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ORIGINAL RESEARCH

Impact of Digital Education on MDT Decision-Making in Shortening Hospital Stay for Patients Undergoing Lumbar Disc Herniation Treatment: A Retrospective Study

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Purpose: More research is required on the efficiency improvements and service optimization brought by wise medical.This study aimed to explore the impact of digital education on multidisciplinary team decision-making in shortening hospital stay for patients with lumbar disc herniation, and providing a decision-making reference for ongoing optimization of clinical workflows.

Methods: This study conducted a retrospective analysis to examine the association between digital education and hospital stay from January 2022 to August 2024. Patients were sequentially divided into a regular education group (receiving routine health education) and a viewed group (receiving the digital education group) to compare hospital stay between the two groups. Univariate analysis and multivariate regression were used to examine factors influencing hospital stay in patients with lumbar disc herniation.

Results: This study included a total of 120 patients with lumbar disc herniation under general anesthesia following day surgery. Patients receiving digital education demonstrated significantly reduced preoperative waiting time (36.19 ± 9.99 vs 41.26 ± 10.49 minutes; P = 0.008) and higher satisfaction scores (98.05 ± 2.54 vs 96.04 ± 4.48; P = 0.003) compared to those who received the regular education. The adjusted multiple linear regression results showed that viewing digital education can shorten hospital stay by an average of 91 minutes compared to regular education (β = −91.11, 95% CI: −128.35, −53.88).

Conclusion: This study suggests that digital education on MDT decision-making, developed through expert consensus, effectively shortens hospital stay and enhances patient experience. Targeted to lumbar disc herniation patients' needs, the content improved self-care compliance, promoted safer postoperative practices, and accelerated recovery.

Keywords: digital education, hospital stay, lumbar disc herniation, MDT, decision-making, retrospective study

Introduction

In recent years, the prevalence of lower back pain has increased due to rising living standards, lifestyle changes, and the growing aging population.[1] Lumbar disc herniation (LDH), a prevalent orthopedic condition, arises from degenerative changes in the intervertebral discs as people age, resulting in damage to the annulus fibrosus and the protrusion of the nucleus pulposus.[2] The displaced tissue compresses the spinal nerves and cauda equina, resulting in a range of symptoms, including radiating pain in the lower back and legs as well as lower limb dysfunction.[3] In addition to physical discomfort, LDH can lead to psychological issues such as anxiety and depression, making it a significant public health concern.[4,5] It is reported that the incidence of lumbar disc herniation has consistently increased over the years.[6]

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Hospital stay refers to the total duration from the time a patient is officially admitted to the hospital until discharge.[7] The current state of hospital stay is influenced by various factors, such as the conditions of medical institutions and the type of surgical procedures performed. With advancements in medical technology and improvements in nursing care, the length of stay for many surgeries and treatments has gradually decreased. However, the ideal length of hospital stay, and specific criteria remain unclear. Moreover, the recovery process for patients typically requires consideration of a variety of factors, including the type of surgery, the patient's overall health status, and the postoperative recovery plan. These ambiguous time frames may pose challenges for clinical healthcare professionals when formulating post-surgical activity plans for these patients, potentially affecting the efficiency and outcomes of recovery.

Health education plays a pivotal role in not only facilitating the standardization of preoperative preparation and postoperative recovery processes for patients but also in significantly reducing hospitalization duration, minimizing medical expenditures, alleviating patient anxiety, and enhancing patient recovery satisfaction.[8] With the rapid development of AI technology and the emergence of the metaverse concept, the idea of virtual digital human has gradually been proposed by scholars and now being researched and applied, have emerged as an innovative research focus in digital health education.[2,9–11] Through role-playing, the virtual digital human can provide users with a more personalized and realistic virtual experience, engaging and motivating patients while offering personalized psychological and behavioral health care.[12] Evidently, virtual digital human, with its unique advantages, presents new opportunities for clinical health education.[13] Moreover, effective health education is a crucial element of high-quality medical services, and the application of virtual digital human aligns seamlessly with this requirement.

