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Classification of reviews of e-healthcare services to improve patient satisfaction: Insights from an emerging economy

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ABSTRACT

The COVID-19 pandemic has brought in many unique challenges and opportunities for patient care, and one is online healthcare practices. Patient satisfaction with online consultation is primary importance as online healthcare practices are evolving with time. Although previous research has examined how patient satisfaction with online doctor services can be further improved, there has been scant research on the satisfaction with online doctor services concerning Indian patients. Within the framework of service science theories, this study examines satisfaction and sentiments of Indian patients with online doctor services from multiple perspectives. A total of 38019 patient online feedback for 343 doctors was used for understanding patient sentiments. The sentiment analysis classified the reviews of the patients on online doctor consultation services. The finding suggests that healthcare service providers consider a systemic approach that includes core health services along with technical and marketing factors to proactively improve online patient satisfaction.

1. Introduction

While the healthcare system witnesses technological advancements, an increased percentage of medical ailments are presenting parallel challenges. Availability of treatment for new diseases, inaccessibility, unaffordability, and overcrowdedness is still impacting the performance of healthcare systems (Almeida & Vales, 2020; Davis et al., 2019). With the increased consumers' desire for healthcare services and relevant expectations, healthcare industry stakeholders are mandated to further scale their services to meet demand (Liu et al., 2020). The COVID-19 pandemic has had a huge impact on the healthcare system all over the world, where a quantum shift was witnessed towards online doctor consulting with a focus on quality health services at the lowest possible cost (Ebersberger & Kuckertz, 2021; Sharma et al., 2020). The online channel of healthcare consulting bloomed both during and post-pandemic and is further growing and evolving with time. Previously, the interaction between patients and doctors use to happen mainly in hospital or clinic buildings, whereas now patients prefer connecting online with doctors anytime and anywhere based on the convenience of both service provider and user. Online health consultancy services provide convenience for patients as they have the option of consulting renowned doctors on health problems and related treatments swiftly and incurring a minimal cost.

Patient satisfaction with online consultation has become an important differentiator for the online success of a doctor as it is the extent to which the doctor effectively and efficiently manages patients' interactions and meets their expectations (Hung et al., 2014). Patient satisfaction can be defined as the extent to of healthcare needs are met as compared with one's perception (Andaleeb, 2001). Ng and Luk (2019), through research, concluded that doctor empathy is one of the key drivers of Patient Satisfaction (Ng & Luk, 2019). Patient satisfaction, as a metric for evaluating the quality of healthcare service, provides improvement opportunities in selected aspects of healthcare services through quality assurance and outcome assessment.

Measuring patient satisfaction is a challenge as it involves a wide range of factors like ease of getting an appointment, reviewers' opinions, access, empathy, responsiveness, assurance, active involvement, etc (Ware et al., 1983). The successful interaction with the patient on these factors may lead to patient satisfaction. Therefore, understanding the sentiments of patients from review and feedback could be considered an effective measure of identifying e-service patient satisfaction as an important goal towards achieving e-healthcare consultancy success. This study investigates the potential influence of online doctor services, healthcare business expectations, and other factors on patient

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satisfaction through sentiment analysis.

Previous research has proposed many avenues to learn how patient satisfaction can be more effectively improved in a healthcare business. Patients' perceived trust in the website source (Wu et al., 2022) the way the website is designed, the transparency of reviews, and search engine optimization can affect patient perception and so satisfaction. A further focus of doctors on improving the system and avoiding information asymmetry plays a vital role.

To provide an integrative view of online doctor services success, service science theories (Maglio et al., 2006) are used to examine patient satisfaction, sentiments, referrals, etc. Service science theories facilitate examining the interdisciplinary approach to patient satisfaction which is a complex attribute to evaluate, as there are many underlying subjective factors like medical quality, allied services quality, approachability, interaction with the doctors, staff, administration, and so on (Cardoso et al., 2009; Osei-Frimpong et al., 2020). A satisfied patient, impacts directly a new patient's as well as an existing patient's decision-making process, thus contributing to word of mouth (Wood et al., 2000). Health service providers are sometimes not sure of the patient's satisfaction level as sometimes the patient cannot immediately give feedback, as the treatment is not complete in most cases, and with time the possibility of getting feedback goes down (Marshall et al., 2004). Also, sometimes a patient is unaware of the importance of feedback, and the doctor struggles to understand the effect of the treatment prescribed to the patient, which is an important aspect considering that the physiology of every individual is unique (Berger et al., 2020). With the emergence of digital technologies, the problem of collecting feedback from hospitals from patients has been addressed to some extent in a very effective manner (Pandey et al., 2021; Thakur et al., 2012). The feedback shared by patients on the online portal remains in the public domain and can be accessed by new patients, thus impacting directly the business (Wang & Hajli, 2017).

Patient satisfaction is unique in terms that every individual is faced with a different problem and so will have a unique solution (Yellen et al., 2002). This complicates the situation in a way that a doctor can only rely on the feedback of patients for their skill of treating the illness, however, feedback on medicine can be considered general and utilized for analysis. As a result, there are many studies done on the satisfaction of patients in literature and many of them are unique (Bernhart et al., 1999; Chow et al., 2009; Shirley & Sanders, 2013).

Although numerous research studies have investigated patient satisfaction with offline doctor services, the study of online doctor services is still preliminary (Yang et al., 2015). With online services, doctors have to keep track of many new factors that are different from offline services. Based on the service science theories, service quality theory, the customer characteristics theory, this paper explores the factors impacting online doctor consulting services.

The objective of this study is to investigate the effects of the service delivery process on patient satisfaction, using data from an online health community. The main research questions are:

(1) What are the sentiments of the patient towards online doctor services?

(2) How these sentiments can be segmented into categories to get meaningful insights for improving patient satisfaction?

This study collected data on the feedback of 38,019 patients on 343 doctors from Practo, using the Octoparse tool. A sentiment analysis algorithm is developed to provide classification to the patients' reviews. This technique emphasizes word emotion to determine the polarity of a sentence. Sentiment analysis provides critical insights and helps to make sense of the enormous and valuable feedback received from patients that many times goes unexamined. Scattered responses are arranged neatly based on evaluation parameters. All functionalities are implemented to facilitate the process of referral, comparison, and selection of medical centers.

There are three contributions of this paper. Firstly, this paper contributes to online healthcare service research in the Indian context by expanding the information integration theory and signaling theory of online health research. Secondly, our research further categorizes the sentiments of Indian patients on doctors' service. This would help doctors to have a customized approach to understanding the dynamic requirements of contemporary patients. Lastly, this paper examines the level of patient satisfaction with online doctor services.

The paper is organized as follows. Section 2 reviews the literature on patient satisfaction studies, patient satisfaction in India, online doctor-patient interaction, patient satisfaction with online consulting, underpinning theories, and sentiment analysis. The methodology is presented in Section 3. In Section 4 we then describe the result, followed by the discussion in Section 5. Section 6 includes the implications of our findings, the conclusion, the limitations of our research, and the scope for further research.

