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Enhance patient self-care and satisfaction with head and neck cancer health education leaflets with information visualization

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Enhance patient self-care and satisfaction with head and neck cancer health education leaflets with information visualization

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***Abstract*—**During radiotherapy for head and neck cancer, between 60% and 95% of patients experience the common side effect of acute and chronic skin reactions. Inadequate comprehension of text-based health education leaflets can lead to insufficient self-care awareness and heightened anxiety during treatment, potentially exacerbating this side effect. This study employed information visualization to transform traditional text-based leaflets into image-based versions, with the aim of improving patients' understanding of the content and thus enhancing the effectiveness of their self-care. This approach was also intended to boost overall patient awareness and satisfaction with the health education received. The effectiveness of the optimized image-based leaflet was assessed by measuring differences in self-care awareness and satisfaction among patients using the traditional or optimized versions of leaflets. Results from a 14-item self-care awareness assessment form tailored to radiotherapy revealed that patients using the optimized image-based leaflet scored higher on 12 of the items than those using the traditional leaflet. This indicates a significant enhancement in patients' awareness. Specifically, patients with head and neck cancer were better able to comprehend care instructions before, during, and after radiotherapy, effectively implemented self-care practices, and reported improved satisfaction with the health education received**.**

Keywords*—*Health education sheet, Health literacy, Information visualization, Awareness, Health education satisfaction

I. INTRODUCTION

Taiwan's universal health insurance system provides the public with access to quality healthcare. However, recent challenges such as an aging population, a shortage of nursing staff, and heavy workloads have led to reduced time for health education and a lack of comprehensive guidance. Health education information is accessible through printed materials, online content, mass media, and public lectures. Filippatou and Pumfrey (1996) and Carney and Levin (2002) have noted that visual aids can significantly enhance understanding, particularly in making complex texts more accessible to those with lower literacy levels. Head and neck cancer patients, varying in age and educational background, often find it difficult to grasp the contents of health education leaflets, resulting in an inadequate understanding of nursing instructions. This lack of comprehension can impair the effectiveness of guidance and the implementation of self-care by patients and their families before, during, and after the operation [3]. Data indicates that head and neck cancer patients in Taiwan are typically aged between 45 and 64 years and often have lower educational levels, suggesting that an image-based layout of information might be more effective. Consequently, this approach was integrated into the design of the health education leaflets in this study [4], which utilized information visualization to simplify and clarify self-care information for head and neck cancer patients, aiming to enhance their understanding of the leaflets and enable effective self-care during treatment. The study involved surveying patients currently undergoing radiotherapy for head and neck cancer, who were divided into experimental and control groups, to examine differences in patients' awareness of self-care instructions and their satisfaction with the health education received after each group read one of two types of health education leaflets. The objective of this study is to transform traditional text-based health education leaflets into image-based versions, making it easier for patients to recognize and understand the content, thereby strengthening their awareness of self-care before and after radiotherapy.

II. LITERATURE REVIEW

The literature indicates that health education leaflets incorporating images for nursing instructions are more effective at enhancing patients' understanding of disease care than leaflets using only textual descriptions. The characteristics of images, including concreteness, complexity, relatedness, and familiarity, are widely leveraged across various media. Images, being more easily recognizable than textual messages, are readily understandable [4]. They capture users' attention instantly and facilitate effective comprehension. Compared to plain-text explanations, informational graphics more closely resemble storytelling. The guidelines for transforming health education leaflets into informational graphics involve carefully selecting and prioritizing key messages to be communicated to patients. These essential messages are then visually enhanced with icons, text, illustrations, and colors in the leaflet design. This method not only increases the visual appeal of the leaflets but also improves their memorability [5].

