Do older patients find multi-compartment medication devices easy to use and which are the easiest?

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Abstract

Background: multi-compartment medication devices (MMDs) are widely used, primarily by older people, to aid correct medication taking. Several MMD types are available yet little is known about the ease with which patients with varying functional ability use these devices and whether some types are easier than others. Such knowledge would assist healthcare practitioners in advising patients on a suitable choice of device.

Objective: this study investigates the ease with which patients with differing functional ability use three types of MMD.

Method: participants were recruited from an older person’s medical ward. Demographic and medication information, cognitive function, visual acuity and manual dexterity were recorded. The Venalink®, Nomad Clear® and Dosett® MMDs were tested. Participants rated each MMD according to text readability, ease of opening, ease of medication removal, transportability and overall rating. These ratings were compared between MMDs for all patients and for subgroups with differing functional abilities.

Results: the MMDs were trialled by 50 patients; the majority rated text readability well but rated MMDs poorly according to the other criteria. Cognitively impaired participants may encounter difficulties in opening and removing medication from Venalink® and Nomad®. The Dosett® consistently rated better across all criteria. Transportability was the most influential criterion for overall MMD usability.

Conclusion: the poor patient rating of MMDs which are widely used in practice is of concern. Some MMDs may be difficult to open and access, especially for patients with cognitive impairment. This offers some guidance to health professionals in advising patients on MMD choice however, overall MMD rating appears dominated by transportability.

Keywords: compliance aid, adherence, functional ability, medication organiser, medication packaging, older people

Introduction

An estimated 50% of patients do not adhere to their prescribed medication regimen [1], resulting in negative health and economic outcomes [2]. The population over 65 years have a higher prevalence of co-morbidities [3] and therefore are prescribed more medicines relative to younger patients [4]. Regimen complexity is negatively associated with medication adherence [5] and ability to self-manage declines with age [3].

Non-adherence arises from a lack of ability or willingness to take medication as intended by the prescriber and is often a combination of intentional and unintentional factors [6].

Despite little evidence of the impact of multi-compartment medication devices (MMDs), they are widely recommended by healthcare professionals to address poor adherence with an estimated 100,000 patients using these devices across the UK [7]. MMDs are usually a variation on the design of a box or a blister pack, divided into days of the week with several compartments per day to allow for different dose timings. Numerous MMDs are available; varying in size and method of medication access from the device [8]. Medication packaging serves a number of roles including protecting the medication from the environment and access by children (Medication is removed from its original manufacturer packaging and

References

1. Available at: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4314939/
2. Available at: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4314939/
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8. Available at: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4314939/
dispensed into the MMD). However, these functions may inhibit access to people with impaired cognitive and/or physical function. Despite MMDs 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.

Patient ability to access medication from commercially produced packaging has been widely explored [9, 10]. In 1994 Atkin et al. reported that 41% of the older participants were unable to perform one or more of the tasks to gain access to varying forms of commercial packaging. The study included one MMD (Dosett®) and reported that poor vision and impaired cognitive function were predictors of inability [9]. There are no subsequent studies reporting the ease of using different types of MMD. Nor are there reports of the relative importance of aspects of MMD characteristics in influencing overall ease of use.

Aims

To investigate the ease with which patients of differing functional ability use various types of MMD and whether some types are easier to use than others.

Objectives

- Compare three types of MMD with respect to ease of use.
- Investigate whether a patient’s functional ability is related to their ratings of ease of use.
- Determine the relative importance of aspects of ease of use in influencing overall patient rating.

Method

Ethical and NHS research governance approval were obtained prior to study commencement at Medicine for Older Persons wards of a large UK teaching hospital. Eligible patients were regularly prescribed a minimum of one medicine and had a conversational level of English. Patients were excluded if not self-administering their medication, access was restricted to staff directly involved in their care or they were unable to provide informed consent.

