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Cost Control and Financial Accountability Frameworks for National Healthcare Construction Programs

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Abstract

Background: National healthcare construction programs represent major public investments, yet they are frequently affected by cost overruns, schedule delays, and weak financial accountability. These challenges undermine service delivery goals and erode public trust, particularly in resource-constrained and rapidly expanding health systems.

Objective: This study develops a cost control and financial accountability framework tailored for national healthcare construction programs, aimed at improving fiscal discipline, transparency, and value for money across the project life cycle.

Methods: A structured analytical review of peer-reviewed literature, public sector project reports, and international infrastructure governance guidelines was conducted. Key cost drivers and accountability failures were examined across planning, procurement, construction, and commissioning phases. Best practices in cost estimation, budgeting, contract management, performance monitoring, and audit mechanisms were synthesized into an integrated framework aligned with public financial management principles.

Results: The proposed framework emphasizes early-stage cost realism through standardized feasibility studies, risk-adjusted budgeting, and reference class forecasting. Transparent procurement processes, clear contractual risk allocation, and milestone-based payment systems strengthen cost control during execution. Financial accountability is reinforced through real-time cost tracking, independent technical and financial audits, and clearly defined institutional roles and reporting lines. The framework also integrates digital project management platforms and open data dashboards to enhance oversight, stakeholder engagement, and decision-making. Evidence suggests that such integrated approaches significantly reduce cost escalation, improve schedule adherence, and enhance accountability outcomes.

Conclusion: Effective cost control and financial accountability are critical to the success and sustainability of national healthcare construction programs. The framework presented offers policymakers and implementing agencies a practical tool for managing public resources more efficiently while safeguarding project quality and service objectives. By embedding accountability mechanisms throughout the project life cycle and leveraging digital transparency tools, healthcare infrastructure investments can deliver improved value, resilience, and public confidence. Future research should focus on empirical validation through comparative case studies and the development of sector-specific cost benchmarks to further strengthen financial governance in healthcare infrastructure development. Such application supports equitable infrastructure delivery, minimizes fiscal leakage, strengthens institutional capacity, and aligns healthcare construction outcomes with national development plans, universal health coverage goals, and long-term socioeconomic sustainability priorities nationwide globally.

Keywords: Cost Control, Financial Accountability, Healthcare Construction, Public Infrastructure Governance, Project Management, Public Financial Management

1. Introduction

National healthcare construction programs represent some of the largest and most complex public investments undertaken by governments. The development of hospitals, laboratories, clinics, and supporting health infrastructure is essential for expanding access to care, improving service quality, and strengthening health system resilience (Obrik-Uloho, *et al*., 2025).

These projects are capital-intensive, technically demanding, and politically visible, often involving multiple stakeholders, long implementation timelines, and substantial public resources. As such, the effectiveness with which healthcare construction programs are planned and delivered has far-reaching implications not only for health outcomes but also for fiscal sustainability and public trust (Ajayi, *et al*., 2023, Ezeanochie, Akomolafe & Adeyemi, 2023, Oludare, *et al*., 2023).

Despite their strategic importance, national healthcare construction programs are frequently affected by persistent challenges related to cost overruns, schedule delays, and weak financial accountability. Empirical evidence from both high-income and resource-constrained settings shows that healthcare construction projects are particularly vulnerable to budget escalation due to scope changes, inaccurate cost estimates, inflationary pressures, and complex regulatory requirements (Adeniyi, Odejobi & Taiwo, 2025, Ezeh, *et al*., 2025, Oparah, *et al*., 2025). Inadequate feasibility studies, limited risk assessment, and optimistic planning assumptions often result in budgets that fail to reflect true project costs. Once construction is underway, weak contract management and insufficient oversight further compound financial risks, leading to inefficiencies and cost leakage (Atobatele, *et al*., 2019, Didi, Abass & Balogun, 2019).

Accountability challenges are closely intertwined with these cost control issues. Healthcare construction programs often involve fragmented institutional responsibilities, with planning, financing, procurement, and implementation spread across multiple agencies and levels of government. This fragmentation can obscure lines of responsibility, weaken oversight, and limit the ability to enforce financial discipline (Baalah, *et al*., 2025, Ezeh, *et al*., 2025, Michael & Ogunsola, 2025, Oparah, *et al*., 2025). In some contexts, opaque procurement processes and limited transparency in project reporting undermine accountability and increase vulnerability to mismanagement or corruption. Even where formal accountability mechanisms exist, they may be applied inconsistently or lack the technical capacity needed to monitor complex construction activities effectively (Amuta, *et al*., 2020, Egemba, *et al*., 2020).

The consequences of cost overruns and weak accountability extend beyond financial loss. Budget escalation can delay project completion, reduce the scope or quality of facilities, and divert resources from other critical health priorities. In extreme cases, incomplete or abandoned projects represent sunk costs that fail to deliver any health benefits, eroding public confidence in government institutions. These outcomes highlight the need for robust frameworks that integrate cost control and financial accountability throughout the entire project life cycle (Ezeh, *et al*., 2025, Ogayemi, Filani & Osho, 2025, Ogbuagu, *et al*., 2025).

Against this backdrop, developing effective cost control and financial accountability frameworks for national healthcare construction programs has become an urgent policy priority. Such frameworks must address not only technical aspects of cost estimation and monitoring but also the governance and institutional arrangements that shape decision-making and oversight. By contextualizing healthcare construction as a major public investment requiring rigorous financial stewardship, governments can strengthen value for money, enhance transparency, and ensure that infrastructure investments translate into sustainable improvements in health system capacity and population health outcomes (Hungbo, Adeyemi & Ajayi, 2021, Oparah, *et al*., 2021).

2.1 Methodology

National healthcare construction programs were approached as complex, multi-stakeholder public investments whose performance depends on disciplined cost governance, traceable financial flows, and auditable project execution. A design-science and evidence-informed framework development method was adopted to build an implementable cost-control and accountability framework that can be embedded within national health infrastructure delivery cycles. The method began by defining the intervention boundary and unit of analysis as end-to-end capital project delivery for public healthcare infrastructure, from needs identification and feasibility through procurement, construction, commissioning, and handover, including post-handover defect liability and early operations stabilization. Stakeholders were defined to include ministries of health and works, procurement authorities, project management units, finance and audit teams, contractors and consultants, health facility managers, and digital governance owners responsible for data standards and oversight reporting. A logic model was specified linking construction inputs and processes to intermediate outputs (timely project delivery, controlled variations, verified payments, reduced leakage) and system outcomes (infrastructure readiness, service availability, fiscal sustainability, and public trust).

Evidence synthesis was conducted using the provided sources as the primary knowledge base. The synthesis followed a targeted integrative review approach: concepts, mechanisms, and implementation lessons relevant to public-sector accountability, healthcare project management, digital governance, and cost containment were extracted and coded into a structured matrix. The matrix captured (i) cost drivers and common leakage points in large programs (scope creep, weak change control, price volatility, poor contractor performance measurement, fragmented approvals), (ii) accountability mechanisms (segregation of duties, audit trails, payment verification, transparent reporting), (iii) enabling digital capabilities (dashboards, data integration, workflow automation, role-based access control, electronic approvals), and (iv) construction-sector digitalization enablers (BIM for quantities and interfaces, program controls integration with enterprise systems). Parallel extraction focused on how healthcare financial optimization work (revenue cycle and automation models) can translate to capital program governance, particularly through standardized workflows, controls embedded in digital platforms, exception management, and performance dashboards that make financial risk visible early enough for corrective action.