The Multidisciplinary Team (MDT) refers to the collaborative efforts of professionals from various specialties within the same discipline, such as surgery, anesthesiology, nursing, and rehabilitation. It is characterized by interdisciplinarity, integration, centralism, individualization, and precision, with the aim of providing reasonable, effective, convenient, and high-quality medical services tailored to the individual needs of each patient.[14–17] Despite the emphasis on the importance of MDT already being emphasized by guidelines and clinical experience, the understanding and application of MDT vary globally, with a lack of standardized practices, and it remains unclear whether and how the MDT approach affects treatment and patient outcomes.[18]

For these purposes, This study addressed the clinical challenges and unmet needs of lumbar disc herniation patients in routine practice by identifying scientific questions and MDT decision-making and then developed a digital education program integrated into the hospital's smart system for patients undergoing treatment.This preoperative home-based intervention aims to reduce preoperative anxiety, address postoperative concerns, shorten hospital stay, and enhance patient experience while ensuring safety.[19–22] The study's contents are reported below.

Methods

Study Design

This was an observational retrospective study of clinical practice performed at a tertiary hospital's Day Surgery Center in Shenzhen. The interesting independent variable in the present work is digital education on MDT decision-making. The dependent variable is hospital stay (continuous variable). Specifically, a retrospective analysis was conducted on the data of patients admitted to the day surgery center of a tertiary hospital in Shenzhen from January 2022 to August 2024.

Study Population

A total of 133 patients were initially screened for eligibility to the day surgery centre. However, 13 participants were excluded due to lack of complete information. In the end, 120 participants were left for data analysis. The time of participants started in January 2022 and ended in August 2024, respectively.

Inclusion Criteria Included: (1) Age of 18 years or older; (2) Meets the diagnostic criteria for lumbar disc herniation; (3) Satisfies the criteria for day surgery, has indications for surgical treatment, demonstrates good surgical tolerance, such as the preoperative blood test, ECG, and anxiety score were normal, and provides informed consent for day surgery; (4) Patients undergoing transforaminal endoscopic lumbar discectomy, high-frequency plasma nucleoplasty decompression, nerve root canal expansion and plasty, and adhesiolysis of spinal nerve roots; (5) Non-endotracheal intubation general

anesthesia was used for the surgery; Anesthetic Agents were included dexmedetomidine hydrochloride injection, dezocine injection, and flurbiprofen axetil injection; (6) Patients classified as American Surgical Association (ASA) classification I–II; (7) No abnormalities in communication abilities; (8) Normal preoperative vital signs and general condition is stable.

The exclusion criteria were as follows: (1) History of spinal deformity, inflammatory diseases, tumor, infection, spondylolisthesis, traumatic injuries in the lumbar spine, and cauda equina syndrome; (2) History of lumbar spine surgery (fusion, laminectomy, or discectomy); (3) Previous and current use of hormones; (4) Severe organic disease, systemic metabolic bone disease, lipodystrophy, and neuromuscular syndromes; (5) Patients with low adherence, mental abnormalities, or psychiatric disorders.

Grouping

The study categorizes January 2022 to June 2023 as the regular education group due to unchanged clinical settings, while July 2023 to August 2024 is the digital education group following the MDT's new health education approach (see Figure 1 for the flowchart).

Regular Education Group

This group received routine health education, with nurses providing verbal instructions on preoperative precautions, surgical procedures, and postoperative care. Patients were invited to join a WeChat group, and their information was recorded in the hospital database. After surgery, nurses gave detailed guidance on postoperative care, including diet, activity, and follow-up appointments. Personalized advice was offered based on individual needs, and nurses addressed questions from patients and families. Follow-up visits via WeChat were conducted to monitor recovery and adjust the care plan as needed.

Digital Education Group

The digital education utilized in this study was produced by the hospital's department. Before surgery, all patients were asked to add the WeChat of the department (for follow-up). Patient information into the "Smart System" (an electronic

