Transforming Healthcare through Sentiment Analysis: Tool for Patient Satisfaction

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Abstract: In today's competitive healthcare industry, hospitals, physician procedures, and health systems focus on improving patient satisfaction. Healthcare facilities that provide comfort, functionality, and access to modern clients who are expected to be emerging leaders in their areas and improve their foundation.

Objective: Today's consumers have many options when it comes to choosing health services. Therefore, health care facilities must play a role in attracting and retaining patients. One way they can do this is by analyzing the patient's sentiment analysis. In this study we would focus on the analysis conducted through online report available of different private hospitals based on the facilities provided by the hospitals and the level of satisfaction received by patients.

Methods: Sentiment Analysis will be performed through a software called Monkey learn to get the reviews of patients based on the level of satisfaction after admission in hospital.

Conclusion : Patients' responses regarding the problem faced during hospital visit for admission, Problem faced regarding service from doctor, casual and unpleasant attitudes of staffs, hospital service received was not up to the mark, hospital facility was expensive according to few patients, operation of patients did not occur in a proper time as informed to the patient relative the doctors and nurses' treatment were not satisfactory to few patients, the rude behaviour of the staffs, the unsupportive nature of the doctors, the unorganised and unsystematic way of handling the patients, and unsafe environment with poor infrastructure in few of the hospitals lead to negative feedback from the patients through sentiment analysis which is received by online platform.

Keywords. Healthcare, Hospitals, Leaders, Patient, Sentiment Analysis, Satisfaction

1.INTRODUCTION

Patient sentiment analysis in healthcare is the process of analyzing a patient's response to actions based on the patient's feelings at the time. Analysis helps to reveal patients' feelings, ideas, and attitudes based on what they say about hospital's performance. It can help health care providers find a competitive edge over the competition and improve their services based on the feedbacks provided based on the hospital service.

There is various application like RepuGen, Monkeylearn, Python etc. to analyze patients' opinions or texts about their experience. The software analyzes patient comments about your location on Twitter, Facebook, and other forums to generate a realistic picture of the patient experience in the hospital visited. Sentiment analysis enables health care providers to understand how patients feel, identify gaps in their patient experience, and apply corrective measures in a timely manner.

2. BENEFITS

1.   It can help health care providers identify areas where they are successful or failing in patient satisfaction. Managers can analyze the data collected to receive the most common complaints or recommendations, classify information based on physicians or departments, and other parameters to identify opportunities to improve patient care.

2.   It can measure the feelings and emotions of patients to paint a clear picture of hospital's performance. Analysis can differentiate a patient's comments into specific categories such as processes, locations, and people, and then give them different points to determine what patients feel about the various aspects of their environment.

For example, the Word Cloud Analysis feature of RepuGen examines the frequency of words used by patients and captures the most used words in comments left by patients. Here are some examples of comments patients may leave about their experience:

We waited for hours for consultation. (Negative)

Excellent service but still needs to improve waiting hours for admission. (Medium)

Helpful and caring staff. I was seen in less than half an hour in the hospital! (Good)

3.   Sentiment analysis also provides insight into the functioning of a health facility. An integrated commentary analysis can provide a clear indication of what patient's need, how hospital employees can be evaluated, and other concerns that may not be apparent to management.

4.   Physicians, health care providers, and health centers can use sentiment analysis to improve clinical quality. Data collected by emotional analysis software can help to understand what factors patients need to have a positive experience in health facilities.

5.   Therefore, sentiment analysis allows everyone in the health sector to have the opportunity to understand appropriate patient self-esteem that creates better health care and increases revenue.

3. RESULTS

In this study 10 Private hospitals have been taken into consideration for the study to analysis the main root cause for negative comments based on the satisfaction level of the patients as well as the positive comments that would help for better growth of the hospitals which are as follows: -

1.   SENTIMENT ANALYSIS OF AMRI HOSPITAL, DHAKURIA

Table 1

REVIEWS	Positive/Negative/Neutral
I am happy and relieved to observe that in spite I couldn't be there physically for the first 4 days, the NEURO TEAM at AMRI was very caring and took care of her. even thou I was very worried about the outcome	Positive
AMRI provided us with cost-effective treatment when our entire family was admitted to this facility for isolation and care after getting Covid	Positive
Consistency towards delivering quality healthcare services is one of the specialities of AMRI Hospitals. The care from every member of rheumatology was exemplary.	Positive
Hardworking & supportive staff members, much appreciate their efforts & services!	Positive
The cordial and cooperative nursing staff are attentive to each patient in the ward. I had been there as an attendant for my aunt, was amazed to see the professionalism of each & every member.	Positive

Very well-managed hospital! A great option for future considerations.	
My sister recovered so soon making us believe in the good healthcare infrastructure of the hospital. Hardworking & supportive staff members, much appreciate their efforts & services!	Positive
The cordial and cooperative nursing staff are attentive to each patient in the ward. I had been there as an attendant for my aunt, was amazed to see the professionalism of each & every member. Very well-managed hospital! A great option for future considerations.	Positive
AMRI Dhakuria Management staff behaviour is very poor / Horrible...which is intolerable. infrastructure is also not in up to mark.	Negative
The service is the worst. Attendants are bogus. Rooms are not at all good. Specially Room No.1459. They don't even clean the pillow cover and towels. Patient is to wait for long time to get a bottle of water.	Negative
Standard and quality of medical treatment is growing exponentially and getting better in India. It's crucial that we have top-notch hospitals like Amri in the country.	Positive

Table 2

SL No.	Positive/Negative/Neutral	% Of Reviews from Patient
1.	Negative	20.00%
2.	Positive	80.00%
	Total	100 %

