Technoleg Iechyd Cymru
Health Technology Wales

Topic Exploration Report

Topic explorations are designed to provide a high-level briefing on new topics submitted for consideration by Health Technology Wales. The main objectives of this report are to:

- Determine the quantity of evidence available for a technology of interest.
- Identify any gaps in the evidence.
- Inform decisions on topics that warrant fuller assessment by Health Technology Wales (HTW).

Topic exploration report number:	TER391
Topic:	Electronic prescribing and medicines administration systems
Summary of findings:	Health records are the documentation of patient's medical history and care and traditionally they have been paper-based. Electronic prescribing and medication administration systems are 'the utilisation of electronic systems to facilitate and enhance the communication of a prescription or medication order, aiding the choice, administration and supply of a medicine through information and decision support and providing a robust audit trail for the entire medicines process' (NHS CFH 2009). These approaches are becoming more common in health services. This topic exploration report summarises evidence on the clinical effectiveness of electronic prescribing and medication administration systems in inpatient and outpatient secondary care settings, including paediatric services. We identified three systematic reviews and meta-analyses and three ongoing systematic reviews. We did not identify any additional recent individual studies after the publication search date of both systematic reviews. The first systematic review and meta-analysis reported outcomes on the changes in mediation error rates and associated patient harm following electronic medication systems utilisation. They found no reduced risk in medical error rates; however, they reported a significant reduction in administration error rates. The second systematic review and meta-analysis reported outcomes on improvements in care processes using clinical decision support systems across different clinical settings. They found that clinical decision support systems increased the proportion of patients receiving desired care as well as achieving guidelines-based goals (e.g., blood pressure control). The third systematic review and meta-analysis evaluated the relationship between electronic health records and hospital costs. They reported that hospitals with basic electronic health record systems were found to have 12.1% lower average costs than comparable hospitals, while hospitals with more advanced electronic health record systems did not have significantly lower costs.

Introduction and aims

Health records are the documentation of patient's medical history and care. Traditionally, health records have been paper based, maintained in folders divided into sections based on the type of note, and required manual replication if multiple copies were required.

Electronic prescribing and medication administration (ePMA) systems are 'the utilisation of electronic systems to facilitate and enhance the communication of a prescription or medication order, aiding the choice, administration and supply of a medicine through information and decision support and providing a robust audit trail for the entire medicines process' (NHS CFH 2009). ePMA has been associated with benefits for patient care and health utilisation, such as improving patient safety, increasing efficiency and reducing medication errors (NHS CFH 2009).

Health Technology Wales researchers searched for evidence on the effectiveness of ePMA systems for all inpatient and outpatient secondary care settings, including paediatric services, and on the optimal design of ePMA systems.

Evidence overview

ePMA is a digital health technology and was determined to be a Tier A technology according to the Evidence Standards Framework for Digital Health Technologies. Technologies within this classification serve as system impact. For technologies of this classification, it is recommended that pilot studies the UK are produced to demonstrate effectiveness of the technology. The framework also recommends the evidence that data on usage, outcomes or user satisfaction should be collected and made available to relevant decision makers (NICE 2022). The nature of clinical decision support systems is highly variable and where recommendations on treatment are given, these may need to be considered within a different tier.

Guidance and HTA

No relevant national guidelines or guidance relating to the use of ePMA in inpatient and outpatient secondary care settings were identified. However, the Welsh Government supports the roll-out of single integrated electronic records that can be accessed by primary and secondary care (NHS Wales 2015). This is further supported by a ministerial statement outlining the introduction of ePrescribing in NHS Wales, within the next three to five years, across four domains: (1) primary care, (2) secondary care, (3) patient access, and a (4) medicines data repository (Welsh Government 2021).

Systematic reviews

We identified three systematic review and meta-analyses focusing on ePMA in inpatient and outpatient secondary care settings (Gates et al. 2021, Highfill 2020). We also identified an additional systematic review and meta-analysis examining clinical decision support systems to improve care processes (Kwan et al. 2020).

