

Research on Refined Cost Control and Operational Optimization Pathways in Intensive Care Units under DIP Payment Reform

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Abstract: With the comprehensive implementation of regional global budget combined with disease-based score settlement (DIP) medical insurance payment reform across medical institutions nationwide, intensive care units (ICUs) are facing all-dimensional structural adjustments in revenue composition, expenditure control, and daily operational models. Based on a review of industry literature, field research in frontline departments, and comprehensive analysis of real operational cases from ICUs in multiple hospitals, this paper systematically deconstructs the operational pressures and management challenges that the DIP payment mechanism imposes on intensive care departments. Incorporating the inherent characteristics of critical care departments—including high resource consumption for critically ill patients, pronounced individual variation in disease conditions, and complex comorbidities—this study constructs a set of actionable refined cost control schemes and long-term operational optimization implementation pathways. The research findings demonstrate that standardizing clinical medication practices throughout the full treatment cycle, establishing a full-process management system for consumables covering procurement, storage, and utilization, and enhancing the utilization efficiency of large-scale monitoring and life-support medical equipment can directly reduce ineffective medical expenditures in the department. Simultaneously, implementing dynamic staffing allocation mechanisms for medical and nursing personnel, shortening average length of stay, and establishing a normalized multidisciplinary collaborative diagnosis and treatment platform can achieve the dual objectives of improving medical service quality and enhancing departmental operating efficiency. The practical management schemes compiled in this paper can provide referable practical evidence for intensive care departments at all levels of hospitals to adapt to DIP medical insurance settlement rules, balance cost control with medical safety, and achieve sustainable high-quality operations.

Keywords: DIP payment reform; Intensive care unit; Refined cost control; Departmental operations; Medical quality and safety

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1. Introduction

1.1. Background of DIP payment reform implementation

DIP, which stands for regional point-based global budget combined with disease-based score payment,

is a core reform initiative for refined management and control of medical insurance funds and optimization of regional medical resource allocation in China. This payment model standardizes and categorizes patients' principal diagnoses and clinical procedures into groups, employs fuzzy mathematical models to calculate scores corresponding to different disease combinations, and completes unified settlement based on the annual global budget of medical insurance pooling, thereby institutionally constraining unreasonable medical behaviors such as excessive examinations, excessive medication, and misuse of consumables by medical institutions^[1]. In 2020, the National Healthcare Security Administration issued pilot implementation documents, and 71 cities nationwide took the lead in launching pilot programs. After years of tiered promotion, DIP payment has now covered the vast majority of public general hospitals and specialized hospitals in China, compelling medical institutions to abandon the previous extensive operational model of "fee-for-service" and shift toward full-process cost accounting and lean management at the disease-specific level.

1.2. Unique operational challenges of intensive care units

Intensive care units undertake the centralized treatment of all types of acute and critical patients throughout the hospital, with overall operating costs significantly higher than those of general internal medicine and surgical clinical departments, and they face long-term heavy operational pressure. First, the diagnosis and treatment of critically ill patients throughout the entire process require large quantities of special anti-infective drugs, disposable high-value interventional consumables, ventilators, CRRT and other life-support equipment, with substantial baseline expenditures on various consumables, equipment depreciation, and pharmaceuticals, making daily management and control significantly more difficult. Second, critically ill patients experience rapid changes in condition, with high incidence of multiple comorbidities and complications, creating substantial resistance to the implementation of standardized clinical pathways and making it extremely easy for single-case medical costs to exceed medical insurance score compensation standards. Industry practice data from the previous DRG payment phase show that most hospital ICUs have long been in a state of medical insurance settlement losses due to excessively high per-case resource consumption, which not only compresses development funds for departmental talent cultivation and equipment renewal but also aggravates the overall financial operational burden of hospitals^[2].

1.3. Research objectives and practical value

This paper takes the new DIP payment regulations as its research foundation, conducts systematic analysis targeting the operational pain points of intensive care departments, and systematically examines the profound transformations that medical insurance payment reform brings to departmental revenue-expenditure structures and daily management models, along with supporting tiered implementation cost control measures and long-term operational optimization strategies. The research aims to address the practical problems commonly existing in current ICUs, including cost overruns, resource waste, imbalanced manpower allocation, and poor interdepartmental collaboration. Under the premise of safeguarding the bottom line of medical safety, it seeks to balance cost control with treatment quality, providing a complete and actionable management scheme for hospital intensive care departments to adapt to the DIP settlement system and achieve quality improvement and efficiency enhancement.

