DECODING THE FACTORS FOR PATIENT SATISFACTION: ANALYSING HCAHPS SURVEY DATA IN SELECTED PRIVATE HOSPITALS OF KOLKATA

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ABSTRACT

This study leverages data from the Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS) survey to explore the factors influencing patients' overall health ratings. Using Python for data analysis, the study employs Label Encoding to preprocess the data and Kernel Density Estimate (KDE) plots to visualize distributions. Through rigorous statistical analyses, including ANOVA and Chi-square tests, we identify key variables that significantly impact patient overall satisfaction. Our findings reveal that factors such as family income, respect and communication from nurses and doctors, cleanliness, and nighttime quietness are highly associated with health ratings. These insights highlight critical areas for healthcare providers to focus on to enhance patient satisfaction and well-being. The study underscores the importance of effective communication, respectful treatment, and a conducive environment in healthcare settings. Our research provides actionable recommendations for improving patient care and patient overall satisfaction, contributing to the advancement of healthcare quality and patient experience.

Keywords: HCAHPS Survey, Patient overall satisfaction, ANOVA, Chi-square Test, KDE.

INTRODUCTION

The Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS) is the first national, standardized, published survey examining patients' perceptions of hospital care relative to hospital money and reputation. Therefore, it is important to understand which interventions will help improve HCAHPS. Some clinical studies identified the role of nursing in improving hospital patient satisfaction as measured by the HCAHPS. Each study will be assessed in this research study. Interventions to improve HCAHPS include patient care, discharge process, physician telephone calls, and continued education of physicians. Since the Affordable Care Act was enacted in 2010, patient experience has become more important than quality measures. It increases expectations of quality care. Hospital Performance is a part of a larger strategy to promote better care at lower costs to individuals and society. In recent years, one of the metrics used to measure patient experience has been patient satisfaction with hospital care. It has become a criterion that hospitals must track and report to the public. When used correctly, patient satisfaction can provide insight into how these processes can improve their daily care and outcomes. For example, patients who are satisfied with their care are more likely to have better relationships with their doctors, accept and stick to their treatment plans, and recommend the hospital to friends and family. If hospitals can improve patient satisfaction, they can increase overall savings by reducing length of stay and readmissions which is important parameters according to analysis on HCAHPS Survey.

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The HCAHPS survey assesses communication with nurses, physicians, staff responsiveness, medication, communication and discharge information, patient understanding of treatment, hospital environment, overall evaluation and willingness to recommend to others. Effective communication with patients is an essential part of patient-centered care. Physicians play a critical role in communicating treatment plans to patients and influencing their overall treatment experience and clinical outcomes. Although communication skills improve in hospitals, many residents are not adequately prepared for effective physician-patient interactions, according to HCAHPS research. Patient satisfaction surveys record patients' self-reported evaluations over multiple sessions during their medical experience. Depending on where patient satisfaction is measured, examples may include staff responsiveness, physician communication, expertise, and hospital environment (Boylan et al., 2019) Whether patients are "*satisfied*" depends on their expectations regarding the different elements which are mentioned in HCAHPS Structured Survey questionnaire. Some hospitals provide HCAHPS surveys, which should be taken in conjunction with other patient-centered surveys to obtain a comprehensive picture of the patient's experience.

LITERATURE REVIEW

Dorrah, T. E. (2014). Clinical competence was considered in this paper but various parameters based on demographics and other variables were not considered which can be a future scope of study. The association of various parameters with overall health was not studied.

Dutta, S., & Abbas, S. U. (2015). This paper only determined reimbursement rates for inpatient care. Specifically, residents' role in influencing HCAHPS scores, how physician communication can be improved, best practices, and future research directions which will be studied further by statistical software.

Horton, D. J., Yarbrough, P. M., Wanner, N., Murphy, R. D., Kukhareva, P. V., & Kawamoto, K. (2017). The purpose of this retrospective controlled intervention time series study was to evaluate the impact of intervention communication on the physician to improve communication. Obstetric, rehabilitation, and psychiatric patients were excluded from the study. The primary outcome measure was the percentage of patients responding "normal" to all HCAHPS questions regarding doctor-patient communication (Godden et al., 2019). Communication standards were associated with improvements in communication therapists' HCAHPS scores. The statistical tool used was limited, which will be exhaustively done through ANOVA, Chi- square, etc.