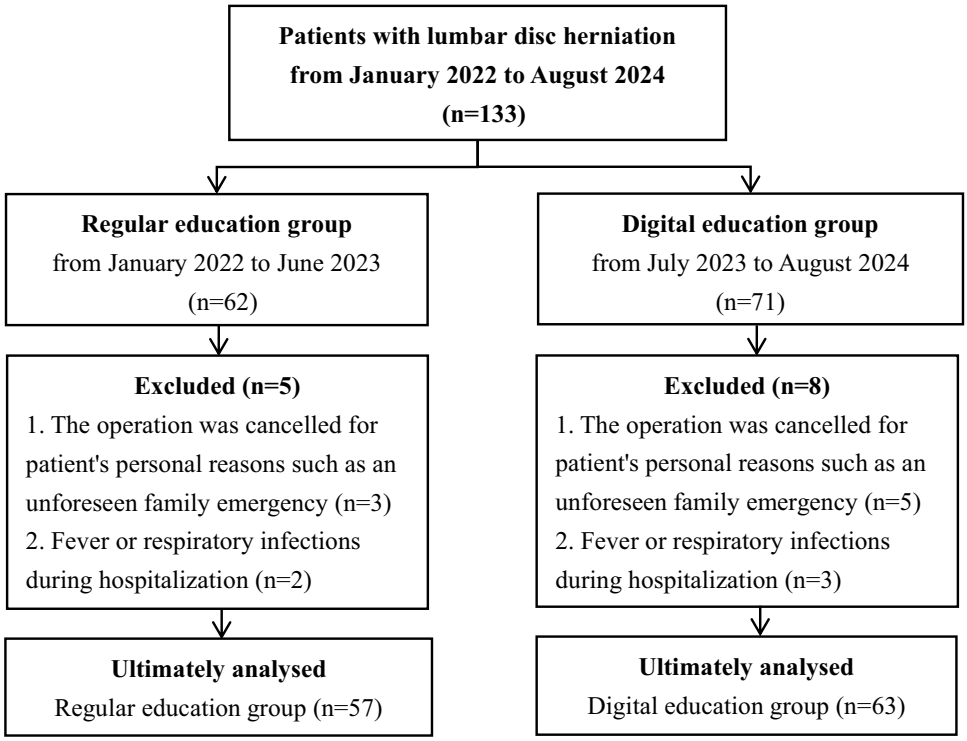

Figure 1 Flow chart.

system for managing patients' perioperative processes), which sends reminders for surgery schedules and provides health education materials, including virtual human video (accessible via QR code). Finally, patients were followed up through WeChat and the "Smart" follow-up system. This aims to guide patients in acquiring perioperative knowledge and skills to support enhanced recovery. Data on video viewing is recorded by the online system's backend.

Study Variables

Dependent Variable

The primary outcome variable was hospital stay (a continuous variable measured in minutes), it included preoperative waiting, duration of operation, and postoperative enhanced recovery time. The preoperative waiting time primarily reflects the management's overall efficiency in controlling hospital stay, the operative time demonstrates the technical proficiency of the chief surgeon, and the duration of enhanced recovery after surgery reflects both patient compliance with health education and the service level of the anesthesia team.The hospital stay calculates as the duration from admission to discharge time, consistent with prior research.[23]

Independent Variable

The independent variable (categorical variable) was the digital education on MDT decision-making. The digital education on MDT decision-making was developed to address the "problems and needs" of patients in daily clinical practice. The MDT was composed of specialists from the department of Spine Surgery, Day Surgery Centre, Anesthesiology, Operating Room, and so on. Based on the Knowledge-Attitude-Practice (KAP) theory, the content and pathway for digital education were scientifically developed, this included incorporating health education materials co-developed through MDT collaborative decisions into videos to enhance participants' trust, and integrating shared experiences from peers who had undergone surgery into the video content during the pre-hospital period, participants could access these health education video at any time by scanning the QR code with their mobile phone, with the aim of improving compliance (see Figure 2).[24,25]

The digital education on MDT decision-making in patients undergoing treatment for lumbar disc herniation was meticulously crafted and presented by day surgery center nurses and specialist doctors with extensive clinical expertise. Following approval from both the head nurse and department head, the virtual human video (digital education) has been produced by professionals within this hospital. The video includes 3 parts: *Part 1 Science popularization and education* Educational material on lumbar disc day surgery (wherein a digital surgeon answers patients' addresses the most concerning preoperative issues raised by patients with a problem-and needs-oriented approach, such as pain and potential leg discomfort caused by nerve compression); *Part 2 Perioperative faster recovery coordination requirements* Detailed

