

**POTENTIAL ADVANTAGES AND DRAWBACKS TO ELECTRONIC MEDICINE MANAGEMENT  
SYSTEMS FOR UK LONG-TERM CARE FACILITIES: A LITERATURE REVIEW**

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**ABSTRACT**

**Purpose:** The use of health information technology (HIT) is increasing in care home settings; although slower than other healthcare providers including hospitals, acute and ambulatory settings. With a growing amount of long-term care facilities keen to research or implement HIT, this literature review aims to provide an overview of possible benefits and drawbacks long-term care facilities could encounter if choosing to implement HIT.

**Methodology:** A literature review using *technology*, *medication management* and *residential care* search terms was conducted in November 2017 using the following databases: Proquest, PubMed and Scopus.

**Discussion and Conclusions:** This literature review suggests that long-term care facilities are at various stages in the transition to using electronic medicines management resources and there are mixed results on the impact of implementing these systems. Possible benefits highlighted are reductions in medication errors and auditing functionality, whilst potential drawbacks could include behavioural consequences on residents. There are inconclusive results on cost efficiency and time requirement measures.

**Future Work:** Future research examining both the impact on care processes and in turn the effect of any changes on resident outcomes when using electronic systems are greatly needed.

**Keywords:** health information technology, electronic medicines management, electronic medication administration records, care home, long-term care facilities

## 1.0 INTRODUCTION

Information management is fundamental to health care delivery (Chassin and Galvin, 1998). All industries have experienced an increase in technological use in recent years, the healthcare industry is no exception (Hamilton, 2006). Many primary and secondary care facilities, including hospitals, pharmacies, doctors' surgeries and care homes are transitioning to use electronic systems for patient medical records and medicines management (AHIMA, 2012).

Older people in care homes are amongst some of the most vulnerable members of society and studies have found an unacceptable prevalence of medication errors within care homes (Allred et al., 2009; CPA, 2014). Care home residents are on average taking seven to eight medications daily (CPA, 2014). With residents often having multiple and complex conditions, managing medication becomes increasingly difficult for the resident and they are usually dependent on care home nurses (Jevon et al., 2010). Medication management is a crucial component to caring for residents within care homes to ensure the individual's condition is controlled as best as possible.

Medicines management is "an evidence-based approach to prescribing which balances the safety, tolerability, effectiveness, cost and simplicity of treatments (NHS Choices, 2017)," as well as helping patients manage their medications better (The King's Fund, 2017). Good medicines management means that patients receive better, safer and more convenient care (NHS Choices, 2017). There are many processes part of medicines management from the care home perspective which include: obtaining medicines by ordering prescriptions and medicine deliveries from the pharmacy; storing and disposing of medicines; recording medicines; actions to be taken if a medicine administration error is identified; patient self-administration or nurse administration processes (JAC, 2017; Royal College of Nursing, 2017). The process of effective medicines management within care homes can be complex and difficult to master (Keogh et al., 2013).

Care homes each have their own medicines management system, however the general tasks are as follows: [1] ordering, [2] prescribing, [3] dispensing and supply, [4] storage, [5] administration of medicine to resident and [6] monitoring of effect of medicines (Allred et al., 2009). A key component common to each task above is relevant documentation (Allred et al., 2009). Relevant documentation is necessary to keep patient records organised with the correct information regarding medicines but also to improve coordination between all stakeholders involved in medicines management (RPSGB, 2016). These stakeholders include the general practice surgery, pharmacy and care home staff involved in receiving and administering medications (RPSGB, 2016).

Previous and current literature continuously identifies the importance of patient-safe and cost-effective medicines management within all primary and secondary care settings (Alldred et al., 2009; CPA, 2014; NICE, 2015). Medication management within care homes is further complicated by the involvement of multiple healthcare professionals who are not collocated (nurses, general practitioners, pharmacists) (Gilmartin et al., 2013; Tariq et al., 2013). Current literature also identifies the importance of integrated care for people with complex conditions (Goodwin et al., 2014). Integrated care involves cross organisation working and is particularly important between all stakeholders involved in an individual's medicines management, such as doctors, pharmacists, care home nurses and managers, district nurses, etc. (NICE, 2015).

