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Clinical governance and healthcare quality in conflict-affected settings: a cross-sectional study of hospitals in Yemen

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Abstract

Background: In fragile and conflict-affected settings, systemic disruptions challenge healthcare quality. Clinical governance (CG) has emerged as a framework for accountability and quality improvement; however, empirical evidence in active conflict environments remains limited. This study examines the relationship between the implementation of clinical governance and healthcare quality (HCQ) in Yemeni hospitals, assessing the differences between the public and private sectors.

Methodology: A cross-sectional analytical study was conducted in Sana'a, Yemen, between June and October 2025, involving 382 healthcare professionals from eight hospitals using proportionate stratified random sampling. Data were collected using a structured, self-administered questionnaire specifically adapted and modified for this study. Clinical governance was assessed using an adapted version of the Clinical Governance Climate Questionnaire (CGCQ), while healthcare quality was assessed using a modified SERVQUAL scale. Data were analyzed using descriptive statistics, Pearson's correlation, Welch's t-tests, and multiple linear regression models, with analysis performed using SPSS version 26.0.

Results: With a 90.9% response rate, a strong positive correlation was found between clinical governance and healthcare quality ($\boldsymbol{R = 0.765}$, $\boldsymbol{p < 0.001}$), with clinical governance explaining 58.5% of the variance in quality outcomes ($\boldsymbol{R^2 = 0.585}$). Multiple regression identified information technology ($\boldsymbol{\beta = 0.271}$, $\boldsymbol{p < 0.001}$), patient involvement ($\boldsymbol{\beta = 0.173}$, $\boldsymbol{p = 0.003}$), and risk management ($\boldsymbol{\beta = 0.156}$, $\boldsymbol{p = 0.010}$) as significant independent predictors. Private

hospitals demonstrated significantly higher scores in both clinical governance and healthcare quality compared to public facilities ($\boldsymbol{p < 0.001}$ for both).
Conclusion: In conflict-affected settings, clinical governance functions as a critical internal stabilizer for healthcare system resilience. The dominance of information technology and risk management reflects an adaptive, crisis-driven operational logic. The public–private performance gap highlights structural inequities exacerbated by conflict, emphasizing the urgent need for targeted policies to restore governance capacity in the public sector and safeguard healthcare quality amidst systemic collapse.

Keywords: Clinical governance, healthcare quality, health system fragility, quality management, Yemeni hospitals, conflict-affected environments

1 Background

Delivering high-quality healthcare in fragile and conflict-affected settings (FCAS) remains a persistent challenge due to severe resource constraints, deteriorating infrastructure, and significant workforce attrition. The World Health Organization (WHO) conceptualizes healthcare quality across three core dimensions: safety, effectiveness, and responsiveness [1]. However, sustaining these standards during protracted crises is exceptionally difficult. Weak or absent governance structures further exacerbate operational disruptions, increasing risks to patient safety and undermining the overall quality of care delivery.

Yemen represents a critical example of these systemic challenges. Since the onset of conflict in 2015, the national health system has experienced profound disruption, including chronic supply chain breakdowns and a severe shortage of healthcare professionals [2]. Recent data from the Health Resources and Services Availability Monitoring System (HeRAMS) and the 2025 OCHA Humanitarian Needs Overview indicate that approximately 40% of health facilities are either partially functional or completely non-functional [3, 4]. This erosion of public-sector capacity has led to a highly fragmented healthcare landscape, characterized by an increasing reliance on private providers and substantial, largely unregulated variation in quality standards across sectors [5–7].

In response to systemic failures in healthcare delivery, the concept of clinical governance has been globally adopted as a structured framework for ensuring accountability and continuous quality improvement. Initially developed in the United Kingdom following major clinical failures in the 1990s, clinical governance was designed to institutionalize quality assurance and promote transparency [8]. Scally and Donaldson [9] defined clinical governance as:

> "A framework through which NHS organizations are accountable for continuously improving the quality of their services and safeguarding high standards of care, by creating an environment in which excellence in clinical care will flourish."

This framework is commonly operationalized through seven core pillars: clinical effectiveness, risk management, education and training, clinical audit, patient engagement,

staff management, and information management [10, 11]. In this study, these pillars serve as the analytical framework for assessing organizational accountability and quality practices.

A substantial body of literature from stable health systems in both high-income countries [12–15] and low- and middle-income countries [16–18] demonstrates a strong association between the implementation of clinical governance and improved patient safety outcomes. However, this evidence is subject to two key limitations. First, it largely assumes the presence of stable institutional structures, adequate resources, and effective regulatory environments—conditions that are typically absent in active conflict settings. Second, the adaptability and effectiveness of clinical governance frameworks under conditions of sustained conflict remain insufficiently explored.