2. Literature review

Patient satisfaction is a very subjective and a vast topic, and at the same time very crucial for the healthcare sector to understand the delivery of their services. To advance the literature in the patients' satisfaction field ahead, we explored the existing literature in this field and the domains, which was done using bibliometric analysis (Lim et al., 2022; Mukherjee et al., 2022). Bibliometric analysis was done in three steps; assembling, arranging, and assessing (Paul et al., 2021) The methodology suggested by (Lim et al., 2022; Mukherjee et al., 2022) is used for a structured literature review. In assembling, "healthcare" or "hospital" and "patient" and "satisfaction" or "dissatisfaction" were the keywords used for extraction of relevant research papers from Scopus Database (Comerio & Strozzi, 2019; Norris & Oppenheim, 2007; Paul et al., 2021), resulting in a corpus of 84,724 articles. Adding "India" as a new keyword, narrowed the corpus to 774 articles. Further, in the arranging stage, the corpus was reduced to 82 quality articles using filters like "Language", "Source Title", "Year", "Document Type" and "Source Type" provided on Scopus website. In the accessing stage, science mapping was done of all 82 articles to know their domains. Also, these 82 articles were thoroughly reviewed by the authors, before arriving at the research gap of patient satisfaction through online consultation with doctors.

2.1. Patient satisfaction studies

Patient satisfaction is at the core when designing medical or healthcare services (Sughra et al., 2021). However, defining patient satisfaction is complicated. One definition of patient satisfaction concludes it is measuring patient's opinions (Sughra et al., 2021), while another informs that patient satisfaction is a patient's attitude towards healthcare services and other aspects of it (Jenkinson et al., 2002; Tanniru & Khuntia, 2017). In a study, (Maconko et al., 2016) concluded that patient satisfaction is the compliance of healthcare services with patients' expectations from them which also includes patients' emotional reactions. Some authors (Korneta et al., 2021; Otani et al., 2011) concluded that patient satisfaction is an outcome of quality services desired and received by the patient from healthcare services. Many types of research are undergoing in the field of patient satisfaction all over the world. For the present study, we conclude that the patient is satisfied upon receiving what is desired from the service for which the patient opted.

2.2. Patient satisfaction in India

Patient satisfaction is very subjective, unique, and personal (Stefanini et al., 2021), whereas feedback provided on medical treatment methods, medicine, and hospital services can be generalized to some extent (Marshall et al., 2004). Presently, the spread and reach of the internet, backed by the online presence of hospitals and doctors have facilitated new as well as old patients to review and understand doctors

before approaching them for a particular condition. In India, research on patient satisfaction started appearing in top journals in 2008. In the first study, the effect of the mode of governance on patient satisfaction was studied while treating HIV-positive patients (Finn & Sarangi, 2008). In 2009, the satisfaction of female patients with the understanding of female sexual dysfunction (Singh et al., 2010) and tuberculosis patients' satisfaction with public sector services as compared to the private sector was analyzed (Jaggarajamma et al., 2009). 2010 marked the patients' satisfaction field by contributing research on medical treatment methods like endoscopic adenoidectomy (Somani et al., 2010), the Singapore Swing Method on the healing of mastoid cavity (Singh et al., 2010), and oral feeding after cesarean (Mehta et al., 2010). Patient satisfaction relating to community insurance schemes (Devadasan et al., 2011) and entitlements of health care services of the poorer section of society (Ergler et al., 2011) contributed largely to studies in 2011. This was the first time when there was a large study on 545 households and 70 interviews respectively. There was a need to understand the fact that patient satisfaction is just a part, whereas household satisfaction is the whole as the members' patients are the ones dealing majorly with the services. Important studies that came in 2012, are on patient perceptions of inequities in the doctor-patient interaction (Mocherla et al., 2012) and educating pregnant women (Murthy & Banerjee, 2013). Some of the important research done in coming years include research on medical ethics (Subramanian et al., 2013), a framework for the evaluation of medical quality (Heidari Gorji & Farooquie, 2013), utilization of healthcare facilities (Tavashi & Naik, 2014) and non-complaining behavior of inpatients (Khadir & Swamynathan, 2014). Further, research also includes a study on service quality (Sathish et al., 2018), the effect on the satisfaction of the rural population (Gupta et al., 2021), the effect of telemedicine (Li et al., 2020), patient satisfaction with daycare (Dwivedi et al., 2020), patients satisfaction with healthcare, factors affecting the satisfaction of patients (Kaur et al., 2020), satisfaction with the medical tourism industry (Datta, 2020), family-centered care (Sarin & Maria, 2019) and renewable insurance policy (Ahire & Rishipathak, 2018). The aforementioned research studies mainly include satisfaction with healthcare service providers, various medical care, and programs of healthcare. However, there is a long way to go in understanding the satisfaction of patients from a complete healthcare system.

2.3. Online Doctor-Patient Consultation/Interaction

Online Healthcare services (OHS) emerge as a new method of delivering medical assistance, while at the same time providing convenience and timeliness to the patient (Atanasova et al., 2018). OHS also helps the patient to receive the best medical assistance by removing geographical barriers. By utilizing OHS patients can effectively gather information relating to their health problems (van der Eijk et al., 2013). Several studies (Durbin et al., 2012; Vermeir et al., 2015) have pointed out some shortcomings in offline interaction like discontinued care and inefficient use of valuable resources. However, in online interaction, patients can share information in the online community, where other doctors and patients can participate in interaction and thus resulting in more suitable service to the patient (Zhang et al., 2020). Thus, both the service provider and service consumer benefit from OHS. However, doctors and patients are different from each other in terms of understanding and knowledge about medicine and so there is a high chance of a communication gap between the two (Atanasova et al., 2018). This gap can lead to misinterpretation of doctors' advice by patients, ultimately dissatisfaction among consumers (Wu et al., 2022). Thus, during the doctor-patient interaction, the doctor needs to take care of the patient's understanding and knowledge of the illness, while giving sufficient time to the patient to explain or share information about his problem for the successful delivery of healthcare service.

2.4. Patient satisfaction with online consulting

The spread of the internet has pushed patients or healthcare service users to take or avail of healthcare services online. Online consultation is increasing after the spread of COVID-19, first for precautionary measures and then for convenience (Korneta et al., 2021; Liu et al., 2020). Online consultation solved one major issue with the healthcare service i. e. providing feedback on the service used. However, there is only one study where cost-effective medical camps are tested (Li et al., 2020) with a focus on the increasing reach of health services rather than patient satisfaction. Online consultation has grown exponentially after the pandemic, which is a good sign as stress on the healthcare sector is diverted or taken care of online, and also the doctor and patient can interact based on their convenience (Andrews et al., 2020). Several websites are coming up providing holistic healthcare services starting from consultation, medicine delivery, and lab tests at the doorstep of patients. This is a good sign considering the doctor-patient ratio not only in India but all over the world. However, the satisfaction of patients with online consulting needs to be measured because the doctor cannot physically examine the patient and has to rely on the patient's understanding of one's problem. There are vast data on the feedback of patients from online consulting that can be targeted to understand patients' requirements and satisfaction with healthcare services in the future.

