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Patient Satisfaction in Clinical Healthcare Data Analytics

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Abstract— In this paper, the importance of the definition of patient satisfaction is a big challenge of clinical healthcare data analytics to manage information is beginning to be recognized by clinical healthcare executives. The appropriate situation is needed in the relationship between best outcomes and patient satisfaction, and it can be found in clinical healthcare data and communication technology. ICT advancements present a problem in two directions: on the inside, with Data Analytics, and on the outside, with clinical and patient data interaction. Patient satisfaction in clinical healthcare data analytics delivery has always been data-intensive, and there are hints that the industry is beginning to recognize the growing relevance of patient data processing in the new managed clinical healthcare service. This paper also highlights various clinical healthcare data, patient data, models used in different contexts for clinical healthcare service around the world. Also, we have tried to study past sequences of advancement, current state of the art and future need of research in clinical data of patients for healthcare.

Keywords—*Patient, Satisfaction, Disease, Clinical, Costs, HealthCare, Data Analytics.*

I. INTRODUCTION

Patient Satisfaction is a situation in which patients are happy or unhappily, and in different hypotheses they carry satisfaction about good, Excellent, Negative and Neural with their Clinical healthcare both inpatient and outpatient of every division or department of healthcare. The measurement of patient care quality of patient satisfaction provides healthcare data analytics. To research patient satisfaction in clinical data analytics, we can find out some hypotheses of patient satisfaction. For patient satisfaction, we would have gathered a huge number of clinical healthcare data.

There is a huge amount of patient satisfaction potential data to make better use of information about people's patient satisfaction records. These data can be manipulated to help in the clinical healthcare sector. Well organized quality data is essential for our clinical healthcare using patient satisfaction data to improve the healthcare system. Everybody should have access to their own health information to check if data is accurate to help or manage.

This document helps with patient satisfaction in clinical healthcare data. It is linked up, pooled, rechargers, doctors,

administrative can look for patient satisfaction data to help us develop the right way of predicting or diagnosing diseases, and identifying to improve clinical healthcare data.

We want to work in clinical healthcare to help some objectives- Patient satisfaction is established in focus on main element of clinical healthcare data. To improve Performance, increase patient's observation. To develop patient's observation, we must analyze Hypothetical study of patient satisfaction in healthcare.

II. RELATED WORK

From this paper, patient satisfaction and clinical healthcare data analytics represents the biggest challenges. The healthcare sector is rife with patient data, medical reports, and coding schemes, several of which are importable and need careful data format. Patient Satisfaction and clinical healthcare data comes from several sources and is delivered in several forms, as well as revealed hospital, medical and patient records from individual spreadsheets, and several other data formats. Here, we have an interest to ask to focus on the healthcare data analysis and development decisions making in constructing a healthcare data, with a stress on the important topic's data staging and quality assurance. [1]

This document presents the findings of an experiment on how patient and clinical healthcare institutions have taken the step of approaching the buildup of information systems for a more common reporting than typical treatments costs data. To that goal, some of the basic concepts referring to management information in patient healthcare institutions are gone through. Second number of data analytical tools that could be used in the buildup of a computer-based management information system. It has no patient satisfaction clinical healthcare data. [2]

This document's importance of patient healthcare data gathering in the healthcare sector and its critical aspects are discussed in this study. It is an attempt to compare between typical clinical or healthcare methods and those required in healthcare. It doesn't discuss the distinct observation of clinical data. [3]

In this paper, Development of National Health Services (NHS) Provider for patient's data gathering in paper, authors proposed a national health services data model in Bangladesh healthcare context. In the proposed star schema model, they showed how data from different government and private sources could be processed and stored in patients' data.[4]

III. METHODOLOGY

A. Selection Criteria

Selection Criteria is a part of my research methodology. It provides searching options in my paper. We take two option to search keywords for find out specific keywords in our research paper. There is more technical writing select this option for easily establish their own methodology. I select to motivate two keywords as “Or”, “AND” to join our main keywords. These and our topics keywords help us to development our research methodology. So, I have selected some common keywords from our research topics. It plays an important to improve our searching keywords with selection criteria.

TABLE 1. Search keywords

SL	Search Keywords for finding task easily
1	“Patient” AND “Satisfaction”
2	“Healthcare” AND “Data” AND "Clinical" “Data” AND “Analytics”
3	“Data” AND “Analytics” AND “Online” AND “Tools”
4	“Clinical” AND “Data” AND “Data” AND “Model”

Inclusion and Exclusion Criteria is most popular after literature review. It is extra features to categorize or difference between more research papers. Inclusion and Exclusion Criteria helps us to find out more option to compare related works or research.

