# SAMPLING DESIGN IN HOSPITAL MANAGEMENT RESEARCH: LESSONS FROM A RESPONDENT SURVEY

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## ABSTRACT

***Background:*** Sampling choices shape the credibility and utility of hospital-management research. This study reports a pragmatic sampling design from a tertiary military hospital in Vietnam and distills operational lessons for future studies. ***Subjects and methods:*** We surveyed 263 health-care workers at Military Hospital 175 using non-probability convenience sampling. After cleaning, 243 valid questionnaires were obtained, with the target size derived from a conservative 50% response assumption for social surveys and adequacy rules for multivariate analyses. The achieved n=243 exceeded thresholds for EFA (≥5 × items) and multiple regression (≥50 + 8m), ensuring stable estimation. ***Results:*** The final sample permitted factor and regression modeling with good model fit (adjusted $R^2 \approx 0.673$), indicating sufficient statistical power for detecting associations between organizational factors and work motivation. Group comparisons were feasible: no differences by sex or age, but significant differences by education, job role, income, and tenure, illustrating how sampling coverage supported meaningful stratified analyses. ***Conclusion:*** The strongest standardized effect was Working Conditions, followed by Welfare/Benefits, Income, Leadership, Job Characteristics, Training, and Recognition. Motivation differed by education, job role, income, and experience, but not by sex or age. Despite convenience sampling, adequacy checks support internal validity.

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## I. INTRODUCTION

Hospitals operate amid persistent workforce pressures that threaten service quality and organizational performance. Globally, shortages and maldistribution of health professionals have been documented, with the WHO estimating substantial gaps and variability in workforce data quality across countries. These constraints heighten the need for robust evidence to guide managerial decisions on retention, incentives, and work design. [1]

Within this context, hospital-management research frequently relies on cross-sectional surveys of health-care workers to examine associations between organizational factors (e.g., working conditions, leadership, pay, and benefits) and outcomes such as motivation, satisfaction, and intent to stay. To ensure that such findings are credible and actionable, sampling design and transparent reporting are critical. The STROBE guidance for observational studies explicitly emphasizes clarity in sampling frames, participant flow, and potential sources of bias, elements that directly affect interpretability and generalizability in hospital settings. [2]

A recurring practical challenge is that probability sampling may be infeasible in busy hospitals because of shifting rosters, multiple cadres, and post-pandemic strain. Under these constraints, non-probability approaches (e.g., convenience sampling) are

often used; however, their defensibility depends on explicit justification of sample size and the adequacy of the data for planned multivariable analyses and subgroup comparisons. Recent methodological literature encourages moving beyond "fixed rules" to design-specific adequacy: for factor models, sample needs should reflect model complexity and communality structure; for regressions, power and precision should be anchored in expected effect sizes and model parameters. [3]

For exploratory factor analysis (EFA), contemporary recommendations emphasize that minimums should not be treated as universal, and that adequacy depends on the intended model, loadings, and communalities, an approach operationalized in new estimation procedures published in 2024. These advances support more transparent planning than legacy "cases-per-item" heuristics. [3]

For multiple regression used to quantify associations between organizational determinants and motivation, classical rules (e.g., $N \geq 50 + 8m$) remain widely cited but are increasingly supplemented by formal power and precision criteria. Although originally developed for prediction model development, modern frameworks (e.g., Riley and colleagues) provide generalizable principles for linking anticipated $R^2$, number of parameters, and target shrinkage/precision to the required n, helping researchers pre-specify defensible sample sizes and avoid underpowered designs. [4]

Beyond point estimates, workforce research must also speak to retention-oriented policy. Recent systematic reviews show that interventions to retain clinicians are multifaceted and context dependent, underscoring the managerial value of stratified analyses by cadre, seniority, and income bands, analyses whose interpretability again depends on sampling clarity and adequate subgroup coverage. [5]

This study contributes a pragmatic, auditable sampling pathway for a tertiary military hospital context, aligning with STROBE expectations and recent adequacy-first guidance for EFA and regression. By detailing the sampling frame, size justification, analytic adequacy checks, and subgroup coverage, we aim to provide a replicable template for hospital-management researchers operating under real-world constraints while preserving interpretability and managerial relevance.

## II. SUBJECTS AND METHODS

### 2.1. Study design and setting

We conducted a cross-sectional survey of health-care workers (HCWs) at Military Hospital 175, a large tertiary military hospital in Viet Nam. Reporting follows STROBE recommendations for observational studies.