Eligible patients were identified and approached by a hospital doctor; patients expressing an interest in participation were subsequently approached by a researcher for recruitment. Data collection was initiated by two researchers post-informed consent.

Based on 148 beds across four wards and an approximate mean turnover of 14 days, it was anticipated that an 8-week data collection period would provide 600 patients. Allowing for doctor and patient availability it was estimated that 25% (150) of these could be identified and approached by a hospital doctor. If a third of these consented and completed the tests, the resulting sample of 50 would be sufficient to detect an effect size of 0.5 between two matched MMDs with 89% power assuming 0.05 significance and a worse case asymptotic relative efficiency of 0.864.

Participant characteristics

Medical records were accessed to obtain age, gender, living arrangements pre-admission and number of regularly prescribed medicines. Participants reported via questionnaire completion whether they had any prior experience of using an MMD or any previous problems with accessing medication from packaging.

Functional ability tests

Validated tests presenting the least burden to participants with acceptable sensitivity were selected. Cognitive function was assessed using the Mini-Cog test which produces binary data of impaired or unimpaired cognitive function [11]. Visual acuity was assessed using the Vocational-Near-Vision Test Type [12], and the Grooved Pegboard was used to assess manual dexterity [13]. The mean time per pin was calculated for all patients who attempted the task.

Participant rating of MMDs

Three MMDs were selected for rating: Venalink®, Nomad Clear® and Dosett® as collectively they account for >60% of the UK market share [14] (and data on file) and represent varying sizes and methods of medication access from the device. Figure 1 illustrates the three MMDs; the Venalink® is a cold-sealed blister pack which is also similar to most commercially available heat-sealed devices. The Nomad Clear® represents the monitored dosage systems and the Dosett® is similar to most MMDs sold within community pharmacies for self-filling or filling by lay carers [15].

Participants were presented with the three MMDs each containing seven days of placebo tablets. For each MMD, participants were asked to read the text indicating the days of the week and times of the day (comprehension was not assessed), remove a placebo tablet and then rate the MMD on a 10-point VAS (ability to open the MMD and remove a tablet was not independently assessed). A score of ‘1’ indicated easy/convenient/very positive rating and ‘10’ difficult/inconvenient/very negative rating. Participants rated each MMD against five criteria

(i) ease of reading the text on the MMD;
(ii) ease of opening the MMD in order to access placebo medication;
(iii) ease of placebo medication removal from MMD;
(iv) perceived convenience of transporting MMD;
(v) overall rating.

Additionally, for each criterion, space was provided for participant comments.

Analysis

Descriptive statistics were calculated for the sample. The scores for the three functional ability tests and participant ratings of MMDs were summarised. Median ratings were compared between MMDs using the Friedman test. For each
MMD the frequency of participants allocating it their highest overall rating was calculated. For the Vocational-Near-Vision Test Type results, the proportion of participants unable to read font size 12 or smaller was calculated as this is the minimum font size for literature recommended by a national organisation for blind and partially sighted people [16].

Bivariate analyses were performed between the criteria ratings of each MMD and functional ability variables using Mann–Whitney U (for cognitive impairment) or Spearman’s correlation. Regression with a random effect for participant was used to investigate which of the four criteria for ease of use and whether participant characteristics and functional abilities predict overall rating. While a nominal significance level of 0.05 was taken, conservative interpretation accounted for simultaneous multiple testing. All statistical work was executed using SPSS versions 14–18.

Participant comments were analysed for common themes using a thematic approach by AM. Not all participants have been referenced in the results; however, every effort was made to give a spread of opinions. The final quotes used were checked against original questionnaire comments by a second researcher (DB) to ensure they were representative of the group.

## Results

Of 120 eligible patients identified, 50 (42%) consented. The sample was primarily female with 12 (24%) male participants. Ages ranged from 77 to 98 years (median of 85 years). Pre-admission, nearly all participants lived in their own home; 26 (52%) were living independently and 18 (36%) with a carer. A further five (10%) lived in a retirement home and one (2%) in a care home with nursing. Participants were prescribed between 1 and 15 medications (median 5) and 11 (22%) had prior experience of using an MMD. Previous problems with accessing medication from its packaging were reported by 27 (54%) participants.

