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**Abstract**

**Background and objectives:** Clinical decision support systems (CDSSs) may help clinicians prescribe opioids for chronic non-cancer pain (CNCP) more appropriately. This scoping review determined the extent and range of the current evidence on CDSSs for opioid prescribing for CNCP in primary care, and whether investigators followed best evidence and current guidance in designing, implementing and evaluating these complex interventions.

**Methods:** We searched nine electronic databases and other data sources for studies from January 1st 2008 to October 11th 2019. Two reviewers independently screened the citations. One reviewer extracted data and a second verified for accuracy. Inclusion criteria: study of a CDSS for opioid prescribing for CNCP in a primary care clinical setting. We reported quantitative results in tables and qualitative results in narrative form.

**Results:** Our search yielded 5068 records of which 14 studies met our inclusion criteria. All studies were conducted in the United States. Six studies examined local (eg, health centre) CDSSs and eight examined prescription drug monitoring program (PDMP) CDSSs. Three CDSSs incorporated evidence-based components. Study aims were heterogeneous and study designs included both quantitative and qualitative methodologies. No studies assessed patient health outcomes. Few studies appeared to be following guidance for evaluating complex interventions.

**Conclusions:** Few studies have rigourously assessed the use of CDSSs for opioid prescribing for CNCP in primary care settings. Going forward, investigators should include evidence-based components into the design of CDSSs and follow guidance for the development and evaluation of complex interventions.

**A Scoping Review on Clinical Decision Support Systems for Opioid Prescribing for Chronic Non-Cancer Pain in Primary Care Settings**

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20   CNCP in primary care settings. Going forward, investigators should include evidence-based

21   components into the design of CDSSs and follow guidance for the development and evaluation

22   of complex interventions.

23

**Introduction**

Two countries at the epicentre of the opioid crisis, Canada and the US, (1–4) recently released

clinical practice guidelines for opioid prescribing for chronic non-cancer pain (CNCP) (5,6).

These guidelines recommend against using opioid analgesics for CNCP because the harms

frequently outweigh benefits (7–10). When opioids are prescribed for CNCP, the guidelines

recommend risk mitigation strategies and opioid dose tapering. Both guidelines target primary

care providers (PCPs), since they write about half of all opioid analgesic prescriptions in North

America (11–13). However, evidence shows that PCPs may have difficulty adopting

recommended clinical practices (14–21). Clinical decision support may provide assistance.

Clinical decision support systems (CDSSs) are electronic systems that assist health care

providers in clinical decision-making, by providing patient-specific data at the point-of-care (14–

16). Studies show that CDSSs lead to improvements in clinician performance (a care process

measure), such as ordering appropriate tests and safer prescribing (17–25). Some CDSS design

components are evidence-based, including; requiring a reason for an over-ride; activating

automatically (i.e., the CDSS runs without requiring provider initiation); integrating into the

electronic medical record (EMR); and providing advice to patients (e.g. written materials), as

well as clinicians (14,20,26–28). These components lead to improvements in care process

outcomes. Studies in which the CDSS evaluators are also the developers tend to show positive

impact on process outcomes (26,27).

However, the impact of CDSS on important patient health outcomes or population health

outcomes is unclear (17–20), and widespread adoption is often limited by implementation issues

(29–34). Additionally, CDSSs can be difficult to develop and evaluate because they are complex

interventions that seek to change the functioning of a complex adaptive system such as a primary

care clinic (35). Therefore, the Medical Research Council in the United Kingdom (UK)

recommends that researchers design and evaluate these interventions through a carefully staged

series of studies targeting key uncertainties as well as a definitive evaluation (35,36). All steps

should include process evaluations and assess for unintended consequences (37).

CDSSs can have a variety of roles in improving adherence to opioid prescribing guidelines for

CNCP. They can be used to reduce the number of new opioid prescriptions for acute pain (38)

55  and to reduce the initiation of opioid prescribing for CNCP. They can also be used to improve

56  prescribing and other measures like risk mitigation strategies for patients already receiving

57  opioids for CNCP. This is the most challenging role for a CDSS these patients are at high risk of

58  harms and changing prescribing is very difficult (39,40).