Hanson, K. T., Zalewski, N. L., Hocker, S. E., Caselli, R. J., Habermann, E. B., & Thiels, C. A. 2018. Multivariable logistic regression evaluated the association of patient factors with HCAHPS measures. A significant driver analysis identified associations between HCAHPS measures and total scores (combination of 0–10 hospital scale and likelihood of recommendation). Multivariable logistic regression was used to compare HCAHPS scores between neurology patients and patients receiving concurrent neurosurgical or internal medicine services. So further study would be conducted on all inpatient departments in the hospital in association with the health of patients.

Shulman, et al. (2018). The Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS) is a national survey measuring patient perceptions of hospital care used for hospital comparison and reimbursement. Health characteristics are not included in the index, although the test attempts to adjust for a variety of factors that can affect the score. The purpose of this study is to determine the impact of socioeconomic status on HCAHPS scores.

Smith, G. A., Chirieleison, S., Levin, J., Atli, K., Winkelman, R., Tanenbaum, J. E., &

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Steinmetz, M. (2019). The authors reported that the probability of obtaining superior responses to some HCAHPS questions after lumbar spine surgery decreased if the LOS (Length of Stay) was long. This study highlights the need for further research on factors affecting length of hospital stay, identifying patients at risk for prolonged hospital stay, and developing protocol standards to improve the quality and extent of care for these patients. Patient satisfaction in association with overall health study was not considered by the researcher, which will be further studied.

Dottino, J. A., He, Meyer, et al. 2019. There are few data on the relationship between patient experience as measured by the HCAHPS and postoperative outcomes after gynaecologic oncology surgery. Associations have been found between inpatient data from the HCAHPS survey and follow-up outcomes among colon cancer patients using the National Inpatient Sample (NIS) database. Future research study can be done with primary data from hospitals.

Rodriguez-Homs, L. G., Hammill, B. G., Ryser, M. D., Phillips, H. R., & Mosca, P. J. 2020. Correlations between HCAHPS scores and survey responses differed between hospitals in terms of least and most information disclosed, communication with medical staff, and hospital silence. Although causality cannot be inferred from this study, response rate may be a direct and/or indirect driver of HCAHPS scores. Future research should aim to further investigate the basis of this relationship and determine how it may contribute to the interpretation of HCAHPS results. The correlation with health was not studied, which will be studied further.

Beckett, et al., (2024) only two potential parameters were identified as important in this paper: quietness and communication with doctors. Electronic medical records, including management systems and caregiver-patient comparisons, overall health can be prospectively examined for potential patient participants. It could be summarized as implications for future policy, practice, and research.

OBJECTIVES OF THE STUDY

The purpose of this study was to explore the factors influencing patients' overall health ratings based on data collected from the HCAHPS survey of 151 respondents. The main contributing factors are: -

- **Assess Factors Influencing Health Ratings:** Identify and evaluate the key factors from the HCAHPS survey that significantly influence the 'Overall Health Rating' of patients.
- **Determine Significant Associations:** Use statistical tests to determine if there are significant associations between various demographic and care-related variables and the 'Overall Health Rating'.
- **Analyze the Impact of Patient Care Experiences:** Investigate how different aspects of patient care, such as nurse and doctor interactions, cleanliness, and communication about medications, impact the overall health outcomes.
- **Guide Healthcare Improvements:** Provide insights to healthcare providers on which areas of patient care require improvement to enhance overall health outcomes and patient satisfaction.

RESEARCH METHODOLOGY

This study analyses data collected from the HCAHPS survey of 151 respondents to explore the factors affecting the overall health rating. The analysis is performed using Python 3.12. Exploratory data analysis has been done using Count Plot. A count plot is a bar plot that shows the frequency of each category in a categorical feature (Figures 1-9). The findings help in understanding the determinants of health outcomes and provide insights for improving patient care (Tables 1 & 2).

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Table 1 DATA PRE-PROCESSING TECHNIQUES	
Label Encoding	Label Encoding is a technique used to convert categorical variables into numerical format. Each unique category is assigned an integer value. Example: Male → 0, Female → 1
Normalization	Normalization is the process of scaling data to a standard range to check Normality.

