



The Effectiveness of International Dysphagia Diet Standardization Initiative–Tailored Interventions on Staff Knowledge and Texture-Modified Diet Compliance in Aged Care Facilities: A Pre-Post Study

Xiaojing S Wu,¹ Anna Miles,² and Andrea Braakhuis³

¹Department of Nutrition, Faculty of Medical and Health Sciences, The University of Auckland, Auckland, New Zealand; ²Department of Speech Science, School of Psychology, The University of Auckland, Auckland, New Zealand; and ³Department of Nutrition, Faculty of Medical and Health Sciences, The University of Auckland, Auckland, New Zealand

ABSTRACT

Background: The International Dysphagia Diet Standardization Initiative (IDDSI) has created global standardized definitions for texture-modified diets (TMDs) and thickened liquids to improve the safety and care for individuals with swallowing difficulties. The IDDSI framework guides health care facilities, such as aged care, to provide food to at-risk patients.

Objectives: This study aims to design, deliver, and evaluate a tailored intervention to facilitate IDDSI implementation in aged care.

Methods: Five aged care facilities received tailored interventions, which were guided by the Expert Recommendation for Implementing Change process and used the corresponding barriers identified in the previous study: 1) tailored material, delivery, and planning; 2) opinion leaders and professional input; 3) strategies to attract and involve staff; and 4) reflections and evaluations. Meal compliance against IDDSI standards and staff knowledge acquisition were the primary outcomes evaluating the impact of the intervention. Written consent was obtained from facility managers. Staff trainings were delivered by a dietitian, accompanied with electronic and printed materials. An audit was conducted on all items listed on the TMD daily menu (lunch, dinner, and midmeals). TMD IDDSI audits and staff self-administered surveys were conducted before and 6 mo after the intervention.

Results: Audits of 68 and 79 TMD meals/items were conducted pre- and postintervention, respectively. Significant improvement in meal compliance was found in all 3 levels of TMDs, including soft and bite-sized (50%; $P = 0.0001$), minced and moist (44%; $P = 0.0024$), and puréed (42%; $P = 0.0024$). The overall IDDSI compliance increased by 46% postintervention ($P < 0.0001$). Staff achieved higher scores in both dysphagia and IDDSI knowledge sections ($P < 0.0001$).

Conclusions: Tailored interventions facilitated IDDSI implementation in aged care evidenced by increased TMD compliance and staff knowledge, which remained at 6 mo postintervention. *Curr Dev Nutr* 2022;6:nzac032

Keywords: IDDSI, texture-modified diets, implementation, aged care, pre-post study

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Address correspondence to XSW (e-mail: xiaojing.wu@auckland.ac.nz).

Abbreviations used: CFIR, Consolidated Framework for Implementation Research; ERIC, Expert Recommendations for Implementing Change; IDDSI, International Dysphagia Diet Standardization Initiative; TF, thickened fluid; TMD, texture-modified diet.

Introduction

Swallowing difficulties, defined as dysphagia, are related to a range of medical conditions. Such etiologies include, but are not limited to, neurological complications, traumas, respiratory disorders, psychiatric disorders, and effects from polypharmacy (1, 2). While dysphagia is often chronic and cannot be cured, access to a safe and nutritious diet can be

managed through adoption of texture-modified diets (TMDs) and or thickened fluids (TFs) (3, 4).

TMDs and TFs are categorized by several variables, including the consistency, viscosity, particle sizes, density, and fluid flow rate (5). Through physical or chemical modification, texture-modified foods can achieve a soft, moist, elastic, and smooth texture that is easy to swallow (6). Despite the common use of TMDs and TFs, there were significant

TABLE 1 Texture-modified foods and thickened fluids classification in the IDDSI¹

IDDSI level	Color coding
Food (texture-modified diets)	
Level 7: regular, easy to chew	Black
Level 6: soft and bite-sized	Blue
Level 5: minced and moist	Orange
Level 4: puréed	Green
Level 3: liquified	Yellow
Drink (thickened fluids)	
Level 4: extremely thick	Green
Level 3: moderately thick	Yellow
Level 2: mildly thick	Pink
Level 1: slightly thick	Gray
Level 0: thin	White

¹IDDSI, International Diet Dysphagia Diet Standardization.

variances in TMD classifications and standards among countries (7). The development of the International Dysphagia Diet Standardization Initiative (IDDSI) aimed to overcome this gap. IDDSI is the first framework that provides global standardized terminology and interpretations for TMDs and TFs that are prescribed for people with dysphagia, and is a suitable framework for persons of all ages and cultures, under all care settings (8). IDDSI categorized the TMDs and TFs into 8 levels as shown in **Table 1**.

While the IDDSI framework clearly outlines the texture requirements of food and fluid for safe consumption, a previous review suggests the meal texture and nutrition intake of those with dysphagia is less than optimal (9). One of the main challenges in caring for individuals with dysphagia is the lack of knowledge of dysphagia and insufficient training in TMD and TF preparation (10–12). Without appropriately prepared meals and drinks, adverse events can occur, including aspiration, pneumonia, malnutrition, asphyxiation, and even death (2, 13). Consequently, to enhance patient safety and quality of life, texture-modified foods and fluids must not only meet nutritional requirements but also be consistently prepared in a way that is compliant with the recommended level (7, 14).