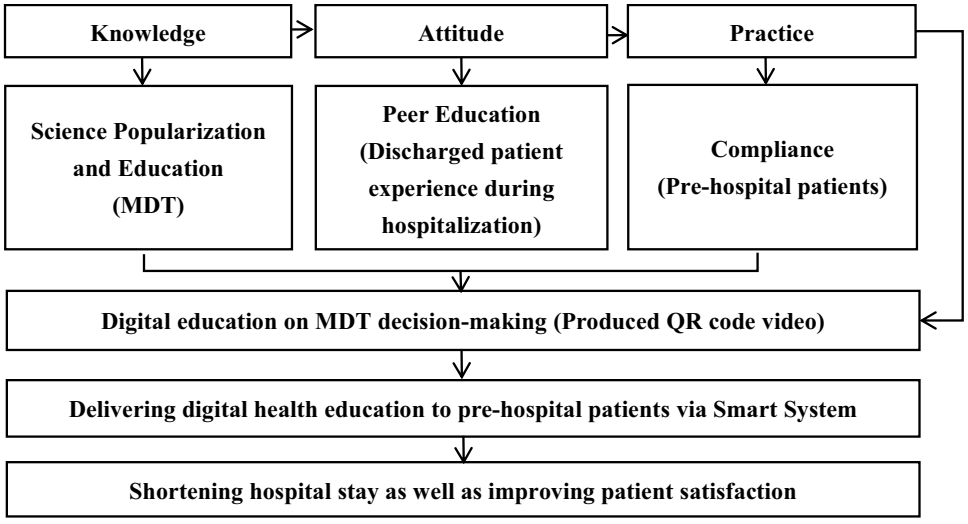

Figure 2 Research framework for guided practice via the Knowledge-Attitude-Practice (KAP) theory.

explanation of preoperative collaboration processes, precautions, as well as postoperative recovery techniques; Guidance on postoperative home-based rehabilitation exercises along with follow-up instructions; *Part 3 Peer education* Peer education was conducted by randomly surveying postoperative patients about their feelings or experiences to provide a valuable reference for patients scheduled for surgery. The digital education has a duration of approximately 7minutes. See Appendix File 2 for details of the digital education video via QR code.

Covariates

The covariates involved in this study were selected based on the clinical experiences and studies from others examining risk factors for hospital stay. Based on the above principles, thus, the following variables were used as covariates: age, gender, education, marital status, occupation, smoking, body mass index(BMI), hemoglobin, site of lesion, preoperative blood glucose, postoperative blood glucose, location of pain, preoperative and post-operative pain, preoperative waiting time, duration of operation, time to first dietary (The time to first solid or liquid food ingestion after evaluating gastrointestinal tract function), and patient satisfaction. For complications, postoperative complications were obtained through follow-up with the smart system, and the follow-up time was 1st day, 3rd day, 7th day, and 1st month after surgery. Pain was assessed using the Numerical Rating Scale (NRS), and satisfaction levels were evaluated through the utilization of a self-made satisfaction survey questionnaire (see Appendix File 3).

Statistical Analysis

Quantitative data are presented as mean ± standard deviation (SD), and comparisons between groups are made using the two-sample *t*-test for normal distribution and the Mann–Whitney *U*-test for non-normal distribution. Categorical data are expressed as rates or proportions, and comparisons between groups are conducted using the χ^2-test (when sample size requirements are met) or the Fisher exact test, to analyze differences between categorical variables. Correlation analysis is performed using univariate and multiple linear regression to test the connection between digital education and hospital stay.

All statistical tests were 2-sided, and a P-value <0.05 was considered statistically significant.Data were analyzed using the statistical software packages R (http://www.R-project.org, The R Foundation), and along with EmpowerStats (www.empowerstats.com).

Results

Characteristics of Participants

A total of 120 lumbar disc herniation patients participated in this study, with 63 allocated to the digital education group and 57 to the regular education group. The demographics and clinical characteristics of included participants are presented in Table 1. The population at baseline, of whom 30% were female, had a mean age of 39.52 ± 10.16 years.

Table 1 Baseline Characteristics of Participants [n (%)/Mean ± SD]

Variables	Digital Education (n = 63)	Regular Education (n = 57)	*P*
Age (years, mean±SD)	39.02 ± 9.75	40.09 ± 10.65	0.566
Gender (n, %)			0.968
Male	44 (69.84)	40 (70.18)	
Female	19 (30.16)	17 (29.82)	
Education (n, %)			0.137
Primary school and under	2 (3.17)	3 (5.26)	
Middle school	8 (12.70)	3 (5.26)	
High school	7 (11.11)	15 (26.32)	
Undergraduate	43 (68.25)	32 (56.14)	
Postgraduate	3 (4.76)	4 (7.02)	

(*Continued*)

Table 1 (Continued).

