



# Construction and Application of a Three-Level Linkage System for the Prevention and Treatment of Pressure Sores in Geriatric Patients in the Henan Province, China

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## Abstract

**Background:** To research effective prevention and treatment strategies for pressure sores in geriatric patients and examine the results from application of a three-level linkage system.

**Methods:** We developed and constructed a three-level linkage intervention system for pressure sores from Jun 2017 to Dec 2018, centered at the geriatrics department of the Ninth People's Hospital of Zhengzhou, China. The changes included improving the organization structure; formulating a unified evaluation system for quantitation of pressure sore risk management; formulating and standardizing the reporting/feedback mechanism; constructing and improving three-level linkage system staff training; and establishing a quality control system for process monitoring guidance and final evaluation feedback.

**Results:** The incidence of pressure sores significantly decreased, nursing staff's knowledge level regarding pressure sore prevention and treatment increased, and pressure sore cure rate and care satisfaction increased.

**Conclusion:** Implementation of a three-level linkage intervention system for pressure sores in geriatric patients and standardizing pressure injury assessment helps achieve pressure sore prevention and early intervention, effectively reduces the occurrence of pressure sores in geriatric nursing homes, increases the cure rate, and improves care satisfaction among patients.

**Keywords:** Elderly; Three-level linkage system; Chronic refractory wounds; Pressure sore

## Introduction

Pressure sores are localized injuries to the skin or underlying soft tissues at bony protrusion sites or in areas that are in contact with medical devices. They are caused by intense or long-term pressure or pressure combined with shear force. The increase in the geriatric population in China is causing pressure sores to become an increasingly

common complication observed in clinical practice that is undesirably affecting the survival and quality of life of these patients. Additionally, the gradual increase in the number of bedridden patients has led to an increase in the prevalence of pressure sores and treatment costs (1-3).



Our group previously disseminated a questionnaire that found that primary care staff lacked pressure sore prevention knowledge, judgment capabilities, and nursing knowledge, and they could not prevent pressure sores or identify pressure sores at an early stage. The nursing staffs often pay attention to pressure sores only when they worsen. Medical staff provide advocacy to caregivers only during patient hospitalization, resulting in limited benefits. Therefore, it is imperative to conduct simultaneous advocacy, training, and technical promotion of nursing staff in the community and in geriatric nursing homes. The standardization of pressure sore treatment and promotion of treatment techniques in a scientific manner would enable geriatric nursing homes to identify and treat pressure sores at an early stage. Only by standardizing pressure sore procedures and promoting technical and scientific implementation, geriatric nursing homes can perform early identification and management and provide timely referral for patients with refractory wounds.

The organization system consists of the Ninth People's Hospital of Zhengzhou (tertiary geriatric

hospital), community health service centers, and geriatric nursing homes. The tertiary staff of this system comprises the wound therapists and nurses from the Ninth People's Hospital of Zhengzhou, secondary staff comprises the medical staff in the community health service centers, and primary staff comprises staff and nurses in geriatric nursing homes. When primary staff discover patients with pressure sores or who are at high-risk for pressure sores, the staff will perform prevention, advocacy, and reporting while the secondary staff will perform consultations, pressure sore risk assessment, formulate the prevention and treatment measures for pressure sores, treat stages 1 and 2 pressure sores, and refer patients with stage 3 pressure sores to tertiary staff for consultations. Patients who are indicated for referral will be referred to the Ninth People's Hospital of Zhengzhou for treatment. Patients will be transferred back to the primary or secondary institution to continue treatment after the improvement of their condition. The specific steps are shown in Fig.1.

