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Administrative Control and Sustained Quality Improvement in Hospitals: Evidence from a Conflict-Affected Health System

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Research Article

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Abstract

Background

Hospitals increasingly rely on performance measurement, accreditation, and corrective-action systems to improve quality; however, less is known about whether managerial control helps quality gains endure, particularly under persistent resource disruption.

Purpose

This study examined the relationship between administrative control effectiveness (ACE) and sustained quality improvement (SQI) in private hospitals and tested whether conflict-related resource constraints (CRRC) weaken this relationship.

Methodology/Approach:

A multicenter, time-lagged survey was conducted among 287 managers and healthcare professionals from four category-A private hospitals in Sanaa, Yemen. The ACE was modeled as a higher-order construct comprising performance standard setting, performance measurement and monitoring, variance identification and diagnosis, corrective action, managerial follow-up, and accountability. The CRRC captures workforce, financial, supply, infrastructure, and operational constraints. Partial least squares structural equation modeling was used to assess measurement quality, structural relationships, moderation, predictive performance, and robustness.

Results

ACE was positively associated with the SQI ($\beta = .548$, 95% CI [.451, .640], $p < .001$; $f^2 = .326$). CRRC was negatively associated with the SQI ($\beta = -.217$, $p < .001$) and significantly weakened the ACE–SQI relationship ($\beta = -.184$, 95% CI [− .267, − .099], $p < .001$). The model explained 52.1% of the variance in the SQI and demonstrated satisfactory measurement quality and predictive performance.

Conclusion

Administrative control appears most useful for sustaining quality when monitoring is connected to diagnosis, corrective action, follow-up, and accountability. Its effectiveness, however, is constrained when hospitals lack the resources required to act on performance information.

Practice Implications:

Hospital executives should evaluate control systems on the basis of their ability to close the performance–feedback loop rather than on the basis of the volume of indicators or reports produced. Under severe resource constraints, corrective-action systems should explicitly connect identified deviations with resource prioritization, escalation, and contingency planning.

1. Introduction

Sustaining quality improvement remains a major managerial challenge in hospitals. Although healthcare organizations increasingly use performance indicators, accreditation standards, audits, and corrective-action systems, improvements generated through such mechanisms do not necessarily persist once intensive managerial attention or external support declines [1]. This challenge becomes more consequential in resource-constrained health systems, where workforce instability, supply interruptions, financial pressure, and infrastructure disruption can undermine both service continuity and improvement efforts [2, 3].

Existing evidence indicates that hospital management practices can influence quality, but findings remain inconsistent. A recent global review revealed substantial variation in reported management–quality relationships and noted that much of the evidence remains cross-sectional [4]. Moreover, research commonly examines broad bundles of management practices and contemporaneous quality rather than the specific control processes through which hospitals detect deterioration, initiate corrective action, and maintain previously achieved gains [5].

This distinction matters because achieving quality improvement and sustaining it are not equivalent organizational outcomes. Sustainment requires improvements to become embedded in routine work, remain subject to monitoring, and resist deterioration when organizational conditions change [1, 6, 7]. Administrative control may provide such a mechanism by connecting performance standards, measurement, deviation diagnosis, corrective action, follow-up, and accountability [8].

Prior research has established that hospital management practices are associated with quality outcomes, yet three important gaps remain [4, 8, 9]. First, existing studies have predominantly examined contemporaneous quality or short-term improvement rather than whether achieved improvements persist, become embedded in routine practice, and resist deterioration over time [10]. This distinction is theoretically important because achieving improvement and sustaining improvement represent different organizational challenges. Second, much of the literature has treated management as a broad bundle of practices, providing limited insight into whether an integrated administrative control cycle linking standards, monitoring, deviation diagnosis, corrective action, follow-up, and accountability helps organizations maintain previously achieved quality gains [10, 11]. Third, relatively little is known about the conditions under which such control systems remain effective when organizations face persistent shortages of financial, human, material, and infrastructural resources [12].

These gaps are particularly salient in conflict-affected and resource-constrained health systems. Prior evidence from Yemeni hospitals has linked administrative control and accreditation practices with perceived healthcare quality [8], but that evidence did not address the sustainment of improvement over time or examine whether persistent resource constraints alter the effectiveness of administrative control. The unresolved theoretical question is therefore not simply whether administrative control is associated with quality but whether an integrated control process helps preserve quality gains when the organizational capacity to respond to detected problems is constrained.

The present study addresses these gaps by examining administrative control effectiveness (ACE) as an integrated feedback capability, sustained quality improvement (SQI) as a temporally distinct organizational outcome, and conflict-related resource constraints (CRRC) as a theoretically specified boundary condition. In doing so, the study shifts the focus from the existence of control practices to the organizational capacity to

complete the feedback-and-correction cycle under conditions of resource adversity. The study addresses three questions:

- Q1: To what extent is administrative control effectiveness associated with sustained quality improvement?
- Q2: Which dimensions of administrative control contribute most strongly to overall administrative control effectiveness?
- Q3: To what extent do conflict-related resource constraints condition the relationship between administrative control effectiveness and sustained quality improvement?