Marital status (n, %)			0.571
Single	14 (22.22)	12 (21.05)	
Married	46 (73.02)	44 (77.19)	
Separated	0 (0.00)	1 (1.75)	
Widowed	1 (1.59)	0 (0.00)	
Divorce	2 (3.17)	0 (0.00)	
Occupation (n, %)			0.262
Professional technicians	8 (12.70)	4 (7.02)	
Workers	2 (3.17)	4 (7.02)	
Staff	29 (46.03)	21 (36.84)	
Civil servants	0 (0.00)	1 (1.75)	
Managers	3 (4.76)	1 (1.75)	
Others	16 (25.40)	13 (22.81)	
None	4 (6.35)	10 (17.54)	
Retired	1 (1.59)	3 (5.26)	
Smoking (n, %)			1.000
No	59 (93.65)	53 (92.98)	
Yes	4 (6.35)	4 (7.02)	
Body mass index (BMI) (scores, mean±SD)	24.72 ± 5.11	24.56 ± 3.93	0.850
Hemoglobin (Hb) (scores, mean±SD)	148.73 ± 14.84	149.65 ± 13.98	0.728
Site of lesion (n, %)			0.668
Unclear location	3 (4.76)	2 (3.51)	
L3/L4	2 (3.17)	3 (5.26)	
L4/L5	33 (52.38)	24 (42.11)	
L5/S1	25 (39.68)	28 (49.12)	
Preoperative blood glucose (scores, mean±SD)	5.40 ± 0.55	5.64 ± 0.62	0.023
Postoperative blood glucose (scores, mean±SD)	5.83 ± 0.92	6.00 ± 1.24	0.409
Location of pain (n, %)			0.867
Left leg	24 (38.10)	22 (38.60)	
Right leg	31 (49.21)	26 (45.61)	
Low back	8 (12.7)	9 (15.8)	
Preoperative pain (scores, mean±SD)	3.37 ± 1.88	3.68 ± 1.70	0.333
Postoperative pain (scores, mean±SD)	1.81 ± 0.96	1.67 ± 1.12	0.455
Preoperative waiting time (mins, mean±SD)	36.19 ± 9.99	41.26 ± 10.49	0.008
Duration of operation (mins, mean±SD)	106.11 ± 21.12	112.61 ± 31.59	0.184
Time to first dietary (mins, mean±SD)	108.86 ± 46.83	135.86 ± 62.26	0.008
Hospital stay (mins, mean±SD)	541.48 ± 77.28	608.18 ± 111.36	0.000
Patient satisfaction (scores, mean±SD)	98.05 ± 2.54	96.04 ± 4.48	0.003

The group of digital education and regular education exhibited no statistically significant differences in terms of age, gender, education, marital status, occupation, smoking, BMI, hemoglobin, site of lesion, postoperative blood glucose, location of pain, preoperative pain, postoperative pain, and duration of operation ($P > 0.05$). However, significant differences were observed between the two groups regarding preoperative blood glucose, preoperative waiting time, time to first dietary, hospital stay, and patient satisfaction ($P < 0.05$). Detailed results are presented in Table 1.

Furthermore, among the subjects of this study, the majority of lumbar disc lesions originated from the lumbar 4 to 5 region, as well as the lumbar 5 to sacral 1 area. Reports indicated that in 47.50% patients of the pain was located in the right leg, 38.33% in the left leg, and 14.17% in the low back pain (see Appendix File 4).

Univariate and Multivariate Analyses

To explore whether pre-hospital digital education affects the hospital stay in patients with lumbar disc herniation, this study used the group as the independent variable (regular education group as the reference group), and the hospital stay as the dependent variable. The results of univariate and multiple linear regression analyses are detailed in Tables 2 and 3. Univariate analysis showed a significant negative association between digital education and hospital stay, with the digital education group having approximately 66.70 minutes shorter stay compared to those with regular education ($\beta = -66.70$, 95% CI: −100.73 to −32.67, $P = 0.0002$). Following the univariate analysis, variables meeting statistical significance criteria (α entry = 0.05, α removal = 0.10) were incorporated into the stepwise regression process. The adjusted multiple linear regression analysis showed that the digital education group was associated with a decrease in hospital stay by approximately 91.11 minutes ($\beta = -91.11$, 95% CI: −128.35 to −53.88).

Table 2 Univariate Analysis of All Other Variables on the Hospital Stay

Variables	Hospital Stay	
	***β* (95% CI)**	***P***
Age	0.22 (−1.56, 2.00)	0.806
Gender		
Men	Reference (0)	
Women	6.36 (−32.96, 45.68)	0.752
Education		
Primary school and under	Reference (0)	
Middle school	23.96 (−82.07, 130.00)	0.659
High school	8.60 (−88.80, 106.00)	0.863
Undergraduate	−6.52 (−97.32, 84.28)	0.888
Postgraduate	−67.54 (−182.65, 47.57)	0.253
Marital status		
Single	Reference (0)	
Married	−9.81 (−54.18, 34.57)	0.666
Separated	−58.96 (−262.05, 144.12)	0.570
Widowed	−71.96 (−275.05, 131.12)	0.489
Divorce	−21.46 (−167.70, 124.78)	0.774

(*Continued*)

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Table 2 (Continued).