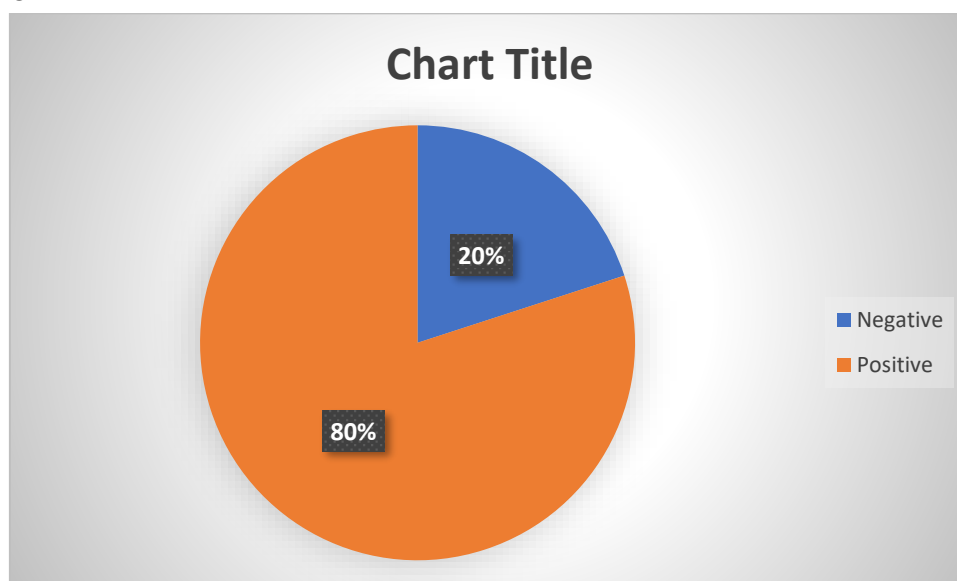**REVIEWS OF PATIENTS IN AMRI, DHAKURIA**

Figure 1

Figure 1 reveals that 80% of patient have given positive feedback and 20% of patient have given negative feedback based on the reviews received through online platforms. (n=10)

2. SENTIMENT ANALYSIS OF DESUN HOSPITAL, KOLKATA

Table 3

REVIEWS	Positive/Negative/Neutral
Good treatment, patient service and ambience. Good communication skills of sisters and doctors are very skilled and polite	Positive
Very good hospital doctors are friendly. Satisfied	Positive
Don't admit your patient here. They only can grab money from the patient party, and you must release the patient in worst condition.	Negative
In my view Desun hospital is a place of wise men.	Positive
Desun is a good hospital in respect of the other hospital in this area.it is situated beside E.M. Bypass Road. The infrastructure is good in this hospital. Doctors are well qualified but not all doctors.	Positive
Please raise your voice to stop these hospitals from exploiting common people.	Negative
Please be aware of Desun hospital, they have branding, but not treatment.	Negative
It would be simply nothing if I only praise Desun Hospital for whatever they have done for us. My thanks to them & I wish all such patients are treated there & get their happy lives back.	Positive

Table 4

SL No.	Positive/Negative/Neutral	% Of Reviews from Patient
1.	Negative	37.5%
2.	Positive	62.5%
	Total	100 %

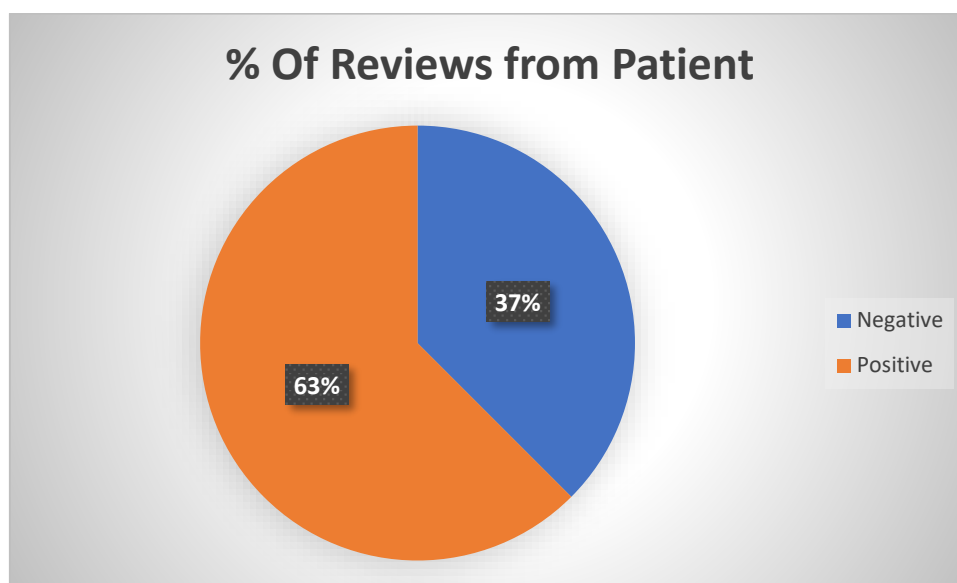**REVIEWS OF PATIENTS IN DESUN HOSPITAL, KOLKATA**

Figure 2

Figure 2 reveals that 63% of patient have given positive feedback and 37% of patient have given negative feedback based on the reviews received through online platforms. (n=8)