Empirical evidence from FCAS, particularly Yemen, is notably scarce. Addressing this gap is critical for two main reasons. First, the pronounced fragmentation between public and private healthcare sectors suggests that governance practices—and their impact on quality of care—may differ substantially across providers [7]. As private sector engagement increasingly becomes a cornerstone of humanitarian health responses, understanding its implications for accountability and quality assurance is essential. Second, frontline healthcare workers in Yemen operate under extreme constraints and security risks [19]. Their perceptions provide an important, yet underutilized, proxy for evaluating the real-world implementation of governance frameworks, reflecting how formal policies translate into practice in crisis conditions.

In light of these gaps, this study aims to: (1) assess variations in clinical governance practices between public and private hospitals in Yemen; and (2) examine the association between these practices and frontline healthcare workers' perceptions of healthcare quality. We hypothesize that stronger implementation of clinical governance is positively associated with higher perceived quality of care, with significant differences between the public and private sectors. By generating empirical evidence from a high-intensity conflict setting, this study seeks to inform policymakers, humanitarian actors, and health system stakeholders on how governance frameworks can be adapted to sustain and improve healthcare quality under conditions of systemic disruption.

2 Methods

2.1 Study design and setting

This analytical cross-sectional study was conducted in eight major hospitals in Sana'a, Yemen, between June and October 2025. Hospitals were selected based on two inclusion criteria: (1) official accreditation status according to the Ministry of Public Health and Population (MoH-Yemen) hospital quality ranking system [20], and (2) institutional stability, defined as the availability of verified and complete personnel records.

The study included five public hospitals (May 22 Hospital, Mohammad Al-Durra Hospital, September 26 Hospital, Al-Police Model Hospital, and Kuwait University Hospital) and three private hospitals (Modern European Hospital, Azal Hospital, and Yemen International Hospital), ensuring representation from both healthcare sectors.

The study was reported in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines to ensure methodological transparency and rigor.

2.2 Study participants

The study population comprised frontline healthcare professionals, including physicians, nurses, laboratory technicians, and pharmacists, working in the selected hospitals. Eligibility criteria included full-time employment and a minimum of six months of continuous service in the current facility. Staff on temporary rotation, interns, and those with less than six months of tenure were excluded, as their exposure to institutional governance structures was considered insufficient for informed evaluation.

2.3 Sample size and sampling technique

The sample size was determined using **Cochran's formula** for finite populations [21], assuming a 95% confidence level (Z = 1.96), a proportion of 0.5, and a 5% margin of error. The initial calculated sample size was 384. After applying finite population correction based on an accessible population of 3,388 healthcare workers, the adjusted sample size was 345. To compensate for potential non-response and incomplete questionnaires, the final sample size was increased to 420 participants [21, 22].

A proportionate stratified random sampling technique was employed. Each hospital represented an independent stratum, and the sample was allocated proportionally based on the size of the eligible workforce in each facility Table 1. Within each stratum, participants were randomly selected using IBM SPSS Statistics (version 29) from updated 2024 payroll records serving as the sampling frame.

Table 1 Proportionate stratified sampling distribution across participating hospitals (target n = 400)

Hospital	Population (N_h)	Weight (%)	Sample (n_h)
Al-Police Model Hospital	710	20.96	84
Modern European Hospital	611	18.03	72
Kuwait University Hospital	480	14.17	57
September 26 Hospital	422	12.46	50
Azal Hospital	421	12.43	50
May 22 Hospital	310	9.15	36
Mohammad Al-Durra Hospital	222	6.55	26
Yemen International Hospital	212	6.26	25
Total	3,388	100	400

2.4 Data collection instrument

Data were collected using a structured, self-administered questionnaire that was specifically adapted and modified for this study, based on a detailed review of the literature and the study's conceptual framework. The instrument consisted of three sections: (1) socio-demographic variables; (2) clinical governance variables (40 items-seven domains) were adapted from the Clinical Governance Climate Questionnaire (CGCQ) [23] and relevant previous studies [13, 15, 17, 24–29]; (3) Healthcare quality variables (25 items-five domains) were modified from the SERVQUAL scale [30]. All items were rated on a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). The full English version of the questionnaire is provided in the supplementary material (see Supplementary File 1).

2.5 Data collection procedure

Data collection was conducted over five months (June–October 2025). Following ethical and administrative approvals from the Ministry of Health and participating hospitals, formal letters were issued to human resources departments to facilitate access to participants.

Trained research assistants distributed paper-based questionnaires during work shifts. To reduce social desirability bias, completed questionnaires were returned anonymously in sealed envelopes via secure collection boxes.

