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ORIGINAL RESEARCH

Early Rehabilitation Activity and Rehabilitation in ICU Wards in Central China: A Cross-Sectional Survey

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Background: Patients in Intensive Care Units (ICUs) face high risks of physical, functional, cognitive, and mental impairments. Early rehabilitation activities are crucial for reducing mortality and complication rates. This survey investigates the characteristics, current implementation, and detailed status of early rehabilitation activities in ICUs across Central China.

Methods: A cross-sectional survey was conducted involving 158 hospitals, with 131 responding. Data on institutional characteristics and early rehabilitation activities were collected through questionnaires. Descriptive statistical analysis described the current status, and a univariate regression model identified factors associated with the implementation of early rehabilitation measures.

Results: A total of 131 ICUs completed the survey, with a response rate of 82.91% (131/158). Results indicated that 82.44% (108/131) of ICUs implemented early rehabilitation activities, but only 65 (49.62%) had explicit early rehabilitation exercise protocols or standards/procedures. Before implementing early rehabilitation activities, approximately 89.97% (110/131) of ICUs conducted assessments, and 46.56% (61/131) regularly held structured interdisciplinary rounds to discuss early activity measures and goals. More than half of the participating adult ICUs reported screening patients for swallowing function (64.89%; 85/131), and 55.73% (73/131) of adult ICUs reported having a nutrition therapy specialist conduct regular consultations/visits. Only 26.72% (35/131) of adult ICUs reported having a speech therapist conduct consultations/visits. A total of 81.68% (107/131) of ICUs believed that the current implementation of early rehabilitation activities was insufficient. In the analysis of influencing factors, the presence of rehabilitation therapists in the ICU was a significant factor for the implementation of early rehabilitation activities ($P<0.05$).

Conclusion: The majority of ICUs in hospitals in central China have implemented early rehabilitation activities; however, less than half have explicit early rehabilitation exercise protocols or standards/procedures. The presence of professional rehabilitation therapists in the ICU is a key factor in the implementation of early rehabilitation activities in ICUs in hospitals in Central China.

Keywords: intensive care unit, early rehabilitation activity, Early Rehabilitation

Introduction

With the rapid development of critical care medicine, the success rate of ICU patient treatment has significantly improved. However, due to prolonged bed rest, ICU patients may experience sequelae such as physical disability, decreased immunity, and cognitive dysfunction, which can greatly impact patient prognosis.[1] Early rehabilitation is an effective measure proposed in recent years to promote early weaning from mechanical ventilation in ICU patients and prevent and control complications during ICU treatment for critically ill patients. It refers to a series of exercises or workouts that patients participate in through their own muscle strength and control, with certain assistive conditions, when hemodynamics are stable and oxygen levels permit.[2,3] The effects of early rehabilitation include promoting the recovery of neuromuscular function, improving patient's ability to perform activities of daily living, reducing the

incidence and duration of delirium, shortening treatment time, decreasing the incidence of pressure ulcers and deep vein thrombosis, preventing and controlling ventilator-associated pneumonia, and improving patient mental health.[4,5]

Numerous studies have confirmed the safety and effectiveness of early rehabilitation in ICU patients. Hickmann et al[6] evaluated the effects of early rehabilitation in 171 ICU patients and found that the feasibility of successfully implementing early rehabilitation was significantly improved with the teamwork of nursing staff, even for patients receiving vasopressor therapy, mechanical ventilation, or renal replacement therapy. Early rehabilitation after ICU admission also showed good safety. Liu et al[7] reported that among 232 patients undergoing early rehabilitation, there were 13 adverse events, including 7 cases of patient intolerance leading to discontinuation and 6 cases of orthostatic hypotension, but no serious events requiring additional treatment such as cardiopulmonary resuscitation, increased doses of vasopressors, increased oxygen flow, or additional analgesia occurred. Sibilia et al[8] used an effective ICU exercise scale in 35 Swiss ICUs and conducted high-level rehabilitation exercises on 161 mechanically ventilated patients. The potential safety event rate after exercise was not different from the control group, and under the same sedative dosage, the effect of deep sedation was significantly enhanced, and the incidence of venous thrombosis caused by prolonged bed rest decreased. Additionally, Chinese scholars' attempts at early rehabilitation have shown that implementing early rehabilitation care in ICU patients can effectively shorten the duration of mechanical ventilation, ICU stay, and total hospital stay, improve muscle function, and reduce mortality and complication rates.[9,10]

The European Respiratory Society and the European Society of Intensive Care Medicine recommend that a series of early rehabilitation exercises of different intensities should be carried out for ICU patients to reduce the incidence of complications, improve the nursing outcomes, and quality of life.[11] However, the implementation of early rehabilitation in clinical practice is not ideal globally.[12] A German study investigated early activities in routine ICU practice, and only 185 out of 783 patients (24%) were mobilized out of bed.[13] In a multicenter survey, 84% of ICU patients in Australia and New Zealand did not receive early rehabilitation treatment,[14] while 71% of ICUs in Canada conducted early rehabilitation, but only 38% had an activity program.[15] A recent study in Swiss ICUs found that nearly one-third of the directors of intensive care units believed that early rehabilitation was not fully utilized in their own intensive care units.[16] A study in 444 ICUs from 11 provinces in China showed that 56.98% of ICUs conducted early rehabilitation activities.[17]

Although Liu et al[17] conducted a survey on early ICU activities across 11 provinces in China, the study found that more than 40% of ICUs were located in Western China, while only 14% were in Central China. Additionally, regarding the occupancy rates of healthcare facility beds, the Western region had the highest rate at 76.2%, above both the national average of 74.6% and the 73.6% in Central China. However, when looking at the number of ICU beds per 100,000 people, Central China leads with 4.6, followed by Eastern China at 4.4, Western China at 4, and Northeastern China at 3.3.[18] This indicates a significant imbalance in the development of ICUs across the regions. Furthermore, the results from Liu et al[17] suggest that economically stronger provinces with more ICU beds are more conducive to the implementation of early activities. Despite Central China being economically more developed than the Western region, its bed occupancy rate remains low. Therefore, we are interested in understanding the current status of early ICU rehabilitation practices in Central China under these circumstances. Accordingly, the purpose of this study is to investigate the specific implementation details and current status of early ICU rehabilitation activities in Mainland China's Central region and to analyze the factors affecting their implementation.