3.   SENTIMENT ANALYSIS OF FORTIS HOSPITAL, ANANDAPUR

Table 5

REVIEWS	Positive/Negative/Neutral
I had a misconception that Fortis is one of the best hospitals in Kolkata. But I from my personal experience can tell that it is nothing but another 3rd class clinic. Even those clinics in rural areas serve better. 1. Fortis is unorganised and unsystematic. 2. Misleads the patients and provides wrong information. 3. Communication and technical facilities are very poor. 4. Provides very poor customer support (far worse than a govt. hospital).	Negative
My grandfather was admitted and well treated by the doctors and nurses. Other stuffs are also ok and good	Positive

Unfriendly staff members, unsystematic process of appointment and doctor visit. Completely unemphatic attitude towards the patients and their families. Fortis is a shadow of what it was even five years ago.	Negative
Staff's attitudes are like some rowdies. Fish market management style runs like political system of some banana republic. A Holter test report is not ready reason no-one knows. The responsible guy claimed, "he never promised me to give it on that particular day". Is	Negative
I had visited fortis for covishield vaccination. My first dose was not bad but when my time came for second dose nobody helped me. I believe this is my worst experience	Negative
My patient got admitted to fortis hospital 1 week back. He was having diabetes and creatinine was high. In one night, they billed 64000 Rs/-. Doctors were unable to give any information about the patient. Even no patient party was allowed to talk to the doctor. We discharged the patient after 3 days of staying	Negative
Negligent nursing Staff and disgusting doctors in MICU. From Doctors to Nursing staff. They should be sued	Negative
The behavior of Dr. Ramesh Agarwal is rough too much. We shall think twice before visit again. Medical care is very bad. The doctor did not pay heed to patient's statement regarding decease for which we visit. The doctor was busy to the plane.	Negative
The fortis hospital infrastructure is very nice and staff attitude, behaviour is amicable, and the most important thing is that medical care is hot cake as a quick service. I know it is bit expensive but better than any other as per my views. I suggest to all of you in case any emergency will come then visit fortis hospital first.	Positive
This hospital is not for middle class people it is very expensive, but the treatment is good but not the staffs. Staffs are very rude but, in my opinion, staff should be rude but not too much. Nice hospital. I get treatment in this hospital I am very lucky to write a review regarding this hospital. I am also wanting to thank mouthshut.com to give me a chance to write a review for a great hospital. Thanks.	Positive

Table 6

SL No.	Positive/Negative/Neutral	% Of Reviews from Patient
1.	Negative	70%
2.	Positive	30%
	Total	100 %

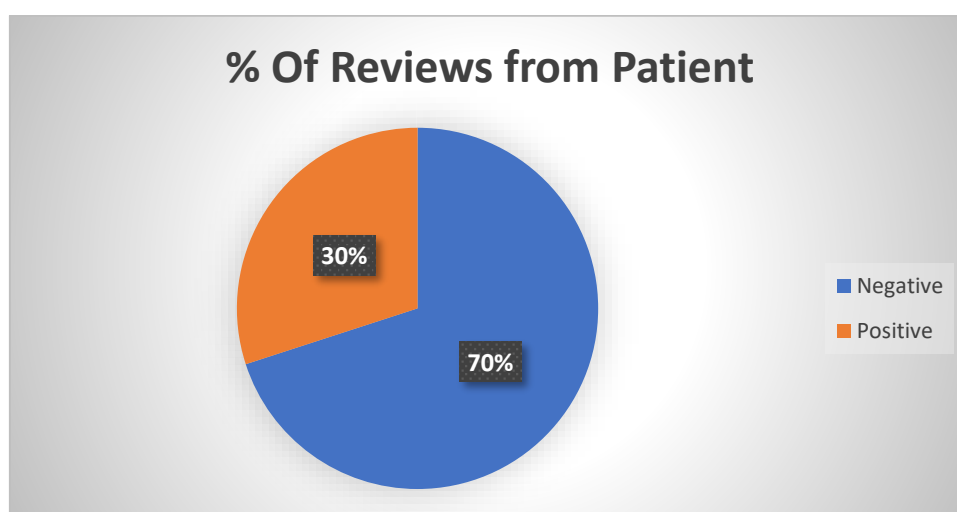**REVIEWS OF PATIENTS IN FORTIS HOSPITAL, ANANDAPUR**

Figure 3

Figure 3 reveals that 30% of patient have given positive feedback and 70% of patient have given negative feedback based on the reviews received through online platforms. (n=10)

4.   SENTIMENT ANALYSIS OF MEDICA SUPERSPECIALTY HOSPITAL, MUKUNDAPUR

Table 7

REVIEWS	Positive/Negative/Neutral
Fake and fraud type junior doctors are working here. They only know how to cut the pockets of a patient parties. Stop this type of fraudial activities	Negative
In one word, I was wrong for choosing Medica.	Negative
Medica hospital is not a bad hospital, rather it is one of the best dialysis facilities hospitals in Kolkata but the staff like Ms. Dutta ruin the name of this hospital.	Negative
The staff does not tell any info.	Negative

There are plenty of good hospitals, one like Medica is an institution which breeds criminals and others supporting it.	Neutral
They try to deceive people's money until you become insolvent.	Negative
Facilities provided in Medica Super specialty Hospital; Kolkata is Superb. Service was up to the mark. Would recommend to everyone	Positive
It is very nice hospitals with best experienced doctors and great medical facilities. Medica Super specialty Hospital, Kolkata Hospital can be considered as one of the Best Hospital in India.	Positive

Table 8

SL No.	Positive/Negative/Neutral	% Of Reviews from Patient
1.	Negative	50%
2.	Positive	40%
3.	Neutral	10 %
	Total	100 %

