Multi-compartment compliance aids (MCAs): Application to the geriatric community

Abstract
The prevalence of co-morbidities in older people gives rise to the number of prescribed medicine increasing the complexity of medicine management. Multi-compartment compliance aids and dispensing systems have the potential to organise the daily life of an older person. Various features of currently available compliance aids (such as multi-compartment design or an automated reminder function) have proved successful in assisting older patients to take their medication. This in turn enables them to manage their own often complex drug regimens. Further investigations and collaborations between healthcare professionals, patients and carers are required for validated and effective use of compliance aids.

Introduction
The proportion of the population above the age of sixty is growing (NIH, 2011) as a result of medical advances and the resulting increase in life expectancy. This combination of factors is placing pressure on the healthcare professionals and the pharmaceutical industry to meet this increased demand for healthcare services and improved patient related outcomes. Studies have shown that older individuals use large numbers of medicines (Ferrini and Ferrini, 2000) and are at risk of polypharmacy (Wilson et al., 2007). The prevalence of polypharmacy is high (Haider et al., 2009) leading to potentially inappropriate drug use and non-adherence in geriatric population.

Although multiple definitions for polypharmacy have been identified in the literature (Fulton et al., 2005; Jorgenson et al., 2001; Veehof et al., 2000), the most commonly used definition is the concurrent use of five or more drugs (Haider et al., 2009). Concerns regarding polypharmacy have been raised (Compton, 2013), particularly due to related issues of
medicine self-administration, medicine administration timing, supply of medicines and most importantly patient adherence to medicine taking.

Adherence as defined by other researchers (Nunes et al., 2009) is the extent to which a patient’s behaviour matches the agreed recommendations of the prescriber. Non-adherence is a common occurrence with older patients and is characterised in several ways including hesitancy towards initiating medication taking, skipping doses, dose adjusting, using unsuitable routes of administration and over-adherence (Oboh, 2011). Unfortunately, these behaviours are not commonly disclosed to healthcare professionals more specifically the prescriber.

The complex medication regimens of older individuals require strategies to assist with medicine self-management. To overcome medicine management issues related to polypharmacy, healthcare professionals such as general practitioners (GPs) and pharmacists, often recommend or assist with the preparation and supply of multi-compartment compliance aids (MCA) (automated and non-automated) for solid dosage forms. The community pharmacy contract in England and Wales recommends assessing and providing MCAs, to individuals who fall within the protection of the Disability Discrimination Act 1995 (DDA) and require assistance with medicine taking.

Electronic health technologies have shown great potential to improve patient quality of life as observed in the outcome of the Automated Pill Dispenser Project which was conducted in the West Midlands region in March 2012. The automated pill dispenser (APD) used in this study comprises of a movable carousel with divisions containing the precise amount of oral medicine to be taken at a specific time. An auditory alarm reminds the patient to take the medicine and an electronic alert provides feedback to carers.
A digital wireless personal information system developed by Proteus Biomedical has recently become available in the United Kingdom (UK). This system consists of a sensor-enabled tablet and sensor patch which detects each time the patient takes their medicine (Lancet, 2012). This system is also able to notify the caregiver and/or healthcare professional about the patient’s daily activities as well as their medicine management. Whilst electronic dispensing systems have the potential to improve medicine management for older individuals, further work is required to ensure their designs promote patient adherence.

As the population ages, it is likely that older individuals will receive solid, orally administered medicines in MCAs (Adams et al., 2013). Recent observations (Orlu-Gul et al., 2014) identified that some community pharmacists do not find the currently available MCAs ‘pharmacist friendly’ in terms of ease of dispensing and accuracy checking. To assist pharmacists in their delivery of efficient and effective medicine services, MCAs should be designed to support this and should be compatible with current dispensing practices whilst maintaining the stability of the repackaged medicines once removed from their original packaging. An evaluation of commonly used adherence aids and future considerations concerning pharmacists in particular community pharmacists involved in the dispensing of MCAs are presented in this paper.

**Defining MCAs**

‘Medicine compliance aids’ including MCAs and monitored dosage systems (MDS) are devices capable of enhancing patient adherence. There are numerous aids which have been designed to improve patient adherence however, there is limited clinical evidence to demonstrate MCA increase the compliance (Fowells et al., 2013). Most MCAs comprise of compartments which correspond to a single medicine administration time and all of an individual’s solid, orally administered medicines prescribed for that time are dispensed into that compartment by pharmacy staff. Where frequency of administration does not exceed four times a day, a 28 compartment MCA provides a seven day dosing regimen for their
medicines. MCAs can be purchased by individuals or supplied by pharmacists and can be disposable or reusable. These devices can also assist with managing medicines when a formal or informal carer is involved.

Medicines are packed into MCAs by removing them from original medicine containers and organising them into the MCA. As this process occurs between pharmacy medicine dispensing and administration, correct MCA preparation is a prerequisite for patient medicine adherence. National institutional regulations outline those responsible for preparing MCAs in healthcare settings; in most cases the responsibility falls to nursing staff or pharmacists and other pharmacy staff (Nunney et al., 2001). As removing medicines from their original container and packing them into a MCA invalidates the manufacturer’s stability guarantee, the healthcare professional should make an informed judgement as to the effect on the quality and safety of this repackaging process (Haywood et al., 2011). Original medicine containers provide medicine protection to appropriate pharmacopoeia and quality standards for a variety of criteria including prevention of moisture and light exposure. However, a compliance aid cannot guarantee the same level of protection (Donyai et al., 2010).

