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Randomized Control Trials

Enhanced referral prioritisation for acute adult dietetic services: A randomised control trial to test a web-based decision training tool

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SUMMARY

Background & aims: Dietitians in acute adult services need to prioritise dietetic referrals in order to manage their daily workload and ensure effective treatment of patients. Newly qualified dietitians do not usually receive specific training on prioritisation and could be helped with an evidence-based, effective, decision-training tool that is based on the practice of experienced dietitians. We developed an internationally available web-based decision-training tool designed to improve novice dietitians' ability to make dietetic prioritisation decisions. The training tool comprised of a pre-training task, a post-training task and training materials. The aim of this study was to test the effectiveness of the training tool on novices' ability for dietetic prioritisation.

Methods: Pre-registration dietitians and recent graduates (one-year) from across the UK were invited to participate in this randomised controlled trial (RCT). Each participant made prioritisation decisions on a set of dietetic referral scenarios: 53 scenarios at pre-training and 27 at post-training. After pre-training the intervention group was presented with the training materials, whereas the control group was told to carry on with the post-training task. Participants did not know which group they had been randomly allocated to. We calculated i) level of agreement between decisions made by each novice and experts' consensus using Pearson correlation, intra-class correlation (ICC(2,1)); ii) intra-rater consistency using ICC(1,1) and iii) intra-group consistency using ICC (2,1). We compared group means at pre-training and post-training; estimated effect size using the degree of change from pre- to post-training, and 2-factor mixed ANOVA to assess overall effect of the training across the groups and time-points.

Results: 151 participants (69 in control and 82 in intervention) completed the trial. The groups did not differ in demographic characteristics. Both Pearson and ICC(2,1) correlations increased with training intervention; a moderate effect of training was found for both metrics, $d = 0.69$ ($r = 0.32$) for the former and $d = 0.54$ ($r = 0.26$) for the latter. Intra-rater consistency improved with training but with a small effect size, $d = 0.32$ ($r = 0.16$). The intra-group consistency also improved with training: ICC = 0.48 pre-training to 0.61 post-training.

Conclusions: The training tool was found to be effective in improving the novice dietitian's ability to prioritise referrals in the acute adult setting. The training tool is freely available at www.dietitianreferral.org for use by all student or early career dietitians internationally.

1. Introduction

Dietitians working in adult acute services receive large numbers of referrals, making it difficult to provide services to all on the day they are received. In order to optimise the safety of patients and maximise the effectiveness of the treatment dietitians have to be selective and decide which patients need the most urgent dietetic intervention and prioritise their referrals accordingly. However, newly qualified dietitians with limited experience may find it

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difficult to know how best to prioritise referrals; it is well recognised that skill in prioritisation is a characteristic of an expert clinician [1]. Since nutrition status impacts significantly on key factors such as health related outcomes, effectiveness of medical treatments, and the quality and cost of care [2], skills in prioritisation are crucial for novice dietitians to learn. In order to share best practice, the decision policies of 50 experienced UK dietitians were statistically modelled using a set of 60 example referrals [3]. Six referral cues were identified from the literature, case experience and through debate among experienced dietitians; presenting complaint, nutrition status from screening tool, reason for referral, previous food intake, weight history, biochemistry picture [3]. The policies identified which of these cues were most influential when making referral prioritisation decisions and provided the experienced dietitians' consensus decision for each of the example referrals. Consensus between experts' dietetic prioritisation decisions was very high: intra-class correlation (ICC) (2,1) = 0.98 (95% confidence interval: 0.97–0.99) [3]. It is proposed that this model of expert practice can be used to develop training materials to upskill students and newly qualified practitioners on professional programmes [4]. Enhanced prioritisation skill would then enable novices to provide a better service to patients that would result in a more efficient use of healthcare resources. Evidence suggests that enhanced work-based skill can increase confidence [5], improve work satisfaction [6], and reduce work based stress [7], and improving prioritisation skills may contribute to this effect.