Published research suggests that attitudes toward the implementation of IDDSI are favorable, and approval of IDDSI is widespread. However, the adoption of IDDSI in many clinical settings is still lacking (15–17). Early work assessing the implementation of IDDSI in pilot hospital sites has demonstrated successful implementation using improved interdisciplinary collaboration and staff proceedings (18). Multiple models of comprehensive interventions have shown positive effects on improving health outcomes in aged care (19). There is an increased success using implementation science in translating clinical guidelines into health care practice—in particular, tailored implementation can be an effective option compared with passive dissemination of guidelines or no intervention at all (20–22). Evidence to date suggests a structured implementation plan may improve adherence to guidelines (20). Specifically, group-tailored approaches to implementation have reduced barriers to implementation (23). The Consolidated Framework for Implementation Research (CFIR) has been recognized as one of the most common conceptual frameworks in guideline implementation (24). The CFIR is a multifaceted framework consisting of 39 constructs from 5 domains, providing a systematic evaluation of determinants that influence implementation outcomes (25). Our research applied CFIR in the pre-

intervention study, to guide a structured gap analysis and to evaluate the determinants associated with the initial stage of IDDSI implementation in aged care facilities (10). The conclusions from the pre-intervention study suggested that one-third of the aged care residents require TMDs, in concordance with earlier country-specific work (26). In addition, the need to facilitate IDDSI implementation, particularly regarding IDDSI understanding and adherence of frontline staff (registered nurses, health care assistants, and foodservice staff), was deemed important to success. This study developed and delivered tailored intervention strategies to overcome the barriers identified from the pre-intervention study (10). In order to assess the effectiveness of the intervention, we conducted a postintervention appraisal assessing staff knowledge acquisition towards dysphagia, IDDSI, foodservice TMD provision, and adherence to IDDSI standards. The goal of the study was to develop an effective intervention to overcome the implementation barriers and improve staff acceptance and use of IDDSI.

Methods

This study continued with the 5 aged care facilities recruited from the previous pre-intervention study (10). We conducted a 1-d TMD audit and self-administered surveys at pre-intervention and 6 mo postintervention. The pre-intervention data collection was completed between July 2019 and April 2020, followed by a 6-mo implementation period, and then, postintervention data were collected between June 2020 and March 2021. The delivery time of the implementation was tailored to the facility arrangement. Two facilities had delayed implementations due to the coronavirus disease 2019 (COVID-19) lockdowns and moving locations. All postintervention assessments were conducted 6 mo after the date that implementation commenced. This study was approved by the University of Auckland Human Participants Ethics Committee (023048) and reported according to Standards for Reporting Implementation Studies (27). Residents were not actively involved in the study. Informed consent was obtained from facility managers to access the facility and conduct the research, including meal audits and survey distribution. Managers were not involved during survey distribution and collection. Staff participation was entirely voluntary. Staff who completed and returned the surveys gave the research team their consent to use their responses in this research, in accordance with the protocol approved by the ethics committees. The study assessments were not used as staff performance review. Neither facilities nor staff received individual compensation. All participants in the study were eligible to win a \$200 voucher at study completion.

Tailored intervention

Following the pre-intervention context assessment and identification of barriers and enablers at each site, a tailored intervention was designed corresponding to the identified enablers and barriers to facilitate IDDSI implementation (10). In order to encourage consistent terminology use by determinants and future researchers, incorporation of the common nomenclature for implementation strategies suggested by the Expert Recommendations for Implementing Change (ERIC) Study was utilized (28, 29). To find the matching expert-endorsed implementation strategies, enablers and barriers identified according to CFIR constructs from pre-intervention were entered in the CFIR-ERIC Matching Tool

version 1.0 (30). Potential strategies were listed in an output table sorted by cumulative level of endorsement across CFIR enablers and barriers indicating the strength of endorsement for the strategy. Each strategy also reflected the percentage of respondents' endorsement to address each of the indicated barriers. To best address each CFIR barrier, up to 7 implementation strategies were selected as recommended by the implementation experts. All 5 sites had common barriers and shared the same strategies to facilitate the implementation of IDDSI. Implementation occurred over a 6-mo period and consisted of 6 main components: 1) share the pre-intervention evaluation results and intervention plans with the facility managers, 2) prepare and deliver education resources (IDDSI posters, food booklet and dysphagia information handouts, online resources access, electronic packages including videos), 3) deliver group-tailored training workshop to foodservice staff (focusing on IDDSI testing and food options) and clinical staff (focusing on IDDSI framework, dysphagia management, TF preparation and feeding technique), 4) design and deliver IDDSI labels and recipe books to foodservice, 5) identify and set up champions, and 6) provide continuous support in meal preparation and IDDSI audits and introduce dysphagia and malnutrition screening tools. Detailed barriers and corresponding intervention strategies for each facility are presented in **Supplemental File 1** (in **Supplemental Table 1**). A summary of study findings with barriers, enablers identified, and an action plan was sent out to individual sites to support further interventions.