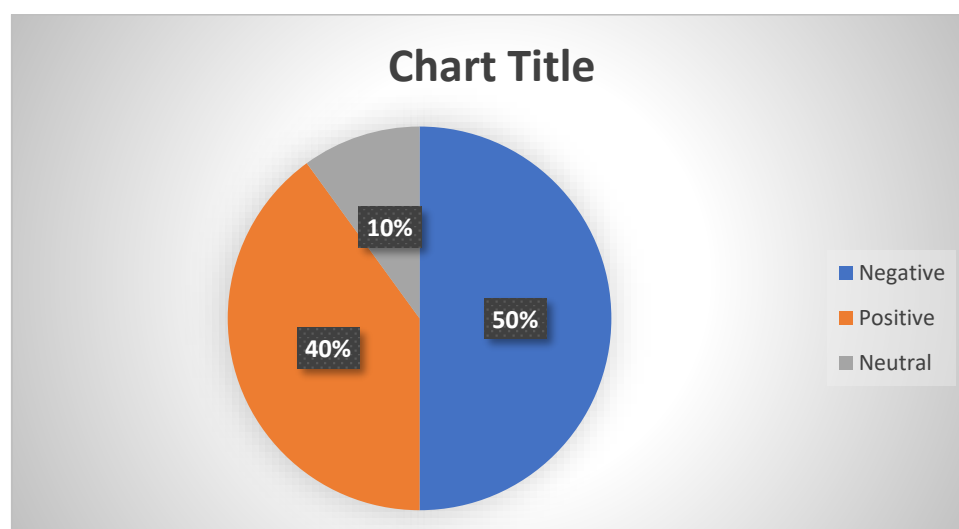**REVIEWS OF PATIENTS IN MEDICA SUPERSPECIALTY HOSPITAL, MUKUNDAPUR**

Figure 4

Figure 4 reveals that 40% of patient have given positive feedback,10% neutral feedback and 50% of patient have given negative feedback based on the reviews received through online platforms. (n=10)

5.   SENTIMENT ANALYSIS OF RUBY GENERAL HOSPITAL, GOLPARK

Table 9

REVIEWS	Positive/Negative/Neutral
I appreciate the gesture on the part of the hospital management, and this reassures all of us and has rekindled the faith that we had on RUBY.	Positive
This is a nice hospital...hospital's staff is too good, and their admission process and treatment level are too good	Negative
I strongly advise not to visit Ruby for your dental problems as it is a very poorly equipped department with unprofessional doctors.	Negative
Doctors will create fear in you and then force you to admit in emergency unnecessarily. After those charges will increases by leaps and heaps.	Negative
The nurses and ward boys behaved like they were the doctors and knew everything.	Negative
Don't waste time give right treatment at right time	Negative
Ruby general hospital is one of the best hospitals	Positive
UNPLEASANT EXPERIENCE IN RUBY HOSPITAL KOLKATA	Negative
Wrong Treatment at Ruby General Hospital	Negative
Plz do not get admitted here	Negative

Table 10

SL No.	Positive/Negative/Neutral	% Of Reviews from Patient
1.	Negative	80%
2.	Positive	20%
	Total	100 %

REVIEWS OF PATIENTS IN RUBY GENERAL HOSPITAL, GOLPARK
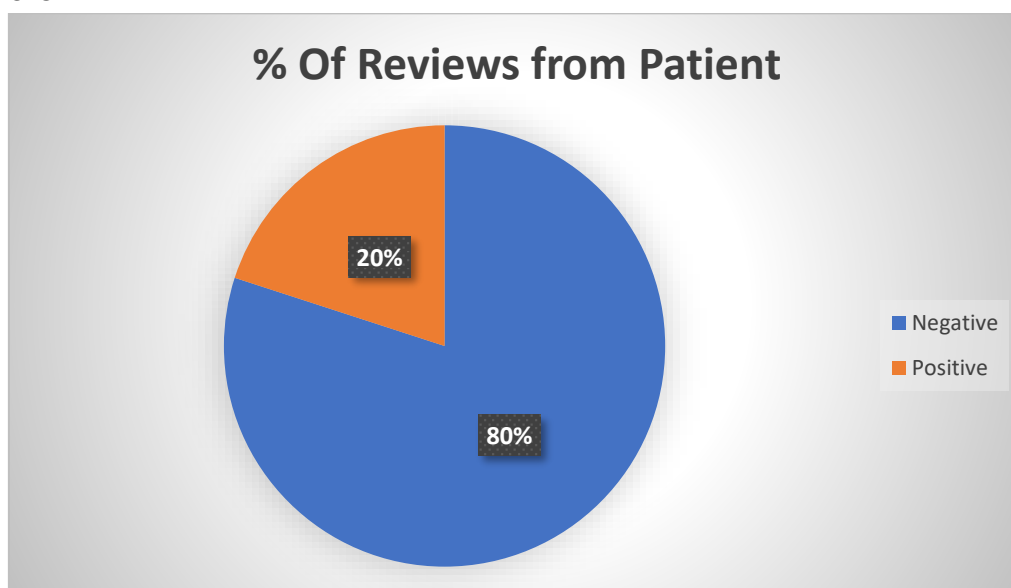
Figure 5

Figure 5 reveals that 20% of patient have given positive feedback and 80% of patient have given negative feedback based on the reviews received through online platforms. (n=10)