A total of 420 questionnaires were distributed, of which 400 were returned (response rate: 90.9%). After data cleaning, 382 questionnaires were included in the final analysis. Missing data were minimal and determined to be Missing Completely at Random (MCAR); therefore, listwise deletion was applied without imputation.

2.6 Study variables

The independent variable was clinical governance, operationalised through seven domains: clinical effectiveness, risk management, education and training, clinical audit, patient and public involvement, staff management, and information management.

The dependent variable was healthcare quality, measured across five SERVQUAL dimensions: reliability, responsiveness, assurance, tangibles, and empathy.

Covariates included gender, educational level, years of experience, hospital type, professional category, and administrative level, which were controlled for in multivariable regression analyses.

2.7 Validity and reliability

Content validity was established through expert review by ten specialists, including senior academics in hospital management, clinical quality directors, and healthcare consultants. Instrument items were evaluated for clarity, relevance, and cultural appropriateness for the Yemeni healthcare context, and minor revisions were implemented accordingly.

Linguistic validity was ensured using a double back-translation procedure conducted by independent professional translators to maintain conceptual equivalence between Arabic and English versions.

A pilot study involving 30 healthcare professionals was conducted to assess clarity and reliability. Item-total correlations and Cronbach's alpha coefficients were used to evaluate construct validity and internal consistency. All constructs demonstrated acceptable reliability levels.

2.8 Statistical analysis

Data were analysed using IBM SPSS Statistics version 26. Descriptive statistics (frequencies, percentages, means, and standard deviations) were used to summarise participant characteristics and study variables.

Survey weights were calculated based on the proportional representation of each hospital and applied using the SPSS Weight Cases procedure to ensure population-representative estimates.

Internal consistency was assessed using Cronbach's alpha. Normality was evaluated using the Shapiro-Wilk test and Q-Q plots. Multicollinearity was assessed using Variance Inflation Factor (VIF), with no significant issues detected.

Pearson's correlation analysis was used to examine relationships between variables. Group differences were assessed using independent samples t-tests and one-way ANOVA. Simple and multiple linear regression models were used to test study hypotheses. Model assumptions, including linearity, homoscedasticity, and independence of residuals, were verified using diagnostic plots and the Durbin-Watson statistic.

All statistical tests were two-tailed, with $p < 0.05$ considered statistically significant. Sensitivity analyses comparing weighted and unweighted models were conducted to assess robustness.

2.9 Ethical considerations

Informed consent was obtained from all participants after providing detailed information about the study purpose and procedures. Participation was voluntary, and respondents could withdraw at any time without consequence. Data confidentiality was strictly maintained through anonymisation and removal of personal identifiers.

Ethical approval was granted by the Independent Ethics Committee of the Yemeni Academy of Graduate Studies, Sana'a, Yemen. The study complied with all relevant institutional and ethical guidelines.

3 Results

The results are presented in three parts: first, a demographic profile of the participants; second, an assessment of the measurement model's reliability and validity; and finally, an analysis of the predictors of healthcare quality, including sectoral comparisons to understand disparities in service delivery.

3.1 Sample Characteristics

A total of 382 health staff members participated in the study, out of 415 eligible staff members approached, yielding a response rate of 92.0%. Table 2 presents the demographic and professional distribution of the sample.

Table 2 Demographic Characteristics of Study Sample

Variable	Category	Frequency	Percentage
Gender	Male	198	51.8
	Female	184	48.2
Education	Diploma	166	43.5
	Bachelor	159	41.6
	Board	20	5.2
	Master	24	6.3
	PhD	13	3.4
Years of Experience	$<$ 1 year	29	7.6
	1–5 years	132	34.6
	6–10 years	120	31.4
	$>$ 10 years	101	26.4
Hospital Type	Public	239	62.6
	Private	143	37.4
Professional Specialty	Specialist Doctor	27	7.1
	General Practitioner	33	8.6
	Pharmacist	25	6.5
	Laboratory	24	6.3
	Radiology	21	5.5
	Nurse	184	48.2
	Administrative	49	12.8
	Other	19	5.0

It is evident from Table 2 that the percentage of males in the study sample reached (51.8%) compared to the percentage of females (48.2%). Also, the majority of those holding scientific qualifications were holders of Diploma and Bachelor degrees with a percentage of (85.1%), where the category (from 1 to 5 years with 34.6%) represented the highest participation rate in the sample. The majority of participants represented the Nursing category with 48.2%, and most of them work in government hospitals (62.6%).

3.2 Psychometric Properties and Descriptive Statistics

To ensure the robustness of the findings, the psychometric properties of the research instruments were evaluated, alongside the descriptive statistics for all study constructs. Table 3 summarizes the internal consistency, construct validity, and the distribution of participants' responses for Clinical Governance and Healthcare Quality dimensions.