The correct employment of technology in medicines management could encourage integrated care and efficient medicines management (Waterson et al., 2012). As many care homes already have or are currently in the transition phase of paper-based to electronic medicines management, it is important to understand the strengths and limitations of each system from a care homes perspective, as well as key aspects, including cost implications of the new electronic medicines management systems. This literature review therefore focusses on potential benefits and drawbacks care homes may face when transitioning from the traditional paper-based medicines management system to an electronic medicines management system.

### **1.1 Paper-based Medicines Management**

Paper-based records include several pages of records for each resident. These pages might include some or all of the following charts or sheets: (1) a medication administration time chart; (2) a primary medication chart; (3) a packed medication signing sheet; (4) a non-packed medication signing sheet; (5) a short-course medication signing sheet; (6) a pro re nata medication signing sheet; (7) telephone orders; and (8) nurse-initiated medication signing sheet (Qian et al., 2015).

Medication Administration Record (MAR) charts are a list of medicines an individual is taking (CPA, 2014). It details when the medication should be administered and allows for the person giving the medication to record if the medicine was administered or not (Alldred et al., 2009). Each MAR chart will have a designated space to sign to signify the completion of each medication during a pre-defined time slot (e.g. morning) (Qian et al., 2015). A nurse signs his/her initials to indicate a medicine has been administered (Qian et al., 2015). If medicines are not administered, nurses must provide a reason, usually a designated letter which provides the explanation (e.g. 'N' for no stock, 'R' for refused) (Qian et al., 2015). See figure 1 and 2 for examples of MAR charts.





## **1.2 Electronic Medicines Management**

Electronic medicines administration record (eMAR) systems vary dependent on the company providing the software. Most systems display a home screen after an initial login page (Tariq et al., 2014). This home screen will have options to different pages including medication rounds (Tariq et al., 2014). The medication round page is usually shows the list of residents who need medication during the selected medication round time (Qian et al., 2015). Each resident record will have the medication 'status', resident room, first and last name. The 'status' can be blank, complete or missed to indicate if the resident has taken their medication or not (Qian et al., 2015). Additionally, some systems will display a resident photograph, and often the photograph will be in colour to indicate needs medication and greyed out to indicate the resident has been given their medication (Qian et al., 2015).

In each resident's record page, there is usually medical details including allergies, special instructions, medication history with drug name, frequency, dose, and a checkbox to indicate the completion of medication administration, and a free text section for notes (Qian et al., 2015). If any medications during a medication round are not ticked, systems usually prompt a message asking for a reason which is then automatically included in the residents progress notes by the electronic system (Qian et al., 2015).

After completion of medication rounds, and throughout the day, it is vital to synchronise the systems to ensure all electronic devices with the system implemented have the most recent set of information (Qian et al., 2015). To avoid chaos during system failures or power outages, daily backups must also be run (Qian et al., 2015).

Most electronic systems are synced to a certain extent with the care home and pharmacy, although the interface each stakeholder views is different whilst most GP systems are not yet linked to care homes or pharmacy (Jevon et al., 2010) except for electronic prescriptions sent to pharmacies (NHSBSA, 2017). However this means users will have access to a complete medicines record for any individual patient (Al-Hamadani et al., 2015) which may ultimately help in documentation and communication.

## **2.0 METHODOLOGY**

### **2.1 Literature Search**

A broad search of the literature was initially conducted by the primary author to determine keywords (electronic medication management, electronic medicine administration, computing technologies,

health information technology, medicine management, medicine administration, residential care facilities). The final comprehensive literature search was conducted in November 2017 using the following databases: Proquest, PubMed and Scopus.

## 2.2 Search Terms and Strategy

The search terms identified in table 1 were used under the *topic* field on the various databases. 'Technology' search terms were combined with 'medication management' search terms and with 'residential care' search term. All publications included are journal articles. Opinion letters, book chapters, commentaries, models or proposals for research were not included.

