Summary of Guidance and Evidence for use of Multi-Compartment Compliance Aids (MCCAs).

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Forward

It has been suggested that, in England, approximately 64 million multi-compartmental compliance aids (MCCAs) are given out by community pharmacies each year. MCCAs are just one type of device among many to support people to take their medicines. They can be used to simplify a medicine regimen (usually solid oral dosage forms) to facilitate adherence or self–administration for a person who struggles to adhere to taking their medicines because they cannot remember to do so or because the medicines schedule is too complex for them to manage.

The concerns surrounding the use of MCCAs and delivering person-centred care in relation to supporting medicines adherence are not new. There have been a number of documents published over the years but change has been slow coming. A multidisciplinary and multi-agency approach is needed across health and social care to drive the change while addressing the concerns of all stakeholders. This briefing document attempts to address the evidence base around MCCA use in all settings, while its sister document (*MCCA scoping and implementation*) provides clear and timely implementation steps (with organisation responsibilities) needed to reduce the inappropriate use of MCCAs.

There are no high quality published evidence to assess the impact that MCCAs have on medicines adherence or patient safety. Other options and strategies to support medicines adherence exist (such as simplifying medicines regimen, eye drop dispensers, reminder charts to wing-capped bottles) but there are no studies comparing the impact of MCCAs with these other medicines adherence aids. Family members and unpaid carers also support people to take their medicines and enabling them to continue to do so safely is crucial in our quest to reduce inappropriate use of MCCAs.

For an MCCA to be useful, the device must address the adherence need identified following an assessment. However evidence shows that in practice, people are often offered an MCCA without assessment of their adherence support needs. It is extremely important for an assessment to be undertaken as it identifies the root cause of why the person cannot or would not adhere to the prescribed regimen and allows an appropriate solution to be developed jointly with the person (and those involved in their care) that meets the identified need.

An MCCA is far from a *fit-for-all* solution to medication adherence. Even when an assessment suggests an MCCA may be appropriate, there may be other factors, which make the MCCA inappropriate and will require the input of a pharmacist. For example, the size or stability of a tablet may render it impossible to pack into an MCCA. Furthermore, the person must be able to use the particular MCCA device supplied in relation to its design. For example some people are unable to access the tablet/capsule from the compartments while others may not be able to work out the right day of the week or time to take the medicines. As the appearance of medicines from different manufacturers vary, people may be unable to recognise or select particular tablets that need to be taken in a certain way for safety reasons. Others may become confused or lose confidence about what to take which may result in further non-adherence.

Vulnerable people like those living with frailty, dementia and multi-morbidities take many medicines (polypharmacy) and are more likely to be given MCCAs. Often they will also be prescribed other medicines that cannot be supplied in MCCAs e.g. light sensitive tablets, inhalers, creams, patches, eye drops etc. Managing two medicine systems in parallel can lead to further non-adherence or adverse medicines outcomes.

Filling MCCAs is labour intensive and it can be difficult to identify individual medicines in each compartment even when there is a label on the device that describes the content.. Perhaps the greatest concern with an MCCA is not being able to reconcile accurately what is in the MCCA with the person's current prescription list or what the person is taking, especially when care is transferred from one setting to another or there is a handover of care e.g. hospital admission, care home

Given current financial pressures in health and social care, there is also concern around medication wastage through MCCAs where changes in prescriptions can result in weeks' worth of medications being destroyed and MCCAs being reissued.

While hard published evidence is lacking on the impact of MCCAs on improving adherence and patient safety, undertaking assessments of people's medicines adherence support needs and reducing the inappropriate use of MCCAs have the potential to improve patient outcomes, reduce risks of medicines related harms and improve efficiencies.

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Summary of Guidance and Evidence for use of Multi-Compartment Compliance Aids (MCCAs)

Key points:

- There are different types of compliance or adherence aids available(1). Multi-compartment compliance aids (MCCAs) are one specific type of compliance aid.
- There is no legal requirement for an MCCA to be provided to a patient, carer or care facility and it should not be presumed that a patient with a disability, who requires an auxiliary aid, must always be supplied with an MCCA, as there are other possibly more appropriate and helpful ways to support people in taking medicines effectively(2).
- Routine use MCCAs without patient adherence assessment is discouraged by the Royal Pharmaceutical Society(3).
- There is a lack of high-quality published research investigating the use, appropriateness, safety and concerns of MCCAs in all UK settings.
- The impact of MCCAs on medication adherence is unknown.
- The evidence comparing the safety of MCCAs against original pack dispensing is limited and comparisons to other adherence aids lacking.
- The published evidence reviewed strongly suggests that patients with medication adherence issues undergo an assessment to jointly identify the best adherence aid for them(4-6).
- The preference for patients with adherence issues is to supply medication in original packaging with appropriate adherence aids(3).
- Patients and carers using MCCAs should be assessed for adherence and concerns after a few weeks of starting the aid. The patient should be re-assessed after any changes in their needs, e.g. after hospital discharge, and regularly at 6-12 months(7).
- The lack of reported incidents around the use of MCCAs does not imply that these aids are without negative impact on patient safety.
- Where the best adherence aid for an individual is suggested to be a MCCA, then the patient and their carers must be educated and trained in the use of the aid.
- Not all medications are suitable for MCCA's. The decision to use an MCCA must therefore include a technical assessment of suitability of each medicine(8). If some medicines are necessarily kept outside an MCCA, this increases the complexity of the medication regimen and may result in some medicines being missed(9).
- There is no consensus on the type or features of the MCCAs to supply and this has led to confusion amongst healthcare professionals, patients and carers(10). This is considered most likely when patients are transferred between settings.
- There are concerns regarding adequate training and remuneration in providing adherence assessment, aids and sustaining these(11).

Introduction and background

Medication adherence aids (also known as medicines compliance aids) such as medication use records, wing-capped lids, and large labels are designed to help patients maintain independence in taking their prescribed medication(4). Multi–compartmental compliance aids (MCCAs), one type of adherence aid, are devices that allow medicines to be packaged into individual compartments (see figure 1). There is no consensus for a standardised presentation of MCCA, therefore many different permeations are available (e.g. daily supply, weekly supply, monthly supply, medication labels, medication cards, medication images, heat sealed compartments, sliding lids allowing access to all compartments, impermeable / permeable to moisture, non-tinted / tinted containers preventing light exposure.) As there is no standardised definition of how an MCCA should look, there is no standardised approach to when these different characteristics should be used. This can lead to medication errors, particularly during transfer of care(10).

A recent study published in 2019 suggested that each year, in England, approximately 64 million MCCAs were given out by community pharmacies(12). The survey reported that 94% of pharmacies dispensed medications in MCCAs but only 28% of pharmacies completed a needs assessment for patients before commencing an MCCA. Furthermore, only 11% of pharmacies re-assessed the needs of MCCA supplied to patients once a year. The concerns surrounding MCCA use are not new and have prompted a number of documents to be published about their use, including guidance from the Royal Pharmaceutical Society (2013) (3) and Specialist Pharmacy Service (2015) (5). However very little progress in practice has be made to date to effectively address these concerns.

The majority of published evidence refers to the care home and residential home setting where MCCAs are used to save staff time and have the perceived idea that MCCAs cause fewer administration errors than manufacturers' original packaging(13).

In the literature, the features of an ideal MCCA have been suggested to(14):

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

The issues around the lack of any standard MCCA were highlighted in a case which reported how an older lady had been discharged from hospital following a respiratory infection with an MCCA (filled by the hospital since she had been admitted on one)(10). She later attended her GP clinic as she had become increasingly confused since discharge. On inspection of her MCCA it was clear she had been taking all the morning doses in one day, all the lunchtime doses the next day, and so on. The hospital issued MCCA was compared with her usual community pharmacy provided MCCA and it became clear that the rows and columns were arranged differently. This explained why she had taken a row of morning medications throughout the course of a day, as she was used to her box running in this direction. She was re-dispensed her medication in her community MCCA and reviewed at a later date where her confusion was noted to have resolved.