A process and control mapping exercise was then performed to translate the synthesized evidence into a national-program delivery blueprint. The delivery cycle was decomposed into discrete “control gates” aligned to public financial management principles: concept approval, feasibility sign-off, budget appropriation, procurement authorization, contract award, mobilization, milestone certification, payment approval, variation approval, final account settlement, and handover acceptance. For each gate, a control objective, minimum evidence set, responsible roles, and required digital artifacts were defined. A cost breakdown structure and cost baseline template were developed to standardize how budgets are built, tagged, and

monitored across projects, enabling aggregation to portfolio level. Risk and control libraries were created by pairing common program risks (inflated bills of quantities, weak measurement, duplicate payments, unapproved variations, delayed certifications, quality failures leading to rework) with preventive and detective controls (three-way matching of contract–certificate–invoice, independent quantity verification, automated tolerance checks, e-approval workflows, contract KPI scorecards, and audit triggers). This step operationalized accountability by ensuring each financial movement is linked to a verified physical progress record and a defined approval trail.

Framework design proceeded iteratively, producing an integrated model that combines governance structures, financial controls, delivery workflows, and digital reporting in one coherent operating system. Governance elements included a national program steering layer, a delivery layer (project management office/program management unit), and an assurance layer (internal audit, independent verification agents, and external audit), each with clearly separated responsibilities to reduce conflict of interest. Financial accountability was implemented through standardized budget baselines, commitment control (ensuring obligations match appropriations), and change control that requires documented justification, quantified cost/time impact, and multi-level approval for variations. Cost control mechanisms included earned-value style progress tracking adapted to public works reporting, milestone-based disbursement rules, and performance-linked contractor management with corrective action pathways. To increase transparency and reduce administrative friction, workflow automation principles were applied so that approvals, certifications, and reconciliations are executed through controlled digital pathways rather than informal channels, and exceptions are escalated based on risk thresholds.

A digital enablement blueprint was specified to make the framework measurable and enforceable at scale. Program information management requirements were defined for a portfolio dashboard environment that integrates project schedules, cost baselines, contract metadata, payment certificates, variations, and quality inspections into a single reporting layer. Consistent with analytics and informatics themes in the evidence base, the framework mandated minimum datasets, data dictionaries, and validation rules to maintain integrity across sites, contractors, and agencies. Dashboards were designed around decision-useful indicators: budget variance, committed vs. appropriated funds, variation frequency and magnitude, time-to-certification, payment cycle time, physical progress vs. financial progress divergence, audit exceptions, and contractor performance metrics. Where BIM is feasible, the methodology incorporated BIM-enabled quantity verification and interface management to reduce measurement disputes and curb overbilling; where BIM maturity is low, standardized digital measurement templates and independent verification procedures were specified as transitional controls. Role-based access and audit logging were built into the digital concept to protect sensitive financial data while ensuring traceability and accountability.

Framework validation was conducted using structured expert review and scenario walkthroughs. An expert panel approach (or Delphi-style rounds where feasible) was used to test completeness, clarity, feasibility, and control effectiveness. Panelists were selected to represent finance/audit, procurement, construction management, health facility operations, and digital governance. Validation involved stress-testing the framework against realistic scenarios: inflation shocks, contractor underperformance, emergency scope expansion, delayed approvals, and suspected payment irregularities. Feedback was captured, coded, and used to refine control gates, escalation thresholds, KPI definitions, and role assignments. The final output of the method was a consolidated cost-control and financial accountability framework package consisting of (i) governance and operating model, (ii) standardized workflows and control gates, (iii) cost breakdown and baseline templates, (iv) risk-control library and audit triggers, (v) digital reporting and data governance blueprint, and (vi) an implementation roadmap describing phased rollout, capacity building, change management, and monitoring schedules suitable for national adoption across diverse regions and facility types.

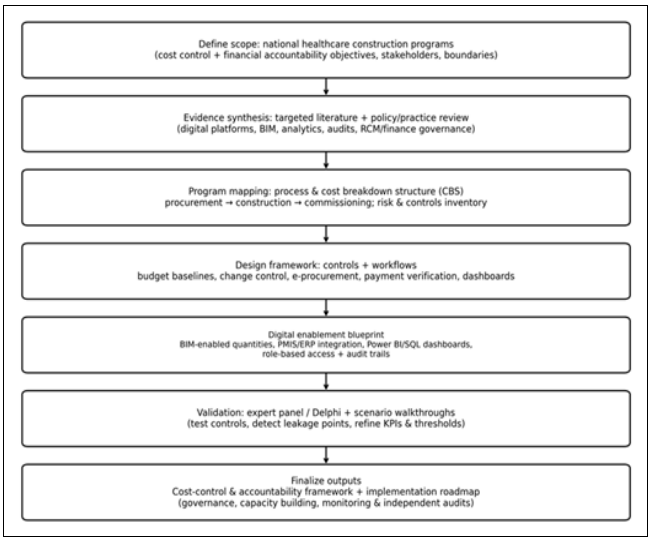

Fig 1: Flowchart of the study methodology

2.2 Theoretical Foundations of Cost Control and Public Financial Accountability

The theoretical foundations of cost control and public financial accountability in national healthcare construction programs draw from an interdisciplinary body of knowledge encompassing project management theory, public financial management, and infrastructure governance. Together, these perspectives provide a conceptual basis for understanding why cost overruns and accountability failures persist in healthcare construction and how structured frameworks can mitigate these risks (Ajayi, *et al*., 2023, Ogunsola & Michael, 2023, Oshoba, Ahmed & Odejobi, 2023). Healthcare infrastructure projects are uniquely complex due to their technical demands, regulatory constraints, social importance, and long implementation horizons, making the integration of these theories particularly relevant (Hungbo & Adeyemi, 2019, Patrick, *et al*., 2019).

Project management theory provides the most immediate lens through which cost control in construction is understood. Traditional project management models emphasize the "iron triangle" of cost, time, and quality, asserting that effective project performance requires balancing these three interdependent constraints (Michael & Ogunsola, 2023, Odejobi, Hammed & Ahmed, 2023, Ogunsola & Michael, 2023). In healthcare construction, cost

control is influenced by scope definition, scheduling accuracy, risk management, and change control processes. Theories of project planning and control stress the importance of early-stage feasibility studies, realistic cost estimation, and baseline setting as prerequisites for financial discipline (Asogwa, *et al*., 2022, Ezeanochie, Akomolafe & Adeyemi, 2022). Techniques such as work breakdown structures, critical path analysis, earned value management, and reference class forecasting are grounded in project management theory and are widely regarded as essential tools for monitoring expenditure and detecting deviations early. From this theoretical perspective, cost overruns are often attributed to optimism bias, scope creep, and inadequate risk identification during project initiation. Figure 2 shows conceptual framework for understanding the organization of health financing systems presented by Kutzin, 2008.

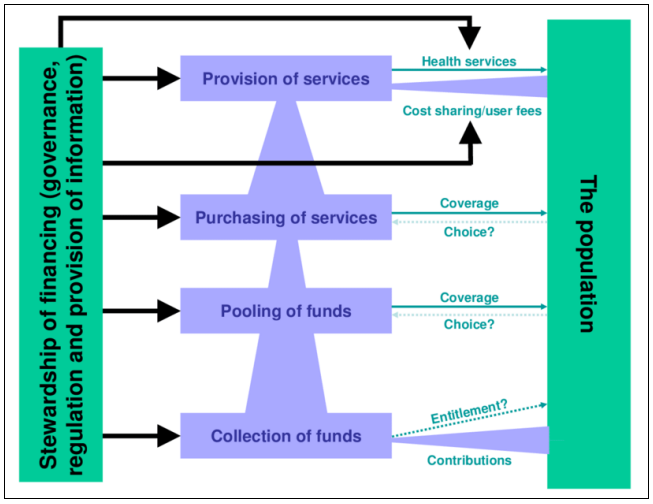

Fig 2: Conceptual framework for understanding the organization of health financing systems (Kutzin, 2008)

Risk management theory within project management further explains cost escalation in healthcare construction. Healthcare facilities are exposed to a wide range of uncertainties, including design changes driven by evolving clinical standards, regulatory approvals, market price volatility, and technological advancements. Risk management theory emphasizes systematic identification, assessment, allocation, and mitigation of risks throughout the project life cycle (Ezeh, *et al*., 2023, Odejobi, Hammed & Ahmed, 2023, Onyelucheya, *et al*., 2023). When risks are poorly understood or inappropriately transferred through contracts, costs tend to escalate during construction. Theoretical models advocate for risk-adjusted budgeting and contingency planning as integral components of cost control, reinforcing the idea that uncertainty must be explicitly managed rather than implicitly ignored (Patrick & Samuel, 2025, Sherifat, *et al*., 2025, Udensi, *et al*., 2025).