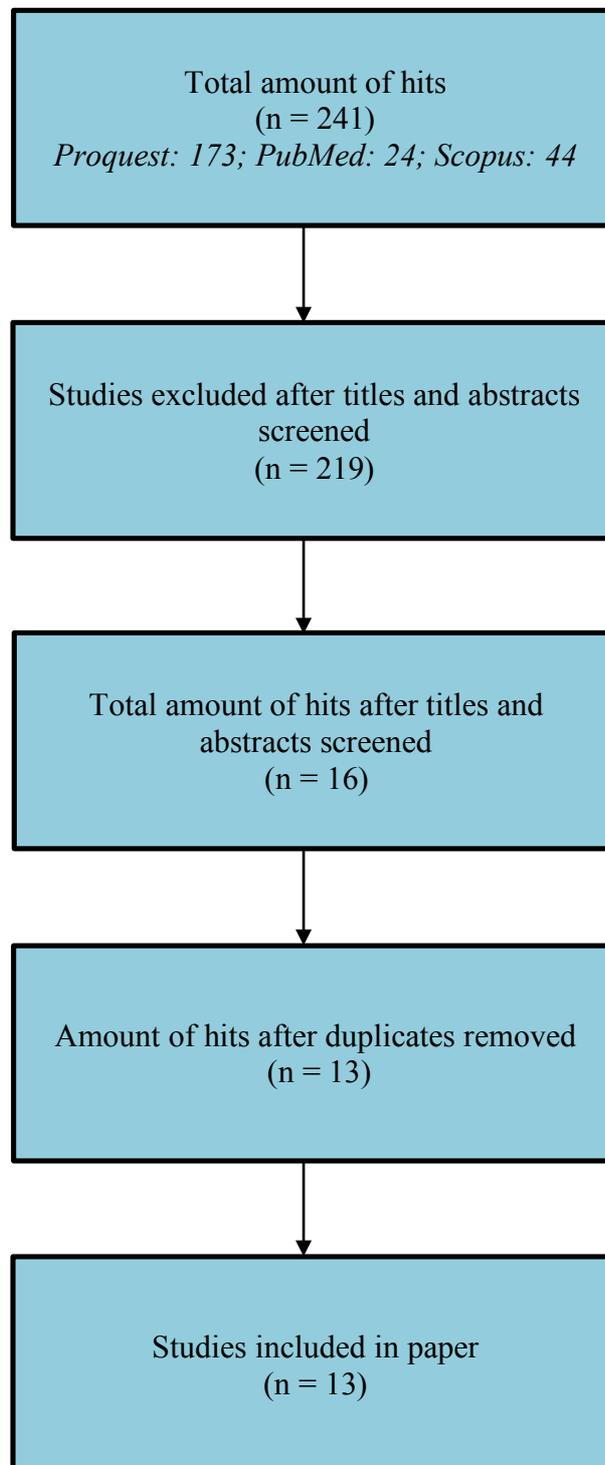
<p>'Technology' search terms: Technology, health information technology, health information technology computer systems, electronic, electronic systems, computing technologies</p>
<p>'Medication Management' search terms: Medication management, medicine management, medication administration, medicine administration</p>
<p>'Residential Care' search terms: Residential care, care home, residential home, secondary care, nursing home, care facilities, residential care facilities, long-term care providers, long-term residential care facilities</p>

Table 1 - Search Terms

## 2.3 Inclusion and Exclusion Criteria

Only studies involving technology used in residential care facilities were used. Additionally, the technology studied must pertain to medicines management and/or administration. No criteria for patient groups or research designs were applied. No limitations on publication year were applied to achieve an inclusive range of results. Studies focused on technology used in care at home were excluded, as well as studies in which technology is not the primary focus of the study.