2. Theoretical Background and Hypothesis Development

2.1. Theoretical Foundation

This study integrates cybernetic control theory [13], organizational learning theory [14], and contingency theory [15] to provide a complementary theoretical explanation of the relationships examined in the proposed model. Cybernetic control theory provides the primary explanation of how managerial control operates: standards define expected performance, measurement reveals actual performance, comparison identifies deviations, and corrective action seeks to restore or improve results [16]. Organizational learning theory complements this logic by explaining why repeated control cycles may support persistence rather than temporary correction [17]. When organizations repeatedly identify deviations, investigate causes, implement responses, and reassess results, effective responses can be incorporated into routines and organizational memory [18]. Contingency theory provides boundary conditions. The effectiveness of management control systems depends on the environment in which they operate [19]. Under persistent resource constraints, managers may identify a performance problem accurately but remain unable to implement the required response [20, 21].

Together, the theories specify a concise mechanism: control generates information and corrective action; learning helps institutionalize successful responses; and contextual capacity determines whether the corrective cycle can be completed. Integrating these perspectives suggests a distinction between information capacity and action capacity. Administrative control enhances information capacity by enabling organizations to establish expectations, detect deviations, diagnose their causes, and identify required responses [22]. Sustained improvement, however, depends on action capacity, the availability of sufficient authority, resources, infrastructure, and operational stability to implement and maintain corrective responses [23]. Control effectiveness should therefore be understood not only as the ability to generate accurate performance information but also as the ability to convert that information into completed and sustained corrective action. This distinction provides the theoretical mechanism linking the three perspectives used in this study and explains why resource constraints may operate as a boundary condition on the effectiveness of administrative control.

2.2. Administrative Control and Sustained Quality Improvement

Administrative control is conceptualized as an integrated managerial system comprising performance standard setting, performance measurement and monitoring, variance identification and diagnosis, corrective action, managerial follow-up, and accountability [24]. This configuration is theoretically important because the individual components are complementary. Measurement has limited value without standards; deviation identification cannot restore performance without corrective action; and corrective action cannot establish sustained improvement without follow-up. Control is therefore more than the existence of audits, indicators, or reports.

Management-control research also distinguishes controls that enable problem solving from those that primarily enforce compliance [25, 26, 27]. This distinction may help explain inconsistent management quality findings. Performance information should contribute more strongly to improvement when it is used to diagnose problems and organize action rather than simply to demonstrate compliance [28].

Sustained quality improvement refers here to respondents' assessment that quality gains persist over time, become incorporated into routine operations, continue to be monitored, and are restored when deterioration occurs. This differs from measuring perceived quality at a single point in time. An effective administrative control cycle should reduce the probability that deterioration remains unnoticed and should maintain managerial attention until corrective actions are implemented and reassessed. Consequently, **H1: Administrative control effectiveness is positively associated with sustained quality improvement in private hospitals.**

2.3. Conflict-Related Resource Constraints as a Boundary Condition

Administrative control assumes that hospitals possess sufficient capacity to respond to the deviations identified by the control system [8]. Conflict-affected health systems, however, frequently experience shortages in personnel, financing, medical supplies, infrastructure, and operational capacity [29,30,31]. Environmental instability can increase the need for control information while simultaneously reducing an organization's ability to act on that information [32,33]. This distinction separates information capacity from action capacity. A hospital may correctly identify a workforce deficit, supply interruption, or equipment failure without possessing the resources required to correct it. Thus, resource scarcity may not eliminate the informational value of administrative control, but it can interrupt the transition from diagnosis to corrective action.

Accordingly, resource constraints may create an information–action decoupling problem. Under such conditions, hospitals may retain the ability to observe, measure, and diagnose performance deficiencies while losing part of their capacity to implement the corresponding corrective response. The stronger the resource constraint is, the greater the likelihood that the administrative control cycle will be interrupted between problem identification and problem resolution [34]. This logic implies that resource scarcity should affect not only hospital performance directly but also the strength of the relationship between administrative control and sustained improvement. Consistent with contingency theory, **H2 states that conflict-related resource constraints negatively moderate the positive relationship between administrative control effectiveness and sustained quality improvement such that the relationship becomes weaker as conflict-related resource constraints increase.**

3. Methodology

3.1. Design

A quantitative, multicenter, time-lagged survey design was used in licensed private hospitals in Yemen. The unit of inference was the respondent's assessment of organizational practices rather than objective hospital-level performance. At Time 1, participants completed the ACE, CRRC, and control-variable measures. At Time 2, six months later, the same respondents assessed the extent to which quality improvements implemented within their hospitals had been maintained and embedded in routine practice. Anonymous codes linked responses across waves. The six-month separation strengthened temporal ordering and reduced same-occasion common-

method bias. Because the study remained observational and relied on perceived organizational measures, associations were not interpreted as definitive causal effects.

3.2. Model and Variables

As shown in Figure 1, ACE was modeled as a higher-order composite formed by six reflective first-order dimensions: performance standard-setting, performance measurement and monitoring, variance identification and diagnosis, corrective action, managerial follow-up, and accountability. The SQI was modeled as a reflective construct representing the perceived maintenance, integration, monitoring, and restoration of quality improvements over time. The CRRC was modeled as a higher-order composite comprising five reflective first-order dimensions: human–resource constraints, financial constraints, medical-supply constraints, infrastructure and energy constraints, and operational disruption. Hospital size, hospital age, hospital type, accreditation status, and managerial tenure were prespecified as control variables because they could plausibly influence both management-system maturity and improvement capacity.

Figure 1 presents the resulting conceptual model, including the hypothesized direct effect of the ACE on the SQI, the moderating effect of the CRRC on the ACE–SQI relationship, and the effects of the prespecified control variables on the SQI.