Table 2 STATISTICAL TESTS	
ANOVA (Parametric test)	ANOVA or Analysis of Variance is a parametric test used to determine if there are statistically significant differences between the means of three or more independent groups. $F = \frac{Varience\ within\ groups}{Variance\ between\ groups}$ **Example:** Determine if variables such as '*Gender*', *'Age Range'*, '*Profession*', etc., significantly influence the *'Overall Health Rating*'. $\boldsymbol{H_0}$**:** $\mu 1 = \mu 2 = \mu 3 = \cdots$ $\boldsymbol{H_1}$**:** *At least one* μ_i *is different*
Chi-square test (Non-parametric test)	The Chi-square test is a non-parametric test used to determine if there is a significant association between two categorical variables. $x^2 = \frac{(0i-Ei)^2}{Ei}$ Where Oi is the observed frequency and Ei is the expected frequency. **Example:** Determine if variables such as 'Gender', 'Age Range', 'Profession', etc., are significantly associated with the 'Overall Health Rating'. $\boldsymbol{H_0}$*: There is no association between the independent variable and 'Overall Health Rating' (e.g., 'Gender' and 'Overall Health Rating' are independent).* $\boldsymbol{H_1}$*: There is an association between the independent variable and 'Overall Health Rating' (e.g., 'Gender' and 'Overall Health Rating' are not independent).*

RESULTS AND DISCUSSIONS

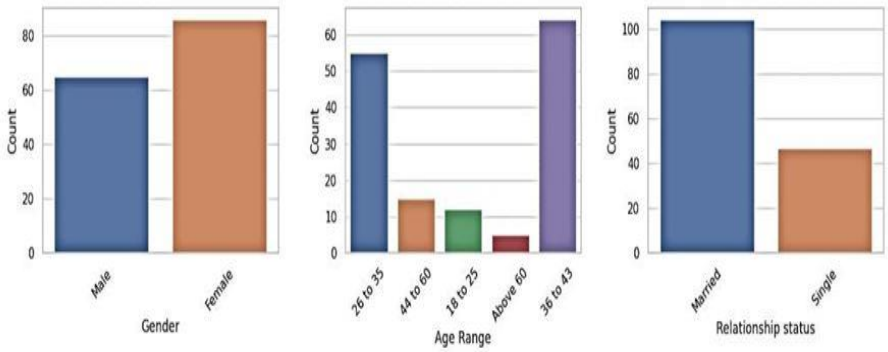

FIGURE 1
GENDER, AGE, RANGE, RELATIONSHIP STATUS

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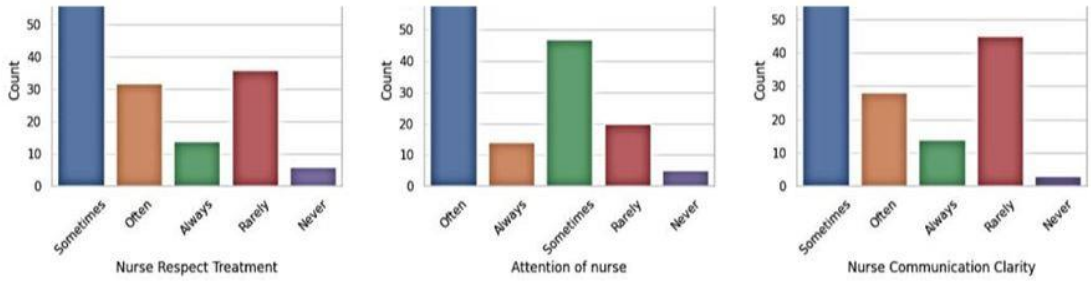

