Scientific Research Publishing

Open Journal of Applied Sciences, 2026, 16(11), 4580-4595
https://www.scirp.org/journal/ojapps
ISSN Online: 2165-3925
ISSN Print: 2165-3917

Construction and Application of a Follow-Up Management Model for Patients Discharged with Drainage Tubes after Head and Neck Tumor Resection Surgery Based on the WeChat Mini-Program "Full-Cycle Management Platform"

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How to cite this paper: Chen, Y.X., Liu, L., Wu, M.T. and Lin, Y.Q. (2026) Construction and Application of a Follow-Up Management Model for Patients Discharged with Drainage Tubes after Head and Neck Tumor Resection Surgery Based on the WeChat Mini-Program "Full-Cycle Management Platform". *Open Journal of Applied Sciences*, **16**, 4580-4595.
https://doi.org/10.4236/ojapps.2026.1611251

Received: September 21, 2026
Accepted: November 20, 2026
Published: November 23, 2026

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Abstract

Objective: To explore an effective follow-up management model for patients discharged with drainage tubes after head and neck tumor resection surgery. The model aims to address shortcomings of traditional follow-up, including poor timeliness, non-standardized information transmission, and lack of early-warning mechanisms, while improving the quality of home-based care. The platform demonstrated a high detection rate for early/mild wound complications (e.g., wound exudate) and showed preliminary safety regarding major complications. **Methods:** A total of 100 patients with head and neck tumors who underwent surgery and were discharged with drainage tubes at the Head and Neck Department of Sun Yat-sen University Cancer Center between January 1, 2022, and December 31, 2025, were conveniently selected. Using a non-concurrent before-and-after controlled design, patients were divided into a control group and an observation group, with 50 cases in each. The observation group received follow-up management via the "Full-Cycle Intelligent Management Platform," which included real-time data collection, dynamic assessment, precise early warning interventions, and personalized health education. The control group received traditional follow-up via WeChat groups. The two groups were compared in terms of drainage tube-related complication rates, unplanned readmission rates, nurse-patient communication, and patient satisfaction. **Results:** The only statistically significant difference in complication rates between the two groups was wound exudate ($P < 0.05$). The

observation group had a higher incidence of wound exudate (26%) than the control group (2%), as well as higher rates of wound redness/swelling (14% vs. 6%) and catheter blockage (2% vs. 0%). This result was contrary to expectations. It may be because patients in the observation group could report wound conditions to healthcare providers more promptly and proactively through the platform, whereas patients in the control group may have had minor early signs of exudate or redness overlooked due to less frequent follow-up or delayed communication. Regarding more serious complications such as wound bleeding and readmission, none occurred in the observation group, while both were observed in the control group, suggesting that the intelligent follow-up model has a positive effect in preventing severe complications. Additionally, the difference in the number of patient questions was statistically significant ($P < 0.05$). Regarding daily platform usage time, 14% of patients completed tasks in 0 - 50 seconds, 46% in 50 - 100 seconds, and 40% took more than 100 seconds, indicating that most patients required a reasonable amount of time to complete daily management tasks, which remained within an acceptable range. Early warning data showed that 72% of patients triggered 0 - 5 alerts, 22% triggered 5 - 10 alerts, and only 6% triggered more than 10 alerts, suggesting that the platform effectively monitored wound and drainage conditions and identified potential risks in a timely manner. Overall, patient satisfaction with follow-up management was significantly higher in the observation group than in the control group. **Conclusion:** This model effectively improves the quality of home care for patients, demonstrates a positive role in preventing severe complications such as wound bleeding and readmission, and enhances patient satisfaction. In terms of nurse-patient communication time and early warning interventions, the platform helps healthcare providers detect potential risks promptly, reduces unnecessary medical resource waste, and provides patients with more standardized and timely health guidance. Overall, the "Full-Cycle Intelligent Management Platform" follow-up model shows clear advantages and is worthy of clinical promotion and application.