2.5. Underpinning theories

Within the framework of service science theories, information integration theory, signaling theory, and social support theory play role in patient satisfaction through patient interaction with online consultation with a doctor.

2.5.1. Information integration theory

Information Integration Theory proposes that any person integrates information gathered from different sources before deciding (Carroll, 1982). When a person suffers from a medical problem, disease, or illness; the first discussion happens with family members or friends from where prima facie information is gathered (Sarin & Maria, 2019). In the process of gathering information, the patient evaluates the symptoms in detail which are then shared with the doctor during an interaction. The richness of the information provided by the patient is crucial for the doctor to evaluate the patient's condition and make an accurate decision for treatment while providing recovery support (Hung et al., 2014). Along the same line, (Yan, 2018) verified that providing social support has a positive association with patient recovery. Thus, the recovery of the patient can be related to the information that one has gathered and how it is being utilized.

2.5.2. Signaling theory

According to Signaling Theory, a firm sends signals conveying its abilities (Porter, 1980) to the customers. Signals are nothing but the information which a customer gathers before purchasing a service or product (Cheung & Xiao, 2014) While analyzing products, signals sent by providers can be like warranty, money-back guarantee, and advertising. For online firms, website quality determines the quality of the product or seller, and the IT infrastructure is a signal for online communities for consumer participation (Benlian & Hess, 2011). But when it comes to services provided, sending signals is difficult and at the same time very important also (Ye et al., 2013). In service industries, signals are majorly sent by customers themselves in the form of social information through action and through opinion also called peer consumer purchase and peer consumer reviews (Cheung & Xiao, 2014; Ye et al., 2013). Thus, signals in service industries are majorly from prior consumers. Hence, analyzing peer opinions is crucial for the healthcare service industry to improve the service and ensure patient satisfaction.

2.5.3. Social support theory

Society has an important role to play in an individual's life directly or indirectly and thus impacts the decision-making and behavior of an individual (Hupcey et al., 1998). In the same context, patients' interaction with the healthcare system is affected by the individuals in society and can lead to both positive and negative effects (N. M. Nasir et al., 2022). When society is on the same side as doctors and patients, positive effects can be seen. We can see an example of this in the green corridor created for organ transportation, where individuals from society come forward for helping in traffic control (Koushal et al., 2018). Thus, if doctors provide support during and after consultation with the patient, then the patient's recovery is fast and positive, leading to long-term patient satisfaction (Da Costa et al., 1999). Social support from the doctor is crucial for patients' cure and satisfaction.

2.6. Sentiment analysis

Sentiment analysis is a technique, where Natural Language Processing (NLP) is used for the analysis of qualitative data to extract meaningful insights with the help of computers (Vinodhini & Chandrasekaran, 2012). Sentiment analysis is sub-categorized into three different levels, document level, sentence level, and aspect level (Farra et al., 2010). Document level informs about the net sentiment of the complete document, similar to the sentence level. Sentence-level sentiment analysis is preferred as analysis of the data is done at the sentence level (Moraes et al., 2013). However, aspect-based sentiment analysis brings forth the features or aspects from the qualitative data, in which individuals taking part are interested. As we used online feedback data from patients, which is in the form of statements, we used sentence-level sentiment analysis for the study. Sentiment analysis is a proven method for the classification of online reviews (Fan et al., 2017; Zhu et al., 2021). Later, we also extracted nouns or aspects from the corpus and evaluated them further for understanding the features in which the individuals are interested when it comes to healthcare online services. The methodology adopted for performing the analysis is discussed further.

3. Methodology and data collection

Data on patients' feedback is available online on multiple websites including the hospital website and telemedicine websites. For this study, data on the feedback of patients were collected from Practo, using the Octoparse tool. On the Practo website, there are filters to help the patient or customer to search for healthcare services according to preference. The two major filters provided are location and doctor (clinic or hospital or specialization). For this study, it was decided to collect data on patients' feedback for doctors from Delhi and Bangalore. Delhi and Bangalore were specifically selected considering that patients there are accustomed to using online healthcare facilities. Only the doctors with more than 30 feedback were targeted for the study, keeping in mind the consideration that doctors who have spent enough time in online consulting are adapted to the online patients' interaction for the understanding exact situation of the patient. 38,019 feedbacks from 343 doctors were extracted for understanding patient satisfaction out of which few were blanks, thus limiting the final data points to 36468.