TABLE 2. Inclusion (IC) and exclusion (EC) criteria for review of literature.

IC		EC	
IC1	Patient Satisfaction Data explanation	EC1	Other topics covered
IC2	Patient Satisfaction & Clinical Data	EC2	Exclude data not healthcare.
IC3	English Language Preferred.	EC3	Other Languages dependent.
IC4	The doc is limited words related	EC4	Not fixed in limit.
IC5	Include Analytics tools	EC5	Not use any tool

B. Survey Papers Comparisn

TABLE 3: Survey Papers Comparison

Title	Author	Ye ar	Framework	Summe ry	Rf.
Developm ent of National Health Data Warehous e for Data Mining	Shahidul IslamKhan, Abu Sayed Md. Latiful Hoque (BUET),	2015	Here the author used a star schema model as logical Clinica Healthcar e Design.	Healthca re model suitable for integrati ng fragment ed data in respect to Banglad esh.	[1]
Data Warehous e Design Considerat ions for a Healthcare Business Intelligenc e System.	Joseph George,Memb er, IAENG, B. Vijay Kumar, V. Santhosh Kumar	2015	The authors provide specific directions for an optimal Clinical structure design. (Modified star schema based)	Guidelin es for creating an optimum Clinical structure for the healthca re area.	[3]
Healthcare data and quality assurance	Donald J. Berndt, Alan Hevner of University of South Florida.	2010		The health status of individu als and commun ities by CATCH reports	[4]

C. Our Proposed Model

My proposed Model with the snowflake schema consists of 3 major components:

1. Data source (Patient Satisfaction and Clinical databases, healthcare datasets)
2. Data Analytics
3. Representation of data.

In these elements, our proposed design model will integrate and represent information from Analytical datasets, enable versatile analysis queries, and supply precise answers at an acceptable level of comprehension. The snowflake model epitome is constructed on prime of the open-sourced data warehouse for information representation.

There are some advantages of our proposed model features like stability facing analytics data and significant traffic—and blessings of our design by exploitation properties, classes, and also the web-based open-source system will be absolutely tending to clinical analytical reports. Once the information of various datasets is extracted, our proposed model provides a platform for representation and an open-source web analytics tool.

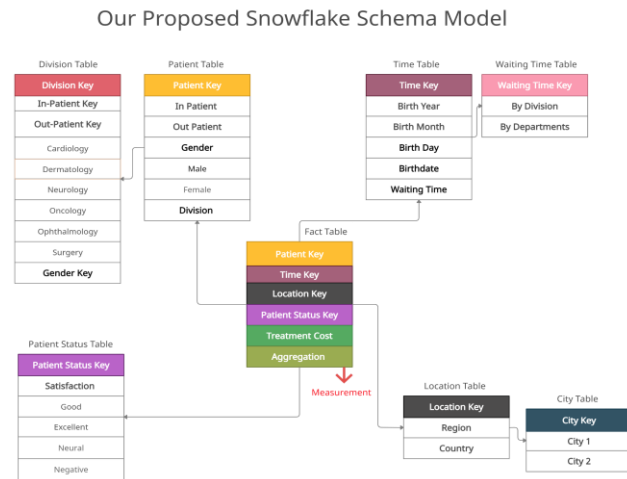


Fig1: Our Proposed Snowflake Schema Model

Our proposed model is a web-based analytical tool for improving data analytics efficiency, accuracy, and scalability. Two levels of instructions are appropriate for our model expansion:

Clinical Data Analytical Representation, Patient Satisfaction, and Clinical Healthcare for aggregating patients, cost, and observation with visual representation, we have produced a web-based Patient Satisfaction and Clinical Healthcare data analytics tool.

At the clinical data analytics level, new healthcare datasets are added, more types of knowledge are identified for target users, and a systematic quality assurance process is used to assure metadata quality.

Reports, Statistics, Query, Data mining and automated methods to extract knowledge, good functionalities to compare similar datasets, and collaborative features, such as Clinical forums that allow users to help each other and suggest healthcare clinical datasets, are all examples of data representation at the data level.

So, we have been motivated to select the Snowflake model for DBMS Query.

TABLE 4: Methodology and Design Perspective Healthcare Data Analytics.