The most prominent published case of errors involving MCCAs was reported in 2016 where methotrexate medication errors resulted in deaths(15). The researchers identified 22 instances where methotrexate was listed as a cause of death from national error reporting data, including 12 with documented bone marrow suppression. Reasons for the errors included MCCA packing by pharmacists resulting in three fatalities due to daily methotrexate dosing rather than weekly. It is likely that adverse patient safety reports involving MCCA are under reported and so a lack of reports does not imply patient safety.

More recently (2019), two of the UK's largest community pharmacy chains (Boots and Lloyds) announced a phased switch from MCCA to original packaging in care homes(16). The switch is

expected to be gradual for existing MCCA users in care homes following assessment of patient medication aid needs.

Figure 1: Examples of MCCAs

Legislation and contractual arrangements

MCCAs were first widely used in the 1980's, prior to calendar blister packs and patients packs being introduced in the 1990's. Before patient packs, solid oral dosage forms were being dispensed from stock pots into identical brown bottles and MCCAs provided a means to assist patients in taking their solid oral medications. After the introduction of patient packs, the place of MCCA was never formally reviewed.

Prior to 2005, pharmacies may have dispensed MCCAs either at their own expense or requested the patient to purchase one(2). Many MCCAs were supplied free of charge to care homes. Subsequent to 2005, the 'Support for People with Disabilities' paper (2004) required pharmacists to assess patients under the Disability Discrimination Act 1995 in order to make medication aid adjustments as necessary(2). Under this legislation, and under legislation carried forward in the Equality Act 2010, it is the pharmacy contractor who is responsible for assessing the need for a medication aid, and it is the pharmacist who must be satisfied that the patient is able to understand and be able to benefit from the adjustment, without introducing additional risks. An MCCA must be assessed as being appropriate and safe for the patient and preserve the integrity of the medication. This applies to all settings and if an adjustment causes harm, the pharmacist could be liable, e.g. providing a reminder chart that the patient cannot understand, or an MCCA which results in incompatibilities or deterioration of the prescribed medication(2).

Examples of adjustments under Disability Discrimination Act 1995 (2)

Level 1: large print labels, easy open containers, reminder charts
Level 2: provision of medication in an MCCA

The single activity fee for all prescription items dispensed by English Pharmacy Contractors includes a contribution for provision of auxiliary aids for people eligible under the Equality Act 2010(17).

Patient groups for MCCA use

Medication adherence aids are not effective for addressing deliberate non-adherence, poor motivation and errors due to more severe cognitive impairment(18). MCCAs are used in the community for many reasons and users tend to fall into one of the categories below(5):

- Individual patients who self-administer their medicines
- Carers and relatives providing support with medicines
- Domiciliary care workers providing support with medicines
- Care home staff (residential and nursing) for their residents

Stakeholders need to be aware that an MCCA is one of many adherence aids for patients who are unintentionally non-adherent to their prescribed medication. The limited and low-quality evidence located indicates that the medication adherence benefit with MCCA use is inconclusive. There is an overall preference to supply original packed medication with greater patient involvement and regular patient assessment and communication between the multidisciplinary healthcare team in all settings. There is a question over adequate and sustainable funding and the clarification of the roles and responsibilities of those involved in MCCA prescribing / advising, filling, supplying and reviewing(3).

The main stakeholders for MCCA use were discussed by two reviews and deemed to be(1;12):

- Regulators (General Pharmaceutical Council (GPhC) and Care Quality Commission (CQC))
- Social services and domiciliary care providers (Local Authorities)
- Care homes (with and without nursing)
- Discharge and rapid response teams
- Community nurses, General Practitioners (GP) and community pharmacists (independent and large chain)
- Hospital Trusts
- Patients, carers and family

National Guidance and support for MCCA use as an adherence aid

Guidance	Description
Royal Pharmaceutical Society The better use of MCCAs (2013)	1. Use of original medicine packs with appropriate support is preferred supply option to patients in the absence of a specific need requiring an MCCA. 2. Patients who can safely self-administer their medicines should be encouraged to do so. When unable, appropriate training for carers to administer medicines from original packaging is needed 3. Patients with a medicine adherence issue should have a robust individual assessment to identify best intervention based on their needs and the evidence currently available. Assessment should incorporate clinical medication review, reasons for non-adherence, medicines suitability, and consideration of all possible support options and follow up. 4. An evaluated national, multi-disciplinary assessment tool designed to identify, assess and resolve medicines issues is needed. Should be suitable for use across health and social care 5. If assessment indicates MCCA is needed, need to provide information, appropriate counselling and patient follow up and that the health or social care professional is aware of the legal, professional and practice considerations. 6. Policies should support people receiving their medicines at the right time, whether or not they are packaged in an MCCA. 7. Pharmaceutical services supporting patient-centred healthcare and best use of medicines should be maintained and developed (e.g. targeted medicines use reviews (MUR), new medication service (NMS), chronic medication service (CMS) and locally commissioned services). 8. Further research into MCCA impact on patient outcomes and safety is needed to determine the place of MCCA as an intervention option to support self-care, reablement and medicines administration.
NICE CG76 Medicines adherence: Involving patients in decisions about prescribed medicines and supporting adherence (2009)	Guidelines on medicines adherence in people aged 18 and over. Recommends how to encourage adherence to medicines by supporting and involving people in decisions about their prescribed medicines. It aims to ensure that a person's decision to use a medicine is an informed choice. Recommendations: • Developing effective, equitable interventions to support adherence to appropriate prescriptions • Informed choice and shared decision-making • Support processes: prescribing related consultations and medicines review
NICE CG138 Patient experience in adult NHS services: improving the experience of care for people using adult NHS services (2012)	Healthcare professionals should tailor services to respond to the needs, preferences and values of the patient. Advice on treatments and care, including risks and benefits, should be individualised as much as possible. The patient needs to be aware of the options available with an explanation of the risks, benefits and consequences.
NICE SC1 Managing medicines in care homes (2014)	A comparison between MCCAs and original packs when managing medicines in care homes. For medicines administration, the advantages of MCCAs were that they provide an additional visual safety check for care staff and could help facilitate self-administration. In comparison, the list of advantages for original packs is much longer. Using MCCAs could result in medicines administration being a robotic task rather than enabling trained carers to deliver person-centred care.

	Care home providers should determine the best system for supplying medicines for each resident based on the resident's health and care needs and the aim of maintaining the resident's independence wherever possible.
NICE NG25 Medicines optimisation: the safe and effective use of medicines to enable the best possible outcomes (2015)	Encourages medicines reconciliation, medication review, and the use of patient decision aids. Stresses the need for self-management plans to empower people and involve them in managing their condition. Plans should include the medications being taken, the responsibilities of the person and healthcare professionals, and a requirement for regular review. Organisations should involve a pharmacist with relevant clinical knowledge and skills when making strategic decisions about medicines use or when developing care pathways that involve medicines use. Nothing specifically about medication administration aids but does stress the need for medication review and self-medication (following capability assessment).
NICE NG27 Transition between inpatient hospital settings and community or care home settings for adults with social care needs (2015)	Lists the responsibilities of the discharge co-ordinator including the central point of contact for health and social care practitioners, the person and their family during discharge planning. The hospital-based doctor responsible for the person's care should ensure that the discharge summary is made available to the person's GP within 24 hours of their discharge. Also ensure that a copy is given to the person on the day they are discharged. Focus around the need for seamless discharge from hospital.
NICE QS85 Medicines management in care homes (2015)	It should be assumed that people who live in a care home can take and look after their medicines themselves, unless a risk assessment has indicated otherwise. Risk assessments determine what support a person needs to help them to self-administer different medicines (for example, a resident may be able to manage oral tablets but not eye drops). The assessments need to be reviewed periodically, and whenever circumstances change, address if any adjustment to support the need. Support may include practical help to self-administer medicine, such as providing a glass of water with which to take medicine, reminder charts, large-print labels, hearing labels, easy-to-open containers, help measuring liquids, devices to help with the use of inhalers, colour coding of labels (for example, for different times of day) and providing prompts for when medicines should be taken, (for example, with or after food or on an empty stomach). Support may also involve providing the person with suitable information about the medicine, information on how to take the medicine and advice on any potential side effects. The frequency of multidisciplinary medication reviews should be based on the health and care needs of the resident, and the interval between medication reviews should be no more than 1 year. A range of health and social care practitioners are listed with regards to who should be included in the medication review.
NICE QS120 Medicines Optimisation (2016)	Guidance does not cover medicines optimisation specific to care home settings. A structured medication review, with the clear purpose of optimising the use of medicines for some people (such as those who have long-term conditions or who take multiple medicines) is advised. These can lead to a reduction in adverse events.
CQC Using multi-compartment compliance aids in care homes (2018)	MCCAs may form part of the reasonable adjustments healthcare professionals are required to make under the Equality Act 2010. MCCAs should not be the first choice intervention to help people manage their medicines. There are other ways to promote people's independence. Make reasonable adjustments and support the person to use original packs of medicines. Examples of adjustments and support include: • reminder charts • winged bottle caps