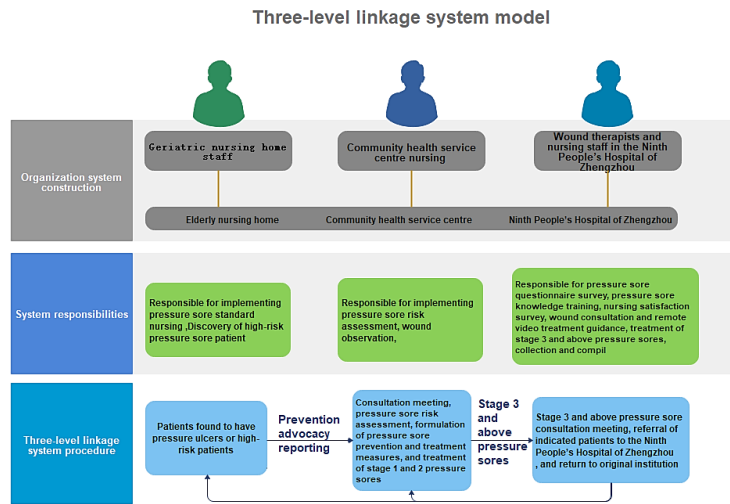


Fig. 1: Three-level linkage intervention system procedure

In order to reduce the incidence of pressure ulcers, improve the cure rate of pressure ulcers, reduce medical expenses, reduce the social burden, our hospital launched the hospital-

community health service center - pension institutions (family) extended services, through continuous practice and improvement, in the preven-

tion of pressure ulcers intervention system has achieved good results.

## **Methods**

We established Jun 2017, Dec 2017, Jun 2018, and Dec 2018 as time points in the construction of the three-level linkage intervention system for pressure sores. We examined the number of patients at risk for pressure sores; incidence of pressure sores; pressure sore knowledge mastery in nursing staff; pressure sore prevention and treatment skill mastery in nurses; pressure sore cure rate; and nursing satisfaction in geriatric patients or their relatives in primary and secondary institutions. We performed a comparison of differences before and after the implementation of the three-level linkage intervention system for pressure sores in geriatric patients and assessed whether these differences were statistically significant.

### ***Statistical methods***

SPSS 21.0 statistics (IBM Corp., Armonk, NY, USA) software was used for the analysis. A chi-squared test was used for the qualitative data, and a difference of  $P < 0.05$  was considered to be statistically significant.

## **Results**

We constructed a three-level linkage intervention system for pressure sores, centered at the Ninth People's Hospital of Zhengzhou, surrounded by community health service centers and extending to surrounding communities (geriatric nursing homes). Pressure sore prevention and treatment training centers were established to formulate standardized pressure sore prevention and treatment procedures. We conducted more than 60 training classes and trained more than 500 medical staff; the awareness rate was 100%. We performed examinations for which the pass rate was 90%. We also drafted a tertiary prevention and treatment manual for pressure sores in geriatric patients. A total of 16,000 manuals were printed

and 10,000 manuals were distributed, which benefited over 300,000 people. We conducted long-term health knowledge seminars in the community, performed a census on the health status of disabled geriatric residents, constructed a primary and secondary prevention system, and strengthened pressure sore prevention and treatment knowledge in residents. We also constructed an information transmission system, improved the "pressure sores green channel," reduced the incidence of pressure sores, and improved the cure rate. We promoted the standardized pressure sore prevention procedure and green treatment channel demonstration points; carried out systematic, long-term, and effective follow-up and intervention on patients; gradually constructed a good network system; and examined the "hospital/community health service center/geriatric nursing homes" three-level linkage intervention system for pressure sores. Pressure sore prevention and treatment knowledge dissemination was performed in 4 community health service centers, 10 geriatric nursing homes, and 500,000 members of the public (60 education seminars in geriatric nursing homes and communities). Basic pressure sore files were constructed for patients with pressure sores in the jurisdiction areas, and the three-level linkage system for pressure sore prevention and management was constructed. Pressure sore wet healing and continuous negative pressure treatment training and guidance were carried out for staff in community health service centers and geriatric nursing homes. We also arranged for observational training for more than 500 staff in the geriatrics department of the Ninth People's Hospital of Zhengzhou, and performed pressure sore prevention and treatment training on patients with pressure sores in the jurisdiction.