Rf	Author	Methodology	Design	Backup	Security
[10]	Nicolas	No	Top-Down	No	Yes
[09]	Iai	Yes	Top-Down	Yes	Yes
[11]	Joh	Yes	Top-Down	No	No
[12]	Lekha	Yes	Top-Down	No	No
[13]	Kislaya	Yes	Top-Down	Yes	Yes
[14]	Christine	No	Top-Down	No	Yes
[15]	Nicolas	No	Top-Down	No	No
[16]	Barrett	No	Top-Down	No	No

TABLE 5: Healthcare Data Analytical Tools and Clinical Data Perspective

Rf	Data			ETL Tools	Purpose		
	Availability	Privacy	Quality		Admin	Manager	Res
[10]	Y	Y	Y	N/A	Y	Y	Y
[09]	Y	Y	Y	ODI	Y	Y	Y
[11]	Y	Y	Y	SSIS	Y	Y	Y
[12]	Y	N	N	N/A	Y	Y	Y
[13]	Y	Y	Y	N/A	Y	Y	Y
[14]	Y	Y	Y	i2b2	Y	Y	Y
[15]	N	N	N	AT	Y	Y	Y
[16]	Y	Y	Y	N/A	Y	Y	Y

D. Our Patient Satisfaction and Healthcare data Process

The patient and clinical healthcare data analytics design includes three levels of data coarseness from oriented data used in generic reports to detailed entry-level information, like hospital discharges. Besides, five levels of patient experience for satisfaction data are most implemented to build in vision and strategy.

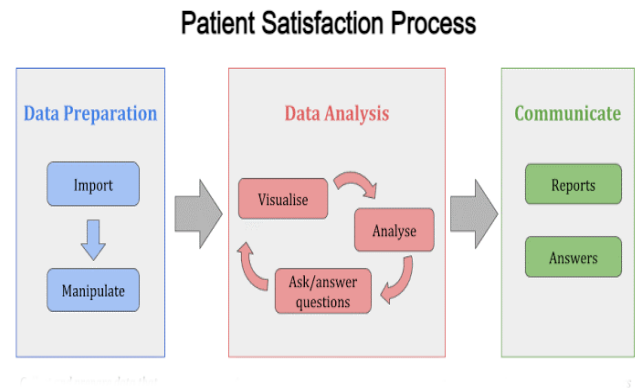


Fig 2: Patient Satisfaction Data Process

Due to the data pyramid, this design is viewed. These three stages of aggregation among information patient healthcare data performance goals combine to meet a wide range of needs, such as patient satisfaction.



Fig 3: Patient Experience for Satisfaction

1. Well Oriented Data Structure
 - a. Vital Statistics
 - b. Patient's data
 - c. Hospital Data
2. Aggregate Structure
 - a. Aggregates
 - b. State indicators
 - c. Demographics
3. Organized Reports and Delivery indicators
 - a. Granted Reports
 - b. Comparisons of Model
 - c. Indicators [5]

IV. DATA ANALYTICS

Data analytics is the science of process with analyzing raw data to make decisions into mechanical processes and algorithms. It provides analysis data to operations. Data analytics help a marketing optimize its goals.

A. Advantages Of Data Analytics.

Make more informed and timely business decisions based on facts. Determine which performance issues require attention. Improve your business relationships by learning more about your customers' needs. Increase risk awareness in order to put preventive measures in place. Visualize the data in various dimensions. Increase your competitive advantage. Improve your understanding of the company's financial performance. Find ways to cut costs and thus increase profits. [6]

B. Techniques for Data Analysis

ICT is critical to analyze raw data in order to comprehend it. We must use a variety of techniques depending on the type of information gathered, so it is critical to define the method before implementing it.

TABLE 6: Qualitative and Quantitative Data Analytics

Rf	Qualitative Data Analytics	Quantitative Data Analytics
[7]	Researchers collect underlying emotions, body language, and expressions from qualitative data.	Quantitative data is presented numerically.
[8]	Open-ended interviews, focus groups, and observation groups are the most common methods for gathering this information.	It focuses on measurable outcomes.
[13]	During the data collection phase, researchers typically analyze patterns in observations.	It is a measurable research analytics approach.

C. Data Analytics Way

There are more data analytics way to analytic data properly. In the modern age, some analytics ways are used all the world. These are- Data Mining and Machine learning, Report: JSON, CSV, and Excel, Statistics: Chart, Visualization, Query: SQL, Database Management, Using Data Analytical Tools and Using Data Analytical Formulas.