### 2.2. Participants and sampling frame

We invited on-duty HCWs across clinical and paraclinical departments. Because probability sampling was impractical amid rotating rosters, we used non-probability convenience sampling, a defensible approach in hospital surveys when paired with transparent size justification. A total of 243 complete questionnaires were obtained after surveying 263 medical staff.

### 2.3. Sample size rationale

The minimum target combined two adequacy criteria: (i) EFA adequacy, at least ~5 observations per item to permit stable factor extraction for our ~34–35 observed variables; (ii) multiple regression adequacy, conventional lower-bound $n \geq 50 + 8m$ (with m predictors) to guard against overfitting. The achieved n=243

exceeded both thresholds. Contemporary guidance emphasizes design-specific adequacy rather than fixed rules: for latent models, sample needs depend on loadings/communalities and planned model complexity; for multivariable models, pre-specifying anticipated $R^2$ and number of parameters improves power/precision planning.

**2.4. Measures and instruments**

The questionnaire captured organizational determinants (working conditions, welfare/benefits, income, leadership, job characteristics, training, and recognition) and work-motivation outcomes; item pools and domains were pre-specified from the thesis framework (details in instrument appendix).

**2.5. Data collection procedures**

Paper forms were distributed in person during shifts; participation was voluntary and anonymous. Administrative permission was obtained from hospital leadership.

**2.6. Statistical analysis**

We screened data for completeness and plausibility. EFA was conducted on organizational items to examine dimensional structure; adequacy was checked using established diagnostics (e.g., sampling adequacy indices; factor extraction and simple-structure rotation as appropriate). Recent tutorials and software (e.g., semPower) inform power/adequacy considerations for latent models.

We then fitted multiple linear regression models to quantify associations between organizational factors and motivation. Modern sample-size principles for multivariable models (anticipated $R^2$, parameter count, target shrinkage/precision) guided our a priori adequacy checks.

For group comparisons, we used t-tests/ANOVA as appropriate and applied Bonferroni adjustments for post-hoc pairwise tests to control family-wise error, acknowledging its conservatism.

All analyses were performed with standard statistical software (e.g., SPSS).

## III. RESULTS

**3.1. Sample and data adequacy**

A total of 243 complete responses from health-care workers were analyzed (details in Methods). Exploratory factor analysis (EFA) showed excellent sampling adequacy (KMO = 0.858) and a significant Bartlett's test ($p < 0.001$), supporting factorability. An eight-factor solution (eigenvalue cutoff = 1.306) explained 72.666% of total variance, with all retained items loading > 0.50, consistent with the pre-specified conceptual domains.

**3.2. Multivariable associations**

The multiple linear regression model was statistically significant ($F = 72.166$, $p < 0.001$), with $R^2 = 0.683$ and adjusted $R^2 = 0.673$, indicating that the organizational factors jointly explained 67.3% of the variance in work motivation. Collinearity was negligible (all VIF 1.068–1.341), and Durbin–Watson = 1.592 suggested no serious autocorrelation. In standardized terms, Working Conditions (DK) had the largest positive association ($\beta = 0.324$, $p < 0.001$), followed by Welfare/Benefits (PL) ($\beta = 0.259$, $p < 0.001$), Income (TN) ($\beta = 0.229$, $p < 0.001$), Leadership (LD) ($\beta = 0.180$, $p < 0.001$), Job Characteristics (DD) ($\beta = 0.167$, $p < 0.001$), Training (DT) ($\beta = 0.162$, $p < 0.001$), and Recognition (DN) ($\beta = 0.117$, $p = 0.005$).

**3.3. Group comparisons**

There were no significant differences in work motivation by sex or age (both $p > 0.05$), but significant differences by education, job role, income, and work

experience (all p < 0.05). Post-hoc Bonferroni tests indicated that postgraduate staff differed from college and university groups; the university group also differed from postgraduate, while college vs university did not differ. For income, the 15–<20 million VND group differed from both <10 million and 10–<15 million, whereas the >20 million group did not differ from other bands.

### 3.4. Factor structure detail

Representative loadings illustrated a clean, simple structure across domains (e.g., Leadership items loading 0.842–0.876; Recognition 0.904–0.929; Welfare 0.825–0.865; Working Conditions 0.759–0.823; Training 0.721–0.822; Job Characteristics 0.739–0.844; Motivation (DLLV) 0.723–0.795), reinforcing construct validity.

Data quality and factorability supported downstream modeling. Table 1 summarizes response metrics, factorability indices, regression diagnostics, and multiple-testing procedures.