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Table 3 Descriptive Statistics, Reliability, and Construct Validity of the Study Scales

Constructs and Dimensions	Mean (SD)	Weight (%)	α	r*
Clinical Governance (CG)	**3.56 (0.78)**	**71.2**	**0.97**	-
IT Management	3.54 (0.89)	70.8	0.89	0.92
Patient & Public Involvement	3.62 (0.89)	72.4	0.83	0.83
Risk & Safety Management	3.67 (0.90)	73.4	0.91	0.87
Recruitment / Human Resources	3.58 (0.91)	71.6	0.90	0.91
Education and Training	3.42 (0.95)	68.4	0.89	0.90
Clinical Audit	3.58 (0.85)	71.6	0.88	0.89
Clinical & Research Excellence	3.50 (0.85)	70.0	0.90	0.90
Healthcare Quality (HCQ)	**3.77 (0.76)**	**75.4**	**0.97**	-
Assurance / Safety	3.83 (0.83)	76.6	0.90	0.92
Empathy	3.81 (0.81)	76.2	0.88	0.89
Responsiveness	3.77 (0.83)	75.4	0.89	0.91
Tangibles	3.76 (0.84)	75.2	0.89	0.92
Reliability	3.71 (0.87)	74.2	0.91	0.91

Note: α = Cronbach's alpha; SD = Standard Deviation; r = Pearson correlation coefficient.
* Pearson correlation between the dimension and the total construct score ($p < 0.001$ for all).

internal consistency, construct validity, and distribution of participants' responses. The Clinical Governance and Healthcare Quality scales exhibited excellent reliability ($\alpha = 0.97$ and 0.97, respectively). Construct validity was confirmed through strong dimension-to-total correlations, ranging from 0.83 to 0.92 ($p < 0.001$), confirming that the dimensions adequately represent their respective constructs.

Overall, respondents evaluated Clinical Governance practices as moderate-to-high ($M = 3.56, SD = 0.78$), with "Risk Management & Safety" ($M = 3.67$) emerging as the most robust dimension and "Education & Training" ($M = 3.42$) as the least. Regarding Healthcare Quality, participants reported positive perceptions ($M = 3.77, SD = 0.76$), with "Assurance / Safety" scoring the highest ($M = 3.83$) and "Reliability" the lowest ($M = 3.71$).

3.3 Determinants of Healthcare Quality: Hierarchical Regression Analysis

Before performing the hierarchical multiple regression, a preliminary simple linear regression was conducted to examine the direct association between clinical governance and healthcare quality. The analysis confirmed a strong positive relationship ($\beta = 0.765, p < 0.001$), explaining 58.5% of the variance. To further understand this association while controlling for socio-demographic factors, a hierarchical multiple regression was subsequently performed Table 4.

A hierarchical multiple regression analysis was performed to identify the determinants of perceived Healthcare Quality. This approach allowed for the assessment of the clinical governance pillars' predictive power while controlling for potential socio-demographic and institutional confounders.

Table 4 Hierarchical multiple regression analysis predicting Healthcare Quality

	Model 1 (Unadjusted)			**Model 2 (Adjusted)**		
Predictor Variables	B (SE)	β	p	B (SE)	β	p
Constant	1.118 (0.135)	-	¡.001	1.082 (0.175)	-	¡.001
CG Pillars						
IT Mgmt	0.233 (0.052)	0.271	¡.001	0.237 (0.054)	0.276	¡.001
Patient Involve	0.147 (0.049)	0.173	.003	0.155 (0.051)	0.183	.002
Risk Mgmt	0.132 (0.051)	0.156	.010	0.118 (0.053)	0.140	.026
Recruit / HR	0.100 (0.054)	0.119	.063	0.101 (0.055)	0.120	.070
Edu/Training	0.082 (0.049)	0.103	.095	0.088 (0.051)	0.111	.083
Clinical Audit	0.077 (0.049)	0.087	.114	0.051 (0.051)	0.057	.315
Clinical Excellence	-0.028 (0.074)	-0.025	.709	-0.018 (0.076)	-0.017	.810
Control Variables	Not Included			Included (see Supplementary file 2: Table S1)		
R^2	0.596			0.612		
ΔR^2	-			0.016		
F-Statistic	78.958***			22.418***		

Model 1 (Unadjusted): The initial model, encompassing the seven clinical governance pillars, was statistically significant ($F = 78.958, p < 0.001$) and accounted for 59.6% of the variance in healthcare quality ($R^2 = 0.596$). Three dimensions emerged as significant positive predictors: Information Technology Management exhibited the strongest association ($\beta = 0.271, p < 0.001$), followed by Patient Involvement ($\beta = 0.173, p = 0.003$) and Risk & Safety Management ($\beta = 0.156, p = 0.010$). The remaining four dimensions did not show statistically significant associations at the 0.05 level.