FIGURE 2
NURSE RESPECT TREATMENT, ATTENTION OF NURSE, NURSE COMMUNICATION

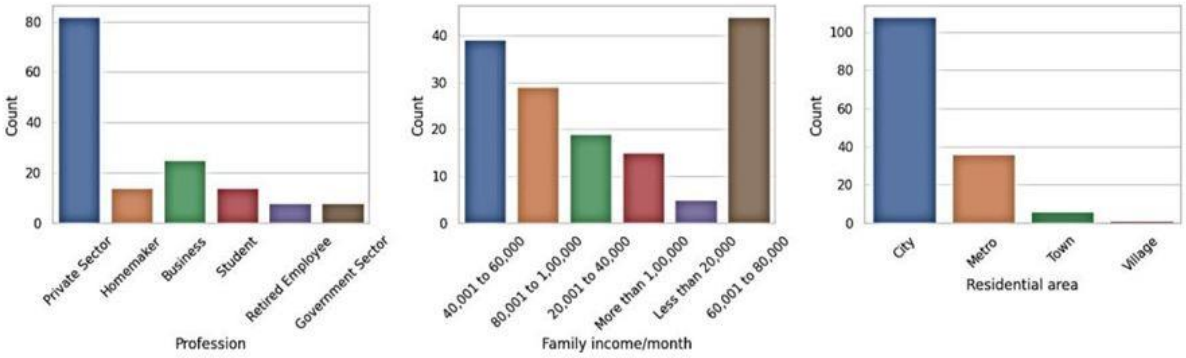

FIGURE 3
PROFESSION, FAMILY INCOME/MONTH, RESIDENTIAL AREA

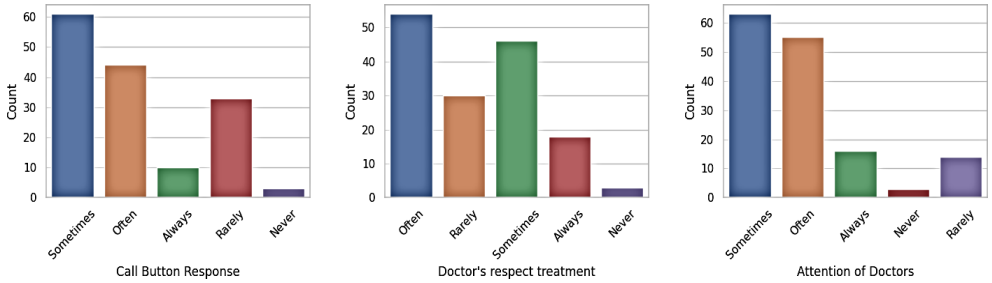

FIGURE 4
CALL BUTTON RESPONSE, DOCTOR'S RESPECT TREATMENT, ATTENTION OF DOCTORS

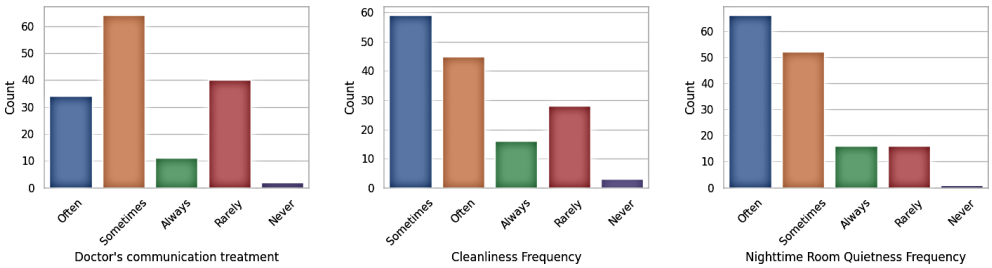

FIGURE 5
DOCTOR'S COMMUNICATION TREATMENT, CLEANLINESS FREQUENCY,

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NIGHT TIME QUIETNESS

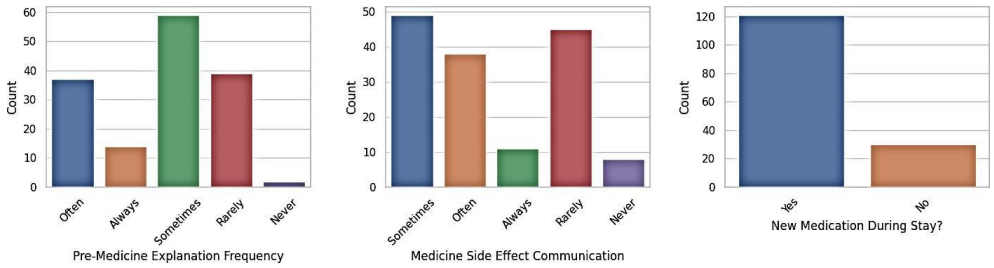

FIGURE 6
PRE-MEDICINE EXPLANATION, MEDICINE SIDE EFFECT, NEW MEDICATION DURING STAY

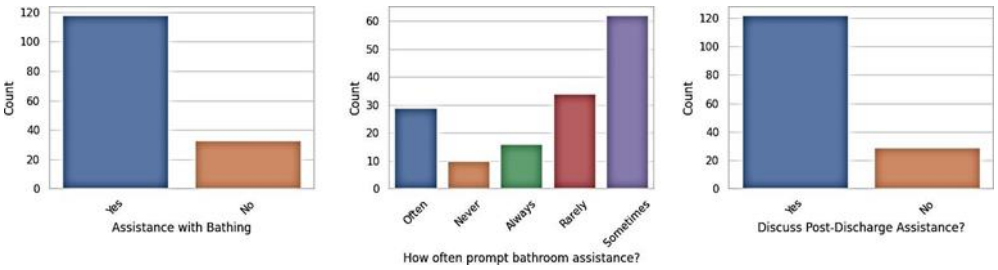

FIGURE 7
ASSISTANCE WITH BATHING, PROMPT BATHROOM ASSISTANCE, POST DISCHARGE ASSISTANCE