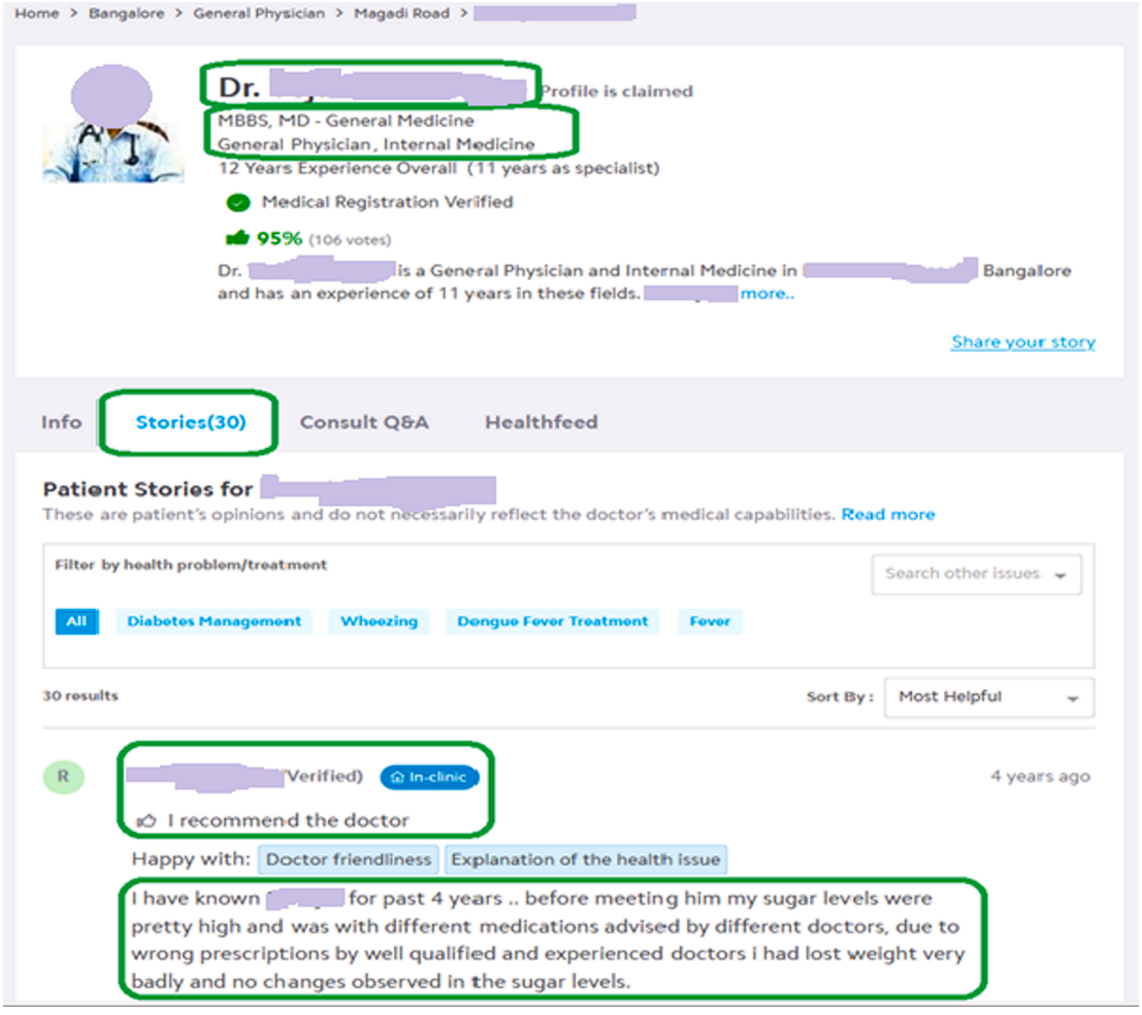

Fig. 1. A Sample Data point retrieved from Practo.com.

Fig. 1 depicts the data that was targeted for extraction using the Octoparse tool from the Practo website.

For extracting data, a process was followed so that human interaction is minimized, and data is collected without bias. Firstly, the location Bangalore was selected on the Practo website, bringing forth all doctors available in Bangalore. Then a flowchart was made in Octoparse, where instructions were provided for clicking on the doctor's name, followed by a click on the stories tab, and then the stories (feedback) were picked up. Once all the feedback from one doctor is captured, the program moved on to the second doctor, and so on. Thus, human biases were eliminated in data extraction. The advanced model of the Octoparse tool was used, which provides the feature of creating a loop or program and collecting the desired data. The data thus collected was exported in excel format to be stored for further analysis.

Sentiment analysis was performed in three different software's, based on their strengths in the sentiment analysis area. The details of the software used and the process performed is explained below.

1. Microsoft Excel is used to get sentence-level sentiments.
   a. Excel has an option for text analysis with the "Azure Machine Learning" Add-in.
   b. The data (in form of sentences in one column) is then given as input to the Azure machine learning add-in, which then gives outcome in the form of sentiment (positive, neutral, and negative) and score (value in the range of 0 to 1) in the next two successive columns.
2. R software is used for sentiment classification and aspect extraction.
   a. R software has all the required packages for text analysis like natural language processing (NLP), syuzhet, tidyverse, dplyr, textdata, sentimentr, and ggplot.
   b. Using NRC sentiment analysis, the data is classified into two categories (positive or negative) and eight sentiments (anger, anticipation, disgust, fear, joy, sadness, surprise, and trust).
   c. After that, using Parts of Speech (POS) tagging all the nouns were extracted. The nouns thus obtained were manually filtered for aspect extraction. For this, firstly irrelevant nouns were removed and then the minimum frequency was fixed for a noun to be considered an as important aspect.
3. JMP Pro is used for the extraction of most recurring phrases
   a. The text mining feature of JMP Pro gives output for most recurring words and phrases. There is also an option for stemming, which helps in combining similar words. The length of the phrase in terms of maximum words can be specified and accordingly the phrases are extracted. Using this stem words and phrases are extracted.
   b. Secondly, JMP Pro also provides sentiment analysis at the sentence level. This feature was used to recheck whether the output obtained from MS Excel and R are in line with it.

For sentiment analysis, using one software can leave space for questions, as the algorithm running in the background will be different for different software. Using three different software addresses this problem as well as strengthens the outcome and so MS Excel, R, and JMP Pro were used together for analysis. The results thus obtained from the analysis are discussed in the following section.

4. Results and findings

The results obtained through all three software are found to be consistent in a manner where all are showing the average slightly positive outcome.

4.1. Microsoft excel outcomes using azure machine learning

Microsoft Excel software is predominantly used and well known for sorting and filtration of data. The outcome from Azure Machine Learning is whether the feedback is positive, neutral, or negative with its value i.e., positive ranges between 0.61 and 1, neutral ranges between 0.46 and 0.60 and negative range is from 0 to 0.45. The feedback consists of data on 343 doctors in ten specializations and had a corpus of 36,468 points.

Table 1 represents the summary of data extracted from Practo.com. General Doctor is the specialization with the highest number of doctors i.e., 176, whereas the highest number of feedbacks 12234, were collected for BDS, MDS specialization. When it comes to the number of feedback received, the highest average feedbacks (235) per doctor are available for the Dermatologist specialization but the highest average positive feedback (97) is received by doctors in BDS, MDS specialization whereas the highest average negative feedback (112) are received by doctors in Dermatologist specialization. The average sentiment score is 0.51208 for 36,468 feedbacks on 343 doctors. Taking a closer look at the value, it lies in the neutral region of the sentiment analysis given by Microsoft Excel. Thus, it informs that the overall average sentiment is Neutral. Total positive responses amount to 17465, whereas total negative responses amount to 14417. Both the above statements contradict the general psychological assumption that when a person has a negative opinion then he/she is likely to share feedback.

4.2. Sentence and word level analysis with R

4.2.1. Overall analysis

R software was used for both sentence-level analysis and word-level analysis. The outcome of sentence level analysis is grouped based on the doctor's specialization and is represented in Fig. 2, where the x-axis represents the overall sentiment score and its spread, and the y-axis represents the grouping based on specialization. The outcome points that the average sentiment score in all the ten groups is positive or slightly shifted to the right of neutral or zero point, which is also evident from the average sentiment scores histogram represented in Fig. 3. This can be attributed to a greater number of positive responses being extracted as compared to negative responses. However, overall positive sentiment does not guarantee satisfaction for all patients and can be a caveat in representing the holistic picture.

4.2.1.1. Words analysis into sentiments. The word-level sentiment analysis of the patient's feedback using syuznet package in R software classified the sentiments into eight major types namely "anger", "anticipation", "disgust", "fear", "joy", "sadness", "surprise", and "trust". The word-level distribution of patients' feedback within these eight sentiments is depicted in Fig. 4. The highest feeling or sentiment expressed by the patient in the feedback is trust followed by anticipation and joy. The Figure represents more positive emotions and fewer negative emotions. Fig. 5 gives the distribution of the eight sentiments percentage-wise in the corpus under study. The contribution of trust is more than 30% followed by anticipation and joy, which are in the range of 15% to 20%. Thus, it can be understood that patients have trust in doctors which forms the basis of their satisfaction with the medical service. The next important sentiment i.e. anticipation is a dicey one because patients anticipate things concerning the doctor, but if the doctor's way of treating the patient differs from the patient's expectation then it can lead to dissatisfaction in the patient. Other sentiments like fear, sadness, disgust, and anger are negative emotions displayed by the patients. However, the contribution of negative sentiments is lower compared to positive ones.

4.2.1.2. Aspect identified. For Aspect extraction, we first need to identify the aspects that are being discussed in the patient's feedback. For this, we extracted frequent nouns using part-of-speech (POS) tagging. POS tagging was done using the NLP package in R software. After collecting and summarizing all the nouns extracted, we calculated their support values using the formula:

Table 1
Feedback data from practo.com and sentiment analysis.

