

## **Single Portion Packaging And The Use Of User Test Protocols To Determine Patient Accesibility**

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1 **ABSTRACT**

2           In 2015, the UK National Health Service (NHS) established a taskforce to review  
3 single portion food and beverage packaging, which has been identified as a potential  
4 challenge to users in hospitals. Hence, a study was undertaken to determine the suitability  
5 and accessibility of the current single portion packs. The packaging was assessed using ISO  
6 17480 (*Guidelines for Accessible Packaging*), Annex D. The standard determines a pass or  
7 fail of packaging opening asking a panel 20 older adults to open a pack. A pack is recorded as  
8 a failure if within the 20 people cohort there is an example of pack being unable to be opened  
9 within the time limit (defined as 1 minute) or the overall satisfaction score ranks below 3 on a  
10 5 point Likert scale.

11           Ten standard single portion packaging items were randomly selected for testing. The  
12 packs were chosen to reflect a broad range of food and beverage and packaging types.

13           The results showed that the standard provided useful assessment data, identifying that  
14 70% of packs were so poorly designed that they failed to pass the standard, with 50% of the  
15 packs having examples that were uopenable by participants, whilst a further 20% rated poorly  
16 for satisfaction.

17

18 **KEYWORDS**

19           Packaging, accessibility, malnutrition

## 1 INTRODUCTION

2 Malnutrition in older people has been identified as a significant problem. A recent  
3 report published by BAPEN (British Association for Parenteral and Enteral Nutrition)  
4 estimates that nearly 3 million people currently suffer malnutrition in the UK, costing more  
5 than £19bn (approximately \$14bn US Dollars) a year, <sup>1</sup>. A further report by this organisation  
6 “Malnutrition among Older People in the community: Policy Recommendations for  
7 Change”, <sup>2</sup> estimated that nearly 10% of the population over the age of 65 in the UK,  
8 currently suffer some form of malnutrition, approximately 1 million people. It is not just in  
9 the community that malnutrition is seen to have a significant impact on the health of older  
10 people. A review paper by Schenker, <sup>3</sup> estimated 40% of UK hospital patients were  
11 malnourished with 60% at risk, with the . . .’ average food intake less than 75% of that  
12 recommended, particularly among the elderly (*sic*).’ Further studies have shown that older  
13 adults are five times more likely to be at risk of malnutrition than younger patients, <sup>4-6</sup>.

14 In 2007, Australian researchers conducted a 1-day malnutrition prevalence audit  
15 across hospital sites in the New South Wales Region and showed 51% (n = 777) to have  
16 some degree of malnutrition. <sup>7</sup> The report highlighted the difficulty experienced by some  
17 patients in opening food and beverage packaging with a number of these patients indicating  
18 that they did not eat the food because they could not open it. Further work by Walton,  
19 Williams, and Tapsell, <sup>8</sup> and Tsang, <sup>9</sup> has also identified inability to access food and beverage  
20 packaging as a contributing factor to malnutrition among older adults and disabled people in  
21 hospitals.

22 Work by Bell et al., <sup>10</sup> studied the relationship between grip strength and the difficulty  
23 to open packaging. The study measured 140 participants (mostly older adult inpatients) and  
24 64 staff members recruited from local public hospitals. Data were collected using interviews,

1 questionnaires, observations and grip strength testing using a Jamar dynamometer. Several  
2 food and beverage packages were found difficult to open by at least 40% of patients. These  
3 included milk and juices (52%), cereal (49%), condiments (46%), tetra packs (40%) and  
4 water bottles (40%). The difficulties were attributed to ‘fiddly’ packaging, hand strength and  
5 vision; however, only tetrapacks demonstrated a relationship between time taken to open and  
6 hand strength, suggesting other aspects of hand function may be more important than strength  
7 when opening food and beverage packages.<sup>10</sup>

8 Interest in understanding accessibility of packaging has grown as an area of study in  
9 recent years, largely concentrating on food packaging in the retail sector,<sup>11-15</sup> and to a lesser  
10 degree pharmaceutical packaging.<sup>16-17</sup> Pressure to understand and eliminate what has been  
11 termed 'Wrap rage',<sup>18</sup> led to the development of user panel tests for packaging assessment.  
12 The first of these was developed as a European Technical specification, CEN15945,  
13 published in 2011.<sup>19</sup> Subsequent use led to the refinement of the test protocol, and the  
14 inclusion of the test protocol as an Annex to an ISO standard '*Guidelines for Accessible*  
15 *Packaging*' ISO17480 (20). The international standard was launched in early 2015 after  
16 several years of development. The guideline outlines useful information for packaging  
17 designers and manufacturers about font size and type, contrast, reductions in strength,  
18 dexterity and cognition along with a designer checklist.