Keywords

Full-Cycle Management Platform, Discharged Patients, Follow-Up Management

1. Introduction

Head and neck tumors are among the most common types of malignant tumors in clinical practice, ranking seventh among all cancers worldwide [1]. Surgical treatment typically involves extensive resection and lymph node dissection. Postoperative placement of drainage tubes plays an important role in preventing subcutaneous fluid accumulation and promoting wound healing. With the promotion of the Enhanced Recovery After Surgery (ERAS) concept [2], an increasing number of patients are being discharged with drainage tubes shortly after surgery. While this approach shortens hospital stays, it also places higher demands on

home-based transitional care. Studies have shown [3] that patients discharged with drainage tubes often encounter a range of challenges, including changes in daily living abilities, body image disturbance, social anxiety, increased psychological stress, catheter-related infections, and the risk of unplanned tube removal. The occurrence of postoperative complications can cause serious physical and psychological harm to patients and may even threaten their lives [4] [5]. Research on transitional care models in foreign countries is generally evidence-based, and the field has developed into a relatively mature and systematic discipline. Nursing teams emphasize interdisciplinary collaboration and professional specialization, with broad research scopes and a strong focus on long-term follow-up and outcome evaluation. In China, the theory of transitional care developed relatively late. Inspired by international progress, attention to transitional care has increased, with research and practice mainly focusing on the critical transition period after patient discharge [6].

In current clinical practice, follow-up management for patients discharged with drainage tubes commonly faces issues such as poor timeliness, non-standardized information transmission, and the absence of early warning mechanisms. After discharge, patients often experience inadequate condition monitoring, lack of real-time professional guidance, poor treatment adherence, and a high risk of complications [7]. Traditional telephone follow-up is limited by high labor costs and communication efficiency, resulting in high loss-to-follow-up rates. It also requires strong communication skills from healthcare providers. Some patients are hesitant or unwilling to participate in telephone follow-up, and telephone communication often leads to incomplete or inaccurate information and insufficient feedback. Healthcare providers must guide patients to describe their problems correctly to obtain useful information [3]. Compared with traditional telephone follow-up, WeChat group follow-up allows for more vivid information exchange through text and images. Patients can visually present key details such as the skin condition around the drainage tube, the color and volume of drainage fluid, helping healthcare providers assess the patient's condition more accurately. In addition, WeChat groups provide a platform for patients to share experiences with each other, which helps alleviate anxiety after discharge and improves treatment adherence.

However, both telephone and WeChat group follow-up methods struggle to achieve dynamic monitoring of patients' drainage conditions, leading to increased risks of complications such as catheter blockage, unplanned tube removal, and infection. This not only affects patients' recovery process but also results in repeated consumption of medical resources. With the continuous emergence of new technologies and the deepening of informatization reform in healthcare services, the use of advanced digital management tools can effectively integrate resources, optimize workflows, and significantly improve the efficiency and quality of nursing care, thereby providing patients with a higher-quality and more efficient healthcare experience.

Based on this, the present study developed a follow-up management model for patients discharged with drainage tubes after head and neck tumor resection surgery, grounded in the concept of "Full-Cycle Intelligent Management." This model aims to create a follow-up platform that integrates real-time monitoring, risk early warning, and personalized guidance functions. It enables real-time collection, dynamic assessment, and precise intervention regarding drainage tube care after discharge, thereby reducing complication rates and unplanned readmissions, improving patient outcomes, and providing new ideas and practical evidence for optimizing transitional care services for head and neck tumor patients postoperatively. The construction and application effects of the follow-up management platform for patients discharged with drainage tubes after head and neck tumor surgery are reported below.

2. Construction of a Follow-Up Management Model for Patients Discharged with Drainage Tubes after Head and Neck Tumor Resection Surgery

2.1. Formation of the Research Team

The research team consisted of 1 head and neck surgery nurse manager, 10 head and neck surgery nurses, 3 head and neck surgeons, and 2 information engineers. The nurse manager served as the team leader and was responsible for overall project coordination. One nurse was assigned to conduct literature searches, develop the research protocol, oversee project implementation and decision-making, and manage data organization and entry. Nine nurses were responsible for recruiting participants and carrying out follow-up interventions. The three surgeons provided consultation for various medical issues encountered by patients during the intervention process. The two information engineers assisted in platform development, provided technical consultation, conducted system testing, performed routine maintenance, and delivered training on the use of the platform's operational rules.