Data collection

In a 1-d visit, 1 researcher (a registered dietitian) audited all available levels of texture-modified meals, snacks, and liquids provided by the foodservice using IDDSI food and drink testing methods and audit sheets (31). Sample meals were audited as per the foodservice daily menu. Breakfast items were not listed on the menu; all residents received standard slow-cooked porridge and bread depending on their chewing and swallowing ability. Breakfast items were excluded because they were not specially modified for TMD residents. Morning tea, lunch, afternoon tea, and dinner meals were included. Samples were tested at 3 time points: immediately after plating and 15-min and 30-min after serving. A standard metal spoon and fork were used for TMDs, and a BDTM 10-mL syringe was used for TFs. The temperature of the sample meals was measured by the SALTER Instant Read Digital Thermometer (518 WHCR). Meals/drinks were rated as compliant if they passed all IDDSI criteria at 3 time points. Photographs and videos were taken during meal audits to support the judgment against IDDSI criteria. In order to minimize rater bias, the third author (AB) evaluated the photos and videos independently.

A survey with 46 multiple-choice questions was developed as part of the pre-intervention assessment to collect information on participants' 1) background and experience with using TMDs, 2) knowledge of malnutrition, 3) knowledge of dysphagia, 4) knowledge of TMDs and the IDDSI framework, and 5) attitudes towards IDDSI implementation and nutrition education (**Supplemental File 2**). To ensure the questions were relevant to the topic and language was appropriate to the participant, the survey was initially developed by a foodservice dietitian researcher and piloted in a small group of staff to test the reliability and validity. Based on the piloted results, the survey questions were revised by 2 other experienced researchers with expertise in foodservice and TMDs (a senior dietitian and a senior speech-language therapist). Dys-

phagia questions measured participants' knowledge around definition, symptoms, complications, feeding technique, and food consistency (2). IDDSI questions were designed based on the information provided by the official website documents, which covered classification, labeling, testing methods, and implications (www.iddsi.org). Questions regarding attitude explored staff's insight of IDDSI implementation and their interests in future education. To avoid bias from memorizing responses, the post-survey used similar knowledge constructs but different question content in the dysphagia and IDDSI questions (**Supplemental File 3**). Frontline staff (registered nurses, health care assistants, and foodservice staff) were invited to participate in this anonymous survey. Surveys were distributed in paper form and collected in a dropbox 1 d afterward.

Data analysis

Raw data were documented in Microsoft Excel for Office 365 (version 1902; Microsoft Corporation) and then imported into GraphPad Prism (version 9.0; GraphPad Software, Inc.) for statistical analysis. Descriptive analyses were performed on all explanatory variables of participants. The percentage of compliance was calculated for each level of TMDs audited from all sites. Chi-square tests were used to determine whether the characteristics significantly differed between pre- and post-survey participants. Pre- and post-survey questions were matched to compare the demographic details and improvement in the knowledge topic. Dysphagia and IDDSI knowledge levels were also assessed by summing the correct results of each section (a total score of 7 for dysphagia and 8 for IDDSI, respectively). To avoid selective bias, incomplete surveys were also included in the analysis. Considering the small sample size, Shapiro-Wilk tests were used to assess the normality of raw survey data distribution ($P > .05$ is considered as normally distributed). Both pre- and post-dysphagia and IDDSI scores were not normally distributed (P , dysphagia: pre, < 0.001 ; post, < 0.006 ; IDDSI: pre, 0.003 ; post, 0.007). Thus, median value, Mann-Whitney U tests were used to compare nonparametric survey responses and Kruskal-Wallis tests were conducted to compare the responses across sites. Fisher's exact tests were used to analyze the statistical significance of the percentage of compliance between pre- and postintervention. Furthermore, to evaluate the effectiveness of the education workshop, the post-survey respondents were split into subgroups, one with attendees of the education workshop and the other with non-attendees. A subgroup analysis was carried out to compare their knowledge acquisition over the 6 mo. A P value < 0.05 was considered statistically significant.

Results

Participant characteristics

A total of 85 and 51 completed responses were obtained from the pre- and post-survey, respectively. **Table 2** summarizes the characteristics of the participants. There was a higher proportion of females and participants aged between 26 and 50 y old. More surveys were completed by health care assistants than registered nurses and foodservice staff. Although the number of responses varied between the pre- and post-survey, there were no statistical differences in staff demographics.

TABLE 2 Participant characteristics of pre- and post-survey responses

Outcomes	Pre-survey	Post-survey	P
Number of staff responses	85	51	
Gender			0.540
Female	79% (n = 67)	80% (n = 41)	
Male	31% (n = 16)	20% (n = 10)	
Gender diverse	24% (n = 2)	—	
Facility role			0.090
Health care assistants	41% (n = 35)	55% (n = 28)	
Nurses	29% (n = 25)	20% (n = 10)	
Chef/foodservice staff	26% (n = 22)	16% (n = 8)	
Others ¹	2% (n = 2)	10% (n = 5)	
Not specified	1% (n = 1)	—	
Age (years)			0.180
≤25	11% (n = 9)	—	
26–30	33% (n = 28)	37% (n = 19)	
31–40	25% (n = 21)	33% (n = 17)	
41–50	18% (n = 15)	18% (n = 15)	
51–60	11% (n = 9)	8% (n = 4)	
≥61	2% (n = 2)	—	
Not specified	1% (n = 1)	4% (n = 2)	

¹Others include a physiotherapist, an occupational therapist, 2 activity coordinators, a clinical support coordinator, and 2 facility managers.

