

Original**A Successful Innovative Meal Ordering System for Hospital Patient-Centered Food Service in Taiwan**Fen-Ling Tseng^{1*}, Yu-Wen Wang¹, Mei-Fang Yang¹.¹*Department of Dietetics & Nutrition, Taipei Veterans General Hospital, Taiwan*

ABSTRACT *Background and purpose.* A general hospital in northern Taiwan was the first to establish an electronic ordering system in 1982. However, the system requires nurses to place orders based on physicians' diet prescriptions and patients' preferences, whereas patients can not order meals by themselves. *Methods.* An innovative meal ordering system (iMOS) was launched at this general hospital to revolutionize the meal ordering process by adopting information technology and providing diverse meals. In addition to the traditional cycle menu, a selective menu of stew dishes, light meals, noodle sets, and other culinary choices were included. Patients whose diet order was non-therapeutic could order meals using their own electronic devices or make an order on meal monitors at the nursing station. The patient satisfaction and ordering rates pre- and post-implementing iMOS were analyzed during 2016-2022. *Results.* The findings indicated a significant improvement in flavor (3.7 vs. 4.3), presentation (3.9 vs. 4.5), and satisfaction (4.0 vs. 4.3) after iMOS was implemented. The rate of ordering diverse meals rose from 7.3% in 2017 to 18.6% in 2022. *Conclusion.* the iMOS meal ordering system successfully improved patient satisfaction and enhanced the meal ordering rate, indicating that an innovative patient-centered foodservice model could be achieved by applying information technology.

Keywords: innovative meal ordering system, hospital patient food service

INTRODUCTION

Nutrition is crucial for patient care, and food service plays a pivotal role in mitigating malnutrition by providing patients with adequate meals. Hospital food service also impacts patients' perception of their entire hospital experience, enhancing their satisfaction (1-3). Studies have demonstrated that electronic menu systems could improve dietary intake while maintaining cost-effectiveness, reducing waste, and ensuring satisfaction.

Jamison et al. (4) found that patients preferred the electronic-based meal ordering system (eBMOS) over the traditional menu (TM) due to factors such as interest, curiosity, convenience, availability, satisfaction, and motivation. McCray et al. (5) and Maunder et al. (6) conducted surveys regarding patient preferences for menu ordering systems. They observed that a significant proportion of patients preferred the eBMOS to the TM in both studies, with percentages of 84% vs. 16% and 80% vs. 15%, respectively.

Since its inception in 1982, a general hospital in Taipei, Taiwan, has been at the forefront of healthcare institutions by implementing an electronic ordering system for patient meals. In this system, dietitians designed cycle menus based on physicians' diet prescriptions. The electronic ordering system offers an array of options, including staple foods such as rice,

porridge, steamed buns, and mixed grain rice as well as dietary avoidance of pork, beef, chicken, seafood, dairy, and sweets. Nurses assist patients in making their selections, subsequently transmitting these choices to the nutrition department for meal preparation.

Despite these strengths, the system has notable limitations. It lacks the capacity to display detailed menu contents or provide diverse meal choices, and it does not allow patients to make autonomous dish selections. In recent years, the hospital has faced challenges related to a shortage of nursing staff and kitchen aides. Therefore, addressing these shortcomings and implementing a more user-friendly system that grants patients greater autonomy in choosing from a diverse array of meal options is imperative.

This project aims to design a web-based meal ordering platform for patients and dietitians in partnership with nurses to provide a diverse selection of meals for patients on non-therapeutic diets and eventually to increase patient satisfaction and meal ordering.

MATERIALS AND METHODS

The innovative meal ordering system (iMOS) is created by dietitians to allow patients taking non-therapeutic diets, such as regular, soft, pediatric, and tocolytic diets, to place diverse meal orders by themselves, as well as enables nurses to place meal orders based on the physician's diet prescriptions.

