Proceedings of Anticancer Research, 2026, Volume 10, Issue 3
http://ojs.bbwpublisher.com/index.php/PAR
Online ISSN: 2208-3553
Print ISSN: 2208-3545

Study on the Impact of the "H2H" Nutritional Management Model Based on the Internet Platform on the Nutritional Status and Quality of Life of Patients after Esophageal Cancer Surgery

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Abstract: *Objective:* To explore the influence of the "H2H" (Hospital to Home) nutrition management model based on the Internet platform on the nutritional status and quality of life of patients after esophageal cancer surgery, and to provide evidence-based evidence for the continuous nutrition management after esophageal cancer surgery. *Methods:* From August 2025 to April 2026, 138 postoperative patients with esophageal cancer in our hospital were randomly divided into a control group of 71 cases and an observation group of 67 cases by convenient sampling method. The control group received conventional nutritional management, while the observation group implemented the "H2H" nutritional management model based on the Internet platform on this basis. The intervention period was 3 months after discharge. The nutritional indicators, the score of Nutritional Risk Screening 2002 (NRS2002) and the score of the Quality of Life Questionnaire for Cancer Patients (QLQ-C30) of the two groups of patients before the intervention (1 day before discharge) and after the intervention (3 months after discharge) were compared. *Results:* Before the intervention, there were no statistically significant differences in various nutritional indicators, NRS2002 scores and scores of each functional domain of QLQ-C30 between the two groups of patients ($P > 0.05$). After the intervention, the levels of body weight, prealbumin, serum albumin and hemoglobin in the observation group were significantly higher than those in the control group ($P < 0.05$), and the standardized scores of physical, cognitive, emotional, social and role functions in the QLQ-C30 scale were significantly higher than those in the control group ($P < 0.05$). There was no statistically significant difference in transferrin levels and NRS2002 scores between the two groups ($P > 0.05$). *Conclusion:* The "H2H" nutrition management model based on the Internet platform can effectively improve the core nutritional indicators of postoperative patients with esophageal cancer, enhance their quality of life, and has high patient compliance. It is an efficient postoperative continuous nutrition management model and is worthy of promotion and application in the field of clinical tumor care.

Keywords: Esophageal cancer; Internet; "H2H" nutritional management model; Quality of life; Nutritional indicators

Online publication: May 31, 2026

1. Introduction

Esophageal cancer is one of the common malignant tumors that threatens the life and health of Chinese residents [1,2], and its incidence ranks 8th in the world [3]. Due to disease consumption, surgical reconstruction of the digestive tract, and adverse reactions of radiotherapy and chemotherapy, patients with esophageal cancer bear a huge nutritional burden during and after treatment. The incidence of malnutrition is as high as 60% to 85%, ranking first among all malignant tumors, and has been proven to be an independent risk factor for complications and prognosis [4]. Therefore, establishing a comprehensive and personalized nutritional management model is crucial to improving the clinical outcomes of postoperative patients with esophageal cancer. Routine nutritional management is mostly limited to the patient's hospitalization period, and nutrition guidance is mostly provided by short-term telephone follow-up after discharge. There are problems such as management gaps, lack of personalized guidance, and insufficient supervision of patients' performance, making it difficult to meet the nutritional needs of patients for long-term home rehabilitation [5]. In recent years, with the rapid development of "Internet + nursing services", the Internet platform has provided technical support for continuous nutrition management outside the hospital, which can break the time and space constraints to achieve real-time monitoring, online guidance and dynamic follow-up, thereby improving patients' awareness and compliance of health management and meeting the personalized health needs of patients at different levels [6]. The H2H (Hospital to Home) nutrition management model was first proposed in China in 2016 by the Clinical Nutrition Department of West China Hospital of Sichuan University [7]. The core is to establish a full-range nutrition management path from hospital to home. Seamless nutrition support is achieved through in-hospital nutritional screening and treatment, development of personalized family meal plans, and continuous follow-up via phone/WeChat/App. Research shows that this model effectively improves the nutritional status of patients (especially patients with chronic diseases), significantly reduces the incidence of complications and re-hospitalization rates, and improves treatment compliance and quality of life [8]. It extends traditional nutritional intervention limited to hospitalization into a long-term, dynamic, full-course health management. Therefore, this study uses the Internet platform to expand the "H2H" nutritional management model to patients after esophageal cancer surgery, build a standardized intervention process, explore its impact on patients' nutritional status and quality of life, and provide a reference for optimizing the nutritional management model after esophageal cancer surgery.