Specialization	Doctors	Feedback	Negative sentiments	Neutral sentiments	Positive sentiments	Word count	Negative Average Score	Positive Average Score
Ayurveda	3	617	259	72	286	24,067	15.85%	79.32%
BDS, MDS	63	12,234	102	28	113	393,731	13.81%	78.89%
Bariatric Surgeon	8	243	4523	1544	6167	10,214	17.39%	79.21%
Dermatologist	29	6820	3254	800	2766	249,538	14.89%	79.12%
General Doctor	176	9156	3427	1204	4525	308,251	17.91%	78.97%
Homoeopath	6	459	192	56	211	17,536	15.50%	78.85%
Neurologist	3	434	185	54	195	15,557	18.19%	79.17%
Ophthalmologist	1	183	83	29	71	7100	14.83%	78.46%
Orthopaedist	15	1651	621	221	809	55,865	18.23%	78.72%
Urologist	39	4671	1771	578	2322	183,913	16.18%	79.85%

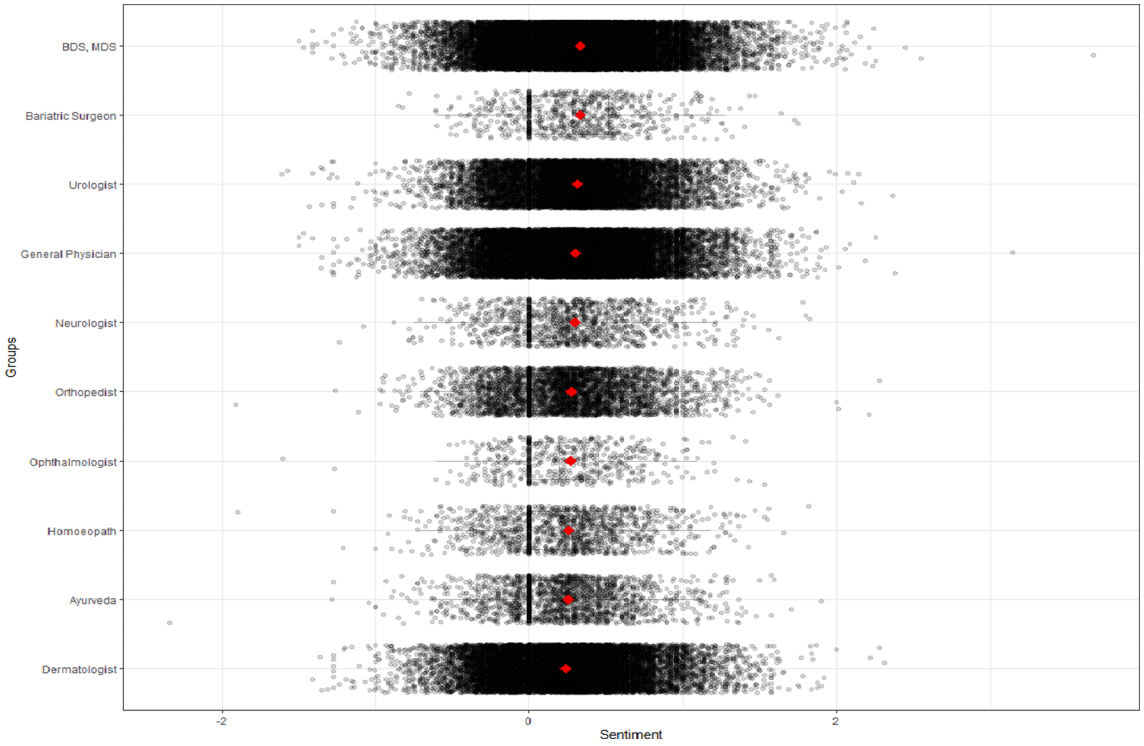

Fig. 2. Group-wise analysis of sentiment from patient feedback.

$$Sup(n) = \frac{count(n)}{|F|}$$

where sup (n) is used for representing support for the noun (n), and count (n) represents the frequency of noun (n) extracted from feedbacks $|F|$. We then fixed a threshold value, or baseline value to determine the most frequent aspects. Noun(n) is considered an important aspect if sup (n) is greater than the threshold. However, it can also happen that some important aspects are ignored in the process due to their frequency, but then it can also be inferred that not much of the population is bothered about it and so the frequency is low. Another important consideration is that the nouns were stemmed to remove duplicity and get original aspects.

The aspects thus identified are represented in Table 2. Table 2 also represents the positive and negative frequencies of each of the aspects. The majority of the aspects identified come to the mind of almost all the patients at different points in time. Interpreting these aspects one by one would be very difficult and so they are clustered based on the expert's opinion. The Expert's committee comprised two Doctors, two Hospital staff, two Academicians, and four patients for clustering the aspects. Clustering was done through online consultation. The clusters thus formed include medical treatment parameters (25 aspects), doctor's behavior (18 aspects), doctor's knowledge or experience (14 aspects), service parameters (17 aspects), patient's need or expectations (16 aspects), and others (9 aspects). The clusters along with their positive and negative sentiments frequency are represented in Table 2 and Fig. 6a-6f.

The aspects of identification and classification into clusters, however, supported the earlier findings of this study, by showing more positive sentiments than negative sentiments. This list of aspects also gives a nearly exhaustive list of factors that a patient looks into during treatment and post-treatment. The first cluster of aspects represents medical treatment parameters, which include aspects like treatment, consultation, procedure, approach, medication, and so on. The second cluster deals with the doctor's behavior, where care, listening, kind, understanding, and similar aspects form a part. A doctor's knowledge or experience takes on the third cluster by including aspects like explanation, details, advice, and suggestions. The fourth cluster is formed from service parameters, consisting of aspects like time, visit, clinic, and staff. It is shocking to get aspects on service parameters from online consulting, however, after going through the feedback consisting of these parameters, it was found that the patients not only gave feedback on online consulting but also shared their feedback after their clinical visit. The