2.2. Development of the Intelligent Follow-Up Management System

With patient needs as the core focus, medical resources and information technology were integrated to build a comprehensive system that combines data collection, risk assessment, risk early warning, interactive communication, and information management. The platform mainly includes the following functional modules.

2.2.1. Patient-End Mini-Program "Health Intelligent Management"

On the day of discharge, nurses guide patients to scan a QR code to join the patient-end mini-program "Health Intelligent Management" and instruct them on how to view and complete the required entries. Patients can access the "Service Account" → "Sun Yat-sen University Cancer Center" → "Follow-up Reminders"

to watch department-produced videos on home care with drainage tubes, such as daily observation and care of the drainage tube, correct procedures for changing the drainage bottle, and methods for disinfecting the home environment. Each day, patients are prompted through "Follow-up Reminders" in the "Health Intelligent Management" module to complete the "Head and Neck Department Drainage Tube Discharge Follow-up Record Form." This form includes the color and 24-hour volume of drainage fluid, condition of the wound dressing, skin condition around the drainage tube insertion site, wound pain level, and whether the tube is displaced or remains patent. Patients may also upload text descriptions, photos, or videos related to drainage tube care based on system alerts or their own needs. The platform is equipped with a timed reminder function to encourage patients to complete daily care tasks and upload information on schedule.

2.2.2. Healthcare Provider Management System "Full-Cycle Health Management Platform"

Healthcare providers can view all data uploaded by patients in real time. The system features an intelligent analysis function that automatically screens patient data based on a preset risk early warning model. When potential risks are detected—such as abnormal increase or discoloration of drainage fluid, wound redness and swelling, or pain—an immediate alert is sent to the responsible healthcare provider. In addition, healthcare providers can bind to the "Teng'ai Medical" service account to receive real-time early warning alerts and consultation notifications from patients. They can also send personalized nursing guidance, health education materials, and follow-up reminders according to each patient's specific condition.

2.2.3. Construction of the Automatic Reply Module and Patient Education Module

The automatic reply module is equipped with an intelligent response system based on a common question database. When patients encounter high-frequency issues during daily care—such as wound abnormalities ("redness and swelling," "bleeding," "pus discharge," or "pain"), "how to secure the drainage tube," care of "non-sutured wound glue," or "shoulder and neck functional exercises"—the system provides standardized and professional answers within seconds. To ensure timely communication, if a patient's message does not contain a high-frequency question, the system automatically sends a prompt stating, "If the situation is urgent, please call the Head and Neck Department nurses' station," along with the contact number. This enables 24-hour instant response, effectively reducing the burden on healthcare providers of repeatedly answering basic questions, allowing them to dedicate more time and energy to critical clinical tasks and further improving the efficiency and quality of overall medical services.

The patient education module integrates various forms of health education resources, including images, text, and videos. The content covers key points of postoperative drainage tube care for head and neck tumors, identification and emergency management of complications, dietary and nutritional guidance, and rehabil-

itation exercise methods. Based on the patient's surgical type, time since discharge, and recovery stage, the system intelligently pushes personalized educational content. Patients can access and review the materials at any time, helping them better master self-care knowledge and improve their ability to manage care at home.

2.2.4. Intelligent Follow-Up Termination and Data Statistical Analysis

During the platform development process, the information engineers placed strong emphasis on data security and system stability. Encryption technology was adopted to protect patients' private information from leakage, and multiple rounds of system testing and optimization were conducted to ensure smooth operation in real-world applications.

The module was designed to achieve automation and precision in the follow-up process, thereby avoiding unnecessary follow-ups that consume medical resources. When a patient indicates on the "Head and Neck Department Drainage Tube Discharge Follow-up Record Form" that the drainage tube has been successfully removed, the system automatically triggers the follow-up termination procedure. After termination, the system sends a notification to the patient indicating that the follow-up is ending and changes the follow-up status to "Completed."

The Healthcare Provider Management System can also generate statistical reports on patient follow-up data, visually displaying key indicators such as trends in drainage fluid volume and wound recovery status. This helps healthcare providers dynamically evaluate the effectiveness of patients' home care, adjust follow-up strategies, and optimize nursing plans in a timely manner.