Model 2 (Adjusted): Upon the introduction of control variables in the second step, the overall model remained highly significant ($F = 22.418, p < 0.001$), with a marginal increase in explanatory power ($R^2 = 0.612$, Adjusted $R^2 = 0.584$). Crucially, the three previously identified clinical governance predictors retained their statistical significance and predictive strength, demonstrating the robustness of their impact independent of confounders. Among the control variables, only male gender showed a slight, yet significant, positive association with perceived healthcare quality ($B = 0.111, p = 0.043$) compared to females. Other demographic and professional factors, including education, specialty, and experience, yielded no significant effects.

Finally, multicollinearity was assessed and ruled out, as all Variance Inflation Factor (VIF) values were well below the conservative threshold of 5 (range: 1.11–4.31), confirming the reliability of the regression coefficients. Furthermore, sensitivity analyses were conducted to ensure the robustness of these findings by comparing weighted and unweighted models; results remained consistent, confirming the stability of the core predictors (see Supplementary file 2: Table S1).

3.3.1 Contextual Differences: Public vs. Private Sector (Sectoral Disparities)

Beyond the overall predictive model, it is essential to determine whether these governance practices and quality outcomes differ systematically across healthcare settings. Therefore, a sectoral comparison was conducted between public and private hospitals, as summarized in Table 5.

Table 5 Descriptive statistics and sectoral differences in CG and HCQ

Variable	Sector	N	Mean ± SD	95% CI	Welch t	df
CG	Public	239	3.39 ± 0.83	[3.29, 3.50]	-6.01	370.47
	Private	143	3.83 ± 0.58	[3.74, 3.93]		
	Mean Difference: -0.437			**Cohen's d: 0.61**	($p < 0.001$)	
HCQ	Public	239	3.64 ± 0.83	[3.53, 3.74]	-5.25	375.92
	Private	143	4.01 ± 0.55	[3.92, 4.10]		
	Mean Difference: -0.372			**Cohen's d: 0.54**	($p < 0.001$)	

Note: Welch's t-test was used due to unequal variances. Negative mean differences indicate higher scores in private hospitals. r (Public) = 0.62, r (Private) = 0.58 ($p < 0.001$).

The results in Table 5 showed that descriptive and inferential analyzes revealed significant differences in clinical governance practices (CG) and perceived healthcare quality (HCQ) between public and private hospitals. Private hospitals reported higher CG scores ($M = 3.83$, $SD = 0.58$) than public hospitals ($M = 3.39$, $SD = 0.83$), with a statistically significant difference confirmed by Welch's t-test ($t = -6.01$, $df = 370.47$, $p < 0.001$; Cohen's $d = 0.61$). Similarly, perceived healthcare quality was higher in private hospitals ($M = 4.01$, $SD = 0.55$) compared to public hospitals ($M = 3.64$, $SD = 0.83$; $t = -5.25$, $df = 375.92$, $p < 0.001$; Cohen's $d = 0.54$).

4 Discussion

Given the complex and severely disrupted nature of the Yemeni healthcare system, this study explored the relationship between clinical governance and perceived healthcare quality and assessed disparities between the public and private sectors. By doing so, it provides rare empirical insights into the implementation of quality frameworks in a protracted, conflict-affected setting, thereby helping to address a critical knowledge gap in the literature that links clinical governance to healthcare outcomes in fragile and low-income contexts. Furthermore, to the best of the researcher's knowledge, this study is the first scholarly attempt of its kind to address this issue within Yemeni hospitals, showing the unique significance of its findings in this area.

4.1 Clinical Governance as a Strategic Response to Systemic Challenges in Fragile Environments

The analysis reveals a statistically significant correlation between clinical governance and healthcare quality, as perceived by staff, with clinical governance accounting for approximately 58% of the variance in service quality. This may be attributed to staff awareness of the role governance plays in filling the near-total lack of external oversight and stable funding mechanisms. In such an environment, hospitals rely on their internal structures to maintain a minimum level of performance and ensure patient safety.

This result aligns with previous studies in low- and middle-income countries, which have emphasized the importance of governance structures in strengthening healthcare delivery systems [13, 16–18]. Evidence from developed contexts further supports this relationship, showing that governance in private hospitals enhances patient safety through the mediating effects of teamwork and continuous improvement [16]. While these findings partially align with Al-Saeedi [12], regarding the importance of patient engagement and information management, they diverge significantly in their approach to risk management. This divergence is likely attributable to the extreme context of war, which forces hospitals to prioritize immediate risk mitigation and daily operational survival over long-term strategic goals. In line with this evidence, recent critical reviews have highlighted that clinical governance is not merely a regulatory framework but an ethical and organizational pillar that directly impacts healthcare quality [31]. However, this study extends the literature by providing evidence that this correlation persists, even amid the structural collapse that characterizes conflict-affected environments.