	• large print labels • alarms (such as notifications on mobile phones) • tablet splitters and “poppa” devices Removing medicines from original packaging may affect stability. MCCAs may not be child resistant, tamper proof or tamper resistant. Staff need to be able to identify and remove (if necessary) individual medicines they administer, which can be hampered by MCCAs. Providers need to consider how people and care staff manage different systems of administration (e.g. use of original packs as well as MCCAs). For some people, MCCAs may simplify the medicines regimen. Staff must be trained and competent to operate whichever system is in use.
SPS Supporting older people in the community to optimise their medicines including the use of multi-compartment compliance aids (MCAs) (2015)	Review of options for medicines optimisation for older people, focussing particularly on the appropriate and cost-effective use of MCCAs. Target audience are those wanting to lead change to improve medicines optimisation for older people. There is a need for a co-ordinated and structured approach in the way older people are assessed for medicines support and how such support is provided. Some effective methods to improve medicines taking: • Reminder systems • Compliance aids and supervision • Reminder charts, non-child proof tops, large labels, record sheets • Simply dosage regimen, reduce number of medicines • Appropriate medicine containers • Personalised instructions and written information MCCA used only where an assessment has shown that it is the best way to support the particular older person to manage their medicines independently. MCCA are: • A simple visual reminder or prompt for the patient to remember to take their medicines • A way to simplify a complicated drug regimen so the patient can manage their medicines safely and effectively • A way for carers However, the review provides a long list of disadvantages and problems associated with MCCA which need to be considered when considering MCCAs for older people. Solutions to some are provided through change in local practice.
PSNC Medicines assessment and compliance support (no guidance)	Portal to examples of medicines assessment and compliance support services that have been commissioned locally. Tools and publications to support the commissioning of these services are also available.
NPA Compliance aids (members access only) (2013)	A list of the types of compliance aids available for community pharmacists to supply (correct as of 2013) from daily dose reminders to liquid medicine aids, including details of suppliers. Tables compare the various features of the compliance aids to assist pharmacist, patient and carer choice.

Concerns relating to MCCA use

The published evidence reports several limitations and concerns with the use of MCCAs ranging from medicine instability to unnecessary medication usage. The National Reporting and Learning System (NRLS) data from the first half of 2018 showed that 507 patient safety incidents involved the terms 'monitored dosage' or 'dosette box'(7).

A review of the evidence highlighted a list of concerns and issues involving MCCA usage, some of which were based on author experience(1):

- Patients not being assessed for medication adherence aids and not being given the opportunity to consent to MCCA use(12).
- The presence of a controlled drug in an MCCA rendering the whole unit a controlled drug container which must be stored in a controlled drug cabinet until the prescription is collected(19).
- Repacking medications into MCCAs falls outside the manufacturers' authorisation license thus rendering the use of medications in this manner unlicensed. The legal responsibility for stability transfers from the manufacturer to the prescriber and pharmacist(19)**.**
- Legislation requires that patient information leaflets (PILs) are supplied with all dispensed medications including those in MCCAs. An original pack containing 28 tablets, for example, would contain one PIL which must then be copied since most MCCAs will be 7-day supplies(19).
- Not all oral medicines can be dispensed into an MCCA and so, in addition to an MCCA, patients may end up with additional boxes of medicine to maintain therapy(9;12). This could complicate adherence and result in missed doses (such as liquids, inhalers, topical, etc.).
- If unsuitable medicines are dispensed in an MCCA, this could potentially lead to lack of therapeutic effect with add-on costs for additional monitoring(8;20;21).
- Even if the medication is suitable for MCCA, there are few data on the effects from direct medication contact in an MCCA compartment(12;19).
- Patients and carers should be able to identify individual medicines to enable informed decision-making with regards to taking medicines. Identifying medication in an MCCA based on appearance alone may be difficult since generics and different brands may appear differently(12). Items may therefore be missed on reconciliation in hospital and delay drug chart completion. Not all MCCAs provide drug cards or labels and even where these are provided, it is not always clear if they provide an accurate reflection of MCCA contents.
- If a medicine from an MCCA is dropped on the floor or otherwise rendered unusable, there is no option to replace these doses(18;22). Errors may arise if patients and/or carers try to identify the same medication from the next dosing compartment and use that in place of the lost medication until a refill can be arranged.
- MCCAs are not designed to be child-resistant containers for prescribed medications therefore there is always a risk that children may access the contents of the MCCA if it is left in an easy to reach location(19). This risk is enhanced if patients leave their MCCA in an easy to see location if it is acting as a reminder for medication adherence.
- MCCAs can be rendered unusable if a patient does not have adequate dexterity, eyesight and cognition(18).
- Where multiple medicines are placed in the same compartment, it is difficult for patients to comply with additional instructions (e.g. take with or after food) in order to achieve full therapeutic effect.
- Other medications, such as oral bisphosphonates, have a high risk of causing oesophageal ulceration if not taken whilst sitting or standing upright. These medicines should be not be included in MCCAs in order to comply with administration requirements for full therapeutic effect and reduce the risk of any administration related adverse effects(23).

- Some MCCAs are sealed blisters and may offer a better barrier to drug instability than those with sliding lids(19). The latter will often be given a 7-day expiry compared to sealed MCCAs having an 8-week expiry.
- Medication and financial wastage from disposing of all the medications in an MCCA if an item is changed after prescription filled(12).
- Implementation of a dosing aid may increase dose-related adverse effects if it leads to a sudden increase in adherence(18). Patients receiving an MCCA to improve adherence should be assessed for adverse effects after implementation.

In a study (2011) analysing incidents reported by 25 Scottish hospitals over a 5 year period, 2% of all incidents related to incorrect dispensing of MCCAs(24).

A study (2013) addressed whether older patients found MCCAs easy to use and tried to identify ones which were easiest to use(25). Fifty participants (aged 77-98 years old, median 85 years, 76% female) were recruited from an older person's medical ward. Participants ability to use three brands of MCCA (Venalink®, Nomad Clear® and Dosett®) were assessed against a range of patient factors. The participants were presented with the three MCCAs, each containing seven days of placebo tablets, and rated each according to text readability, ease of opening, ease of medication removal, transportability and overall rating via questionnaires. The key points raised were:

- Older people find some commercially available MCCAs easier to use than others.
- Cognitively impaired patients may experience more difficulty than others in opening and accessing medicines from some MCCAs.
- Patient rating of MCCAs was dominated by ease of transportability.

Despite MCCAs being largely targeted at older people, their manufacturers do not claim that they have been tested with or are accessible to this population hence the need for independent research to evaluate their relative ease of use(25). There are no subsequent studies reporting the ease of using different types of MCCAs. Nor are there reports of the relative importance of MCCAs characteristics in influencing overall ease of use. The study provides interesting insight into considerations that need to be taken into account when offering an MCCA to an older adult. This study did not elicit the variables that explain all the difference in ratings between the three different MCCAs tested, so further work is needed to identify other factors that affect MCCA preference.