Public financial management theory extends the analysis beyond individual projects to the broader fiscal and institutional environment in which healthcare construction programs operate. Public financial management focuses on how governments plan, allocate, execute, and account for public resources in a manner that promotes efficiency, transparency, and accountability (Ezeh, *et al*., 2024, Michael & Ogunsola, 2024, Ogunsola & Michael, 2024, Uduokhai, *et al*., 2024). Core principles include budget credibility, comprehensiveness, transparency, predictability, and control. Within this framework, cost control in healthcare construction is not merely a technical project issue but a function of how projects are integrated into national budgeting processes. Weak links between capital planning, medium-term expenditure frameworks, and annual budgets often lead to funding gaps, delayed payments, and ad hoc cost increases (Akinrinoye, *et al*., 2023, Ezeani, *et al*., 2023).

Accountability is a central concept in public financial management theory and is closely tied to cost control. Accountability frameworks emphasize clear assignment of roles and responsibilities, transparent reporting, and effective oversight by legislative bodies, audit institutions, and the public. In healthcare construction programs, accountability failures often arise from fragmented institutional arrangements where multiple agencies share responsibility for planning, procurement, and implementation (Abass, Balogun & Didi, 2024, Ezeh, *et al*., 2024, Omotayo, *et al*., 2024). Public financial management theory highlights the importance of unified reporting systems, standardized financial controls, and independent audits to ensure that expenditures align with approved budgets and intended outcomes. Without such mechanisms, cost overruns may go undetected or unaddressed until projects are significantly over budget. Figure 3 shows framework for cost control of construction projects presented by Yang, Li & Yang, 2023.

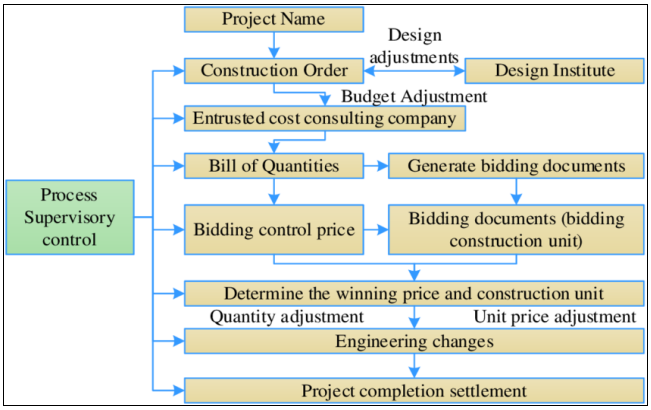

Fig 3: Framework for cost control of construction projects (Yang, Li & Yang, 2023)

Infrastructure governance theory provides a complementary perspective by focusing on the institutional, political, and relational dimensions of large-scale public investments. Governance theory recognizes that infrastructure projects are embedded in complex networks of actors, including government ministries, contractors, consultants, financiers, and communities. Decision-making is influenced not only by technical considerations but also by power relations, incentives, and accountability structures (Ajayi, *et al*., 2023, Onyelucheya, *et al*., 2023, Oshoba, Ahmed & Odejobi, 2023). From this viewpoint, cost overruns in healthcare construction are often symptoms of governance weaknesses, such as poor coordination, conflicting objectives, and inadequate stakeholder engagement. Infrastructure governance theory underscores the need for coherent governance frameworks that align incentives, enforce accountability, and support long-term value creation (Amuta, *et al*., 2021, Egemba, *et al*., 2021).

The concept of value for money is a unifying principle across project management, public financial management, and infrastructure governance theories. Value for money extends beyond minimizing initial costs to encompass efficiency, effectiveness, and economy over the asset's life cycle. In healthcare construction, this perspective challenges narrow cost-cutting approaches that compromise quality or functionality (Olatunji, *et al*., 2023, Oparah, *et al*., 2023, Uduokhai, *et al*., 2023). Theoretical models emphasize life-cycle costing, which considers capital costs alongside operation, maintenance, and eventual replacement. By adopting a life-cycle view, decision-makers can better assess trade-offs between upfront investment and long-term performance, aligning financial accountability with sustainable health outcomes (Adeyemi, *et al*., 2021, Halliday, 2021).

Institutional theory further enriches the understanding of cost control and accountability by examining how formal rules, norms, and organizational cultures shape behavior. In many public sector contexts, informal practices and political pressures can undermine formal financial controls. Institutional theory suggests that strengthening cost control requires not only technical reforms but also cultural change within public organizations (Atobatele, Hungbo & Adeyemi, 2019). This includes fostering norms of transparency, professional competence, and ethical conduct among officials involved in healthcare construction programs. Figure 4 shows conceptual framework for economic case for PHC investment presented by Anderson, *et al*., 2018.

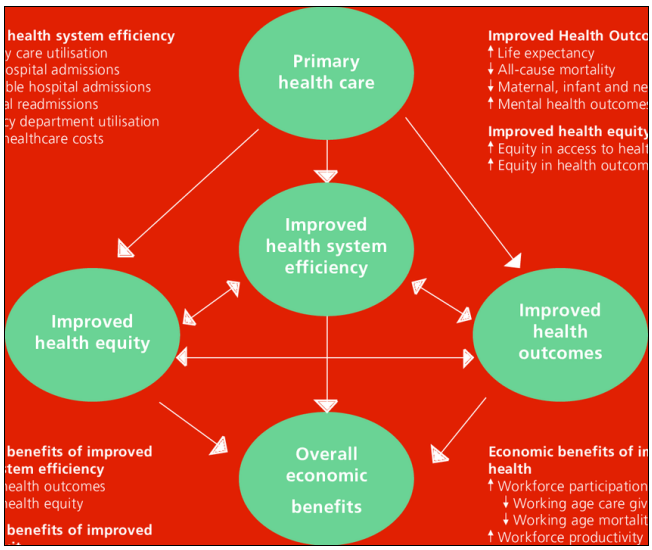

Fig 4: Conceptual framework for economic case for PHC investment (Anderson, *et al*., 2018)

Collectively, these theoretical foundations demonstrate that effective cost control and public financial accountability in national healthcare construction programs depend on the integration of project-level management practices with system-level financial governance and institutional accountability (Ezeh, *et al*., 2025, Michael & Ogunsola, 2025, Oparah, *et al*., 2025, Sanusi, Chinwendu & Kehinde, 2025). Project management theory provides tools for planning and monitoring costs, public financial management theory ensures fiscal discipline and transparency, and infrastructure governance theory addresses coordination and incentive alignment among stakeholders. When these perspectives are applied in isolation, reforms are often partial and ineffective (Atobatele, *et al*., 2021, Oparah, *et al*., 2021). When integrated, they offer a robust conceptual framework for designing cost control and accountability mechanisms capable of safeguarding public investment and ensuring that healthcare construction delivers lasting value to society (Udechukwu, 2025).

2.3 Cost Drivers and Risk Factors in National Healthcare Construction Programs

National healthcare construction programs are inherently complex undertakings, characterized by high capital intensity, long project timelines, and significant public visibility. These features make them particularly vulnerable to cost overruns and inefficiencies, which have been widely documented across both developed and developing health systems. Understanding the cost drivers and risk factors that contribute to budget escalation is essential for designing effective cost control and financial accountability frameworks. These drivers are multifaceted, spanning technical, financial, institutional, and political domains, and they often interact in ways that compound risks rather than operate in isolation (Asogwa, *et al*., 2024, Egemba, *et al*., 2024, Omotayo, *et al*., 2024).

