

Research on the High-quality Development Path of Tumor Prevention and Control in Frontier Minority Counties under the Background of Public Hospital Reform-based on the Empirical Analysis of Lufeng City

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Abstract: *Objective:* To analyze the shortcomings of tumor prevention and control in multi-ethnic counties in border areas, explore the construction path of mutual adaptation, and provide a reference for the coordinated reform of medical prevention and control in similar areas. *Methods:* Taking Lufeng City as an empirical case, using the configuration perspective and the resource integration theory of multiple medical institutions, the qualitative configuration analysis was carried out from six aspects: organizational coordination, talent allocation, information construction, technical resources, service process and performance incentive. Combined with the data on tumor registration, screening, and medical community operation, the relationship between various elements was analyzed. *Results:* The hardware equipment for tumor diagnosis and treatment in Lufeng City improved significantly, but the multi-factor configuration mismatch was prominent, showing “strong hardware and weak system”. It is mainly manifested in the lack of cross-agency coordination mechanisms, the concentration of talents at the county level, the obvious data barriers of business systems, the emphasis on hardware investment, the unsmooth full-cycle service chain of “prevention, screening, treatment, management and health”, and the imperfect assessment and incentive mechanism. It is difficult to improve the overall service efficiency by upgrading hardware. *Conclusion:* The prevention and treatment of tumors in border ethnic counties cannot simply copy the reform model of focusing on equipment and attracting talent in the central and eastern regions. We should start from the aspects of system priority, talent-ability sinking and information-process reengineering based on local reality, promote the coordinated integration of multiple factors, and build a full-cycle closed-loop management system of tumors suitable for border ethnic counties.

Keywords: Public hospital reform; Border ethnic counties; Tumor prevention and treatment; Resource integration; Configuration perspective; Tight medical community; Lufeng City

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1. Introduction

Cancer has become a major public health issue threatening the life and health of ethnic minority populations in border regions. National policies such as the Cancer Prevention and Treatment Action, the construction of compact county-level medical communities, and the Thousand-County Project all explicitly require that tumor prevention and control efforts be shifted to an earlier stage^[1-5]. County-level public hospitals serve as the key vehicle for implementing healthcare reform policies and safeguarding the health of grassroots populations. At present, many ethnic minority counties have equipped themselves with large-scale devices such as linear accelerators, afterloading treatment machines, and PETCT scanners. However, the service system still operates inefficiently: grassroots tumor screening mobilization is insufficient, postoperative rehabilitation and followup are inadequate, and patients are referred to provincial and prefectural hospitals, leading to increased outofcounty consumption of medical insurance funds. This indicates that tumor prevention and control are not merely a matter of hardware facilities, but rather a systemic problem involving intertwined institutional, human, informational, technical, procedural, and assessment dimensions. Most existing studies focus on the internal specialty capacity building of county-level hospitals, with few empirical studies on county-level tumor prevention and control in border ethnic regions from a multiinstitutional collaborative perspective^[6]. Configuration theory holds that the effectiveness of public services depends on the coordinated matching of multiple factors; optimizing a single condition alone is insufficient to achieve overall system improvement. This offers a new analytical perspective for the construction of county-level tumor prevention and control systems^[2].

Lufeng City, a multiethnic county in central Yunnan where ethnic minorities account for 27.8% of the population, was among the first batch of national pilot sites for compact countylevel medical community construction. Leveraging the ThousandCounty Project, Lufeng established the first countylevel tumor radiotherapy center in Chuxiong Prefecture, integrated tumor management into the “four highs and seven diseases” medicalprevention integrated fullcycle management framework, and simultaneously built a management information system. It has preliminarily achieved tumor chronic diseaseoriented and informationbased management, thereby providing a typical case for research. Taking Lufeng City as an example, this paper, from the perspectives of resource integration and configuration, analyzes the existing dilemmas, distills replicable construction pathways, and offers references for similar countylevel reforms.

2. Realistic logic of resource integration driving countylevel tumor prevention and control construction in border ethnic regions

Tumor prevention and control require the integration of clinical diagnosis and treatment with public health efforts. Highrisk interventions and screening fall under public health services, diagnosis and treatment are concentrated in countylevel hospitals, and postoperative rehabilitation and followup rely on township and village health centers for implementation. In the health system of border counties, these functions are dispersed across multiple institutions, including countylevel hospitals, CDC, maternal and child health hospitals, township health centers, and village clinics. Medical and health service resources are fragmented. Therefore, the highquality development of countylevel health services should emphasize the promotion of systematic crossinstitutional resource integration^[3].