In a retrospective observational study (2016), 100 care home residents in Australia were observed to detect drug dosing errors(26). MCCAs were used by nearly half of care home residents and only 16% had a medication administration chart. Twenty-six medication errors relating to discrepancies between prescription record and MCCA were detected during this study, including twelve where medication was taken from the wrong compartment. Although this study was not designed to assess the impact of MCCAs on the medication errors; 41% of residents experienced a medication error and 13% of residents had more than one adverse medication event that required medical consultation or hospitalisation. Around 60% of adverse medication events were potentially preventable. In this study, almost half the MCCA users also received community nursing services seven days a week and about a quarter had their MCCA stored in a locked box. It is likely that some of these residents could have managed without an MCCA since they were not self-administering their medications.

A cross-sectional study (2017) conducted in Aberdeen investigated the extent of potentially inappropriate medications in 48 community pharmacies supplying a total of 2,060 patients with MCCAs during the study period(27). Almost half of the study group (47.9%, 988) had at least one medication concurrently dispensed outside of the MCCA, of which 8.1% (80) were prescribed five or more medications outside of the MCCA. Only 13.9% (286) of the study population collected their medications in person. The study suggested that in almost half of all cases, it is not possible to dispense a person's medication entirely in an MCCA, which throws doubt on the benefit of an MCCA to that individual. The study was not designed to assess the impact of medication errors.

A report (2019) investigating the use of MCCAs, stated that damage could be caused by inappropriate MCCA use such as the patient either being unable to refuse a medication and experiencing adverse effects as a result; the patient not having the cause of their non-adherence assessed; or the patient having a progressive disease where medication administration would not get assessed(12). These

themes were based upon two years of interviews, meetings and conversations with experts across health and social care. It was suggested that any benefits of the MCCA may therefore be lost over time.

Comparison of MCCAs with other medication adherence tools

No head-to-head comparisons powered to compare MCCAs with other adherence aids were located in the published literature. However, one large study (2017) did compare three different types of reminder devices to a control (no device) with regards to medication adherence(28). The investigators compared a pill bottle strip with toggles for each day of the week, a pill bottle cap with a digital timer displaying the time elapsed since the medication was last taken, and a plastic organisation box with one compartment for every day of the week. Patients were aged 18 to 64 years and were on a maximum of three medications to treat a variety of chronic conditions; therefore the sample was not representative of the typical MCCA user population in England. Patients were assessed prior to inclusion for adherence using drug prescription claims and those considered sub-optimal were included. Interestingly, in the entire cohort the average age was 45 years and around 56% of patients were female (sample size of 36,739 in chronic disease stratum and 15,555 in the antidepressant stratum). In head-to-head comparisons of individual devices, patients who received the standard pillbox tended to have higher adherence than patients who received the digital timer cap and the pill bottle strip with toggles, although these effects were of relatively small magnitude and were of inconsistent statistical significance. It was concluded that for these devices to work, there may be a need for additional support mechanisms. Multicomponent interventions, particularly those led by pharmacists, were suggested by the authors to be the most effective.

Prior to this study, a Health Technology Assessment (HTA) was published (2016) which aimed to find out if it was feasible to test the effects of MCCAs on outcomes and quality of life(29). The systematic review conducted during the project also identified that studies on MCCAs were largely of poor quality and that the evidence regarding the effects of MCCAs was contradictory. The majority of studies reported adherence but no health outcomes. Those studies reporting both adherence and health outcomes did not unequivocally report a positive relationship; some studies reported increased hospitalisation associated with MCCAs. No study reported any humanistic outcomes such as health-related quality of life. This feasibility study was small scaled (N=26) however pertinent points were raised such as the:

- Primary outcome of MCCA trials should be health outcome rather than medication adherence.
- Medication management strategies (including MCCAs) and discussions are often omitted from medical notes.
- Prevalence of patients choosing not to adhere to their prescribed medication requires regular discussions with patients to adopt a concordant approach to prescribing.
- Increase in adherence to a medication may result in a dose-related adverse drug reaction therefore medication doses should be reviewed prior to implementing an MCCA and reviewed regularly after the intervention to ensure medication optimisation.

Other methods to support patients in taking their medications include(19):

- Medication reviews to avoid unnecessary polypharmacy
- Simplifying medication regimens
- Effective patient counselling and education
- Reminder charts
- Medicines administration record charts
- Labels with large print or pictograms
- Information sheets
- Reminder alarms
- IT solutions, such as phone apps and telemedicine
- Wing-capped bottles
- Blister popping devices or pill presses

User opinion towards MCCAs

Most of the evidence around MCCA safety stems from semi-structured interviews with small cohorts of patients, carers and healthcare professionals. These are too small to provide direct evidence of practice nationally, but the outcomes are important to note since they may impact on any implementations plans regarding MCCAs. Appendix 3 summarises the opinions of surveyed stakeholders based on the literature. It should be noted that the validity of the surveys used, and the methodology was questionable in most of the published research, e.g. inconsistent recruitment and range of participants surveyed, lack of quantitative research by recruiting large numbers, no identification of participant experience with MCCA, introduction of bias by interviewer, lack of a validated survey, poor survey response rates, and the effect of observation on care home medication rounds(11;22;30-34). The greatest limitation in the qualitative studies was small sample size.

Stability of medications in MCCAs

The use of MCCAs involves the transfer of medicines from the manufacturer's original packaging to the MCCA. Original packaging is designed to protect the contents to appropriate pharmacopoeial and quality standards for a variety of criteria, e.g. water vapour transmission, as required in the product licence(8). MCCAs cannot guarantee the same level of protection. Many systems are not disposable and are frequently reused without cleaning, whereas all other dispensing containers are designed for single use. The hazards associated with physical, chemical and microbiological cross-contamination could be a risk factor, yet there is very little data regarding drug stability in MCCAs (see appendix 4). It should be noted that the type of MCCA varied between studies and results were based on controlled environments which are unlikely to mimic that seen in practice. Most comparators used medication stored in original manufacturers packaging and explored conditions such as humidity, room temperature, high temperatures, fridge temperatures, and direct light. Studies then used chemical and physical tests to determine the content and appearance of the medication.
Medication instability can lead to(20):

- loss of potency due to the degradation of the active ingredient
- accumulation of potentially toxic degradation products causing adverse drug reactions
- changes in the physical appearance of a product that may affect patient adherence

Some medicines are unsuitable for inclusion in an MCCA (see box below), so if these form part of a patient's medication regimen there will be a need for two separate systems (e.g. MCCA and original pack).

Medication formulations unsuitable for MCCA(19):

- Effervescent or dispersible tablets
- Buccal and sublingual tablets
- Cytotoxic medicines
- Liquids
- Hygroscopic formulations
- Inhalers
- Refrigerator items
- Dosage forms too large for MCCA compartment
- Medicines taken at varying doses (e.g. warfarin)
- Medicines taken in a specific manner (e.g. before or after food, when required)
- Injections

The properties of some medicines mean that they may not be suitable for placing next to other medicines in an MCCA (12;19).

Evidence supporting the use of MCCA

A MCCA should be considered when a person is struggling to manage a complex medicine regimen that cannot be simplified and primarily consists of regularly scheduled, solid oral dose forms that are suitable for packing(1). They may also be considered for a person who sometimes forgets whether they have taken their medicines (leading to risk of double dosing) and requires a visual cue. They may also be useful where a carer monitors a patient's medication-taking. Ideally the medication regimen should be stable and unlikely to change frequently. MCCAs are most effective in people who are motivated and willing to take their medications. They should possess adequate vision, cognition and dexterity to use the device(18).

A Cochrane review pooled data from several studies and found that MCCAs modestly increased the percentage of medication taken (mean difference of 11%, 95% confidence interval 6–17%)(35). The evidence for MCCA benefits was not strong enough to recommend widespread use and it was suggested that their use be reserved to overcome practical problems, if there was a specific need.
Appendix 5 summaries the published evidence where MCCAs are suggested to be an appropriate system for medication adherence in the given setting.