59  Several studies have evaluated CDSSs for opioid prescribing for CNCP in primary care settings

60  (41–44). These studies report that the use of a CDSS led to a reduction in opioid prescribing or

61  improved adherence to clinical practice guidelines (41–44). Several studies have also evaluated

62  prescription drug monitoring program (PDMP) CDSSs for opioid prescribing for CNCP in

63  primary care settings. PDMP CDSSs are large, centralized, government-run databases that

64  prescribers can provide point-of-care for information on a patient's opioid prescriptions (45,46).

65  While one PDMP CDSS study found that physicians wrote fewer opioid prescription in 61% of

66  cases, (47); another study reported no association between PDMP implementation status and

67  requirement levels (from no requirements to a mandatory requirement to check the PDMP before

68  prescribing) and physicians' opioid prescribing for CNCP (48). Four other PDMP CDSS studies

69  examined PCPs' use of, and views on PDMPs (49–52).  To date, however, the literature in this

70  emerging field has not been systematically summarized and analyzed so the benefits and risks of

71  implementing a CDSS are unclear.

72

73  This scoping review determined the extent and range of the current evidence on CDSSs for

74  opioid prescribing for CNCP in primary care. Our secondary aim was to determine whether

75  researchers followed best evidence for the design of the CDSSs and current guidance for the

76  evaluation of complex interventions.

77

78  **Methods**

79  We conducted a scoping review using the frameworks (53,54) described by Colquhoun et al (55),

80  and the methods outlined by The Joanna Briggs Institute (56). We followed the reporting

81  guidelines from the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-

82  Analyses) Extension for Scoping reviews (PRISMA-ScR) (57). We created an a priori protocol

83  and used an iterative approach. Modifications included a secondary research aim and a change to

84  the data extraction plan.

85

86 *Study eligibility:* We included peer- and non-peer reviewed studies that used quantitative,

87 qualitative and mixed-methods methodologies. We excluded non-systematic reviews, letters,

88 opinion articles, analysis articles, clinical practice guidelines and policy documents. We included

89 all studies where the population was PCPs (ie, family physicians, emergency medicine

90 physicians, nurse practitioners (NPs) and primary care internists) working in a primary care

91 setting. Studies that reported less than 50% PCPs or did not report the percentage of PCPs were

92 excluded unless results were reported by subgroup. We included all studies that assessed a CDSS

93 that sought to improve to improve opioid prescribing for CNCP patients in a primary care

94 clinical setting. We excluded studies where primary care providers were working in a secondary

95 and tertiary settings such as a pain clinic or addiction clinic. We excluded primary care pediatric

96 clinics. We defined a CDSS as an electronic system that assisted health care providers in clinical

97 decision-making, by providing patient-specific data at the point-of-care (14–16). We included

98 studies where the CDSS was integrated into the EMR, or functioned independently (eg, web-

99 accessed), or was embedded within a larger intervention. We excluded studies where CDSS use

100 was not specified, where it was used for another reason, or where it was not implemented in

101 clinical settings.

102

103 *Data sources and searches*

104 We searched electronic databases (MEDLINE (via OVID), EMBASE, CINAHL, CENTRAL,

105 PsycINFO and International Pharmaceutical Abstracts (via OVIDSP)) from January 1$^{st}$ 2008 –

106 October 11 2019. CDSSs developed prior to this period likely evolved or became obsolete (59).

107 We built a comprehensive search strategy, including the terms "opioid," and "clinical decision

108 support systems." Since studies used a large number of different keywords and medical subject

109 headings (MeSH) for a CDSS, we had to conduct a broad search using a large variety of terms,

110 including; computer systems, health informatics, clinical decision making (Appendix 1 Medline

111 search strategy). The Medline strategy (Appendix 1) was adapted for the other databases. We

112 used the Canadian Agency for Drugs and Technologies (CADTH) approach to our grey literature

113 search (Appendix 2 Grey literature search) (60). We also searched trial registries

114 (ClinicalTrials.gov, World Health Organization International Clinical Trials Registry Platform

115    (WHO ICTRP)), checked reference lists of additional eligible studies and contacted experts (ie,

116    lead authors on included studies, registered protocols and systematic reviews of CDSSs).

117

118    *Screening and selection*

119    Two researchers independently screened abstracts to determine if they met inclusion criteria.

120    Two researchers then independently screened the full-text of all relevant articles. For both steps,

121    after we screened 10 to 15 titles and articles, we checked inter-reviewer agreement to ensure it

122    was least 80% before continuing further. When there were disagreements, a third researcher

123    (MAO) assisted in making the final decision. We contacted authors for more information when

124    full text was not available online (58).