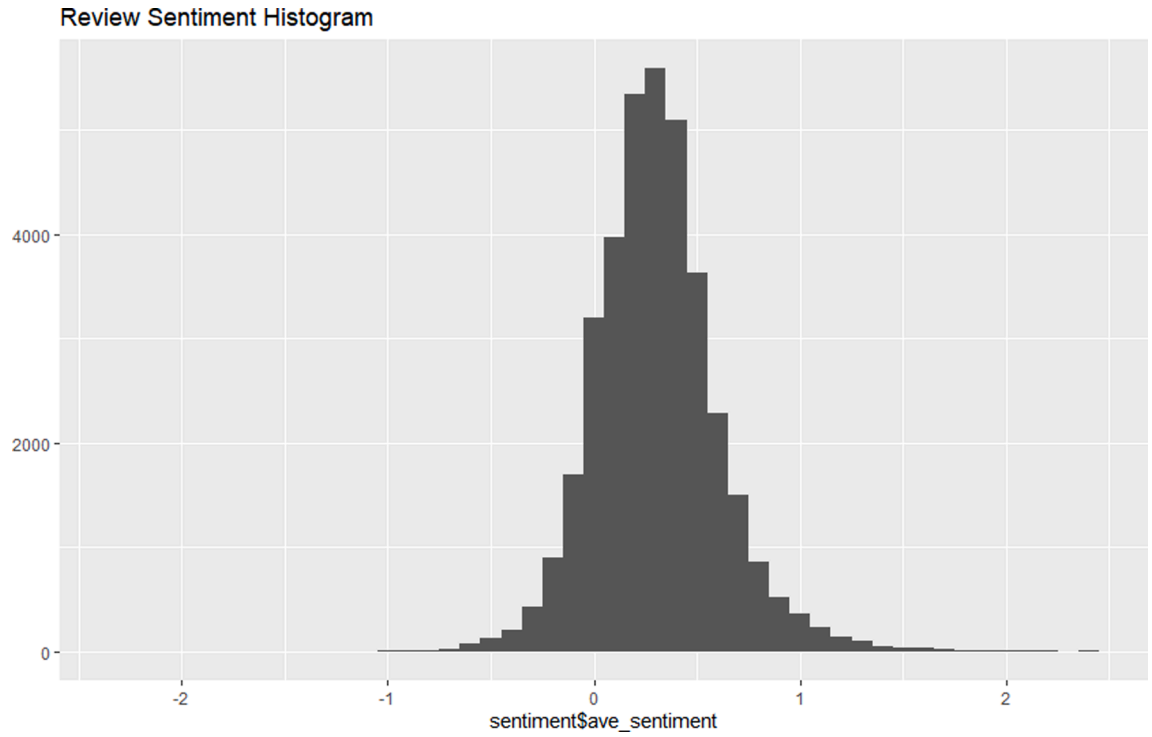

Fig. 3. Average sentiment score distribution histogram.

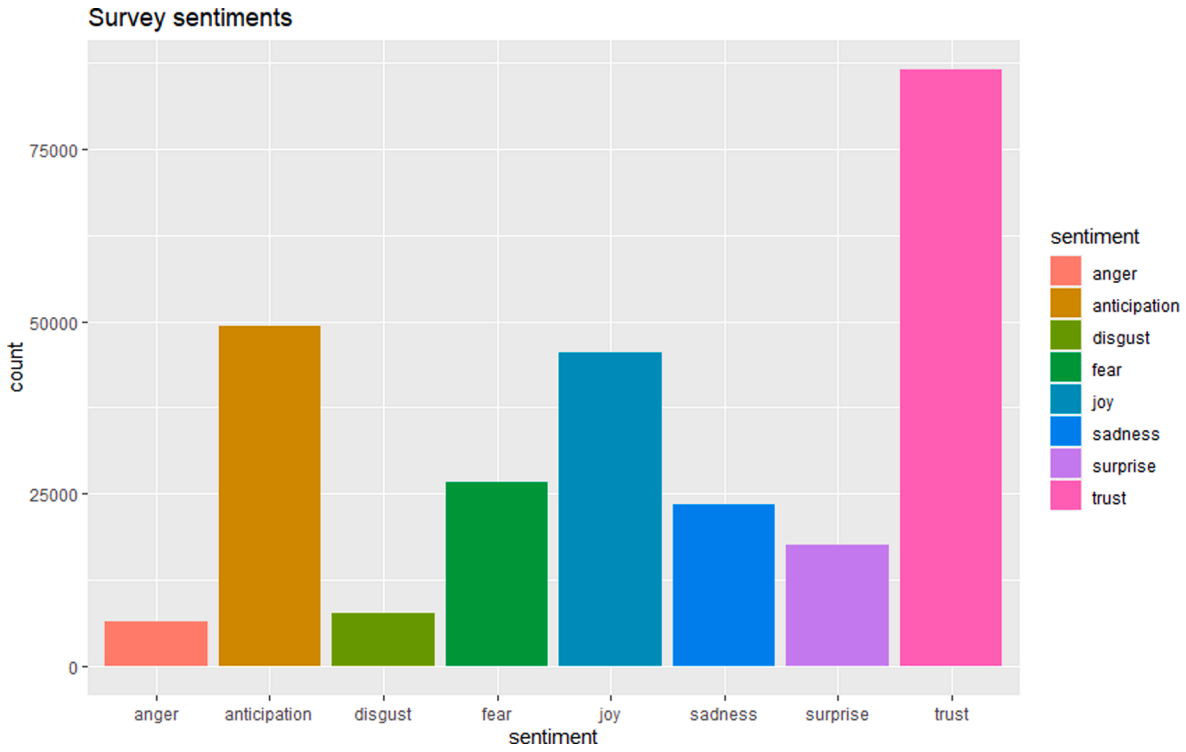

Fig. 4. Word-level Distribution of Patient Feedback in Eight Sentiments.

fifth cluster is made up of aspects of patients' expectations or needs, like problems, issues, feeling, work and ease. The sixth and last cluster is a general cluster including aspects like friend, plan, family, place, and life.

Identified aspects give an overall picture of healthcare parameters that can affect patients' satisfaction when it comes to an online consultation and some extent clinical interaction. The aspects thus identified form an exhaustive list of parameters important from the perspective of patient care.

4.3. Phrase level analysis using JMP pro

Results from JMP Pro software comprised a list of repetitive words after stemming and also phrases. Since the aspects are already identified using R software, the focus of JMP Pro is more on the phrases. The

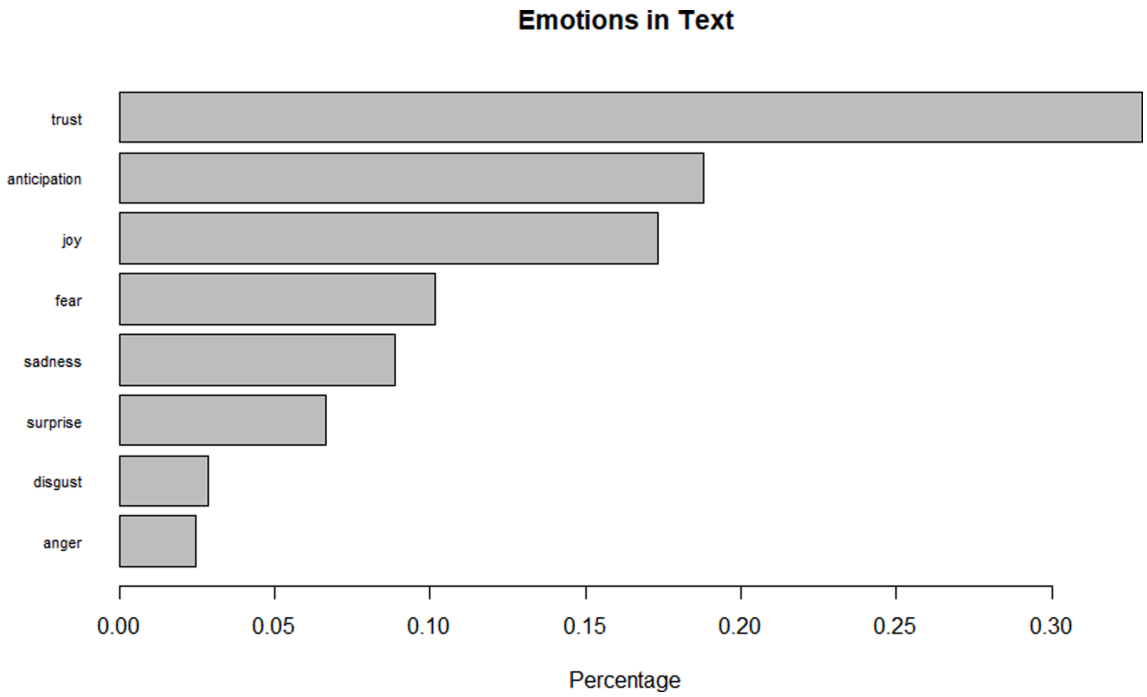

Fig. 5. Percentage-wise Distribution of Sentiments into Eight Categories.