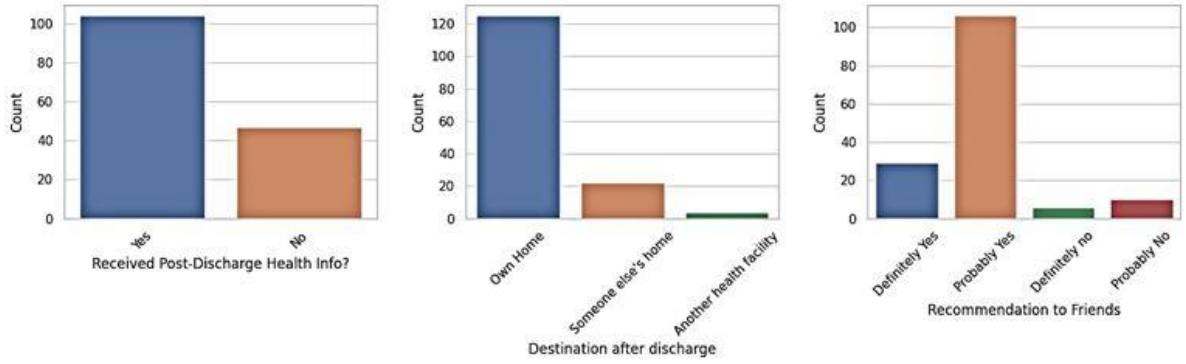

FIGURE 8
POST-DISCHARGE HEALTH INFO, DESTINATION AFTER DISCHARGE, RECOMMENDATION TO FRIENDS

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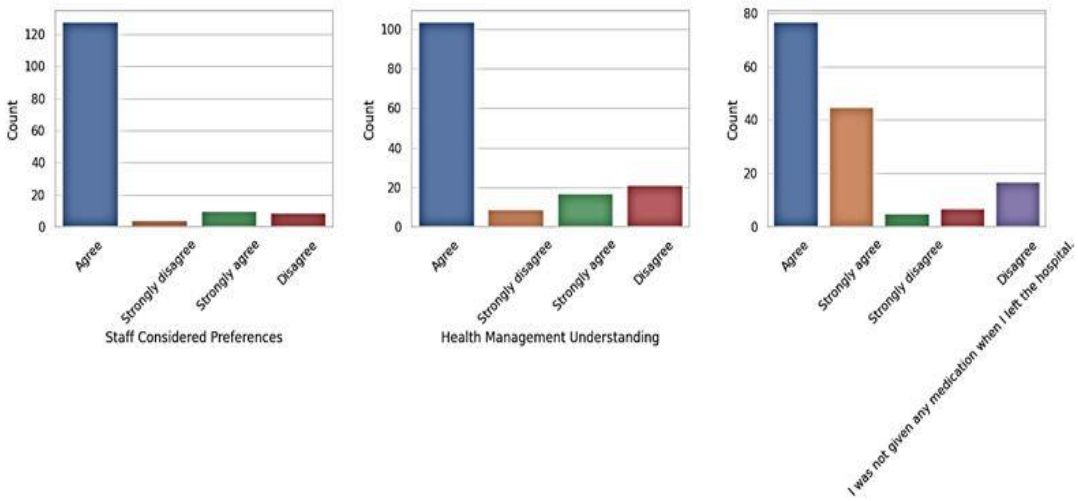

FIGURE 9
STAFF CONSIDERED PREFERENCES, HEALTH MGMT. UNDERSTANDING, MEDICATION UNDERSTANDING

Statistical analysis was done extensively to understand the impact of independent variables on the dependent variable which is the overall health condition of the patients. The variables follow normal distribution as understood by Kernel Density Estimate (KDE) plots of the variables (plots are not shown so as not to extend the page limit of this paper).