Technical factors are among the most immediate and visible contributors to cost escalation in healthcare construction. Healthcare facilities are technically sophisticated structures that must accommodate specialized clinical functions, advanced medical equipment, and stringent safety standards. Inadequate project scoping and design development at early stages frequently lead to underestimated costs (Ezeh, *et al*., 2024, Michael & Ogunsola, 2024, Oparah, *et al*., 2024, Uduokhai, *et al*., 2024). When clinical requirements are poorly defined or evolve during construction, design changes become inevitable, triggering variations, rework, and delays. Technological advancements in medical equipment and treatment modalities can also alter space, power, and environmental requirements mid-project, increasing both construction and installation costs (Hungbo, Adeyemi & Ajayi, 2020, Pamela, *et al*., 2020). Additionally, poor site investigations, inaccurate assessments of ground conditions, and insufficient integration of building systems can result in unforeseen technical challenges that drive up costs during construction.

Financial risk factors further exacerbate these technical challenges. Inflation in construction materials, labor costs, and equipment prices can significantly affect project budgets, particularly in long-duration healthcare projects. Inadequate financial planning that fails to account for inflation, exchange rate volatility, or supply chain disruptions often leads to funding gaps (Olatunji, *et al*., 2023, Oziri, *et al*., 2023, Rukh, Seyi-Lande & Oziri, 2023, Uduokhai, *et al*., 2023). Weak cost estimation practices, including reliance on outdated benchmarks or optimistic assumptions, contribute to unrealistic budgets that are difficult to maintain. Delayed payments to contractors, common in publicly funded projects, can increase financing costs and lead to claims, disputes, and schedule slippage, all of which translate into higher overall expenditure (Adeleke & Ajayi, 2023, Ezeh, *et al*., 2023, Ogbuagu, *et al*., 2023).

Institutional factors play a critical role in shaping how technical and financial risks are managed. Fragmented institutional arrangements are a recurring challenge in national healthcare construction programs. Responsibilities for planning, budgeting, procurement, and implementation

are often distributed across multiple ministries, agencies, and levels of government. This fragmentation can lead to poor coordination, inconsistent decision-making, and unclear accountability for cost control. Weak institutional capacity, particularly in project management and financial oversight, limits the ability of public agencies to monitor complex construction activities effectively (Amuta, *et al*., 2023, Ezeani, 2023, Udensi, *et al*., 2023). In some contexts, the absence of standardized procedures for cost estimation, contract management, and reporting further undermines financial discipline.

Procurement and contracting practices represent another institutional risk factor. Inadequate procurement planning, poorly drafted contracts, and inappropriate risk allocation between public clients and contractors can create incentives for cost escalation. Contracts that lack clear performance requirements or mechanisms for managing variations may encourage opportunistic behavior and excessive claims (Nwaigbo, *et al*., 2025, Sanusi, 2025, Uduokhai, *et al*., 2025). Conversely, overly rigid contracts that transfer excessive risk to contractors can lead to inflated bid prices or compromised quality. Institutional weaknesses in procurement oversight and dispute resolution mechanisms often result in prolonged conflicts that increase project costs and delay completion (Patrick & Samuel, 2025, Udensi, *et al*., 2025).

Political factors introduce additional layers of complexity and risk to national healthcare construction programs. Healthcare infrastructure projects are highly visible and politically sensitive, making them susceptible to political interference and short-term decision-making. Changes in political leadership or policy priorities can disrupt project continuity, leading to scope changes, funding reallocation, or delays (Oziri, *et al*., 2023, Sanusi, Bayeroju & Nwokediegwu, 2023, Uduokhai, *et al*., 2023). Political pressure to announce projects prematurely or to meet symbolic deadlines may result in inadequate preparation and rushed approvals, increasing the likelihood of cost overruns later. In some cases, political considerations influence site selection, contractor choice, or project scope in ways that undermine technical and financial rationality (Ameh, *et al*., 2022, Ogayemi, Filani & Osho, 2022).

Corruption and governance-related risks, while not universal, remain significant contributors to inefficiencies in some healthcare construction programs. Lack of transparency in procurement, weak enforcement of regulations, and limited accountability can create opportunities for rent-seeking behavior. Such practices distort cost structures, inflate prices, and reduce value for money. Even where outright corruption is absent, informal practices and patronage networks can weaken adherence to formal cost control mechanisms and accountability standards (Ezeh, *et al*., 2025, Obadimu, *et al*., 2025, Oparah, *et al*., 2025).

The interaction among technical, financial, institutional, and political factors often amplifies their individual effects. For example, weak institutional capacity may limit the ability to manage technical complexity, while political interference may exacerbate financial instability by disrupting funding flows (Udechukwu, 2025). Similarly, inadequate financial planning can constrain technical solutions, leading to suboptimal design choices that increase long-term costs. These interdependencies highlight the need for integrated risk assessment approaches that consider the full spectrum of cost drivers rather than addressing them in isolation (Hungbo & Adeyemi, 2019).

In addition, external risk factors such as natural disasters, public health emergencies, and global supply chain disruptions can significantly affect healthcare construction costs. The COVID-19 pandemic, for instance, exposed vulnerabilities in construction supply chains and labor availability, leading to delays and cost escalation in many projects worldwide. While such risks may be unpredictable, their impact underscores the importance of contingency planning and adaptive management within cost control frameworks (Amuta, *et al*., 2021, Elebe, Imediegwu & Filani, 2021).

In conclusion, cost drivers and risk factors in national healthcare construction programs are complex, interrelated, and deeply embedded in technical, financial, institutional, and political contexts. Budget escalation and inefficiencies rarely result from a single cause; rather, they emerge from the cumulative effect of multiple weaknesses across the project life cycle (Oziri, Arowogbadamu & Seyi-Lande, 2025, Uduokhai, *et al*., 2025, Ukamaka, *et al*., 2025). Effective cost control and financial accountability frameworks must therefore address these diverse drivers holistically, strengthening early planning and design, improving financial management practices, enhancing institutional capacity, and insulating project decisions from undue political influence. By understanding and mitigating these risks, governments can improve value for money, protect public resources, and ensure that healthcare construction programs deliver sustainable and equitable health infrastructure (Adegoke, Odugbose & Adeyemi, 2024, Ogbuagu, *et al*., 2024, Oparah, *et al*., 2024).

2.4 Cost Estimation and Budgeting Strategies for Healthcare Infrastructure

Effective cost estimation and budgeting strategies are foundational to cost control and financial accountability in national healthcare construction programs. Given the scale, complexity, and long implementation horizons of healthcare infrastructure projects, early-stage financial decisions have a disproportionate influence on eventual outcomes (Udechukwu, *et al*., 2025). Inaccurate or overly optimistic estimates established during planning often become entrenched, creating structural pressures that lead to cost overruns, scope reductions, or compromised quality. Robust cost estimation and budgeting approaches therefore play a critical role in safeguarding public resources and ensuring that healthcare construction investments translate into functional and sustainable assets (Adeyemi, *et al*., 2021, Olatunji, *et al*., 2021).

Feasibility studies represent the first and arguably most important stage in establishing realistic cost expectations for healthcare infrastructure projects. A comprehensive feasibility study goes beyond technical design considerations to assess financial viability, institutional capacity, demand projections, and implementation risks. In healthcare construction, feasibility studies must account for clinical service requirements, regulatory compliance, site conditions, utility infrastructure, and long-term operational implications (Bayeroju, Sanusi & Nwokediegwu, 2021, Rukh, Oziri & Seyi-Lande, 2023, Uduokhai, *et al*., 2023). Weak or superficial feasibility assessments frequently result in underestimated costs, as critical assumptions about land acquisition, equipment integration, staffing, and regulatory

approvals are overlooked (Pamela, *et al*., 2021, Umoren, 2021). By contrast, rigorous feasibility studies provide an evidence-based foundation for cost estimation, enabling decision-makers to assess affordability, prioritize investments, and align projects with national health strategies and fiscal constraints.