2.1. Countylevel public hospitals serve as the hub for countylevel tumor prevention and control

County-level hospitals function as the central node, undertaking the transfer of technical support from higherlevel institutions, referral of complex cases upward, and guidance of townshiplevel services. In border mountain areas, patients face long travel distances and high transportation costs. Highrisk interventions, early screening mobilization, postoperative rehabilitation, and routine followup rely heavily on rural medical institutions. If the countylevel fullchain service system operates poorly, many patients are forced to travel long distances to provincial or prefectural hospitals. This not only contradicts the original intention of hierarchical diagnosis and treatment reform but also increases the financial burden on patients' families.

2.2. Resource fragmentation constrains service efficiency improvement

Tumor prevention and control resources are distributed across different institutions such as countylevel public hospitals, CDC, maternal and child health hospitals, and township health centers, each with inconsistent assessment objectives. This leads to issues such as poor communication, ambiguous rights and responsibilities, and redundant work ^[3]. Additionally, ethnic regions face practical challenges including difficulties in attracting and retaining talent, large service radii in mountainous areas, and differences in ethnic health perceptions. No single institution can independently accomplish the fullcycle management of tumors; it is necessary to promote crossinstitutional coordination of multiple factors—human resources, funding, information, technology, and institutions. In Lufeng, all 21 oncology specialists are concentrated in the countylevel hospital. After hardware improvements, followup efforts in talent deployment, health education, and public health followup services have been insufficient. Overall service efficiency has not achieved expected results, and hardware advantages have not translated into accessible services for the public.

2.3. Fulllifecycle health management is an essential requirement for effective prevention and control

Traditional countylevel medical care has emphasized inhospital treatment, prioritizing surgery, radiotherapy, and chemotherapy, while paying insufficient attention to predisease highrisk intervention, postoperative rehabilitation, and psychological counseling. Many ethnic minority populations have limited awareness of tumors ^[4]. Health education needs to be adapted to local folk customs. It is necessary to rely on the integrated medical community to consolidate resources and, in conjunction with public hospital reform in ethnic regions, extend services from hospitals to rural areas outside the hospital. This should cover the complete cycle of highrisk intervention, early cancer screening, standardized diagnosis and treatment, postoperative rehabilitation, psychological intervention, and routine followup, matching the health needs of the population.

3. Theoretical framework and research methods

3.1. Theoretical framework

This study constructs an analytical framework combining configuration theory and multiinstitutional resource integration theory. Configuration theory posits that the effectiveness of complex public health systems arises from the coordination of multiple conditions, with complementarity, substitution, and constraint relationships among elements; no single condition can independently achieve highquality system operation ^[2].

Incorporating multiinstitutional resource integration theory, this paper takes the countylevel tumor prevention and control system as the subject and examines the integration pathways of multifactor coordination and adaptation across six core dimensions: organizational collaboration, workforce allocation, information infrastructure, technical resources, service processes, and performance incentives^[3].

3.2. Research methods

An embedded singlecase study design is adopted, using the Lufeng experience for empirical analysis with qualitative configurational logical interpretation, without conducting fsQCA operations, to identify factor interactions and practical dilemmas. Meanwhile, policy documents on public hospital reform, the ThousandCounty Project, cancer prevention and treatment, and compact countylevel medical community construction are reviewed to identify gaps between policy and grassroots practice.

3.3. Data sources

Data sources include: national, provincial, and prefectural policy documents; Lufeng tumor management monitoring data, medical community operational data, medical insurance system data, health statistics annual reports, and twoway referral business data; annual tumor management work reports; and onsite observation and analysis materials.

3.4. Analytical dimensions

The six conditions are assessed in terms of completeness, practical shortcomings, configurational interactions among factors, and existing dilemmas.