Evidence of implementing change

There are few examples in the published literature of implementing wide-scale changes to ensure the MCCA use is targeted to the appropriate patients in the relevant settings(36). Most implementation examples refer to the care home setting and are sustainable since they relate to a designated area of the country. Others are targeted to a specific patient population, e.g. post-stroke.

The CHUMS study is perhaps the most structured with regards to implementing change in care homes(9;37). The change from MCCA to original packaging involved a comprehensive training package (half day face-to-face session, work book, and practical assessment). Before the switch, agreement was reached with local community pharmacies to supply medicines in original packs and provide medication administration record charts. Care homes were then switched one wing at a time, with the switch taking place at the end of a monthly dispensing cycle. Transferring to original packs provided an opportunity to change from drug trolleys in care homes to individual patient-own drug lockers within the resident's room. This was a more patient-centred approach, but it did bring implications for cost (installing the lockers) and staff time.

Assessing patient medication adherence is essential when deciding if an MCCA is appropriate. There are a number of published assessment tools but none standardised for use in all care settings. The BMJ recently suggested a question tool but gave no scoring system to assist clinicians in deciding the need for an MCCA(38). The tool covered questions such as:

- Why are we considering using a multi-compartment MCA?
- Does the patient need a cognitive screen?
- Is the patient/carer aware of problems associated with multi-compartment MCAs and alternatives?
- How likely is it that the medicines regimen will change in the coming months?
- How suitable are the medicines for dispensing in a multi-compartment MCA?

Conclusion

Based on the poor quality and limited published evidence surrounding MCCA use specifically, it is not possible to suggest that MCCAs be used for all patients with unintentional medication non-adherence. However, the limited positive evidence (both published and specialist based) does suggest MCCAs to have a role in improving medication adherence in a selected population of patients who are best identified by person-centred adherence assessments.

Based on published evidence, figure 2 identifies the barriers to the safe and appropriate use of MCCAs.

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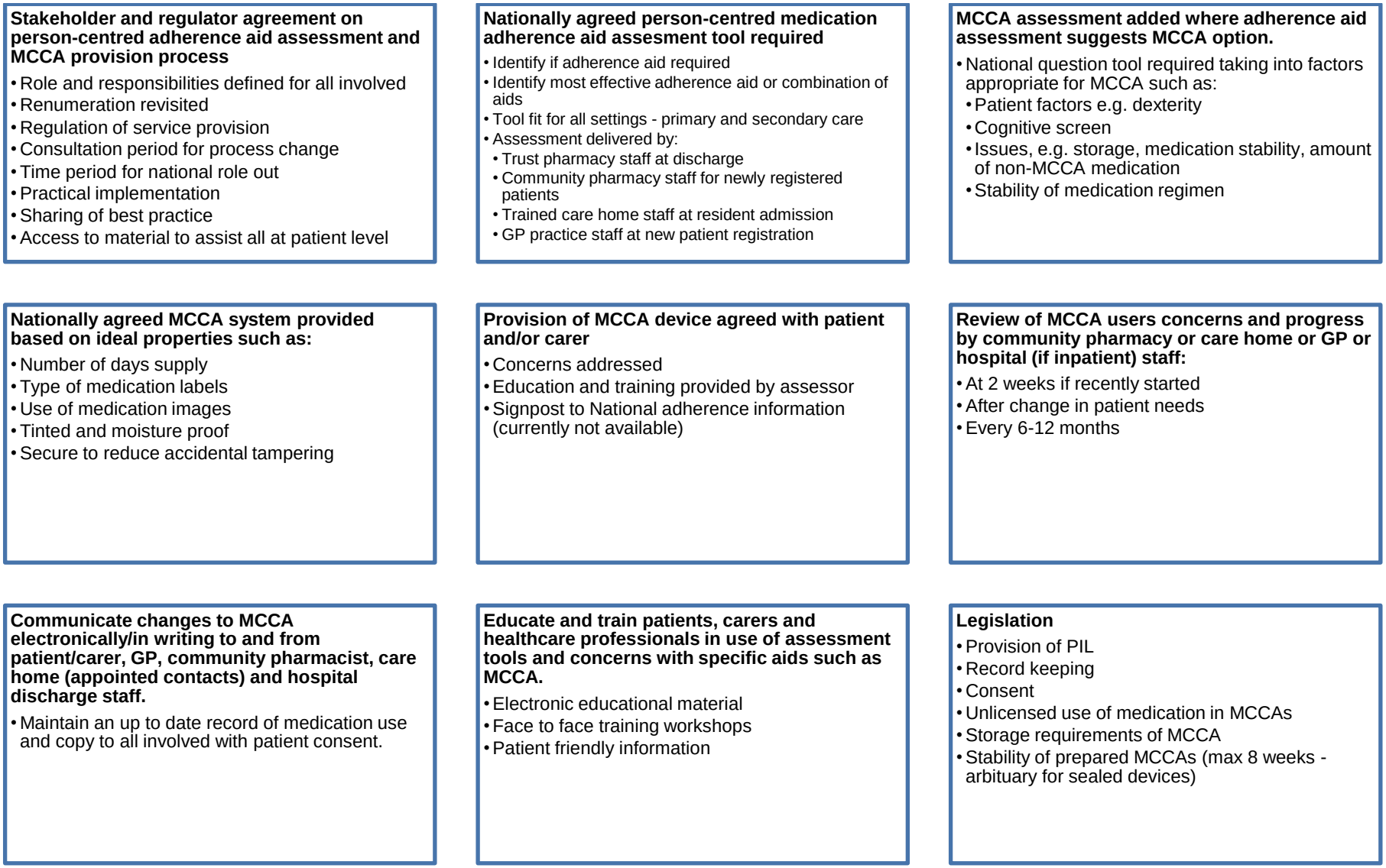
Figure 2: Summary of barriers to initiation and appropriate use of MCCA based on the published literature.



Appendix 1: Reference List

(1) Oboh L. Frequently Asked Questions (FAQ) on the use of Multi compartment compliance aids (MCAs) in the community: A resource for community pharmacists and other health and social care professionals involved in medicines management for older people. NHS Lambeth 2011.

(2) Anon. Disability Discrimination Act 1995: Equality Act 2010; And Multi-compartment compliance aids. Pharmaceutical Services Negotiating Committee 2016.

(3) Anon. Improving patient outcomes: The better use of multi-compartmental compliance aids. Royal Pharmaceutical Society 2013.

(4) Nunes V, Neilson J, O'Flynn N et al. Clinical Guidelines and Evidence Review for Medicines Adherence: Involving patients in decisions about prescribed medicines and supporting adherence: Full guidance. The National Collabortaing Centre for Primary Care & Royal College of General Practitioners 2009.

(5) Oboh L. Supporting older people in the community to optimise their medicines including the use of multi compartment compliance aids (MCAs). Specialist Pharmacy Services 2015.

(6) Kvarnstrom K, Airaksinen M, Liira H. Barriers and facilitators to medication adherence: A qualitative study with general practitioners. BMJ 2018; 8.

(7) Robinson J. Are we dispensing too many multicompartment compliance aids? The Pharmaceutical Journal 2019; 302(7922).

(8) Church C, Smith J. How stable are medicines moved from original packs into compliance aids? The Pharmaceutical Journal 2006; 276(7384):75-81.

(9) Alldred DP, Standage C, Fletcher O et al. The influence of formulation and medicine delivery system on medication administration errors in care homes for older people. BMJ Quality & Safety 2011; 20(5):397-401.

(10) Illsley A, Brown A. Multi-compartment compliance aids - a clinical reminder. Age Ageing 2016; 46:337.

(11) Gilmartin JFM, Jani Y, Smith F. Exploring the past, present and future of care home medicine management systems: pharmacists' perceptions of multicompartment compliance aids. Journal of Pharmaceutical Health Services 2015; 6:177-184.

(12) Yeung A. Medicines Adherence Support Project. Academic Health Science Network: North East and North Cumbria 2019.