3. Application of the Follow-Up Management Model for Patients Discharged with Drainage Tubes after Head and Neck Tumor Resection Surgery

3.1. Study Participants (Table 1)

Table 1. Comparison of general patient information [n (%)].

Indicator	Research Group (n = 50)	Control Group (n = 50)	χ^2 Value	P Value
Gender			1.000	0.317
Male	28 (56%)	23 (46%)		
Female	22 (44%)	27 (54%)		
Age (years)	43.62 ± 12.28	47.28 ± 13.48	1.419 (t value)	0.159
Tumor Type			0.732	0.693
Parotid gland tumor	15 (30%)	19 (38%)		
Thyroid tumor	22 (44%)	20 (40%)		
Cervical lymph node metastasis of head and neck tumor	13 (26%)	11 (22%)		

Continued

Past Medical History			1.853	0.396
Hypertension	3 (6%)	10 (20%)		
Diabetes mellitus	2 (4%)	2 (4%)		
History of tumor	11 (22%)	14 (28%)		
Education Level			1.534	0.465
Primary school and below	6 (12%)	8 (16%)		
Middle school	21 (42%)	25 (50%)		
College and above	23 (46%)	17 (34%)		
Medical Insurance Status			0.000	1.000
With medical insurance	48 (96%)	48 (96%)		
Without medical insurance	2 (4%)	2 (4%)		
Marital Status			1.864	0.394
Married	43 (86%)	45 (90%)		
Unmarried	7 (14%)	4 (8%)		
Widowed	0 (0%)	1 (2%)		
Divorced	0 (0%)	0 (0%)		

3.1.1. Non-Concurrent Before-and-After Controlled Design

Patients who underwent surgical treatment for head and neck tumors and were discharged with drainage tubes at a tertiary general hospital in Guangzhou from January 2022 to December 2025 were conveniently selected as the study subjects. They were divided into a control group and a study group using a non-concurrent before-after controlled design, with 50 cases in each group. A total of 127 subjects were screened for eligibility. Among them, 10 were excluded for not meeting the inclusion criteria, 11 for meeting the exclusion criteria, and 6 for refusing to participate or declining to sign the informed consent form. After screening, 100 subjects were enrolled and assigned to the study group (n = 50) or the control group (n = 50) using a non-concurrent before-after controlled design. In the study group, there were 28 males and 22 females, aged 18 - 70 years (mean age: 43.62 ± 12.28 years). In the control group, there were 23 males and 27 females, aged 19 - 73 years (mean age: 47.28 ± 13.48 years). There were no statistically significant differences in baseline characteristics between the two groups ($P > 0.05$).

3.1.2. Grouping

The control group received traditional WeChat group-based transitional care: Patients who underwent head and neck tumor resection surgery and were discharged with drainage tubes between January 2022 and December 2023, and who received follow-up care via WeChat groups, were included.

The research group received transitional care via the "Full-Cycle Intelligent Management Platform": Patients who underwent the same type of surgery and were discharged with drainage tubes between January 2024 and December 2025 were included and subsequently received follow-up care through the Full-Cycle Intelligent Management Platform.

Both groups received standard discharge instructions, including verbal guidance on drainage tube care (fixation, observation, and dressing changes), medication instructions, and follow-up appointment arrangements. Patients in both groups also watched the educational video titled "Home Care for Patients Discharged with Drainage Tubes."

3.1.3. Inclusion and Exclusion Criteria

Inclusion criteria: 1) First discharge with a drainage tube after head and neck tumor resection surgery; 2) Clear consciousness and able to cooperate with follow-up; 3) Basic ability to perform activities of daily living at the time of discharge; 4) Age ≥ 18 years.

Exclusion criteria: 1) Presence of severe underlying diseases (e.g., cerebrovascular accident); 2) Early removal of the drainage tube; 3) Inability to use WeChat or participate in follow-up; 4) Concurrent tumors in other sites.

3.2. Intervention Measures

Control group: On the day of discharge, the bedside nurse added the patient to a WeChat group to establish a communication channel and explained the purpose of the group as well as precautions related to the drainage tube. The responsible nurse contacted patients via the WeChat group on postoperative days 1, 3, and 5, and again before drainage tube removal, to inquire about the drainage tube status, wound recovery, and any discomfort symptoms, and provided individualized health guidance accordingly.