2. Literature review

2.1. Theoretical foundations of DIP payment

Disease-based score payment (DIP), as a novel medical insurance settlement tool, has as its core logic the achievement of balanced allocation of medical resources and curbing unreasonable loss of medical insurance funds through standardized disease grouping. The theoretical foundation of this system originates from the practical needs of domestic medical insurance payment reform, while simultaneously accommodating two core objectives: stability of medical service quality and efficiency of fund utilization. The DIP mechanism, through unified standardized assessment of diagnosis and treatment behaviors for different diseases, assigns corresponding score weights, directly linking medical insurance fund disbursement with disease complexity and diagnostic resource consumption, thereby compelling hospitals to establish internal disease-specific cost accounting systems and promoting standardized transformation of in-hospital diagnostic and treatment processes. At the same time, DIP reform closely aligns with the overall direction of China's healthcare system reform, possessing irreplaceable institutional value in enhancing the efficiency of medical insurance fund utilization and reducing the economic burden of medical treatment for ordinary patients ^[3].

2.2. Existing research on ICU costs and operations

Existing academic achievements both domestically and internationally discuss ICU cost composition and departmental operational models from multiple dimensions. Established research generally confirms that high operating expenditures in intensive care departments primarily originate from three major categories: high-priced anti-infective drugs, disposable interventional consumables, and depreciation and maintenance of large-scale monitoring equipment, with the management level of these items directly determining the annual operating profit or loss of the department. Some scholars, drawing on previous DRG payment implementation experience, analyze the contradictions existing in ICUs regarding the balance between cost control and medical quality, and propose improvement approaches such as retrospective review of loss-making cases and optimization of diagnostic and treatment plans ^[4]. However, existing research still has notable shortcomings: most literature focuses on cost management approaches under traditional fee-for-service and DRG payment models, while systematic research targeting ICU revenue-expenditure changes and management adaptation schemes under the DIP score settlement system is relatively scarce, lacking practical research on refined departmental operations that aligns with DIP rules.

2.3. Insights from existing research

A review of existing literature yields two core research insights: First, the implementation of DIP payment brings entirely new opportunities for cost control and operational model upgrading in intensive care departments, while also imposing strict cost constraint requirements, with disease-specific cost accounting and diagnostic efficiency improvement being the core improvement directions for departmental transformation. Second, existing research achievements related to ICU cost control possess foundational reference value, but there exists a research gap in specialized management schemes adapted to DIP settlement rules, necessitating empirical analysis based on real operational data from frontline departments to fill this practical research gap. Based on this, this paper takes the DIP payment system as its core thread, combines the unique diagnostic and treatment attributes of intensive care departments, and explores new models of cost control and refined operations adapted to ICUs, contributing to the enhancement of overall hospital operational efficiency.

3. Multidimensional impact analysis of DIP payment on intensive care units

3.1. Changes to departmental revenue structure

After the implementation of DIP payment, the revenue sources and composition of intensive care departments have undergone fundamental adjustments, with the overall departmental revenue level directly tied to disease grouping scores and the matching degree of admitted cases. Under the traditional fee-for-service model, ICU revenue primarily relied on high-value consumable usage fees, high-priced drugs, and complex invasive procedure service charges. However, DIP adopts an annual global budget plus disease-based score settlement mechanism, whereby medical insurance fund disbursement no longer separately accounts for individual medical service charges, substantially reducing the contribution proportion of consumables and drugs to total departmental revenue. Clinical operational data show that disease score levels directly determine departmental operating returns, primarily manifested in two aspects: First, critically ill cases with extremely high resource consumption have diagnostic and treatment input costs exceeding the medical insurance compensation amount corresponding to the disease score, directly resulting in per-case losses. Second, cases of low-risk mild conditions transferred into the ICU have score compensation higher than actual diagnostic and treatment consumption, possessing certain operating profit margins. This requires intensive care departments, under the premise of ensuring treatment safety, to precisely analyze the profitability and loss situations of various diseases, proactively adjust diagnostic and treatment plans to optimize revenue structure, and adapt to DIP settlement rules to achieve long-term stable operations.