2. Materials and methods

2.1. Research objects

A convenience sampling method was used to select esophageal cancer surgery patients who visited a cancer specialist hospital in Guangzhou from August 2025 to April 2026 as the research subjects.

Inclusion criteria: (1) meet the diagnostic criteria for esophageal cancer in the "Standards for the Diagnosis and Treatment of Esophageal Cancer (2018 Edition)" [9]; (2) undergo elective radical resection

for esophageal cancer; (3) Karnofsky functional status score (Karnofsky, KPS) ≥ 60 points; (4) estimated survival time is more than 3 months; (5) normal language communication ability; (6) able to use smartphones independently to cooperate with questionnaires; (7) informed consent and cooperation with follow-up.

Exclusion criteria: (1) distant metastasis of tumors; (2) multiple organ failure; (3) severe lesions in the lungs and pleura before surgery; (4) combined with metabolic diseases such as diabetes; (5) receiving immunotherapy; (6) severe cognitive dysfunction.

Taking serum albumin as the main outcome indicator, referring to previous studies [10], the mean difference in serum albumin between the experimental group and the control group after intervention was $\delta = 3.3$ g/L, and the standard deviation was 4.8. It was assumed that two-sided $\alpha = 0.05$, and the test power was $1-\beta = 0.90$. Using the sample size calculation formula for comparing the means of the two groups, the minimum sample size for each group was calculated to be 62 cases. Considering the 20% loss to follow-up rate, 75 cases were included in each group. During the course of the study, 1 case died in the control group, 3 cases received immunotherapy, 2 cases died in the observation group, 1 case suffered multiple organ failure, and 5 cases received immunotherapy. The final loss to follow-up rate was 8%. A total of 138 valid samples were included: 71 cases in the control group and 67 cases in the observation group.

This study was approved by the Medical Ethics Committee of Sun Yat-sen University Cancer Center, and all subjects signed informed consent. This study was approved by the Ethics Committee of the Clinical Medical Research Center of our hospital (Approval No. B2025-669-01).

2.2. Intervention methods

2.2.1. Control group

Standardized routine nutrition management after esophageal cancer surgery is implemented, which is completed by nutrition specialist nurses and esophageal cancer specialists: (1) nutritional risk screening using the NRS2002 scale within 24 hours of admission, one-on-one nutrition education and personalized dietary guidance, and explanation of dietary principles, food selection and energy intake points after esophageal cancer surgery; (2) preoperative assessment of the patient's nutritional status, based on The NRS2002 score provides targeted nutritional support such as oral nutritional supplements, enteral nutrition, and intravenous nutrition; (3) a paper nutrition guidance manual is issued upon discharge to inform the patient of home nutrition precautions, review time and items; (4) telephone follow-up is conducted every 2 weeks after discharge, with each follow-up lasting 10 to 15 minutes. The content includes diet implementation, weight changes, symptoms of discomfort, etc. Targeted nutritional guidance is provided and the patient is reminded to return to the hospital for review on time.

2.2.2. Observation team

On the basis of the control group, "Internet +" H2H nutrition management was implemented. A "H2H" nutritional management team was established, consisting of a head nurse, an esophageal cancer specialist, and two nutrition specialist nurses. All members have received professional training in tumor nutrition management, Internet platform operation, etc., and can only participate in the study if they pass the assessment with a 100% passing rate. Relying on the hospital's "Internet + Nursing" service platform and self-developed mini-programs, the intervention period is 3 months after discharge.

2.2.2.1. In-hospital nutrition management

(1) Strengthening nutrition education: In addition to conventional guidance, patients and primary caregivers are provided with intensive training on dietary transition principles, energy and food estimation methods after esophageal cancer surgery using teaching aids such as food models and energy calculation turntables.

(2) Develop a personalized nutrition plan: 1 day before discharge, doctors and nutrition specialist nurses will jointly develop an individualized family nutrition treatment plan based on the patient's nutritional risk level, energy needs and digestive tract function, and clarify the nutritional support path (oral, tube feeding or combined), the type and dosage of nutritional preparations, and the diet transition plan.