Research group: On the day of discharge, the bedside nurse added the patient to the "Health Intelligent Management Platform" and instructed them on how to use it, including how to record drainage status and communicate with healthcare providers. The platform tracked drainage tube conditions daily (including drainage volume, color, and characteristics, as well as local signs such as redness, swelling, bleeding, or exudate) and provided early warning alerts (e.g., drainage tube fixation methods and management of abnormal conditions). Online consultation services were available throughout the post-discharge period, allowing patients to seek advice at any time in case of abnormalities such as tube dislodgement or blockage.

There were no statistically significant differences between the two groups in baseline characteristics, including gender, age, tumor type, surgical method, and the type and number of drainage tubes ($P > 0.05$), indicating that the groups were comparable. The effectiveness of the "Full-Cycle Intelligent Management Platform" in the follow-up care of patients discharged with drainage tubes after head and neck tumor resection was evaluated by comparing the incidence of drainage

tube-related complications (such as blockage, dislodgement, and infection), unplanned readmission rates, patients' knowledge of drainage tube care, patient satisfaction, and follow-up nursing efficiency (including the number of patient inquiries and the completeness of information records). However, because clinical practices, staffing levels, discharge processes, and patient case mix may change over time, differences may exist between the cohorts from different periods. Therefore, this study design cannot confirm that the observed differences were caused by the research platform.

3.3. Evaluation Indicators

1) Clinical outcomes: incidence of drainage tube-related adverse events (wound bleeding, catheter blockage, wound exudate, wound erythema and swelling, lymphatic leakage/chylous leakage) and readmission rate.

a) Wound bleeding: Drainage fluid appears bright red with a significant increase in volume, or the dressing is saturated with blood, accompanied by local swelling and increased pain.

b) Drainage tube blockage: Localized swelling and pain or increased pressure in the drainage area; normal drainage can be restored after standard interventions such as tube milking.

c) Wound exudate: Dressing around the drainage tube is soaked with drainage fluid, with an exudate area exceeding 5 cm in diameter, excluding leakage caused by improper dressing placement or disconnection at the tube junction.

d) Wound erythema and swelling: Redness, swelling, heat, and pain at the wound site, possibly accompanied by purulent discharge.

2) Nursing satisfaction: Assessed using a hospital-developed satisfaction questionnaire (total score: 50 points).

3) Follow-up nursing efficiency: Measured by the number of follow-up days and the number of patient inquiries in each group.

4) Full-Cycle Intelligent Management Platform: Number of alerts triggered and average daily time taken by patients to complete tasks (in seconds).

The alert thresholds of the early-warning model include the following conditions: wound bleeding or exudate, wound redness/swelling/heat/pain, drainage tube dislodgement, drainage tube blockage, drainage volume exceeding 200 mL within 24 hours, and abnormal drainage fluid color. When an alert is triggered, an automatic notification is sent to both the patient and nursing terminals. Nursing staff then provide timely online guidance or telephone follow-up based on the alert content and arrange for the patient to return to the hospital early for treatment if necessary.

3.4. Data Processing

Statistical analysis was performed using SPSS version 29.0.2.0. Continuous variables (such as the number of inquiries and follow-up days) were compared using the t-test, while categorical variables (such as the incidence of adverse events) were

analyzed using Fisher's exact test. A P-value < 0.05 was considered statistically significant (Tables 2-4).

Table 2. Comparison of complication rates and readmission rates between the two groups [n (%)].

Group	No.	Wound bleeding	Catheter blockage	Wound exudate	Wound redness & swelling	Lymphatic/Chylous leakage	Readmission
Research group	50	0 (0%)	1 (2%)	13 (26%)	7 (14%)	1 (2%)	0 (0%)
Control group	50	2 (4%)	0 (0%)	1 (2%)	3 (6%)	1 (2%)	1 (2%)
OR value		0.000	∞	17.216	2.550	1.000	0.000
P value		0.495	1.000	<0.001	0.318	1.000	1.000

Table 3. Comparison of communication, follow-up status, and satisfaction between the two groups [n (%)].