### Functional ability tests

The Mini-Cog identified 20 (40%) participants as having impaired cognitive function. Visual acuity ranged from a point size of 5 to 48; median (IQR) of 9 (8, 12), with 11 (22%) participants being unable to read font size 12 or smaller.

The Grooved-Pegboard test was refused by 22 (44%) participants; all cited feeling too tired. A further 15 (30%) did not complete the test. For the 28 participants attempting the test (13 completed), the time per pin ranged from 3.2 to 57.5 s, median (quartiles) of 10.75 (6.43, 18.17) s.

### MMD rating

Table 1 summarises participant ratings of the three MMDs. The distributions were bimodal and ratings of 1 or 2 were categorised as easy/convenient, ratings >7 as difficult/inconvenient. For ‘text readability’ there was no significant difference between median ratings for the three MMDs; the majority of participants reported the text easy to read. The clarity of text on the Venalink® was, however, cited as a problem:

- ‘light shines off reflective cover, can be difficult to read’
- ‘clear but would be better on black background’

Similarly, with the Nomad® it was suggested that:

- ‘different colour would be better’

The days of the week on the Nomad® were easy to read but the timings were considered too small and the font on the Dosett® was generally considered too small. The Venalink® was particularly difficult to open; reportedly requiring too much pressure to open the blister, being ‘too small’ and ‘too flexible’. Despite scoring well, some participants reported that the Nomad® was ‘stiff and hard’, ‘indistinct. Not easy to contrast between grey and blue’ and that the Dosett® was ‘awkward’ and ‘stiff’.

### Figure 1

Multi-compartment medication devices (MMDs) tested.
Both Venalink\(^\text{®}\) and Nomad\(^\text{®}\) were more difficult than the Dosett\(^\text{®}\) for removing medication and less transportable. No comments were provided about the Venalink\(^\text{®}\) but for the Nomad\(^\text{®}\) it was reported that the flap hindered medication removal. The Dosett\(^\text{®}\) was reported to be ‘stiff to slide’ and that ‘tablets would easily spill everywhere’.

Only 18 and 14\% of participants reported the Venalink\(^\text{®}\) and Nomad\(^\text{®}\), respectively, to be convenient to transport; the repeated theme was that they are too large. Conversely, 32\% of participants reported the Dosett\(^\text{®}\) easy to transport.

The Dosett\(^\text{®}\) was allocated their best overall rating by 27 (54\%) participants followed by the Venalink\(^\text{®}\), which was rated most highly by 7 (14\%) participants and the Nomad\(^\text{®}\) by 5 (10\%). The remaining participants allocated multiple MMDs their best overall rating.

Tables 2–4 summarise the bivariate analyses between the ratings and each functional ability test. Cognitively impaired participants reported even more difficulty in opening the Venalink\(^\text{®}\) and removing medication from the Nomad\(^\text{®}\) than non-impaired participants. However, as five similar tests were conducted for each MMD, the results should be interpreted with caution. No significant associations were identified between the Grooved-Pegboard results and ability to open or remove medication from MMDs. Highly significant positive correlations were identified between the Vocational-Near-Vision Test Type score and text readability of all three MMDs.

A regression to determine which of the four criteria ratings of ease of use were predictors of overall rating identified only transportability as significant, explaining 46.2\% \((R^2 = 0.462)\) of the total variance (coefficient 0.62, \(P < 0.001\), 95\% CI: 0.49–0.75).

For models investigating the contribution of functional abilities and patient characteristics to overall MMD rating, time per pin was included as low (\(\leq 10\) s), high (\(>10\) s) or missing to address missing Pegboard results. The bivariate associations differed for each MMD suggesting that separate models should be fitted. A mixed-effect linear model including the interections of functional abilities and patient characteristics with type of MMD confirmed existence of significant interactions.