19 The test protocol employed is inspired by the principles described in an earlier series  
20 of published standards for testing child resistant packaging and the design requirements and  
21 testing the ease of use of everyday products.<sup>21-25</sup> Hence, in Annex D of ISO17480 an older  
22 cohort of 20 people, with specified representation of gender and age range from 65-80 years,  
23 are asked to open a pack and rate that packaging on a series of pictorial satisfaction scales  
24 and give an overall satisfaction rating.

1           In 2015, the UK National Health Service (NHS) set up a taskforce, comprised of  
2 representatives from a range of interested parties, including, NHS professionals, hospital  
3 caterers, industry supplier, NHS supply chain and academia, to look at the problem of poorly  
4 designed single portion packaging and possibility of implementing a strategy of removing it  
5 from the supply chain.

6           Hence, as a starting point, it was decided to undertake research to understand the  
7 following;

- 8           • the current situation by undertaking a pilot study to assess the 'state of the art', how  
9           accessible single portion packaging purchased by the NHS
- 10          • to use the Annex D of ISO17480 described above as a way of assessing the packaging
- 11          • identify if this Annex could select poorly performing packaging
- 12          • provide insight into the reasons why the packaging was failing (and hence how the  
13          packs could be redesigned) and implications for patients mealtime experience

## 14   **METHOD**

15           As outlined previously, the method used to assess the packs was similar to that  
16 proposed by the User Panel Test method CEN15945 (2011) and Annex (D) of ISO 17480  
17 (2015).

18           The test panel participants are skewed towards females (70 % of the panel make-up)  
19 with an upper age limit of 80 years. In this test, four different NHS sites were involved in the  
20 study, participants were randomly selected from patient representative groups from each  
21 hospital.

22           Participants are asked to familiarize themselves with each packaging item and then  
23 subsequently attempt to open the packaging. For the purposes of this research participants

1 were asked to only give a rating of their overall satisfaction on the opening experience.  
2 Packaging is rated on a Likert scale (the scale is defined in the standard). For the purposes of  
3 a pass or fail of the pack the ratings of "Extremely Dissatisfied", "Dissatisfied" etc., are  
4 converted to a score (1 for "Extremely Dissatisfied", and 5 for "Extremely Satisfied"). A  
5 pack is recorded as a failure if within the 20 people cohort there is an example of pack being  
6 unable to be opened within the time limit (defined as 1 minute) or the overall satisfaction  
7 score ranks below 3 ("Satisfied"). The test can be repeated on another cohort if there is a  
8 likelihood that the number of failures will remain below two or the likelihood of a score of 3  
9 ("Satisfied") can be attained. The number of permitted failures allowed increases as the  
10 cohort size increases. The test is stopped completely when the number of participants reaches  
11 100.

12 Whilst ISO17480 does not request measurement of strength or dexterity it is of  
13 interest to understand the possible relationship between capability and the likelihood of  
14 opening the pack. To that end grip strength of each participant was measured using a Jamar  
15 Dynamometer whilst dexterity was measured using a Perdue Pegboard. Both instruments  
16 have significant published normative data for which our sample population could be  
17 compared. The measurements were taken by project lead with a significant track record in  
18 observing, measuring and analysing the capabilities of older adults. The tests were  
19 undertaken as per defined protocols provided with the instruments.

20 Ten standard single portion packaging items were randomly selected for testing. The  
21 packs were chosen to reflect a broad range of food and beverage and packaging types as  
22 possible and to facilitate comparisons to earlier work undertaken by Australian researchers.  
23 All the packs were familiar to the participants and all participants had opened that pack or  
24 similar pack prior to testing. The packaging was also chosen to mostly reflect the common  
25 packaging formats used, i.e. 'flow-wrap' items, lidded-pots and shrink-wrap. The packaging

1 chosen was single portion, cheese, jam, jelly, crackers, spread, orange juice, fruit pot, biscuits  
2 milk and sandwiches.