Methods
Study Design
This study is a cross-sectional survey.

Participants
Convenience sampling was used to select 158 hospitals - 131 are the number that responded, from 24 cities in Central China for the survey conducted between August 2023 and December 2023. The inclusion criteria were secondary or tertiary hospitals with independent ICUs and head nurses familiar with early rehabilitation activities. Head nurses unwilling to participate or unfamiliar with staffing and early rehabilitation activities were excluded. According to the

rule that the sample size should be 5 to 10 times the number of variables,[19] the survey questionnaire contained 23 items, and with a consideration of a 10% no response rate, the sample size was determined to be at least 127.

Measurements

The survey tool we used was developed by Tomonaga et al[16] based on the results of literature research for early mobility and rehabilitation in Swiss intensive care units (ICUs). Before conducting the survey, we obtained authorization from Tomonaga and revised the questionnaire using the Delphi method. We invited 17 doctors and nurses from seven provinces in China, with more than 10 years of experience working in ICU or rehabilitation nursing, specializing in critical care medicine and rehabilitation medicine, to revise and improve the questionnaire twice. To conform to the cultural specificity of the Chinese context, we modified the wording of the original questionnaire and added an item: "What is the distribution of nursing staff titles in the ICU?". The questionnaire underwent reliability and validity testing. The final content validity ratio (S-CVI/Ave) was 0.974, Cronbach's α coefficient was 0.821, and the split-half reliability coefficient was 0.798, all of which were ≥0.7, indicating good reliability, internal consistency, and stability. The content of the questionnaire is shown in Table S1.

The questionnaire collected basic ICU information (province and city, hospital type and size, university-affiliated status, ICU type and size, staffing types and scale, patient characteristics and scale), preparation for early rehabilitation activities, implementation of early rehabilitation activities, rehabilitation measures related to swallowing, speech, nutrition, and psychological impact, follow-up and evaluation of patient outcomes, and reasons and evaluations for poor implementation of early rehabilitation measures.

In our study, early rehabilitation activities were defined as a series of movements or exercises involving patients' own muscle strength and control under the condition of hemodynamic stability and allowable blood oxygen level, with certain assistive conditions.[2,3] Currently, the main methods of early rehabilitation treatment for ICU patients include:① Therapeutic exercise, which can be divided into active and passive movements. The main content includes trunk control, active or passive resistance training, limb strength training, functional training, passive joint movement of limbs, sitting at the bedside, sitting in a wheelchair at the bedside, standing at the bedside, and assisted walking.② Electro-neuromuscular stimulation (ENMS), which involves applying low-power electrical pulses through surface electrodes to the skin and muscles. This method is mainly used for patients who cannot perform effective exercises. It can promote skeletal muscle growth, enhance muscle strength and endurance.③ Functional electrical stimulation (FES) uses a low-intensity pulsed current through a preset program to stimulate one or more groups of muscles, causing the muscles to produce movement or simulate normal voluntary movements, thereby improving or restoring the function of the stimulated muscles or muscle groups.④ Other exercise methods such as treadmill ergometer exercise, interactive video game machines, occupational therapy, etc. can be selected based on the specific conditions of the patient and the available resources in the ICU.

Data Collection

This study set up a questionnaire through the Questionnaire Star platform (https://www.wjx.cn/jq/10040555.aspx). Members of the research team, who had received unified training, explained the significance and method of filling out the questionnaire to the head nurses of the surveyed ICU using a unified instructional language. After obtaining consent, questionnaire links or QR codes were distributed to respondents via the internet, WeChat, QQ, email, etc., to be filled out anonymously. The author, after registering, can view the status and number of questionnaires filled out in the background, and freely export the data. For the ICU head nurses who answered the questions, participation in the survey was voluntary. After reading the electronic informed consent form, the participating head nurses entered the study by clicking the "Confirm" button. When sending out the questionnaires, we emphasized that if an ICU employed two or more head nurses, only one of them who is most familiar with early rehabilitation activities needed to participate.

Ethics Statement

According to the "Regulations on Integrity and Related Conduct in Medical Research" (National Health Commission Education [2021] No. 7) and the "Ethical Review Methods for Life Sciences and Medical Research Involving Humans"

(National Health Commission Education [2023] No. 4), all research involving humans must complete ethical review before application. However, our study only collected comprehensive information from hospital ICUs and did not collect data at the individual level (patients or staff), thus exempting us from the ethical application process.

Quality Control

To prevent unrelated individuals from responding, the online questionnaire link was set to non-forwardable, and all questions were mandatory to prevent data loss. Each IP address was allowed to respond only once to avoid duplicate responses. Each participant could fill out the questionnaire only once, and all questions had to be answered before submission.