6.   SENTIMENT ANALYSIS OF BHAGIRATHI NEOTIA WOMAN & CHILD CARE CENTRE, NEWTOWN

Table 11

REVIEWS	Positive/Negative/Neutral
The overall management is outstanding. Doctors, Sisters, and admin is helpful.	Positive
Worst experience ever I will sincerely request people to not visit this hospital u can put our patient at high risk.	Negative
Best care and services given to the patient. Our baby was delivered from Neotia Newtown branch.	Positive
I am happy that during this pandemic month they could provide such excellent care for the paediatric patients maintaining all the COVID protocols.	Positive
They Overall system is very poor & Sick. Only the outlook does not prove the backbone of infrastructure.	Negative
I am highly satisfied and would like to recommend to all.	Positive
the best child and woman care centre where treatment is done with care. Very homely atmosphere. In one word the BEST.	Positive
The best Hospital for women and childcare centre	Positive
Best childcare hospital in this city with very helpful, caring, experienced supportive staff.	Positive

My experience in Neotia was full of warmth and care.	Positive

Table 12

SL No.	Positive/Negative/Neutral	% Of Reviews from Patient
1.	Negative	80%
2.	Positive	20%
	Total	100 %

REVIEWS OF PATIENTS IN BHAGIRATHI NEOTIA WOMAN & CHILD CARE CENTRE, NEWTOWN
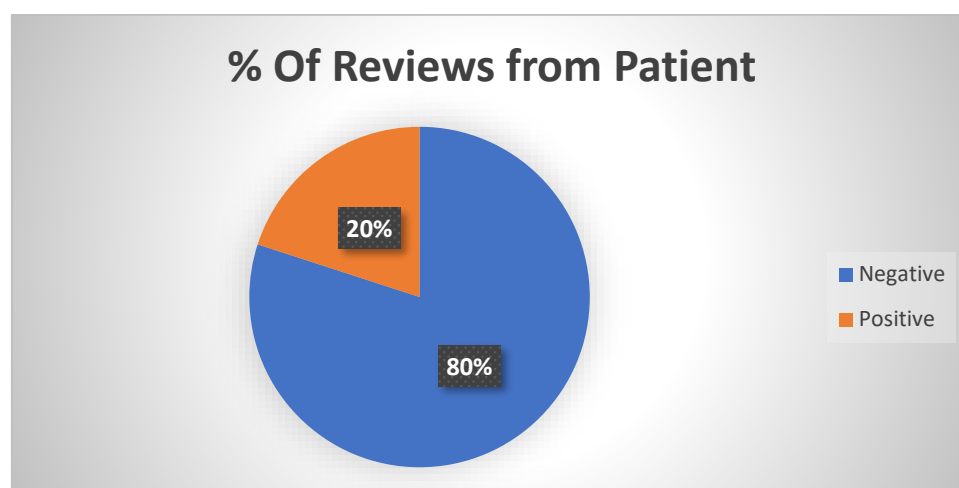
Figure 6

Figure 6 reveals that 20% of patient have given positive feedback and 80% of patient have given negative feedback based on the reviews received through online platforms. (n=10)

7.   SENTIMENT ANALYSIS OF TATA MEDICAL CENTER NEWTOWN

Table 13

REVIEW	Positive/Negative/Neutral
The worst hospital ever. All the staffs are rude, and they make waiting for long hours without any reason.	Negative
Very good, good work everyone, provides good service, staff Have to believe Attitude is so good I can't explain	Positive
I have visited there for my cousin's operation, but the behaviour of staff and management were very rude I just said for the possible facilities on time that's it.	Negative
This hospital is nothing but a place with money-making agenda under the brand name of Noble TATA.	Negative

Most of the nurses' behaviour is rude. They only focus how fast they can finish their job.	Negative
Doctors are very careless	Negative
Worst service of this hospital	Negative
DON'T TRUST TMC	Negative
Whenever I needed medical attention, they wasted no time in helping me in whatever way possible. Thanks to both I have got a second life.	Positive
Doctors are very inexperienced or very rude. Medical staff, especially the nurses are the worst.	Negative

Table 14

SL No.	Positive/Negative/Neutral	% Of Reviews from Patient
1.	Negative	80%
2.	Positive	20%
	Total	100 %

REVIEWS OF PATIENTS IN TATA MEDICAL CENTER NEWTOWN
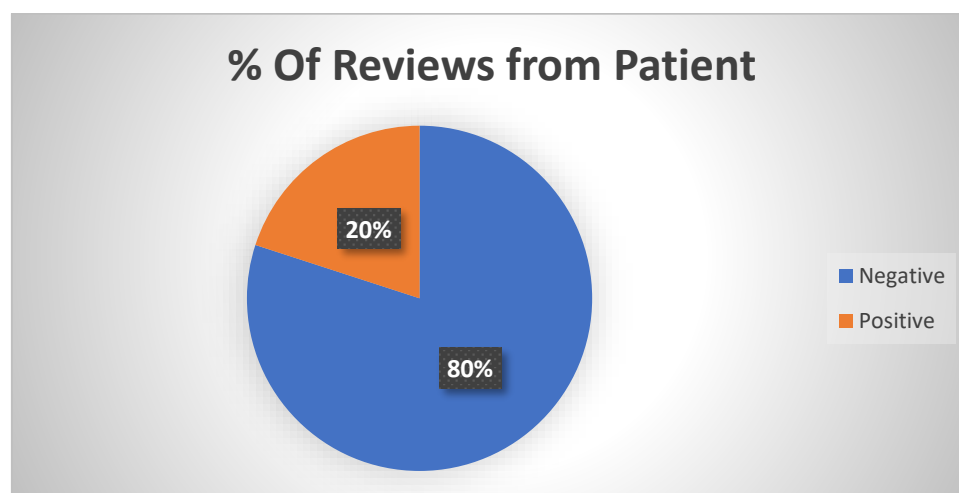
Figure 7