3.2. Deep impact on departmental cost structure

The DIP payment mechanism comprehensively constrains departmental expenditures, exerting significant management and control pressure on the three core cost sectors of drugs, consumables, and manpower. First, pharmaceutical expenditure, as the largest cost item in ICUs, is strictly limited under score settlement rules. Departments must prioritize cost-effectiveness in drug selection, strictly control the frequency and duration of use of high-grade antibiotics without indications and high-priced adjuvant drugs, and reduce ineffective pharmaceutical expenditures. Second, high-value disposable consumables represent another major expenditure in ICUs. The use of catheters, interventional consumables, and monitoring accessory consumables is no longer unrestricted. With disease scores imposing cost ceiling constraints, departments must restructure consumable procurement and usage processes to eliminate waste and excessive use. Third, pressure for manpower cost control increases simultaneously. Medical and nursing staff scheduling and position allocation must match disease admission volumes to avoid idle manpower inflating per-case labor costs. Overall, DIP payment compels departments to conduct all-dimensional refined cost accounting, transforming the previous extensive resource deployment model^[5].

3.3. Reshaping of traditional operational management models

DIP payment fundamentally disrupts the original extensive operational management system of ICUs from two dimensions: resource allocation and performance assessment^[6]. At the resource allocation level, the traditional management model took patient treatment needs as the sole orientation, prioritizing the supply of materials and equipment to critically ill patients. However, under DIP global budget constraints, when allocating medical equipment, drugs, and manpower, departments must simultaneously consider diagnostic efficiency and cost-effectiveness, dynamically allocating resources according to differences in resource consumption across diseases, driving departments to shift from “demand-oriented” to “efficiency-balanced”

refined management. At the performance assessment level, traditional departmental assessment indicators focused on workload metrics such as admission volume, nursing procedure volume, and diagnostic completion rate. After DIP reform, departmental performance assessment adds efficiency-type indicators including disease cost control, proportion of profitable versus loss-making cases, and average length of stay, with cost control effectiveness directly linked to medical and nursing performance. In summary, DIP payment drives comprehensive upgrading of intensive care departmental operational management through bidirectional promotion from resource allocation and assessment systems.

4. Actionable cost control measures for intensive care units under DIP payment

4.1. Standardizing rational drug use throughout the full clinical process

Intensive care departments utilize a complex variety of drugs with large single-day dosages and high proportions of total pharmaceutical costs, making medication rationality directly determinative of departmental medical insurance settlement profitability. Currently, common clinical problems include misuse of adjuvant drugs, escalated use of antibiotics, and excessively prolonged medication courses, which not only elevate patients' medical economic burden but also cause medical insurance score overrun losses. To address these issues, departments need to establish tiered medication protocols based on standardized clinical pathways combined with DIP disease-specific cost ceilings. For anti-infective treatment, priority should be given to first-line antibiotics with high cost-effectiveness within the medical insurance catalog, strictly limiting the indications and duration of use for special high-grade antibiotics. A dynamic departmental pharmaceutical monitoring ledger should be established, with monthly statistics on usage amounts and frequencies of various drugs, and special medication reviews conducted for drugs with abnormal usage or high unit prices to promptly correct irrational prescribing behaviors. Simultaneously, normalized specialized training on rational drug use should be conducted for medical and nursing staff to strengthen cost control awareness among all personnel and compress ineffective pharmaceutical expenditures from the clinical source.

4.2. Establishing a full lifecycle refined management system for consumables

Consumable management is the core lever for cost reduction in ICUs and must cover all stages of procurement, warehousing, and clinical use. Procurement stage: precise procurement plans should be formulated based on monthly departmental consumable usage to avoid large-scale stockpiling that ties up working capital; centralized collective price negotiation with consumable suppliers should be conducted to reduce unit procurement prices through bulk purchasing. Warehousing stage: a consumables information management system should be deployed to monitor inventory quantities and expiration dates in real time, regularly clearing near-expiry consumables to eliminate capital losses from expired disposal. Clinical use stage: a dual-person verification and full-process registration system for high-value consumables should be established, with each interventional and monitoring consumable necessarily matched to corresponding patient diagnostic and treatment records, standardizing operational procedures to reduce human-induced losses; regular practical training on standardized consumable use should be organized for nurses and resident physicians to reduce consumable losses caused by improper operation ^[7].