Data Analysis

Descriptive statistics were presented as frequencies and percentages for categorical variables, and means (standard deviation, SD) or medians (interquartile range, IQR) as appropriate for continuous variables. The analysis explored hospital and ICU characteristics, preparation for early rehabilitation activities, implementation of early rehabilitation activities, follow-up and evaluation of patient outcomes, and reasons and evaluations for poor implementation of early rehabilitation measures. Chi-square tests or Fisher's exact probability tests and univariate linear regression models were used for statistical analysis of influencing factors. A two-sided $p < 0.05$ was considered statistically significant. All data were analyzed using SPSS 23.0 software. The analysis of the results will be based on the type of hospital (tertiary vs secondary).

Results

Hospital and ICU Characteristics

The central region of China, which includes Hubei, Hunan, and Henan provinces, was the focus of this study. Surveys were conducted in 24 cities across these three provinces. A total of 158 ICUs were contacted, and 131 ICUs completed the questionnaire, resulting in a response rate of 82.91%. The types of hospitals surveyed included tertiary hospitals (n=81, 61.83%) and secondary hospitals (n=50, 38.17%). The types of ICUs were categorized into three groups: specialized ICUs (n=18, 13.74%), partially integrated ICUs (n=12, 9.16%), and general ICUs (n=101, 77.1%). The median number of ICU beds was 20, with the majority having ≤20 beds (n=69, 52.67%). Tertiary hospitals had more ICU patients, a higher number of nursing staff (73.93 vs 33.22/ICU), and more physicians compared to secondary hospitals.

Overall, about 31% to 50% of patients received mechanical ventilation during their ICU stay, and more than half of the patients were over 65 years old (57.47%). Only 32.06% of ICUs had a dedicated physical therapy team, with an average of 1.02 physical rehabilitation therapists (SD=2.561) and an average of 0.76 rehabilitation specialists (SD=2.346). There were no significant differences between hospital types except for the presence of a dedicated ICU physical therapy team. Table 1 provides additional details.

Implementation of Rehabilitation and Early Activity Practices

According to the results, 82.44% (108/131) of ICUs implemented early rehabilitation activities, with a higher implementation rate in tertiary hospitals compared to secondary hospitals (64.81% vs 35.19%). However, only 65 ICUs (49.62%) had a defined early rehabilitation exercise protocol or standard procedure. Overall, 38.93% (51/131) of ICUs reported that the percentage of patients receiving any form of rehabilitation therapy was ≤10% of the total ICU patient population. Among patients undergoing early rehabilitation, the percentage of postoperative patients in most ICUs (50/131, 38.17%) was ≤10%. For patients receiving early rehabilitation, the percentage of mechanically ventilated patients was mostly concentrated in the ≤10% (44/131, 33.59%) and 11%~30% (45/131, 34.35%) ranges. There were no significant differences between hospital types. Detailed information is provided in Table 2.

The results indicate that among the ICUs with a defined early rehabilitation exercise protocol or standard procedure, 46.15% (30/65) started early rehabilitation exercises only after achieving hemodynamic stability, approximately 21.54% (14/65) began on the first day of ICU admission, and 10.77% (7/65) started on the second day of ICU admission.

Table 1 Characteristics of Hospitals and Intensive Care Units (ICUs) (n=131)

Item		Total (n=131)	Hospital type		X²/F	P value
			Tertiary Hospitals (n=81, 61.83%)	Secondary Hospitals (n=50, 38.17%)		
Hospital Location, n (%)	Hubei province	102 (77.86)	62 (60.78)	40 (39.22)	7.944	0.094
	Hunan province	18 (13.74)	10 (55.56)	8 (44.44)		
	Henan province	11 (8.39)	9 (81.82)	2 (18.18)		
Teaching Hospital, n (%)	Yes	75 (57.25)	68 (90.67)	7 (5.34)	0.616	0.432
	No	56 (42.75)	13 (23.21)	43 (76.79)		
ICU type, n (%)	Specialized ICU	18 (13.74)	17 (94.44)	1 (5.56)	1.144	0.980
	Partial Comprehensive (ICU)	12 (9.16)	10 (83.33)	2 (16.67)		
	General ICU	101 (77.1)	54 (53.47)	47 (46.53)		
Number of Hospital Beds, n (%)	100~499	15 (11.45)	1 (1.2)	14 (93.33)	5.931	0.655
	500~1000	38 (29.01)	13 (34.21)	25 (65.79)		
	1001~1500	29 (22.14)	18 (62.07)	11 (37.93)		
	1501~2000	17 (12.98)	17 (100)	0 (0)		
	2001 and above	32 (24.43)	32 (100)	0 (0)		
Number of ICU Beds, n (%)	≤20	69 (52.67)	27 (39.13)	42 (60.87)	2.925	0.818
	21~50	37 (28.24)	30 (81.08)	7 (18.92)		
	51~100	16 (12.21)	16 (100)	0 (0)		
	>100	9 (6.87)	8 (88.89)	1 (11.11)		
Number of ICU Patients (per year), n (%)	≤200	10 (7.63)	4 (40)	6 (60)	12.50	0.709
	201~500	45 (34.35)	22 (48.89)	23 (51.11)		
	501~800	25 (19.08)	12 (48)	13 (52)		
	801~1000	21 (16.03)	15 (71.43)	6 (28.57)		
	1001 and above	30 (22.9)	28 (93.33)	2 (6.67)		
Patient characteristics						
Patient Characteristics (per year), % Mean (SD)	Cardiovascular %	27.18 (23.29)	28.33 (25.51)	25.30 (19.24)	0.416	0.984
	Respiratory/otolaryngology%	29.11 (23.89)	30.67 (25.30)	26.58 (21.42)	0.720	0.795
	Gastrointestinal %	22.89 (21.70)	24.44 (24.34)	20.38 (16.49)	0.866	0.643
	Neurology/Neurosurgery %	34.19 (28.12)	33.53 (30.23)	35.26 (24.57)	0.701	0.811
	Endocrine %	16.53 (18.84)	15.51 (18.59)	18.18 (19.31)	0.689	0.824

(Continued)

Table 1 (Continued).