The multiple regression exploring impact of functional ability and patient characteristics on MMD rating identified for the Venalink\(^\text{®}\) that living independently predicted a higher rating (more difficult to use) \((2.41, 95\% \text{ CI}: 0.90–3.94, P = 0.003)\) as did the number of prescribed medications \((0.389, 95\% \text{ CI}: 0.11–0.67, P = 0.007)\). Previous MMD experience made it easier \((-2.03, 95\% \text{ CI}: -3.94–0.13, \ P = 0.038)\). For the Nomad\(^\text{®}\), those living independently predicted a higher rating \((1.64, 95\% \text{ CI}: 0.06–3.23, P = 0.043)\), whereas those previously experiencing problems with accessing medication predicted a lower rating (easier to use) \((-1.56, 95\% \text{ CI}: -3.11, -0.1, P = 0.049)\). For the Dosett\(^\text{®}\), those reporting previous access problems had higher scores although this was not significant \((1.54, 95\% \text{ CI}: -0.12, 3.20, P = 0.068)\). No other predictors were significant.

As a sensitivity analysis, variants of the models were fitted with time per pin in seconds; broadly similar coefficients, but higher \(P\)-values were obtained.

### Discussion

The reasonable consent rate which is similar to other MMD studies [7] and sample demographics reflecting the characteristics of the population primarily using MMDs [7, 17] afford some confidence in the generalisability of the results. The magnitude of impaired cognitive function and visual acuity was also similar to other studies [18, 19]. The Grooved-Pegboard test despite being simpler to complete than the ‘gold-standard’ Purdue Pegboard test [20], proved too onerous as a manual dexterity assessment and therefore an alternative measure is necessary for any subsequent study.

The results suggest that a large proportion of patients provided with MMDs may be unable to access their medication with ease. All three MMDs performed reasonably well
The Venalink® was rated particularly badly by participants with previous study findings that cognitive function is associated with ease of medication access from packaging. [9] Participant reported problems were contradictory to these findings as they related to the force and dexterity necessary to manipulate the MMD. There may therefore be an element of participants being reluctant to report MMD complexity as a barrier to use. This requires further exploration but introduces the notion that healthcare professionals may need to be aware of such sensitivities when involving a patient in decision-making.

in terms of readability although manufacturers may wish to consider the materials and colours used due to negative remarks about text clarity.

The Nomad® clear and Dosset® were better rated than the Venalink in terms of ease of opening and removing medication. The Venalink® was rated particularly badly by participants with impaired cognitive function which is in accordance with previous study findings that cognitive function is associated with ease of use.

### Table 2. The relationship between MMD ratings and participant functional ability, relationship between MMD rating and Mini-Cog Test score (n = 50)