TMD IDDSI audit

During the study period, 3 levels of TMDs (soft and bite-sized, minced moist, and puréed) and 4 levels of TFs (extremely thickened, moderately thickened, mildly thickened, and slightly thickened) were provided in all participating sites, with the exception of site 1, where no residents were requiring TFs, and site 4, where no residents required a minced moist diet.

Six months after the intervention, audit results showed an increase in TMD compliance across all levels of TMDs and TFs (Table 3). Although all individual sites demonstrated an improvement in compliance, a statistically significant result was only found in soft and bite-sized from site 3 (Figure 1).

Changes in TMD provision over 6 mo

Two sites (sites 1 and 5) changed from cook-fresh to commercial packaged minced moist and puréed main meals for lunch and dinner. Other changes in TMD provision are summarized in Table 4.

Staff knowledge level

The majority of surveys were returned with the completed dysphagia questions section (98% and 100% from the pre- and post-survey). Only 41% of the pre-survey responses indicated they had prior knowledge about IDDSI. The knowledge score comparisons between pre- and post-surveys are shown in Table 5. Overall, respondents scored significantly higher in both the dysphagia and IDDSI sections.

There were significant differences in dysphagia knowledge between sites in the pre-survey, with site 2 scoring higher than site 1 ($H = 9.85$, $P = 0.043$), but no significance was found in the post-survey ($H = 8.99$, $P = 0.061$). Conversely, significant differences in IDDSI knowledge were shown in the post-survey ($H = 13.86$, $P = 0.0078$), with site 5 scoring less than other sites and not in the pre-survey ($H = 3.23$, $P = 0.520$) between sites.

Despite an overall increase in the proportion of correct responses for the dysphagia and IDDSI questions, certain subtopics were answered

better than others (Table 6). Detailed site-specific comparisons are summarized in Supplemental Tables 2 and 3 (in Supplemental File 4). All the participants defined “dysphagia” correctly in the post-survey. The question regarding dysphagia symptoms/signs had the least correct response in the pre-survey, following by the inappropriate consistency question. There were significant improvements in knowledge of dysphagia symptoms/signs (49%; $P < 0.001$), complications (19%; $P = 0.012$), and appropriate feeding position (18%; $P = 0.048$). Inappropriate consistency had the most nonsignificant change (2%; $P > 0.99$).

Compared with the low correct response rate in the pre-survey, over one-third of the participants were able to correctly identify the IDDSI levels, including the name, number, and color, in the post-survey ($P = 0.002$). The least-accurate responses were found in questions related to TMD and TF testing methods. The most significant improvement was the question related to the appropriate food for a puréed diet (60%; $P = 0.008$), followed by tools used in testing (59%; $P < 0.001$), IDDSI descriptor matching (59%; $P < 0.001$), soft and bite-sized-appropriate food (50%; $P = 0.007$), and minced moist-appropriate food (49%; $P < 0.001$).

Education workshop subgroup outcomes, attendees vs. non-attendees

Table 6 highlights the accuracy of each question answered correctly by the respondents from the pre- and post-surveys. In post-surveys, 63% of participants indicated attending the education workshop in their facilities, with 1 site having less than half of the participants present (38%). When comparing the knowledge level between participants who attended the education session against those who were absent, total scores showed no significant differences (Table 6). Although both groups scored significantly higher in dysphagia and IDDSI knowledge, the significance level of the improvement in IDDSI knowledge was higher in those participants who attended the workshop. Compared with the non-attendees, participants who attended the education workshop had more accurate responses in 3 IDDSI-related questions (IDDSI

TABLE 3 Texture-modified diet compliance audited using IDDSI testing methods at the pre- and 6-mo postintervention¹

Level of texture-modified diets	Pre-intervention, % (n/total n)	Postintervention, % (n/total n)	Changes, %	P ²
All texture-modified diets	44 (30/68)	90 (71/79)	46	<0.0001
Soft and bite-sized	37 (10/27)	87 (26/30)	50	0.0001
Minced and moist	47 (9/19)	91 (21/23)	44	0.002
Puréed	50 (11/22)	92 (24/26)	42	0.002
Thickened fluids	31 (4/13)	100 (12/12)	69	0.0005

¹IDDSI, International Diet Dysphagia Diet Standardization.

²Fisher's exact test was used to analyze the statistical significance of the meal compliance between pre- and 6 mo postintervention, *P* < .05 indicates statistical significance.

levels, tools used for TMD/TF testing, IDDSI descriptors with numbers and color).