Figure 7 reveals that 20% of patient have given positive feedback and 80% of patient have given negative feedback based on the reviews received through online platforms. (n=10)

8. SENTIMENT ANALYSIS OF APOLLO GLENEAGLES HOSPITAL,KOLKATA

Table 15

REVIEWS	Positive/Negative/Neutral
They do really take care of you.	Positive
Worst customer service representative when I call Apollo hospital Kolkata, keep disconnecting the phone.	Negative

I won't recommend this place even to my worst enemy.	Negative
Apollo Hospital Kolkata is Such a Pathetic Hospital & They are very much into Fraud; they misguide & took the opportunity to do something unethical.	Negative
I had my worst experience of my life at Apollo Gleneagles Hospital	Negative
Apollo hospital is a scam.	Negative
They messed up during operation	Negative
Least recommended hospital	Positive
They treated well to my cousin brother	Positive
I will NEVER trust Apollo Kolkata Hospital	Negative

Table 16

SL No.	Positive/Negative/Neutral	% Of Reviews from Patient
1.	Negative	70%
2.	Positive	30%
	Total	100 %

REVIEWS OF PATIENTS IN APOLLO GLENEAGLES HOSPITAL, KOLKATA
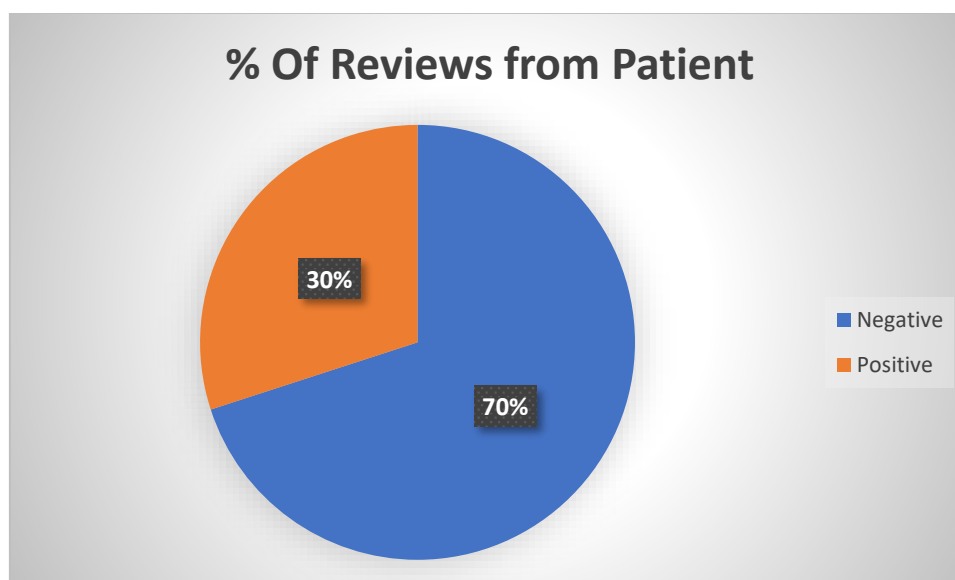
Figure 8

Figure 8 reveals that 30% of patient have given positive feedback and 70% of patient have given negative feedback based on the reviews received through online platforms. (n=10)

8.   **SENTIMENT ANALYSIS OF NARAYAN MULTISPECIALITY HOSPITA, HOWRAH**

Table 17

REVIEWS	Positive/Negative/Neutral
Doctors and staff are good.	Positive
My experience is very bad	Negative
The receptionist cannot give right information. They always harass people.	Negative
Good care of present and many more department. Its hospital staff attitude is so good.	Positive
The best hospital with all types of medical care is available. The front office staff, Doctors and all the support staff are most helpful.	Positive
But overall problem is this hospital is very expensive.	Negative
Experience at the facility was not good.	Negative
The facility is expensive.	Negative
Medical condition was resolved at the facility.	Positive
Did not receive value for their money at the facility.	Negative

Table 18

SL No.	Positive/Negative/Neutral	% Of Reviews from Patient
1.	Negative	60%
2.	Positive	40%
	Total	100 %

REVIEWS OF PATIENTS IN NARAYAN MULTISPECIALITY HOSPITA, HOWRAH
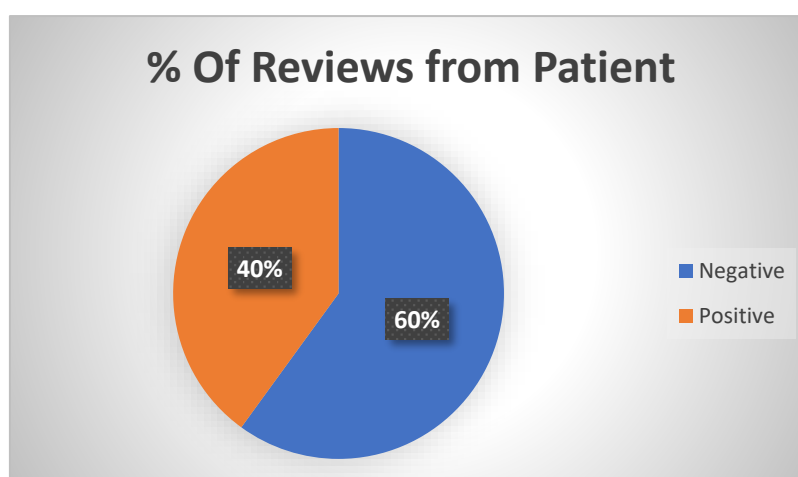
Figure 9