125

126    *Data extraction*

127    We created and pilot-tested a data extraction form to record the following <u>items:</u> study

128    population and setting, description of the intervention and implementation process, type of

129    CDSS, inclusion of evidence-based CDSS components (components that the literature has

130    consistently found to have an impact on outcomes: <u>requiring a reason for an over-ride; activating</u>

131    <u>automatically; integrating into the electronic medical record (EMR); and providing advice to</u>

132    <u>patients and clinicians (14,20,26–28)</u>, study aims, methodology and design, study outcomes,

133    funding information, conflicts of interest, and adherence to guidance for complex interventions

134    (eg, study was part of a stepped approach to development and evaluation; assessment for

135    unintended consequences; planned process evaluation; process and outcome measures;

136    theoretical approach to guide implementation and/or evaluation). <u>One reviewer extracted data</u>

137    <u>and another researcher reviewed their work (SMS, MAO, QG, SM, SH). This was a modification</u>

138    <u>from our protocol that specified that two researchers would independently extract the data.</u>

139

140    *Data synthesis*

141    We used a flow diagram to report on study selection. We reported quantitative data in tabular

142    format. We wrote narrative summaries using contextual and process-oriented data. We did not

143    conduct a detailed assessment of study quality, assess for reporting bias, or risk of bias consistent

144    with current guidance on conducting scoping reviews (55–57).

145

146

**Results**

Our literature search <u>identified 5068</u> citations from which <u>14 </u>were included in the scoping

review (Figure 1). <u>Six </u>studies examined local CDSSs (e.g., specific health system, centre or

clinic) (41,43,44,61–63) while <u>eight</u> examined state-run, web-based, central PDMP CDSSs

(47,49–52,64–66) Results using these two typologies are summarized in Table 1.  Study

descriptions are detailed in Appendix 3.

*CDSS description*

Types of CDSSs included protocols (i.e., forms that guide clinical management) in the EMR,

intranet dashboards, EMR alerts, data repositories and web-based clinical tools. <u>Four local</u>

<u>CDSSs were integrated into the EMR (43,44,62) and two automatically activated (44,62). The</u>

<u>other two required the PCP to activate the CDSS.</u> Studies assessing PDMP CDSSs did not report

any evidence-based design components.

*Study characteristics*

All studies occurred in the US and practice settings were mostly primary care clinics. <u>Three were</u>

<u>set in the emergency department (44,47,49). All of the local CDSSs, and three of the PDMP</u>

<u>CDSS studies (47,64,66) were designed to assess whether a CDSS alone or incorporated into a</u>

<u>multi-faceted intervention improved prescribing or adherence to guidelines. The remaining</u>

<u>PDMP CDSS studies determined providers' behaviour, knowledge of, attitudes toward and use</u>

<u>of CDSSs. Local CDSS study designs included four pre-post interventions, a cluster RCT and a</u>

<u>mixed-methods evaluation. The eight PDMP CDSS studies included a wide variety of study</u>

<u>designs including: three pre-post interventions, a cross-sectional survey, two qualitative, one</u>

<u>mixed methods and one retrospective cohort. Study aims and designs are summarized in Table 2</u>

<u>and described in detail in Appendix 3. One study was part of a stepped approach in evaluating a</u>

<u>complex intervention (63). About half of the studies that assessed the impact of an intervention</u>

<u>included a process evaluation (measures assessing if program components had been implemented</u>

175  as intended) (41,43,47,49,62–64). Two studies reported using a theoretical approach in

176  implementation and evaluation processes (61,63).

177

178  ***Implementation processes***

179  All of the studies on local CDSSs described their implementation process, but provided little

180  detail. None of the PDMP CDSS studies described implementation processes.

181

182  ***Study Findings***

183  *Local CDSSs*

184  Anderson et al. found that the CDSS and summary reports improved compliance with guidelines

185  (41); Canada et al. reported that a CDSS plus monetary incentives improved adherence to

186  guidelines (43); Downes et al. found that a CDSS and electronic reports reduced opioid

187  prescribing and increased urine drug testing and use of pain contracts (62); Gugelmann et al.

188  found that the CDSS reduced opioid prescribing (44); Liebschutz et al. reported that a multi-

189  faceted intervention that included a CDSS in both study arms also reduced opioid prescribing

190  (61); and Seal et al. found in a multi-component intervention (with CDSS in both arms) that

191  providers "abandoned use" of the CDSS (63).