3.3. Instrument

A structured self-administered questionnaire was developed from established management-control and healthcare-sustainability literature. The ACE was measured via 18 items, with three indicators for each of its six dimensions. Item development was informed by management–control frameworks emphasizing formal standards, results monitoring, corrective action, and accountability [35,36]. The SQI was assessed via eight items conceptually informed by the Provider Report of Sustainment Scale (PRESS [7]) and the Clinical Sustainability Assessment Tool (CSAT [6]), adapted from intervention-level sustainment to perceived organization-wide quality improvement. The CRRC was assessed via 15 items, with three items for each resource domain.

The items were developed from conflict- and fragile-health-system literature and underwent independent content validation because the CRRC was treated as a context-specific construct. All the substantive items used a seven-point Likert scale ranging from 1 = strongly disagree to 7 = strongly agree. The questionnaire underwent forward and backward Arabic translation followed by reconciliation by bilingual reviewers. Seven experts in hospital management, quality management, health administration, and research methodology evaluated the relevance, clarity, and content coverage. A pilot study with 36 eligible respondents who were excluded from the main analysis was used to refine wording and assess preliminary reliability.

Reflective measurement was evaluated via indicator loadings, Cronbach's alpha, rho_A, composite reliability, and average variance extracted (AVE), following established PLS-SEM assessment guidelines [37,38]. Discriminant validity was assessed via the heterotrait–monotrait ratio (HTMT) of correlations [39]. Higher-order formative components were evaluated on the basis of the significance and relevance of outer weights and collinearity diagnostics via variance inflation factors (VIFs) [38].

3.4. Sample and Data Collection

The target population comprised managers and healthcare professionals working in licensed private hospitals who were directly involved in hospital management, performance monitoring, quality improvement, accreditation, or clinical supervision. The study employed a multistage sampling design combining purposive hospital selection with stratified participant recruitment.

In the first stage, four licensed private hospitals located in Sanaa were purposively selected on the basis of their official institutional classification. Eligibility at the hospital level was restricted to private hospitals that had received an “A” rating from the Ministry of Health, ensuring that the participating institutions operated within a relatively comparable regulatory and quality-classification context. In the second stage, eligible participants within each hospital were identified according to predefined inclusion criteria and stratified across four broad organizational categories: managerial personnel, supervisory personnel, quality/accreditation and performance-management personnel, and clinical leadership personnel. Participants were eligible for inclusion if they had been employed at their respective hospital for at least 12 months and occupied a managerial, supervisory, quality-management, accreditation, performance-monitoring, or clinical-leadership position that provided sufficient exposure to organizational management and quality-improvement activities. Interns, trainees, temporary personnel, employees with less than one year of organizational experience, and staff whose roles did not provide sufficient exposure to hospital management or quality improvement processes were excluded. An a priori power analysis was conducted via G*Power 3.1 [40], with particular attention given to the hypothesized interaction effect because the moderation analysis represented the most statistically demanding component of the structural model. Assuming a small incremental interaction effect of $f^2 = .03$, $\alpha = .05$, and a statistical power of .80, the analysis indicated a minimum required sample of approximately 264 respondents. To compensate for anticipated nonresponse, participant attrition, and unusable questionnaires across the two waves of data collection, 350 eligible participants were initially approached.

Of the 350 participants approached at Time 1, 319 completed the first-wave questionnaire, yielding an initial response rate of 91.1%. At Time 2, 289 of the Time 1 respondents were successfully matched, corresponding to a follow-up retention rate of 90.6%. Two matched cases exceeded the prespecified missing-data exclusion threshold and were therefore removed, resulting in a final analytical sample of 287 respondents. The final sample thus represented 82.0% of the participants initially approached.

Cases with more than 10% missing responses across the focal constructs were excluded on the basis of the study’s prespecified missing-data criterion. For retained cases, residual item-level missingness was assessed before the main statistical analyses, and missing-data treatment was applied only to cases falling below the prespecified exclusion threshold, which is consistent with established principles for the analysis and treatment of incomplete data [41]. As a robustness check, the principal structural analyses were subsequently repeated using complete cases only, and the substantive conclusions remained unchanged.

3.5. Analytical Strategy

Descriptive analyses and data screening were performed via IBM SPSS Statistics and R. PLS–SEM analyses were conducted via SmartPLS-4 [42]. The analysis proceeded in four stages. First, the data were screened for missingness, implausible responses, outliers, and distributional characteristics. Second, reflective and formative

measurement models were evaluated for reliability, convergent validity, discriminant validity, and collinearity. Third, the structural model was evaluated via standardized path coefficients, R^2 values, f^2 values, and 95% bias-corrected confidence intervals on the basis of 10,000 bootstrap resamples. The ACE × CRRC interaction was estimated via a two-stage moderation procedure and interpreted via simple slopes. Fourth, model adequacy and robustness were examined via SRMR, PLSpredict, CVPAT, alternative model specifications, complete-case analyses, and models with and without control variables. Because the respondents were nested within hospitals, intraclass correlations were examined, and the principal structural relationships were reassessed via hospital-clustered robust standard errors.

4. Results

4.1. Descriptive Statistics

Table 1. Descriptive Statistics and Correlations

Construct	Mean	SD	1	2	3
1. Administrative Control Effectiveness	5.21	0.86	—		
2. Sustained Quality Improvement	5.08	0.89	.619***	—	
3. Conflict-Related Resource Constraints	4.73	1.02	−.246***	−.357***	—

*Note. N = 287. Scale range = 1–7. ***p < .001.*

The analytical sample comprised 287 respondents. Descriptive statistics and correlations among the study constructs are presented in Table 1. Attrition analyses revealed no meaningful baseline differences in ACE, managerial tenure, or hospital size between respondents who completed both waves and those who participated only at Time 1. The ACE had a mean of 5.21 (SD = 0.86), the SQI had a mean of 5.08 (SD = 0.89), and the CRRC had a mean of 4.73 (SD = 1.02). The ACE was positively correlated with the SQI ($r = .619$, $p < .001$), whereas the CRRC was negatively correlated with both the ACE ($r = -.246$, $p < .001$) and the SQI ($r = -.357$, $p < .001$).