ANOVA Results: The ANOVA test was performed to determine if there are significant differences in 'Overall Health Rating' across various categorical variables (Table 3).

Table 3
ANOVA TABLE AND ITS INTERPRETATION

Variable	F-statistic	p-value	Interpretation
Gender	0.395	0.757	No significant effect
Age Range	2.759	0.044	Significant effect
Relationship status	2.020	0.114	No significant effect
Profession	3.673	0.014	Significant effect
Family income/month	1.707	0.028	Highly significant effect
Residential area	3.392	0.020	Significant effect
Nurse Respect Treatment	6.805	0.000	Highly significant effect
Attention of nurse	4.420	0.005	Significant effect
Nurse Communication Clarity	2.148	0.047	Significant effect
Call Button Response	6.766	0.000	Highly significant effect
Doctor's respect treatment	8.565	0.000	Highly significant effect
Attention of Doctors	6.499	0.000	Highly significant effect
Doctor's communication treatment	4.758	0.003	Significant effect
Cleanliness Frequency	7.864	0.000	Highly significant effect
Night time Room Quietness Frequency	5.398	0.001	Significant effect
Pre-Medicine Explanation Frequency	13.157	0.000	Highly significant effect
Medicine Side Effect Communication	9.889	0.000	Highly significant effect
New Medication During Stay?	1.398	0.246	No significant effect
Assistance with Bathing	0.762	0.517	No significant effect
How often prompt bathroom assistance?	2.660	0.050	Significant effect
Discuss Post-Discharge Assistance?	3.754	0.012	Significant effect
Received Post-Discharge Health Info?	1.693	0.041	Significant effect
Destination after discharge	0.240	0.869	No significant effect
Recommendation to Friends	9.369	0.000	Highly significant effect
Staff Considered Preferences	4.021	0.009	Significant effect

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Health Management Understanding	7.850	0.000	Highly significant effect
When I left, I understood medications	1.148	0.032	Significant effect
Admitted via Emergency	2.375	0.072	No significant effect
overall health rating	11.600	0.000	Highly significant effect

Interpretation of ANOVA Results

- **Highly significant effects** ($p < 0.001$): *'Nurse Respect Treatment*', *'Call Button Response'*, *'Doctor's respect treatment*', *'Attention of Doctors*', *'Cleanliness Frequency*', '*Pre-Medicine Explanation Frequency*', *'Family income/month'*, '*Medicine Side Effect Communication*', '*Recommendation to Friends*', *'Health Management Understanding*', *'overall health rating'*.
- **Significant effects at 5% level** ($0.001 < p < 0.05$): *'Age Range'*, '*Profession*', *'Residential area'*, *'How often prompt bathroom assistance?*', *'Discuss Post-Discharge Assistance?*', *'Attention of nurse*', *'Doctor's communication treatment*', *'Night time Room Quietness Frequency'*, *'Nurse Communication Clarity*', *'Staff Considered Preferences'*, *'When I left, I understood medications'*, *'Received Post-Discharge Health Info?*'.
- **No significant effect** ($p > 0.05$): Variables like '*Gender*', *'Relationship status'*, *'New Medication During Stay?*', *'Assistance with Bathing'*, *'Destination after discharge'*, *'Admitted via Emergency'*.

Chi-square (χ^2) Test Results: - The Chi-square test results help us understand if there are statistically significant associations between the categorical variables and *'Overall Health Rating'*. Below is the detailed interpretation of the Chi-square test results (Table 4).