192

193  *PDMP CDSSs*

194  Baehren et al. found that physicians who used PDMP data wrote fewer opioid prescriptions in

195  61% of cases and more opioid prescriptions in 39% of cases (47); Binswanger et al. found that a

196  multi-component intervention improved adherence to guidelines (64); Chaudhary et al. found

197  that most PCPs reported always checking the PDMP before prescribing opioids to new patients

198  (52). Click et al. found that providers have positive views about PDMPs, but reported barriers in

199  using them (50). Coleman et al. found that in five of seven records of patient prescribed opioids,

200  providers accessed the PDMP (51). Freeman et al. reported that PDMPs are key tools for PCPs

201  and that barriers include a lack of integration (65); Kohlbeck et al. reported that an educational

202  intervention increased providers' knowledge of, behaviour and attitudes toward PDMP CDSSs

203  (49); Patchett et al. reported that a multi-component intervention increased use of a PDMP and

204  led to a reduction in opioid prescribing (66).

205

206

207 *Funding and conflict of interest*

208 All but two local CDSS studies reported on funding for CDSS evaluation (44,62); and three

209 others were missing information on funding for CDSS development (44,63). All PDMP studies

210 except one (66) provided information on funding for evaluation, but none provided information

211 on funding for developmentFor all six local CDSS studies, the developers were also the

212 evaluators or the relationship was unclear or not stated. No evaluators of PDMPs provided

213 information on their relationship to the PDMP developer (Table 3).

214


215

216 **Discussion**

217 We identified 14 studies published between 2009 and 2019 that examined CDSSs for opioid

218 prescribing for CNCP in primary care clinical settings. Six of the studies examined local CDSSs

219 (that were used locally within a specific health centre, health system or clinic) and eight

220 examined PDMP CDSSs. Studies evaluating CDSS impact found that the CDSS (alone or more

221 commonly, part of a dual or multi-component intervention) led to more appropriate prescribing

222 practices and/or adherence to guidelines. Several PDMP CDSS studies assessed providers' views

223 on, and/or their use of PDMP CDSSs. These studies reported frequent use of the PDMP CDSS

224 and positive views towards the CDSS with some acknowledgement of the barriers and

225 limitations. These findings are similar to a recent qualitative rapid review that asked providers

226 about the use of PDMPs (67). No study, however, contained an assessment of patient health

227 outcomes or assessed for unintended consequences. Additionally, in four studies the evaluators

228 were also the CDSS developers, a potentially useful situation but one that presents a potential

229 conflict of interest (26,27), that was not addressed by the investigators. We also found that few

230 CDSSs included evidence-based components and that in only one study investigators reported

231 following current guidance for development and evaluation of complex interventions (35,36).

232

233 Our finding that there were only 14 studies, and only one RCT, which met our inclusion criteria

234 is surprising. In contrast, a 2015 systematic review found seven RCT studies of CDSSs for

235 antiobiotic prescribing by primary care providers (28). There may be several contributing factors.

236 The prescription opioid crisis only gained widespread attention in the last decade (68), and it

237    takes time to develop a complex intervention like a CDSS (36). It is also possible that some

238    CDSSs failed to show promise early on and development was subsequently stalled or halted.

239    Accordingly, there are a number of reports on the development of a CDSSs for opioid

240    prescribing for CNCP where clinical outcomes have not been reported yet (69–72). And finally,

241    it is possible that CDSSs are being used without an evaluation plan, as has occurred with many

242    PDMP CDSSs (73). This may be because of a demand for immediate solutions to the opioid

243    crisis and an evaluation of a CDSS takes significant time and money.  However, since CDSSs

244    frequently do not improve patient outcomes (17–20), and may lead to unintended consequences,

245    a comprehensive evalution is essential (74).

246

247    Most studies in our review that assessed the impact of the CDSS reported an improvement in

248    prescribing or better adherence to clinical practice guidelines. This aligns with previous research

249    in other fields: CDSSs have a modest impact on clinican performance (a care process outcome)

250    (17–25). However, these results need careful interpretation. Most studies were pre-post, non-

251    randomized control or observational designs.  Although—consistent with guidance for scoping

252    reviews (55,56)—we did not conduct a quality assessment; these types of study designs have

253    greater threats to validity (75). Additionally, in most of the studies, the CDSS was part of a larger

254    intervention, so its specific impact was unclear. Another reason for caution is that no studies

255    assessed patient health outcomes, such as quality of life, morbidity and mortality (76–78).