<table>
<thead>
<tr>
<th>Criterion</th>
<th>Impaired</th>
<th>Unimpaired</th>
<th>Impaired</th>
<th>Unimpaired</th>
<th>Impaired</th>
<th>Unimpaired</th>
</tr>
</thead>
<tbody>
<tr>
<td>Text readability MMD rating [median (quartiles)]</td>
<td>1.5 (1, 6.25)</td>
<td>2 (1, 4.25)</td>
<td>1.5 (1, 7)</td>
<td>2 (1, 4)</td>
<td>2 (1, 7.5)</td>
<td>1.5 (1, 4.5)</td>
</tr>
<tr>
<td>Mann-Whitney U (P)</td>
<td>0.983</td>
<td>0.760</td>
<td>0.760</td>
<td>0.748</td>
<td>0.514</td>
<td>0.514</td>
</tr>
<tr>
<td>Ease of opening MMD rating [median (quartiles)]</td>
<td>9 (3.5, 10)</td>
<td>7 (2, 8.25)</td>
<td>3 (2, 7.75)</td>
<td>2 (1, 4.25)</td>
<td>4 (2, 9)</td>
<td>3 (1.75, 5)</td>
</tr>
<tr>
<td>Mann-Whitney U (P)</td>
<td>0.042</td>
<td>0.090</td>
<td>0.090</td>
<td>0.090</td>
<td>0.210</td>
<td>0.210</td>
</tr>
<tr>
<td>Ease of removal MMD rating [median (quartiles)]</td>
<td>8 (3, 10)</td>
<td>5 (1.75, 8.25)</td>
<td>6.5 (3, 9.75)</td>
<td>4.5 (1.75, 8)</td>
<td>3 (2, 8)</td>
<td>2.5 (2, 5.25)</td>
</tr>
<tr>
<td>Mann-Whitney U (P)</td>
<td>0.094</td>
<td>0.027</td>
<td>0.027</td>
<td>0.027</td>
<td>0.408</td>
<td>0.408</td>
</tr>
<tr>
<td>Transportability MMD rating [median (quartiles)]</td>
<td>5 (4.25, 8)</td>
<td>5 (3, 7.5, 8)</td>
<td>4.5 (3, 8)</td>
<td>6 (3.75, 8)</td>
<td>3 (2, 5)</td>
<td>3.5 (2, 6)</td>
</tr>
<tr>
<td>Mann-Whitney U (P)</td>
<td>0.714</td>
<td>0.530</td>
<td>0.530</td>
<td>0.530</td>
<td>0.810</td>
<td>0.810</td>
</tr>
<tr>
<td>Overall rating MMD rating [median (quartiles)]</td>
<td>5 (3.5, 7)</td>
<td>5 (4, 7.25)</td>
<td>5 (4, 7)</td>
<td>5.5 (2, 7.25)</td>
<td>4 (2, 6)</td>
<td>4 (2, 5.25)</td>
</tr>
<tr>
<td>Mann-Whitney U (P)</td>
<td>0.841</td>
<td>0.992</td>
<td>0.992</td>
<td>0.992</td>
<td>0.802</td>
<td>0.802</td>
</tr>
</tbody>
</table>

| High (>10 s) mean time per pin (n = 13) and low (≤10 s) mean time per pin (n = 15). |

### Table 3. Relationship between MMD rating and Vocational Near Vision Test Type score (n = 50)

<table>
<thead>
<tr>
<th>Criterion</th>
<th>Venalink®</th>
<th>Nomad® Clear</th>
<th>Dosset®</th>
</tr>
</thead>
<tbody>
<tr>
<td>Text readability MMD rating [median (quartiles)]</td>
<td>3.5 (1.25, 8.5)</td>
<td>2 (1, 7.75)</td>
<td>4.5 (1.25, 8.5)</td>
</tr>
<tr>
<td>Spearman correlation (P)</td>
<td>0.491 (0.003)</td>
<td>0.383 (0.006)</td>
<td>0.571 (0.00002)</td>
</tr>
<tr>
<td>Ease of opening MMD rating [median (quartiles)]</td>
<td>8 (2, 9.75)</td>
<td>7.5 (2, 9)</td>
<td>2 (1, 7.5)</td>
</tr>
<tr>
<td>Spearman correlation (P)</td>
<td>0.075 (0.604)</td>
<td>0.100 (0.490)</td>
<td>0.240 (0.093)</td>
</tr>
<tr>
<td>Ease of removal MMD rating [median (quartiles)]</td>
<td>8 (2, 10)</td>
<td>5 (2, 9.25)</td>
<td>6.5 (2, 9)</td>
</tr>
<tr>
<td>Spearman correlation (P)</td>
<td>0.121 (0.402)</td>
<td>0.260 (0.069)</td>
<td>0.247 (0.084)</td>
</tr>
<tr>
<td>Transportability MMD rating [median (quartiles)]</td>
<td>5 (4, 7.75)</td>
<td>5 (3, 7.5, 8)</td>
<td>5.5 (3, 8)</td>
</tr>
<tr>
<td>Spearman correlation (P)</td>
<td>0.022 (0.881)</td>
<td>0.011 (0.941)</td>
<td>0.042 (0.774)</td>
</tr>
<tr>
<td>Overall rating MMD rating [median (quartiles)]</td>
<td>5 (3.5, 7)</td>
<td>5 (4, 7.75)</td>
<td>5 (4, 7.75)</td>
</tr>
<tr>
<td>Spearman correlation (P)</td>
<td>−0.105 (0.466)</td>
<td>0.017 (0.905)</td>
<td>0.095 (0.512)</td>
</tr>
</tbody>
</table>