Item		Total (n=131)	Hospital type		X²/F	P value
			Tertiary Hospitals (n=81, 61.83%)	**Secondary Hospitals (n=50, 38.17%)**		
	Trauma %	22.11 (22.94)	22.69 (24)	21.16 (21.31)	0.423	0.981
	Sepsis %	26.63 (26.28)	26.60 (27.10)	26.66 (25.16)	0.533	0.938
	Obstetrics %	10.89 (17.51)	12.17 (20)	8.8 (12.40)	0.291	0.997
Postoperative Patients, n (%)	≤10%	31 (23.66)	10 (32.26)	21 (67.74)	14.575	0.103
	11%~30%	49 (37.4)	31 (63.27)	18 (58.06)		
	31%~50%	33 (25.19)	26 (78.79)	7 (21.21)		
	≥51%	18 (13.74)	14 (77.78)	4 (22.22)		
Mechanical Ventilation Patients, n (%)	≤10%	6 (4.58)	5 (83.33)	1 (16.67)	4.613	0.867
	11%~30%	28 (21.37)	15 (53.57)	13 (46.43)		
	31%~50%	50 (38.17)	28 (56)	22 (44)		
	≥51%	47 (35.88)	33 (70.21)	14 (29.79)		
Age Distribution of Patients (per year), % Mean (SD)	<18%	11.39 (13.54)	11.80 (14.99)	10.72 (10.90)	1.748	0.084
	18–64%	46.24 (19.58)	46.11 (20.81)	46.46 (17.61)	0.790	0.725
	>65%	57.47 (21.25)	57.17 (21.77)	57.94 (20.50)	0.620	0.881
Dedicated ICU Physical Therapy Team, n (%)	Yes	42 (32.06)	31 (73.81)	11 (26.19)	14.607	0.006
	No	89 (67.94)	50 (56.18)	39 (43.82)		
Staffing in ICUs (Full-Time)						
Physicians in ICU (Full-Time), Mean (SD)	Chief Physicians	1.75 (2.44)	2.35 (2.87)	0.78 (0.91)	0.238	0.869
	Associate Chief Physicians	3.11 (4.07)	4.01 (4.82)	1.64 (1.58)	0.674	0.671
	Attending Physicians	5.93 (7.05)	7.57 (8.27)	3.28 (2.96)	0.247	0.979
	Resident Physicians	5.40 (9.61)	6.78 (11.46)	3.16 (4.71)	0.473	0.897
Nurses in ICU (Full-Time), Mean (SD)	Total number	58.39 (90.34)	73.93 (98.67)	33.22 (68.64)	1.051	0.449
	Specialized nurses	17.39 (41.05)	23.28 (51.10)	7.84 (7.44)	1.378	0.214
	Trainees/Assistive Personnel	8.65 (16.22)	12.27 (19.55)	2.78 (4.15)	1.292	0.271

(*Continued*)

Table 1 (Continued).

Item		Total (n=131)	Hospital type		X²/F	P value
			Tertiary Hospitals (n=81, 61.83%)	Secondary Hospitals (n=50, 38.17%)		
Distribution of Nursing Staff by Title (Mean (SD))	Head Nurses	0.34 (0.82)	0.47 (0.99)	0.12 (0.33)	1.764	0.190
	Associate Head Nurses	1.46 (2.62)	1.79 (3.10)	0.92 (1.44)	1.413	0.245
	Supervising Nurses	14.34 (20.17)	19.33 (23.90)	6.26 (6.24)	0.962	0.501
	Staff Nurses	22.92 (35.85)	30.53 (42.61)	10.60 (13.96)	0.598	0.856
	Nurses	13.83 (23.99)	15.64 (21.22)	10.90 (27.89)	0.861	0.623
Physical Rehabilitation Therapists (Mean (SD))		1.02 (2.561)	1.31 (3.015)	0.56 (1.487)	0.539	0.708
Rehabilitation Specialist Nurses		0.76 (2.346)	1.10 (2.901)	0.24 (0.625)	0.198	0.897

Notes: Specialized ICU: Units where critical patients within a specific specialty are concentrated and given intensive monitoring and treatment, such as obstetric ICUs, neurosurgical ICUs, and cardiac surgical ICUs. General ICU: Units that provide mixed medical and surgical care. Partial Comprehensive ICU: Units that include surgical ICUs, medical ICUs, emergency ICUs, and pediatric ICUs.
Abbreviation: SD: Standard Deviation.

Table 2 Implementation of Rehabilitation Protocols and Early Rehabilitation Activity (n=131)

Item		Total (n=131)	Hospital type		Chi-Square/F	P value
			Tertiary Hospitals (n=81, 61.83%)	Secondary Hospitals (n=50, 38.17%)		
ICU implementing early rehabilitation activities, n (%)		108 (82.44)	70 (64.81)	38 (35.19)	2.153	0.314
ICUs with defined early rehabilitation exercise protocol or standard/procedure, n (%)		65 (49.62)	44 (67.69)	21 (32.31)	0.062	1.000[a]
Percentage of patients receiving any rehabilitation therapy (as a proportion of total ICU patients), n (%)	≤10%	51 (38.93)	32 (62.75)	19 (37.25)	5.812	0.990
	11%~30%	40 (30.53)	23 (57.5)	17 (42.5)		
	31%~50%	24 (18.32)	16 (66.67)	8 (33.33)		
	≥51%	16 (12.22)	10 (62.5)	6 (37.5)		
Proportion of postoperative patients among those undergoing early rehabilitation, n (%)	≤10%	50 (38.17)	27 (54)	23 (46)	14.446	0.953
	11%~30%	38 (29.01)	26 (68.42)	12 (31.58)		
	31%~50%	22 (16.79)	15 (68.18)	7 (31.82)		
	≥51%	21 (16.03)	13 (61.90)	8 (38.10)		

(*Continued*)

Table 2 (Continued).