Staff attitudes

Fifty percent more participants were aware of the IDDSI guidelines after the intervention (pre vs. post: 25% vs. 75%; *P* < 0.001). Eighty-two percent of participants reported making positive changes in TMD practice after the intervention. Of participants who had learned about

IDDSI, the majority of them reported receiving sufficient learning resources after the intervention (pre vs. post: 40% vs. 91%; *P* < 0.0001), with only 4% indicating it as insufficient. Figure 2 indicates that workshops and posters were well received by most participants. The requirement of online resources remained in high demand. The majority of the participants found that the names of IDDSI descriptors were the most useful component to remember, followed by the color. There were more participants who reported the number in each level

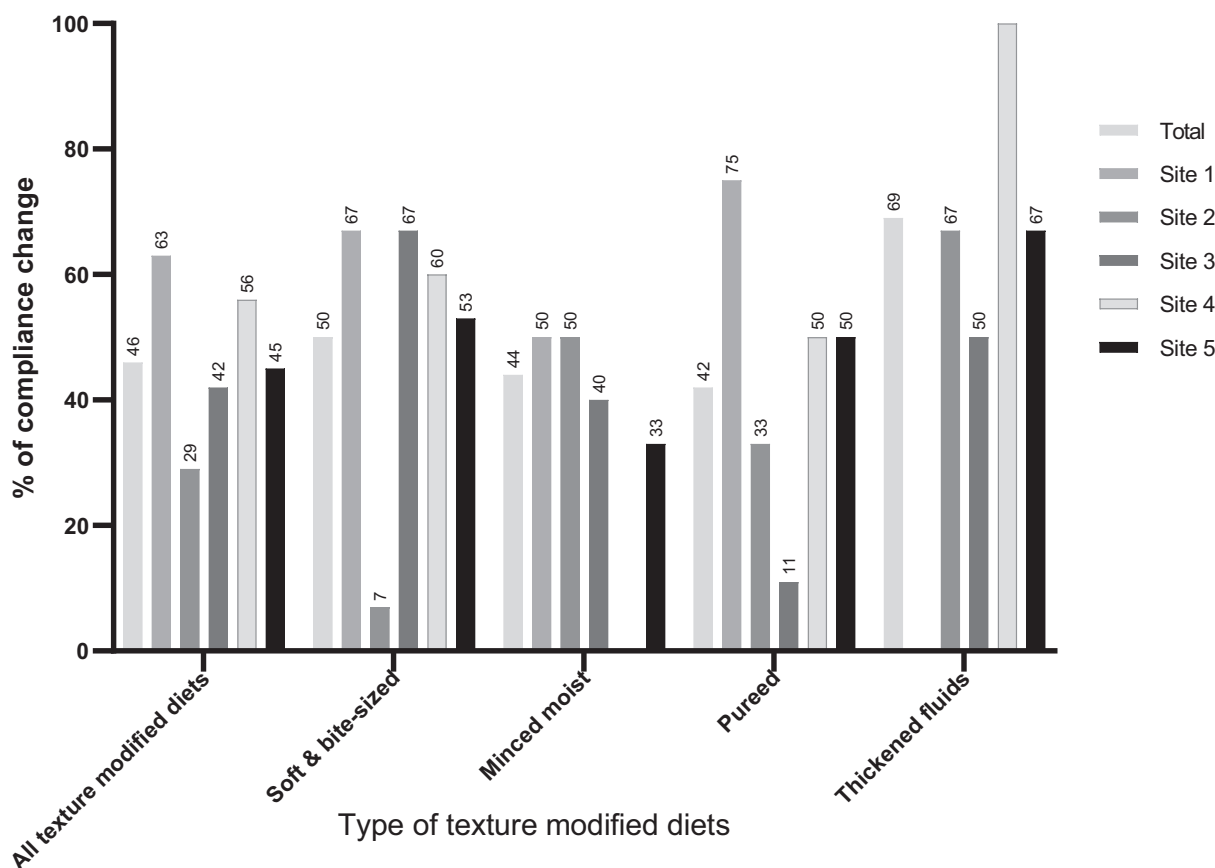


FIGURE 1 Improvement in the percentage of meal compliance audited in all texture-modified diets, soft and bite-sized, minced moist, and puréed, between the pre-intervention and 6 mo postintervention across 5 participating aged care facilities. Fisher's exact test was used to analyze statistical significance. **P* < .05 indicates statistical significance.

TABLE 4 Summary of foodservice changes in TMD provision between pre- and 6 mo postintervention¹

Category	Pre-intervention	Postintervention	No. of sites
Dietary variety	No suitable light meal (dinner), teatime options for MM and PU	Was able to modify the teatime options following IDDSI guidelines for all TMD levels	4
	Only have supplement/smoothies/yogurt for MM and PU at teatime	Added options by using a combination of commercial packaged PU dessert and freshly made modified snacks	4
Texture	Commercially packaged MM and PU meals were too sticky	Added thickened gravy to help achieve the correct consistency	2
	Meals/desserts were not cut into suitable sizes for SB	Meat, vegetables, and cakes were cut into appropriate square pieces in the kitchen	3
	The soup was not blended to smooth texture before serving to MM and PU residents	The soup was blended to no lumps; otherwise, was not served to PU	2
Thickened fluids	Used thickened powder or gum as thickening agents without mixing properly; lumps in the drink	Changed to alternative products (liquid thickening agent or branded thickened powder)	2
	Unsure about resident thickened fluid level, and no standard measurement tool or mixing proportion methods	Resident requirements were printed and posted in the dining room; thickening powder/liquid came with a standardized scoop/pump; staff were able to look up and follow mixing instructions	4

¹IDDSI, International Dysphagia Diet Standardization Initiative; MM, minced and moist; PU, puréed; SB, soft and bite-sized; TMD, texture-modified diet.

to be the most useful component in the post-survey (pre vs. post: 4% vs. 28%).