(3) Platform usage training: Provide one-on-one guidance to patients and caregivers to master various functions of the "Esophageal e-Nutrition" applet to ensure that they can independently complete information entry, course learning, online consultation and other operations.

2.2.2.2. Home nutrition management

Relying on the nutrition management applet to realize the management of four core functional modules, the nutrition specialist nurse is responsible for the maintenance and operation:

(1) Online education: According to the family enteral nutrition guide, nine standardized teaching videos are filmed, covering the knowledge and skills that must be mastered in family nutrition such as nutrient solution preparation, bolus injection, use of nutrition pumps, home care of nutrition tubes, common complications and their treatment. After patients or caregivers complete all courses and pass the online assessment, they can obtain electronic certificates to ensure that nutrition knowledge is in place;

(2) Online Consultation: A 24-hour online consultation module is set up. Patients can raise nutritional issues during home health care at any time, and nutrition specialist nurses will reply within 12 hours. Questions that appear frequently on the platform (such as diet transition, weight loss treatment) are sorted out, summarized, and made a special push for all patients to refer to;

(3) Nutritional monitoring: The platform design embeds commonly used nutrients and food ingredients and energy selection modules. Patients check and enter their daily diet, and the mini program automatically calculates whether the nutritional intake meets the target needs. For patients with insufficient intake, personalized nutritional supplement recommendations are pushed in real time; patients measure and upload their weight once a week at a fixed time, and if the weight drops by >5% or continues to drop compared with discharge, the system automatically warns, and the nutrition management team immediately intervenes for review;

(4) Program supervision and offline support: If the patient fails to check in for nutrition for 3 consecutive days, the system automatically triggers a reminder, and the management team conducts a follow-up phone call to understand the reasons and assist in solving the problem. Patients who need home care can make an appointment through the "Online Nurse Appointment" function of the hospital APP, and a nutrition specialist nurse will come to provide nutrition tube maintenance and other services.

2.2.2.3. Outpatient follow-up

Nutrition specialist nurses conduct telephone follow-up visits once a week, with each follow-up lasting 15 to 20 minutes. The content includes the implementation of the nutrition plan, the patient's stress state, treatment compliance and psychological state, etc.; combined with objective data such as laboratory indicators and

body composition analysis reports from the nutrition specialist clinic when the patient returns to the hospital for follow-up visits, personalized and dynamic nutrition plan adjustments are made for the patient to ensure the pertinence and effectiveness of nutrition management until the end of the intervention cycle.

2.3. Observation indicators

2.3.1. Nutritional indicators

Collect nutritional indicators related to patients' morning fasting, including: (1) Body weight/kg; (2) Prealbumin (PA): The normal value of PA is 25–40 mg/dL, which reflects the short-term nutritional status and has high sensitivity; (3) Serum albumin (albumin, ALB): The normal value of ALB is 40–55 g/L, which reflects the body's long-term nutritional reserve; (4) Hemoglobin (HGB): normal value for men is 130–175 g/L, and for women is 115–150 g/L; (5) Transferrin (g/L): normal value is 2.0–4.0 g/L, assisting in assessing nutritional status. On the day of enrollment, the patients' fasting venous blood was collected uniformly, and the blood samples were sent to the Laboratory Department of our hospital for laboratory biochemical index testing. For re-examination after the patient left the hospital (90 days after the intervention), the fasting venous blood was collected by the blood collection center of the outpatient department of our hospital, and the blood samples were sent to the Laboratory Department for laboratory biochemical index testing.

2.3.2. Nutritional Risk Screening 2002 (NRS2002)

NRS2002 is the preferred tool [11] for nutritional risk assessment of inpatients, with good reliability and validity (Cronbach's α coefficient is 0.82–0.86). The scale includes nutritional status score (0–3 points), disease severity score (0–3 points), and age-adjusted score (≥ 70 years old plus 1 point). A total score of < 3 points indicates no nutritional risk, and nutritional risk screening is only performed once a week; a total score of ≥ 3 points indicates the existence of nutritional risk, and timely nutritional support intervention is required. Members of the research team will evaluate the patients on the day of enrollment and 90 days after the intervention.