Figure 9 reveals that 40% of patient have given positive feedback and 60% of patient have given negative feedback based on the reviews received through online platforms. (n=10)

9. SENTIMENT ANALYSIS OF ROMALINDA MULTI SPECIALITY HOSPITAL & RESEARCH CENTRE

Table 19

REVIEWS	Positive/Negative/Neutral
Good	Positive
Very Good	Positive
Good	Positive
Good	Positive
Very good place	Positive
Worst facilities.	Negative
Waste of money if you want to waste money then goes there.	Negative
Staff are very casual and unprofessional.	Negative
Doctor is the worst he doesn't even know about his work.	Negative
Fraudulent service	Negative

Table 20

SL No.	Positive/Negative/Neutral	% Of Reviews from Patient
1.	Negative	50%
2.	Positive	50%
	Total	100 %

REVIEWS OF PATIENTS IN ROMALINDA MULTI SPECIALITY HOSPITAL & RESEARCH CENTRE
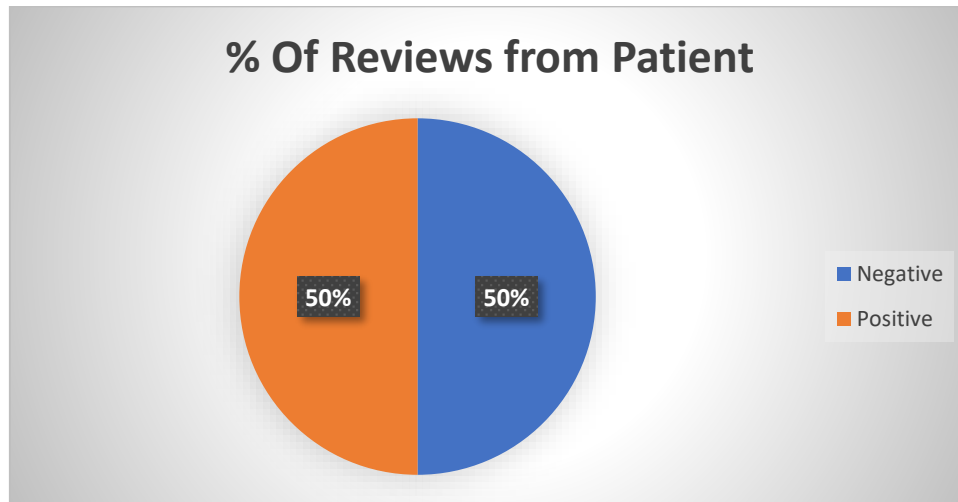
Figure 10

Figure 10 reveals that 50% of patient have given positive feedback and 50% of patient have given negative feedback based on the reviews received through online platforms. (n=10)

4. MODEL FIT INDEX

Table 21

	Saturated Model	**Estimated Model**
SRMR	0.086	0.086
d_ULS	2.018	2.018
d_G	1.260	1.260
Chi-Square	226.786	226.786
NFI	0.951	0.951

Table 21 shows that the data has model fit interpretation since the NFI value is 0.951(NFI values above 0.9 usually represent acceptable fit) and SRMR value is 0.086(The acceptable range for the SRMR index is between 0 and 0.08).