256    Reductions in opioid prescribing and better adherence to guidelines may have unintended

257    consequences (36). For example, studies report that patients often turn to illicit sources of

258    opioids when they have reduced access to prescribed opioids, increasing their risk of overdose

259    (79–84). Several studies in a systematic review found that heroin overdoses increased after a

260    PDMP CDSS was implemented (74). A more recent systematic review, however, found no

261    consistent association between population-level opioid-related harms (including heroin use and

262    overdoses) and PDMP CDSSs (85). We also noted a conflict of interest in some studies where

263    the developers were also the evaluators. Systematic reviews in other fields have demonstrated

264    that when the CDSS evaluator is also the developer, outcomes are better (26,27). It is possible

265    that developers achieve better outcomes because they design effective implementation plans

266    (26), but it is possible that the conflict of interest leads to conscious or unconscious bias (26,86–

267    92). Interestingly, none of the studies reported funding from or involvement of for-profit entities.

268   It is possible that CDSSs developed by for-profit entities are not undergoing a publicly-reported

269   evaluation. This is problematic, and as a recent criminal case demonstrated, can lead to potential

270   harm to patients (93).

271

272   We found that few of the CDSSs incorporated evidence-based design components. In only one

273   study did researchers follow guidance for designing and evaluating complex interventions.

274   Developers may not have incorporated evidence-based components because of the lag time

275   between development and evaluation: when the CDSS was created the developers may not have

276   had access to systematic reviews on the various components.  The developer may also feel that

277   the evidence does not apply to this particular subspecialty or setting (94). Another reason may be

278   a general excitement and overconfidence in e-health technologies (95). Funders and developers

279   may be too eager to solve the problem of unsafe opioid prescribing using e-health technologies

280   and are not ensuring that developers are building on information from the medical literature (95).

281   Changes are occurring. Between 2012 and 2016, the Substance Abuse and Mental Health

282   Services Administration (SAMHSA) funded nine projects to integrate PDMP data into EMRs

283   (96). Investigators might not follow guidance for complex evaluations because it is a lengthy and

284   expensive iterative process prior to a definitive evaluation (35–37,97).  This is a widespread

285   issue—few complex interventions appear to undergo modelling, pilot and feasibility testing (98),

286   and many lack process evaluations (99,100). This is problematic. If researchers conduct a trial

287   without testing components, possible causal pathways, uncertainties, contextual factors, and

288   implementation approaches, they risk wasting resources on an expensive trial and perhaps

289   causing harm (35,37,101). Conversely, if the evaluation takes too long, the technology could

290   become obsolete before it gains widespread uptake (59). Adopting rapid, concurrent and iterative

291   pilot and feasibility studies may be the best approach (102–104).

292

293   *Limitations*

294   There are two main limitations in our review. In the grey literature search we may have missed

295   non-English language studies, as we conducted the searches only in English. Second, several of

296   the studies included both PCPs and other provider types (we excluded those with less than 50%

297   PCPs), and, as these studies only reported aggregate outcomes, they may not accurately reflect

298   the PCP population.

299

### *Conclusion and next steps*

Our review reveals that few studies have rigourously assessed the use of CDSSs in the context of
opioid prescribing for CNPP in the primary care setting. More high quality studies are needed.
Going forward, investigators should include evidence-based components into the design of
CDSSs and follow guidance for the development and evaluation of complex interventions,
including pilot studies, process evaluations and an assessment for unintended consequences.

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Table 1

**Table 1. Study setting, participants, clinical decision support system (CDSS) type and inclusion of evidence-based components**

| Characteristic | | Local CDSS* N (%) | PDMP CDSS** N (%) |
|---|---|---|---|
| **Country** | United States | 6/6 (100%) | 8/8 (100%) |
| **Practice settings** | Primary care clinic | 5/6 (83%) | 6/8 (75%) |
| | Emergency department | 1/6 (17%) | 2/8 (25%) |
| **Types of PCPs** | Physicians | 6/6 (100%) | 7/8 (88%) |
| | NPs | 6/6 (100%) | 4/8 (50%) |
| **CDSS type** | Dashboard | 2/6 (33%) | 0/8 (0%) |
| | Protocol | 2/6 (33%) | 0/8 (0%) |
| | Alert | 1/6 (17%) | 0/8 (0%) |
| | Clinical tool | 1/6 (17%) | 0/8 (0%) |
| | Data repository | 0/6 (0%) | 8/8 (100%) |
| **Evidence-based CDSS components°** | Integrated into EMR | 3/6 (50%) | 0/5 (0%) *** |
| | Automatically activates | 2/6 (33%) | 0/5 (0%) *** |
| | Requires a reason for over-ride | 0/6 (0%) | 0/5 (0%) *** |
| | Provides advice to patients and  providers | 0/6 (0%) | 0/5 (0%) *** |