We summarized the project's implementation experience to form a mature and promotable three-level linkage prevention and intervention system for pressure sores and completed the drafting of the tertiary prevention and treatment knowledge manual for pressure sores in geriatric patients. We accelerated the construction of an informative network system and rapid transmis-

sion system centered at the Ninth People's Hospital of Zhengzhou, extending to 4 community health service centers and 10 geriatric nursing homes; constructed a 24-h pressure sore service hotline and online service platform; achieved real-time wound consultation and remote video meetings for diagnosis and management of refractory pressure sores; carried out real-time follow-up on the pressure sore treatment status of every patient; and constructed a pressure sore treatment green channel. A partial fee waiver was provided to patients with pressure sores having financial constraints after they signed the relevant documents. This waiver benefited 1700 patients with pressure sores. Through promotion, training, and treatment in this project, the overall incidence of pressure sores decreased, pressure wound videos before and after treatment were

archived, and the three-level prevention and treatment model for pressure sores in geriatric patients was successfully constructed.

The three-level linkage intervention system for pressure sores in geriatric patients was implemented from Jun 2017 to Dec 2018 and covered 26 primary and secondary institutions, involved 3112 elderly patients, and trained 587 staff.

The Braden scale was used for pressure sore risk assessment. There was no significant difference in the risk of pressure sores in geriatric patients before and after training. After pressure sore knowledge training, risk assessment, and preventative intervention, the incidence of pressure sores after training was lower than that before the training, and this difference was statistically significant. Results are shown in Fig. 2 and Table 1.

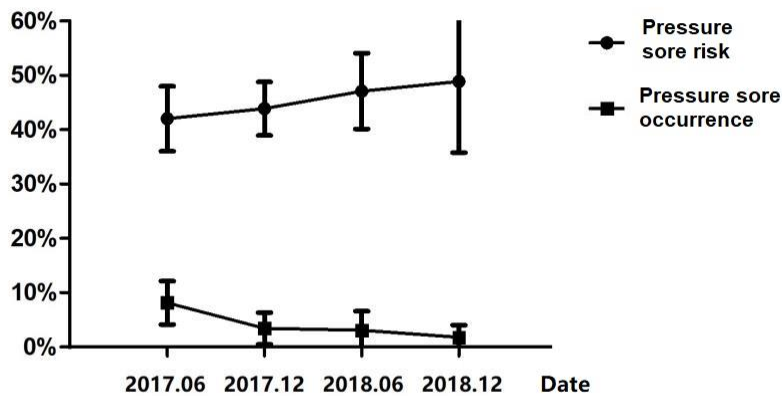


Fig. 2: Pressure sore risk and incidence before and after training

Table 1: Comparison of pressure sore risk and incidence before and after the training

Date	High risk of pressure ulcers		Incidence of pressure sore	
	n	Percentage (%)	n	Percentage (%)
Before prevention and treatment	542	38.12	288	20.71
After prevention and treatment	605	41.07	61	4.14*

\*P<0.05, compared with before prevention and treatment

Through education regarding pressure sores and training for their prevention and treatment, these

skills significant improved in nursing staff after training compared with that before training, and

this difference was statistically significant ( $P < 0.05$ ). Results are shown in Fig. 3 and Table 2. Through standardizing risk assessment, nursing intervention measures, and pressure sore diagnosis and treatment, pressure sore cure rate and

nursing satisfaction after training was improved compared with that before training, and the differences were statistically significant ( $P < 0.05$ ). Results are shown in Fig. 4 and Table 3.

