

Supplementary File 1: (Methodological & Reporting Appendices)

1. Fornell–Larcker Criterion Matrix

Table S1. Assessment of Discriminant Validity using the Fornell–Larcker Criterion (N = 108).

Table S1. Fornell–Larcker Criterion Matrix of Latent Constructs

Latent Construct / Sub-dimension	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
(1) Senior Leadership & Management Support (SL)	0.762								
(2) Training & Capability Building (TR)	0.512	0.767							
(3) DMAIC Improvement Cycle (DM)	0.445	0.438	0.740						
(4) Patient-Centric Focus (PF)	0.420	0.395	0.482	0.720					
(5) Healthcare Technology & Info Systems (TI)	0.468	0.415	0.534	0.452	0.772				
(6) Clinical Quality (CQ)	0.418	0.380	0.542	0.465	0.585	0.777			
(7) Operational Efficiency (OP)	0.395	0.362	0.528	0.430	0.612	0.564	0.718		
(8) Patient / Beneficiary Satisfaction (PS)	0.405	0.374	0.460	0.490	0.478	0.512	0.485	0.760	
(9) Human Resources Performance (HR)	0.382	0.355	0.415	0.390	0.435	0.470	0.492	0.520	0.821

Methodological Notes on Table S1:

- **Diagonal elements (in bold):** Represent the square root of the Average Variance Extracted ($\sqrt{AVE}$) for each reflective construct.
- **Off-diagonal elements:** Represent Pearson bivariate correlation coefficients (r) between constructs ($p < 0.01$ for all correlations).
- **Discriminant Validity Compliance:** The square root of the AVE for every single construct (range: 0.718 - 0.821) is strictly higher than any off-diagonal correlation involving that construct (maximum inter-construct correlation is $r = 0.612$ between Healthcare Technology and Operational Efficiency). This confirms that each latent dimension measures a conceptually and empirically unique construct, fulfilling the classical Fornell–Larcker criterion and ruling out construct redundancy.

2. STROBE Checklist)

Table S2. Completed STROBE Reporting Checklist for Cross-Sectional Studies

Item No.	STROBE Recommendation	Reported in Section / Sub-section	Specific Details and Implementation in Current Study
1a	Indicate the study's design with a commonly used term in the title or the abstract	Title & Abstract	Specified as a cross-sectional hybrid study integrating a total census survey (N = 108) with a retrospective clinical audit (N = 2,588 records).
1b	Provide an informative and balanced summary of what was done and what was found	Abstract	Unstructured abstract detailing background, census sampling, regression metrics ($R^2 = 0.524$), beta coefficients, DPMO calculation (1,545 DPMO), and clinical implications.
2	Explain the scientific background and rationale for the investigation	1. Introduction (1.1 & 1.2)	Impact of armed conflict on health infrastructure, severe acute malnutrition burden in Yemen, operational failure modes in TFCs, and theoretical LSS rationale.
3	State specific objectives, including any prespecified hypotheses	1. Introduction (Objectives & Hypotheses)	Defined four primary research objectives and two main formal hypotheses (with 5 sub-hypotheses for each LSS dimension) tested at $\alpha \leq 0.05$.
4	Present key elements of study design early in the paper	3. Methods (3.1 & 3.2)	Cross-sectional observational and retrospective design encompassing healthcare workers across all operational public hospital TFCs in Sana'a Governorate.
5	Describe the setting, locations, and relevant dates	3. Methods (3.1 & 3.5)	Six public and rural referral hospitals in Sana'a Governorate (22 May, Al-Wahdah, Aomrah, Emergency Hospital Bani Mansour, Hamdan General, Al-Samad); audit window: Jan 1 – Dec 31, 2024.
6a	Give the eligibility criteria, and the sources and methods of selection of participants	3. Methods (3.1 & 3.2)	Inclusion criteria: Permanent medical doctors, pediatricians, clinical nutritionists, nursing staff, and administrative directors working in active TFC units. Exclusion: Temporary volunteers and incomplete submissions.
7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers	3. Methods (3.3)	Predictor: LSS (5 dimensions, 30 items). Outcome: Institutional Performance (4 dimensions, 24 items). Clinical Outcome: Admission protocol defect density (DPMO) and sigma level.
8	Give sources of data and details of methods of assessment (measurement)	3. Methods (3.3 & 3.5)	5-point Likert questionnaire (content and construct validated; Cronbach's $\alpha = 0.932 - 0.950$); dual independent retrospective review of 2,588 inpatient admission charts against WHO SAM protocols.
9	Describe any efforts to address potential sources of bias	3. Methods (3.2 & 3.6)	Non-response bias mitigated by total census (97.3% response); Common Method Bias addressed via Harman's single-factor test (34.2% < 50% threshold); Inter-rater bias assessed via