## 2.4 Search Results



### **3.0 LITERATURE REVIEW**

#### **3.1 Potential Benefits**

Long-term care facilities have lagged behind other providers in comprehensive adoption of health information technology (HIT) and existing technology may be underutilised (Darren Liu and Nicholas G. Castle, 2009). Many studies have explored the use of HIT in acute and ambulatory settings, however there is a lack of information regarding its' use and slow adaptation in long-term care facilities (Bezboruah et al., 2014).

Quality of care, cost effectiveness, efficiency, clinician satisfaction and other outcomes have been well documented in acute care and ambulatory settings that are using HIT (Hamilton, 2006). HIT has the potential to streamline healthcare by helping patients obtain medications, renew medications, and for healthcare professionals to retrieve medical histories during emergency situations (Shekelle et al., 2006). Studies have also indicated HIT has the potential to reduce medical errors (Armstrong and Chrischilles, n.d.; Bates et al., 1998; Bates and Gawande, 2003; Kaushal et al., 2003; Koppel et al., 2005). However, there is a dearth of empirical research regarding the impact of HIT in long-term care facilities (Brandeis et al., 2007).

The University of Cardiff evaluated electronic medication administration systems and equipment implemented in 50 care homes and their supplying pharmacies in South Wales (Al-Hamadani et al., 2015). Potential benefits to the care home from the electronic medication management solution included: safer and quicker administration of medicines through an automated checking process; improved efficiency via automatic stock control, booking in and prescription ordering; electronic records can be produced by the system allowing for better audit trails than paper-based MAR charts; and there were improved medicines handling with no repackaging of medicines from manufacturers packing (Banner, 2015).

A study interviewing care home residents reported that only 51% of residents were aware of a hand-held device being used by staff, suggesting that for many residents the impact of technology was so minimal as to be unnoticed (Pillemer et al., 2012). Of residents who were aware: 70.8% agreed the handheld device helps staff to better manage their care; 72.8% were pleased that staff use the handheld devices to better track and manage their care and 69.3% reported that staff using the handhelds did not interfere with the time they spent with him or her (Pillemer et al., 2012). Majority (62.2%) felt their care stayed the same, 30.6% believed it improved, 7.1% felt it declined (Pillemer et al., 2012). From resident perspectives, use of computerised technology does not appear to overall have led to resident dissatisfaction or poor communication (Pillemer et al., 2012).

Some studies have examined the key advantages and disadvantages to implementing electronic medicines management systems in care homes. Care transitions might be better managed with electronic access to information using HIT (Resnick et al., 2009). Furthermore, electronic reminder prompts may improve the responsiveness of provider behaviour in long-term care facilities (Field et al., 2009; Linder et al., 2007). Some studies have found improved legibility of medication administration charts, improved access to medicines information at the point of care and reporting functionality (e.g. missed dose reports to reduce the incidence of missed doses) (Burns et al., 2007).

Further to improvements in reporting, a study found improved nurse compliance with documentation requirements (Qian et al., 2015). It has been suggested that the actual way that eMAR are used by the staff on the floor may impact the effectiveness of it and can potentially prevent realisation of the expected benefits (Qian et al., 2015). Improvements in reporting also included increased documentation space with electronic medication management systems (Qian et al., 2015). The unit using electronic systems was also associated with significantly less time spent on locating and reading documentation in comparison to the paper-based unit of the study (Qian et al., 2015). However, in contrast, several studies from non-long-term care settings have found mixed results on time spent on paperwork and documentation, with some studies actually showing increased documentation time (Overhage et al., 2001; Poissant et al., 2005; Tierney et al., 1993).

A notable improvement to paper-based medicines management present in many studies is the auditing functionality in electronic systems (Elliott et al., 2016). Long-term care facilities have found the ability to create daily, monthly and annual reports using electronic systems very useful and believe this function can help determine regular performances within and across care settings (Richardson et al., 2015).