Item		Total (n=131)	Hospital type		Chi-Square/F	P value
			Tertiary Hospitals (n=81, 61.83%)	**Secondary Hospitals (n=50, 38.17%)**		
Proportion of mechanically ventilated patients among those undergoing early rehabilitation, n (%)	≤10%	44 (33.59)	23 (52.27)	21 (47.73)	9.427	0.399
	11%~30%	45 (34.35)	30 (66.67)	15 (33.33)		
	31%~50%	32 (24.43)	21 (65.63)	11 (34.38)		
	≥51%	10 (7.63)	7 (70)	3 (30)		
Percentage distribution of age among patients undergoing early rehabilitation, mean (SD)	<16 (%)	11.41% (16.123)	10.51 (14.011)	12.88 (19.122)	0.697	0.798
	16–65 (%)	43.24% (23.119)	46.21 (22.573)	38.42 (23.408)	1.166	0.388
	66–80 (%)	38.73% (20.649)	40.52 (20.082)	35.82 (21.423)	0.866	0.648
	>80 (%)	21.67% (22.701)	23.56 (24.715)	18.62 (18.831)	1.009	0.499

Note: [a]Fisher's exact probability test was used.

Additionally, 41 ICUs reported that their rehabilitation protocols were applicable only to certain ICU patients. Specifically, 90.24% (37/41) of ICUs indicated that patients with unstable fractures and orthopedic activity contra-indications were not suitable for early rehabilitation activities. Furthermore, 70.73% (29/41) of ICUs deemed early rehabilitation unsuitable for patients undergoing prone ventilation, those experiencing anxiety and agitation, and those with increased intracranial pressure.

In our survey results (Table S2), before implementing early rehabilitation activities, approximately 89.97% (110/131) of ICUs conducted assessments, with tertiary hospitals accounting for 66.36%. The assessments mainly focused on risk factors for complications (82.27%), indications for Early rehabilitation activity (88.18%), ICU environment, and patient physiological status (93.64%). Over 70% of ICUs obtained informed consent from patients/families and provided explanations about the benefits and precautions of Early rehabilitation activity before initiating any activities. They also conducted Early rehabilitation activity knowledge training for healthcare personnel. Additionally, 46.56% (61/131) of ICUs held structured interdisciplinary rounds to discuss measures and goals of Early rehabilitation activity, with a frequency of once a month in 44.26% (27/61) of them; however, this percentage was only 37.70% (23/61) in secondary hospitals. Moreover, among the 61 ICUs with structured interdisciplinary rounds, 4.92% (3/61) reported involving patients' relatives in devising early rehabilitation measures, and one ICU reported involvement of beauty therapy teams and religious support groups in the process.

Among the three definitions provided for Early rehabilitation activity in our survey, 70.99% (93/131) of ICUs defined it as "physical activities involving physicians, nurses, and rehabilitation therapists carried out on critically ill patients admitted to the ICU for 48 to 72 hours". 13.74% (18/131) of ICUs defined it as "physical activities that can induce physiological effects on skeletal muscles performed by patients within 48 to 72 hours of ICU admission". Finally, 15.27% (20/131) of ICUs defined it as "physiologically beneficial activities initiated at any time during ICU admission".

Status of Early Rehabilitation Measures Implementation in ICUs

In our survey results (Table S3), overall, 57.25% (75/131) of ICUs initiated early rehabilitation activities with passive bedside exercises (limb passive exercises, passive cycling, raising the head of the bed to sitting position, positioning maintenance, passive turning) and 29.01% (38/131) initiated them with active bedside exercises (active turning, active muscle exercises, limb training, active cycling, active sitting position training, active breathing exercises, bridging exercises). There was no significant difference between hospital types.

Our results show that over half of the ICUs implemented early rehabilitation activities including passive exercises (89.31%; 117/131), raising the head of the bed to sitting position, positioning maintenance, bed tilting (80.92%; 106/131), neuromuscular electrical stimulation (64.12; 84/131), activation and training of active muscle movements (64.12; 84/131), active Early rehabilitation activity (86.26; 113/131), bedside sitting, bed-chair transfer activities (74.81%; 98/131). However, less than half of the ICUs (45.8%; 60/131) implemented Early rehabilitation activity activities related to walking training (Table 3).

The percentage of ICUs providing these measures, the percentage of patients receiving them, the average daily time for providing these measures, the average daily frequency of providing these measures, and the average number of days for providing these measures seemed to differ according to hospital type. In our results, the duration of raising the head of the bed to sitting position, positioning maintenance, bed tilting, neuromuscular electrical stimulation, active Early rehabilitation activity, bedside sitting, bed-chair transfer activities, and walking training had statistical significance differences due to hospital type ($P \leq 0.05$); additionally, the average daily time for providing activation and training of active muscle movements also showed statistical differences due to hospital type ($P \leq 0.05$) (Tables S4).

