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A literature review of the training offered to qualified prescribers to use

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electronic prescribing systems: Why is it so important?

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47 **Abstract**

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49 **Objectives:** A key element of the implementation and on-going use of an electronic
50 prescribing (ePrescribing) system is ensuring that users are, and remain, sufficiently
51 trained to use the system. Studies have suggested that insufficient training is
52 associated with suboptimal use. However, it is not clear from these studies how
53 clinicians are trained to use ePrescribing systems or the effectiveness of different
54 approaches. We sought to describe the various approaches used to train qualified
55 prescribers on ePrescribing systems and to identify whether users were educated
56 about the pitfalls and challenges of using these systems.

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58 **Methods:** We performed a literature review, using a systematic approach across three
59 large databases: Cumulative Index Nursing and Allied Health Literature (CINAHL),
60 Embase and Medline were searched for relevant English language articles. Articles
61 that explored the training of qualified prescribers on ePrescribing systems in a
62 hospital setting were included.

63

64 **Key Findings:** Our search of ‘all training’ approaches returned 1,155 publications, of
65 which seven were included. A separate search of ‘online’ training found three relevant
66 publications. Training methods in the ‘all training’ category included clinical
67 scenarios, demonstrations and assessments. Regarding ‘online’ training approaches; a
68 team at the University of Victoria in Canada developed a portal containing simulated
69 versions of electronic health records, where individuals could prescribe for fictitious
70 patients. Educating prescribers about the challenges and pitfalls of electronic systems
71 was rarely discussed.

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73 **Conclusions:** A number of methods are used to train prescribers; however the lack of
74 papers retrieved suggests a need for additional studies to inform training methods.

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88 **INTRODUCTION**

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90 Electronic Prescribing (ePrescribing) systems have been associated with a
91 range of potential benefits over paper-based systems, particularly when implemented
92 with clinical decision support (CDS).(1-4) Benefits, including improved patient
93 outcomes, safer patient care and potential cost savings from improved formulary
94 management, by prompting clinicians to prescribe generic rather than branded
95 medications,(5) has meant that the number of ePrescribing systems (home grown and
96 commercial), implemented across a diverse range of settings is growing. The

97 implementation of these systems in United Kingdom (U.K.) hospitals has surged and
98 is expected to continue increasing partly due, to the financial incentives offered such
99 as the National Health Service's (NHS) Integrated Digital Care Fund, the Safer
100 Hospitals Safer Wards Fund and the recent government recommendations to
101 encourage increased productivity.(6-8) Similar increases in the use of healthcare
102 technology have also been seen in the United States, where the use of computerized
103 provider order entry (CPOE) systems has more than tripled since 2010.(9) This has
104 been largely driven by The Health Information Technology for Economic and Clinical
105 Health (HITECH) Act, which offered financial incentives to organisations that could
106 demonstrate 'meaningful use' of Electronic Health Records (EHRs).(10) Australian
107 government incentives, have also been associated with increased uptake of
108 computerised prescribing in primary care.(11)

109 A key element of the implementation and on-going use of an ePrescribing
110 system is ensuring that users are, and remain, sufficiently trained and competent to
111 use the system effectively. The user training should be comprehensive enough to
112 cover all aspects of how a user may need to interact with a system to undertake their
113 role, but also highlight potential pitfalls and challenges that they may encounter.
114 Organisations can learn from those who have experienced the implementation process
115 about what 'went well' and 'not so well'. Ash et al. stressed the importance of
116 educating clinicians about the unintended consequences of ePrescribing systems, so
117 that clinicians do not fall into the trap of over reliance on technology, and risk patient
118 harm.(12) The number of different professionals (e.g. nurse or pharmacists) who can
119 prescribe is also expanding, thus the training provided needs to accommodate users'
120 varying backgrounds and roles. These systems are continuously evolving and offer an
121 ever increasing range of new features thus it is important to not only consider

122 introductory training but also the approaches used to inform existing staff about
123 system changes. Training is not sufficient to overcome poor design, but vendors
124 should be incentivised to develop systems using user-centred design principles.

125 Organisations face challenges in delivering effective training including: large
126 numbers of staff; staff resistance/availability to attend training; rotation between
127 wards and specialties; and temporary/short term staff. Little evidence has been
128 published on the training strategies used to familiarise staff with these systems, many
129 of which change following implementation through local customisation and system
130 upgrades. Online training strategies have been utilised in medical education and can
131 offer a potentially convenient and efficient way of training large numbers of
132 practitioners;(13) however, the effectiveness of this approach for users of ePrescribing
133 systems is not clear.