This paper reports on the design and testing of the decision training tool which aimed to improve novices' decision making ability when prioritising referrals for acute adult dietetic services. There were three specific research questions: (1) do trained novices make dietetic prioritisation decisions that are more aligned with the experts' consensus decisions than untrained novices?; (2) do trained novices make more consistent dietetic prioritisations on repeated scenarios?; (3) do trained novices agree more with each other about the prioritisation decisions made than untrained novices?

2. Materials and methods

A Randomised Controlled Trial (RCT) was undertaken, using a two-factor mixed design with one between-subjects factor (group), with two levels (no training materials provided (control) and training materials viewed (intervention)), and one within-subjects factor (time-point of training) with two levels (pre-training and post-training). To maintain blinding volunteers were told they were participating in a study to investigate prioritisation of referrals, not a study to test a training website. Ethical Approval for the study was obtained from Brunel University Research Ethics Committee (14/10/STF/03).

The training materials were developed using the findings of the previous study [3] and used as the intervention for this RCT. In Hickson et al. [3] six cues were identified as being important when assessing dietetic referrals, and a total of 21 cue levels were defined in order to enable generation of a range of referrals. The training information was informed by how the six cues were weighted by the experienced clinicians in their prioritisation decisions, and the training explained to the novices how to use these cues when prioritising referrals to their acute adult dietetic services (see supplementary information for further detail).

In order to measure the novices' ability to prioritise referrals, the control and intervention group participants were asked to make decisions on the same dietetic referral case scenarios that the experts had prioritised previously. The novice's decisions on identical cases could be measured, and then be compared with the experts' decisions. The case set of 80 was made up of 60 original cases and 20 repeated cases. Cooksey [8] recommends that at least one third of case profiles are repeated in order to measure consistency. An example of a case scenario and the five possible prioritisation outcomes are presented in Fig. 1.

Since web-based decision training has been found to be most successful when applied at the pre-registration stage of training [9,10], pre-registration dietetic students and recent graduates (less than one-year experience) were identified as suitable participants. Pre-registration students had to have at least completed the first part of their practical placement, so they had some experience of ward work and could relate to the scenarios. To identify a medium effect (Cohen's d = 0.5) between two independent sample means at 0.05 significance and for 0.8 power, it was calculated that 64 participants were needed for each group [11].

The participants were recruited from across the UK via University dietetic programme leads. Of the 14 universities contacted, 12 replied and gave permission and facilitated access to students and

You have received a referral for a 65-year-old patient who may require dietetic assessment. The patient's presenting complaint is Dysphagia; and they have screened as 'High risk of malnutrition'. They have been referred for enteral tube feeding. The referrer reports that the patient is not eating and has stable weight. The biochemistry results show normal biochemistry.

Prioritisation options:

1. Does not need to be assessed during admission- refer on to community dietetics
2. Non-urgent - assess before discharge
3. Non-urgent - assess within two working days
4. Urgent - assess on next working day
5. Urgent - assess today

Fig. 1. Example of a case referral and the five possible prioritisation options.

recent graduates. Recruitment materials directed interested individuals to the research website, where the information sheet was also provided and had to be accessed before participation could proceed. When a request to participate was received via the website, a password was automatically generated and sent to their email; this is the point at which they were automatically randomised into control and intervention groups. This was achieved by the on-line recruitment system using a coin toss approach. Participation was on voluntary basis, and consent was implied through their willingness to enter their email address and the website password to access the on-line task. A small honorarium in the form of an online £10 amazon voucher was provided to all participants who completed the task in recompense for the time given.

All participants completed the task individually, on-line at a place and time of their choosing. Upon login to the website, data were collected on age, gender, stage of training, university and country. The participant was then presented with instructions and was reminded that they should do the tasks independently. There were two practice scenarios provided before the actual set of scenarios. The scenarios were presented one at a time and in a randomised order to each participant. Participants were asked to choose their prioritisation decision by clicking on one of the five ordered options (see Fig. 1).