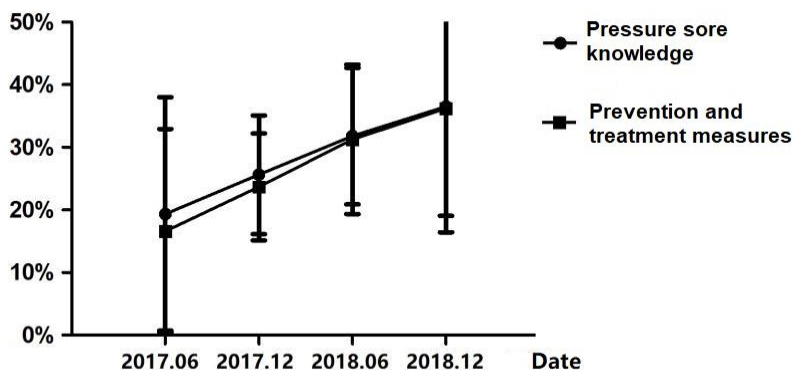


Fig. 3: Pressure sore knowledge and prevention and treatment skills in nursing staff before and after training

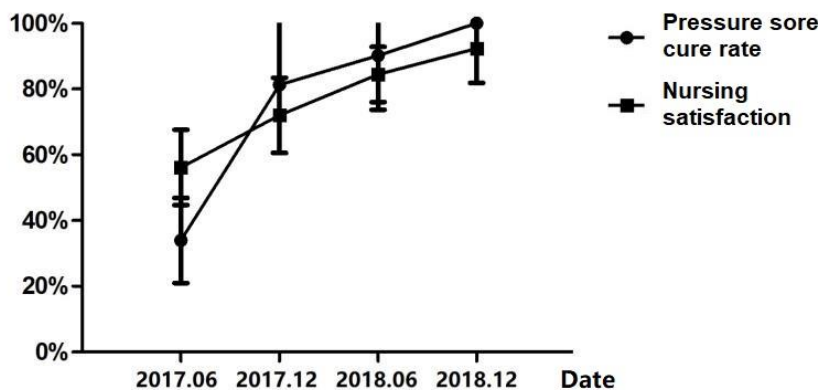


Fig. 4: Pressure sore cure rate and nursing satisfaction before and after training

Table 2: Comparison of pressure sore knowledge, and prevention and treatment skill mastery in nursing staff before and after training

Date	Pressure sore knowledge		Prevention and treatment skills	
	Number of qualified staff	Percentage (%)	Number of qualified staff	Percentage (%)
Before prevention and treatment	83	39.21	70	33.62
After prevention and treatment	192	90.57*	187	88.04*

\*  $P < 0.05$ , compared with before prevention and treatment

**Table 3:** Comparison of pressure sore cure rate and nursing satisfaction before and after training

<i>Date</i>	<i>Cure rate (%)</i>	<i>Nursing satisfaction (%)</i>
Before prevention and treatment	26.43	56.73
After prevention and treatment	90.11*	91.27*

\*  $P < 0.05$ , compared with before prevention and treatment

## Discussion

Pressure sores are localized injuries to the skin or underlying soft tissues at bony protrusion sites or in areas that are in contact with medical devices. They are caused by intense or long-term pressure or pressure combined with shear force. Pressure sores present as deep tissue injuries with intact skin or open ulcers and are associated with pain, causing immense stress to patients, families, society, and healthcare institutions (4,5). Statistical data showed that the prevalence of pressure sores in overseas general hospitals is 3.4%–17.6% (6). One study at an Italian family palliative treatment center showed that the prevalence of pressure sores is 9.2%–15.5% (7). A cross-sectional study performed on inpatients aged  $\geq 18$  yr in 12 general hospitals demonstrated that the prevalence of pressure sores and the incidence of hospital-acquired pressure sores was 1.6% and 0.6%, respectively (8).

The increase in the geriatric population in China is causing pressure sores to become an increasingly common complication observed in clinical practice that is undesirably affecting the survival and quality of life of these patients. Additionally, the gradual increase in the number of bedridden patients has led to an increase in the prevalence of pressure sores and treatment costs. The incidence and prevalence of pressure sores in community residents is 0.05% and 0.08%, respectively, and the results of 37,481 questionnaires showed that the prevalence of pressure sores is 0.1% (9). However, the latest knowledge on pressure sore prevention and treatment has not been disseminated to community health service centers and geriatric nursing home, resulting in a lack of effective nursing and professional guidance for