3 Twenty participants were chosen with their age and gender profile matching that as  
4 defined by the ISO standard protocol. Each participant opened all ten packs with a break  
5 between packaging opening events. The order in which packaging was presented to each  
6 participant was also randomised. For each participant their grip strength for each hand,  
7 dexterity, time to open each pack (or failure) was recorded along with a satisfaction score and  
8 any other comments made by the participant around the opening experience. Data were  
9 analysed using the Statistical Package for the Social Sciences V24 (SPSS 21, 2016, IBM  
10 Chicago, IL.). Satisfaction ratings, time to open the pack, grip strength and dexterity were  
11 analysed using descriptive statistics. Correlations using Spearman's rho was used to  
12 determine any relationships between grip strength and dexterity with time to open the pack  
13 and satisfaction ratings. Ethical approval was obtained from Sheffield Hallam University.

## 14 **RESULTS**

15 The results indicated that seven of the ten packs tested failed the ISO standard panel  
16 test. Five packs; jam, cheese, biscuits and the fruit pot failed due to participants being unable  
17 to open the contents in the allotted time with milk and sandwiches failing due to being rated  
18 below 3.

19 The mean age, dexterity and strength for male and female participants is shown below  
20 in Table 1. The dexterity data has been rounded down to the nearest whole number. Table 2  
21 below, shows the mean opening time, number of failures the mean score for each of the items  
22 tested.

1           Statistical analysis of the results revealed that for the five items that were uopenable,  
2 the Fruit Pot, Jam and Biscuits time to open was more highly correlated with participants  
3 strength (Fruit Pot,  $r = -0.64$ ,  $P = 0.006$ , Jam,  $r = -0.46$ ,  $P = 0.071$ , Biscuits,  $r = -0.46$   $P =$   
4  $0.057$ ). The single portion cheese item that also was also uopenable by a number of  
5 participants, was most highly correlated to a participants dexterity (Cheese  $r = -0.52$   $P =$   
6  $0.069$ ). The fifth uopenable pack, the single portion Crackers item, was not highly correlated  
7 to either strength or dexterity. Large and significant correlations were found between the time  
8 to open many of the packs and the satisfaction rating, as shown in Table 3 below.

## 9 **DISCUSSION**

10           The aims of this study were twofold. The first was to gain an initial understanding of  
11 the accessibility of single portion packaging purchased by the NHS. The second aim was to  
12 use Annex D of ISO17480 as an assessment method of the packaging to determine if this  
13 Annex could select poorly performing packaging and identify issues and the pack attributes.  
14 Clearly, the results show that the ISO17480 user panel test is able to select poorly performing  
15 packaging items, with this study showing that it is likely a significant amount of single  
16 portion packaging sourced by the NHS would currently fail testing as per Annex D of  
17 ISO17480. The study found that 50% of the ten packs tested in this instance could not be  
18 opened, whilst a further 20% failed because of a low satisfaction score. Hence, 70% of the  
19 packaging tested would fail the standard and is likely to be unopenable by a significant  
20 proportion of hospital patients. The items that failed outright were single portion jam, cheese,  
21 fruit pot, crackers and biscuits. Cheese, crackers and the jam portions were seen to be the  
22 worst performing items with 6, 4 and 3 failures to open these items respectively.

23           The 70 % failure rate of packaging is based on a test panel with an age limit of 80  
24 years old. Clearly, there will be and are patients older than this within the NHS healthcare



1 system. Indeed, as the population ages, older adults are increasingly over-represented in the  
2 hospital system and many of the older old have complex medical conditions and high levels  
3 of frailty. Further, the patient representatives were all independent living well adults, hence it  
4 is likely that the panel test under predicts a patients inability to open packaging of this type.

5         Discussions with catering and nursing staff indicated that patients were in many cases  
6 helped to open packaging which may mitigate some of the problems with poor packaging.  
7 However, discussions with patients indicated there were instances of packaged items  
8 remaining unopened. Recent research by Bell (personal communication) has found that many  
9 patients are reluctant to ask nursing or catering staff for assistance to open packs as they  
10 would either prefer to be independent, or feel the ward staff are too busy to ask.

11         Further, it was seen that the types and amount of packaging used varied significantly  
12 from hopsital to hospital and was seen to depend on experience with certain types of  
13 packaging (and a subsequent willingness and ability to remove it from the system), hospital  
14 size and layout, catering facilities, interpretation of hygiene rules and cost.