The intervention group were asked to complete three consecutive tasks; prioritisation of 53 case scenarios, reading the training material, and prioritisation of a further 27 case scenarios. The control group participants were asked to judge the same case scenarios, but at the time point that the intervention group had received training, the control group participants only got a message confirming the number of cases they had completed and asking them to continue. It was not expected that there would be any effect on the control group's prioritisation ability since they had not received the training material and only had undertaken practice in making decisions on the cases.

2.1. Statistical considerations

To answer the first question 'do trained novices start to make dietetic prioritisations that are more aligned with the experts' consensus decisions than those from untrained novices?', we correlated each novice's decision with experts' consensus decision at each time point, using Pearson correlation and intra-class correlation (ICC(2,1) using 'absolute agreement' definition) [12–14]. We pooled results from the control and intervention groups for pre- and post-training, giving four sets of results. We compared the results across the groups at pre-training to determine if the two groups had similar levels of prioritisation capacity, and then compared at post-training to examine the effect of the training intervention. If the two study groups were similar at the baseline, then no statistically significant difference should be observed between correlation coefficients for the two groups at the pre-training. If the correlation coefficients were significantly larger for the trained novices (i.e. the intervention group at post-training), then the training materials can be said to be effective in increasing the capacity of novice dietitians for making dietetic referral prioritisation. A two-factor mixed design analysis of variance (ANOVA) was conducted to examine overall effect of training across the two time points and between the study groups. The effect size was calculated using Cohen's d [15]. We compared the amount of change from pre-training to post-training for the intervention group relative to that for the control group.

To answer our second question: 'do trained novices start to make more consistent dietetic prioritisations on repeated scenarios?' we investigated intra-rater correlation between the decisions made by individual novices on scenarios that were repeated on separate occasions. For this purpose, we calculated ICC(1,1) coefficient between decisions made by each novice on repeated scenarios (13 repeat scenarios in pre-training and 7 at post-training) [12–14,16]. We pooled the results for each group and time point. In order to investigate whether training had any positive effect that is statistically significant, we carried out 2-factor mixed ANOVA and calculated effect size.

Finally to examine the third question 'do trained novices agree more about the prioritisation decisions made than untrained novices?' we investigated intra-group correlation for each study group at each time point. We calculated ICC(2,1) correlation coefficient using prioritisation decisions made by participants of a group at each time-point. The higher the correlation coefficient for a group of novices, the less the variation between prioritisation scores given to each scenario by the novices in that group, hence the more the agreement between decisions made. The investigator (HG) who undertook the analysis was blind to the group allocation.

3. Results

Participants were recruited from 8 April to 21 June 2015. The number of potential participants was approximately 800 (1/3 recent graduates and 2/3 students), and 197 were randomised into the study (25% response rate). 151 participants completed the task; 69 of whom were in control group and 82 of them in intervention (see Fig. 2). Between allocation to a group and completion of the task 33 participants in the intervention group and 13 in the control group were lost to the study.

Demographic characteristics are given in Table 1. Distribution of demographics data across groups were compared using t-test for age and chi-squared (χ^2) for stage. No statistically significant differences were found: $t(149) = -0.077$, $p = .94$ for age; $\chi^2 = 3.96$, $p = .28$ for stage.

3.1. Do trained novices start to make dietetic prioritisations that are more aligned with the experts' consensus decisions than those from untrained novices?

Agreement between each novice's prioritisation judgements and expert consensus judgement is shown in Table 2. ANOVA showed significant interaction between time point and group: $F(1,149) = 8.30$, $p < .01$; partial eta sq $= 0.06$, with a medium effect. Simple main effects analysis showed significant effect of group at post-training ($F(1,149) = 9.5$, $p < .01$). These results confirm that the training had significantly improved agreement between the prioritisation decisions made by trained novices and by expert consensus. This suggests that the training had positive effect on novice dietitians' referral prioritisation, and this effect was moderate.

Table 3 shows the Pearson's correlation coefficients pre- and post-training which indicated a similar pattern to the ICC results. ANOVA of the Pearson correlation statistics showed significant interaction between time point and group: $F(149) = 16.7$, $p < .001$. Partial eta square $= 0.101$, medium effect [15]. Simple effects analysis showed significant effect of group at post-training ($F(1,149) = 13.5$, $p < .001$) and significant effect of time-point in intervention group ($F(1,149) = 13.32$, $p < .001$). Therefore, significant differences between the intervention and control group at the post-training could be attributed to the training intervention.