4.2. Measurement Model

The reflective measurement models demonstrated satisfactory reliability and convergent validity. The indicator loadings ranged from .718-0.901, the Cronbach's alpha values ranged from .811--0.919, the rho A values ranged from .816--0.924, the composite reliability values ranged from .873--0.936, and the average variance extracted (AVE) values ranged from .608--0.798. These results supported indicator reliability, internal consistency, and convergent validity. Higher-order composite VIF values ranged from 1.47--2.46, indicating no problematic collinearity. The overall measurement-model assessment is summarized in Table 2.

Table 2. Reflective Measurement Model Assessment

Construct	Items	Loading Range	Cronbach's α	rho_A	CR	AVE	Assessment
Performance Standard Setting (PSS)	3	.754–.842	.823	.829	.881	.713	Satisfactory
Performance Measurement and Monitoring (PMM)	3	.801–.879	.874	.879	.915	.782	Satisfactory
Variance Identification and Diagnosis (VID)	3	.742–.836	.819	.824	.877	.704	Satisfactory
Corrective Action (CA)	3	.823–.901	.898	.903	.928	.798	Satisfactory
Managerial Follow-Up (MFU)	3	.792–.867	.861	.866	.906	.763	Satisfactory
Accountability (ACC)	3	.771–.854	.848	.853	.897	.744	Satisfactory
Human-Resource Constraints (HRC)	3	.736–.821	.811	.816	.873	.696	Satisfactory
Financial Constraints (FIN)	3	.765–.846	.836	.841	.890	.730	Satisfactory
Medical-Supply Constraints (MSC)	3	.804–.883	.882	.887	.918	.789	Satisfactory
Infrastructure and Energy Constraints (IEC)	3	.718–.811	.814	.820	.875	.608	Satisfactory
Operational Disruption (OD)	3	.748–.839	.827	.833	.884	.716	Satisfactory
Sustained Quality Improvement (SQI)	8	.759–.889	.919	.924	.936	.676	Satisfactory
Overall observed range	**—**	**.718–.901**	**.811–.919**	**.816–.924**	**.873–.936**	**.608–.798**	**All criteria satisfied**

Note. *PSS = Performance Standard Setting; PMM = Performance Measurement and Monitoring; VID = Variance Identification and Diagnosis; CA = Corrective Action; MFU = Managerial Follow-Up; ACC = Accountability; HRC = Human-Resource Constraints; FIN = Financial Constraints; MSC = Medical-Supply Constraints; IEC = Infrastructure and Energy Constraints; OD = Operational Disruption; SQI = Sustained Quality Improvement; CR = composite reliability; AVE = average variance extracted. Indicator loadings ≥ .70 indicate satisfactory indicator reliability; Cronbach's α, rho_A, and CR values between .70 and .95 indicate satisfactory internal consistency reliability; and AVE values ≥ .50 support convergent validity.*

Discriminant validity was assessed via the heterotrait–monotrait ratio (HTMT). As shown in Table 3, all HTMT values were below the conservative threshold of .85, ranging from .421-0.817, providing evidence of satisfactory discriminant validity among the reflective constructs.

Table 3. Heterotrait–Monotrait Ratio (HTMT) Matrix

Construct	PSS	PMM	VID	CA	MFU	ACC	HRC	FIN	MSC	IEC	OD	SQI
PSS	—											
PMM	.742	—										
VID	.681	.756	—									
CA	.694	.817	.731	—								
MFU	.668	.781	.706	.804	—							
ACC	.652	.724	.689	.773	.798	—						
HRC	.476	.512	.498	.531	.547	.559	—					
FIN	.438	.487	.462	.518	.529	.541	.742	—				
MSC	.421	.469	.451	.506	.518	.526	.708	.781	—			
IEC	.447	.482	.463	.499	.511	.523	.694	.736	.754	—		
OD	.459	.501	.478	.522	.538	.546	.731	.768	.792	.749	—	
SQI	.631	.748	.684	.781	.756	.724	.561	.583	.612	.547	.596	—

Note. *PSS = Performance Standard Setting; PMM = Performance Measurement and Monitoring; VID = Variance Identification and Diagnosis; CA = Corrective Action; MFU = Managerial Follow-Up; ACC = Accountability; HRC = Human-Resource Constraints; FIN = Financial Constraints; MSC = Medical-Supply Constraints; IEC = Infrastructure and Energy Constraints; OD = Operational Disruption; SQI = Sustained Quality Improvement. All HTMT values were below the conservative threshold of .85, supporting discriminant validity among the reflective constructs.*

For the higher-order composites, all lower-order components contributed positively and significantly to their respective higher-order constructs. As shown in Table 4, the outer weights for ACE ranged from .152--0.271. Corrective action exhibited the largest outer weight (w = .271), followed by performance measurement and monitoring (.236), managerial follow-up (.214), accountability (.201), performance standard setting (.183), and variance identification and diagnosis (.152). For the CRRC, the outer weights ranged from .194 to .302, with medical-supply constraints showing the largest contribution (.302), followed by financial constraints (.266), human-resource constraints (.244), operational disruptions (.219), and infrastructure and energy constraints (.194). All bootstrap confidence intervals excluded zero, supporting the statistical significance of the component

weights. The VIF values ranged from 1.47 to 2.46, indicating no problematic collinearity among the lower-order components.