Healthcare institutions can address imperfections in execution through satisfaction surveys, which also help identify the real needs of patients, thereby enhancing trust and satisfaction between healthcare institutions and patients. They can also utilize patient feedback and assessments to improve the quality of health education and guide the strategic direction of treatments, thereby enhancing both the quality of care and the institution's reputation. Health education information, designed to be concise and clear, allows patients to quickly grasp the content and provide feedback on any unclear parts or questions to the nursing staff. This process not only strengthens patients' understanding of the surgical procedures but also facilitates the repeated confirmation of self-care methods. Clear and straightforward health education materials not only enable patients to read them swiftly but also help build trust and satisfaction with the surgical process

because of better understanding of self-care instructions before, during, and after the operation, thereby reducing preoperative anxiety. The more information and education provided by nurses, the higher the patient satisfaction [6]. Conversely, when patients perceive the information provided by nursing staff as insufficient, their satisfaction tends to be lower [7–10]. Through feedback on satisfaction with health education received, healthcare institutions can determine whether their services meet patient expectations, whether they effectively convey the correct health education messages, whether the comprehensibility of the information meets patient expectations, whether the communication skills of medical or nursing staff with patients are adequate, and whether the channels for obtaining health education information are convenient. Satisfaction surveys enable healthcare institutions to identify and improve deficiencies, better understand the real needs of patients, and thereby enhance the trust and satisfaction between healthcare institutions and patients. Healthcare institutions can also use patient surveys, feedback, and assessment to improve the quality of health education and the effectiveness of treatments, thereby enhancing the overall image of the institution.

III. METHOD

A. Optimization Process of Health Education Leaflets

Three radiation oncology specialists from Chung Shan Medical University Hospital conducted a team meeting to identify key words from the Taiwan head and neck treatment guidelines [11, 12] (Table 1, A). These words were then used to gather approximately 250–300 images per word through Google searches. The most relevant images were categorized, and the key images that appeared most frequently were compiled. Subsequently, five medical visual designers discussed and created these key images in another meeting. Finally, these images were combined with simple-structure sentences to optimize the graphic health education leaflets. The awareness scale and satisfaction questionnaire items were validated through literature review and consultations with three radiation oncology specialists (Tables B and C).

TABLE I. KEY INFORMATION FOR PATIENTS IN THE TRADITIONAL TEXT-BASED HEALTH EDUCATION LEAFLET, AWARENESS ASSESSMENT FORM, AND SATISFACTION SURVEY

(A) Key Information for Patients in Traditional Text-Based Health Education Leaflet	
Before Radiotherapy for Head and Neck Cancer	Visit the Oral Surgery Clinic: Consult a dentist for the following evaluations and treatments: 1. Oral Health Check: Includes examination of teeth, oral mucosa, dentures, and fillings, with guidance on oral hygiene. 2. Extraction of Teeth with No Retention Value: Includes removing residual roots, teeth with severe periodontal disease, irreparable teeth, and poorly fitted restorations. Avoid extractions post-radiotherapy to prevent bleeding and complications in healing. 3. Fluoride Application on Teeth: To alleviate the soreness and tenderness in the teeth caused by a period of treatment, apply fluoride topically. This helps reduce sensitivity to temperature extremes and prevent radiation-induced cavities.
Treatment Duration	1. Radiotherapy Course Varies Across Disease Conditions: Typically consists of 30 to 36 sessions, once daily, five days a week (Monday to Friday; weekends off). 2. Special Circumstances: In the event of typhoons or extended holidays, patients will be notified of alternative arrangements.
Markers	Do not wash off the positioning marks placed on your skin by the radiation therapist. These marks are not at the direct treatment site but are used by the machine to determine the correct orientation for treatment. Keep the irradiated area clean by washing with water only; avoid using soap or scrubbing the marks to prevent them from washing away. If the marks fade, contact a radiation therapist for assistance; do not redraw the lines or apply adhesive tape yourself.
Common Side Effects and Care	(1) Dry Mouth: Typically develops in the first and second weeks of treatment, characterized by mouth dryness and reduced saliva production, which can lead to complications like cavities, periodontal disease, and tooth decay. The following care methods may be adopted: 1. Keep a water bottle handy for drinking or rinsing; aim for an intake of more than 2000 cc of water daily. 2. Use prescribed artificial saliva, suck on ice cubes, or rinse with mouthwash. 3. Administer medications such as Salagen to treat dry mouth, depending on the patient's condition. 4. Schedule regular visits to the Oral Surgery Clinic for oral health checks and maintenance after completing radiotherapy. (2) Taste Changes: Radiotherapy to the oral cavity can affect the taste buds on the tongue, altering the taste perception of food. Generally, taste sensation gradually recovers about 1 to 2 months after treatment, but the extent of recovery depends on the severity of the disease and the radiation dose. The following care methods may be adopted: 1. Choose strongly flavored foods or condiments, such as shiitake mushrooms, onions, and ginger. 2. Frequently change the texture of food, combinations of dishes, and cooking methods to enhance olfactory and visual stimulation, compensating for the diminished sense of taste.