(13) Oboh L. Monitored dosage systems are not the only solution for older people. The Pharmaceutical Journal 2007; 278(7453):606.

(14) Edirisinghe S, Raimi-Abrham BT, Gilmartin JF et al. Multi-compartment compliance aids (MCA): Application to the geriatric community. European Geriatric Medicine 2015; 6(1):65-68.

(15) Cairns R, Brown JA, Lynch AM et al. A decade of Autralian methotrexate dosing errors. Med J Aust 2016; 204(10):384.e1-384.e6.

(16) Robinson J. Boots to switch from onitored dosage systems to patient pack dispensing in care homes. The Pharmaceutical Journal 2019.

(17) Anon. Drug Tariff - Feb 2019. NHS Business Services Authority 2019.

(18) Elliott RA. Appropriate use of dose administration aids. Aust Prescr 2014; 37:46-50.

(19) Wang L-N. Multi-compartment compliance aids: Do you need to review what you do? The Pharmaceutical Journal 2013; 291:120.

(20) Glass B, Mangan M, Haywood A. Prochlorperazine tablets repackaged into dose administration aids: Can the patient be assured of quality? Journal of Clinical Pharmacy and Therapeutics 2009; 34(2):161-169.

(21) Donyai P. Quality of medicines stored together in multi-compartment compliance aids. Journal of Clinical Pharmacy and Therapeutics 2010; 35(5):533-543.

(22) Lecouturier J, Cunningham B, Campbell D et al. Medication compliance aids: A qualitative study of user' views. British Journal of General Practice 2011; 61(583):93-100.

(23) Kockler J, Robertson S, Hope D et al. Stability of paracetamol tablets repackaged in dose administration aids for *prn* use: Implications for practice. Journal of Pharmacy Practice and Research 2013; 43(3):218-220.

(24) Irwin A, Seaton J, Mearns J et al. Retrospective analysis of DATIX dispensing error reports from Scottish NHS hospitals. The International Journal Of Pharmacy Practice 2011; 19(6):417-423.

(25) Adams R, May H, Swift L et al. Do older patients find multi-compartment medication devices easy to use and which are the easiest? Age Ageing 2013; 42:715-720.

(26) Elliott RA, Lee CY, Beanland C et al. Medicines management, medication errors and adverse medication events in older people referred to a community nursing service: A retrospective observational study. Drugs - Real World Outcomes 2016; 3(1):13-24.

(27) Counter D, Stewart D, MacLeod J et al. Multicompartment compliance aids in the community: The prevalence of potentially inappropriate medications. British Journal of Clinical Pharmacology 2016; 83:1515-1520.

(28) Choudhry NK, Krumme AA, Ercole PM et al. Effect of reminder devices on medication adherence: The REMIND randomised clinical trial. JAMA Internal Medicine 2017; 177(5):624-631.

(29) Bhattacharya D, Aldus CF, Barton G et al. The feasibility of determining the effectiveness and cost-effectiveness of medication organisation devices compared with usual care for older people in a community setting: systematic review, stakeholder focus groups and feasibility randomised controlled trial. Health Technol Assess 2016; 20(50).

(30) Gilmartin JFM, Marriott JL, Hussainy SY. Exploring factors that contribute to dose administration aid incidents and identifying quality improvement strategies: the views of pharmacy and nursing staff. International Journal of Pharmacy Practice 2014; 22(6):407-414.

(31) Urban R, Paloumpi E, Rana N et al. Communicating medication changes to community pharmacy post-discharge: the good, the bad, and the improvements. Int J Clin Pharm 2013; 35(5):813-820.

(32) Mansoor SM, Aslani P, Krass I. Pharmacists' attitudes and perceived barriers to provision of adherence support in Australia. Int J Clin Pharm 2014; 36(1):136-144.

(33) Nunney J, Raynor DK, Knapp P et al. How Do the Attitudes and Beliefs of Older People and Healthcare Professionals Impact on the Use of Multi-Compartment Compliance Aids? A Qualitative Study Using Grounded Theory. Drugs & Aging 2011; 28(5):403-414.

(34) Barber ND, Alldred DP, Raynor DK et al. Care homes' use of medicines study: prevalence, causes and potential harm of medication errors in care homes for older people. Qual Saf Health Care 2009; 18(5):341-346.

(35) Mahtani KR, Heneghan CJ, Glasziou PP et al. Reminder packaging for improving adherence to self-administered long-term medications (review). Cochrane Database of Systematic Reviews 2011;(9).

(36) Alhomoud F, Alhomoud F, Miller I. How effectively are your patients taking their medicines? A critical review of the Strathclyde Compliance Risk Assessment Tool in relation to the 'MMAS' and 'MARS'. Journal of Evaluation in Clinical Practice 2016; 22(3):411-420.

(37) Morrison C. Care homes: The move away from using monitored dosage systems. The Pharmaceutical Journal 2014; 292(7805):394-395.

(38) Furmedge DS, Schiff R, Davies JG. Evidence and tips on the use of medication compliance aids. BMJ 2019; 362.

(39) Perks S, Robertson S, Haywood A et al. Clozapine repackaged into dose administration aids: a common practice in Australian hospitals. International Journal of Pharmacy Practice 2012; 20(1):4-8.

(40) Redmayne N, Robertson S, Kockler J et al. Repackaged sodium valproate tablets--Meeting quality and adherence to ensure seizure control. Seizure 2015; 31:108-111.

(41) Raimi-Abrahim BT, del Valle AG, Galcera CV et al. Investigating the physical stability of repackaged medicines stored into commercially available multicompartmental compliance aids (MCAs). Journal of Pharmaceutical Health Services Research 2017; 8:81-89.

(42) Ashurst A, Deans J. Using a monitored dosage system. British Journal of Nursing 1992; 1(8):379-382.

(43) George J, Elliott RA, Stewart DC. A systematic review of interventions to improve medication taking in elderly patients prescribed multiple medications. Drugs & Aging 2008; 25(4):307-324.

(44) George J, McNamara K, Laua R et al. The HAPPY trial: A randomised controlled trial of a community pharmacy-based intervention for improving patient adherence to antihypertensive medicines. International Journal of Pharmacy Practice 2010; 18(S2):22-23.

(45) Mosca C, Castel-Branco MM, Riberiro-Rama AC et al. Assessing the impact of multi-compartment compliance aids on clinical outcomes in the elderly: a pilot study. International Journal of Pharmacy Practice 2014; 36(1):98-104.

(46) Gilmartin-Thomas JFM, Smith F, Wolfe R et al. A comparison of medication administration errors from original medication packaging and multi-compartment compliance aids in care homes: A prospective observational study. International Journal of Nursing Studies 2017; 72:15-23.

(47) Gilmartin JFM, Marriott JL, Hussainy SY. Improving Australian care home medicine supply services: Evaluation of a quality improvement intervention. Australasian Journal on Ageing 2016; 35(2):E1-E6.

Appendix 2: Search Strategy.