Other General Rehabilitation Practices and Patient Follow-U

Results indicate that over half of the participating adult ICUs reported screening patients for swallowing function (64.89%; 85/131) and 55.73% (73/131) of adult ICUs reported regular consultations/visits from nutrition therapy specialists. Only 26.72% (35/131) of adult ICUs reported consultations/visits from speech therapy specialists, with no significant differences observed between hospital types, as shown in Table 4. Among adult ICUs reporting screening

Table 3 Status of Early Rehabilitation Measures Implementation in ICUs (n=131)

Early Rehabilitation Measure	Percentage of ICUs Providing this Measure, % (n/N)	Proportion of Patients Receiving this Measure, Mean Percentage (SD)	Average Daily Time Spent Providing this Measure, minutes (SD)	Average Daily Frequency of Providing this Measure, times (SD)	Average Number of Days for Providing this Measure, days (SD)
Passive activities for preventing contractures (such as passive limb exercises, passive turning, passive cycling on the bed)	89.31 (117/131)	45.48 (33.820)	21.47 (19.846)	2.50 (3.097)	5.60 (4.778)
Bedside Passive Elevation, Positioning Maintenance, Bed Tilt	80.92 (106/131)	43.15 (33.712)	20.40 (25.785)	2.29 (3.278)	4.66 (4.030)
Neuromuscular Electrical Stimulation	64.12 (84/131)	20.79 (22.887)	17.05 (18.449)	1.34 (1.960)	4.23 (4.365)
Activation and Training of Active Muscle Movements	64.12 (84/131)	24.02 (26.182)	14.44 (16.368)	1.44 (1.845)	4.11 (4.838)
Active early mobilization (such as active turning from side to side, active limb exercises, active sitting exercises on the bed, active resistance training, active breathing exercises, active bridging exercises, active cycling on the bed, etc.)	86.26 (113/131)	45.12 (121.076)	21.73 (26.861)	2.49 (3.25)	5 (4.208)
Bedside Sitting, Bed-Chair Transfer	74.81 (98/131)	22.80 (26.161)	20.90 (26.393)	1.55 (1.824)	4.47 (4.603)
Walking Training, Standing Training, Stepping Training	45.8 (60/131)	13.02 (22.440)	11.15 (16.659)	0.94 (1.744)	2.83 (4.190)

Table 4 Other General Rehabilitation Practices (n=131)

Item	Total (n=131)	Hospital type		Chi-Square/F	P value
		Tertiary Hospitals (n=81,61.83%)	**Secondary Hospitals (n=50, 38.17%)**		
Swallowing Function Screening, n (%)	85 (64.89)	49 (57.65)	36 (42.35)	3.368[a]	0.099
Consultation/Visits by Speech Therapist	35 (26.72)	16 (45.71)	19 (54.29)	0.333[a]	0.727
Regular Consultation/Visits by Nutrition Expert	73 (55.73)	48 (65.75)	25 (34.25)	0.085[a]	1.000

Notes: *,[a]Fisher's exact probability method.

patients for swallowing function, the estimated percentages of ICU patients undergoing screening for swallowing abnormalities ranged between 11% and 30% (30/85, 35.29%) and 31% and 50% (26/85, 30.59%). Additionally, an estimated average time of approximately 5–10 minutes per patient was reported by 40 ICUs (47.06%, 40/85), with nurses typically performing the screening (54.12%, 46/85). Specific results are detailed in Table S5.

Our results indicate that 71.76% (94/131) of adult ICUs document rehabilitation activities in nursing records, with tertiary hospitals accounting for 64.89% (61/94) of these instances. Of these documented activities, 94.68% (89/94) are recorded by nurses, followed by physical therapists at 31.91% (30/94). Only 35.88% (47/131) of participating ICUs reported psychological support teams providing psychological care to patients, with only 31.91% (15/47) of ICUs in secondary hospitals reporting the presence of such teams.

Regarding follow-up assessments, 57.25% (75/131) of adult ICUs reported regularly evaluating the rehabilitation outcomes of patients admitted to the ICU. These evaluations primarily include patient-related outcomes such as muscle strength (73.33%; 55/75), physical activity capacity (80%; 60/75), quality of life (77.33%; 58/75), safety/adverse event-related outcomes (89.33%; 67/75), cognitive function, and psychological outcomes (82.67%; 62/75). ICU-related outcomes such as ICU or hospital length of stay (97.33%; 73/75), duration of mechanical ventilation (96%; 72/75), use of sedatives or analgesics (86.67%; 65/75), readmissions (66.67%; 50/75), and mortality rate (57.33%; 43/75) are also evaluated. There were no significant differences between hospital types (see Table S6). Assessments are mostly conducted during ICU stays (92%; 69/75) or upon ICU discharge (69.33%; 52/75).

Furthermore, 75.52% (95/131) of ICUs conduct follow-up assessments for patients discharged from the ICU, primarily through telephone follow-ups (76.84%; 73/95), with 89.47% (85/95) of these assessments conducted by nurses. Additionally, 81.68% (107/131) of ICUs believe that the current implementation of early rehabilitation activities is insufficient. The main reasons cited include a lack of ICU early rehabilitation teams (88.55%; 116/131), inadequate nursing staff (81.68%; 107/131), patient-related factors (67.94%; 89/131), family-related factors (54.96%; 72/131), and a lack of clinical practice guidelines and standard protocols for early activities (58.02%; 76/131).