4.3. Enhancing comprehensive utilization efficiency of advanced medical equipment

Intensive care departments are equipped with large quantities of high-priced specialized equipment such

as ventilators, blood purification machines, and extracorporeal life support devices, with high costs for procurement, annual maintenance, and depreciation allocation, where equipment idleness substantially inflates per-case fixed costs. Improving equipment utilization can be implemented from two aspects: First, establish an intra-hospital cross-departmental equipment sharing and scheduling mechanism, whereby idle high-end monitoring and therapeutic equipment in the ICU can be reserved for use by operating rooms, emergency departments, and general surgery to share depreciation costs. Second, formulate regular equipment maintenance plans, conducting monthly equipment inspection and upkeep to reduce downtime and ensure equipment is always ready for clinical use. Simultaneously, departments should predict critical patient flow across different seasons based on historical admission data, rationally plan new equipment procurement to eliminate long-term idleness of blindly purchased equipment, and reduce fixed cost waste.

5. Long-term operational optimization strategies for intensive care units under DIP payment

5.1. Dynamically optimizing medical and nursing human resource allocation

DIP payment requires departmental manpower allocation to balance treatment quality and labor cost control. ICU critically ill patients experience significant fluctuations in condition, with obvious peak-valley differences in manpower demand, and fixed scheduling patterns easily result in insufficient manpower during peaks and idle personnel during valleys. Departments can establish a dynamic manpower allocation system: calculate medical-nursing ratio standards based on monthly DIP disease admission volumes and critical patient proportions; activate mobile nursing staff and in-hospital specialist nurse support during critical peak periods; and rationally arrange rotation rest and training when patient flow declines to reduce idle labor costs. Simultaneously, optimize the medical and nursing position structure, increase the proportion of critical care specialist nurses, rationally delineate physician and nurse responsibilities, and balance workload across positions. A performance distribution scheme aligned with DIP management objectives should be implemented, incorporating cost control effectiveness and disease profitability into medical and nursing performance calculations to mobilize proactive cost control enthusiasm among all staff^[8].

5.2. Optimizing diagnostic and treatment processes to shorten average length of stay

Patient average length of stay directly affects bed turnover efficiency and overall departmental costs, with prolonged hospitalization simultaneously elevating pharmaceutical, consumable, and equipment depreciation expenditures, making DIP disease cost overruns highly likely. Core measures for shortening average length of stay are divided into two points: First, implement standardized DIP-adapted clinical pathways, unifying examination, medication, and treatment processes for critically ill patients, and eliminating valueless repetitive tests and unnecessary adjuvant therapeutic items^[9]. Second, routinely conduct multidisciplinary joint diagnosis and treatment, with early organization of consultations from surgery, nephrology, respiratory, laboratory and other departments for critically ill patients with multiple comorbidities to rapidly clarify diagnostic and treatment plans and shorten diagnostic waiting periods. A supporting diagnostic information platform should be deployed to track each patient's hospitalization duration and cost consumption progress in real time, with early intervention for cases approaching threshold values, and early initiation of rehabilitation and transfer assessment under safety assurance to improve bed turnover efficiency.

5.3. Building a normalized multidisciplinary collaborative diagnosis and treatment mechanism

Critically ill patients mostly present with multiple organ damage and multiple underlying diseases, making it difficult for a single ICU department to independently complete comprehensive diagnosis and treatment, and insufficient multidisciplinary collaboration prolongs treatment cycles and increases ineffective medical expenditures. Strengthening disciplinary collaboration possesses dual value: On one hand, establishing rapid green channels with laboratory and imaging departments ensures priority issuance of critical examination reports, shortening diagnostic waiting time and reducing hospitalization consumption. On the other hand, linking with surgery, cardiovascular, neurology and other clinical departments for early intervention treatment, formulating integrated diagnosis and treatment plans to avoid duplicate examinations and duplicate medication from segmented treatment. Departments can conduct fixed weekly multidisciplinary critical care consultations, utilizing electronic medical record systems to open up hospital-wide patient data sharing channels, with all departments synchronizing patient diagnostic and treatment progress in real time, reducing communication costs, and lowering overall diagnostic and treatment expenses while improving treatment efficiency.

6. Practical challenges in implementation and countermeasures

6.1. Insufficient in-hospital information system adaptation

Currently, most hospitals' existing HIS and LIS systems only meet basic billing and medical record requirements, making it difficult to adapt to DIP payment's refined management requirements for real-time disease score calculation, automatic disease cost accounting, and cost control data early warning, with data lag and inconsistent statistical calibers constraining cost control implementation. Countermeasures: Hospitals should uniformly upgrade and transform in-hospital information architecture, establish a DIP-specific data management module to achieve real-time disease score calculation and dynamic per-case cost early warning; introduce big data analysis tools to automatically aggregate departmental drug, consumable, and hospitalization duration data, and automatically screen cost-overrun cases for departmental review; adopt modular system design so that subsequent medical insurance policy adjustments require only partial updates without overall reconstruction, reducing long-term transformation costs; assign dedicated information department personnel to interface with the ICU, regularly maintaining the system and optimizing data statistical functions to ensure real-time accuracy of cost control data ^[10].