4. Current state of configurational conditions and dilemmas of Lufeng’s tumor prevention and control system

4.1. Organizational collaboration: Organizations established but institutional constraints insufficient

Based on the joint management requirements of “responsibility, management, service, and benefit” within the compact medical community, Lufeng has established a countylevel tumor prevention and control organizational structure led by the municipal government, coordinated by the Municipal Health Bureau, guided by the Municipal Tumor Prevention and Treatment Center, and involving collaborative participation from the Traditional Chinese Medicine Hospital, CDC, Maternal and Child Health Hospital, and township health centers. However, crossdepartmental tasks are mostly coordinated on an ad hoc basis without clear collaborative mechanisms, and the overall planning and assessment of each institution remain independent. Organizational collaboration is a prerequisite condition; the absence of collaborative institutions directly hinders talent deployment and data sharing^[7].

4.2. Workforce allocation: Countylevel concentration with weak grassroots capacity

All 21 countylevel oncology professionals (including those recruited from provincial and prefectural levels) are concentrated at the county hospital. Services from regular “senior physician” assistance and workstation experts are essentially provided only at the county level. Townships have no fulltime oncology staff, and grassroots medical personnel lack standardized training in tumor risk identification, rehabilitation

assessment, and followup. Township health centers have multiple competing tasks, and tumor prevention and control accounts for only 4.2% of the public health assessment, resulting in low work motivation ^[8]. Although telemedicine can compensate for some operational shortcomings, it cannot replace homebased health education and onsite followup. Insufficient grassroots service capacity makes it difficult to accept downward referrals of postoperative patients, limiting the reach of reform benefits to remote mountainous areas.

4.3. Information infrastructure: Basic platforms exist, but data silos are prominent

Lufeng has established a population health information platform and a chronic disease management system. However, HIS, tumor registry, maternal and child screening, and resident electronic health records remain independent of each other. There are still issues such as inconsistent data standards, duplicate data entry, delayed information updates, difficulty in tracking screenpositive individuals, and difficulties in achieving closedloop followup.

4.4. Technical resources: Hardware advantages evident, but funding structure imbalanced

Lufeng has established a tumor radiotherapy center, with investment in tumorrelated hardware equipment accounting for 77.45% of total spending, whereas investment in education, training, and rehabilitation services accounts for only 22.55%. Mutual recognition of examination and test results across counties has not been fully realized, and appropriate screening technologies have been insufficiently deployed to mountain townships. Grassroots medical staff have considerable room for improvement in basic service capabilities, and patient guidance toward grassroots facilities is inadequate.

4.5. Service processes: Breaks in the full chain and insufficient services adapted to ethnic populations

Lufeng has implemented highrisk screening, MDT multidisciplinary diagnosis and treatment, and fullcycle management for highrisk (red), mediumrisk (yellow), and lowrisk (green) tumor patients. Twoway referral channels have been established, along with countytownship onestop service centers and a central pharmacy within the medical community to optimize service processes. However, breaks remain in the service chain: the downward referral rate for stable postoperative patients is only 18.7%, and the supply of rehabilitation and psychological intervention at the township level is inadequate. Some ethnic minority highrisk populations living in mountainous areas, affected by transportation and cognitive factors, show low screening willingness and poor followup compliance. The transformation of service processes is not synchronized with the needs of ethnic regional populations.

4.6. Performance incentives: Emphasis on task volume, lacking outcome orientation

Lufeng's current assessment focuses mainly on the quantity of screening tasks completed, lacking targetoriented indicators such as early diagnosis rate, screening participation rate, patient referral rate, followup completeness rate, and quality of life measures ^[9]. The linkage between assessment and institutional and individual incentives is weak, with insufficient binding on grassroots followup and highrisk interventions, leading to low motivation among medical staff.

Table 1. Current status of configurational conditions across six elements of Lufeng’s tumor prevention and control system

Analytical Element	Condition Completeness	Lufeng Real-world Data Support	Main Shortcomings	Configurational Interaction Among Elements
Organizational Coordination	Moderate	Multi-agency collaborative framework is complete	Lack of clear authorityresponsibility coordination mechanism	Prerequisite, systematic linkage across institutions
Talent Allocation	Moderate	Countylevel talents sufficient; township basic capacity weak	No fulltime staff at primary level; extremely low weight of performance incentive	Affects implementation of primary basic health services
Information System Construction	Moderate	Built national health information platform and chronic disease management system	Existence of information system barriers, difficulty in efficient data governance	Information barriers weaken the effect of hardware and manpower investment
Technical Resources	Moderate	Built tumor radiotherapy center	High proportion of hardware investment, insufficient investment in soft services	Resource allocation constrains basic universal medical services
Service Process	Moderate	Conduct screening, MDT, graded and dynamic management with clear indicators; smooth upward referral	Low downward referral rate, weak primary health service capacity	Various systemic shortcomings ultimately manifest as service process breaks
Performance Incentive	Moderate	Has assessment mechanism	Lacks health outcome indicator assessment	Weakens the actual effectiveness of various reforms