Univariate Linear Regression Analysis of Factors Influencing Early Rehabilitation Activities in the ICU

Univariate linear regression analysis was performed with variables related to hospital characteristics as independent variables and the presence or percentage of patients undergoing early rehabilitation activities in the ICU as dependent variables. The results indicate that the involvement of rehabilitation therapists in the ICU is a significant factor influencing the implementation of early rehabilitation activities ($P < 0.05$). Moreover, variables such as the percentage of annual mechanically ventilated patients, nursing auxiliary staff, the number of chief nursing officers, and the percentage of trauma cases significantly influence the percentage of patients undergoing early rehabilitation activities in tertiary hospital ICUs ($P < 0.05$). Similarly, in secondary hospital ICUs, factors such as the percentage of annual mechanically ventilated patients, nursing auxiliary staff, ICU type, the number of chief nursing officers, and the percentage of trauma cases significantly influence the percentage of patients undergoing early rehabilitation activities ($P < 0.05$). (See Table 5).

Table 5 Univariate Linear Regression Analysis of Factors Influencing Early Rehabilitation Activities in the ICU (n=131)

ICU Whether Early Rehabilitation Activities are Conducted									
Item	Overall (n=131)			Tertiary Hospitals (n=81,61.83%)			Secondary Hospitals (n=50, 38.17%)		
	T value	P value	95% Confidence Interval	T value	P value	95% Confidence Interval	T value	P value	95% Confidence Interval
ICU Involvement of Rehabilitation Therapists	5.022	0.000	0.188~0.433	4.728	0.000	0.196~0.481	2.087	0.042	0.009~0.490
Proportion of Patients Undergoing Early Rehabilitation Activities in ICU									
ICU Involvement of Rehabilitation Therapists	−3.230	0.002	−1.030~-0.248	−2.471	0.017	−1.404~-0.143	—	—	—
Proportion of Annual Mechanically Ventilated Patients	2.048	0.043	0.008~0.455	4.051	0.000	0.426~1.269	5.250	0.000	0.593~1.333
Nursing Auxiliary Staff	—	—	—	2.088	0.043	0.003~0.161	2.415	0.020	0.014~0.152
Number of Chief Nursing Officers	—	—	—	—	—	—	2.410	0.020	0.165~1.846
ICU Type	—	—	—	—	—	—	2.667	0.011	0.221~1.588
Proportion of Trauma Cases	—	—	—	−2.695	0.010	−0.035~-0.005	−2.133	0.039	−0.027~-0.001

Discussion

This study represents the first multicenter investigation in the central region of mainland China on the implementation of early rehabilitation activities in ICUs, focusing on the details of their provision and the factors influencing their implementation. We reported information from 131 ICUs regarding early rehabilitation activities, with 81.68% of them acknowledging the current insufficiency in early rehabilitation activities. The analysis of influencing factors revealed that the involvement of rehabilitation therapists in ICUs significantly influenced the implementation of early rehabilitation activities. Differences in hospital types and the allocation of relevant rehabilitation therapy personnel may affect the quality of early rehabilitation activities in ICUs, providing crucial guidance for devising more effective strategies to promote early rehabilitation in ICUs.

The main findings of the survey indicate that the implementation of early rehabilitation activities in central China is relatively ideal, with a rate of 82.44%, which is higher than the national level of 56.98% reported by Liu et al[17] across 11 provinces, and also surpasses the rates observed in Sichuan Province (67.96%) by Xie et al[20] among 103 ICUs and Guangdong Province (66.1%) by Wu et al[21] among 62 ICUs. This suggests that there are still significant disparities in the initiation of early rehabilitation activities in ICUs across different regions of China. In our survey, only about half of the ICUs conducting early rehabilitation activities (49.62%) have standardized procedures and norms for these activities, indicating substantial room for improvement. This aligns with the findings from a study in Switzerland,[16] and is higher than the levels reported by Liu et al[17] and Xie et al[20] in their respective studies. However, it is lower than another Swiss study reported by Sibilla et al, which found that 74% of the ICUs surveyed had early activity programs.[8] Additionally, a study conducted by Bakhru et al in the United States reported that two-thirds of the ICUs had written protocols for early activities.[3] The reasons for the discrepancies between our results and those of other studies are unclear and might be due to differences in study design and related biases, changes in rehabilitation practices over time (Liu et al's study was conducted in 2021), or differences between countries. This suggests that although early rehabilitation activities have gradually been implemented on a large scale in Chinese ICUs, the quality of implementation is insufficient, and the

development levels are uneven. Early rehabilitation activity of ICU patients is an intervention that requires multi-disciplinary cooperation,[22] involving the participation of nurses, rehabilitation therapists, respiratory therapists, and physicians. Standardized sedation, daily awakening, and the standardized weaning of mechanically ventilated patients are prerequisites for the successful initiation of early activities. All of these require a multidisciplinary approach to ensure that patients receive scientifically sound and safe exercise regimes.[6] Studies have shown that the lack of standardized procedures and guidelines can affect ICU nurses' beliefs in conducting early activities.[23]

Our results show that among patients receiving early rehabilitation activities, the percentage of those on mechanical ventilation is higher than that of postoperative patients. This suggests that in the implementation of early rehabilitation activities in Chinese ICUs, there is a perceived importance of applying this measure to mechanically ventilated patients. Additionally, this might be related to the fact that some postoperative patients have shorter stays in the ICU (1–2 days), and many believe that the necessity of conducting early rehabilitation in this group is not very high. In the study by Yang et al,[24] the percentage of Early rehabilitation activity among ICU patients on mechanical ventilation was slightly lower than that of non-mechanically ventilated patients. They suggest that this may be due to various factors such as the relatively more severe condition of mechanically ventilated patients, weaker constitution, lower cardiopulmonary reserve function, discomfort caused by tube traction during activity, and the higher mechanical and manpower requirements for getting out of bed activities, which often make it difficult to complete higher-level activities, thus resulting in a lower percentage.