*To whom correspondence should be addressed:
fltseng@vghtpe.gov.tw

The iMOS has been developed with two distinct meal-ordering models. The first model is to order traditional meals, comprising three daily meals and adhering to the cycle menu. The second model offers diverse meal choices based on the patient's preferences, such as stew dishes, light meals, noodle sets, and other culinary options. Orders for both models can be placed by nurses, patients, or caregivers, as illustrated in Photo 1.

Patient satisfaction is evaluated via a comprehensive questionnaire. A 5-point Likert scale is used to assess the quality of the hospital's food service.

The survey was conducted biennially between July 2016 and 2022, excluding patients in the intensive care unit and psychological wards. All inpatients on non-therapeutic diets were surveyed during data collection periods. The patients or their caregivers answered the survey questionnaire.

The statistical analysis methods to analyze the data obtained from patient satisfaction surveys and meal order rates, including descriptive statistics, chi-square test, t-test, and ANOVA, were performed using statistical software packages of SPSS.



Photo 1. Diverse meals for patient selection

RESULTS

The iMOS provides flexibility in terms of devices for meal ordering. Patients or caregivers can place meal orders using their own electronic devices, including smartphones, pads, or monitors at the nursing station, and nurses operate the system using computers in the nurse station or on mobile nursing carts, as depicted in Figure 1.

To promote iMOS, social media by LINE accounts and instructional videos are developed to guide patients using the website for ordering meals via the

hospital's WiFi network. The nursing station's notice board displays the QR code for the LINE account, as illustrated in Photo 2.

A total of seven instruction videos are developed, guiding patients on meal selection, WiFi connectivity, adding food items, recipe selection, meal set choices, a la carte ordering, and bill checking (Photo 3). In addition, diverse meal options are made available for guest trays. The menu for the iMOS is also featured on the LINE accounts.