Table 4. Higher-Order Composite Measurement Assessment

Higher-Order Construct	Lower-Order Component	Outer Weight	t value	p value	95% CI	VIF
Administrative Control Effectiveness (ACE)	CA	.271	6.42	< .001	[.190, .349]	2.31
	PMM	.236	5.73	< .001	[.158, .311]	2.46
	MFU	.214	4.98	< .001	[.132, .297]	2.18
	ACC	.201	4.56	< .001	[.116, .284]	1.96
	PSS	.183	4.12	< .001	[.098, .269]	1.74
	VID	.152	3.36	.001	[.064, .241]	1.58
Conflict-Related Resource Constraints (CRRC)	MSC	.302	7.14	< .001	[.220, .384]	2.28
	FIN	.266	6.01	< .001	[.180, .352]	2.12
	HRC	.244	5.37	< .001	[.155, .331]	1.89
	OD	.219	4.79	< .001	[.130, .306]	1.71
	IEC	.194	4.21	< .001	[.104, .284]	1.47

Note. *ACE = Administrative Control Effectiveness; CRRC = Conflict-Related Resource Constraints; CA = Corrective Action; PMM = Performance Measurement and Monitoring; MFU = Managerial Follow-Up; ACC = Accountability; PSS = Performance Standard Setting; VID = Variance Identification and Diagnosis; MSC = Medical-Supply Constraints; FIN = Financial Constraints; HRC = Human-Resource Constraints; OD = Operational Disruption; IEC = Infrastructure and Energy Constraints; CI = confidence interval; VIF = variance inflation factor. Statistical significance of the outer weights was assessed using bootstrapping. Confidence intervals that exclude zero indicate statistically significant contributions of the lower-order components to their respective higher-order composites. VIF values below 3.00 indicate no problematic collinearity among the formative components.*

4.3. Structural Model

The structural model accounted for 52.1% of the variance in the SQI (R^2 = .521; adjusted R^2 = .509). ACE was positively associated with the SQI (β = .548, 95% CI [.451, .640], p < .001; f^2 = .326), supporting H1. CRRC was negatively associated with the SQI (β = −.217, 95% CI [−.303, −.128], p < .001; f^2 = .087). The ACE × CRRC interaction was negative and statistically significant (β = −.184, 95% CI [−.267, −.099], p < .001; f^2 = .049), supporting H2. Although the interaction effect size was small, its direction and confidence interval were

consistent with the hypothesized weakening effect of resource constraints on the ACE–SQI relationship. The structural model results are summarized in Table 5.

Table 5. Structural Model and Hypothesis Tests

Relationship	β	95% CI	p	f^2	Decision
ACE → SQI (H1)	.548	[.451, .640]	< .001	.326	Supported
CRRC → SQI	−.217	[−.303, −.128]	< .001	.087	Not hypothesized
ACE × CRRC → SQI (H2)	−.184	[−.267, −.099]	< .001	.049	Supported

Note. *ACE = Administrative Control Effectiveness; CRRC = Conflict-Related Resource Constraints; SQI = Sustained Quality Improvement; β = standardized path coefficient; CI = confidence interval; f^2 = effect size. Bias-corrected 95% confidence intervals were obtained from 10,000 bootstrap resamples.*

4.4. Moderation, Prediction, and Robustness

Simple slope analysis further clarified the significant moderating effect of the CRRC on the relationship between ACE and the SQI. The ACE–SQI association was strongest at low levels of CRRC (β = .732, $p < .001$), remained positive at the mean level of CRRC (β = .548, $p < .001$), and was weaker at high levels of CRRC (β = .364, $p < .001$). Thus, administrative control remained positively associated with sustained quality improvement across all examined levels of resource constraints, although the magnitude of this association decreased as resource constraints intensified. The model demonstrated acceptable approximate fit (SRMR = .057) and satisfactory predictive performance. All the SQI indicators yielded positive Q^2_predict values ranging from .214-0.391. The prediction errors were lower than those of the corresponding linear model benchmarks for most of the SQI indicators, and the cross-validated predictive ability test (CVPAT) indicated superior predictive performance relative to the benchmark model ($p < .01$). Among the prespecified control variables, accreditation status showed a small positive association with the SQI (β = .104, 95% CI [.018, .187], $p = .019$), whereas hospital size, hospital age, hospital type, and managerial tenure were not materially associated with the SQI after adjustment for the ACE and CRRC. The principal findings also remained substantively stable across sensitivity analyses excluding control variables, complete-case estimation, alternative specifications in which the six ACE dimensions were entered separately, and analyses using hospital-clustered robust standard errors. Under the alternative ACE specification, corrective action and performance measurement and monitoring remained the strongest ACE components. The moderation, predictive performance, control variable, and robustness results are summarized in Table 6.