A unanimous set of aims for the general use of MCAs have been identified (Wick, 2011):

- to provide easily accessible medicine storage;
- to reduce the complexity of medicine adherence;
- to minimise errors associated with administration incorrect doses at incorrect times;
- to act as a memory aid;
- to show whether medicine doses have been administered or taken.

The Royal Pharmaceutical Society (RPS) (Fowells et al., 2013) suggests that the patient or carer should be involved in the decision making process and educated on the advantages, uncertainties and risks of MCA use. Assessment for MCA use should include consideration
of the patient characteristics, benefit versus risk of supplying medicines in a MCA and the
equality and disability discrimination legislation during the assessment (PSNC, 2013).

Comparison of MCAs
While MCAs can decrease the complexity associated with polypharmacy (George et al.,
2008), there is no universal awareness of the most effective and easy-to-use compliance
aid, additionally, no single MCA is suitable for all individuals. Moreover the information
about the cost-effectiveness of various compliance aids is limited. In the UK, Boots MDS®,
Nomad®, Dossette®, Medidos® and 7-day Venalink® systems are commonly used (Oboh,
2011).
A Healthcare Compliance Packaging Council of Europe has been developed, to represent
the pharmaceutical industry, the packaging industry and representatives of patient
organisations in Europe, with the aim of advising the healthcare sector on how to improve
patient adherence with packaging solutions (Council HCP, 2014). This Council has been at
the forefront of enhancing devices including:
  • multi-dose dispensing systems;
  • alarmed pill boxes;
  • specific medical alarms; and
  • pictograms to act as instruction and reminders.
In addition, other equally effective yet simpler methods exist (Oboh, 2013) including
  • Reminder systems such as timed alarms, telephone reminders, fridge stickers, and
    positioning medication in visible places.
  • Automatically generated reminder charts are practical and cost effective
  • Simplifying drug regimens and dispensing into appropriate containers
  • Explaining about the personalised importance of their medicines
  • Repeat dispensing, prescription collection and medicines delivery services
  • Patients keeping records of their medicine taking and monitoring their conditions
• Non-childproof tops, large labels, large prints, medicines administration records (MAR) sheets (Gujral et al., 2013).

**Current challenges related to MCAs**

Although MCAs are commonly used, their effectiveness has not been proven in the literature (Nunney et al., 2001; Rivers, 1992; McGrow et al., 2000). There is on-going debate about the overreliance of MCAs and there is insufficient evidence to support its benefit in improving medicine adherence. The analysis of the cost-consequence of a pharmacist-led medication review service, which included the provision of MCAs, showed that the mean cost saving was £307 per patient after an intervention was implemented for six months. The resulting increase in medicine adherence did not lead to a significant change in quality of life (Desborough et al., 2012).

An important issue associated with MCA use is the stability of medicines once they are removed from their original containers and packed into the MCA. The Royal Pharmaceutical Society advises that medicines should not be stored in a MCA for longer than eight weeks (RPS, 2013) and have noted that the lack of sufficient stability data to support the repackaging of medicines into MCAs is an important issue when considering the usefulness of MCAs. Research conducted to investigate stability has shown little changes to drugs such as paracetamol after light and temperature alterations within a six week window (Haywood et al., 2006). However there is a handling process allowing for ruptured seal errors changing the previous stable conditions before even reaching the patient (Haywood et al., 2006). Possible interactions between medicines packed within the same MCA compartment is another consideration. For example, atenolol and aspirin have shown changes to hardness when packed together, potentially affected their quality. To assist with preserving medicine stability, time associated with packing medicines should be limited and medicines should be removed from the original container just prior to packing within a MCA. MCAs should be sealed and exposure to heat sealing should be limited (Haywood et al., 2011).
MCAs are also associated with a risk of secondary dispensing errors that may go undetected (Oboh, 2013; Allred et al., 2009). This raises the issue of the safety of MCAs. As the usage increases there is a strain placed on the workload of both GPs and community pharmacists (Oboh, 2011). MCAs administered by carers also have the potential to lead to errors if medicine identification is difficult and if the MCA fail to accommodate dose and medicine descriptions.

MCAs have limited available space for each medicine dose, are not airtight and offer less moisture and light protection than original medicine containers. There is a shortage of short-term stability data for the transfer of medicines into MCAs (Mylrea et al., 2013).

**Current considerations on MCAs**

GPs should promote self-administration where possible in older individuals to facilitate autonomy in medicine taking. A patient-centred approach to medicine adherence intervention would involve liaising with local pharmacists and care home staff to understand reasons for non-adherence, and the suitability of MCAs for individual patients.