134 Some studies suggest that insufficient training is associated with suboptimal
135 use of a system.(14, 15) Baysari et al. found that large numbers of CDS alerts were
136 generated by the improper use of the system, leading to the production of ‘technically
137 preventable’ alerts.(14) Additionally, high override rates of CDS alerts have been
138 reported.(16) Her et al. found that almost 1 in 5 non-formulary medication alerts were
139 inappropriately overridden, thus reducing the potential for cost savings.(5) Shulman et
140 al. also found that the rate of errors made when using an ePrescribing system,
141 decreased over time, demonstrating a learning curve that had taken place.(17) Such
142 studies highlight the pitfalls of these systems and the importance of training and
143 education both in facilitating successful implementation of electronic systems and
144 averting errors. Furthermore, although there are fundamental differences between the
145 provision of healthcare services between clinical settings and countries, there are key

146 elements of the prescribing process that all prescribers must perform, such as the
147 selection of a drug dose and frequency.

148 We conducted a literature review to describe the approaches used to train
149 qualified prescribers on ePrescribing systems in a hospital setting. We were also
150 interested in knowing whether online training approaches were used and whether
151 training covered the pitfalls and challenges of using these systems.

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153 **METHODS**

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155 **Inclusion and Exclusion Criteria**

156 Articles that explored the training of qualified prescribers (including medical
157 and non-medical practitioners) on ePrescribing systems in a hospital setting were
158 included. We chose to focus on the training of qualified and practicing prescribers due
159 to the specific challenges associated with training large groups of busy clinicians,
160 which can be different to the challenges faced with training undergraduate students in
161 a more ‘relaxed’ environment. We were interested in the types of training approaches
162 used, the relative effectiveness of any specific approach (if discussed), and any
163 challenges encountered. Studies that explored training of undergraduate medical
164 students, training of clinical skills other than prescribing, or the use of ePrescribing or
165 EHRs in medical education (e.g., to enable students to monitor patient progress) were
166 excluded (Appendix 1 and 2). Studies did not need to include a comparator group, as
167 this may have presented practical and ethical challenges to carrying out the study in a
168 hospital population.

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170 **Search Strategy and Study Selection**

171 Three large databases were searched including: Cumulative Index Nursing and
172 Allied Health Literature (CINAHL), Embase (OVID), and Medline (OVID). The
173 search terms used are listed in Table 1. Sets of search terms employed included
174 “Electronic Prescribing” OR “Computerized Provider Order Entry” in Set 1; and
175 “Clinical Decision Support” OR “Decision Support System” in Set 2; and “Electronic
176 Medical Record” in Set 3; and “Education Clinical” OR “Medical Education” in Set
177 4; and “Education Distance” in Set 5; and “Prescribing” in Set 6 (Table 1). These sets
178 were combined and our full search strategy for one database can be accessed in
179 appendix 3. The search was performed on the 15th May 2015. Only papers published
180 in English were considered. A separate search, which included ‘electronic
181 prescribing’ and ‘online training’, was also conducted. We did not restrict the
182 timeframe for these searches. In addition, we searched the websites of vendors of
183 electronic prescribing systems supplied in the U.K for suggested training approaches.
184 We included all publication types (including editorials and opinion pieces).

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186 **Data Extraction and Synthesis**

187 All duplicate articles were removed. Titles and abstracts were initially
188 reviewed followed by the full text by one author (CLB) and any queries were
189 discussed with a further reviewer (SPS), if necessary. Reference lists were also
190 examined for additional papers. Data were abstracted onto a customised data
191 extraction sheet by one author (CLB), which included variables such as: title of the
192 study; country of origin; decision to include and justification for the choice. A
193 narrative synthesis of all eligible studies was undertaken. Papers were read and re-

194 read, and key recurring themes and sub-themes were identified iteratively from the
195 data. In keeping with the aim of this review, we focused on the types of training
196 approaches used to train qualified prescribers in the hospital setting and the
197 challenges associated with training.