	3. Adopt a diet of small, frequent meals, consuming high-calorie, high-protein foods that are soft and easy to swallow. (3) Oral Mucositis: The oral mucosa is particularly sensitive and mucositis often develops in the 2nd to 3rd week of head and neck cancer radiotherapy, slowly appearing and generally recovering within 2 to 3 weeks after treatment ends, provided nutritional status is adequate. The following care methods may be adopted: 1. Avoid smoking, alcohol, and foods that are spicy, very cold, or very hot during treatment. 2. Maintain oral hygiene by regularly rinsing with tepid water or mouthwash (or tea water). 3. Frequently hold ice cubes or ice water in the mouth during treatment, using it for 15–20 minutes each morning, noon, and night. 4. Use pain relief medications, anesthetic mouth rinses, and oral ointments prescribed by a doctor as soon as pain begins. 5. Supplement with L-glutamine to promote mucosal tissue repair. (4) Skin Reactions: Starting in the 2nd to 3rd week of head and neck cancer radiotherapy, patients may experience redness, swelling, warmth, and slight itching of the skin. In the 4th to 5th weeks, the skin may darken and exhibit dry peeling; severe cases can exhibit moist peeling, similar to sunburn. The following care methods may be adopted: 1. Do not apply adhesive tapes or ointments, or use cosmetics on the treatment area to avoid increasing skin reactions. Use a towel to apply cold compresses to the face and neck three times a day, each for 15–20 minutes. 2. For mild itching, do not scratch with nails. Instead, gently pat the area or use cold compresses. After showering, apply moisturizing lotion to reduce skin irritation or damage. 3. Avoid clothing that is rough or tight. Wear loose, absorbent cotton clothing. 4. Avoid excessive exposure to sunlight (especially at noon; wear a hat if going outdoors), and avoid using heat packs or cold packs (as extreme cold can cause frostbite) and electric heaters. 5. If severe skin reactions occur, the attending physician will prescribe medications, such as water-soluble ointments, as needed. 6. If wounds in the treatment area do not heal, they must be checked by a doctor before deciding whether to rest or continue treatment. (5) Trismus: Patients who have undergone radiotherapy often experience fibrosis of the masticatory muscles, leading to trismus, which prevents the mouth from opening as widely as before treatment. During and after radiotherapy, practice mouth-opening exercises 3 to 4 times daily for 10–15 minutes each time, opening the mouth to its fullest extent and moving the jaw left and right. Regularly measure the distance between the upper and lower front teeth to monitor progress in mouth opening. Tools such as a tongue depressor or a mouth opener may also be used to assist. (6) Fatigue: During radiation therapy, it is common for patients to feel increasingly fatigued, especially in the final weeks of treatment. Gradual recovery is usually seen after the treatment concludes; it is advised that patients get ample rest and sleep during radiotherapy and consume adequate nutrition and engage in appropriate exercise to help with the recovery of normal cells. (7) Neck Muscular and Skin Fibrosis: Surgery for extensive dissection of neck lymph nodes or radiotherapy in the neck area can lead to localized fibrosis and stiffness, causing patients to experience a sensation of tightness and difficulty moving their necks. Some patients may even feel soreness in the neck area. The following care methods are recommended: 1. Enhance local skin and muscle activity by performing head and neck rehabilitation movements in all directions during and after radiotherapy to alleviate discomfort. 