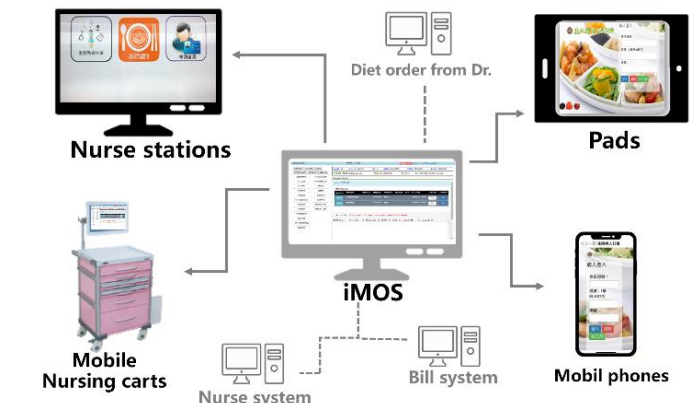


Fig 1. Meal order devices

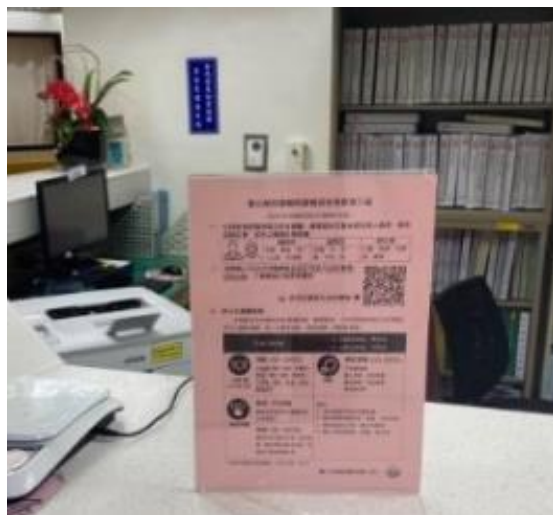


Photo 2. LINE QR code for meal ordering at the nurses' station



Photo 3. Seven instruction videos for meal-ordering operations on the LINE

Table 1. Characteristics of participants in the patient satisfaction survey

Variables		Years				p
		2016 Pre- iMOS	2018	2020 Post-iMOS	2022	
Total n=1298		33.8%		66.2%		
Sex	male	240 (54.7) ^a	176 (59.5) ^a	230 (70.1) ^b	122 (51.9) ^a	<.001
	female	199 (45.3) ^a	120 (40.5) ^a	98 (29.9) ^b	113 (48.1) ^a	
Age	<=29	21 (4.8) ^a	30 (10.1) ^b	16 (4.9) ^{ab}	17 (7.2) ^{ab}	<.05
	30-49	81 (18.5) ^a	59 (20.0) ^a	50 (15.2) ^a	38 (16.2) ^a	
	50-69	199 (45.3)	130 (43.9)	145 (44.2)	111 (47.2)	
	>=70	138 (31.4)	77 (26.0)	117 (35.7)	69 (29.4)	
Education	Primary school	110 (25.1)	52 (17.6)	72 (22.0)	52 (22.1)	<.05
	Junior and High school	195 (44.1)	114 (38.5)	142 (43.2)	104 (44.3)	
	College and University	134 (30.5) ^a	130 (43.9) ^b	114 (34.8) ^{ab}	79 (33.6) ^{ab}	
Participants	Patient	368 (83.8) ^a	284 (95.9) ^b	265 (80.8) ^a	194 (82.6) ^a	<.001
	Relatives	68 (15.5) ^a	10 (3.4) ^b	47 (14.3) ^a	36 (15.3) ^a	
	Caregiver	3 (0.7) ^a	2 (0.7) ^a	16 (4.9) ^b	5 (2.1) ^{ab}	

Data presented by n(%), 2016 (n=439), 2018 (n=296), 2020 (n=328), 2022 (n=235)

Chi-square was used by analyzed data and significantly different marked by ^{ab} (p<.05)

The patient satisfaction survey involved 439 patients in 2016, 296 patients in 2018, 328 patients in 2020, and 235 patients in 2022. The demographic characteristics of these patients are summarized in Table 1.

There is a significant improvement in flavor, presentation, and satisfaction of non-therapeutic diet order patients after iMOS implementation (Table 2). Compared with pre-iMOS (2016), the flavor, presentation, and satisfaction ratings in the post-iMOS

period (2018, 2020, and 2022) exhibited a significant increase. (P<0.001)

Table 3 reveals a significant difference in flavor and satisfaction with age but not in presentation after implementing the iMOS system. Patients aged between 30 and 49 exhibit significantly lower scores of flavor and satisfaction than other age groups.

Table 4 displays the diverse meal order rate of 7.3% in 2017, 13.2% in 2018, 13.8% in 2019, 15.9% in 2020, 19.1% in 2021, and 18.6% in 2022. The results suggest an increasing trend from 2017 to 2022.

Table 2. Comparison between Pre and Post-iMOS

Years	Variables	Flavor		Presentation		Satisfaction	
		Mean (SD)	<i>p</i>	Mean (SD)	<i>p</i>	Mean (SD)	<i>p</i>
2016 vs 2018	2016	3.7 (0.87)		3.9 (0.90)		4.0 (0.72)	
	2018	4.2 (0.82)***		4.5 (0.68)***		4.4 (0.71)***	
2016 vs 2020	2016	3.7 (0.87)	<.001	3.9 (0.90)	<.001	4.0 (0.72)	<.001
	2020	4.0 (0.75)***		4.3 (0.73)***		4.3 (0.58)***	
2016 vs 2022	2016	3.7 (0.87)		3.9 (0.90)		4.0 (0.72)	
	2022	4.5 (0.68)***		4.7 (0.52)***		4.5 (0.74)***	
Pre vs Post	2016	3.7 (0.87)	<.001	3.9 (0.90)	<.001	4.0 (0.72)	<.001
	2018-2022	4.3 (0.80)***		4.5 (0.72)***		4.3 (0.71)***	

Data presented by Mean (SD), 2016 (n=439), 2018 (n=296), 2020 (n=328), 2022 (n=235)

