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Digital Transformation of Nursing Services in Health 4.0 Hospitals

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Abstract

With the shift in healthcare models from "disease-centered treatment" to "health-centered management," nursing services are facing the need for digital transformation. During his tenure as the president of the 251st Hospital of the People's Liberation Army, the author created a model of "separate accounting for medical and nursing services and refined disciplinary management," which drove the hospital's sustained and rapid development. This research won the second prize for scientific and technological progress, and the hospital was recognized as a "National Digital Hospital Demonstration Pilot Unit." Subsequently, the author served as the president of several hospitals, including Xi'an Chang'an Hospital, Nanchang 334 Hospital, Beijing Beiya Orthopedic Hospital, Chengde Shuangluan District Hospital, and Chengdu Qingchengshan Hospital, successfully replicating and promoting this refined digital management model. After assuming the role of president at Hebei Hua'ao Hospital in January 2024, the author proposed specific strategies for the digital transformation of nursing services based on the hospital's actual conditions. This paper explores the necessity and implementation pathways for the digital transformation of nursing services, both within and beyond hospital walls, based on the author's Health 4.0 hospital service model and the practical context of Hebei Hua'ao Hospital. The discussion focuses on the definition of nursing service products, optimization of nursing service processes, separate accounting for medical and nursing services, and performance management.

Keywords

Nursing Services, Digital Transformation, Health 4.0, Separate Accounting for Medical and Nursing Services, Performance Management

1. Introduction

The global healthcare system is undergoing a profound transformation from "dis-

ease treatment" to "health management." According to WHO data, chronic diseases account for 70% of the global disease burden [2], making the traditional hospital-centered nursing model inadequate to address this challenge. China's "National Nursing Development Plan (2021 - 2025)" and the "Healthy China 2030" outline explicitly propose the establishment of a health service system that covers the entire life cycle, creating an urgent need for the digital transformation of nursing services [3]. Currently, the digital transformation of nursing services faces three major contradictions:

1) The contradiction between limited service supply and unlimited health demands, with a shortage of 2 million registered nurses in China [4].

2) The contradiction between process standardization and personalized services [5].

3) The contradiction between cost control and quality improvement [6].

Based on the author's "Health 4.0 Hospital Nursing Airport Management Model" [7], Hebei Hua'ao Hospital is undergoing a digital transformation of nursing services, using digital technologies to break through time and space limitations and provide more efficient, precise, and personalized nursing services. This paper explores the pathways and strategies for the digital transformation of nursing services through the definition of nursing service products, optimization of nursing service processes, and cost accounting and performance management.

2. Definition of Nursing Service Products in Health 4.0 Hospitals

The scope of nursing services is undergoing a qualitative shift from "disease-centered care" to "health-centered services." Traditional nursing services exhibit three major limitations: spatial limitations (coverage < 40%), temporal limitations (average service cycle of 7 days), and content limitations (health management programs < 20%) [7]. The traditional nursing service model primarily targets inpatients, making it difficult to meet the needs of an aging society in communities and households. In China, the prevalence of chronic diseases among people aged 60 and above is 75.8%, and the number of disabled elderly exceeds 40 million [8].

With the intensification of population aging and the rising incidence of chronic diseases, the demand for nursing services is extending from hospitals to communities and households, with service content expanding from disease care to health management, rehabilitation nursing, and long-term care. The Health 4.0 era has given rise to a new paradigm for nursing services. By constructing a digital platform for nursing services, the service scope can cover the entire cycle of pre-hospital prevention, in-hospital treatment, and post-hospital rehabilitation, forming a three-level service network of "hospital-community-household" [9].

Digital transformation is a key driver of the transformation of nursing service models. In the Health 4.0 era, nursing services exhibit the characteristics of "three crosses and four comprehensives." The "three crosses" refer to crossing different health states (disease, sub-health, health), different life stages (infancy, adolescence, middle age, old age), and different regional medical and health service in-

stitutions to provide life-cycle health services [1]. The "four comprehensives" refer to comprehensive population coverage, comprehensive life-cycle coverage, comprehensive health factor coverage, and comprehensive scenario integration [10]. Achieving these requirements necessitates a structural reconstruction of the nursing service product system. Nursing services are no longer an appendage to medical services but an essential component of health services. The goal of nursing services is not only to help patients recover but also to achieve disease prevention, health promotion, and quality-of-life improvement [11]. Therefore, the definition of nursing service products should include:

- In-hospital nursing services: including daily nursing for inpatients, post-operative nursing, and intensive care.

- Community nursing services: including home nursing, community health management, and family sickbeds.

- Health education and consultation: including health knowledge dissemination, disease prevention guidance, and lifestyle intervention.

- Rehabilitation and long-term care: including chronic disease management, rehabilitation training, and elderly care.