Discussion

To our knowledge, this is the first study to evaluate the use of a tailored intervention to support the implementation of IDDSI into aged care facilities. The foodservice facilities were able to provide more IDDSI-compliant TMD options, as evidenced by the increased compliance on testing and the changes in foodservice practices. Positive impacts on staff knowledge of dysphagia and the IDDSI framework were found in all participating aged care facilities. However, the overall score of ID-

DSI knowledge was still less than optimal—in particular, the testing methods of TMDs and TFs. Results of the 6-mo postintervention survey demonstrated that the intervention effectiveness was sustained.

This tailored implementation was designed to achieve 2 main goals: to advance the foodservice production quality of IDDSI-compliant TMDs and to expand staff understanding of IDDSI. Previous literature emphasizes the importance of key personnel engagement and tailored resources for the local context (32, 33). Therefore, the training of kitchen staff was independently developed and conducted, compared to clinical staff. The training of kitchen staff focused on the requirements of each level of TMD, labeling, and how to conduct testing using the IDDSI audit sheet. Clinical staff required theoretical exploration of the framework, snack options, feeding technique, and preparation and

TABLE 5 Mean score of staff knowledge score comparisons between pre- and 6 mo postintervention¹

Outcomes	Pre-survey		Post-survey		Changes, median score	P
	n/Total responses	Median score	n/Total responses	Median score		
Dysphagia knowledge (/7)						
Total	83/85	4.0	51/51	6.0	2.0	<0.0001 ²
Site 1	6/7	2.5	6/6	7.0	4.5	0.002 ²
Site 2	14/14	4.5	8/8	6.0	1.5	<0.0001 ²
Site 3	22/22	4.0	7/7	7.0	3.0	<0.0001 ²
Site 4	20/20	4.0	14/14	6.0	2.0	0.0002 ²
Site 5	21/22	4.0	16/16	6.0	2.0	<0.0001 ²
IDDSI knowledge (/8)						
Total	35/85	2.0	48/51	4.5	2.5	<0.0001 ²
Site 1	2/7	1.5	6/6	4.5	3.0	0.110
Site 2	11/14	2.0	8/8	4.5	2.5	<0.0001 ²
Site 3	6/22	1.5	7/7	5.0	3.5	0.031 ²
Site 4	14/20	2.0	13/14	6.0	4.0	<0.0001 ²
Site 5	2/22	1.5	14/16	3.0	1.5	0.330

¹IDDSI, International Dysphagia Diet Standardization Initiative.

²Mann-Whitney *U* test was used to analyze the statistical significance of the score differences between pre- and 6 mo postintervention, *P* < 0.05 indicates statistical significance.

TABLE 6 Median score of staff knowledge and the percentage of correctly answered questions between education workshop attendees and non-attendees in the post-survey and comparison to the overall responses in the pre-survey and post-survey¹

Outcomes	Attendees (n = 32; 63%)	Non-attendees (n = 19; 37%)	Pre-survey (total) (n = 85; 100%)	Post-survey (total) (n = 51; 100%)	P values		
					P ²	P ³	P ⁴
Median staff knowledge level of dysphagia, score (no. of staff responses)	6.0 (32)	6.0 (19)	4.0 (83)	6.0 (51)	0.190	<0.0001 ⁵	<0.0001 ⁵
Median staff knowledge level of IDDSI, score (no. of staff responses)	5.0 (31)	4.0 (17)	2.0 (35)	4.5 (48)	0.155	<0.0001 ⁵	0.0003 ⁵
Definition	100% (32)	100% (19)	91% (77)	100% (51)	>0.990	0.100	0.350
Symptoms	63% (20)	37% (7)	4% (3)	53% (27)	0.091	<0.0001 ⁵	0.0002 ⁵
Complications	91% (29)	95% (18)	73% (62)	92% (47)	>0.990	0.047 ⁵	0.067
Feeding position	91% (29)	68% (13)	64% (54)	82% (42)	0.063	0.005 ⁵	0.790
Inappropriate consistency	19% (6)	16% (3)	16% (14)	18% (9)	>0.990	0.790	>0.990
Staff responsibility	81% (26)	84% (16)	74% (63)	82% (42)	>0.990	0.480	0.550
Mix solid and liquid	66% (21)	79% (15)	60% (51)	71% (36)	0.360	0.670	0.190
Levels	47% (15)	11% (2)	2% (2)	33% (17)	0.013 ⁵	<0.0001 ⁵	0.150
TF testing methods	34% (11)	11% (2)	8% (7)	25% (13)	0.096	0.001 ⁵	0.670
TMD testing methods	16% (5)	16% (3)	1% (1)	16% (8)	>0.990	0.006 ⁵	0.019 ⁵
Tools used in testing	75% (24)	42% (8)	4% (3)	63% (32)	0.035 ⁵	<0.0001 ⁵	<0.0001 ⁵
IDDSI descriptors	84% (27)	47% (9)	12% (10)	71% (36)	0.010 ⁵	<0.0001 ⁵	0.001 ⁵
Soft and bite-sized food	69% (22)	58% (11)	15% (13)	65% (33)	0.550	<0.0001 ⁵	0.0003 ⁵
Minced and moist food	41% (13)	68% (13)	2% (2)	51% (26)	0.083	<0.0001 ⁵	<0.0001 ⁵
Puréed food	94% (30)	89% (17)	32% (27)	92% (47)	0.620	<0.0001 ⁵	<0.0001 ⁵