Paired t-test was used by analyzed data and significantly different marked by ****p*<.001

Table 3. Comparison by age group for flavor, presentation, and satisfaction in post-iMOS

Ages	Number	Flavor		Presentation		Satisfaction	
		Mean (SD)	<i>P</i>	Mean (SD)	<i>P</i>	Mean (SD)	<i>P</i>
<=29	47	4.2 (0.76) ^{ab}		4.4 (0.69)		4.3 (0.72) ^{ab}	
30-49	97	4.1 (0.96) ^b		4.4 (0.76)		4.2 (0.78) ^b	
50-69	333	4.3 (0.78) ^a	<.005	4.5 (0.70)	0.149	4.4 (0.71) ^a	<.001
>=70	198	4.4 (0.73) ^a		4.5 (0.68)		4.4 (0.66) ^a	

Data was presented by Mean (SD), which was analyzed by one-way ANOVA and pointed out the significant difference as "ab" by Tukey post hoc analysis. (*p*<0.05)

Table 4. Diverse meal order rate of the non-therapeutic diet

Years	Diet order numbers from physician's prescription	Meal order numbers from patients	Diverse meal order numbers from patients	Diverse meal order rate
	(A)	(B)	(C)	(D)=C/B
2017	341822	166831	12146	7.3%
2018	414827	220591	29164	13.2%
2019	387262	216089	29734	13.8%
2020	370335	219852	35001	15.9%
2021	321160	200422	38230	19.1%
2022	321683	211781	39459	18.6%

DISCUSSION

The results confirm that implementing this iMOS has significantly increased the satisfaction of non-therapeutic diet order patients. Other investigators in their studies have also demonstrated that patients perceived greater involvement and information regarding their meal selection decisions, resulting in higher satisfaction (7-11).

Furthermore, this iMOS has progressively increased hospital meal order rates, including diverse meal ordering rates. Roberts et al. (12) have indicated that patients value the flexibility and convenience offered by meal-ordering systems, which enables them to access nutritional information and make informed menu selections. Similarly, Ottrey and Porter (13) have demonstrated that spoken and visual menu systems can help patients have better meal experiences by supporting them in making correct menu selections and delivering a more individualized meal-ordering service. The current project implementing an innovative computerized meal ordering system in hospitals allows patients to make their own meal decisions, resulting in more individualized service and steadily increasing patient meal order rates. However, in 2022, the diverse meal order rate experienced a decline that could be attributed to the severe spread of COVID-19 in Taiwan, which resulted in a shortage of hospital kitchen workers and paused iMOS's diverse meal service for two months.

An interesting finding of this project reveals that younger patients, particularly those aged 30 to 49, exhibit lower levels of satisfaction and flavor than their older counterparts. The younger patients have had ample opportunities to make meal choices before being admitted to the hospital and are proficient in using electronic meal order systems. In this regard, Hussien and Mansour (14) found that younger customers, especially those aged 25-34, were inclined to use food applications, placing a higher value on convenience and control than their older customers, who expressed a greater need for human interaction. As a solution, Hussien and Mansour's study suggests providing a call center with human interaction to encourage older customers to use applications for additional assistance.

The limitation of this project underscored the importance of promoting the iMOS approach to younger patients to inform them of this service in the hospital. Meanwhile, providing online meal ordering assistance to elderly patients could also be a strategy for improving their nutritional status during their hospital stay. With the advancement of technology, the meal ordering system should continuously update the version of the menu selection according to the patient's needs.

Barrington et al. (15) observed a statistically significant rise in mean daily energy and protein

intake in patients using a patient-directed eBMOS compared to a TM. Furthermore, McCray et al. (8) discovered that a considerably more significant proportion of patients who used eBMOS fulfilled their estimated energy and protein needs and showed a substantial decline in plate waste compared to the TM. Future research directions may investigate the dietary intake of inpatients in Taiwan who choose from a diverse meal to clarify whether there is a discernible trend of increased daily energy and protein dietary consumption among inpatients who utilize an electronic ordering system for meal selection.