Abbreviations: CDSS = Clinical Decision Support System; EMR = electronic medical record;

N/A = Not Applicable; NP = nurse practitioners; PDMP = Prescription Drug Monitoring

Program; PCPs = primary care providers;

*Local CDSSs are used locally within a specific health centre, health system or clinic

**PDMP CDSSs are large, centralized, government-run databases

***We excluded 3 studies because they included multiple PDMP CDSSs, and did not provide

information on a specific CDSS (45,47,49)

° Unless a study stated a component was included (e.g. automatic activation), we assumed it was not

Table 2

**Table 2. Aims and designs of included studies**

| Aims | Design | Local CDSS* N (%) | PDMP CDSS** N (%) |
|---|---|---|---|
| **To determine if a multi-faceted intervention improved prescribing/guideline adherence** | • Cluster RCT*** | 1/6 (17%) | 0/8 (0%) |
| | • Pre-post | 4/6 (33%) | 0/8 (0%) |
| **To detemine if a CDSS improved prescribing/guideline adherence** | • Pre-post | 0/6 (0%) | 1/8 (13%) |
| **To determine if PCPs used a CDSS** | • Retrospective cohort | 0/6 (0%) | 1/8 (13%) |
| | • Cross-sectional survey | 0/6 (0%) | 1/8 (13%) |
| **To determine if an intervention affected provider knowledge, behaviour, attitudes and/or use related to CDSS** | • Mixed-methods | 0/6 (0%) | 1/8 (13%) |
| | • Pre-post | 0/6 (0%) | 2/8 (25%) |
| **To learn about factors affecting opioid prescribing for CNCP, including use of CDSS** | • Qualitative | 0/6 (0%) | 2/8 (25%) |
| **To pilot a multi-component intervention, including a CDSS** | • Mixed-methods | 1/6 (17%) | 0/8 (0%) |

Abbreviations: CDSS = Clinical Decision Support System; CNCP = chronic non-cancer pain;

N/A = Not Applicable; PDMP = Prescription Drug Monitoring Program; RCT = Randomized

controlled trial

*Local CDSSs are used locally within a specific health centre, health system or clinic

**PDMP CDSSs are large, centralized, government-run databases

***CDSS included in both study arms

Table 3

**Table 3. Funding and relationship between developers and evaluators**

| | | Local CDSS* N (%) | PDMP CDSS** N (%) |
|---|---|---|---|
| **Funding for CDSS development** | Public/Non-profit | 3/6 (50%) | 0/8 (0%) |
| | Industry | 0/6 (0%) | 0/8 (0%) |
| | Not sponsored | 0/6 (0%) | 0/8 (0%) |
| | Unclear or not reported | 3/6 (50%) | 8/8 (100%) |
| **Funding for evaluation** | Public/non-profit | 4/6 (67%) | 5/8 (63%) |
| | Industry | 0/6 (0%) | 0/8 (0%) |
| | Not sponsored | 0/6 (0%) | 2/8 (25%) |
| | Unclear or not reported | 2/6 (33%) | 1/8 (13%) |
| **Relationship between developers and evaluators** | Same person, group or organization | 4/6 (67%) | 0/8 (0%) |
| | Different person, group or organization | 0/6 (0%) | 0/8 (0%) |
| | Unclear or not reported | 2/6 (33%) | 8/8 (100%) |