2.3.3. Quality of life

Use the Quality of Life Questionnaire-Core 30 (QLQ-C30) for cancer patients to evaluate the quality of life of patients before and after intervention [12]. This scale is widely used to assess the quality of life of patients with various types of tumors. Its reliability and validity have been verified by many domestic studies, and it is suitable for patients after esophageal cancer surgery. The scale contains 15 domains with a total of 30 items. This study focuses on evaluating its 5 functional domains, namely physical function (PF), role function (RF), cognitive function (CF), emotional function (EF) and social function (SF). There are 15 items, each of which has a score ranging from 1 to 4 points. The rough score is equal to the total score of the items in each field divided by the number of items. The extreme difference method is used to convert the rough score into a standardized score (0 to 100 points). The higher the score, the better the quality of life. The Cronbach's alpha coefficient of the scale is 0.885, indicating good internal reliability and validity. Members of the research team will evaluate the patients on the day of enrollment and 90 days after the intervention.

2.4. Data collection and quality control

Before the investigation began, the project was approved by the hospital ethics committee and the hospital nursing department provided consent. Team members were uniformly trained and assessed. Only those

who passed the training could participate in the study. The same group of specialist nurses conducted all interventions. During the investigation process, unified instructions were used to explain the purpose and significance of the study to the respondents, solicit the patient's consent and understanding, and explain the filling instructions in detail. The intervention process is regularly supervised and inspected. The head nurse organizes an intervention quality inspection every month, establishes a follow-up quality control mechanism, and conducts random checks on follow-up records (spot check rate ≥ 20%) to ensure that the follow-up information is true and complete. After the survey is completed, check whether there are any errors or omissions, confirm in a timely manner, and collect the questionnaire after confirmation.

2.5. Statistical methods

Two trained researchers will enter the data in pairs. After the entry is completed, cross-checking will be carried out. Abnormal data will be verified and corrected in a timely manner. SPSS 26.0 software was used for data processing. If the measurement data conformed to the normal distribution, it was expressed as mean ± standard deviation (SD). If it did not conform to the normal distribution, it was expressed as the median M. The count data was expressed as the rate (%). The t-test and χ^2 test were used to compare the differences between groups. P <0.05 was considered a statistically significant difference.

3. Results

3.1. Comparison of general information between the two groups of esophageal cancer patients

Before intervention, there were no statistically significant differences between the two groups of patients in terms of gender, age, lesion location, tumor type and other general information (P > 0.05). See **Table 1** for details.

Table 1. Comparison of general information between the two groups of patients after surgery for esophageal cancer

Characteristics	**Control group (n = 71)**	**Observation group (n = 67)**	**Test statistic**	***P* value**
Gender, *n* (%)				
Male	52	53	χ^2 = 0.953	0.329
Female	19	13		
Age (years), mean ± SD	64.93 ± 8.26	63.38 ± 7.55	t = -1.145	0.254
Lesion location, *n* (%)				
Upper thoracic esophagus	5	9		
Middle thoracic esophagus	39	35	χ^2 = 0.198	0.884
Lower thoracic esophagus	27	23		
Tumor type, *n* (%)				
Adenocarcinoma	36	32		
Squamous cell carcinoma	24	23	χ^2 = 0.953	0.923
Adenosquamous carcinoma	11	12		

3.2. Comparison of nutritional indicators and NRS2002 scores between the two groups of esophageal cancer patients before and after intervention

Before the intervention, there was no statistically significant difference in the nutritional indicators (body weight, prealbumin, serum albumin, hemoglobin, transferrin) and NRS2002 scores between the two groups of patients ($P > 0.05$); after the intervention, the observation group's weight, prealbumin, and The levels of albumin, serum albumin, and hemoglobin were significantly higher than those in the control group, and the difference was statistically significant ($P < 0.05$); when comparing the transferrin levels and NRS2002 scores between the two groups, the difference was not statistically significant ($P > 0.05$). See **Table 2** for details.