2. After completing radiotherapy, it is crucial to continue and intensify head and neck rehabilitation exercises. (8) Weekly Visits to the Attending Physician: Patients should see their physician weekly to monitor the side effects of treatment. If discomfort occurs unexpectedly, additional appointments should be made for management and medication.
Dietary Guidelines	1. **A high-protein diet is recommended:** Consume fresh meats, eggs, dairy, fish, tofu, soy milk, vegetables, fruits, and supplementary medical formula milk to increase nutritional intake. 2. **Intake more than 2000 cc of water daily.** 3. Choose foods that are cool, soft, and high in water content; eat small, frequent meals. 4. Supplement with L-glutamine to aid in mucosal tissue repair.
Post-Radiotherapy Care	1. After radiotherapy, follow-up visits and relevant examinations should be scheduled with radiation oncology, ENT, and dental specialists to monitor patient recovery. 2. Symptoms of dry mouth should gradually improve but are contingent on the secretory function of the salivary glands and the dosage of radiation received. It is crucial to maintain consistent oral cleanliness and to have regular dental check-ups at the Oral Surgery Clinic, which should include cleanings specifically aimed at preventing periodontal disease, to avert cavities or other dental complications. 3. Engage in moderate physical activity or walking daily to aid physical recovery. 4. Avoid dental extractions within a year after treatment to prevent poor wound healing. If extraction is unavoidable, it should only be done after careful examination by an oral surgeon.
(B) Form Assessing Understanding of the Health Education Leaflet	
Q1 I find the educational content practical for self-care during treatment.	
Q2 I can apply the care techniques learned from the educational content during treatment.	
Q3 Learning from the educational content has increased my understanding of self-care during radiotherapy.	
Q4 I am satisfied with the professionalism of the educational content.	
Q5 I am satisfied with the overall effectiveness of the educational experience.	
Q6 Avoid smoking, alcohol, and other irritants.	
Q7 Hold ice in mouth for 15 minutes, three times a day during treatment.	
Q8 Apply a cold compress to the skin for 15 minutes, three times a day during treatment.	
Q9 Apply lotion at least twice a day.	
Q10 Do not apply lotion three hours before treatment.	
Q11 Maintain a balanced diet and consume high-quality proteins during treatment.	
Q12 Perform mouth-opening exercises: 3–4 times daily, 10–15 minutes each.	
Q13 Regularly revisit the physician to assess treatment response.	
Q14 Avoid dental extractions within one year after treatment.	
(C) Health Education Satisfaction Survey	