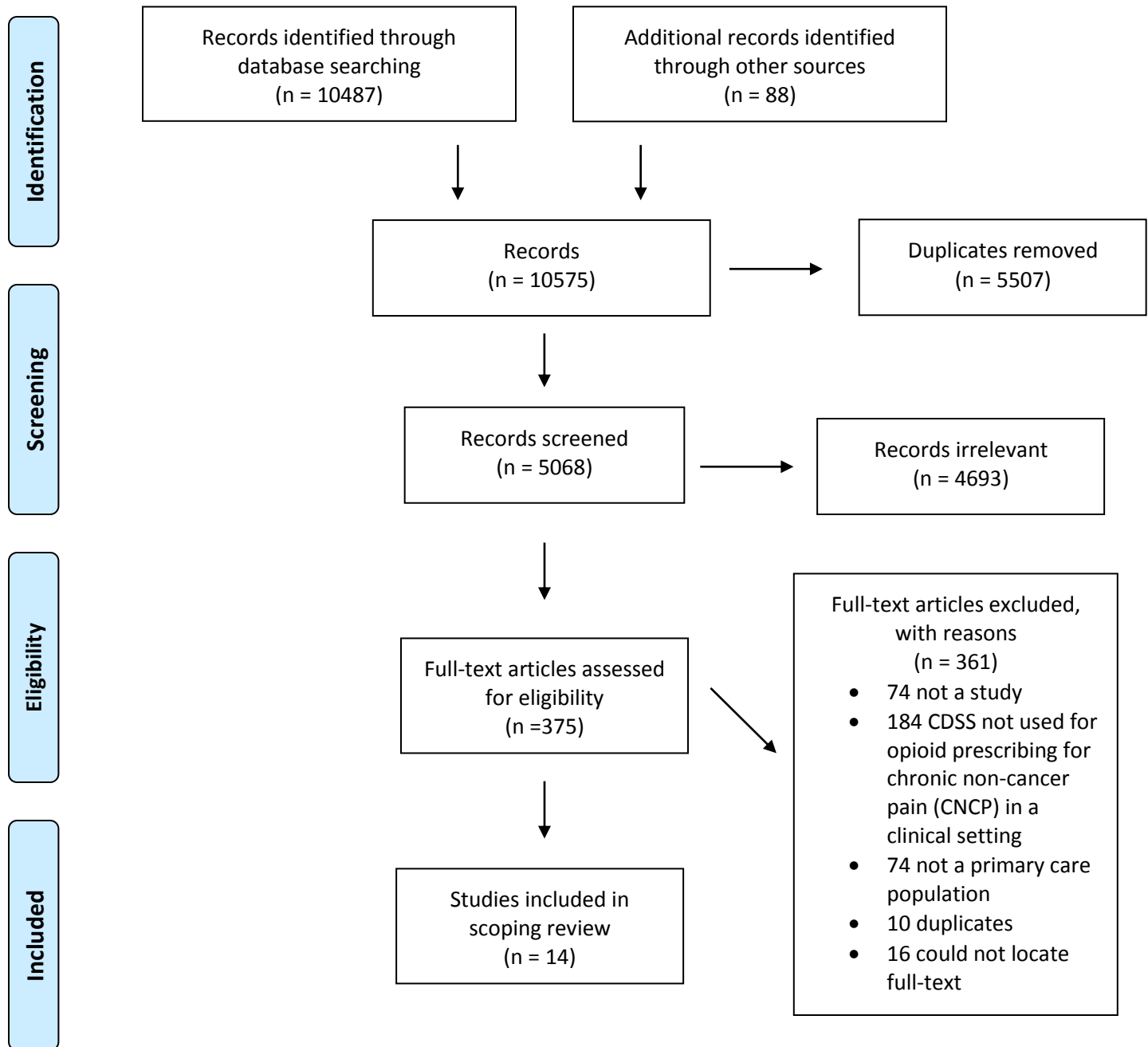Abbreviations: CDSS = Clinical Decision Support System; PDMP = Prescription Drug Monitoring Program

*Local CDSSs are used locally within a specific health centre, health system or clinic

**PDMP CDSSs are large, centralized, government-run databases

## PRISMA 2009 Flow Diagram

**Identification**

| Records identified through database searching (n = 10487) | Additional records identified through other sources (n = 88) |

**Screening**

Records (n = 10575) → Duplicates removed (n = 5507)

Records screened (n = 5068) → Records irrelevant (n = 4693)

**Eligibility**

Full-text articles assessed for eligibility (n = 375) → Full-text articles excluded, with reasons (n = 361)
- 74 not a study
- 184 CDSS not used for opioid prescribing for chronic non-cancer pain (CNCP) in a clinical setting
- 74 not a primary care population
- 10 duplicates
- 16 could not locate full-text

**Included**

Studies included in scoping review (n = 14)