D. Patient Satisfaction in Clinical Healthcare Data Analytics: Hypothesis

In a hypothetical case study, there are two hypotheses with gender perspective (Male and Female) in our clinical dataset. Our clinical dataset has 200 patients, satisfied by two hypotheses (Excellent and Negative) or patient satisfaction from Surgery.

Chi-Square Test:

TABLE 7: The results are below:

Gender	Patient Satisfaction from Surgery		Total
	Excellent	Negative	
Male	90	17	107
Female	30	63	93
Total	120	80	200

Expected Values Calculating:

TABLE 8: Multiply each column total by each row total and divide by the overall total:

Gender	Patient Satisfaction from Surgery		Total
	Excellent	Negative	
Male	$\frac{(107 \times 120)}{200}$	$\frac{(107 \times 80)}{200}$	107
Female	$\frac{(93 \times 120)}{200}$	$\frac{(93 \times 80)}{200}$	93
Total	120	80	200

TABLE 9: Which gives us value:

Gender	Patient Satisfaction from Surgery		Total
	Excellent	Negative	
Male	64.2	42.8	107
Female	55.8	37.2	93
Total	120	80	200

χ^2 Table is given below:

In other words, we use formula $(O-E)^2/E$, where are-

O = **Observed** (actual) value

E = **Expected** value

TABLE 10: Observed and Expected Value

Observed	Expected	F = $(E-O)^2/E$
90	64.2	10.3682
17	42.8	15.5523
30	55.8	11.929
63	37.2	17.8936
Total = 200	200	F = $\sum(E-O)^2/E = 55.7431$

Chi-Square = 55.7431

Degree of Freedom:

$$= (\text{rows} - 1) \times (\text{columns} - 1)$$

$$= (2 - 1) \times (2 - 1) = 1 \times 1$$

$$= 1$$

$$P = 0$$

Table 11: Crude Odds Ratio Calculating:

Gender	Patient Satisfaction from Surgery		Total
	Excellent	Negative	
Male	90	17	107
Female	30	63	93
Total	120	80	200

Crude odds ratio = $(90 \times 63) / (30 \times 17) = 11.11764$

95% confidence interval: (1.07, 2.41)

We have noticed our result that in our data analytics with Chi-Square test and Crude Odds Ratio is Highly Positive Correlations. The confidence interval includes (1.07, 2.41), focused on the fact that we can't exclude the null hypothesis; we can't reject Excellent Satisfaction is associated with Patient Satisfaction from Surgery at all in our Clinical datasets.

V. MY PROJECT OBERVATION AND REPRESENTATION

From our web-based tools, we see some result with our observation. The patient datasets are represented a statistical view, reports on JSON and CSV of the project. Now tools are represented patient datasets into graphical representation of patient satisfaction.

A. Patient Dataset in CSV format:

```
Division,Satisfaction,Patien Status,Birthday,Year,Gender,Treatment Cost
Oncology,Excellent,Outpatient,Invalid date,Female,$322.00,192.00
Cardiology,Excellent,Inpatient,Invalid date,Male,$222.00,39.00
Cardiology,Negative,Outpatient,Invalid date,Female,$800.00,128.00
Cardiology,Negative,Outpatient,Invalid date,Male,$800.00,169.00
Cardiology,Excellent,Outpatient,Invalid date,Male,$800.00,116.00
Oncology,Negative,Outpatient,Invalid date,Male,$800.00,33.00
Oncology,Negative,Inpatient,Invalid date,Male,$499.00,175.00s
Oncology,Excellent,Inpatient,Invalid date,Female,$499.00,176.00
Oncology,Excellent,Inpatient,Invalid date,Female,$499.00,136.00
Oncology,Negative,Outpatient,Invalid date,Male,$800.00,99.00
Cardiology,Excellent,Inpatient,Invalid date,Male,$499.00,31.00
Cardiology,Negative,Outpatient,Invalid date,Female,$800.00,25.00
Cardiology,Negative,Outpatient,Invalid date,Male,$800.00,61.00
Oncology,Negative,Inpatient,Invalid date,Female,$499.00,151.00
Cardiology,Negative,Outpatient,Invalid date,Male,$800.00,92.00
Cardiology,Excellent,Inpatient,Invalid date,Male,$444.00,153.00
Oncology,Negative,Inpatient,Invalid date,Female,$499.00,25.00
Cardiology,Excellent,Outpatient,Invalid date,Male,$800.00,168.00
Oncology,Excellent,Inpatient,Invalid date,Female,$499.00,179.00
Cardiology,Negative,Outpatient,Invalid date,Male,$444.00,8.00
Cardiology,Excellent,Outpatient,Invalid date,Male,$444.00,74.00
Oncology,Excellent,Inpatient,Invalid date,Female,$499.00,7.00
```