Group	No.	Number of inquiries	Follow-up days	Days with drainage tube	Missed follow-up days	Satisfaction score
Research group	50	1.08 ± 3.53	3.22 ± 2.21	4.8 ± 2.79	0.85 ± 1.31	47.18 ± 3.15
Control group	50	3.10 ± 4.16	1.94 ± 2.15	4.14 ± 1.53	0.93 ± 1.49	45.64 ± 4.01
t value		2.467	0.379	0.337	0.202	2.133
P value		0.019	0.708	0.742	0.842	0.018

Table 4. Full-cycle intelligent management platform.

	No.	Proportion
Number of early warnings		
0 - 5 times	36	72%
5 - 10 times	11	22%
More than 10 times	3	6%
Average daily completion time (seconds)		
0 - 50 seconds	7	14%
50 - 100 seconds	23	46%
More than 100 seconds	20	40%

4. Discussion

In this study, by implementing a daily questionnaire module, the system can automatically send early warning alerts when patients exhibit abnormal signs related to the drainage tube, without requiring patients to make self-judgments. Patients can also report special physical conditions to nurses through text, images, videos, and other formats. This communication channel overcomes the limitations of time and space, enabling nurses to obtain timely information about the drainage

tube and wound status, conduct remote assessments and nursing guidance, and accurately determine whether patients need immediate medical attention. This mechanism of early identification and rapid response can help prevent many complications at an early stage [8]. Secondly, standardized and multi-dimensional health education reduces risk factors for complications at the source [9]. Complications often result from improper behaviors caused by patients' lack of knowledge. Traditional verbal education is easily forgotten, and printed materials are often not intuitive. In contrast, the WeChat mini-program can present home care knowledge related to drainage tubes in a standardized and engaging manner through videos, images, and other formats. Patients can watch and review the materials at any time and as often as needed, ensuring better retention of health education [10]. The intelligent full-cycle platform effectively fills the gap in post-discharge support by providing continuous monitoring, early warnings, and proactive interventions to promptly detect and address potential postoperative complications [11]. By comparing the effects of traditional follow-up models with those of the intelligent system, this study explores effective pathways to optimize transitional care for patients discharged with drainage tubes after head and neck tumor surgery, providing practical evidence for the development of a standardized and intelligent home care system.

The results of this study showed that among the complication rates between the two groups, only the difference in wound exudate was statistically significant ($P < 0.05$), with the incidence in the study group (26%) being higher than that in the control group (2%). In addition, the incidence of wound erythema and swelling was higher in the study group (14%) than in the control group (6%), and the incidence of catheter blockage was also higher in the study group (2%) than in the control group (0%). This finding was contrary to expectations. It is speculated that the intelligent follow-up management system improved the detection rate of early and mild wound complications (such as wound exudate) through timely monitoring and intervention, while demonstrating preliminary safety in preventing major complications. The higher detection rate in the study group may be attributed to patients using the full-cycle management platform, which enabled them to report wound conditions to healthcare providers more promptly and proactively. In contrast, patients in the control group may have had a lower frequency of follow-up or less timely communication, resulting in some early and mild cases of wound exudate or erythema going undetected and unrecorded, thereby making the complication rate appear lower. Furthermore, patients in the study group may have developed greater awareness and self-monitoring of their wounds due to the use of the mini-program, making them more likely to identify potential issues. This could also contribute to the higher reported incidence, rather than reflecting a true difference in the severity of complications.

Regarding more serious complications such as wound bleeding and readmission, none occurred in the research group, whereas both were observed in the control group. This result indicates that the intelligent follow-up management

model has a positive effect in preventing severe complications. The underlying reason may be that patients in the research group, through the use of the "Health Intelligent Management" mini-program, were able to report abnormal wound conditions—such as early signs of bleeding or significant changes in the color and volume of drainage fluid—more promptly to healthcare providers. The healthcare provider platform could receive and process this information quickly, enabling staff to intervene in a timely manner before serious complications developed. For example, when patients reported changes in drainage color or an abnormal increase in drainage volume via the mini-program, the system would trigger an early warning alert, prompting healthcare providers to pay close attention. They could then immediately communicate with the patient through the platform, provide preliminary care instructions, or arrange for timely hospital evaluation, thereby effectively preventing severe outcomes such as wound bleeding. In contrast, the control group lacked this real-time and convenient communication and feedback mechanism. As a result, early signs of serious complications may not have been promptly noticed by healthcare providers, or problems may have gradually worsened due to delayed communication and longer follow-up intervals, ultimately leading to wound bleeding or the need for readmission. This further demonstrates that the intelligent follow-up management model offers advantages in ensuring patient safety and reducing the risk of severe complications by enhancing the timeliness and effectiveness of nurse-patient communication.