¹Subtopic questions are expressed as the percentage of correct responses out of the total number of participants (number of correct responses). IDDSI, International Dysphagia Diet Standardization Initiative; TF, thickened fluid; TMD, texture-modified diet.

²Differences between attendee and non-attendee groups at 6 mo postintervention.

³Differences between attendee group at 6 mo postintervention and the pre-intervention group.

⁴Differences between the non-attendee group at 6 mo postintervention and the pre-intervention group.

⁵Mann-Whitney U test was used to analyze the statistical significance of the total score differences between groups and Fisher's exact test was used to analyze the statistical significance of the correct response rate between groups. P < .05 indicates statistical significance.

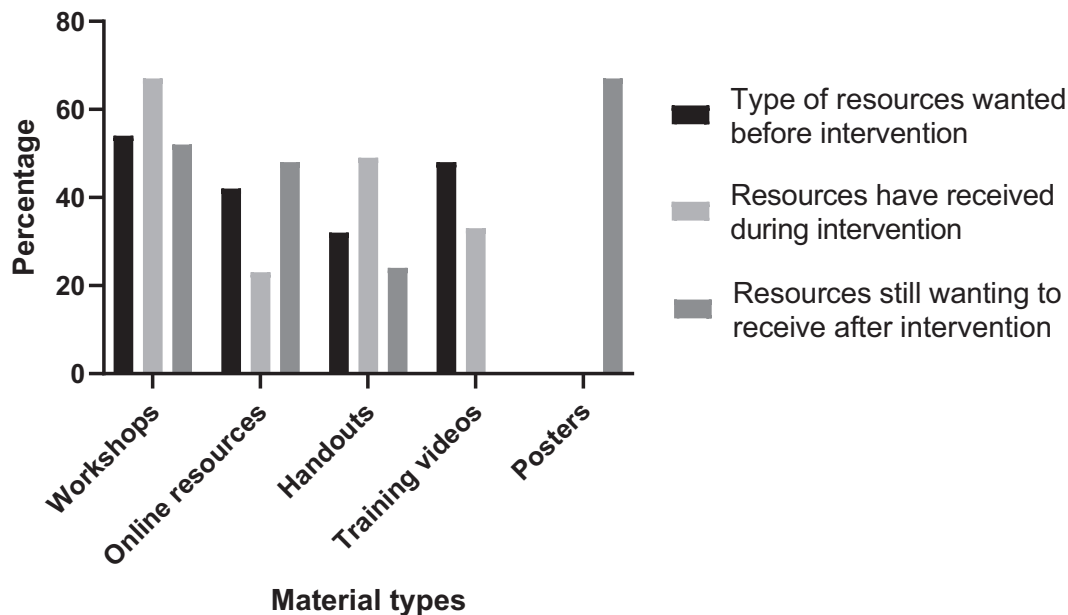


FIGURE 2 Comparison of materials needs and receipt by participants.

testing of TFs. The individual group-focused intervention demonstrated promising effects, as evidenced by improvement in foodservice production and overall staff knowledge level. Although all sites showed better compliance in TMD provision, some sites showed more significant improvements than others. The reason that some sites had fewer changes in TMD compliance was based on their initial implementation already being more successful, so the range of improvement was limited. According to Baker et al. (22), tailored interventions tend to provide small to moderate changes in guideline implementation, in agreement with our findings. A lack of compliant soft and bite-sized meals' provision in aged care facilities was found in both the study by Miles et al. (26) and our pre-intervention audits. Compared with other levels of TMD, soft and bite-sized showed the most improvement in compliance after the intervention. Staff misperception of soft and bite-sized particle size and softness requirements led to the poorest compliance of soft and bite-sized meals pre-intervention.

From our evaluation, the tailored intervention including the education workshop, handout materials, and training videos positively influenced staff knowledge. Although nursing staff knowledge and attitudes have been identified as a fundamental role in improving dysphagic and nutrition care (34–36), studies suggest that health care and foodservice staff who are responsible for assisting residents should be appropriately trained on monitoring nutrition risks and providing ideal mealtime assistance (37–39). Multiple studies highlighted the concern of clinical staff's lack of knowledge in optimizing nutritional care for people living with dysphagia (40–42). Although we also found that the knowledge levels of dysphagia and IDDSI in pre-surveys were dissatisfactory, survey respondents expressed willingness for training. An Irish national survey conducted in 122 aged care facilities also reported the nursing staff's desire for dysphagia training, particularly in dysphagia screening, choking management, TMDs, and TFs (11). Despite the demand for dysphagia training, aged care facilities reported a lack

of access to speech-language therapist services (10, 11). The observed improvement in staff knowledge level could be attributed to the involvement of both a dietitian and speech-language therapist in the intervention.