Fig 4: Patient Dataset in CSV format

B. Statistical View in Chart:

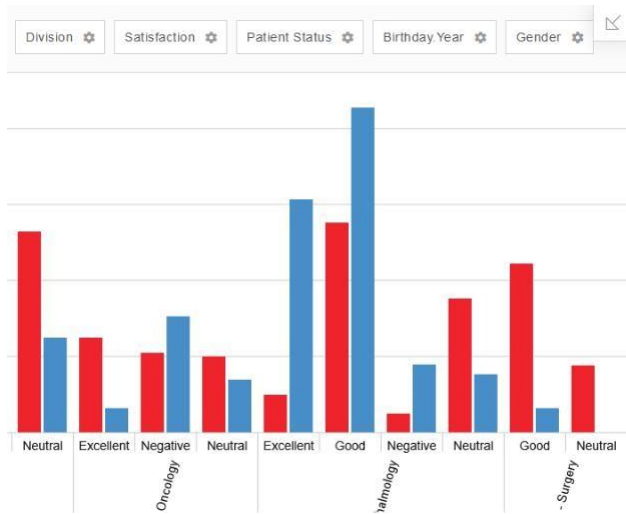


Fig 5: Statistical view in chart of patient satisfaction

C. Line Chart of patient satisfaction:

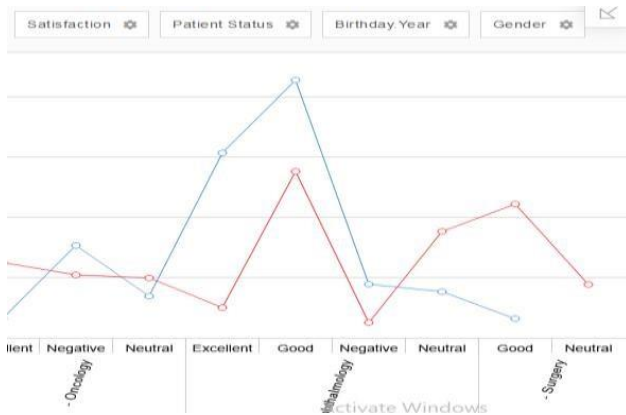


Fig 6: Line Chart of patient satisfaction

D. Pie-Chart of patient satisfaction:

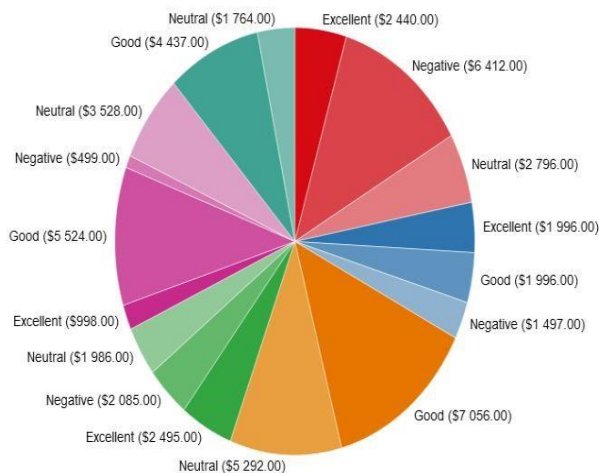


Fig 7: Pie-Chart of patient satisfaction.

VI. CONCLUSION

Our tool is very effective patient satisfaction and clinical healthcare data analytics. From Fig4-7 [17] we should try to represent patient satisfaction data clearly. It provides to easily represent data for data analytics using statistical formulas. In future work these tools are increased scalable system of patient satisfaction. [18] [19].

There is more point of view our tool uses in public healthcare system. It plays an important role in regulating our life in patient and clinical healthcare data [20] analytics.

VII. FUTURE PLAN

Our future plans include incorporating a national level dataset from the Bangladesh public healthcare context and developing a Real-time dashboard to forecast public health issues. We want to develop our patient satisfaction into clinical healthcare in public sector in Bangladesh and we want to use our patient satisfaction web based tools with professionally in marketplace and trade.

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