The distinction between medical services and health services is particularly evident in pricing mechanisms. Traditional nursing services are charged on a fee-for-service basis, while digital transformation enables a composite pricing model of "basic service fees + health performance rewards" [12]. Although medical services and health services are closely related, they differ significantly in service objectives, target populations, and service methods. Medical services primarily aim to treat diseases, targeting patients and focusing on diagnosis and treatment, while health services aim to maintain and promote health, targeting the entire population and focusing on prevention and management [13].

Under the Health 4.0 hospital model, the nursing service product system needs to establish a new value coordinate system, shifting the focus from medical services to health services. Nursing services are no longer confined to hospitals but extend to communities and households, with service content expanding from disease care to health management, rehabilitation nursing, and long-term care [14]. This transformation not only expands the market space for nursing services but also provides new opportunities for their digital transformation.

3. Optimization of Nursing Service Processes

Traditional nursing service processes are typically tied to medical specialties, with nursing beds monopolized by various departments, leading to uneven distribution and inefficient use of nursing resources. A survey of a tertiary hospital [15] revealed a 63.5% difference in bed utilization rates among specialized wards, with waiting times exceeding 72 hours in high-demand departments, while rehabilitation wards had a vacancy rate of 38%. This structural contradiction stems from the traditional "medical-nursing binding" management model, which prevents the dynamic allocation of nursing resources across departments. High-demand

departments are constrained by bed shortages, while ordinary departments suffer from low bed utilization rates. Additionally, nursing wards can only provide services to specific specialties, making it impossible to offer cross-departmental nursing services within the hospital, let alone external health nursing services [16].

This tightly coupled departmental management system not only restricts the optimal allocation of nursing resources but also affects the efficiency and quality of nursing services. Under the Health 4.0 hospital model, nursing services need to break through traditional departmental and hospital boundaries to achieve the sharing and optimal allocation of nursing and health service management resources within and outside the hospital [7].

Separate accounting for medical and nursing services, as a new model for nursing service management, establishes a loosely coupled economic accounting relationship between medical and nursing services by clarifying the revenue and expenditure division ratio for each medical and nursing service project [17]. This model retains the technical leadership of medical technical services over nursing services while enabling nursing wards to provide "airport-style" nursing services to all departments within the hospital and even external customers [18].

Hebei Hua'ao Hospital has achieved three breakthroughs by establishing a "medical-led, nursing-independent, separate accounting for medical and nursing services" system:

1) Breakthrough in nursing service space: Nursing beds are no longer monopolized by a single department but are open to the entire hospital, improving bed utilization efficiency. Hebei Hua'ao Hospital, a new hospital built for the 2022 Beijing Winter Olympics, is equipped with 10 nursing wards and 17 clinical departments. The nursing department trains and assesses the qualifications of each ward to admit patients with specific diseases, and upon passing the assessment, the ward is opened to the corresponding department. Department doctors also have the right to choose wards for patient admission. After implementing the airport-style nursing service model, the hospital's cross-department admission rate reached 41%, consistent with Li Juan's research findings [19].

2) Expansion of nursing service scope: Nursing wards can provide services to all departments within the hospital [20] and even offer health nursing services to communities and households. Digital technologies play a key role in optimizing nursing service processes. Through the application of electronic medical records, mobile nursing, and remote monitoring technologies, seamless integration of nursing services from hospitals to communities and households is achieved [3]. For example, through the mobile nursing system, nurses can record patient nursing information in real time, doctors can monitor patient condition changes at any time, and patients can manage their health through mobile apps [5].

At Hua'ao Hospital, 90 nurses have obtained qualifications for "Internet + nursing at home" services. Through app applications, they provide remote monitoring of vital signs, injections, wound dressing, and nursing services. Last year, the hospital provided over 100 home nursing visits, receiving positive feedback from cus-

tomers. Nurses earned additional income during their off-duty hours, and the hospital's reputation was enhanced.

3) Reconstruction of nursing service value: A project library involving nursing services, examinations, and tests was established, clarifying the division ratios for over 200 medical, nursing, and technical operations in terms of orders, execution, and coordination [2]. This ensures transparent and reasonable cost allocation for each medical and nursing service project, avoiding duplicate calculations of medical revenue among medical, nursing, and technical departments.

The application of artificial intelligence and big data technologies provides new possibilities for optimizing nursing service processes. For example, by analyzing patient health data, health risks can be predicted, and intervention measures can be taken in advance to reduce the probability of disease occurrence and progression [21].