6.2. Policy adaptation difficulties among medical and nursing staff

DIP payment involves entirely new management requirements including disease score calculation, disease cost control, and clinical pathway constraints. Most medical and nursing staff have long been accustomed to traditional diagnostic and treatment models, with insufficient understanding of cost control rules and medical insurance settlement logic, and problems of resistance and non-standard operations existing at the clinical implementation level. Countermeasures: Conduct tiered, normalized specialized training. For department directors and head nurses, conduct in-depth DIP policy interpretation training explaining disease profitability accounting and core departmental cost control indicators; for frontline physicians and nurses, conduct case-based practical training, using departmental loss-making case reviews to explain settlement losses caused by irrational diagnostic and treatment behaviors; regularly organize internal departmental cost control case discussions, sharing practical methods for compliant cost control while ensuring treatment efficacy, gradually

transforming the ingrained mindset of prioritizing treatment over cost among medical and nursing staff.

6.3. Multidisciplinary collaboration communication barriers

DIP implementation involves coordination among multiple departments including medical affairs, nursing, finance, information, equipment, pharmacy, and procurement. Differences in work objectives and assessment indicators across departments easily lead to communication disconnection and lagging implementation of control measures. Countermeasures: Establish a hospital-level DIP special working group led by the medical affairs department, with designated personnel from finance, information, ICU, pharmacy, and equipment departments participating, clarifying departmental responsibilities and collaboration processes; hold monthly cross-departmental joint meetings to collectively address bottlenecks in ICU cost control, data statistics, and equipment and consumable procurement, and uniformly formulate solutions; establish an online collaborative communication ledger to synchronize problem rectification progress in real time, break through departmental communication barriers, and ensure synchronized implementation of all cost control and operational measures ^[11].

7. Conclusion

7.1. Summary of core research findings

Through systematic analysis of the multidimensional impact of DIP payment on intensive care department revenue-expenditure and operational models, this paper provides a complete set of cost control and operational optimization schemes. The research confirms that through three core measures—standardizing clinical medication, full-cycle consumable management, and revitalizing large-scale medical equipment utilization efficiency—departmental unnecessary medical expenditures can be effectively reduced, achieving refined cost savings. Simultaneously implementing dynamic manpower allocation, optimizing diagnostic and treatment processes to shorten length of stay, and establishing a multidisciplinary collaborative diagnosis and treatment system can simultaneously improve medical service efficiency and departmental operating returns. The entire set of management measures aligns with ICU clinical reality, possesses strong operability, and can provide complete theoretical support and practical reference for refined operations of intensive care departments under the DIP payment environment ^[12].

7.2. Practical significance for hospital and departmental development

Intensive care units are the core carriers of a hospital's comprehensive acute and critical care treatment capacity. ICU cost control and operational level optimization can directly enhance the utilization efficiency of hospital-wide medical resources, improve overall medical insurance settlement performance, and strengthen long-term stable operating capacity. Simultaneously, standardized cost-controlled diagnostic and treatment models can reduce excessive medical treatment, lower patients' medical economic burden, balance hospital operating efficiency with public medical access satisfaction, and achieve a three-way equilibrium among medical quality, departmental efficiency, and patient satisfaction.

7.3. Research limitations and future research directions

This study primarily relies on existing medical insurance policies, industry literature, and departmental cases for analysis, lacking large-scale multicenter clinical operational data as empirical support, and the long-term quantitative effects of some management measures remain to be verified. Additionally, given the relatively

short time since DIP payment implementation nationwide, long-term policy impacts and ICU adaptation differences across hospitals of different levels have not yet fully manifested. Future related research can be deepened from three directions: First, collect long-term operational data from intensive care departments across multiple hospitals to empirically test the actual cost-reduction and efficiency-enhancement effects of the management measures in this paper. Second, conduct in-depth analysis of the dynamic equilibrium mechanism between ICU medical quality and cost control under long-term DIP payment operation. Third, explore innovative applications of digital and intelligent tools in ICU cost control to adapt to the management needs of continuous medical insurance policy updates and iterations.

Disclosure statement

The author declares no conflict of interest.

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