Table 2. Comparison of nutritional indicators and NRS2002 scores between two groups of patients after esophageal cancer surgery before and after intervention

Indicators	Group	Before intervention	After intervention	Intergroup *t*-value (after intervention)	*P* value (after intervention)
Body weight (kg)	Control	58.39 ± 10.10	57.58 ± 9.81	-2.003	0.049
	Observation	61.42 ± 10.10	61.05 ± 10.20		
NRS2002 score (points)	Control	2.93 ± 0.72	2.91 ± 0.68	0.230	0.410
	Observation	2.86 ± 0.47	2.79 ± 0.62		
Prealbumin (mg/dL)	Control	24.69 ± 4.80	22.50 ± 4.47	-2.751	0.033
	Observation	23.27 ± 4.48	26.11 ± 4.48		
Serum albumin (g/L)	Control	42.79 ± 5.24	44.23 ± 4.61	-2.239	0.024
	Observation	43.28 ± 4.74	46.85 ± 5.37		
Transferrin (g/L)	Control	2.77 ± 0.52	2.70 ± 0.55	2.920	0.250
	Observation	2.18 ± 0.48	2.44 ± 0.50		
Hemoglobin (g/L)	Control	106.70 ± 8.52	107.43 ± 11.26	-2.712	0.007
	Observation	105.54 ± 9.51	109.92 ± 11.35		

3.2. Comparison of quality of life between the two groups of esophageal cancer patients before and after intervention

Before the intervention, there was no statistically significant difference in the scores in each functional domain of the QLQ-C30 scale between the two groups of patients ($P > 0.05$); after the intervention, the scores in each functional domain of the two groups were significantly higher than before the intervention ($P < 0.05$), and the scores of physical function, cognitive function, emotional function, social function, and role function in the observation group were significantly higher than those in the control group, and the difference was statistically significant ($P < 0.05$). See **Table 3** for details.

Table 3. Comparison of quality of life between two groups of patients after esophageal cancer surgery before and after intervention (minutes, mean ± SD)

Functional domains	Group	Before intervention	After intervention	Intergroup *t*-value (after intervention)	*P* value (after intervention)
Physical function	Control	47.25 ± 9.35	51.21 ± 8.19	0.631	0.008
	Observation	47.87 ± 9.18	54.03 ± 8.21		
Cognitive function	Control	51.16 ± 6.74	56.22 ± 5.35	3.071	0.003
	Observation	50.67 ± 6.43	62.56 ± 5.15		

Functional domains	Group	Before intervention	After intervention	Intergroup *t*-value (after intervention)	*P* value (after intervention)
Emotional function	Control	56.17 ± 7.85	62.73 ± 6.56	-4.213	0.001
	Observation	57.09 ± 7.53	65.01 ± 6.24		
Social function	Control	53.86 ± 6.37	61.26 ± 6.24	-2.916	0.004
	Observation	54.85 ± 6.56	67.63 ± 7.56		
Role function	Control	55.15 ± 4.23	59.71 ± 5.45	-4.356	0.001
	Observation	54.95 ± 3.45	63.05 ± 4.22		

4. Discussion

4.1. The "H2H" nutritional management model based on the Internet platform can effectively improve the nutritional status of esophageal cancer patients

The results of this study show that after the intervention, the core nutritional indicators such as body weight, prealbumin, serum albumin, and hemoglobin in the observation group were significantly higher than those in the control group ($P < 0.05$), suggesting that the "H2H" nutritional management model based on the Internet platform can effectively improve the nutritional status of patients after esophageal cancer surgery. This is consistent with the research conclusions of Liu Jiahuan et al. on gastric cancer patients [10].

The "H2H" nutrition management model based on the Internet platform has constructed a three-level full nutrition management system of "hospital-home-follow-up", which effectively makes up for the out-of-hospital disconnection problem of the traditional management model: in-hospital standardized education and personalized plan formulation lay a solid foundation of knowledge and plans for patients' home nutrition management; the home stage relies on the Internet The platform realizes real-time monitoring of nutritional intake and dynamic tracking of weight, and provides timely intervention for those with insufficient intake and excessive weight loss to ensure the timeliness of nutritional intervention. The convenient management based on the nutrition management applet, combined with the dynamic adjustment plan of follow-up indicators, achieves precise and dynamic nutrition management, effectively avoiding the limitations of a single plan. At the same time, the online education module of the platform improves the practical nutrition skills of patients and caregivers through practical videos. 24-hour online consultation and door-to-door nursing services solve practical difficulties in home rehabilitation, significantly improve the implementation compliance of nutrition plans, and ultimately achieve effective improvements in nutritional status.

In this study, there is no significant difference in the level of transferrin between the two groups, which is presumed to be related to the short intervention period and long-term targeted intervention for postoperative iron absorption disorder in patients with esophageal cancer. The possible reason why there was no significant difference in the NRS2002 score before and after intervention was that the intervention cycle was short and the baseline nutritional risk level of the two groups was similar.