### Table 4. Relationship between MMD rating and Grooved-Pegboard test score (n = 28)

<table>
<thead>
<tr>
<th>Criterion</th>
<th>Venalink®</th>
<th>Nomad® Clear</th>
<th>Dosset®</th>
</tr>
</thead>
<tbody>
<tr>
<td>Text readability MMD rating [median (quartiles)]</td>
<td>1 (1, 3)</td>
<td>2 (1, 4)</td>
<td>1 (1, 4)</td>
</tr>
<tr>
<td>Spearman correlation (P)</td>
<td>−0.250 (0.199)</td>
<td>−0.455 (0.015)</td>
<td>−0.248 (0.203)</td>
</tr>
<tr>
<td>Ease of opening MMD rating [median (quartiles)]</td>
<td>5 (2, 8)</td>
<td>7 (1.9)</td>
<td>2 (1, 5)</td>
</tr>
<tr>
<td>Spearman correlation (P)</td>
<td>0.166 (0.399)</td>
<td>−0.47 (0.811)</td>
<td>0.277 (0.154)</td>
</tr>
<tr>
<td>Ease of removal MMD rating [median (quartiles)]</td>
<td>5 (1.5, 9)</td>
<td>3 (2.5)</td>
<td>3 (1.5, 6.5)</td>
</tr>
<tr>
<td>Spearman correlation (P)</td>
<td>−0.118 (0.549)</td>
<td>−0.313 (0.489)</td>
<td>0.320 (0.107)</td>
</tr>
<tr>
<td>Transportability MMD rating [median (quartiles)]</td>
<td>5 (2, 8)</td>
<td>5 (3.5, 8)</td>
<td>5 (3.8)</td>
</tr>
<tr>
<td>Spearman correlation (P)</td>
<td>−0.231 (0.237)</td>
<td>−0.376 (0.049)</td>
<td>−0.041 (0.837)</td>
</tr>
<tr>
<td>Overall rating MMD rating [median (quartiles)]</td>
<td>5 (4, 6)</td>
<td>6 (4.2, 8.5)</td>
<td>6 (4, 8)</td>
</tr>
<tr>
<td>Spearman correlation (P)</td>
<td>−0.266 (0.172)</td>
<td>−0.157 (0.425)</td>
<td>0.018 (0.926)</td>
</tr>
</tbody>
</table>

High (≥9) mean time per pin (n = 30) and low (≤9) mean time per pin (n = 20).
Given that the Dosett® is smaller than the other two MMDs, it is unsurprising that it was considered most convenient to transport. All of the MMDs, however, performed poorly in this category with participants expressing a clear desire for smaller devices. The Dosett® was most frequently given the best overall rating; while performing well for all criteria, the key factor predicting overall rating was transportability. There is some indication that the Venalink® and Nomad® were more difficult to use for those living independently which may be related to them being less transportable.

Inter-participant variation in MMD rating indicates that selection should be made from a range of MMDs and that it is not a case of ‘one size fits all’. The results provide some guidance for health professionals in advising their patients; <50% of the variability in overall rating could be accounted for by the four criteria of ease of use, suggesting that other factors may play a part in patient preference. Hence, it seems appropriate that patients should be involved in the decision-making despite evidence that this is not currently widely adopted [7].

Key points

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

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Conflicts of interest

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