**Table 1:** ***Data adequacy and model performance (primary analysis)***

| Domain | Metric | Value | Note |
|---|---|---|---|
| Response & data quality | Questionnaires distributed / valid (response rate) | 263 / 243 (92.4%) | After data cleaning. |
| | Missing-data handling | Listwise (no material missingness) | Specify in Methods. |
| Factorability (EFA) | KMO | 0.858 | "Meritorious"; adequate for EFA. |
| | Bartlett's test | $\chi^2$ (df), $p < 0.001$ | Rejects the identity-correlation null. |
| | Factors retained | 8 | Eigenvalue > 1; item loading threshold ≥ 0.50. |
| | Total variance explained | 72.666% | After rotation (specify varimax/oblimin in Methods). |
| Regression (DV: work motivation) | $R^2$ / adjusted $R^2$ | 0.683 / 0.673 | ≈67–68% of variance explained. |
| | Durbin–Watson | 1.592 | No meaningful autocorrelation. |
| | Multicollinearity | VIF (all < 5) | No practical multicollinearity. |
| | Significant standardized betas (descending) | DK > PL > TN > LD > DD > DT > DN | All p < 0.05 after multiplicity control. |
| Multiple testing | Procedure | Bonferroni (family-wise) | Applied to group comparisons. |
| Group differences (summary) | Sex, age | No significant differences | t-tests/ANOVA, p ≥ 0.05. |
| | Education, job position, income, tenure | Significant differences | Bonferroni-adjusted post-hoc, p < 0.05. |

## IV. DISCUSSION

In a tertiary military hospital, organizational determinants jointly explained two-thirds of the variance in work motivation (adjusted $R^2 \approx 0.673$), with the largest standardized effects from Working Conditions, followed by Welfare/Benefits, Income, Leadership, Job Characteristics, Training, and Recognition. Collinearity and residual diagnostics supported model stability (VIF 1.068–1.341; Durbin–Watson 1.592). These results align with contemporary reviews showing supervision or leadership, financial or benefit packages, and training opportunities as core motivational drivers for healthcare workers [6].

Multiple systematic reviews and global assessments indicate that strengthening the workforce requires targeted action on workplace environment, compensation, and career development, particularly post-pandemic. Our gradient of effects mirrors recent syntheses on hospital retention and engagement [5]. This is consonant with WHO's workforce outlook that underscores the need to improve availability, acceptability, and quality amidst a projected shortfall of ~10–11 million workers by 2030 [7].

The absence of motivation gaps by sex/age, contrasted with significant differences by education, job role, income, and experience, suggests that interventions should be cadre-specific and banded by career stage/compensation. For example, the observed contrasts between postgraduate vs. college/university groups and between mid-income bands (15–<20 million VND vs. <10 and 10–<15 million) argue for calibrated benefit/allowance ladders and targeted development tracks. These priorities echo retention evidence that bundles financial and non-financial levers for maximal effect [5].

The clean eight-factor structure (KMO 0.858; Bartlett $p<0.001$; total variance 72.666%; loadings mostly >0.70) supports the dimensionality of the instrument in this context, strengthening the interpretation of regression results. Contemporary EFA guidance encourages design-specific adequacy (loadings/communalities) over rigid case-per-item heuristics, which our findings meet [8].

Post-hoc Bonferroni control was used to limit family-wise error in multiple comparisons; while conservative, it remains acceptable when accompanied by transparent reporting and effect interpretation [9],[10].

Given the dominance of Working Conditions and significant roles for Benefits/Income and Leadership, a practical roadmap is: (1) fix the basics (workload, staffing, safety, tools); (2) layer predictable benefits and performance-linked allowances; (3) invest in unit-level leadership and training pathways; (4) plan stratified monitoring by cadre and income band. This aligns with current retention syntheses and global workforce strategies [5],[7].

Strengths include an auditable latent structure and a high explanatory model with robust diagnostics. Limitations include non-probability sampling, which constrains external generalizability and may under-represent off-shift cadres; however, transparent size justification and adequacy checks mitigate internal validity concerns. Future work should (i) replicate via probability or quota sampling across hospitals, (ii) extend to longitudinal designs to test causal pathways, and (iii) pair organizational levers with implementation and cost-effectiveness evaluation as urged by retention reviews.

## V. CONCLUSION

Among 243 health-care workers in a tertiary military hospital, organizational factors explained work motivation well (adjusted $R^2 \approx 0.673$). Working conditions exerted the strongest effect, followed by welfare/benefits, income, leadership, job characteristics, training, and recognition. Motivation differed by education, role, income, and experience, but not by sex/age. Despite convenience sampling, adequacy checks support internal validity. Priorities: fix basics (workload, safety, tools), strengthen benefits/income, and invest in unit-level leadership/training. Future studies should be multi-site, probabilistic, and longitudinal..

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