Within feasibility studies, early cost estimation techniques play a crucial role in shaping budget credibility. At this stage, estimates are necessarily high-level, but they must be grounded in realistic assumptions and informed by comparable projects. Healthcare facilities are not generic buildings; their cost structures are heavily influenced by specialized spaces, infection control requirements, medical equipment, and building systems. Failure to reflect these factors adequately can lead to systematic underestimation. Incorporating multidisciplinary input from clinicians, engineers, quantity surveyors, and financial analysts strengthens the accuracy of early estimates and reduces the likelihood of costly revisions later (Adeleke & Ajayi, 2024, Ezeanochie, Akomolafe & Adeyemi, 2024, Udensi, *et al*., 2024).

Reference class forecasting has emerged as a powerful tool for improving cost estimation accuracy in large public infrastructure projects, including healthcare construction. This approach involves comparing proposed projects with a statistically relevant set of completed projects of similar scope, complexity, and context (Akinrinoye, *et al*., 2024, Seyi-Lande, Arowogbadamu & Oziri, 2024, Uduokhai, *et al*., 2024). By examining actual cost outcomes rather than planned estimates, reference class forecasting helps counteract optimism bias and strategic misrepresentation, which are common in public sector planning. In healthcare construction programs, applying reference class forecasting allows planners to identify typical cost overruns and adjust budgets accordingly. This method shifts the focus from what planners believe will happen to what has historically occurred, improving realism and transparency in budgeting decisions (Atobatele, *et al*., 2022, Ogbuagu, *et al*., 2022).

Risk-adjusted budgeting builds on feasibility analysis and reference class forecasting by explicitly incorporating uncertainty into cost estimates. Healthcare construction projects face numerous risks, including design changes, regulatory delays, market volatility, and unforeseen site conditions. Traditional budgeting approaches often treat these uncertainties implicitly or assume they can be managed within tight cost ceilings (Udechukwu, *et al*., 2025). Risk-adjusted budgeting, by contrast, involves identifying key risks, estimating their probability and potential impact, and incorporating these estimates into the overall budget. This approach acknowledges that uncertainty is inherent and that credible budgets must reflect the true risk profile of the project (Amuta, *et al*., 2021, Loto, Ajibare & Okunade, 2021).

Quantitative risk analysis techniques, such as Monte Carlo simulations, are increasingly used in large infrastructure programs to model cost variability and inform risk-adjusted budgets. By generating a range of possible cost outcomes and associated probabilities, these methods provide decision-makers with a more nuanced understanding of financial exposure (Bayeroju, Sanusi & Nwokediegwu, 2023, Uduokhai, *et al*., 2023). In healthcare construction, where delays or design changes can have cascading effects on cost, such analyses support more informed decisions about funding levels, contingency allocation, and risk mitigation strategies. Importantly, risk-adjusted budgeting enhances accountability by making assumptions about uncertainty explicit rather than hidden within optimistic estimates (Hungbo, Adeyemi & Ajayi, 2025, Ogbuagu, *et al*., 2025, Udensi, *et al*., 2025).

Contingency planning is a closely related component of effective budgeting strategies. Contingencies are financial provisions set aside to address unforeseen events or cost increases that cannot be precisely predicted at the planning stage. In healthcare infrastructure projects, contingencies are often underfunded or treated as negotiable buffers that can be reduced to meet political or fiscal constraints (Bayeroju, Sanusi & Nwokediegwu, 2023, Seyi-Lande, Arowogbadamu & Oziri, 2023). This practice undermines financial resilience and increases the likelihood of cost overruns when risks materialize. A well-designed contingency framework distinguishes between different types of contingencies, such as design development contingencies, construction contingencies, and escalation allowances, each aligned with specific risk categories (Ajayi, *et al*., 2025, Balogun, *et al*., 2025, Oparah, *et al*., 2025).

Effective contingency planning also requires clear governance rules governing when and how contingency funds can be accessed. Without such rules, contingencies may be used to absorb avoidable inefficiencies or scope changes unrelated to genuine risk events. Transparent approval processes and documentation requirements help ensure that contingency use is justified and traceable, reinforcing financial accountability. As projects progress and uncertainties are resolved, contingencies can be progressively reduced or reallocated, reflecting improved cost certainty and strengthening budget discipline (Ameh, *et al*., 2024, Ezeani, *et al*., 2024, Ogbuagu, *et al*., 2024).

Integrating these cost estimation and budgeting strategies into national healthcare construction programs requires alignment with public financial management systems. Budgets derived from feasibility studies, reference class forecasting, and risk-adjusted analysis must be integrated into medium-term expenditure frameworks and annual budget processes. When capital budgets are disconnected from long-term financial planning, projects are vulnerable to funding interruptions that increase costs through delays and contract claims. Aligning cost estimates with realistic funding commitments enhances predictability and reduces the risk of ad hoc budget adjustments (Ayeni& Olagoke-Komolafe, 2024, Ezeh, *et al*., 2024, Udensi, *et al*., 2024).

Institutional capacity is a critical enabler of effective cost estimation and budgeting. Public sector agencies responsible for healthcare construction must possess or have access to technical expertise in cost engineering, risk analysis, and financial modeling. Where such capacity is limited, reliance on external consultants may be necessary, but this should be complemented by internal knowledge transfer to ensure sustainability. Standardized guidelines, cost databases, and benchmarking tools further support consistency and transparency across projects and programs (Amuta, *et al*., 2021, Ezeh, *et al*., 2021).

In conclusion, cost estimation and budgeting strategies for healthcare infrastructure are central to cost control and financial accountability in national construction programs. Rigorous feasibility studies establish a realistic foundation, reference class forecasting counters systematic bias, risk-adjusted budgeting explicitly incorporates uncertainty, and robust contingency planning enhances financial resilience

(Arowogbadamu, Oziri & Seyi-Lande, 2024, Oparah, *et al*., 2024, Rukh, Seyi-Lande & Oziri, 2024, Uduokhai, *et al*., 2024). When these approaches are applied systematically and integrated into public financial management frameworks, they significantly reduce the likelihood of budget escalation and improve value for money. Strengthening these strategies is essential for ensuring that healthcare construction investments deliver durable, high-quality infrastructure while safeguarding public resources and maintaining public trust (Adegoke, Odugbose & Adeyemi, 2024, Odugbose, Adegoke & Adeyemi, 2024).

2.5 Procurement, Contracting, and Risk Allocation Mechanisms

Procurement, contracting, and risk allocation mechanisms are central determinants of cost control and financial accountability in national healthcare construction programs. The way projects are procured, contracts are structured, incentives are designed, and risks are shared between public clients and private contractors has a direct and lasting influence on project costs, delivery timelines, and value for money (Udechukwu, *et al*., 2025). In healthcare construction, where technical complexity, regulatory requirements, and public scrutiny are high, poorly designed procurement and contracting arrangements frequently become key drivers of budget escalation and inefficiency (Ezeh, *et al*., 2025, Obadimu, *et al*., 2025, Okojie, *et al*., 2025).

Procurement models define how contractors and suppliers are selected and how competition is structured. Traditional design–bid–build models, commonly used in public sector healthcare construction, separate design and construction responsibilities and award contracts primarily on the basis of lowest price. While this model can promote price competition and transparency, it often incentivizes underbidding, followed by cost recovery through variations and claims once construction begins (Shah, Oziri & Seyi-Lande, 2025, Sanusi, 2025, Ukasoanya, *et al*., 2025). In healthcare projects, where design evolves in response to clinical input and regulatory review, this separation can lead to frequent scope changes and disputes, undermining cost control. Alternative procurement models, such as design–build or integrated project delivery, aim to address these weaknesses by aligning design and construction responsibilities and encouraging earlier collaboration among stakeholders (Atobatele, Hungbo & Adeyemi, 2019).