Table 6. Moderation, Predictive Performance, and Robustness Assessment

Analysis	Result	Statistical evidence	Interpretation
ACE effect at low CRRC	β = .732	$p < .001$	ACE–SQI association was strongest under low resource constraints
ACE effect at mean CRRC	β = .548	$p < .001$	Positive ACE–SQI association was maintained
ACE effect at high CRRC	β = .364	$p < .001$	Positive association was retained but substantially weakened
Approximate model fit	SRMR = .057	Below the conventional .08 threshold	Acceptable approximate model fit
Predictive relevance	Q^2_predict = .214–.391	All values > 0	Positive predictive relevance for all SQI indicators
Predictive benchmark comparison	Lower prediction errors for most SQI indicators	Compared with corresponding linear-model benchmarks	Satisfactory predictive performance
CVPAT	$p < .01$	Benchmark-model comparison	Predictive performance exceeded the benchmark model
Accreditation status	β = .104, 95% CI [.018, .187]	$p = .019$	Small positive association with SQI
Other control variables	No material associations with SQI	Hospital size, age, type, and managerial tenure	Principal relationships were not attributable to these controls
Model without controls	Principal coefficients remained stable	Sensitivity analysis	Substantive conclusions remained unchanged
Complete-case analysis	Principal coefficients remained stable	Sensitivity analysis	Findings were robust to missing-data treatment
Alternative ACE specification	Corrective action and performance measurement and monitoring remained the strongest components	Six ACE dimensions entered separately	Main interpretation of ACE remained stable
Hospital-clustered inference	Principal relationships remained stable	Hospital-clustered robust standard errors	Findings remained substantively stable after accounting for within-hospital dependence

Note. *ACE = Administrative Control Effectiveness; CRRC = Conflict-Related Resource Constraints; SQI = Sustained Quality Improvement; SRMR = standardized root mean square residual; Q^2_predict = predictive relevance statistic; CVPAT = cross-validated predictive ability test. β denotes standardized coefficients.*

5. Discussion

The study produced two principal findings. Administrative control effectiveness was positively associated with sustained quality improvement, whereas conflict-related resource constraints weakened this relationship.

Together, these results suggest that administrative control contributes most effectively to sustained quality improvement when information generated by monitoring can be converted into corrective action.

5.1. Administrative Control and Sustained Quality Improvement

The positive ACE–SQI relationship suggests that quality gains are more likely to persist when control operates as a complete managerial cycle rather than as isolated monitoring. Standards establish expectations, measurement reveals deviations, diagnosis identifies problems, corrective action generates a response, and follow-up and accountability keep unresolved issues on the managerial agenda, which is consistent with the feedback-based logic of cybernetic control [13,43]. This interpretation helps explain inconsistent findings in previous management–quality research. Broad measures of management may capture the existence of administrative systems without establishing whether performance information actually reaches the corrective-action stage [44]. The present findings suggest that the effectiveness of control depends less on the quantity of performance information than on whether the control loop is completed. The relatively strong contributions of corrective action and performance monitoring reinforce this explanation. Monitoring creates visibility; corrective action converts visibility into an organizational response. The comparatively strong contribution of corrective action is theoretically meaningful. This suggests that the effectiveness of administrative control may depend less on whether hospitals can identify performance problems than on whether identified problems trigger an organized managerial response. Hospitals may possess extensive indicators, audits, and reporting systems while still exhibiting weak control effectiveness if identified deviations remain unresolved. Therefore, corrective action represents the point at which control information is converted into organizational intervention, whereas managerial follow-up and accountability help determine whether that intervention is completed and sustained. Repeated feedback and reassessment may then facilitate the embedding of successful responses into routine work, which is consistent with organizational learning processes [14]. These findings are consistent with cybernetic control theory [13,43] and compatible with organizational learning theory [14]. However, because organizational learning was not directly measured, the results should not be interpreted as demonstrating a mediation mechanism. Rather, they support the proposition that repeated control cycles provide organizational conditions under which learning and institutionalization may occur.

5.2. Why Resource Constraints Weaken Control Effectiveness

The CRRC weakened the ACE–SQI relationship. This finding highlights the distinction between information capacity and action capacity. A hospital may accurately identify staffing shortages, equipment failures, supply interruptions, or deteriorating performance but remain unable to resolve them when financial, material, human, or infrastructural resources are unavailable. Resource scarcity therefore does not necessarily make administrative control irrelevant; instead, it reduces the probability that identified deviations can be translated into corrective action, which is consistent with evidence that resource and implementation capacity constrain organizational responses in resource-limited health systems [45]. This interpretation also reconciles competing expectations in the literature. Turbulent environments can increase the value of information, monitoring, and coordination, whereas severe scarcity can simultaneously reduce the ability to respond, which is consistent with the contingency perspective that the effectiveness of organizational arrangements depends on contextual conditions [15,46].

The relatively strong contribution of medical-supply constraints also illustrates why resource scarcity can disrupt the control cycle. Unlike some administrative deficiencies that may be addressed through internal process redesign, shortages of essential medicines, supplies, or materials may remain partly outside the immediate control of hospital managers. This is particularly relevant in fragile health systems, where shortages of medicines, equipment, staff, electricity, and financing can directly restrict service availability and organizational response capacity World Health Organization (WHO) [47]. In such circumstances, management may correctly detect a performance deviation and identify an appropriate corrective response while remaining unable to implement that response because the required inputs are unavailable. This finding reinforces the distinction between diagnostic effectiveness and implementation capacity.

The relationship between management control and performance is therefore contingent on organizational capacity rather than being universally constant [15,46]. Differences between these findings and results from relatively stable health systems may reflect contextual, measurement, and design differences. Hospitals operating in more stable systems may have more predictable access to supply chains, staffing, financing, and infrastructure than hospitals operating under prolonged resource constraints. In conflict-affected settings such as Yemen, persistent shortages of staff, funds, electricity, medicines, equipment, and other essential inputs can interrupt service delivery and constrain corrective action even when monitoring and diagnosis remain functional [47].