Furthermore, according to the early warning data from the Full-Cycle Intelligent Management Platform, 72% of patients triggered 0 - 5 alerts, 22% triggered 5 - 10 alerts, and only 6% triggered more than 10 alerts. This distribution indicates that the platform can effectively monitor patients' postoperative conditions and detect potential risks in a timely manner. The majority of patients remained relatively stable during recovery and did not require frequent interventions, while the platform was able to continuously track the small number of patients with multiple alerts, providing healthcare providers with precise targets for intervention. This aligns closely with the core focus of drainage tube management in clinical practice and validates the scientific and practical value of the platform's early warning logic. By responding promptly to these alerts, healthcare providers can adjust follow-up frequency, strengthen health education, or arrange urgent follow-up visits as needed, thereby addressing potential risks at an early stage.

Regarding the average daily time spent completing tasks on the platform, 14% of patients took 0 - 50 seconds, 46% took 50 - 100 seconds, and 40% took more than 100 seconds. This suggests that while most patients required a certain amount of time to complete their daily management tasks, the overall time remained within an acceptable range. These findings indicate that although the intelligent platform provides patients with a convenient self-management tool, there is still room for improvement in optimizing the operational process. Future enhancements could include simplifying data entry steps, improving interface design, and adding features such as voice input to reduce the time burden on patients

and improve user experience and adherence. Additionally, the results reflect potential differences in digital skills and familiarity with the platform among patients. During pre-discharge training, healthcare providers should place greater emphasis on individualized instruction, particularly for elderly patients or those with lower digital literacy. Repeated demonstrations and patient guidance can help ensure that all target patients are able to use the platform effectively.

The number of patient inquiries showed a statistically significant difference in communication between the two groups and healthcare providers ($P < 0.05$). In the research group, the intelligent management platform was equipped with an automatic reply module and a patient education module. Patients could independently access information on drainage tube care and wound observation through images, videos, and other educational materials available on the platform. Common questions could be answered instantly, resulting in a significantly lower number of inquiries. Moreover, the questions asked were more targeted and focused on personalized or complex situations. This effectively reduced the communication burden on healthcare providers and improved the efficiency and quality of follow-up interactions.

The study results showed that patients in the observation group had significantly higher satisfaction with follow-up management compared to those in the control group. This was mainly attributed to the convenient services provided by the intelligent management platform, such as 24-hour online automatic replies that addressed urgent questions after discharge, comprehensive educational resources that met patients' needs for recovery-related knowledge, and personalized communication that made patients feel continuously supported by healthcare providers. In contrast, patients in the control group relied on WeChat follow-up, which was associated with delayed responses and inconvenient access to information, resulting in relatively lower satisfaction. These findings indicate that the intelligent follow-up management model can effectively improve patients' recognition of and satisfaction with follow-up care by optimizing service processes, enhancing communication efficiency, and improving the overall patient experience, thereby promoting active patient cooperation and adherence to rehabilitation.

This study has several limitations. First, a non-concurrent cohort design was used, with the control and study groups enrolled at different times. Temporal factors such as seasonal variations, changes in nursing practices, platform function updates, and team experience were difficult to fully control. Therefore, differences between the groups may partly reflect time trends rather than the intervention itself. Second, surveillance bias may exist. Patients in the study group completed daily questionnaires and frequently uploaded images, videos, and text, resulting in significantly higher sensitivity in detecting abnormal signs compared with the control group. Mild complications were more likely to be identified, which may have overestimated the complication rate in the study group. Thus, the finding of a higher wound exudate incidence in the study group should be interpreted with caution. Third, single-center convenience sampling was employed. The sample