198

199 **RESULTS**

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201 The search for ‘all training’ returned a total of 1,155 publications; after
202 reviewing titles, abstracts and full texts, a total of 1,149 were excluded (Figure 1).
203 After reviewing the reference lists of the remaining publications, one further article
204 was included. A total of seven articles were included, comprising of three full text
205 publications from the US,(18-20) and two from Canada.(20, 21) The remaining two
206 articles were conference abstracts, one from the UK (22) and one from
207 Pakistan/Tanzania.(23) Further detail about the range of study types can be obtained
208 in Appendices 1 and 2. The authors of the conference abstracts were contacted and
209 asked for additional information, including (i) the type of training delivered and
210 whether online training methods were used (if unclear from the publication), (ii)
211 whether a competence assessment was used, and (iii) whether the training was
212 developed internally or by the vendor. We obtained responses from all authors apart
213 from one.(23) We decided to include the two studies by Borycki et al. and Kushniruk
214 et al., as there was potential for these training methods to be used for practicing
215 prescribers.(20, 21)

216 The separate search for the use of ‘online’ training methods returned 25
217 publications. After reviewing the titles, abstracts and full text, three relevant articles
218 were identified (Figure 2), two of which were previously identified and included in

219 the search of “all training” approaches. The additional article found in this separate
220 ‘online’ search(24) was included making eight publications in total.

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222 **Traditional training approaches**

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224 Typically, a variety of training methods were used such as classroom-based
225 sessions, which included ‘run through’ demonstrations and practical exercises, as well
226 as face-to-face or ward-based training facilitated by ‘super-users’ (expert staff
227 members that have received additional training). Super-users were found to play a
228 valuable role in providing ward-level support and reduce the need for costly external
229 training.(25) Tools such as e-learning packages, quick reference guides, for example a
230 list for keyboard short cuts and ‘how to’ guides, were also provided.(18, 22) Three
231 studies used traditional classroom-based learning to train users; one on a paediatric
232 intensive care unit,(22) another across an integrated delivery system(18), and a third
233 study conducted at two United States (U.S.) hospitals.(25) Users were given an
234 overview of the specific features of their system, using a combination of
235 demonstrations, lectures and practical exercises, thus allowing the users to gain
236 ‘hands-on’ experience of using the system.(18, 22) In particular Bredfeldt et al.
237 encouraged staff to customise their own live version of the EHR by, for example,
238 creating preference lists, thus allowing users to experience the benefits of this
239 functionality immediately.(18) Ensuring clinicians have ample opportunities to attend
240 training was important, so weekend and out-of-hour sessions were organised in one
241 study.(25)

242 In terms of user evaluation, formal assessments, quizzes and feedback
243 methods were utilized in three studies.(18, 22, 23) Bredfeldt et al. evaluated post-

244 training performance of two skills (covered during the training session) to measure
245 the effect of training.(18) Classroom-based training and ‘hands-on’ activities were
246 found to have been associated with improved utility of certain functions.(18)
247 However, users would have appreciated more opportunities to receive training on the
248 ‘live’ system and felt that the range of topics covered should be broader.(18)
249 Bredfeldt et al. also sent e-mails to users to report their usage of specific features and
250 compared their activity with that of their peers, serving to remind users of the learning
251 material and track their progress.(18)

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253 **Online training approaches**

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255 Web-based demonstrations were used in only one study.(23) Three papers
256 describe the work of one team, which have developed an online portal, which housed
257 a range of simulated versions of different EHRs containing electronic prescribing
258 functionality. Healthcare professional students, practicing professionals and
259 healthcare informaticians were given access to this portal where they could prescribe
260 for fictitious patients in a safe environment.(20, 21, 24) The portal also provided an
261 opportunity for users to learn about the design of different systems that influence
262 clinical practice.(20, 21, 24)

263 Evaluation of online training methods was limited. Experiences and lessons
264 learned from the University of Victoria’s EHR portal appeared to be positive, with
265 users perceiving the experience as valuable and having a greater understanding of
266 how EHR systems were to be used in practice.(20) Ayoub et al. did not specify how
267 quizzes were developed or which areas were assessed; although trainees reportedly
268 scored highly in these.(23) Jimenez highlighted the importance of providing timely

269 feedback to users after completing exercises.(19)

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271 **Clinical scenarios and exercises**