Table 4
CHI-SQUARE (X^2) TEST VALUES TABLE AND ITS INTERPRETATION

Gender	1.208	0.751	No significant association
Age Range	21.490	0.044	Significant association
Relationship status	5.979	0.113	No significant association
Profession	19.762	0.031	Significant association
Family income/month	51.957	0.000	Highly significant association
Residential area	17.686	0.039	Significant association
Nurse Respect Treatment	41.094	0.000	Highly significant association
Attention of nurse	31.987	0.001	Significant association
Nurse Communication Clarity	29.495	0.003	Significant association
Call Button Response	46.696	0.000	Highly significant association
Doctor's respect treatment	47.558	0.000	Highly significant association
Attention of Doctors	43.745	0.000	Highly significant association
Doctor's communication treatment	23.219	0.026	Significant association
Cleanliness Frequency	50.907	0.000	Highly significant association
Night often prompt bathroom assistance?	44.736	0.000	Highly significant association
Pre-Medicine Explanation Frequency	56.602	0.000	Highly significant association
Medicine Side Effect Communication	45.813	0.000	Highly significant association
New Medication During Stay?	4.187	0.242	No significant association
Assistance with Bathing	2.311	0.510	No significant association
How often prompt bathroom assistance?	28.216	0.005	Significant association
Discuss Post-Discharge Assistance?	10.746	0.013	Significant association
Received Post-Discharge Health Info?	5.043	0.049	Significant association
Destination after discharge	4.523	0.606	No significant association
Recommendation to Friends	88.170	0.000	Highly significant association
Staff Considered Preferences	31.491	0.000	Highly significant association
Health Management Understanding	35.054	0.000	Highly significant association
When I left, I understood medications	29.711	0.003	Significant association
Admitted via Emergency	6.981	0.073	No significant association
Overall health rating	138.229	0.000	Highly significant association

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Interpretation of Chi-square Test Results

- **Highly significant associations** ($p < 0.001$): *'Family income/month'*, *'Nurse Respect Treatment'*, *'Call Button Response'*, *'Doctor's respect treatment'*, *'Attention of Doctors'*, *'Cleanliness Frequency'*, *'Night time Room Quietness Frequency'*, *'Pre-Medicine Explanation Frequency'*, *'Medicine Side Effect Communication*', *'Recommendation to Friends'*, *'Staff Considered Preferences'*, *'Health Management Understanding*', *'Overall health rating'*.
- **Significant associations at 5% level** ($0.001 < p < 0.05$): *'Age Range'*, *'Residential area'*, *'Doctor's communication treatment*', *'Discuss Post-Discharge Assistance?*', *'Attention of nurse'*, *'Nurse Communication Clarity*', *'How often prompt bathroom assistance?*', *'When I left, I understood medications*', '*Profession*', *'Received Post- Discharge Health Info?*'.
- **No significant association** ($p > 0.05$): Variables like '*Gender*', *'Relationship status'*, *'New Medication During Stay?*', *'Assistance with Bathing'*, *'Destination after discharge'*, *'Admitted via Emergency*'.

From the χ^2 test results it can be concluded that the variables under "*Highly significant effects*" and "*Significant effects at 5% level*" have profound associations on health conditions of patients in private hospitals of Kolkata. From the ANOVA table, it can be concluded that the variables under "*Highly significant effects*" and "*Significant effects at 5% level*" have profound impact on health conditions of patients with satisafcation in private hospitals of Kolkata.

CONCLUSION

In this study we analysed the effect of variables as in HCAHPS survey on health condition of patients with satisfaction level in private hospitals in Kolkata. The analysis of the HCAHPS survey data using Python programming language has revealed significant insights into the factors affecting patients' overall health ratings. Exploratory data analysis and statistical tests, including ANOVA and Chi-square tests, showed that variables such as *'Family income/month'*, *'Nurse Respect Treatment'*, *'Call Button Response'*, *'Doctor's respect treatment*', *'Attention of Doctors'*, and *'Cleanliness Frequency'* have highly significant associations and effects on health ratings. Additionally, factors like *'Age Range'*, *'Residential area*', *'Doctor's communication treatment'*, and *'Discuss Post-Discharge Assistance'* also play crucial roles. These findings highlight the importance of effective communication, respectful treatment, and a clean and quiet environment in improving health outcomes. By focusing on these key areas, healthcare providers can enhance patient satisfaction and overall health, thereby contributing to better healthcare quality and patient experiences.

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