature

^a p-values obtained using a univariate binary logistic regression model

Discussion

This systematic review was limited by a small sample size of studies which prevented statistical analysis of all 3 levels of outcome success. In addition to a shortage of RCTs on RxCDSS, no single study was found that formally examined features predicting success of RxCDSS with a proper control group. The general under-reporting of the features of RxCDSS interventions makes evaluation of this issue and, therefore, future design of effective RxCDSS, problematic. A first step to assist the more efficient development of these expensive resources would be to agree on a list of features that all studies should report.

Conclusion

Features related to system integration, ease of use and adequate justification of decision support were more prevalent in successful systems relative to unsuccessful ones. Future studies should strive to impact patient outcomes, while also attempting to be more descriptive with the features and specifications of their system.

References

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