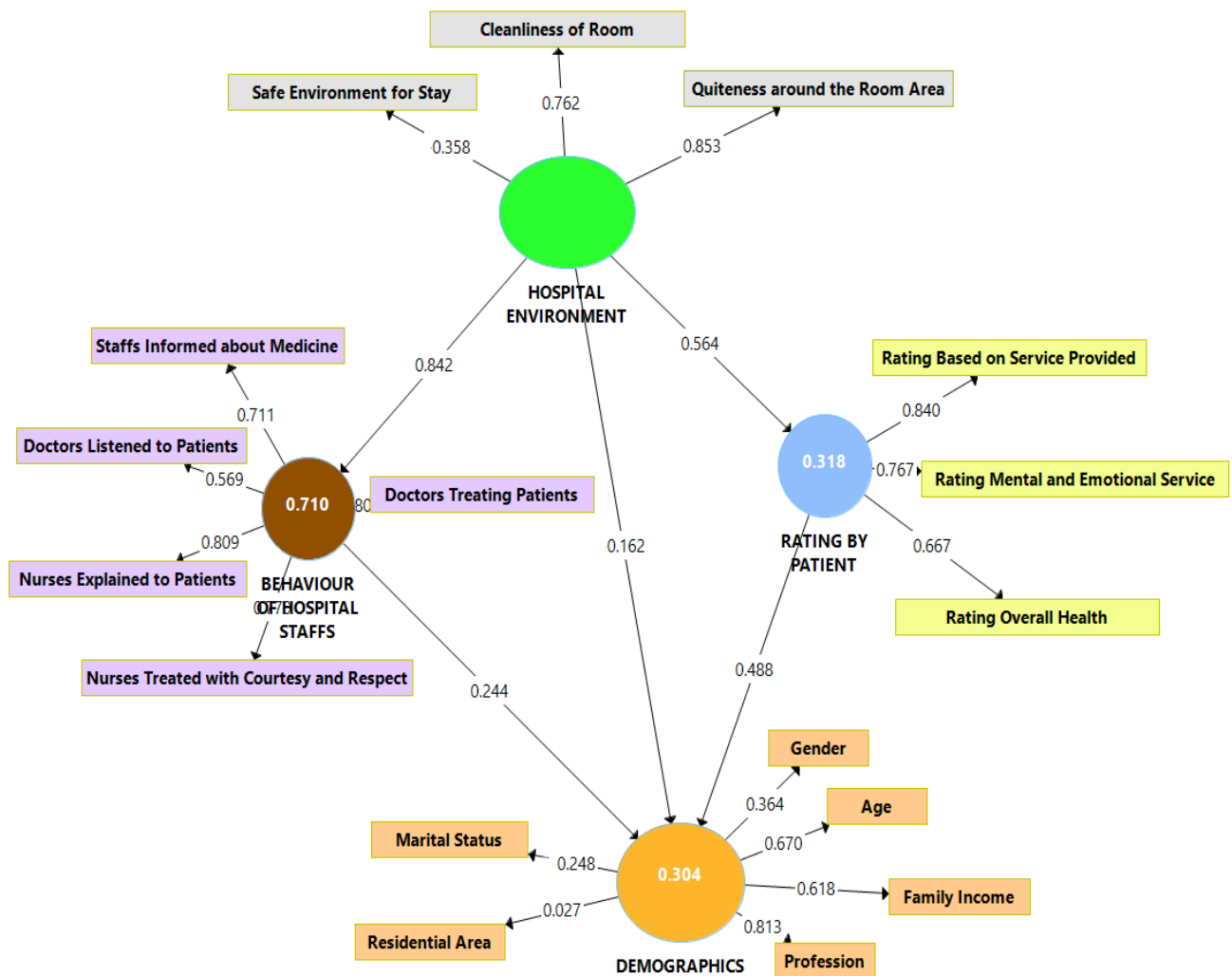**STRUCTURAL EQUATION MODEL**

Figure 11

Figure 11 shows the structural equation modelling through smart PLS which is extracted from a standardized HCAHPS Survey questionnaire circulated to the patients and their respondents during discharge from hospital. In this the hospital environment, behavior of doctors and nurses and all other hospital staffs based on information about medication being given to patients in proper time, explanation of treatment by doctors and nurses have overall rating of the hospital to provide an impact based on the demographic parameters like gender, age, family income, marital status, residential area, and profession. From this model we can interpret that behavior of nurses and doctors have strong effect on the overall rating of the hospital received by patients which is mediated through the demographic factors and hospital environment also plays an important role on patient satisfaction.

5. COMPARISON ON THE LEVELS OF SATISFACTION OF PATIENTS BY STRUCTURAL EQUATION MODELLING AND SENTIMENT ANALYSIS IN HOSPITAL

Results of HCAHPS Survey on patient satisfaction questionnaire (n=44)

Table 22

SL NO.	PARAMETERS	PERCENTAGE OF SATISFACTION
1.	Doctors and nurse	60%
2.	Medical procedures	40%

3.	Comfortableness	80%
4.	Accessibility	45%
5.	Overall satisfaction	73%

Results of Sentiment Analysis on patient satisfaction through online platform (n=44)

Table 23

SL NO.	PARAMETERS	PERCENTAGE OF SATISFACTION
1.	Doctors and nurse	54%
2.	Medical procedures	60%
3.	Comfortableness	72%
4.	Accessibility	51%
5.	Overall satisfaction	68%

Based on the comparison analysis between the HCAHPS Survey questionnaire and sentiment analysis report, it has been observed that the level of patient satisfaction varies among the different parameters based on the behavior of doctors and nurses, medical procedures or amenities used, hospital environment, accessibility and overall satisfaction including mental and emotional health. The level of satisfaction is more based on the behaviour of doctors and nurses from the result obtained from HCAHPS Survey but based on medical procedures the level of satisfaction is more as generated from the sentiment analysis conducted. Based on comfortable or safe environment of hospital and overall satisfaction level is higher in case of HCAHPS Survey report but the level of accessibility is more as observed from the sentiment analysis.

6. Discussion and Conclusion

Patients' responses regarding the problem faced during hospital visit for admission, Problem faced regarding service from doctor, casual and unpleasant attitudes of staffs, hospital service received was not up to the mark, hospital facility was expensive according to few patients, operation of patients did not occur in a proper time as informed to the patient relative the doctors and nurses' treatment were not satisfactory to few patients, the rude behaviour of the staffs, the unsupportive nature of the doctors, the unorganised and unsystematic way of handling the patients, and unsafe environment with poor infrastructure in few of the hospitals lead to negative feedback from the patients through sentiment analysis which is received by online platform. There were also some positive cases like patient want to recommend the hospital to their friends and family members since the hospital was affordable to them, nurses and doctors explained everything properly, they also listened to the problems of the patients carefully, the infrastructure and the environment of the hospital was amicable according to few patients, good communication skills, the consistency to provide quality health service to the patients and polite behaviour of the hospital staff were also reason of positive feedback as received from the online platform through sentiment analysis.

In the current study patients visiting an inpatient patient department gave their feedback through online platform if they had faced any problem in accessing the service from different categories and resources. Patients going to the hospital are messenger to spread the good image of the hospital and therefore the patient's satisfaction is equally important for hospital managers to improve the quality of health care. Timely and appropriate access to health services is an important factor in patient satisfaction. Therefore, the time gap between going to the hospital for admission and getting the right treatment is important. Long wait time creates frustration and dissatisfaction among patients. In the current study most, patients were satisfied with the services provided, so they also like to recommend

these hospitals for others. Patient feedback as well reveals a great deal of understanding about the various aspects, namely may improve the quality of services provided to the social environment.

Competing Interests

The authors declare that they have no competing interests. All data was collected on 08-06-2022 to 09-06-2022.

Authors' Contributions

All the authors contributed significantly to writing this article. The authors read and approved the final manuscript.

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