Pharmacists should use their expertise to tailor medicine delivery in the best way to older individuals through tools such as Medicine Use Review (MUR). MUR is one of the four advanced services within the NHS community pharmacy contract and assesses whether individuals are receiving the best possible outcomes from their medicines and can identify problems associated with medicine taking, such as side-effects, medicine accessibility, adherence issues (Oboh, 2013). This is only a compulsory procedure in the case of a patient who qualifies under the DDA (PSNC, 2013). Pharmacist-led interventions for older patients can be resource intensive which makes their cost-benefit reasoning questionable (Banning et al., 2009). There is need for a formal and objective approach to making the decision to
use an MCA. The RPS states `Although MCA may be of value to help some patients with problems managing their medicines and maintaining independent healthy living, they are not the only intervention for all patients and many alternative interventions are available. Pharmacists need to be empowered to work with patients to find the best intervention that helps people use their medicines` (RPS, 2013).

Blister pack MCAs are commonly used by UK community pharmacists, potentially due to low costs and ease of use when faced with manual dexterity issues. However, it is limited to four possible times of medicine administration (morning, lunch, evening and night) and may not easily accommodate medicines designed to be administered outside of these. Examples include alendronate for osteoporosis which should be taken first thing in the morning or medicines for Parkinson’s disease which requires multiple daily dosing. Although there is a strong argument to suggest that adherence aids may not be cost-effective (Mahtani et al. 2011), it is necessary to weigh up the advantages and disadvantages of their use, including the cost of a device compared to the cost of hospital readmission due to poor adherence. Another issue is how some care companies refuse to administer from MCAs and others help prompt them. It is expected to be the same policy across all care homes in the UK.

Many older individuals, particularly those who experience polypharmacy and co-morbidities will be assisted by carer. There is said to be a large support base for the use of MCAs from care homes due to their convenience for the staff and stock control. However there is also concern about providing inadequate information on pharmacological effects and therefore patient responses to their regime. Carers are allowed to prompt the patient to take a dose for example which essentially removes the need for an MCA and also educates them of the patient’s personalised routine making it less like a chore. Some carers argue that the need for an MCA on their behalf is for protection and accuracy of medication administration due to lack of resources and time to educate all staff about each patient’s circumstances. MAR (medication administration record) charts play a crucial role in the care home delivery of
medication to their patients (Alldred et al., 2009). It is a possible suggestion to maintain the rigorous use of MAR charts but incorporate them into provision of original packs and not MCAs which currently has good responses in terms of adherence from rural practices. Documentation and education are advised to be of higher value to safe handling of medication than use of an MCA (Oboh, 2011).

For those patients without a carer, the use of an MCA can restore a sense of control to their lives as adherence does not only require physical capability but also a behavioural motivation. From research, patients would ideally want these aspects in a compliance aid:

- Accessibility – matchbox style, reference panels, foam inserts for release
- Reminder element – display of current week of regime, physical or audible cue
- Transportable – to accommodate for their own lifestyle
- Design – accounted for physical, sensory and cognitive issues faced by older patients

Furthermore, reasons for non-adherence should be understood carefully as intentional non-adherence will mean a compliance aid is ineffective.

There have been developments in enhancing total medication management through the Biodose® system which looks to be promising for the future of MCAs. It contains 28 sealable and removable pods with a MAR chart and patient information. These features are targeted for care home staff and it can cater for liquid as well as oral medications. Other characteristics of Biodose® include:

- pictures of the medication;
- highly accurate and specific measurement devices where liquids are titrated based on their viscosities;
- no need for cups and less time wastage;
each pod has patient and medicine information;
- tamper evident, but medicines are still easily accessed by arthritic patients;
- cannot be resealed, thus ensuring security, safety and accountability; and
- claims to improve adherence.

Future Considerations on MCAs

Future research into adherence aids for older individuals should consider the opinions of GPs through surveys and interviews, as well as social care workers. It would be valuable to consult older individuals to identify what they would desire in an adherence aid and how they evaluate current devices available. A usability test could be developed to compare adherence aids, with consideration given to their ease of opening, transportability and display features. Another aspect of adherence aids which is still quite unclear is the stability of medicines once removed from original containers. Stability of medicines in MCAs should be researched in more depth. Future research should assist with the development of MCAs that are both aesthetically agreeable and account for the physical impairments of older patients. This will require active research and the collaboration of GPs, patients, pharmacists and carers.

Conclusion

Due to the large variety of adherence aids available, it is difficult to select one device to suit all individuals or for the one individual. Further research is required into patient medicine adherence before MCAs are widely used, particularly concerning older populations. When considering an older individual’s medication regimen, their GP, the carer, and the pharmacist are important individuals to consider in all decision making.

What was clear from the research concerning MCAs is the need for a thorough and patient-centred assessment tool for pharmacists to use when choosing whether MCAs are
appropriate for their patient. A tool should be developed to assist with determining if non-adherence is intentional or unintentional. If unintentional, it should be proceed to utilise reminders and methods to easily access their medication. The MCA chosen must be tailored towards the patient considering factors such as accessibility, function as a medication storage container and convenience for the patient or person responsible for administering medication.

Disclosure of interest

The authors declare that they have no conflicts of interest concerning this article.

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