Resource – date accessed	Search terms
Specialist Pharmacy Services - 20/12/2018	• Search: compliance aids
NICE Evidence - 20/12/2018	• Search: Medicines compliance aids
Cochrane Library – 20/12/2018	• Search: compliance aids
NICE – 20/12/2018	• Search: Medicines adherence
UpToDate – 20/12/2018	• Search: Medication compliance
Micromedex – 20/12/2018	• Search: Medication compliance, adherence
Medline – 14/01/2019	• **"**"MEDICATION ADHERENCE"/ AND ((multi-compartment compliance aids).af OR (monitored dosage systems).af OR (dosette).af OR (Dose administration aids).af OR (Multi-dose drug dispensing system).af)**"** • **"**exp "TREATMENT OUTCOME"/ AND ((multi-compartment compliance aids).af OR (monitored dosage systems).af OR (dosette).af OR (Dose administration aids).af OR (Multi-dose drug dispensing system).af)**"** • **:"**"COMMUNITY PHARMACY SERVICES"/ AND ((multi-compartment compliance aids).af OR (monitored dosage systems).af OR (dosette).af OR (Dose administration aids).af OR (Multi-dose drug dispensing system).af)**"** • **"**exp "DRUG PACKAGING"/ AND ((multi-compartment compliance aids).af OR (monitored dosage systems).af OR (dosette).af OR (Dose administration aids).af OR (Multi-dose drug dispensing system).af)**"** • **"**exp "MEDICATION ERRORS"/ AND ((multi-compartment compliance aids).af OR (monitored dosage systems).af OR (dosette).af OR (Dose administration aids).af OR (Multi-dose drug dispensing system).af)**"** • **~"**"MEDICATION ADHERENCE"/ AND "COMMUNITY PHARMACY SERVICES"/**"**
Medline – 26/04/2019	• **"**MEDICATION ADHERENCE"/ AND *"REMINDER SYSTEMS"/
Embase – 15/01/2019	• **"**"MEDICATION COMPLIANCE"/ AND ((multi-compartment compliance aids).af OR (monitored dosage systems).af OR (dosette).af OR (Dose administration aids).af OR (Multi-dose drug dispensing system).af)**"** • **"**((multi-compartment compliance aids).af OR (monitored dosage systems).af OR (dosette).af OR (Dose administration aids).af OR (Multi-dose drug dispensing system).af) AND ("NURSING HOME"/ OR "HOME FOR THE AGED"/ OR exp "HOME CARE"/)**"** • **"**exp "MEDICATION ERROR"/ AND ((multi-compartment compliance aids).af OR (monitored dosage systems).af OR (dosette).af OR (Dose administration aids).af OR (Multi-dose drug dispensing system).af)**"** • **"**((multi-compartment compliance aids).af OR (monitored dosage systems).af OR (dosette).af OR (Dose administration aids).af OR (Multi-dose drug dispensing system).af) AND ("DRUG MONITORING"/ OR PHARMACY/)**"**
EMBASE – 26/04/2019	• **"**MEDICATION COMPLIANCE"/ AND *"REMINDER SYSTEM"/
HMIC – 18/01/2019	• Search: compliance aids.af
BNI – 18/01/2019	• Search: compliance aids.af
AMED, BNI, CINAHL, HBE, HMIC, PsycINFO – 18/01/2019	• Search: "(multi-compartment compliance aids).af**"**
Google.com – 20/12/2018	• Search: what are Multi Compartment Compliance Aid, best practice for multi compartment compliance aids

Appendix 3: Summary of opinions from semi-structured surveys on MCCA usage in the literature.

Survey participants	Negative opinions noted	Positive opinions noted
The CHUMS study used qualitative measures to gather data from 256 residents (55 care homes) where 220 residents (80%) were dispensed some of their medicines in a MCCA(34).	Lack of space to accommodate warning labels Difficulty filling compartment. Similar appearance of preparation once removed from original packaging's. Variation between prescription and medication administration record. Lack of knowledge by pharmacy regarding care home systems. The prevalence of dispensing errors was three times higher than the rate found in primary care in the UK (based on a 2007 study which excluded MCCAs). The higher rate here reflected one type of MCCA that was difficult to label.	The authors suggested the idea of a lead (not sole) GP for each home. This role would need protected time and associated funding. In addition to caring for patients, they should liaise with other GPs and have responsibility to ensure, possibly by commissioning services, that patients on riskier medicines are appropriately monitored and that all patients' medication are regularly reviewed by a pharmacist. Consideration should be given to having one person with overall responsibility for medicines use in one or more care homes.
19 MCCA users(22).	Lack of dexterity to access the compartments requiring carer to access MCCA. No reminder to take medication so having to co-ordinate taking the MCCA medication with a daily activity. Carers finding the filling of MCCA labour intensive where interruptions led to errors such as loading the wrong compartment or accidently double filling. Users dropping medication from compartments without then being able to refill the lost tablet/capsule. Dispensing pills from blister pack could end up in the wrong compartment.	Reduction in the number of occasion's patients dispensed from the original packaging. Improved adherence to non-prescribed medication by adding to the MCCA. Medications unsuitable for MCCA could be kept next to the MCCA unit to assist in taking. Advanced preparation of the MCCA ensured users knew when to renew their prescriptions.
15 patients over 65 years living at home and taking between 4-15 solid dose oral medications via an MCCA(33). 17 pharmacies filling the MCCA of the 15 patients	Need a reminder to take the MCCA medications. Decanting MCCA medications into another smaller container for ease. Difficulty opening the MCCA. Unable to identify what tablets or capsules were being taken.	MCCA recommended for patients with poor memory, dexterity, and on polypharmacy. MCCA recommended by family member. A convenient device for polypharmacy.

Survey participants	Negative opinions noted	Positive opinions noted
	Changes to prescription causing delays. Provision of MCCA not discussed with patient who would then un-fill the MCCA. Patients feeling disempowered with less independence and control over their medications.	
Semi-structured interviews were used to establish the extent to which 14 community pharmacies received discharge medication information from 3 acute Trusts and for which patient groups, and to determine community pharmacy staff opinion on where and how current communication practice could be improved(31). The information received was predominantly for patients receiving MCCAs.	Hospitals do not communicate with community pharmacies since patients do not use the same community pharmacist consistently, making it difficult to know where to send discharge information or for the hospital to know who to liaise with. Community pharmacists reported that the receipt of information regarding medication changes was inconsistent. The pharmacists described a lack of standardisation in communication received. Eleven pharmacies dispensed medication for nursing homes and five of these reported never having received any information from the nursing home following hospital discharge of one of their patients. Seven pharmacists felt that the consequences of poor communication could be 'fatal' and lead to patient harm.	Where communication was received pharmacists reported finding it helpful and informative provided it was complete. Positive examples of good communication included hospitals notifying pharmacies regarding MCCA patients in advance of discharge to allow medication to be altered in a timely manner.
126 pharmacies surveyed to investigate their strategies for identifying non-adherent patients and how they supported adherence(32).	Respondents reported that they used strategies to identify non-adherent patients for less than half (42 %) of the prescriptions dispensed in their practice. The majority (95 %) of respondents reported that providing MCCAs was the most common strategy they used when a patient was identified as not adhering to medications, followed by recommending a medication management review (78 %). Patients' time pressure was the most common barrier identified by respondents (n = 80). The main pharmacist-related barriers reported	More than half (62 %) reported that they are interested in receiving training (with 76 % preferring online training and 42 % via workshops).

Survey participants	Negative opinions noted	Positive opinions noted
	were pharmacists' time pressures (38 %), followed by a lack of clinical information about patients (22 %). Most respondents (75 %) reported that they had not received any special training in monitoring and support of patients' adherence to medications.	
13 healthcare professional (6 pharmacists, 1 pharmacy technician, 5 registered nurses and 1 resident care home worker) regarding the factors contributing to MCCA incidents(30).	Lack or delayed communication between residential care home staff and MCCA filler. Prescribers were poor at communicating medication changes with residential care home workers. All groups felt medication records were often outdated. Sources of MCCA errors included: failing to incorporate recent medication changes, time restrictions when preparing large volumes of MCCAs, concerns when handling a large volume of small tablets, difficulty identifying medication in the MCCA and frustration with inadequate remuneration for MCCA services.	
8 pharmacists on the factors that led to the widespread adoption of MCCAs into UK care homes(11).	MCCAs would continue to be used in care homes with little change to existing practices since a significant catalyst for change and the evidence of harm could not be identified.	MMCAs had been used for many years and were favoured by care home staff. Completely remove MCCAs from care homes and store medicines in resident rooms alongside training care home staff to administer medication from original packaging. MCCA use could continue where pharmacist and prescriber provided medicine reviews. Greater staff collaboration and consultation to assess MCCA appropriateness and renumeration.

Appendix 4: Summary of published stability of medications in MCCAs.