Q15 I find the educational content practical for self-care during treatment.
Q16 I can apply the care techniques learned from the educational content during treatment.
Q17 Learning from the educational content has increased my awareness of self-care during radiotherapy.
Q18 I am satisfied with the professionalism of the educational content.
Q19 I am satisfied with the overall effectiveness of the educational experience.

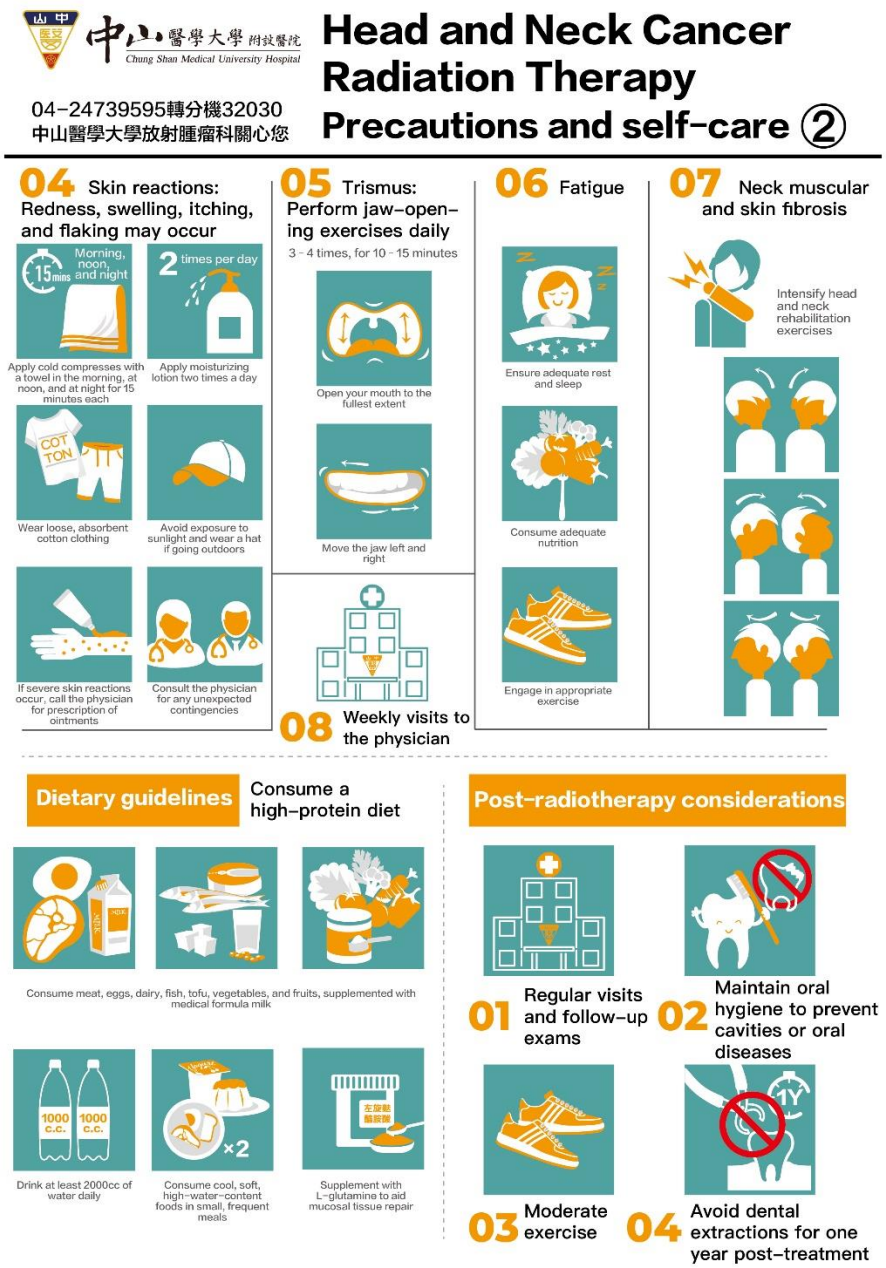

Figure. 1. Image-based Health Education Leaflet After Optimization

B. Study and Survey Processes

The study was conducted at Chung Shan Medical University Hospital with 56 participants undergoing radiotherapy, averaging 58.4 years of age. The control group consisted of 28 participants who received traditional text-based health education post-surgery; the experimental group comprised 28 participants who received optimized health education materials post-surgery. Two weeks after receiving the health education information, 56 participants were surveyed using a Likert scale to assess their understanding of and satisfaction with the health education, with the results shown in Table 2.

IV. ANALYSIS AND DISCUSSION

A. Analysis of Understanding of Traditional Text-Based Versus Optimized Image-Based Health Education Leaflets

The results of a 14-item self-care awareness survey indicated that on average, patients who read the optimized image-based health education leaflet had higher awareness than those who read the traditional text-based leaflet (Table 2, A), and thus had better understanding of health education materials than those who read the text-based leaflet. Table 2, B presents an analysis of variance (ANOVA) of the post-test awareness for traditional text-based versus optimized image-based health education leaflets, revealing significant differences in awareness for questions 1, 3, 4, and 10 ($*p < 0.05$). Reviewing the average scores in Table 2 alongside the question items in Table 1,B, it is noted that patients who read the optimized image-based leaflet showed higher awareness regarding "Q1 I find the educational content practical for self-care during treatment," "Q3 Learning from the educational content has increased my understanding of self-care during radiotherapy," "Q4 I am satisfied with the professionalism of the educational content," and "Q10 Do not apply lotion three hours before treatment."