Variables	Hospital Stay	
	β (95% CI)	*P*
Occupation		
Professional technicians	Reference (0)	
Workers	30.00 (−70.43, 130.43)	0.559
Staff	10.11 (−54.46, 74.67)	0.760
Civil servants	16.17 (−192.89, 225.22)	0.880
Managers	−13.08 (−129.05, 102.88)	0.825
Others	6.51 (−62.43, 75.45)	0.853
None	43.95 (−35.06, 122.97)	0.278
Retired	6.42 (−109.55, 122.38)	0.914
Smoking		
No	Reference (0)	
Yes	−25.88 (−98.00, 46.23)	0.483
BMI	0.74 (−3.22, 4.70)	0.714
Hb	−0.14 (−1.40, 1.12)	0.828
Site of lesion		
Unclear site and L3/L4	Reference (0)	
L4/L5	114.00 (−8.37, 236.37)	0.070
L5/S1	22.41 (−67.83, 112.65)	0.627
Preoperative blood glucose	36.82 (7.06, 66.57)	0.017
Postoperative blood glucose	16.67 (0.26, 33.07)	0.049
Location of pain		
Left leg	Reference (0)	
Right leg	18.80 (−19.86, 57.46)	0.343
Low back	61.00 (5.81, 116.19)	0.032
Preoperative pain	−1.93 (−12.00, 8.14)	0.708
Postoperative pain	6.56 (−10.79, 23.90)	0.460
Preoperative waiting time	−0.90 (−2.61, 0.82)	0.308
Duration of operation	0.21 (−0.46, 0.89)	0.536
Time to first dietary	0.07 (−0.26, 0.39)	0.685
Patient satisfaction	−9.53 (−14.09, −4.97)	0.000
Digital education	−66.70 (−100.73, −32.67)	0.0002

Table 3 Multiple Linear Regression Analysis Between Hospital Stay and Other Variables

Variables	Hospital Stay			
	Non-Adjusted Mode		Adjusted Mode	
	β (95% CI)	*P*	*β* (95% CI)	*P*
Digital education	−66.70 (−100.73, −32.66)	0.000	−91.11 (−128.35, −53.88)	0.000
Preoperative blood glucose	36.82 (7.06, 66.57)	0.017	4.65 (−32.55, 41.86)	0.807
Low back	68.91 (5.68, 132.14)	0.035	91.44 (10.24, 172.63)	0.027
Patient satisfaction	−9.63 (−14.09, −4.97)	0.000	−6.13 (−11.74, −0.52)	0.037

Notes: Adjusted model was adjusted for, age, gender, education, marital status, occupation, smoking, body mass index, hemoglobin, site of lesion, preoperative glucose and pain, postoperative glucose and pain, location of pain, preoperative waiting time, duration of operation, time to first dietary,and patient satisfaction.

Table 4 Follow Up on Long-Term Outcomes After Discharge

Groups	Day 1	Day 3	Day 7	1st Month	3rd Month	6-12th Month
Digital education	4[a]	5[a]	2[a]	0	1[b]	0
Regular education	5[a]	6[a]	2[a]	0	1[b]	0

Notes: [a] Minor complications include mild pain, numbness, and swelling of the limbs.[b] Unplanned reoperation (The rate in this study is 1.6%). The unplanned reoperation for lumbar degenerative diseases is 1.5%-3.0% as reported.

Long-Term Follow-Up Results

This study conducted a retrospective analysis of 120 patients suffering from lumbar disc herniation, followed up the postoperative complications such as the cleanliness of incision dressings, incision pain, numbness, and soreness of the extremities. This analysis utilized the follow-up smart system, a tool developed by the research institution, which tracked patients' conditions at postoperative day 1, 3, and 7, as well as at 1st month, 3rd month, and 6–12th month (see Table 4).