A major contributor to the success of the intervention were the multiple tailored materials prepared as per staff requests provided in the pre-surveys. We combined the commonly recommended dissemination learning style (electronic resources, printed materials, didactic learning) with an interactive workshop (43). IDDSI website self-learning materials have previously been proved as effective learning resources to improve participants' knowledge of IDDSI (17). It is worth noting that the effectiveness of printed educational materials on health care professionals' practice has previously been reported as inconclusive (44). Kreuter et al. (45) suggested using audience-targeted tailored materials as more effective and better perceived by the participants.

Considering the staff availability and high turnover rate, an electronic orientation package with descriptions, videos, and website links was developed and provided to the aged care facilities. Participants expressed a strong willingness to review online resources, and web-based materials should be considered in the future. Web-based tailored interactive nutrition intervention can produce immediate behavior change (46), as found with a web-based dysphagia screening education module demonstrating improved knowledge among hospital nurses (12). In both dysphagia and IDDSI questions, sites that scored higher in the pre-survey also scored higher in the post-survey. This result agrees with Rule's study (17), which reported that positive post-training performance was predicted by better baseline performance, a younger age, and higher educational level. These results suggest that learning behavior may be varied across demographic groups; participants with higher baseline knowledge may be more interested in the topic and therefore more motivated in training. Due to the small sample size, we were unable to assess the contributing factors, such as participant characteristics

or motivation level. Future research should study the factors that may influence participant learning outcomes.

Results from our study reflected the success of following the implementation framework and developing tailored strategies corresponding to the determinants identified (47). Despite the review suggesting that a tailored intervention may only have a moderate impact on health professional knowledge and practice (23, 48), systematic assessment using a conceptual implementation framework facilitated the development of suitable and targeted interventions for the local context. Clinician-led interventions based on interviews and audit results have shown positive changes in TMD and TF provision in acute care hospitals (16, 49). Our study supports this finding, as we collaborated with health professionals and foodservice, clinical, and management teams to assess and develop an integrated intervention to facilitate IDDSI implementation.

The success of knowledge attained from the intervention and improved compliance to TMD production demonstrated the potential benefits using a tailored intervention approach to implement IDDSI. However, there were still some staff members who failed to adhere to the IDDSI recommendations in practice, which raised our concerns of patient safety. Failure to classify or prepare the correct level of TMDs and TFs may increase the chances of choking and aspiration (7). The need to support foodservice, nursing staff, and health care assistants to become competent towards IDDSI standards is therefore crucial. Considering that the intervention strategies were developed based on the determinants identified from pre-intervention evaluation, the strategies used in this research may not be applicable to patient education.

Limitations

The current research was pragmatically designed, and as such relied on a convenience sample that was not pair-matched in the pre- to the post-intervention survey. There was no need for tracking individual participant data as the comparisons of interest for the study were based on whole-site changes, and not individual changes pre- and postintervention. Although the survey has been piloted in a small group of participants, it has not been validated through statistical analysis. Therefore, measurement error may occur. In order to gather reliable conclusions, future study may consider developing a validated tool to measure IDDSI knowledge. Response rates were not measured as participant identity was anonymous to encourage realistic responses. The pragmatic design does make further interpretation of the data problematic. A delayed postintervention outcome approach was used to demonstrate maintenance of change. However, variance in changes among sites could also be a result of uncontrollable factors, such as facility size, staff turnover, and other barriers that occurred after the intervention. Future studies should consider evaluating the immediate effect and learning resources to minimize human factors. Another limitation to this study is that the investigators were aware of the implementation; therefore, blinding in audits was not possible. However, using an objective measurement tool in audits minimized the risk of bias. Participant age, educational level, work experience, and role may also contribute to the acceptance of tailored interventions. Last, our participating sites had already been introduced to IDDSI before the intervention and they voluntarily participated in the research. Consequently, results from this tailored intervention may only be applied to motivated and prepared aged care facilities and cannot be generalized to all aged care facilities. In order to identify whether the organization is ready for the implementation and whether

this intervention approach will be suitable, a needs assessment is recommended.

Conclusions

Compared with studies that assessed the IDDSI implementation alone, our study shows improvement in short-term (6 mo) compliance to IDDSI standards and positive impact on staff knowledge acquisition. This study provides findings and insights that may contribute to future IDDSI implementation interventions. Implementation of IDDSI will be beneficial for patient safety and can enable a stronger interprofessional collaboration. More research is required to further explore the most efficient implementation strategies to facilitate foodservice with implementation (50). Continuous staff education and multidisciplinary collaborations with stakeholders are important in developing guideline translation into practice.

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Data Availability

Data described in the manuscript, code book, and analytic code will be made available from the corresponding author on reasonable request.

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