Design–build procurement models have been associated with improved cost predictability in healthcare construction by reducing interface risks between designers and contractors. When a single entity is responsible for both design and construction, there is greater incentive to optimize constructability and manage costs proactively. However, this model requires strong client capacity to define performance requirements clearly and to evaluate bids beyond price alone. Without adequate oversight, design–build arrangements can shift risk in ways that compromise quality or long-term operational performance, highlighting the importance of balanced procurement design (Pamela, *et al*., 2022).

Public–private partnership models represent a further evolution in procurement, particularly for large healthcare infrastructure programs. These arrangements often bundle design, construction, financing, and sometimes operation into long-term contracts. When appropriately structured, they can incentivize life-cycle cost optimization and innovation by linking contractor returns to asset performance (Akinrinoye, *et al*., 2020, Sanusi, Bayeroju & Nwokediegwu, 2023). Evidence suggests that public–private partnerships can enhance cost discipline during construction due to rigorous upfront planning and private sector financing scrutiny. However, they also introduce complexity and require sophisticated contract management capacity. Poorly negotiated partnerships may obscure costs, limit flexibility, and create long-term fiscal commitments that reduce transparency and accountability (Adeyemi, *et al*., 2022, Ogbuagu, *et al*., 2022).

Contract types are closely linked to procurement models and play a critical role in shaping cost behavior. Lump-sum or fixed-price contracts are often favored for cost control because they provide price certainty and transfer cost overrun risk to contractors. In healthcare construction, however, fixed-price contracts can be problematic when project scope is not fully defined at contract award (Arowogbadamu, Oziri & Seyi-Lande, 2023, Sanusi, Bayeroju & Nwokediegwu, 2023). Contractors may price in risk premiums or aggressively pursue variations, leading to adversarial relationships and increased administrative costs. Conversely, cost-plus or reimbursable contracts offer flexibility in managing evolving requirements but provide weaker incentives for cost efficiency unless paired with robust oversight and incentive mechanisms (Amuta, *et al*., 2024, Davies, *et al*., 2024, Ogbuagu, *et al*., 2024).

Hybrid contract types, such as guaranteed maximum price contracts, attempt to balance flexibility and cost control. Under these arrangements, contractors are reimbursed for actual costs up to a predefined ceiling, beyond which they bear the risk. This structure can encourage collaboration and transparency while protecting the public client from unlimited cost escalation. In healthcare construction programs, guaranteed maximum price contracts have been used to manage uncertainty during early design stages while maintaining cost discipline as scope becomes clearer. Their effectiveness, however, depends on accurate cost baselines, clear change management processes, and trust between parties (Atobatele, *et al*., 2022, Olatunji, *et al*., 2022).

Incentive structures embedded within contracts significantly influence contractor behavior and cost outcomes. Traditional public sector contracts often focus on penalties for delay or non-compliance, which can foster defensive behavior rather than proactive cost management. Performance-based incentives, by contrast, reward contractors for achieving or exceeding targets related to cost, schedule, quality, or sustainability. In healthcare construction, incentives tied to early completion, cost savings, or reduced life-cycle costs can align contractor objectives with public value. Shared savings arrangements, where cost underruns are split between client and contractor, encourage innovation and efficiency, provided that savings do not come at the expense of quality or safety (Adeleke & Ajayi, 2024, Ezeanochie, Akomolafe & Adeyemi, 2024, Oparah, *et al*., 2024).

Risk allocation is perhaps the most critical and misunderstood aspect of contracting in healthcare construction. Effective cost control depends on allocating risks to the parties best able to manage them. In practice, public clients often attempt to transfer excessive risk to contractors through rigid contract terms. While this may appear to protect public finances, it frequently results in higher bid prices, increased claims, and adversarial

relationships. For example, transferring design risk to contractors without providing sufficient information or decision-making authority can lead to disputes and cost escalation. Similarly, allocating risks related to regulatory approvals or unforeseeable site conditions to contractors can create inefficiencies, as these risks are often beyond their control (Amuta, *et al*., 2022, Moruf, Durojaiye & Okunade, 2022).

Balanced risk-sharing arrangements recognize that some risks, such as changes in clinical standards or public policy, are more appropriately retained by the public sector. Other risks, such as construction means and methods, productivity, and supply chain management, are better managed by contractors. Clear risk allocation matrices and contractual provisions that define responsibilities and compensation mechanisms reduce ambiguity and support cooperative problem-solving. In healthcare construction programs, evidence shows that projects with well-defined and realistic risk allocation experience fewer disputes and better cost outcomes (Patrick & Samuel, 2022).

Procurement and contracting mechanisms also influence financial accountability through their impact on transparency and oversight. Competitive procurement processes with clear evaluation criteria enhance accountability by demonstrating that public funds are allocated based on merit and value for money. Contract provisions that require detailed cost reporting, open-book accounting, and regular audits strengthen financial oversight during construction. These mechanisms are particularly important in large healthcare programs, where complexity and scale increase the risk of cost leakage and mismanagement (Hungbo, Adeyemi & Ajayi, 2025, Obadimu, *et al*., 2025, Oparah, *et al*., 2025).

Institutional capacity is a critical enabler of effective procurement, contracting, and risk allocation. Public agencies must possess the skills to design appropriate procurement strategies, evaluate complex bids, negotiate contracts, and manage relationships throughout the project life cycle. Weak capacity undermines even well-designed frameworks, leading to poor enforcement of contract terms and inadequate response to emerging risks. Capacity building, standardized procurement guidelines, and access to legal and technical expertise are therefore essential components of cost control and accountability frameworks (Adegoke, Odugbose & Adeyemi, 2024, Obadimu, *et al*., 2024, Olorunsogo, *et al*., 2024).

In conclusion, procurement models, contract types, incentive structures, and risk-sharing arrangements exert a profound influence on cost control and financial accountability in national healthcare construction programs. No single model or contract type is universally optimal; effectiveness depends on project complexity, institutional capacity, and risk profile. However, evidence consistently shows that transparent procurement, balanced risk allocation, performance-oriented incentives, and strong contract management improve cost predictability and value for money. Integrating these mechanisms into coherent frameworks is essential for ensuring that healthcare construction investments deliver high-quality infrastructure while safeguarding public resources (Adeyemi, *et al*., 2022, Oparah, *et al*., 2022).

2.6 Financial Monitoring, Reporting, and Audit Systems

Financial monitoring, reporting, and audit systems are central pillars of cost control and financial accountability in national healthcare construction programs. Given the scale, complexity, and public significance of healthcare infrastructure investments, robust oversight mechanisms are essential to ensure that allocated funds are used efficiently, transparently, and in accordance with approved objectives. Without effective financial monitoring and accountability structures, even well-designed budgets and procurement frameworks are vulnerable to cost overruns, misallocation of resources, and erosion of public trust (Adeyemi, Adegoke & Odugbose, 2024, Muonde, *et al*., 2024, Ogbuagu, *et al*., 2024).

Real-time cost tracking plays a critical role in strengthening financial discipline throughout the construction life cycle. Traditional reporting systems in public sector construction often rely on periodic, retrospective financial reports that identify problems only after significant deviations have occurred. In healthcare construction programs, where delays or scope changes can rapidly escalate costs, this lag undermines timely decision-making. Real-time cost tracking systems enable continuous monitoring of expenditures against approved budgets, work progress, and contractual milestones. By integrating financial data with project schedules and physical progress indicators, project managers and oversight bodies can identify emerging cost pressures early and implement corrective measures before overruns become entrenched (Amuta, *et al*., 2022, Ezeh, *et al*., 2022).