Discussion

Prehospital Digital Education on MDT Decision-Making Shortens Hospital Stay

With the integration of digital technologies into MDT decision-making, significant advantages have been observed in optimizing health education.[26] This approach makes it recommended and adopted in clinical practice, which is consistent with the previous studies.[23,27] The results of this study found that the digital health education group had a shorter hospital stay than the regular group (Table 1), and regression models (Tables 2 and 3) indicate that higher satisfaction is associated with shorter hospital stay. This finding aligns with Yu et al's (2021) study, which found that the inpatient endoscopic lumbar discectomy (FELD-I) group had a significantly longer postoperative stay (44.59 ± 32.69 hours) compared to the day-surgery FELD-D group (2.79 ± 1.08 hours), with satisfaction rates exceeding 90% in both groups.[28] Although the regression analysis also found that the only significant pain location affecting hospital stay was low back pain ($\beta = 91.44$, $P = 0.03$), other types of pain did not significantly impact the hospital stay. This may be because patients with low back pain at specific sites recover more slowly, resulting in a longer hospital stay. However, pain location may not be the primary factor influencing hospital stay, and future studies could focus on pain intensity or other related variables. Given the small sample size of low back pain (17 participants), these results should be interpreted with caution.

A scientific and comprehensive design of the digital education was developed. Standardized digital education on MDT decision-making is derived from the scientific summary of the practical experience of discharged patients with lumbar disc herniation who underwent spinal surgery, and serves the pre-hospital patients.

Specifically, the research team in this study first designed a pre-hospital digital education based on years of clinical practice and the guidance of KAP theory with an MDT. The research team adopted a patient-centered approach, prioritizing patients' specific needs and concerns. Nurses in the day surgery centre have daily 5-minute communication with each patient, record their doubts, and then integrate them into scientific questions. Based on the Pareto principle,

MDT members then discuss the major scientific issues of concern to 80% of patients and create specific digital education content.[29] After that, the team produced a pre-hospital digital health education (virtual human video) via QR code for patients (see Appendix File 2), and integrated it into the Smart System of the hospital. The Smart system automatically sent QR codes for the virtual human video to pre-hospital lumbar disc herniation patients and tracked their viewing progress, allowing healthcare providers to offer education resources, especially for those with busy schedules or unable to attend face-to-face health education.

Although the length of hospital stay was shortened, no complications affecting health occurred within one year after discharge, which also verified that the study continued to reduce hospital stay on the basis of patient safety. As shown in Table 4, the complication rate in the digital education group may be slightly lower than in the conventional education group, although the sample size was small, and no significant differences were found between the two groups. The study showed that 20% (24/120) of patients experienced minor complications in the first-week post-surgery, all of which were self-limiting and did not require clinical intervention. The unplanned reoperation rate at three months was 1.6% (2/120), consistent with the safety benchmark for lumbar spine surgery. This aligns with the complication rates of 1.5%-3.0% seen in other degenerative lumbar spine surgeries, confirming the safety of the procedure.[30] Thus, it suggests that digital health education is worth promoting due to its potential benefits.

To sum up, digital education on MDT decision-making may effectively shorten hospital stay through mechanisms such as improved patient compliance and optimized perioperative management. These results are consistent with previous research,[31] which highlights the pivotal role of digital education for patients. This may be because the video in this study not only covers the basics of lumbar disc herniation surgery, preoperative preparation, and postoperative care but also explores the physical and psychological challenges patients may face and coping strategies. Through clear visuals and intuitive explanations, the video helps patients better understand the surgical process and alleviates the fear caused by the unknown.

Prehospital Digital Education on MDT Decision-Making Improves Intervention Compliance and Patient Satisfaction

Digital education, as an effective tool, could enhance patient understanding and acceptance of treatment plans, reducing anxiety and improving patient compliance, satisfaction, and overall healthcare experience.[32]

This study examined the impact of digital education on lumbar disc herniation patients. The results showed a statistically significant difference in preoperative blood glucose levels, preoperative waiting time, time to first dietary, hospital stay, and satisfaction between the digital education and regular education groups (Table 1). For surgery patients, factors like preoperative blood glucose and preoperative waiting time are crucial determinants of surgical success and postoperative fast recovery.[33,34] Firstly, the preoperative blood glucose difference between the two groups may result from reduced physical activity due to disease-related pain, leading to higher glucose levels. This difference could also stem from the positive effects of the virtual human video, which may enhance patients' emotional and psychological states, improve dietary compliance, and promote earlier preoperative dietary initiation. Both groups exhibited a slight postoperative blood glucose increase, likely due to stress-induced hyperglycemia from surgical trauma. While no direct studies on lumbar surgery exist, previous research suggests optimizing preoperative glucose levels can reduce waiting times and complications.[35,36] However, Table 2 showed a significant link between preoperative blood glucose and hospital stay, while Table 3 found no such association, indicating other influencing factors. In sum, preoperative blood glucose likely reflects improved compliance following the video, rather than directly affecting hospital stay. As for the preoperative waiting time, the digital education group had a shorter preoperative waiting time compared to the regular education group. This may be related to higher patient compliance, as digital education helps patients better understand the surgical process and preoperative preparations, leading to more efficient decisions regarding surgery and time management. However, the research team also found that factors such as personal issues, distance, or communication misunderstandings with healthcare staff could lead to delays in patient preoperative waiting time. Therefore, this result should be interpreted with caution.