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			Cohen's kappa (kappa = 0.892).
10	Explain how the study size was arrived at	3. Methods (3.2)	Complete census (N = 111, target population). Statistical power confirmed post-hoc via G* Power 3.1.9.7 (N = 108, $f^2 = 0.15$, $\alpha = 0.05$, yielding achieved power $1 - \beta = 0.884 > 0.80$).
11	Explain how quantitative variables were handled in the analyses	3. Methods & 4. Results	Questionnaire dimensions aggregated into composite mean scores; clinical admissions quantified into defect counts, error opportunities (4 per admission), and DPMO metrics.
12a	Describe all statistical methods, including those used to control for confounding	3. Methods (3.2) & 4. Results (4.3)	Pearson correlation, simple linear regression, enter-method multiple linear regression, collinearity diagnostics ($VIF < 3.0$), and cluster-robust standard errors.
12b	Describe any methods used to examine subgroups and interactions	4. Results (4.4)	Independent samples t-tests (gender, training status) and one-way ANOVA (educational level, experience years, job role).
12c	Explain how missing data were addressed	3. Methods (3.2)	One incomplete survey record with >10% missing responses was dropped listwise during data pre-processing (N = 109 to 108).
12d	If applicable, describe analytical methods taking account of sampling strategy	3. Methods (3.2)	Intra-class correlation coefficients calculated ($ICC < 0.041$); cluster-robust standard errors computed across the six hospital facilities.
12e	Describe any sensitivity analyses	4. Results (4.5)	Comparative facility-level sensitivity: Cross-referencing perceptual maturity with objective DPMO rates across centers to test predictive robustness.
13a	Report numbers of individuals at each stage of study	3. Methods (3.2) & 4. Results (4.1)	Target census: 111; returned: 109 (98.2%); valid analyzed: 108 (97.3% net response rate). Clinical records audited: 2,588.
13b	Give reasons for non-participation at each stage	3. Methods (3.2)	Two non-respondents due to field duties; one survey excluded due to extensive missing responses.
14a	Give characteristics of study participants and information on exposures	4. Results (4.1)	Distribution by gender (64.8% male, 35.2% female), education (47.2% diploma, 34.3% BSc, 10.2% MSc, 8.3% PhD), and LSS training status (76.9% untrained).
15	Report numbers of outcome events or summary measures	4. Results (4.2 & 4.5)	Mean LSS practice = 4.13/5.00; Mean Performance = 4.26/5.00. Clinical audit: 16 admission defects across 10,352 opportunities (1,545 DPMO; 4.5–4.7 sigma).
16a	Give unadjusted estimates and, if applicable, confounder-adjusted estimates	4. Results (4.3)	Simple regression: $R = 0.724$, $R^2 = 0.524$, $F = 116.695$, $p < 0.001$. Multiple regression: adjusted $R^2 = 0.587$, $F = 29.015$, $p < 0.001$.
16b	Report category boundaries when continuous variables were categorized	4. Results (4.2)	5-point Likert scale thresholds: Low (<2.33), Moderate (2.34–3.66), High (3.67–5.00).

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17	Report other analyses done (e.g., subgroup differences)	4. Results (4.4)	Significant gender perception gap favoring males in LSS practice ($t = 2.272$, $p = 0.027$) and Performance ($t = 2.905$, $p = 0.004$). No differences across education, experience, or training.
18	Summarize key results with reference to study objectives	5. Discussion (5.1)	Demonstrated procedural and technological primacy ($\beta = 0.325$ and 0.179) over soft management enablers under conflict settings.
19	Discuss limitations of the study	6. Conclusions (6.3)	Cross-sectional design limits causal claims; limited to public TFCs in Sana'a Governorate; need for longitudinal multi-center trials in other governorates.
20	Give a cautious overall interpretation of results	5. Discussion (5.1 & 5.2)	Shift toward "system-dependent resilience"; digitized standard operating procedures act as institutional fail-safes during acute humanitarian disruption.
21	Discuss the generalisability (external validity) of the study results	5. Discussion (5.2) & 6.1	Highly generalizable to inpatient pediatric nutrition and emergency public health facilities operating in conflict zones and resource-constrained environments.
22	Give the source of funding and the role of the funders	6. Declarations (6.4)	Self-funded research; no external financial support from governmental or commercial entities.