Digital project management platforms increasingly support real-time cost tracking by consolidating data from contractors, consultants, and supervising agencies into centralized dashboards. These platforms enhance transparency by providing consistent and up-to-date information on commitments, disbursements, and remaining contingencies. In national healthcare construction programs, such systems are particularly valuable due to the involvement of multiple stakeholders and funding streams. Real-time visibility into financial performance reduces information asymmetry, limits opportunities for cost manipulation, and supports evidence-based decision-making at both project and program levels (Atobatele, Hungbo & Adeyemi, 2019).

Performance measurement complements cost tracking by linking financial inputs to outputs and outcomes. Financial accountability is strengthened when expenditures are assessed not only in terms of compliance with budgets but also in relation to delivery performance. Key performance indicators such as cost variance, schedule variance, unit costs, and productivity rates provide structured metrics for evaluating efficiency. In healthcare construction, performance measurement should also consider qualitative dimensions, including adherence to technical specifications, quality standards, and safety requirements, as cost savings achieved at the expense of functionality or compliance undermine long-term value (Adegoke, Odugbose & Adeyemi, 2024, Odugbose, Adegoke & Adeyemi, 2024).

Effective performance measurement systems enable benchmarking across projects and facilities within national programs. By comparing performance metrics across similar healthcare construction projects, governments can identify

systemic inefficiencies, assess contractor performance, and refine planning assumptions for future investments. Benchmarking also strengthens accountability by setting clear expectations and enabling objective evaluation of whether projects deliver value for money. When performance data are publicly reported or shared with oversight institutions, they further reinforce transparency and institutional learning (Adeyemi, *et al*., 2023, Ibrahim, Abdulsalam & Farounbi, 2023).

Independent audits are a cornerstone of public financial accountability, providing objective assurance that financial information is accurate, expenditures are justified, and controls are functioning as intended. In national healthcare construction programs, audits play a critical role in detecting irregularities, verifying compliance with laws and contracts, and assessing the effectiveness of internal control systems. Financial audits examine whether funds have been spent in accordance with approved budgets and accounting standards, while performance audits assess whether projects have achieved their intended objectives efficiently and economically (Atobatele, *et al*., 2023, Ogayemi, Filani & Osho, 2023).

The independence of audit institutions is fundamental to their credibility and effectiveness. Auditors must be insulated from political or administrative interference to provide impartial assessments of complex and often sensitive construction programs. Evidence from public infrastructure projects shows that strong supreme audit institutions contribute to improved financial discipline by increasing the likelihood that mismanagement or inefficiencies will be identified and addressed. In healthcare construction, where projects are politically visible and technically complex, independent audits serve as a critical check on executive authority and contractor behavior (Adeleke, 2023, Ezeh Funmi, *et al*., 2023, Olatunji, *et al*., 2023).

Compliance mechanisms complement audits by ensuring that financial rules, procurement regulations, and contractual obligations are consistently applied throughout the project life cycle. Compliance systems include internal controls, approval hierarchies, segregation of duties, and standardized procedures for financial transactions. In national healthcare construction programs, weak compliance mechanisms often result from fragmented institutional responsibilities and limited capacity. Strengthening compliance requires clear guidelines, training for staff, and enforcement mechanisms that apply proportionate sanctions for violations (Akinrinoye, *et al*., 2020, Sanusi, Bayeroju & Nwokediegwu, 2023, Uduokhai, *et al*., 2023).

An important aspect of compliance is ensuring adherence to approved scope and change management procedures. Unauthorized scope changes are a common source of cost overruns in healthcare construction, particularly when driven by political pressure or informal decision-making. Robust compliance systems require that all variations be formally justified, costed, and approved through defined governance structures. This process not only controls costs but also creates an auditable trail that supports accountability and transparency (Amuta, *et al*., 2022, Oludare, *et al*., 2022).

The integration of financial monitoring, reporting, and audit systems enhances their collective effectiveness. When real-time cost tracking feeds into performance measurement frameworks and audit processes, oversight becomes more proactive and less reactive. For example, auditors can use real-time financial data to conduct risk-based audits, focusing attention on projects or contracts exhibiting unusual cost patterns. Similarly, performance measurement data can inform audit planning and policy review, strengthening the feedback loop between implementation and governance (Patrick & Samuel, 2020).

Transparency is a cross-cutting benefit of strong financial monitoring and accountability systems. Transparent reporting of project costs, progress, and performance builds public confidence in healthcare construction programs and reinforces democratic accountability. In contexts where public trust in large infrastructure projects is fragile, transparency can reduce suspicion and resistance, enabling smoother implementation. Open reporting also creates reputational incentives for contractors and public officials to adhere to best practices, complementing formal compliance mechanisms (Akinrinoye, *et al*., 2025, Asere, *et al*., 2025, Nwafor, *et al*., 2025, Sanusi, 2025, Ukamaka, *et al*., 2025).

Capacity is a critical enabler of effective financial monitoring and accountability. Public agencies responsible for overseeing healthcare construction programs must possess the technical skills to interpret financial data, assess performance indicators, and engage constructively with auditors. Without adequate capacity, sophisticated monitoring systems may exist on paper but fail to influence decision-making. Investment in training, standardized tools, and professionalization of project finance and audit functions is therefore essential to realizing the benefits of accountability frameworks (Hungbo, Adeyemi & Ajayi, 2024, Jane Osareme, *et al*., 2024, Ogbuagu, *et al*., 2024).

In conclusion, financial monitoring, reporting, and audit systems are indispensable components of cost control and financial accountability frameworks for national healthcare construction programs. Real-time cost tracking enables early detection of deviations, performance measurement links spending to outcomes, independent audits provide objective assurance, and compliance mechanisms enforce financial discipline. When integrated and supported by institutional capacity and transparency, these systems safeguard public resources and enhance value for money. Strengthening financial oversight is not merely a technical exercise but a governance imperative, ensuring that healthcare construction investments deliver high-quality infrastructure while maintaining fiscal integrity and public trust (Akinrinoye, *et al*., 2023, Sanusi, Bayeroju & Nwokediegwu, 2023, Uduokhai, *et al*., 2023).

2.7 Digital Tools, Transparency, and Stakeholder Oversight

Digital tools, transparency mechanisms, and stakeholder oversight have become increasingly important in strengthening cost control and financial accountability within national healthcare construction programs. As these programs grow in scale and complexity, traditional paper-based reporting and closed decision-making structures are often insufficient to manage financial risks, prevent inefficiencies, or maintain public trust. The integration of digital project management platforms, open data dashboards, and participatory oversight mechanisms offers a transformative approach to improving decision-making, enhancing transparency, and ensuring that public investments in healthcare infrastructure deliver value for money (Ajayi, *et al*., 2023, Ogbuagu, *et al*., 2023, Oparah, *et*

al., 2023).

Digital project management platforms are at the core of modern cost control frameworks. These platforms integrate scheduling, budgeting, procurement, contract management, and performance monitoring into a single digital environment, enabling real-time visibility across the project life cycle. In healthcare construction programs, where multiple facilities and contractors may be operating simultaneously, such integration reduces information fragmentation and improves coordination among stakeholders. Project managers and oversight bodies can track expenditures against budgets, monitor progress against milestones, and identify emerging risks early. This real-time insight supports proactive intervention rather than reactive crisis management, which is critical for preventing small deviations from escalating into major cost overruns (Adeleke, 2025, Ezeh, *et al*., 2025, Ogbuagu, *et al*., 2025).

The use of digital tools also enhances standardization and consistency across projects within national programs. Standardized data fields, reporting formats, and workflows reduce variability in how financial and performance information is captured and interpreted. This consistency enables aggregation and comparative analysis across projects, strengthening program-level oversight and strategic planning. For healthcare construction, where facilities may differ in size and function but share common cost drivers, digital platforms support benchmarking and institutional learning. Over time, these data repositories become valuable assets for improving future cost estimation, procurement strategies, and risk management practices (Adeyemi, *et al*., 2023, Ogbuagu, *et al*., 2023, Umoren, *et al*., 2023).