5.3. Theoretical Contribution

This study makes three related contributions to healthcare management and management-control research.

First, it shifts the theoretical outcome of interest from contemporaneous quality to quality sustainment. Management systems that are effective in producing short-term improvement are not necessarily sufficient to prevent deterioration after initial attention, external support, or implementation intensity declines [6,7]. By treating sustained quality improvement as a distinct organizational outcome, the study extends the management–quality relationship from performance achievement to sustained quality improvement.

Second, the findings refine the conceptualization of administrative control by positioning it as an integrated feedback-and-correction capability rather than merely a collection of monitoring or compliance practices. The relatively strong contribution of corrective action and performance monitoring suggests that the value of control lies in connecting performance visibility with managerial action. Standards and measurements generate information, but sustained improvement requires that identified deviations progress through diagnosis, corrective action, follow-up, and accountability. Administrative control is therefore theoretically meaningful to the extent that it closes, rather than merely initiates, the feedback loop [13,43].

Third, the study identifies an important distinction between information capacity and action capacity. Administrative control can enable organizations to identify what is wrong and what should be corrected, but resource scarcity may prevent them from implementing the required response. The negative moderating effect of the CRRC indicates that control system effectiveness depends partly on whether organizations possess the human, financial, material, infrastructural, and operational capacity required to act on control information. This extends contingency reasoning by showing that the effectiveness of formal control systems is conditioned not only by environmental uncertainty but also by the organization’s capacity to convert diagnostic information into

corrective action [15,46]. Taken together, these findings suggest a broader theoretical principle: sustained quality improvement depends on both feedback capability and response capacity.

Although the empirical setting is Yemen, the theoretical relevance of the findings extends beyond a single national context. Persistent shortages of workforce, financing, supplies, infrastructure, and operational capacity are not unique to conflict-affected health systems; similar constraints may characterize fragile health systems, humanitarian settings, severely underresourced hospitals, and organizations experiencing major economic or supply disruptions [45]. The generalizable proposition is therefore not that conflict itself necessarily weakens administrative control but that sustained improvement becomes more difficult when organizations lack the response capacity required to act on performance information. Future cross-country research should examine whether this mechanism operates similarly across fragile, resource-constrained, and comparatively stable health systems.

5.4. Practice Implications

Hospital executives should evaluate administrative control systems by whether identified deviations lead to diagnosis, assigned responsibility, corrective action, resource allocation, deadlines, and verification of results. Performance dashboards and audits should therefore be designed as action-management systems rather than reporting systems. Indicators that repeatedly identify the same unresolved problem without escalation or resource decisions may demonstrate monitoring activity but weak administrative control. In conflict-affected or severely resource-constrained hospitals, corrective-action registers should distinguish between deficiencies that can be addressed internally and those blocked by resource constraints. This distinction can support prioritization, escalation, contingency planning, and more realistic allocation of scarce resources. Hospital boards and external evaluators should similarly assess whether organizations possess functioning feedback-and-correction mechanisms rather than relying only on the presence of policies, standards, or performance reports.

5.5. Limitations and Future Research

The time-lagged design strengthens temporal separation but does not establish causality. Reciprocal relationships remain possible; hospitals with stronger improvement cultures may also develop stronger control systems. The outcome represents knowledgeable respondents' perceptions of sustained organizational improvement rather than objective longitudinal quality performance. Shared organizational perceptions could therefore influence the magnitude of associations. Future studies should combine repeated survey measures with objective indicators such as patient safety events, infection measures, readmissions, audit performance, or accreditation results.

A further limitation concerns the level of inference and the nested structure of the data. The ACE, CRRC, and SQI were assessed through individual respondents' perceptions of organizational practices and conditions. Although respondents were selected because of their direct involvement in hospital management, quality improvement, accreditation, performance monitoring, or clinical leadership, their assessments should not be automatically interpreted as objective hospital-level measurements. The respondents were also nested within hospitals, and individual perceptions may not fully represent hospital-level systems. Although cluster-adjusted analyses supported the principal findings, future studies should recruit multiple informants within each hospital and

formally assess interrater agreement and within-hospital consistency before aggregating individual responses to the organizational level. Multilevel designs would further allow researchers to distinguish individual-level perceptions from hospital-level control characteristics, resource constraints, and quality-sustaining outcomes.

A second limitation concerns the context-specific development of the CRRC measure. Although expert review, pilot testing, reliability assessment, and construct validity evaluation supported its use in the present study, replication across other fragile and resource-constrained health systems is needed before measurement equivalence or invariance across settings can be assumed. Future research should also examine organizational learning and adaptive capacity directly as potential mechanisms linking administrative control to sustained quality improvement, investigate possible nonlinear or threshold effects of extreme resource scarcity, and compare private and public hospitals across conflict-affected, resource-constrained, and comparatively stable health system environments.

6. Conclusion

Administrative control effectiveness was positively associated with sustained quality improvement, but this relationship weakened as conflict-related resource constraints increased. The findings suggest that the managerial value of control lies not only in monitoring performance but also in closing the cycle between information, corrective action, follow-up, and accountability. More broadly, the findings indicate that sustaining improvement requires two complementary organizational capacities: the capacity to detect and diagnose performance problems and the capacity to act on the information generated by the control system. Administrative control can strengthen the first capacity, but its contribution to sustained improvement becomes progressively constrained when resource scarcity weakens the second capacity. This information action distinction provides a potentially transferable explanation for variations in control effectiveness across hospitals and other organizations operating under persistent resource adversity.