Currently, there is no unified standard for the timing of early rehabilitation activities. In our results, among ICUs with a clear early rehabilitation exercise plan or standard/process (65/131), 46.15% (30/65) of the ICUs only start early rehabilitation exercises after "hemodynamic stability", and approximately 21.54% (14/65) begin on "the first day of ICU admission". Liu et al's study[17] suggests that early rehabilitation activities generally commence 48 hours after ICU admission or are flexibly adjusted/determined based on the personal experience of clinical doctors. However, evidence indicates that conducting early rehabilitation activities within the first 48 hours or even 24 hours of ICU stay is safe and feasible for the majority of ICU patients and can improve outcomes.[6,25,26] Additionally, research shows that ICU patients lose about 20% of muscle strength after one week of bed rest, and more than 50% of patients develop Post-Intensive Care Syndrome. Therefore, numerous studies have set the early activity time for ICU patients within 72 hours to reduce muscle strength loss and lower the incidence of Post-Intensive Care Syndrome.[27–29] In recent years, scholars have proposed that mechanically ventilated ICU patients should undergo rehabilitation exercises as soon as possible, based on hemodynamic stability and in conjunction with clinical assessment results and rehabilitation goals.[30] This aligns with our research findings; considering the severe conditions and numerous tubes in ICU patients, especially for those on mechanical ventilation, starting activities within 48–72 hours not only adheres to the concept of early activity but also maximizes patient safety.

Overall, more than half of the ICUs (57.25%) indicated that early rehabilitation activities commenced with passive exercises in bed (passive limb movements, passive cycling in bed, raising the head of the bed for sitting training, maintaining postures, and passive turning). However, we believe this outcome may pertain specifically to patients on mechanical ventilation and is related to the lack of standardized rehabilitation activity plans. A literature review by Peng[31] suggests that the initiation of early rehabilitation activities should be based on the patient's muscle strength, choosing between passive/active modes of activity. Therefore, the initiation of early rehabilitation activities should be personalized, and the rehabilitation plan should also be tailored to the specific conditions of the patient. Moreover, our results show that "ICUs providing a certain measure", "the percentage of patients receiving a certain rehabilitation measure", "the average daily time spent on providing a certain measure", "the average daily frequency of providing a certain measure", and "the average number of days providing a certain measure" seem to vary by hospital type. In China, tertiary hospitals have higher medical standards and more sufficient staffing than secondary hospitals, thus potentially offering higher quality early rehabilitation activities. However, it is worth mentioning that there is no difference between the two types of hospitals in terms of the percentage of early rehabilitation activities conducted, other rehabilitation practices (swallowing function screening, follow-up by speech therapists, nutritionists), and the content assessed during follow-ups. Even though tertiary hospitals have higher medical standards, due to environmental

factors in China (the number of patients far exceeds the number of physicians), there is still a significant shortage of rehabilitation therapists, with an average of only 1.31 per ICU, less than 2 people per ICU in our results.

Limitations

In this survey, we collected information on early rehabilitation activities from 131 ICUs and conducted detailed statistics and analysis. However, several limitations must be considered. Firstly, the questionnaire used in this survey was referenced from Switzerland, and although its content validity and Cronbach's α coefficient were tested, showing good reliability and validity, further verification is still needed. At the same time, the content of the questionnaire used in this survey is extensive, the survey period is relatively long and complex, coupled with the general lack of time among ICU staff to participate in such studies, which may lead to lower quality answers. Secondly, the standards for conducting early activities for ICU critical patients vary across hospitals in this study, and as time progresses, the requirements for patients to meet early activity criteria also change, which may result in an underestimation of actual early activities. Thirdly, we targeted ICU head nurses instead of clinical doctors and physiotherapists surveyed in other studies to understand the situation of early rehabilitation activities in ICUs, because in the Chinese context, all ICUs have head nurses who can provide comprehensive and accurate information about routine clinical practices and patient management, thereby helping the reliability of the results. However, studies have reported[32] that there may be differences in perspective between nurses and doctors on the same clinical issue, and since all responses were self-reported by the head nurses, the results may be biased. This survey is only a better understanding of the details of early rehabilitation activities carried out in hospital ICUs in central China. These results, combined with surveys related to patient outcomes, may emphasize the importance and necessity of national guidelines and local standards, thereby comprehensively improving nursing quality and patient outcomes at the government level.

Conclusions

The majority of ICUs in hospitals in the central region of China conduct early rehabilitation activities. However, less than half of them have clear protocols or procedures for early rehabilitation exercises, and the presence of specialized rehabilitation therapists in ICUs is a key factor in the implementation of early rehabilitation activities in hospitals in the central region of China. The proportion of patients on mechanical ventilation annually, the ratio of nursing assistants to patients, and the percentage of cases involving trauma are common factors affecting the implementation of early rehabilitation activities in ICUs at both tertiary and secondary hospitals.

Data Sharing Statement

The datasets used and/or analyzed during the current study available from the corresponding author on reasonable request.

Ethics Approval and Consent to Participate

Ethical approval for this cross-sectional survey was not required under the Chinese Human Research Law. Participation in the survey was voluntary for the ICU head nurses who responded, and after reading the electronic informed consent form, the participating head nurses entered the study by clicking the "Confirm" button. No individual-level (patient or staff) data were collected.

Consent for Publication

All participants in this study were made aware that their data could be used in publications and gave approval for this use.

Acknowledgments

Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

Funding

Disclosure

The authors report no conflicts of interest in this work.

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