3.2. Do trained novices start to make more consistent dietetic prioritisations on repeated scenarios?

The analysis exploring the consistency of decisions made for repeated scenarios is shown in Table 4. Both groups are similar pre-training and both groups showed improvement at post-training,

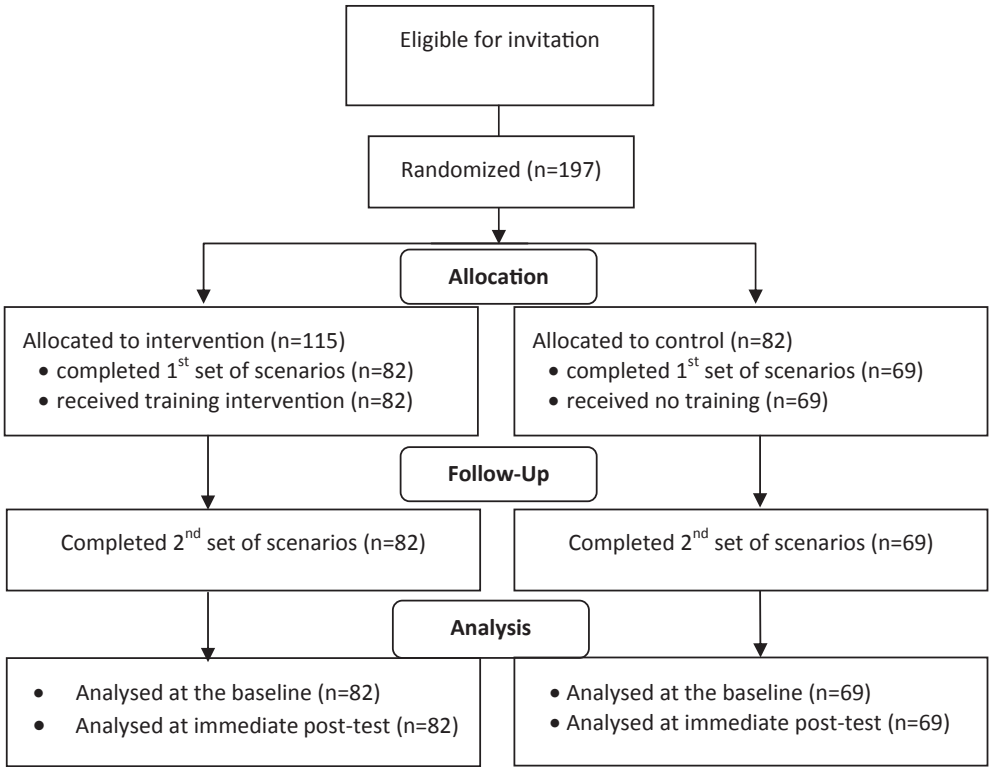

Fig. 2. Flow chart of recruitment process.

Table 1
Demographic characteristics for control and intervention groups at baseline.

Characteristics	Intervention group (n = 82)	Control group (n = 69)
Mean age in years (SD)	25.9 (7.1)	25.8 (5.4)
Male, n (%)	4 (4.9)	7 (10.1)
Female, n (%)	78 (95.1)	62 (89.9)
Stage n (%)		
Newly qualified	19 (23.2)	17 (24.6)
Late stage of professional training	44 (53.7)	34 (49.3)
Mid stage of professional training	16 (19.5)	10 (14.5)
Early stage of professional training	3 (3.6)	8 (11.6)
Country n (%)		
England	55 (67.1)	54 (78.3)
Ireland	6 (7.3)	2 (2.9)
Scotland	17 (20.7)	10 (14.5)
Wales	4 (4.9)	3 (4.3)

Table 2
Inter-rater correlation coefficients between individual novices and expert consensus at pre- and post-training.