In contrast, this result is at odds with some regional research that focuses on implementation barriers limiting the effectiveness of governance frameworks [32, 33]. This distinction is attributed to contextual differences, as governance enhancements in conflict-affected settings are often perceived positively by staff due to the lack of viable external support structures. Thus, even minor internal improvements may give an exaggerated impression of quality development.

Theoretically, these results are fully consistent with systems theory [34], which views organizations as open systems influenced by their environment.

In the Yemeni case, the collapse of external stability drivers led the health system to turn inward in search of survival, making internal governance mechanisms the primary driver of organizational performance. In this context, clinical governance emerges not only as a framework for quality but also as a system that fosters organizational resilience and ensures the continuity of care delivery during protracted crises [35, 36]. The robustness of these findings is further underscored by the sensitivity analysis (see Supplementary file 2: Table S2), which demonstrated that the primary predictors Information Technology, Patient Involvement, and Risk Management remained highly stable across both weighted and unweighted models. This stability enhances the study's internal validity, confirming that the identified link between governance quality and the sampled population is consistent across all observations.

4.2 The Logic of Emergency vs. The Logic of Development

The multiple regression analysis revealed an interesting pattern that reflected wartime priorities. Information technology, patient engagement, and risk management were the most influential predictors of quality of care, whilst clinical auditing, research excellence, and education and training were not significantly influential. This can be explained by the context's conflict-driven nature, which may prioritize short-term operational procedures over long-term development activities.

4.2.1 The Centrality of Technology and Information

This is attributed to staff awareness of IT management's role in supporting clinical decision-making, reducing errors, and ensuring continuity of care, as IT management represents the fundamental infrastructure for the other dimensions of clinical governance. The results are aligned with local studies [37, 38], and regional studies [12, 39], as well as with studies in numerous conflict-affected regions [40, 41], all of which concluded that digital health interventions have a tangible, positive impact on governance responsiveness and employee satisfaction.

Patient engagement also contributes to improved treatment adherence and trust-building, ensuring continuity of care despite limited resources and operational pressures. Meanwhile, risk management focuses on minimizing clinical errors and protecting patients, contributing to stable performance and improved health outcomes. This finding partially aligns with previous studies [12, 42, 43], which concluded that patient engagement and risk management are essential pillars for promoting patient safety. The prominence of these dimensions is linked to hospitals' current awareness of the immediate operational methods needed to ensure continuity of care in conflict-affected areas, rather than long-term activities. These results can be explained by the Donabedian framework (Structure–Process–Outcome), in which risk management concurrently enhances safety-related structures, improves clinical practices, and reduces adverse outcomes [44]. In the context of Yemeni hospitals, characterized by limited resources and multiple clinical risks, effective risk management translates directly into significant improvements in care outcomes and patient safety.

4.2.2 The Puzzle of Training and Education in Fragile Contexts

The statistically unexpected result that education and training have no effect on quality points to a deeper problem than just the tool's weakness; it reflects the collision between knowledge and an unsupportive organizational environment, as well as dated operational resources. This may be attributed to the perception of healthcare. workers that the adequacy of training may be affected by the serious challenges facing their work environment, as healthcare institutions shift from a long-term learning model to one of immediate crisis response.

This result is consistent with studies in conflict-affected contexts (such as Syria, Sudan, and Palestine) [45–50], where the training system suffers from fragmentation and collides with severe structural obstacles, creating a large gap between receiving training and the ability to apply it. This contrast becomes clear when comparing our study with stable contexts [12].

In comparison with local studies, the findings of this study partly differ from those of a local study [51]. This is because the influence of such dimensions within an all-encompassing governance framework may be implicit or indirect. This is to say that the achievement of quality in Yemeni hospitals is the result of multiple intricate interferences that go beyond the autonomous effects of training and education.

This result can be explained in accordance with Kirkpatrick's model [52] and the literature on training transfer [53]. Acquired skills cannot be effectively translated into actual performance improvement unless a suitable transfer climate is in place [54]. This result is consistent with the Resource-Based View (RBV), which asserts that human resources do not produce added value in the absence of the necessary material and logistical resources to activate them [55]. This suggests that clinical governance priorities shift according to context. In conflict settings, achieving good outcomes primarily relies on robust operational systems and rapid response, rather than workforce preparation. Therefore, the weak link between quality and training effectiveness does not mean education is unimportant, but rather that immediate operational needs have a greater impact in these environments.