Clinical effectiveness

Gates et al. (2021) conducted a systematic review and meta-analysis focusing on the changes in mediation error rates and associated patient harm following introduction of electronic medication systems. They included 18 before-after studies comparing medication and harmful error rates before and after the use of electronic medication systems. The meta-analysis on changes in patient harm after electronic medication systems included five studies that found no reduced risk in error rates (RR: 1.22, 95% CI 0.18 to 8.38) (p = 0.8), while the meta-analysis on changes in administration errors included three studies that showed a significant reduction in error rates (RR: 0.77, 95% CI 0.72 to

0.83) (p = 0.004). Gates et al. (2021) highlighted that there is a high level of heterogeneity in the design of systems and in research design and that evidence on the effectiveness of electronic medication systems in medication and associated harm reduction is variable. Further, they conclude that there is a high level of uncertainty around design features which are most effective or may introduce new risks.

The introduction of ePMA can facilitate the use of computerised clinical decision support systems which aim to support health professionals to deliver optimal care. Kwan et al. (2020) conducted a systematic review and meta-analysis focusing on improvements in care processes using clinical decision support systems across different clinical settings. They included 108 studies, 94 randomised and 14 quasi-randomised, involving data from 1.203.053 patients and 10.790 providers. They reported that clinical decision support systems increased the proportion of patients receiving desired care by 5.8% (95% CI 4.0% to 7.6%). Based on 30 trials reporting clinical endpoints, Kwan et al. (2020) found that clinical decision support systems increased the proportion of patients achieving guidelines-based goals (e.g., lipid or blood pressure control) by a median of 0.3% (interquartile range: -0.7% to 1.9%). Kwan et al. (2020) concluded that most interventions using clinical decision support systems appear to achieve small to moderate improvements in targeted care processes.

Cost effectiveness

Highfill (2020) conducted a systematic review and meta-analysis evaluating the relationship between use of electronic health records and hospital costs. They included six studies comparing hospitals using electronic health systems and those that does not and extracted information on the type of record system. Highfill (2020) reported that hospitals with electronic health systems were associated with relatively lower costs of care. In particular, they found that hospitals with basic electronic health record systems had relatively lower costs than comparable hospitals (-12.1%, 95% CI -23.8 to -0.3), while hospitals using more advanced electronic health record systems did not show a significant cost difference (-3.0%, 95% CI -14.6 to 8.5). Highfill (2020) concluded that these findings could suggest marginal declines in cost-effectiveness with more advanced electronic health record systems.

Ongoing systematic reviews

We identified three systematic reviews that are currently ongoing and have not yet published results (Wiebe et al. 2017, Ni et al. 2019, Tomar et al. 2020). We did not identify any ongoing RCTs which considered ePMA systems in inpatient and/or outpatient secondary care settings.

Areas of uncertainty

Based on the identified evidence, some areas of uncertainty remain to be clarified. These include:

- Both electronic health records and clinical decision support systems can vary widely in their design and functionality. The identified studies suggests that evidence on specific features which drive effectiveness has a high level of uncertainty.
- Details of the implementation methods of the studies, included in Gates et al. (2021), were only briefly reported in studies or entirely omitted.
- Moreover, the evidence included focus only on the impact of electronic health record systems on patient harm and medication errors and does not provide additional information regarding other benefits that this technology might offer.

- Most of the studies included in both systematic reviews and meta-analysis were conducted outside the United Kingdom and there are likely to be differences in delivery of services across these settings.

Literature search results

Health technology assessments and guidance

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Evidence reviews and economic evaluations

Gates PJ, Hardie RA, Raban MZ, et al. (2021). How effective are electronic medication systems in reducing medication error rates and associated harm among hospital inpatients? A systematic review and meta-analysis. J Am Med Inform Assoc. 28(1): 167-76. doi: https://doi.org/10.1093/jamia/ocaa230

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Ongoing research

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Include in the 'Introduction and aims' section

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Date of search:	August 2022
Concepts used:	electronic prescribing and medicines administration system* or ePMA; electronic health record* or EHR; health information technology or HIT; inpatient; outpatient; pe?diatric*; secondary care; quality improvement*