5. Empirical analysis of configurational effectiveness

From the perspective of empirical outcomes in county-level medical operations, the benign configuration and alignment of the six key elements have effectively driven the formation of a closed-loop tumor diagnosis and treatment service system at the county level. This has directly led to the return flow of tumor patients for local care, the retention of medical insurance funds within the county, and increased revenue from enhanced primary-level diagnostic and treatment capacity, thereby significantly reversing the previous situation of large-scale outreferral of tumor patients, outflow of quality medical resources, and underutilization of specialized primarylevel services. In contrast, the earlier development model—which emphasized optimization of individual conditions and fragmented resource allocation—lacked comprehensive support in terms of organization, talent, mechanisms, and informatization. As a result, the advantages of hardware investment could not be translated into actual diagnostic and treatment service capacity, making it difficult to effectively retain patients and medical insurance resources within the county and failing to meet the convenient healthcare needs of remote ethnic populations, thus constraining the highquality development of countylevel public hospitals. The comparative configurational findings fully confirm that highquality development of tumor prevention and treatment in border ethnic counties is not achieved through singleresource input alone, but rather represents a systemic outcome resulting from the synergistic alignment and configurational optimization of the six core elements. The relevant comparative indicators are presented below.

Table 2. Comparison of core performance indicators before and after the reform of the tumor prevention and treatment system in Lufeng City

Core Evaluation Indicators	Inefficient Configuration Stage	Moderate Adaptation Stage	Change
TNM staging rate (%)	61%	77.7%	+16.7%, notable improvement in standardized service
CMI value	1.1328	1.28	+0.1472, improvement in diagnosis and treatment service capacity
Number of oncology inpatients transferred out (person-times)	2483	2407	Outbound transfers decreased by 3.06%; mild and stable patients returning to local medical care
Medical insurance funds consumed by oncology patients outside the city (10,000 yuan)	1939	1687	Out-of-region medical insurance fund consumption decreased by 2.52 million yuan
Proportion of primary care visits	71.27%	74.11%	+2.84%, improvement in primary care service capacity
Per capita income of primary healthcare institutions (yuan)	80456.5	85258.06	+4801.56, increase in primary care income

6. Pathways for building a county-level tumor prevention and treatment system in border ethnic regions guided by resource integration

Based on configuration theory, the quality of county-level tumor prevention and treatment is a systemic process requiring multi-element coordination, complementarity, and substitution. Optimizing a single condition is insufficient to achieve overall system improvement, nor is it necessary to pursue optimal performance across all elements. A differentiated combination model of “one main pathway supplemented by others” can be adopted ^[2].

6.1. Organizational integration: Consolidating cross-institutional collaborative responsibilities.

Relying on the compact county-level medical community, the responsibility and authority lists for tumor prevention and treatment among county-level hospitals, CDC, maternal and child health institutions, and township health centers should be refined, breaking down barriers of fragmented governance and independent assessment ^[7]. Mechanisms for regular meetings, special supervision, and annual joint evaluation should be established, with high-risk population tracking, positive screening disposition, and closed-loop referral management incorporated into mandatory assessments. Institutionalized coordination should resolve ad hoc cross-departmental coordination and operational disconnection issues, laying a solid institutional foundation for talent deployment, data interoperability, and business linkage.

6.2. Talent empowerment

Consolidating Primary-Level Service Capacity. A mechanism should be established whereby county-level teams assume responsibility for designated townships with regular deployment to grassroots levels. Practical rotational training should be conducted on tumor initial screening and identification, post-operative

rehabilitation assessment, and high-risk follow-up^[8], addressing gaps in primary-level professional capacity. The public health assessment system should be optimized by increasing the incentive weight for tumor prevention and control to over 10%, thereby enhancing grassroots work motivation. This addresses the challenges of mountainous-area household mobilization, home-based follow-up, and insufficient patient acceptance capacity, thereby strengthening the primary-level service foundation.