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273 Two studies described using targeted clinical scenarios that focused on
274 particular problem areas to train staff. Foster et al. developed exercises based on
275 commonly encountered prescribing errors, such as the prescribing of Tazocin[®]
276 (piperacillin-tazobactam, an antibacterial) at non-standard times.(22) Bredfeldt et al.
277 targeted training to specific clinical areas, such as pre-operative patient visits, where
278 there had been a number of support requests from existing users.(18) Developing
279 expertise-specific scenarios relevant to clinicians from different specialist areas was
280 considered important.(19, 24)

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282 **DISCUSSION**

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284 The papers identified a range of approaches used to train qualified prescribers,
285 including the use of ‘traditional’ training, online training, and clinical scenarios and
286 exercises. The use of a range of different approaches may appeal to individual
287 learning styles, with users appreciative of relevant and tailored clinical-scenarios in
288 particular. We chose to search for published studies in three large databases.
289 However, it is possible that studies may have been published in other databases or
290 unpublished work (e.g., reports or working papers) may exist in the grey literature.
291 We only focused on the training of qualified prescribers due to the specific
292 requirements of their training. However, we are conscious that some training
293 approaches used for other groups, such as undergraduate students, may have been

294 potentially applicable and possibly useful. We also acknowledge that only one
295 researcher (CLB) conducted the data extraction and no quality assessment of the
296 included studies was undertaken. Notwithstanding these limitations, it is clear that
297 there is a lack of published research in this area, which needs to be addressed;
298 organisations should also share any lessons learnt from their experiences of training
299 prescribers during the implementation stage and after continued use of ePrescribing
300 systems to fill the knowledge gap.(26)

301 The papers identified outlined a number of methods used to train qualified
302 prescribers, including classroom-based sessions,(18, 22, 25) demonstrations and
303 ‘hands-on’ exercises. Some studies incorporated assessment, which allowed users to
304 track their own progress and informed senior staff about those who may need further
305 assistance.(18, 22, 23) Clinical scenarios aimed at addressing commonly encountered
306 prescribing errors or frequent technical support requests were also used.(18, 22) Such
307 problem areas may reveal systems flaws that may contribute to the occurrence of
308 errors or poor usability. For instance, although ePrescribing can decrease prescribing
309 of ‘non-formulary medicines’,(27) formulary alerts are often inappropriately
310 overridden.(5) Therefore, understanding how users interact with these systems is
311 important for the development of informed training strategies.

312 This review found that combinations of different learning methods were used,
313 which appealed to the learning styles of different users. For example, Ross and
314 Banchy used a combination of one-to-one and group classroom-training sessions to
315 address the specific needs of medical staff and maximise attendance.(25) Evidence of
316 this was also apparent when training staff on other non-ePrescribing forms of
317 healthcare-information systems. For instance, McCain et al. reported how challenging
318 it was to get nurse and physician users to attend classroom-based training sessions on

319 an EHR system (as opposed to an electronic prescribing system) due to other clinical
320 commitments. Users felt that these sessions failed to address their learning needs by
321 either being too simplistic or too advanced. This resulted in a blended learning
322 strategy being adopted that included a combination of computer-based learning
323 exercises and a training CD, which facilitated 'self-study' where users could train at a
324 convenient time and pace.(28) Clearly, this approach may be beneficial when training
325 prescribers on ePrescribing systems. Therefore, due to the heavy workloads and often
326 unpredictable schedules of prescribers, it would seem reasonable to suggest a training
327 approach that allows users to train at their own pace and convenience. Laramee et al.
328 found that participants preferred written guidance on how to perform tasks rather than
329 computer 'help' functions. Organisations should therefore consider providing a range
330 of learning tools to meet users' needs.(28-30) Notably, we found a relatively small
331 number of studies, which have been conducted either on one particular ward or
332 organisation, thus may not be generalisable to other settings. The workforce in rural
333 or remote locations for instance, may lack sufficient resources to hire healthcare
334 informatics staff who are important for the deployment and ongoing support of
335 ePrescribing systems, therefore more targeted and accessible approaches such as
336 checklists and toolkits may be useful.(10)

337 It is likely that other training methods employed in practice are not discussed
338 in the small number of articles found in this review. Suppliers of ePrescribing systems
339 may provide a range of training options, such as workshops or e-learning; however
340 these are typically focused towards key internal staff who will disseminate training to
341 others or are primarily delivered during the implementation phase, rather than during
342 the later stages when the systems are embedding (on-going support).