Meanwhile, other dimensions, such as clinical audit and human resources, did not show statistical significance when entered into the model. This study is partly consistent with a previous study in the Yemeni context, which showed that the human resources dimension was not statistically significant when other variables were included in the model [56]. This reinforces our finding that certain dimensions, such as education, training, and clinical auditing, may have an indirect or implicit impact, and that current priorities in Yemeni hospitals tend to focus more on daily processes and policies as key drivers of quality improvement.

4.2.3 Demographic Differences in Quality Perception

Furthermore, regarding control variables, the study found that male gender was significantly associated with higher perceptions of healthcare quality ($B = 0.111$, $p = 0.043$). This could suggest that male health workers in the Yemeni context may have different access to operational resources or perceive the organizational environment differently than their female counterparts. This disparity warrants further gender-sensitive research in conflict-affected health systems.

4.3 The Gap Between the Two Sectors: A Resource-Based View Perspective

Statistically significant differences were observed between public and private hospitals, with the private sector demonstrating higher levels of both clinical governance implementation and perceived service quality. This is attributed to the private sector's understanding of the fee-for-service model, which has preserved governance mechanisms through self-financing models and insulated it from financial collapse, effectively creating pockets of resilience amid conflict and resource scarcity. Meanwhile, prolonged salary interruptions and administrative fragmentation have significantly constrained the performance of government hospitals.

Despite the limited number of studies comparing private and public hospitals, particularly regarding clinical governance, the results of our study partially align with those from studies conducted in lower-middle-income settings [57–60], and in stable settings [61]. In contrast, this finding differs from studies conducted in the United Arab Emirates (UAE) [62], which found that the perceived quality of healthcare in public and private hospitals did not differ significantly. This may be attributed to the UAE's public health system being fully government-funded and provided free of charge to its citizens.

From a theoretical perspective, this result can be interpreted through the resource-based view [55], which holds that sustainable competitive advantage arises from developing superior capabilities and resources. In Yemen, protracted salary disruptions and administrative fragmentation have severely constrained the performance of the public sector, while private hospitals have maintained their governance through self-financing models.

However, the current study highlights how these disparities are exacerbated by armed conflicts, thereby transforming them into structural threats to the health system's equity and sustainability. Therefore, the results of the comparative study represent an implicit critique of the fragmentation of public system governance and the fragility of government coordination. It also suggests that strategies to enhance governance should focus not on completely restructuring the system but on restoring public institutional cohesion, clarifying governance authority, and providing sufficient stability and autonomy for public facilities to implement governance frameworks that private-sector providers have proven can improve quality.

4.3.1 Theoretical Contribution

This study advances theoretical understanding by demonstrating how clinical governance functions as a mechanism for health system resilience in conflict-affected settings. By applying Systems Theory and the Resource-Based View (RBV), our findings suggest that internal governance structures and strategic resource allocation have a direct influence on perceived healthcare quality. This framework can guide future studies and interventions in other fragile settings, providing a conceptual model to predict the effectiveness of governance-based quality improvement under crisis conditions.

The significant positive correlation found between clinical governance dimensions and healthcare quality underscores that governance is not merely a quality assurance tool, but a vital mechanism for institutional resilience amid the ongoing conflict in Yemen. Our findings suggest that hospitals, particularly those in the private sector (as shown in the T-test results), that adhered to governance standards were better equipped to navigate the challenges of war. This resilience is manifested in the ability to maintain service reliability and responsiveness despite the collapse of central support systems. Therefore, clinical governance acts as an 'internal stabilizer' that allows Yemeni hospitals to adapt and continue delivering high-quality care under extreme pressure.

4.4 Limitations and Directions for Future Research

This study is subject to several limitations. First, the cross-sectional design precludes causal inferences regarding the impact of clinical governance on quality over time. Second, data from self-report questionnaires are susceptible to common method and social desirability biases. Furthermore, the reliance on perceived quality measures, rather than objective clinical indicators, reflects subjective staff experiences rather than clinical outcomes. Methodologically, the reliance on official payrolls for sampling may have excluded informal or volunteer healthcare workers, who provide substantial care in conflict zones. Finally, because the study was restricted to hospitals in Sana'a, the findings may have limited generalizability to rural or actively besieged governorates in Yemen. Future longitudinal research is recommended to enhance the ability to interpret the results and provide accurate, practical recommendations for the health sector.