6.3. Data empowerment

Breaking Down Information Silos. Relying on the county-level universal health information platform, data from diagnosis and treatment, tumor registries, maternal and child screening, and resident health records should be integrated, with unified data entry and update standards. A dynamic database for high-risk tumor populations should be established, enabling a digital closed loop of screening alerts, case tracking, and follow-up management, while reducing duplicate reporting, improving follow-up control quality and efficiency, and fully unleashing the potential of hardware and human resources.

6.4. Resource reciprocity

Addressing Gaps in Soft Services. While ensuring the operation and maintenance of large-scale radiotherapy equipment, the funding structure should be adjusted to increase the proportion of funding allocated to soft services—including health education, professional training, rehabilitation nursing, and technology deployment—to over 30%^[3]. Appropriate screening technologies should be promoted at the grassroots level, and county-level mutual recognition of examinations and tests, along with telemedicine services, should be deepened to reduce healthcare costs, curb the outflow of medical insurance funds, and ensure that quality resources benefit mountain communities.

6.5. Service coordination

Improving Service Chains Adapted to Ethnic Characteristics. The criteria for graded referral of tumor patients should be refined, with clear indications for referring stable-phase and rehabilitation-phase patients to primary-level facilities, and the proportion of post-operative patients referred downward should be continuously increased^[10]. Gaps in rehabilitation nursing, psychological counseling, and palliative care services at the township level should be addressed. Culturally appropriate bilingual health education materials should be developed based on ethnic characteristics, and innovative communication methods should be adopted. At the same time, convenience measures for mountainous areas should be enhanced, including paired assistance for key populations, green channels for elderly patients, home visits to remote villages, and local notification of screening results, thereby narrowing service gaps in mountainous regions and enhancing the public's sense of healthcare access.

6.6. Outcome benefits

Establishing a Health-Oriented Assessment System. The performance evaluation system should be optimized by reducing process-oriented indicators and focusing on outcome measures such as tumor early diagnosis rate, screening participation rate, follow-up completeness rate, out-of-county referral rate, quality of life, and patient satisfaction. The linkage between assessment results and funding allocation, awards and recognition, and individual performance should be strengthened, balancing positive incentives with negative constraints. This will drive primary-level institutions to shift from “completing tasks” to “delivering effective health

management”, fully leveraging the guiding role of performance assessment and activating work momentum across the board.

There is no strict sequential order among the six pathways. Organizational integration provides the underlying rules, talent empowerment provides the implementing agents, data empowerment provides the technical tools, resource reciprocity provides material support, service coordination provides the ultimate vehicle, and performance assessment provides incentive and restraint mechanisms. The pathways interact and mutually reinforce one another, aligning with the differentiated and compound reform needs of border ethnic counties.

7. Conclusion

The high-quality development of public hospitals in border ethnic counties is not equivalent to hardware upgrades at the county hospital level; its essence lies in the multi-institutional resource reconfiguration serving multi-ethnic populations. Lufeng County has made progress in supplementing tumor diagnosis and treatment hardware through the medical community model, yet it still faces configurational challenges including the absence of collaborative systems, imbalanced talent structures, information barriers, imbalanced funding allocation, insufficient adapted services, and a lack of outcome-oriented incentives, resulting in a phenomenon of “strong hardware, weak system”. Such regions should not simply replicate the linear reform models of central and eastern China that emphasize heavy equipment acquisition. Instead, they should leverage local resource endowments, rely on the resource integration facilitated by the compact medical community, and adopt a multi-dimensional synergistic approach encompassing institutionalized organization, grassroots-oriented talent deployment, digital information systems, balanced resources, accessible services, and effective performance assessment. This will enable the seamless integration of the full-cycle service chain of “prevention, screening, treatment, management, and rehabilitation” for tumors, optimize the accessible and welfare-enhancing service system adapted to ethnic and mountainous characteristics, and transform the county’s hardware advantages in tumor prevention and treatment into tangible, perceptible, and sustainable health service benefits for all ethnic groups. This effectively meets the healthcare needs of remote ethnic populations for convenient and nearby services, and provides a replicable practical paradigm for the high-quality development of public hospitals and integrated tumor prevention-treatment governance in southwestern border counties.

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