Abbreviations

ACE
Administrative Control Effectiveness
SQI
Sustained Quality Improvement
CRRC
Conflict-Related Resource Constraints
PLS-SEM
Partial Least Squares Structural Equation Modeling
PRESS
Provider Report of Sustainment Scale
CSAT
Clinical Sustainability Assessment Tool
AVE
Average Variance Extracted
HTMT
Heterotrait–Monotrait Ratio

VIF
Variance Inflation Factor
SRMR
Standardized Root Mean Square Residual
CVPAT
Cross-Validated Predictive Ability Test
CI
Confidence Interval.

Declarations

Ethics approval and consent to participate: Ethical approval for this study was obtained from the **Ethics Committee of the Private Hospitals Union, Yemen** (Approval No. 24/2025). All methods involving human participants were performed in accordance with the relevant ethical guidelines and regulations and with the principles of the **Declaration of Helsinki**. Informed consent to participate was obtained from all participants prior to questionnaire administration. Participation was voluntary, and participants were informed about the purpose of the study, confidentiality protections, and their right to withdraw from the study. No patient-level data or directly identifying employee information were collected, and all responses were analyzed in anonymized or aggregated form.

Consent for publication: Not applicable.

Availability of data and materials: The datasets generated and/or analyzed during the current study are available from the corresponding author upon reasonable request.

Competing Interests: The author declares that he has no competing interests.

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Authors' contributions: Ammar Ali Al-Raimi is the sole author of this manuscript and was responsible for the conceptualization and design of the study, development of the research instrument, coordination of data collection, statistical analysis, interpretation of the findings, and preparation and critical revision of the manuscript. The author read and approved the final manuscript.

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Figures

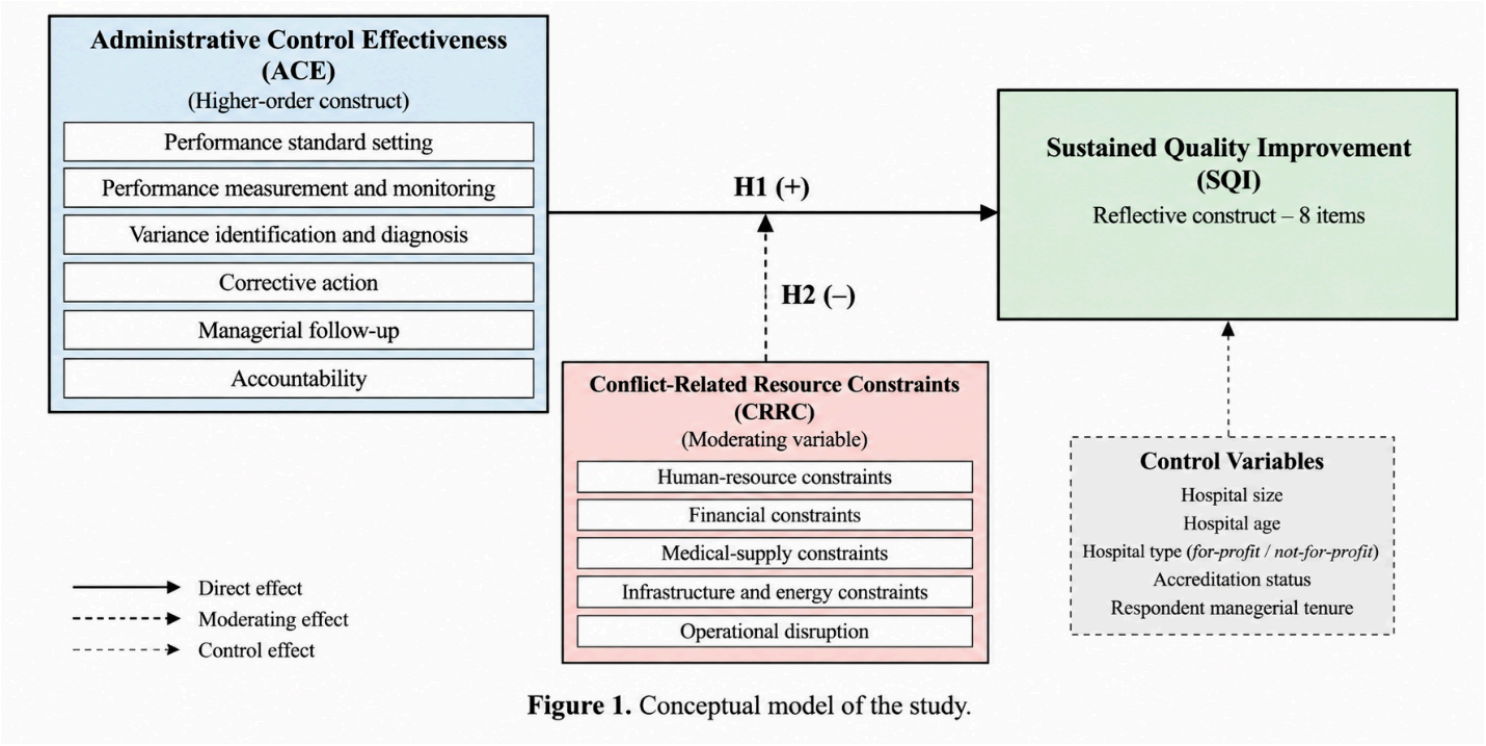


Figure 1. Conceptual model of the study.

Figure 1

See image above for figure legend

Supplementary Files

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- AppendixA.docx