15         Whilst capability measurement is not stipulated as part of the ISO 17480 user panel  
16 test, hand grip strength and dexterity were measured as part of this study. The fruit Pot, Jam  
17 and Biscuits were seen to be correlated to a user's strength whilst the Cheese portion the  
18 items were seen to be related to dexterity. The time taken to open a pack was significant in  
19 the rating score of many of the packs

20         In the study by Bell et al.,<sup>10</sup> users described their frustration at their inability to open  
21 packaging describing many items as 'fiddly'. This led researchers to hypothesize that the  
22 relationship between this perceived 'fidliness' is not related to strength but a person's  
23 dexterity. Further work by the authors has shown that links between dexterity and some  
24 single portion packaging can be identified, however the results here suggest that inability to

1 access single portion packaging may be more nuanced. For example, little correlation was  
2 seen in the packs tested here and the measured dexterity (apart from Cheese). This difference  
3 could be possibly be explained by the example of the crackers, which had multiple failures in  
4 attempting to open the pack. Observations showed that the typical grip style used to attempt  
5 to open this type pack is a low strength pinch grip and this style of grip is actually used to  
6 open a number of items tested in this study. (It is again worth noting that ISO17480 does not  
7 stipulate capability measurement as part of the protocol.)

8 Precision pinch grip was not measured as part of this study, however observations  
9 suggest that it is the kind if grip used for many of the typical single portion packaging items  
10 and that there is a potential relationship between pinch grip and accessibility. Hence, future  
11 work should measure pinch grip strength rather than gross hand grip strength. Further, the  
12 number and simplicity of the tasks required to undertake the opening event will clearly affect  
13 a user's opening time and satisfaction rating and those tasks may have elements of dexterity,  
14 pinch and grip strength. Work is ongoing by the authors to understand the relationship  
15 between number and simplicity of tasks utilising a task analysis approach based on the  
16 ergonomic ideas by Stanton;<sup>26</sup> this work was presented at the Design4Health Conference in  
17 Melbourne.<sup>27</sup>

18 The example of crackers also shows how poor design affordances and graphical  
19 information work against the participant. In this instance no participants noticed the arrow on  
20 the indicating the point to open the pack and all participants attempted to open the pack  
21 pulling against the pack spine rather than tearing across the seal. Small design changes and  
22 more prominent opening information would aid in changing the patient experience and  
23 increase the likelihood of opening. The best performing pack, the spread item, had a strong  
24 opening affordance with a large easy accessible and prominent tab on the size of the pack  
25 which was clear to see, easy to hold and separated the pot and lid easily and effectively.

1 Work by Yoxall, <sup>28</sup> has shown that packs with low cognitive demands and lower dextrous  
2 demands are more likely to be accessible.

3 It is hoped that by implementing the ISO standard into the purchasing guidelines,  
4 poorly designed packaging will drop out of the system as suppliers and brand owners select  
5 packaging that meets the standard, and that the process of certification will create a loop  
6 where failed packaging will be redesigned and re-tested, creating a loop of progress towards a  
7 better design of single portion packaging.

## 8 **CONCLUSIONS**

9 Poorly performing packs that were generally difficult to open largely failed due to  
10 participants being unable to locate the opening feature, and if or when located, manipulate the  
11 pack in such a way that would facilitate access. It is recommended that the next steps be (1)  
12 packaging testing to be incorporated into NHS food packaging purchasing guidelines or  
13 contracts, and (2) assessment of the packaging be part of the Patient Led Assessments of the  
14 Care Environment (PLACE) protocol to aid best practice around food packaging accessibility  
15 and use into the NHS supply chain system. In incorporating this protocol, it is anticipated  
16 that the NHS will drive the development of the design of single portion packaging and  
17 improve patient experience and wellbeing. This change will be the result of poorly  
18 performing packing being removed from the system and the likelihood of manufacturers and  
19 suppliers engaging with the findings of tested packaging to improve the designs to ensure  
20 compliance with the protocol. Further, it is likely that as a major purchaser of single portion  
21 packaging the implementation of the standard will influence single portion packaging in other  
22 sectors. Many of the items purchased by the NHS are also used in canteens, hotels, service  
23 stations, prisons and airlines; hence this work has the potential for significant impact across a  
24 range of sectors.

1 **TAKE AWAY POINTS**

2 1. The results show that ISO 17480 is able to identify poorly performing single use  
3 packaging of the type commonly used in the hospital catering sector.

4 2. This pilot study indicated that 70% of the packaging tested in this study fails the ISO  
5 17480 user test protocol.

6 2. For packing to be properly and routinely accessible, it should have opening features  
7 and opening mechanisms that are intuitive and/or clearly identified, opening  
8 mechanisms such as tabs large enough to grip, the use of stronger grip taxonomies  
9 where possible and low peel and tear forces as possible.

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