phrases are further grouped manually to take care of similar phrases. The list of top phrases thus identified from the patient's feedback is mentioned in Table 3. Taking a close look at the phrases, it is clear that the majority of the patients are satisfied with the treatment received, which is apparent from the phrases like highly recommend, good experience, doctor is very friendly, good doctor, doctor explained, thank you doctor and happy with the treatment. The identified phrases also include some names of specific problems and treatment like root canal, hair fall, skin problem, x-ray, and laser treatment. Overall the phrases thus identified are in line with the findings of the present study pointing toward satisfied patients.

5. Discussion

Online medical consulting is an e-service, which is one of its kind due to the uniqueness of the requirements of both the service provider and the customer. Online services from a doctor are intangible and so proper care is required to meet the expectation of the patient. The prior research has examined how patient satisfaction with healthcare services can be further improved (Ng & Luk, 2019; Sughra et al., 2021). However, there has been scant research on satisfaction with online doctor services concerning Indian patients. Little attention has been given to the sentiments and the factors that may have an impact on patient satisfaction (Ravi and Systems, 2015)

The present study is targeted to understand patient satisfaction in the Indian context by analyzing patients' sentiments towards online doctor services. The scope of the study is restricted to India, primarily for two reasons, one, medical insurance is not mandatory in India so health is supposed to be a responsibility of an individual. So, the perception and behavior of Indian patients are different from patients who are insured in developed countries. Further, the COVID pandemic has badly hit the healthcare system in India, forcing it to adopt online doctor services to cater to the medical needs of the huge population.

Using sentiment analysis, we identified various factors relating to patients' expectations from online healthcare services. The results from MS Excel, R, and JMP Pro, show that there is a huge scope for improvement in online healthcare services for patient satisfaction. Also, the result shows that not only the patient-doctor interaction but also there are other technical factors like the perceived trust of the website, website design, transparency of reviews, search engine optimization, etc, are equally important factors to attract the eyeball of the potential customer (patient). Further, the behavioral factors like empathy, information quality, and information factors are of paramount importance (Chaulagain et al., 2021).

The study also identifies aspects that lead to six clusters, Medical treatment parameters, Doctor's behavior, Doctor's knowledge/experience, Service parameters, and Patient's needs/ expectations, and the rest are collated under Others. The output thus obtained is a result of patients' online feedback on even offline consulting and so clusters like service parameters and others hold the least value in online consulting. Now when we consider a cluster of medical treatment parameters, it deals with the treatment suggested, the procedure that one needs to follow, the causes of the problem, medications, and so on. These all things depend on the problem the patient is suffering from and the doctor has the least control over it. The doctor can slightly vary these parameters to suit the patient's requirements, but there won't be any major changes as far as the problem is related. Thus, making medical treatment parameters cluster a bit rigid.

Medical services dealing with the human body are critical because a patient who suffers from pain would expect a straight solution. A diagnosis can be drastically different for two individuals having the same symptoms, which increases the complexity of the medical services further (Mulchandani et al., 2019). Despite all these complexities, the service provider (doctor) tries her best to understand the patient's problems and address them at the earliest in the online consulting session. In offline consulting, the doctor can quickly go through a few physical tests to examine the patient or understand the problem faced by the patient, which is not possible in the online mode. In online mode, the doctor has to rely on the information provided by the patient, which at times can be misleading, depending on the understanding of the patient about the problem. In such a situation, the knowledge and experience of the doctor help treat the patient. However, the stakes are high for both the parties involved; the reputation of the doctor and the satisfaction of the patient. All these factors make the delivery of online medical services further complicated and critical for the service provider.

Another cluster, Doctors' Behavior has a major role to play as patient

Table 2
Clusters of Aspects and their frequencies.

Medical treatment parameter			**Doctor's Behaviour**			**Doctor's knowledge or experience**		
Aspect	**+ve freq**	**-ve freq**	**Aspect**	**+ve freq**	**-ve freq**	**Aspect**	**+ve freq**	**-ve freq**
treatment	5694	4964	care	1419	1491	experience	3478	2081
procedure	732	949	listens	682	353	detail	997	808
approach	681	506	patience	642	439	explanation	757	340
consultation	617	765	kind	559	546	advice	478	414
medication	558	957	support	395	328	suggestion	431	227
solution	541	380	understanding	393	258	reason	305	365
cause	538	1069	concern	370	374	suggestions	299	137
medicines	531	1030	smile	353	367	confidence	252	385
results	529	638	caring	335	220	knowledge	208	181
tests	497	1179	nature	307	161	response	167	114
diagnosis	440	351	talk	287	283	wisdom	140	496
disease	173	181	manner	239	155	answers	116	87
procedures	157	192	hope	205	368	attention	105	108
course	143	161	concerns	200	172	opinion	54	159
infection	134	376	friendliness	186	89			
prescription	128	193	guidance	174	155			
delivery	114	186	trust	171	212			
quality	109	125	attitude	119	78			
symptoms	106	229						
relief	105	199						
improvement	97	263						
precautions	90	88						
sessions	63	207						
tablet	43	189						
Service parameter			**Patient's Need or expectations**			**Other**		
Aspect	**+ve freq**	**-ve freq**	**Aspect**	**+ve freq**	**-ve freq**	**Aspect**	**+ve freq**	**-ve freq**
time	2073	2700	problem	3287	3603	friend	4813	3276
visit	1804	3130	issue	1933	2377	plan	1155	951
clinic	1550	2137	feel	546	1511	family	525	596
staff	1073	589	work	544	835	place	348	469
service	757	341	ease	466	675	life	206	397
wait	391	928	need	448	800	options	192	162
team	343	268	quer	382	363	environment	156	38
Process	335	378	condition	286	482	situation	154	282
hospital	290	760	questions	270	344	feedback	104	157
appointment	289	814	cure	248	492			
ambience	178	58	details	239	212			
money	140	331	doubts	223	291			
staffs	132	81	acne	149	478			
information	126	104	satisfaction	141	88			
quality	109	125	feeling	120	476			
minutes	54	241	recovery	116	152			
reports	53	184						