was drawn from only one tertiary hospital and primarily consisted of patients with head and neck tumors discharged with drainage tubes. The demographic characteristics, health literacy, and access to medical resources of the participants were relatively homogeneous. Therefore, caution should be exercised when generalizing the findings to primary care institutions, other disease populations, or individuals with different educational backgrounds. Fourth, the follow-up period was relatively short, and long-term functional recovery data were lacking. This study mainly observed complications, platform usage, and satisfaction during the period from discharge to tube removal. Long-term outcomes such as swallowing, speech, shoulder and neck function, and quality of life were not assessed, nor was a cost-effectiveness analysis conducted. Consequently, the impact of this model on long-term rehabilitation outcomes and healthcare resource utilization remains unclear. Future multicenter, concurrent controlled prospective studies with extended follow-up periods, objective functional assessment tools, and cost-effectiveness measures are needed to further validate the clinical value of the platform.

5. Summary and Outlook

This study implemented targeted interventions for patients discharged with drainage tubes, aiming to explore effective ways to improve their ability to perform self-care of drainage tubes at home. From a clinical practice perspective, the platform demonstrated preliminary safety in preventing major complications. It can not only directly improve patients' rehabilitation outcomes and quality of life, and reduce the physical and psychological distress caused by complications, but also significantly alleviate the caregiving burden and financial pressure on patients' families. For nursing practice, optimizing the follow-up model and improving follow-up efficiency help nurses better understand patients' home care conditions and provide timely professional guidance, thereby enhancing the overall quality of nursing services and patient satisfaction while allowing for more rational allocation of nursing resources and reduced ineffective workload. From the perspective of the healthcare system, if the findings of this study can be widely applied, they will help reduce the waste of medical resources, lower healthcare costs, and provide empirical evidence for building an efficient and high-quality transitional care service system, contributing positively to the optimization of healthcare service models. In addition, in-depth research on patients' self-care abilities and quality of life can serve as a reference for similar studies and enrich both theoretical and practical experience in this field.

The "Full-Cycle Intelligent Management Platform" based on a WeChat mini-program can effectively reduce the incidence of severe complications among patients discharged with drainage tubes after head and neck tumor surgery through real-time monitoring, risk alerts, and standardized health education. It also improves nursing satisfaction and follow-up efficiency, providing practical evidence for optimizing continuity of care. This model addresses the shortcomings of traditional follow-up and lays the foundation for building an intelligent and stand-

ardized home care system.

In the future, we will further optimize the functional modules of the intelligent follow-up management platform. For example, by introducing more advanced image recognition technology, the platform can automatically analyze and evaluate images uploaded by patients showing the skin condition around the drainage tube, the color and volume of drainage fluid, thereby improving the accuracy of remote monitoring. Additionally, combined with big data analysis, we will explore potential patterns and risk factors within patient follow-up data to provide data-driven support for developing individualized follow-up plans. We also plan to expand the sample size and conduct multicenter clinical studies to verify the applicability and effectiveness of this follow-up management model across different healthcare settings, promoting its wider adoption. Ultimately, this will provide a more comprehensive and efficient intelligent solution for the transitional care of patients discharged with drainage tubes after head and neck tumor surgery, helping to improve both home care quality and overall quality of life.

AI Use Declaration

The research ideas, study design, data collection and analysis, interpretation of results, and the core content of the manuscript were all independently completed by the author. In the later stage of manuscript writing, the author used AI tools for text polishing, sentence optimization, and formatting adjustments, but did not use AI to directly generate the research plan, experimental results, core arguments, or main conclusions. The author has reviewed the entire manuscript item by item and takes full responsibility for all data, views, and text in the paper.

Author Contributions

Yuexuan Chen: Conceptualized the study, drafted the protocol, developed the "Full-Cycle Intelligent Management Platform," and was responsible for conducting follow-ups, collecting, analyzing, and organizing data, as well as writing and reviewing the manuscript. Yongqin Lin: Contributed to study conceptualization and provided supervision and manuscript review. Li Liu: Conducted follow-ups and participated in data collection and analysis. Mengting Wu: Conducted follow-ups and participated in data collection. All four authors have reviewed and approved the final manuscript and agreed to its submission for publication.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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