4.5 Implications for Policy and Practice

Based on the results that showed the priority of technology and risks and the decline of training, we recommend the following:

- **For Policy Makers in the Ministry of Health:**
  - Institutionalizing Governance: Moving from imposing impossible ideal quality standards to adopting basic emergency quality standards that focus on patient safety and operational reliability. And activating partnership models between the public and private sectors to transfer administrative efficiency expertise and digital systems from private to government hospitals.
- **For Hospital Managers:**
  - Investing in Digitization: Prioritizing information systems; the results have proven that they are the strongest factor in improving perceived quality.
  - Reorienting Training: Shifting from "traditional training" (which showed no effect in the study) to "on-the-job training" and clinical simulation to deal with risk scenarios, to ensure a direct impact on daily performance.
- **For International Non-governmental organizations (NGOs) and Donors:**
  - Supporting Systems, Not Just Inputs: Allocating a portion of humanitarian funding to support governance systems (such as quality and automation programs) and not just to purchase medicines and fuel, to ensure the sustainability of the impact after funding ends.

5 Conclusion

This study concluded that clinical governance in conflict-affected settings, such as Yemen, is no longer an additional quality standard or institutional luxury; it has evolved into a vital mechanism for ensuring the survival, resilience, and continuity of healthcare delivery. The results demonstrated a strong predictive capacity of governance dimensions in determining the quality of service. In this regard, it is essential to

emphasize that even in fragile and resource-poor environments, structured governance frameworks are crucial for maintaining performance and ensuring patient outcomes.

Notably, the policies governing the prioritization of governance dimensions in this context reflect the logic of crisis management rather than long-term, sustainable development. The prominence of information technology and risk management reflects the adaptive response to the instability, insecurity, and volatility of resources. These dimensions provide data exchanges between the speed and coordination of crisis operations and mitigation operations. By contrast, the relative decline of education and training implies a reactive orientation, with proximate operational survival taking precedence over strategic human capital development. While understandable under prolonged conflict conditions, such an imbalance creates long-term risks to system sustainability, professional competency, and institutional memory.

The study indicates a structural gap between the two sectors of the health system. The private sector enjoys greater financial, administrative, and technical flexibility, whereas the public sector struggles with resource shortages, deteriorating infrastructure, and staff emigration. This undermines governance and exacerbates inequalities in service quality. Therefore, there is a need for more equitable policies for resource allocation, capacity building, and the provision of financial and technical support to public institutions. The findings also confirm that governance conflict-affected areas, and that strengthening clinical governance in Yemen is a strategic imperative for rebuilding a more equitable and sustainable health system. Further research is needed on the long-term effects of governance reforms, as well as the role of education and professional development.

List of Abbreviations

CG	Clinical Governance
CGCQ	Clinical Governance Climate Questionnaire
FCAS	Fragile and Conflict Affected Settings
HCQ	Healthcare Quality
HeRAMS	Health Resources and Services Availability Monitoring System
HR	Human Resources
IT	Information Technology
MoH-Yemen	Ministry of Public Health and Population - Yemen
NGOs	Non-Governmental Organizations
NHS	National Health Service
OCHA	Office for the Coordination of Humanitarian Affairs
RBV	Resource-Based View
SDGs	Sustainable Development Goals
SERVQUAL	Service Quality Model
UAE	United Arab Emirates
WHO	World Health Organization

Declarations

Ethics Approval and Consent to Participate

This study was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki. Ethical approval was obtained from the Ethics Committee of the Yemeni Academy of Graduate Studies Approval No. RY/YAGS/100006-109. All participants provided written informed consent before their inclusion in the study. To protect participant privacy, all data were collected and processed anonymously. This study was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki. Helsinki. Ethical approval was obtained from the Ethics Committee of the Yemeni Academy of Graduate Studies (Approval Number: [Insert Number if available]). All participants provided written informed consent before their inclusion in the study. To protect participant privacy, all data were collected and processed anonymously.

Consent for Publication

Not applicable. This manuscript does not contain any person's data in any form (including individual details, images, or videos).

Availability of Data and Materials

The datasets generated and analyzed during the current study are not publicly available due to ethical restrictions and the need to protect participant confidentiality. However, the data are available from the corresponding author (sham16lan@gmail.com) upon reasonable request, contingent upon approval by the Ethics Committee of the Yemeni Academy of Graduate Studies.

Competing Interests

The authors declare that they have no competing interests.

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Authors' Contributions

M. A. S. conceived and designed the study, collected and analyzed the data, and was a major contributor to the writing of the manuscript, ORCID iD: https://orcid.org/0009-0006-7078-5079. M. M. A. supervised the project, contributed to the study design and methodology, and critically revised the manuscript. All authors read and approved the final manuscript, ORCID iD: https://orcid.org/0000-0003-0599-0923.

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Supplementary Materials

Supplementary file 1: Study Questionnaire. Format: PDF. Description: The English version of the structured questionnaire used in this study.
Supplementary file 2: Supplementary Tables. Format: PDF. Description: Supplementary statistical tables (Tables S1 to S2) supporting the findings.

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