4.2. The "H2H" nutritional management model based on the Internet platform can significantly improve patients' quality of life

The results of this study show that after the intervention, the scores of physical function, cognitive function, emotional function, social function and role function in the QLQ-C30 scale of the observation group were significantly higher than those of the control group ($P < 0.05$), suggesting that this model can effectively improve the quality of life of patients with esophageal cancer after surgery [13]. Nutritional status is closely

related to the quality of life of cancer patients. Patients after esophageal cancer surgery are prone to physical symptoms such as fatigue, weight loss, and loss of appetite due to malnutrition, which seriously affects physical functions. At the same time, impaired eating function and poor nutritional status can easily trigger negative emotions such as anxiety and depression, reduce social willingness and role functions, and then lead to a decline in quality of life [14]. Comprehensive nutritional management can reduce fatigue and other physical symptoms by improving nutritional status, ensuring the recovery of physical functions; improvement of physical symptoms can alleviate negative emotions, enhance recovery confidence, promote patients to better assume family and social roles, and improve emotional and role functions [15]; the self-management module of the Internet platform can enhance patients' sense of control over recovery and improve cognitive functions; online consultation and follow-up interaction can strengthen the doctor-patient relationship, reduce loneliness and helplessness, and improve social functions. However, due to insufficient out-of-hospital intervention, traditional routine nutrition management has limited improvements in patients' nutritional status, physical symptoms, and psychological status, and has poor effects on improving quality of life. The results of this study confirm that comprehensive nutritional management has important clinical significance in improving the quality of life of patients with esophageal cancer after surgery.

4.3. The significance of the "H2H" nutrition management model based on the Internet platform for the continued care of patients after esophageal cancer surgery

The "H2H" nutritional management model based on the Internet platform provides an efficient, practical path for continued care after esophageal cancer surgery. It guides patients to actively participate in nutritional management through online education, real-time monitoring, independent check-in, etc., which not only improves patients' disease self-management capabilities and nutritional knowledge [16–19], but also uses 24-hour The active communication model of online consultation and regular online follow-up has enhanced the trust between nurses and patients, alleviated patients' negative emotions, significantly improved the implementation of nutritional plans and overall compliance with treatment, and is in line with the development trend of chronic cancer management. At the same time, this model realizes the deep integration of the Internet platform and extended care, effectively making up for the disconnection of traditional out-of-hospital nutrition management, strengthening the coordination and integration of health care between hospitals and communities, and providing an evidence-based basis for the networked and diversified development of clinical extended care [20–22]. It also provides practical ideas for the expanded application of Internet technology in the full-cycle health management of cancer patients. It can further improve the extended care process and provide better and more convenient full-cycle health care services for patients after esophageal cancer surgery.

4.4. Research limitations and clinical application suggestions

This study has certain limitations: first, the sample size of the study is small and it is a single-center study, so the extrapolation of the study results is limited; second, the intervention period is short, and the intervention effect was only observed 3 months after discharge. There was no long-term follow-up of the patients, so the long-term intervention effect of this model cannot be evaluated.

5. Summary

The H2H nutrition management model based on the Internet platform constructed in this study realizes the seamless management of esophageal cancer patients from hospital to home, can effectively improve their nutritional status, and improve their quality of life from multiple dimensions, such as body, role, emotion, cognition, and social function. At the same time, it can also improve patients' nutritional management compliance and self-management ability. It is an efficient and feasible continuous nutritional management model after esophageal cancer surgery. It conforms to the development trend of the "Internet + medical health" era and has high clinical practical value and promotion significance. In the future, randomized controlled clinical studies with large samples, multi-centers, and long-term follow-up can be carried out, and a long-term intervention mechanism can be established to further verify the long-term effects and cost-effectiveness of this model. At the same time, joint intervention plans can be developed with sports rehabilitation specialists, psychotherapists, etc., and the functions of the Internet platform can be continuously expanded to achieve multi-dimensional and full-course rehabilitation management for patients after tumor surgery, and provide more powerful support for the long-term survival and improvement of the quality of life of tumor patients.

Funding

Science and Technology Plan Project of Guangdong Esophageal Cancer Research Institute (Project No.: M202319)

Disclosure statement

The authors declare no conflict of interest.

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