4. Cost Accounting and Performance Management

Full-cost accounting is an essential foundation for the digital transformation of nursing services. Through full-cost accounting, the cost structure of each nursing service project can be clarified, providing a basis for nursing service pricing and performance management [4]. Under the Health 4.0 hospital model, nursing service cost accounting includes not only direct costs (e.g., labor and material costs) but also indirect costs (e.g., equipment depreciation and management expenses). Based on the DIP nursing cost accounting model, costs are subdivided into: direct costs: labor (62%), materials (23%), equipment (10%); and indirect costs: information technology construction (3%), management expenses (2%), etc.

Through cost driver analysis and refined cost accounting management, equipment utilization rates are improved, and labor and material waste are reduced [8]. The advantages of full-cost accounting are reflected in:

1) Cost control: By refining cost accounting, weak links in cost control can be identified, and targeted measures can be taken to reduce costs [22].

2) Performance management: Full-cost accounting provides data support for performance management, making the evaluation of nursing service efficiency and quality more scientific [9].

3) Resource allocation: By analyzing the cost-effectiveness of various nursing services, resource allocation can be optimized, and the efficiency of human and material resources can be improved [10].

Performance management methods, such as setting clear goals and key results, motivate employees to achieve higher performance [11]. In the digital transformation of nursing services, performance management helps nursing teams clarify work goals, improve work efficiency, and enhance service quality.

The implementation steps of performance management include:

1) Goal setting: Set specific, measurable goals based on the strategic objectives of nursing services. Establish a performance management system based on digital platforms and cost accounting, covering four dimensions: nursing quality, nursing efficiency, nursing effectiveness, and disciplinary development [12].

2) Definition of key results: Define key result indicators for achieving goals, clarify responsible persons, and set completion deadlines. Nursing disciplinary development is assessed from three dimensions: intra-department employee evaluation, cross-department evaluation, and 360-degree customer satisfaction evaluation. Setting a 90% participation rate and satisfaction standard significantly promotes the improvement of nursing work efficiency and effectiveness, enhancing the management level of nursing and health services [22].

3) Tracking and feedback: Regularly track the completion of key results from the four dimensions of nursing quality, nursing efficiency, nursing effectiveness, and disciplinary development, and provide timely feedback and adjustments [13].

4) Assessment and incentives: Assess performance based on the completion of key results and provide corresponding incentives. According to the "Grading Hospital Evaluation Guidelines," nursing units that meet the nursing quality requirements through self-assessment, secondary department assessment, and nursing department assessment automatically receive performance rewards. Indicators such as the nurse-to-bed ratio, nurse-to-critical patient ratio, and per-bed income are included in the assessment, motivating nursing staff to actively learn nursing skills and admit critical patients, thereby addressing the challenges of hospitalization and nursing difficulties [14].

Hebei Hua'ao Hospital has established a separate accounting system for medical and nursing services and actively promotes the integration of medical and elderly care. The hospital provides health education and nursing rounds to nursing homes and home-based elderly care customers. It has built 10 clinical nursing wards with beds and five bedless nursing units, including emergency wards, outpatient wards, operating rooms, supply rooms, and dialysis rooms, achieving airport-style support for inpatient beds, surgical beds, emergency beds, dialysis beds, and disinfection supply work. This empowers the hospital's "one-bed management" system, leveraging the advantages of separate accounting for medical and nursing services to effectively address hospitalization difficulties and create space for the development of high-demand departments, transforming nursing work from passive assistance to active leadership [15].

Through separate accounting for medical and nursing services and performance management, Hebei Hua'ao Hospital has enabled nursing wards to provide services to all departments within the hospital, expanding the scope of nursing services from hospitals to community and household health nursing services. The number of service recipients has increased by over 30%, bed utilization rates have increased by over 20% compared to the same period in 2023, nursing service costs have decreased by over 15%, and nursing team work efficiency has improved by over 25% [16].

5. Conclusion and Outlook

The digital transformation of nursing services is an inevitable trend under the Health 4.0 hospital model and a key breakthrough in the reform of the medical

service system. Through the definition of nursing service products, optimization of nursing service processes, and implementation of cost accounting and performance management, Hebei Hua'ao Hospital has broken through the "three barriers" of organizational silos, unified data standards, and value distribution reconstruction. The "technology empowerment + institutional innovation" dual-drive model has been validated, particularly the separate accounting mechanism for medical and nursing services, which addresses the long-standing challenge of value recognition in nursing development [18]. Through the application of big data, artificial intelligence, and the Internet of Things, nursing services can achieve seamless integration from hospitals to communities and households, providing the public with efficient, precise, intelligent, and personalized health services throughout the entire life cycle [19].

The theoretical framework and practical pathways constructed in this study not only improve the efficiency and quality of nursing service supply but also reconstruct the value system of nursing services. Future research should continue to deepen the theoretical exploration of nursing digital transformation, particularly in data governance, human-machine collaboration, and value assessment, to provide stronger support for the construction of a Healthy China [20].

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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