Literature on efficiency measures for electronic medicines management systems in long-term care facilities is very limited, if at all available. A systematic review on the impact of HIT found empirical cost data was limited and data on other efficiency measures, such as time utilisation was mixed (Chaudhry et al., 2006). This systematic review however was evaluating the impact of HIT within hospitals and therefore the data cannot be directly extrapolated to long-term care facilities. However, similarly, empirical cost data is yet to be seen for HIT in long-term care facilities.

Evidence suggests medication administration errors can be reduced by use of electronic systems (Jevon et al., 2010). One study found the electronic system provided freedom from the error of signing twice, reducing the possibility of forgetting to medicate a resident and facilitated nurses to record the time of medication administration to residents (Qian et al., 2015). The potential for other types of

errors when using electronic systems is currently unknown as no formal investigations have taken place (Jevon et al., 2010). However, long-term care facilities will only use systems which are reliable, easy to use and do not add significantly to staff workload (CPA, 2014). Many systems have been successful in meeting these criteria and therefore are being implemented within homes.

### **3.2 Potential Drawbacks**

Although service providers continually promote their products and evidence has shown likely benefits to implementing HIT within healthcare settings, long-term care facilities should be adequately informed and prepared from non-biased sources when considering electronic systems.

The transition period when implementing electronic systems can be difficult, especially for staff members (CPA, 2014). Harrison et al. (2007) found “disturbingly mixed reports” on HIT outcomes in health care settings, with research showing unanticipated negative consequences of implementation, some of which resulted in actual harm (Harrison et al., 2007; Pillemer et al., 2012). Several of the negative consequences documented by Harrison and colleagues could potentially affect nursing home residents, including changing or disrupting oral communication among clinicians or with patients; causing cognitive overload for providers by emphasizing “over-complete” information entry; and the inflexibility of electronic records, causing lost detail about resident conditions (Pillemer et al., 2012).

Training is essential for all staff members who will be using the system. Training is usually provided by the company implementing the system and although technology is a part of every industry, it can be difficult for care home staff to adapt to the new system (Yang et al., 2012). Familiarising themselves with the system does take time and mistakes can still occur, especially when new to the system or certain electronic devices such as handheld scanners or laptops (Jevon et al., 2010).

Additionally, if the system is poorly implemented initially and the transition between the paper-based system to the electronic system is not smooth, this can cause many errors and added complications leading to a stressful environment within the long-term care facility during this period (Baysari et al., 2016; Yang et al., 2012).

Moving from handwritten charting to electronic health records could lead to changes in coordination of care and thus affect common problems to long-term care facility residents such as falls or behavioural disturbances (Brandeis et al., 2007). Most problematic for the long-term care context, given the importance of person-centred care (Tellis-Nayak, 2007), is evidence of changes in the provider-patient relationship, as professionals become more occupied with the computer and less oriented toward the patient (Ludwick and Doucette, 2009). Thus, it is possible that HIT could lead to

less personalised and more routinized care, as well as less direct observation and interaction with residents, and in turn to negative clinical outcomes such as increased falls, diminished function, and dissatisfaction with care (Pillemer et al., 2012).

One study found a statistically negative effect, where there was no change in behavioural disturbances when using electronic systems in comparison to facilities using paper-based systems which showed improvements on a measure of behavioural disturbances (Pillemer et al., 2012). However, without detailed observational data on the effect of HIT on staff behaviours, it is not possible to determine the mechanism for this finding (Pillemer et al., 2012).

Drawbacks to the electronic medication administration system could include the cost associated with implementation of the system in the care home and subscription/maintenance fees (Jevon et al., 2010). One study quoted a medical home interviewee stating: “the maintenance of all those interfaces – the costs are ridiculous...” (Richardson et al., 2015). Data on expected costs however is lacking in the field, which could be the reason long-term care facilities are slow to adapting HIT (Bezboruah et al., 2014).

Other concerns from studies on electronic medicines management systems included inadequate information about residents on the system, late addition of new resident’s medication profiles in the records and nurses forgetting to medicate a resident due to potential power outages on portable devices (Qian et al., 2015).