geriatric patients with chronic diseases in the community. This has led to an increase in the overall incidence and severity of pressure sores. Advanced training and education for caregivers was an important factor for improving pressure sore prevention knowledge among caregivers (10). The risk of developing pressure sores in long-term home-dwelling geriatric patients is 27.5%, due to inadequate nursing capabilities and lack of equipment. Additionally, there is an increasing incidence of pressure sores in geriatric nursing homes. Some effective methods that can be employed for pressure sore management include the improving pressure sore prevention and treatment in the community and in geriatric nursing homes, educating patients and caregivers regarding the prevention and treatment, highlighting the concept of focusing on pressure sore prevention supplemented by treatment and combined prevention and treatment, and constructing a three-level linkage intervention system for pressure sores in geriatric patients.

At present, as the geriatric population increases, the incidence of pressure sores remains high in medical institutions, families, and geriatric nursing homes. The resultant medical expenditure and caregiver stress causes an immense social and family burden (2, 11). The risk factors for pressure sores include older age, immobility, multiple comorbidities, and malnutrition (12). Although prevention costs of pressure sores are far lower than treatment costs, effective prevention and control requires the construction of a comprehensive pressure sore management system and feasible work flow to achieve pressure sore monitoring standardization and proceduralization (13, 14). In recent years, many exploratory studies on pressure sore management models have been

conducted. For example, Tian et al (15) constructed a pressure sore management system, Liu (16) used the Plan-Do-Study-Act cycle model to effectively control intra-hospital pressure sores, and Li et al (17) employed the concept of care bundle for pressure sore prevention and control. Although this increased intra-hospital pressure sore nursing efficiency to some extent and reduced the incidence of pressure sores, there were still gaps in pressure sore prevention and control in geriatric patients at home and after discharge from the hospital. Therefore, only the construction of a three-level linkage intervention system for pressure sores in geriatric patients could achieve pressure sore prevention and control in the entire society.

Conducting seminars and educating community residents under the jurisdiction of community health service centers and nursing staff in geriatric nursing homes regarding pressure sores leads to professional knowledge dissemination at a grassroots level. This training effectively improves the theoretical and technical skill levels of nursing staff, enabling them to obtain the latest knowledge on pressure sore prevention, thereby fundamentally reducing its incidence. In the three-level linkage intervention system for pressure sores in geriatric patients we constructed, stages 1 and 2 pressure sores were diagnosed and treated in community health service centers and geriatric nursing homes. This approach helped achieve early discovery, prevention, and standardized diagnosis and treatment, thereby reducing the risk of pressure sore worsening, lowering the hospitalization rate, and reducing the time, energy, and financial burden of families from visiting geriatric nursing homes and hospitals. Stage 3 and above pressure sores were referred for timely evaluation, intervention, and inpatient treatment, which shortened the treatment cycle, reduced medical costs, and increased the pressure sore cure rate. The bidirectional referral between geriatric nursing homes and hospitals and optimization of medical resources were also concrete presentations of the national tiered diagnosis and treatment policies (18). The National Health Commission recommended medical institutions

meet the criteria to construct a wound repair department. There was also a clear requirement for wound management specialists proposed in view of the severe disease situation in China.

The implementation of the three-level linkage intervention system for pressure sores in geriatric patients and a bidirectional linkage and referral system between major hospital wound treatment centers and community health service centers (19) helped solve actual problems in patients with pressure sores and had positive effects in preventing pressure sores and increasing their treatment rate. This replicable pressure sore prevention and treatment model is worthy of promotion on a larger scale and also provides other regions with reference experiences for pressure sore prevention and treatment.

## **Conclusion**

Our construction of the three-level linkage intervention system for pressure sores in geriatric patients also addressed the current social situation and disease spectrum evolution, which includes increased numbers of geriatric and bedridden patients and the increased incidence of pressure sores. Timely exploration of chronic disease prevention and treatment interventions is also an exploration of how to construct wound repair departments with Chinese characteristics.