343 The use of e-learning as a method of training clinicians on an ePrescribing
344 system was considered important in the included studies.(18, 19) A study, which
345 delivered educational material primarily to nurses via an e-learning tutorial, was
346 associated with high completion rates of the training module (74% of the 2,080
347 nurses) and perceived improvements in the completeness of documentation within the
348 EHR, thus supporting this approach.(31) The American Health Information
349 Management Association (AHIMA) and the American Medical Informatics
350 Association (AMIA) developed recommendations related to workforce issues during
351 EHR implementation and suggested that a range of innovative learning techniques,
352 including electronic-methods, should be used.(26) E-learning material should be
353 engaging, potentially including interactive scenarios, simple and concise, clearly
354 specify learning outcomes, and take care to limit the amount of information
355 presented.(31) With organisations choosing to migrate from one system to another
356 (e.g., Brigham and Women’s hospital in Boston recently transitioned from a home-
357 grown system to a commercial system), and clinicians often rotating between sites
358 (e.g., between a tertiary care and a community hospital) or specialities (e.g., between
359 a medical and a surgical rotation), it is important that users feel able to carry out their
360 key tasks on different systems. Tools such as the University of Victoria’s EHR portal
361 that provided users with an opportunity to train on a range of systems may be
362 particularly useful. These ‘virtual learning environments’ should replicate as much as
363 possible the interoperability issues associated with using multiple systems (e.g. failure
364 to integrate allergy information from the EHR into the ePrescribing software)(32) so
365 that prescribers are prepared for these challenges. The importance of intra-system
366 interoperability, and the need to improve the transfer and use of information between
367 systems is well-recognised in the literature.(33, 34)

368 Training specifically aimed towards educating prescribers about the
369 challenges and pitfalls of ePrescribing was rarely discussed. However, studies
370 frequently include education and training as a solution to some of “the issues”
371 encountered, or as an explanation for why users fail to use the system as intended.(14,
372 35-37) Sittig et al. made specific recommendations, such as, providing adequate
373 training opportunities for clinicians to experience the system before implementation,
374 potentially enforcing a minimum level of training before use of the system is
375 authorised. They also proposed that organisations deliver ‘walk-throughs’ of the
376 different processes for specific clinical staff.(36) This supports the studies by Foster et
377 al. and Bredfeldt et al, which highlight the need to tailor the clinical scenarios and
378 content of training to the role, expertise and tasks performed by the user.(18, 22, 38,
379 39) Training approaches should encompass both procedural tasks (e.g., prescribing)
380 and cognitive tasks (e.g., interpreting CDS alerts) so that prescribers realise the full
381 potential of the system.(38) Importantly, prescribers should be able to identify and
382 address gaps in their own knowledge;(26) learning outcomes can provide a
383 benchmark for users to judge themselves against.(40) Alongside training, it is
384 important for system developers to improve the design and usability of ePrescribing
385 and CDS systems. Increasing CDS alert specificity and sensitivity to produce more
386 ‘patient-centred’ recommendations is likely to reduce the impact of alert-fatigue and
387 improve patient outcomes.(41, 42) Implementation is costly,(3) therefore the effect of
388 interventions, should be evaluated to inform practice.

389

390 **CONCLUSION**

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392 Organisations are currently using a range of learning methods to train
393 qualified prescribers to use electronic systems. Online learning may facilitate the
394 training for many users. However, the lack of papers retrieved suggests a need for
395 additional studies to inform training and assessment methods. Finally, further research
396 should explore the best way of training users about the pitfalls and challenges
397 associated with electronic systems.

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399 **Competing Interests Statement:** The authors have no competing interests to declare.

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531 Table 1: Search Terms

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Set 1	Set 2	Set 3	Set 4	Set 5	Set 6
(Electronic Prescribing)	(Clinical Decision Support)	(Electronic Medical Record)	(Education Clinical)	(Education Distance)	(Prescriber (Included in Embase Search Only))
Computerized prescriber order entry Computerized provider order entry Electronic physician order entry Electronic order entry Electronic prescribing Electronic prescription Computerized physician order entry CPOE Computerized order entry Medical order entry systems	Clinical decision support Decision support system CDS Drug therapy, computer assisted	Electronic medical record/ Electronic health record Electronic patient record	Education Clinical education Training Course Competence Medical education Clinical competence Competence assessment Prescriber training Prescriber assessment	Education Distance Distance learning Educational non-traditional (CINAHL only)	Prescribed Prescribing Prescription