#### **4.0 DISCUSSION AND CONCLUSIONS**

There is a scarcity of literature examining the impact of HIT specifically within long-term care facilities. Results of existing studies have shown mixed findings, one specifically concludes that electronic medication administration records may not change nursing time spent on various activities in a medication round or substantially alter the medication administration processes, but can generate both benefits and unintended adverse consequences (sections 2.2 and 2.3) (Qian et al., 2015). Furthermore, although there are mixed findings on nursing time spent on various activities using the electronic system compared to paper-based systems; some studies have suggested that time requirements decreased as physicians grew used to the electronic system (Chaudhry et al., 2006), which may be similar to findings within long-term care facilities in the future.

Another study used quality outcome measures (ADL function, falls, resident mood, behavioural symptoms, and mortality) to distinguish differences in control groups versus HIT groups to assess changes in quality of care. No measurable improvement in resident condition was found as a result of

using HIT, suggesting that claims for HIT to have direct benefits on residents should be taken with caution (Pillemer et al., 2012). Similar to a number of studies on HIT in acute and ambulatory care, there appears to be no demonstrable positive effect of the technology on residents directly. If this finding is supported by future research, studies of cost and efficiency will be of key importance to make the case for HIT in nursing homes (Pillemer et al., 2012).

Potential advantages as outlined in this literature review include: the ability to automate some processes, including stock control and prescription ordering in some cases (Banner, 2015); the fact that many residents do not notice the use of handheld devices may suggest they do not have a negative impact as well as many residents believing the handheld device helps in their care (Pillemer et al., 2012). Additionally, care transitions may be better managed with use of HIT and reporting and documentation may be easier (Burns et al., 2007; Resnick et al., 2009). Studies have also found long-term care facilities appreciate the auditing functionality of HIT (Elliott et al., 2016). Studies have also highlight a reduction in medication administration errors, however potential for other types of error with the use of HIT have not been investigated (Jevon et al., 2010).

The transition period between paper-based systems to electronic medicines management systems can produce an array of drawbacks. It is often difficult for both staff members and residents, which can result in behavioural disturbances (Brandeis et al., 2007; Harrison et al., 2007; Pillemer et al., 2012; Yang et al., 2012). Implementing HIT can be poorly done which can lead to a stressful environment within the long-term care facility (Baysari et al., 2016). With HIT, there is also the risk of moving from patient-centred and personalised care to more routinized care and less direct observation and resident interaction (Ludwick and Doucette, 2009; Pillemer et al., 2012; Tellis-Nayak, 2007). Other concerns include problems arising from power outages and depletion in portable devices (Qian et al., 2015).

Furthermore, there are mixed results in the efficiency of documentation with electronic medication systems compared to paper-based systems (Pillemer et al., 2012; Qian et al., 2015). Cost and time requirement measures are also scarce in research and show mixed results (Bezboruah et al., 2014).

This literature review suggests that long-term care facilities are at various stages in the transition to using electronic medicines management resources and there are mixed results on the impact of implementing these systems. Some long-term care facilities have fully implemented electronic health records and electronic medicines management systems, others are solely relying on the tradition paper-based systems, and some are using a mixture of both electronic and paper-based systems.

However, with the world using an increasing amount of technology in day to day life, it is anticipated that all long-term care facilities will undergo the transition to at least some extent in the near future.

#### **4.1 Future Work**

As more long-term care facilities begin using electronic medicines management systems, system providers will be continuing to improve their systems to meet the demands of healthcare organisations. A study examining a needs assessment of HIT for improving care coordination in patient-centred medical homes discovered needs for tools in the following areas: monitoring, notifications, collaboration, reporting and interoperability (Richardson et al., 2015). Improvement within these areas suggest potential practical benefits in future care coordination within long-term care facilities as well as between all primary and secondary healthcare organisations (Richardson et al., 2015). Future research examining both the impact on care processes and in turn the effect of any changes on resident outcomes when using electronic systems are greatly needed (Pillemer et al., 2012).

#### **5.0 CONFLICTS OF INTEREST**

None

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