TABLE 2 Awareness and Satisfaction Survey Coefficients and Analysis for Text-Based Versus Optimized Image-Based Health Education Leaflets

A. Awareness and Satisfaction Survey Coefficients for Text-Based and Optimized Image-Based Health Education Leaflets

Awareness Items	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	MEAN
Text-Based	4.18	4.68	4.32	3.43	4.43	4.32	4.39	4.29	4.39	4	4.54	4.29	4.29	4.18	4.27
Image-Based	4.46	4.61	4.82	4.04	4.5	4.61	4.5	4.5	4.5	4.54	4.46	4.39	4.5	4.29	4.48
Satisfaction Items	Q15	Q16	Q17	Q18	Q19										
Text-Based	4.25	3.75	4.04	3.75	3.79										3.92
Image-Based	4.25	4.5	4.46	4.46	4.32										4.40

B. ANOVA of Awareness for Text-Based Versus Optimized Image-Based Health Education Leaflets

source	Sum of Squares	df	Mean Square	F	Sig.	R^2
Q1	1.14	1	1.14	4.10	0.05	.15
Q2	0.07	1	0.07	0.30	0.59	
Q3	3.50	1	3.50	10.38	0.00	
Q4	5.16	1	5.16	10.79	0.00	
Q5	0.07	1	0.07	0.24	0.62	
Q6	1.14	1	1.14	3.29	0.08	
Q7	0.16	1	0.16	0.55	0.46	
Q8	0.64	1	0.64	2.36	0.13	
Q9	0.16	1	0.16	0.55	0.46	
Q10	4.02	1	4.02	11.44	0.00	
Q11	0.07	1	0.07	0.24	0.63	
Q12	0.16	1	0.16	0.60	0.44	
Q13	0.64	1	0.64	2.36	0.13	

Q14		0.16	1	0.16	0.49	0.49
Error		16.74	54	0.31		
Total	1091		56			
Corrected Total	17.97		55			

B. Satisfaction Analysis of Traditional Text-Based Versus Optimized Image-Based Health Education Leaflets

The type of health education leaflets—text-based or image-based—was used as the independent variable, while participants' satisfaction levels served as the dependent variable in the ANOVA, the results of which are displayed in Table 3. The analysis revealed that for satisfaction items Q16 "I can apply the care techniques learned from the educational content during treatment," Q17 "Learning from the educational content has increased my awareness of self-care during radiotherapy," Q18 "I am satisfied with the professionalism of the educational content," and Q19 "I am satisfied with the overall effectiveness of the educational experience," patients reported higher satisfaction with the image-based leaflet than with the text-based version. The only item that did not show significant differences was Q15 "I find the educational content practical for self-care during treatment." According to the mean satisfaction scores listed in Section A of TABLE 2, the optimized image-based version scored an average of 4.40, which is higher than the traditional text-based version's score of 3.92.

TABLE 3 ANOVA Analysis of Satisfaction for Text-Based Versus Optimized Image-Based Health Education Leaflets

source	Sum of Squares	df	Mean Square	F	Sig.	R^2
Q15	.000	1	.000	.000	1.000	.23
Q16	7.875	1	7.875	17.536	.000	
Q17	2.571	1	2.571	4.640	.036	
Q18	7.143	1	7.143	17.363	.000	
Q19	4.018	1	4.018	8.741	.005	
Error	25.14	54	0.47			
Total	997.60	56				
Corrected Total	29.46	55				

V. CONCLUSIONS

The participants of this study were patients with head and neck cancer. According to cancer registry reports, head and neck cancer predominantly affects males aged 45–64, typically those with low education levels, diabetes, other cancers, severe comorbidities, and habits of smoking or chewing betel nuts [4]. When designing health education leaflets, it is essential to consider the needs, comprehension levels, or educational backgrounds of the target audience to ensure that the conveyed information achieves the intended effects. Filippatou and Pumfrey (1996) and Carney and Levin (2002) have both shown that visuals can enhance understanding [1, 2], noting that images particularly aid in deciphering complex texts, especially for readers with lower literacy levels [5]. By leveraging the characteristics of images—concreteness, complexity, relatedness, and familiarity—alongside clear visuals and simple layouts, text-based health education leaflets can be transformed into image-based versions that are easier for patients to read. The purpose of these visual elements is to make the leaflets more comprehensible and memorable, thus enhancing public awareness of health information. The results of this study demonstrate that optimized image-based health education leaflets, compared to traditional text-based leaflets, significantly improve self-care awareness and result in higher satisfaction levels. These findings indicate that patients can quickly and effectively grasp important treatment details and self-care methods during treatment using optimized image-based health education leaflets instead of traditional text-based versions.

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