	Mean (SD) correlation ICC(2,1) with 'absolute agreement' definition		Mean difference pre- to post-training
	Pre-training	Post-training	
Control	0.58 (0.18)	0.53 (0.20)	−0.049 (0.156)
Intervention	0.59 (0.17)	0.63 (0.17)	0.037 (0.16)
Cohen's d (r)			0.54 (0.26)

but consistency scores of the intervention group were significantly higher than those of the control group ($z = 3.02$, $p < .01$). The effect size of training on consistency was small.

The two-factor mixed ANOVA showed a significant interaction between the group and time-point factors: $F(1,149) = 9.80$, $p < .01$; Partial eta sq = 0.062, with a medium effect. Testing for simple main effects of group factor at both levels of time-point factor revealed that the group factor did not have a significant effect at pre-training ($F(1,149) = 0.0$, $p = .95$), but had significant effect at post-training ($F(1,149) = 13.5$, $p < .01$). The results show that the training had significantly improved reliability between prioritisation decisions made on different occasions.

3.3. Do trained novices agree more about the prioritisation decisions made than untrained novices?

Finally the data showed that agreement between the decisions made by trained novices (ICC(2,1) = 0.61; 95% CI: 0.47–0.76) was higher than for untrained novices (ICC = 0.44; 95% CI: 0.31–0.63), with both groups similar pre-training (ICC = 0.48; 95% CI:

Table 3
Pearson correlation coefficients between prioritisation scores made by individual novices and expert consensus at pre- and post-training.

	Mean (SD) correlation		Mean difference pre- to post-training
	Pre-training	Post-training	
Control	0.66 (0.19)	0.61 (0.21)	−0.047 (0.17)
Intervention	0.66 (0.17)	0.73 (0.17)	+0.072 (0.18)
Cohen's d (r)			0.69 (0.32)

Table 4
ICC (1,1) for the consistency of decisions made on repeated scenarios by individual novices at pre- and post-training.

	Mean (SD) consistency		Mean difference pre- to post-training
	Pre-training	Post-training	
Control	0.65 (0.23)	0.74 (0.28)	0.13 (0.27)
Intervention	0.65 (0.21)	0.87 (0.13)	0.21 (0.22)
Cohen's d (r)			0.32 (0.16)

0.38–0.61), indicating that training improved agreement between decisions made by novices.

4. Discussion

This study showed that a web-based training intervention designed to improve novice dietitians' ability to prioritise referrals was effective. The novices who received the training intervention were more able to make decision like experts after receiving the training. This demonstrates that enhanced skill had been obtained and that the training materials that are based on the judgement policies derived from experts' consensus could successfully be used to train novices on what information should be used when making dietetic prioritisation decisions.

Not only did the novices start to make decisions more like the experts post-training, but they made decisions more like each other and more consistently in repeated scenarios, demonstrating another positive effect of the training. Some caution is required when considering consistency data since high consistency does not guarantee expertise; it is possible to be consistently wrong and the analyses used do not distinguish between correct and incorrect but only consistency of responses in the repeated scenario data.

An improvement in consistency and/or consensus following training can also be due to a flaw in the training materials which may cause decision makers to use consistently inappropriate cues in dietetic referrals [17]. Although neither intra-rater consistency nor intra-group consistency guarantees expertise, experts are expected to repeat their judgement in similar situations (intra-rater consistency) and have high level of consensus (intra-group consistency) [18]. For these reasons, we are presenting results both for consistency and consensus to supplement results of measure of agreement between decisions made by novices and experts' consensus.

Newly qualified dietitians will continue to learn in clinical practice through advice or discussions with colleagues, but this will be based on individual experiences, which may not always represent the broad practices that a decision training tool designed using experts' consensus can provide. In the UK, mentoring immediately after qualification is not mandatory, although it is recommended and often provided, however there can be variation in the advice mentors provide as they can only draw from their own experience. Less confident novices may avoid discussions with colleagues which may limit the knowledge exchange between novice and experienced dietitians. Training materials will help novices to build up their knowledge and skills in the task of referral prioritisation and facilitate fruitful discussion among novices and between a novice and experienced colleagues, through which they could learn the reasoning behind decisions made by experienced dietitians.