Open data dashboards extend the benefits of digital project management beyond internal oversight to broader transparency and accountability. By publishing key information on project budgets, expenditures, timelines, and performance indicators, governments can make healthcare construction programs more visible to legislators, civil society, and the public. Open dashboards transform financial data from static reports into accessible, user-friendly formats that support informed scrutiny. Evidence from infrastructure sectors suggests that transparency alone can influence behavior, as public officials and contractors are more likely to adhere to budgets and schedules when performance is visible and comparable (Pacifico Silva, *et al*., 2018).

In the context of healthcare construction, open data dashboards can also support equity and trust. Public access to information on facility locations, project status, and resource allocation helps communities understand how investments align with health needs. This visibility is particularly important where past infrastructure projects have been associated with delays, abandonment, or perceived misuse of funds. Transparency reduces speculation and misinformation, creating a more constructive environment for public engagement. It also provides a factual basis for parliamentary oversight and media reporting, reinforcing democratic accountability.

Digital transparency tools further enhance decision-making by enabling evidence-based governance. When policymakers and planners have access to timely, accurate data on cost performance and implementation progress, they are better equipped to make informed adjustments to budgets, schedules, or scope. Data-driven insights can reveal systemic issues such as recurrent procurement delays, contractor underperformance, or regional disparities in cost efficiency. Addressing these issues at the program level strengthens overall financial accountability and improves outcomes across the healthcare construction portfolio (Atobatele, *et al*., 2023, Obadimu, *et al*., 2023, Olatunji, *et al*., 2023).

Stakeholder oversight complements digital transparency by ensuring that information is actively used to hold decision-makers accountable. Oversight extends beyond formal audit institutions to include legislators, professional associations, civil society organizations, and affected communities. In national healthcare construction programs, stakeholder oversight is particularly valuable because projects directly affect public service delivery and community well-being. Citizen engagement mechanisms, such as public consultations, grievance redress systems, and participatory monitoring, provide additional channels for identifying problems and ensuring responsiveness (Amuta, *et al*., 2022, Ezeh Funmi, *et al*., 2022).

Citizen oversight initiatives have shown potential to deter mismanagement and improve service delivery when designed effectively. Community monitoring of construction progress, for example, can identify delays, substandard workmanship, or discrepancies between reported and observed activities. When linked to digital platforms, citizen feedback can be systematically captured and integrated into project management processes. This two-way flow of information strengthens accountability by connecting ground-level observations with institutional decision-making.

Professional stakeholders, including engineers, architects, and healthcare practitioners, also play a critical role in oversight. Their technical expertise enables informed assessment of whether cost-saving measures compromise safety, functionality, or long-term performance. Engaging these stakeholders through advisory committees or review panels enhances the quality of oversight and supports balanced decision-making. Digital collaboration tools facilitate this engagement by enabling document sharing, virtual reviews, and transparent tracking of recommendations and responses.

The effectiveness of digital tools and stakeholder oversight depends on supportive governance frameworks and institutional capacity. Transparency initiatives must be accompanied by clear rules on data quality, disclosure standards, and accountability for inaccuracies. Without such safeguards, digital platforms risk becoming symbolic rather than substantive tools. Capacity building is equally important, as public officials, legislators, and citizens must possess the skills to interpret and use data meaningfully. Investments in digital literacy, data analytics, and participatory governance are therefore integral to realizing the benefits of transparency (Amuta, *et al*., 2022, Ezeh Funmi, *et al*., 2022).

There are also risks associated with digitalization that must be managed. Incomplete or misleading data can create false confidence or misdirect attention. Information overload may overwhelm users if dashboards are poorly designed or lack clear indicators. Privacy and security concerns must be addressed, particularly when financial data intersect with sensitive contractual or personal information. Effective frameworks balance openness with appropriate safeguards, ensuring that transparency enhances rather than undermines accountability.

In conclusion, digital tools, transparency, and stakeholder oversight represent powerful enablers of cost control and financial accountability in national healthcare construction programs. Project management platforms provide real-time visibility and coordination, open data dashboards enhance transparency and informed scrutiny, and stakeholder oversight ensures that information is actively used to hold decision-makers accountable. When integrated within coherent governance frameworks and supported by institutional capacity, these mechanisms strengthen decision-making, reduce inefficiencies, and build public trust. As healthcare infrastructure investments continue to expand, leveraging digital and participatory approaches is essential for safeguarding public resources and ensuring that construction programs deliver sustainable health system benefits.

2.8 Conclusion and Policy Implications

Cost control and financial accountability are central to the success and legitimacy of national healthcare construction programs, given their scale, complexity, and reliance on public resources. The analysis across theoretical foundations, cost drivers, estimation and budgeting strategies, procurement and contracting mechanisms, and financial monitoring systems highlights that cost overruns and inefficiencies are rarely the result of isolated technical failures. Rather, they emerge from systemic weaknesses in planning, governance, institutional capacity, and incentive alignment across the project life cycle. Addressing these challenges therefore requires integrated frameworks that embed financial discipline, transparency, and accountability from project conception through completion and operation.

Key insights from this body of work emphasize the importance of early-stage rigor and realism. Weak feasibility studies, optimistic cost estimates, and inadequate risk assessment create structural vulnerabilities that are difficult to correct once projects are underway. Evidence consistently shows that robust feasibility analysis, reference class forecasting, risk-adjusted budgeting, and well-designed contingency planning significantly improve cost predictability and protect public investment. These tools counter optimism bias, make uncertainty explicit, and enable informed decision-making that balances ambition with affordability.

Procurement, contracting, and risk allocation mechanisms further shape cost outcomes and accountability. Transparent and competitive procurement processes, contract types suited to project complexity, performance-oriented incentive structures, and balanced risk-sharing arrangements are critical to controlling costs without compromising quality. Overly rigid or poorly designed contracts often exacerbate disputes and claims, while excessive risk transfer inflates prices and undermines collaboration. The most effective frameworks align incentives between public clients and contractors, encourage innovation, and support life-cycle value rather than short-term cost minimization.

Financial monitoring, reporting, and audit systems emerge as essential safeguards throughout implementation. Real-time cost tracking, performance measurement, independent audits, and strong compliance mechanisms enable early detection of deviations, corrective action, and institutional learning. Digital project management platforms and open data dashboards enhance transparency, while stakeholder and citizen oversight strengthen democratic accountability and public trust. These mechanisms are most effective when integrated into coherent governance structures and supported by adequate technical capacity within public institutions.

For policymakers, several practical recommendations follow from these insights. First, healthcare construction should be treated as a strategic public investment requiring the same rigor in financial governance as other major infrastructure sectors. National frameworks should mandate standardized feasibility studies, cost estimation methodologies, and risk management practices for all major healthcare construction projects. Second, governments should strengthen institutional capacity in project finance, procurement, and contract management through targeted training, professionalization, and access to specialized expertise. Third, procurement and contracting policies should prioritize transparency, balanced risk allocation, and performance-based incentives that promote value for money over the full life cycle of assets.

Policymakers are also encouraged to institutionalize digital tools and transparency mechanisms as core components of financial accountability. Mandating real-time reporting, open data disclosure, and independent audit follow-up enhances oversight and reduces opportunities for mismanagement. Integrating citizen and professional stakeholder engagement into monitoring processes further reinforces accountability and responsiveness. Importantly, these measures should be supported by clear legal and regulatory frameworks that define roles, responsibilities, and sanctions for non-compliance.

Looking ahead, future directions for strengthening financial governance in healthcare construction include deeper integration of capital planning with medium-term fiscal frameworks, greater use of data analytics for risk-based oversight, and development of standardized performance benchmarks across projects and countries. Comparative research and knowledge sharing can support continuous improvement and adaptation of cost control frameworks to different institutional and economic contexts. As health systems face growing demands and fiscal constraints, robust cost control and financial accountability frameworks will be essential to ensuring that healthcare construction programs deliver sustainable, equitable, and high-quality infrastructure while safeguarding public trust and fiscal integrity.

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