## **Journalism Ethics considerations**

Ethical issues (Including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc.) have been completely observed by the authors.

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## Conflict of interest

The authors declare that there is no conflict of interest.

## References

1. Li L, Jiang L, Zeng Y, Chen X, Li Y, Fan X (2020). Nursing behaviors relevant to pressure injury in the general hospitals of Changsha, China. *Zhong Nan Da Xue Xue Bao Yi Xue Ban*, 45(6):722-732.
2. Jiang L, Li L, Lommel L (2020). Nurses' knowledge, attitudes, and behaviours related to pressure injury prevention: A large-scale cross-sectional survey in mainland China. *J Clin Nurs*, 29(17-18):3311-3324.
3. Lawrence P, Fulbrook P, Miles S (2015). A Survey of Australian Nurses' Knowledge of Pressure Injury/Pressure Ulcer Management. *J Wound Ostomy Continence Nurs*, 42(5):450-60.
4. National Pressure Ulcer Advisory Panel. NPIAP pressure injury stages [EB/OL]. (2016-04-08) [2020-07-01].
5. Dealey C, Posnett J, Walker A (2012). The cost of pressure ulcers in the United Kingdom. *J Wound Care*, 21(6): 261-2, 264, 266.
6. National Pressure Ulcer Advisory Panel, European Pressure Ulcer Advisory, Pan Pacific Pressure Injury Alliance (2014). Prevention and Treatment of Pressure Ulcer: Clinical Practice Guideline. *Perth: Cambridge Media*, 28.
7. Artico M, Dante A, D'Angelo D, et al (2018). Prevalence, incidence and associated factors of pressure ulcers in home palliative care patients: A retrospective chart review. *Palliat Med*, 32(1): 299-307.
8. Jiang Q, Guan X, Su C (2013). Multi-center joint survey on the prevalence of pressure ulcers in general hospitals. *Chinese Nursing Management*, 01: 26-30.
9. Li J, Wang Y, Chen Y, Qiu J, Guo H (2015). Analysis of the incidence of pressure ulcers and related factors among urban residents in Panyu area. *Chinese General Practice*, 11: 1821-1823.
10. Ekama Ilesanmi R, Morohunfoluwa Oluwatosin O (2016). A Quasi-experimental Study to Assess an Interactive Educational Intervention on Nurses' Knowledge of Pressure Ulcer Prevention in Nigeria. *Ostomy Wound Manage*, 62(4): 30-40.
11. Wilson L, Kapp S, Santamaria N (2019). The direct cost of pressure injuries in an Australian residential aged care setting. *Int Wound J*, 16(1):64-70.
12. Lindhardt CL, Beck SH, Ryg J (2020). Nursing care for older patients with pressure ulcers: A qualitative study. *Nurs Open*, 7(4):1020-1025.
13. Xu S, Miao T, Bi D (2018). Application of information system in the management of patients with high risk of pressure ulcers. *Hospital Management Forum*, 35(7): 73-76.
14. Su M, Zhou G (2019). Progress in the knowledge and training of pressure injury protection. *China Medical Journal*, 01: 181-184.
15. Tian Y, Pan H, Fang J, Hu H, Ye Z (2017). Construction and practice of a structured pressure ulcer management system. *Nursing and Rehabilitation*, 16(9): 981-983.
16. Liu Y (2016). Analysis of the application effect of PDCA circulation model in the management of pressure ulcers. *Chinese Medical Guide*, 14(29): 285-286.
17. Li H, Che Y (2017). The concept and clinical application progress of clustered nursing for the prevention and treatment of pressure ulcers. *Chinese Journal of Preventive Medicine*, 35(7): 830-832.
18. Huang Y, Fu X (2020). Suggestions and reflections on building a high-level wound repair department in China. *Chinese Journal of Trauma*, 36(10): 876-879.
19. Fu X (2019). Innovation and development of modern Chinese trauma repair discipline construction. *Chinese Journal of Trauma*, 35(9): 780-784.