Medication	Outcome
Prochlorperazine (anti-emetic)(20).	Risk of discoloration in prochloroperazine tablets following 2 weeks of storage in MCCAs due to light exposure. This could lead to reduced patient adherence through inability to identify the tablet being taken though chemical analysis showed no product degradation.
Atenolol (antihypertensive) Aspirin, dispersible (anti-platelet)(21).	The use of aspirin tablets in MCCAs is not supported because they are deemed hygroscopic. The storage of atenolol tablets in one brand of MCCA at elevated temperature and humidity softened the tablets, prolonged disintegration time and hindered dissolution, which together had the potential to reduce bioavailability. The stability of medications in MCCAs would be manufacturer and MCCA specific.
Clozapine (antipsychotic)(39).	Clozapine tablets, when correctly repackaged into MCCAs and appropriately stored with protection from light and heat maintained physical and chemical stability for 6 weeks. The study highlighted the role of the pharmacist in ensuring the stability of repackaged drug products in the pharmacy by limiting the time between removal of these tablets from the original packaging and repackaging into the MCCA. In addition, the pharmacist was ideally placed to counsel patients on the importance of maintaining the integrity of the MCCA.
Paracetamol (analgesic)(23).	Australian care homes routinely repacked paracetamol tablets at maximum daily dose for when required use via the MCCA. No physical or chemical degradation of paracetamol was seen at 12 months in vitro when the MCCA was stored correctly away from exposure to humidity and light.
Enteric coated sodium valproate (anti-epileptic)(40).	Repackaged enteric coated sodium valproate tablets could be stored for up to 28 days under either refrigerated or controlled room temperature conditions. However, storage under accelerated conditions of humidity and temperature caused tablet rupture after 8 days.
Atenolol (antihypertensive) Aspirin, dispersible (anti-platelet) Lansoprazole (gastro-protector)(41).	The findings suggested that the presence of excipients (including film coat and capsule shell) may influence the water uptake mechanisms within a formulation, which in turn could have an impact on the dosage form properties and performance. Findings from this study confirmed that changes in solid dosage form quality are observed when repackaged into MCCAs compared to manufacturers' packaging resulting in differences in in-vitro dissolution performance, though the products remained within British Pharmacopeia specifications.

Appendix 5: Summary of published evidence where the outcome does not suggest a detrimental outcome from use of MCCAs in the stated setting.

Brief review of citation	Outcome
Review of the published research to date with a large amount of author opinion presented(42). The review focused on the use of multiple MCCA devices in care homes: one for regular medication, one for when required medication, and original packs for non-MCCA suitable medications (with a reminder aid). No data presented to support the suggested outcomes.	MCCA had the potential to make medication administration easier, safer, more hygienic and quicker in care homes. Medication wastage was noted to be a problem following medication changes in the MCCA since the device would need to be re-filled. The authors proposed a 7 day MCCA to overcome this issue.
A follow up to the CHUMS study was designed to determine if there were any differences in administration error rates between tablets and capsules and other formulations; and if there were any differences in medication administration error rates between tablets and capsules dispensed in MCCA and those dispensed in the manufacturer's original packaging in UK care homes(9). The study sampled 55 residential and nursing care homes and included 233 patients (taking at least one or more prescribed medication). Data was taken from observed administration error paperwork which was completed by two clinical pharmacists observing two drug rounds at each care home.	For 1,380 medicines, 732 were administered from MCCAs and 404 tablets or capsules not in non-MCCA, with the remainder being combinations of liquids, inhalers, topicals, topical transdermal systems, injections. In addition, 105 medications were noted to be when required dosing and 1,275 medicines were prescribed for regular administration. Suggested that 86% of UK care homes at the time used MCCAs. Administration errors occurred in 22.3% of residents and in 8.4% of observed medication administration events. Tablets and capsules in MCCAs accounted for 53% of observed administrations, and the mean number of errors per resident was similar for tablets and capsules in MCCA (0.17) and tablets or capsules not in MCCAs (0.20). The mean number of errors per resident was higher for the combined category of topical/transdermal/injection (0.55) and inhalers (1.13). The unadjusted odds ratio suggested that administration of tablets and capsules in their original packaging was associated with an approximately 70% higher risk of error compared with administration of tablets and capsules in MCCA (1.00 vs 1.68), but this difference was not statistically significant (p=0.15). Liquid formulations were commonly prescribed in this setting owing to dysphagia, and the risk of administration errors with liquids was four times higher than tablets and capsules. The observed evidence suggested that MCCA were safer in care homes, with approximately half the odds of administration errors when compared with tablets and capsules in the manufacturers' original packaging. The evidence for this observation, however, was of marginal significance (p=0.04).
A systematic review researching the evidence of medication adherence in patients over 65 years old in the community / recently discharged from hospital and prescribed at least 4 long-term medications(43). Patients were followed up for at least 4 weeks.	Eight studies included where 3 used MCCA in selected patients. The MCCA studies showed no impact on overall adherence with only one paper showing an improvement in adherence where pharmacists provided the MCCA and regular home visits to discuss medication use. It was no possible to differentiate the impact between MCCA alone and pharmacist input.
Fifty-five Australian community pharmacies were randomised to evaluate the impact of various interventions on patient adherence to blood pressure medications(44). The study arms were blood pressure monitoring, self-monitoring blood pressure training, motivational interview, medication use review, and prescription refill reminders.	Overall, the study found around a 6% improvement in adherence with usual care compared to a 22% improvement in adherence with pharmacist care. No significance data presented.

Brief review of citation	Outcome
MCCAs were offered based on pharmacist review though no data specific to the impact of these was generated.	
Portuguese prospective non-randomised controlled study assessing the impact of using MCCAs (for 3 or more medications) over 4-months in self-reported medication compliance and clinical biomarkers of patients over 65 years in a community pharmacy(45). Allocation to intervention (N=44) or control group (N=10) was based upon acceptance of the MCCA and all patients had a baseline evaluation and one consultation with the pharmacist every month (a total of 4 consultations). At each monthly consultation, intervention group patients received four MCCAs filled with the medication. Patients in control group obtained their medication in original packaging and received regular follow-up in the pharmacy.	The researchers found an apparent improvement in the MCCA group however, a multivariate statistical model demonstrated that the difference was not associated with the use of MCCA. This suggests that the pharmacist's follow-up had an effect on medication adherence, but MCCA had no additional effect.
Compared the effect of original medication packaging and MCCAs on medication administration accuracy in care homes(46). A pharmacist researcher directly observed solid, orally administered medications in tablet or capsule form at ten care homes (five only used original medication packaging and five used both MCCAs and original medication packaging). Forty-two staff (36 nurses, 6 carers) were observed administering medications to 823 residents during 90 medication administration rounds. A total of 2,452 medication doses were observed (1,385 from original medication packaging and 1,067 from MCCAs). Observed medication doses could include both 'regular' and 'when required' medications and medication consumption by the resident was not always observed but instead confirmed with staff.	One hundred and seventy-eight medication administration errors were identified from 2,493 opportunities for error (7.1% overall medication administration error rate). A greater medication administration error rate was seen for original medication packaging than MCCAs (9.3% and 3.1% respectively, risk ratio (RR)=3.9, 95% confidence interval (CI) 2.4 to 6.1, p<0.001). A significant difference in error rate was not observed between use of single or combined medication administration system (p>0.05).
Australian study to determine the impact of a quality improvement intervention on how accurately and suitably medicines were supplied to residents of care homes(47). The objectives of the study were to: identify the types and frequency of MCCA incidents in care homes that had received a quality improvement intervention (post-intervention), compare the incident rates identified post-intervention, with pre-intervention MCCA audit results, and compare the incidents identified pre- and post-intervention according to their potential risk of causing an adverse event. The quality improvement intervention was education session for 45 care home staff delivered by a pharmacist and an awareness toolkit, followed by a survey 3 months later. An MCCA error was defined as a discrepancy between the medicine chart and the MCCA; unsuitable medicine packing according to pharmaceutical guidelines; damaged medicines; and inappropriately altered/divided medicines.	The overall MCCA incident rate was significantly higher (21.0%, $P < 0.001$) than the incident rate identified pre-intervention (11.5%). The conclusion was that the intervention failed to improve medication safety in care homes.

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