The effect sizes for the improvements gained from the use of the training material were moderate. This could mean that novices had already acquired a certain level of ability for dietetic prioritisation before using the decision training tool. Although they may not have received specific training on how to prioritise, they may have been able to apply their current knowledge about the cues and severity of their levels. Alternatively, the novices may need more time, more scenarios, or even some practice in a real setting, to fully develop their expertise.

The final decision training website, which just contains the intervention arm of the trial, is hosted in an open-access website for use by dietitians internationally and can be found at www.dietitianreferral.org. Usage of the final open-access decision training website will be monitored via Google Analytics to assess the demand for training. The website provides information about how the training tool was developed and purpose of the training tool as well as instructions on how to use cue information in a referral in order to make dietetic prioritisation. The decision training tool presents 40 pre-training dietetic referral scenarios that are followed by training materials. After the training materials, 20 post-training dietetic referral scenarios are presented. Users who complete all the case scenarios ($n = 60$; 40 pre-training and 20 post-training) are provided with feedback on how they have performed before and after training and with a downloadable certificate stating they have completed the open-access training. The feedback presents Pearson correlation coefficients between their decisions and expert consensus at the pre-training and post-training, and provides an explanation of whether their decisions have become more like those of the expert consensus.

We propose that the benefits of the training tool for dietitians will be three fold. In the short term the tool will enable best practice to be shared and assist dietitians to provide an optimum service to patients. It may also potentially reduce work-related stress generated by workload mismanagement. In the medium term the tool will increase evidenced based practice as the enhanced decision-making capacities lead to changes in practice. Finally, in the long term there may be more efficient use of healthcare resources.

The dietetic profession will benefit from access to a tested decision making training tool so newly qualified professionals can prioritise more like an expert. Referral prioritisation is a common area in which newly qualified professionals struggle and would benefit from further training. It is also a source of stress for many professionals; a more skilled ability to make work-based decisions may improve work satisfaction and the quality of service delivery.

Patients in acute adult services will ultimately benefit from this research as the decision training tool will assist dietitians to appropriately prioritise referrals, thus ensuring a consistently high quality of service delivery and meaning those in greatest need can be clearly identified for assessment.

This study was conducted with mainly pre-registration dietitians rather than those are already in practice, and did not follow participants in practice; we could not measure the effect on practice. Also it was not designed as a longitudinal study so we did not measure whether the effect of the training tool was maintained over time. Some participants dropped out of the study; the most likely reasons were a lack of motivation to complete the task or competing demands on time, however, no objective data was collected on this.

Our study used a set of the most common presenting complaints based on admission data from an acute adult setting. In practice dietitians will come across other complaints which they would have to consider when prioritising referrals. The cues used were also determined through discussion with experts although in practice dietitians may need to prioritise with fewer cues available to them or different information. The design of the study does limit the number of cues that can be included; additional cues would require significantly more case scenarios, resulting in undue burdens on the participants during the study and a training tool that would take longer to complete. Nevertheless, this training tool should assist dietitians in seeking the information they need in order to prioritise the most commonly encountered referrals as accurately as possible.

5. Conclusion

Novice dietitians who were trained with the expert policy for dietetic prioritisation were able to improve their prioritisation ability whereas those who did not receive training did not improve. The training materials can be used to successfully improve novices'

prioritisation skills. An open-access web-based tool has been developed and launched in order to enable translation of this study into practice and to enable the best practice to be shared among novices.

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Author contributions

PH and MH designed the overall study. CT designed the web-site for the randomisation to group and data collection. MH and HG participated in the recruitment and data collection. HG carried out data analysis. HG, MH and PH drafted the manuscript and all authors approved the final version of the paper.

Conflict of interest

No conflicts of interest are declared by any of the authors.

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Appendix A. Supplementary data

Supplementary data related to this article can be found at http://dx.doi.org/10.1016/j.clnu.2017.08.019.

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