In terms of the time to first dietary, the digital education group had a shorter average time. Additionally, patient satisfaction in the digital education group was significantly higher than in the regular group, further emphasizing the

positive impact of digital education on postoperative recovery and overall patient experience (Tables 2–3). This may be due to the fact that digital education shortened hospital stay by improving patients' preoperative preparation and postoperative compliance, thereby promoting postoperative recovery. For example, family members were able to prepare postoperative meals, ensuring that patients could eat as soon as they were fully awake, thus achieving the goal of "to eat, to move, to sing the trilogy, and to ambulate without discomfort. This is also in line with the Post-Anesthesia Discharge Scoring System (PADSS) standards and helps ensure smooth discharge, consistent with the previous findings in other populations.[7,23,25] Additionally, patient satisfaction was notably higher in the digital education group compared to the regular group, along with a shorter hospital stay (Tables 2–3), further emphasizing the positive impact of digital education on overall patient satisfaction and experience.

In conclusion, the digital health education is distributed via wise system, the convenience of service has been greatly enhanced, and the number of pre-hospital patients coming back to the hospital for consultation and receiving health education is reduced. The personal health information and skills and knowledge related to faster recovery that patients are required to master can be "fly" to their homes anytime and anywhere, which virtually improves the medical experience of patients.The methodology's simplicity and scalability suggest strong potential for broader implementation across surgical specialties.

Strengths and Limitations

Firstly, this study provides a preliminary exploration of virtual digital human technology, focusing on innovative video content creation and distribution channels, with further development needed in interactivity and intelligence. Secondly, the correlation between the low back pain and hospital stay in this study, is potentially due to variations in patients' literacy levels and pain tolerance, which may introduce measurement bias. In addition, the study inadequately examined how operation and post-operative recovery times impact hospital stay. The lastly, the present study was conducted as a single-center retrospective analysis with a limited sample size. As with any non-randomized study, there is potential selection bias and residual confounding. The relatively small sample size increases the risk of Type II errors, potentially leading to undetected true effects due to insufficient statistical power.

In the future, there is scope to broaden the sample size to enhance the generalizability of the results and to investigate other potential factors that may affect hospitalization duration, such as duration of operation, duration of enhanced recovery after surgery, and perioperative psychological assessment. Furthermore, the content and format of digital education could be further refined.

Conclusion

This retrospective study suggests that digital education on MDT decision-making may help reduce hospital stay for lumbar disc herniation patients, improve their understanding of surgery, and effectively increase patient compliance, and satisfaction. While the observed association requires further validation, this approach shows promise for optimizing nursing quality. Future prospective studies are required to validate the causal relationship and further explore the impact of such interventions.

Data Sharing Statement

Some or all datasets generated during and/or analyzed during the current study are not publicly available due to patient privacy restrictions and institutional policies but are available from the corresponding author on reasonable request. Study protocol: Available from Pengjun Jiang (email, 2020t0775@pwu.edu.ph).

Ethics Approval and Informed Consent

This study was approved by the ethics committee of the Shenzhen Nanshan People's Hospital (NO.LW-2024-023) and in accordance with the Declaration of Helsinki (see Appendix File 1). The data on patients diagnosed with lumbar disc herniation was extracted from the electronic data gathering system and collected from the team of the day surgery care unit of Shenzhen Nanshan People's Hospital in China. The participants' identities were anonymized to protect the

privacy of the patients. Participants were allowed to freely participate or withdraw and were respected. Formal consent was waived as this was a retrospective study, this waiver was granted based on institutional guidelines.

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Author Contributions

All authors made significant contributions to the paper reported, encompassing the conception, study design, execution, data acquisition, analysis, and interpretation. Each author participated in drafting, revising, or critically reviewing the manuscript; provided final approval of the version to be published; agreed on the journal to which the article was submitted; and agrees to be accountable for all aspects of the work.

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Disclosure

All authors declare no competing interests in this work.

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