CONCLUSION

Implementing an innovative, patient-centered food service model through a meal ordering system can improve patient satisfaction and increase meal ordering rates. The crucial point of success lies in empowering patients to make diverse meal selections using a convenient device, ultimately enhancing patients' satisfaction and nutrition care.

ACKNOWLEDGEMENT

Grateful acknowledgments are extended to Taipei Veterans General Hospital for providing financial support for this system. I sincerely thank Mr. Chen Tzu-En, RD, for his assistance in statistics. I would also like to express my deep appreciation to Dr. Chwang Leh-chii for her valuable encouragement and guidance on this paper.

REFERENCES

- 1) Ottrey E, Porter J. Hospital menu interventions: a systematic review of research. *Int J Health Care Qual Assur.* 29(1):62-74. 2016.
- 2) Allison SP. Hospital food as treatment. *Clin Nutr.* 22(2): 113-114. 2003.
- 3) Dijkhoorn DN, Mortier MJM, Van Den Berg MGA, Wanten GJA. The currently available literature on inpatient foodservices: systematic review and critical appraisal. *J Acad Nutr Diet.* 119(7):1118-1141. 2019.
- 4) Jamison J, Bednar C, Alford B, Hsueh A. A computerized interactive menu selector system for hospitals. *J Am Diet Assoc.* 96(10):1046-1047.1996.
- 5) McCray S, Maunder K, Norris R, Moir J, MacKenzie-Shalders K. Bedside menu ordering system increases energy and protein intake while decreasing plate waste and food costs in hospital patients. *Clin Nutr ESPEN.* 26, 66-71.2018.
- 6) Maunder K, Lazarus C, Walton K, Williams P, Ferguson M, Beck E. Energy and protein intake increases with an electronic bedside spoken meal ordering system compared to a paper menu in hospital patients. *Clin Nutr ESPEN.* 10(4):e134-e139. 2015.
- 7) Wadden K., Wolf B., and Mayhew A. Traditional

- versus room service menu styles for pediatric patients. *Canadian Journal of Dietetic Practice and Research* 67(2): 92-94. 2006.
- 8) McCray S., Maunder K., Krikowa R., and MacKenzie-Shalders K.. Room service improves nutritional intake and increases Patient Satisfaction while decreasing food waste and cost. *Journal of the Academy of Nutrition and Dietetics* 118, no. 2: 284-293. 2018.
 - 9) Elliott E, Mannik L, Goodwin J, et al. Implementation of an electronic spoken menu system at St. Michael's Hospital, Annual Dietitians of Canada National Conference. 2012.
 - 10) Kuperberg K, Caruso A, Dello S, et al. How will a room service delivery system affect dietary intake, food costs, food waste, and Patient Satisfaction in a pediatric hospital? A pilot study, *J. Foodserv.* 19, 255–261. 2008.
 - 11) Doorduijn AS, van Gameren Y., Vasse E. et al. At your Request® room service dining improves Patient Satisfaction, maintains nutritional status, and offers opportunities to improve intake, *Clin. Nutr.* 35, 1174–1180. 2016.
 - 12) Roberts S, Marshall A, Gonzalez R., et al. Technology to engage hospitalized patients in their nutrition care: a qualitative. *J Hum Nutr Diet* 30, 563–573. 2017.
 - 13) Ottrey E, Porter J. Exploring patients' experience of hospital meal-ordering systems. *Nursing Standard* 31(50):41-51. 2017.
 - 14) Hussien FM, Mansour NM. Factors Affecting Customer Satisfaction towards Mobile Food Ordering Applications (MFOAs). *JFTH*.17(1):17-35. 2020.
 - 15) Barrington V, Maunder K, Kelaart A. Engaging the Patient: improving dietary intake and meal experience through bedside terminal meal ordering for oncology patients. *J Hum Nutr Diet.* 31(6):803-809. 2018.