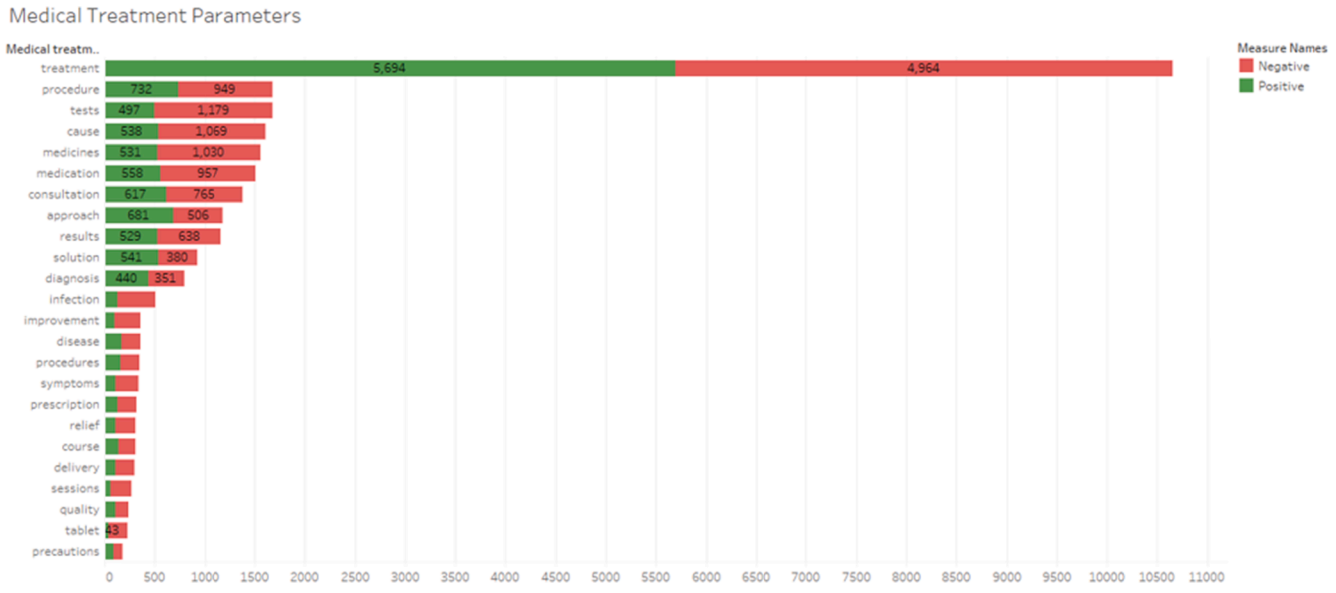

Fig. 6a. Aspects classified under Medical Treatment Parameters.

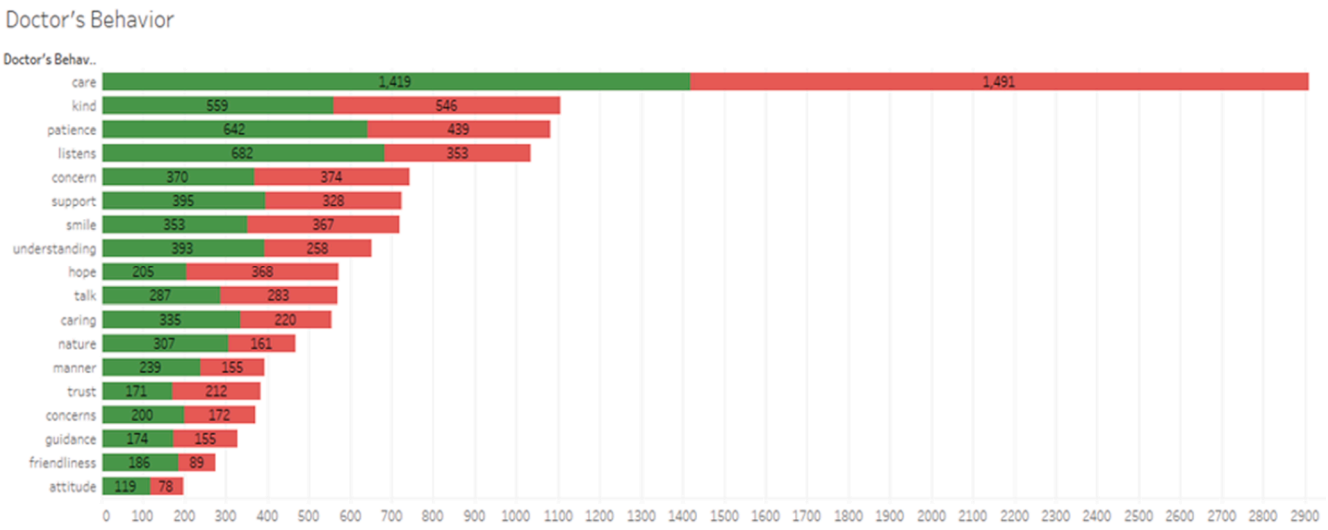

Fig. 6b. Aspects classified under Doctor's Behaviour.

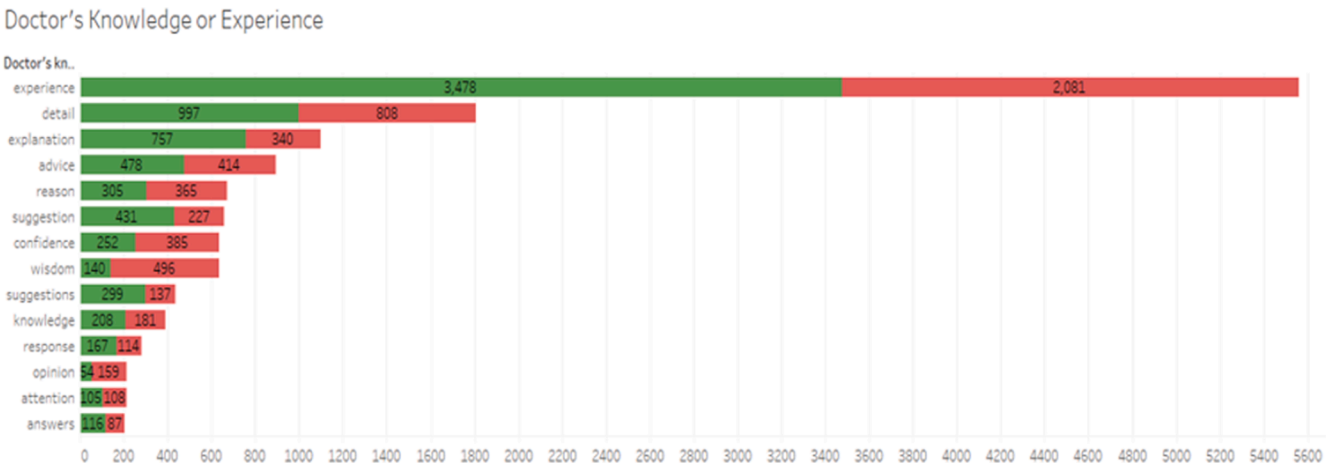

Fig. 6c. Aspects classified under Doctor's Knowledge or Experience.

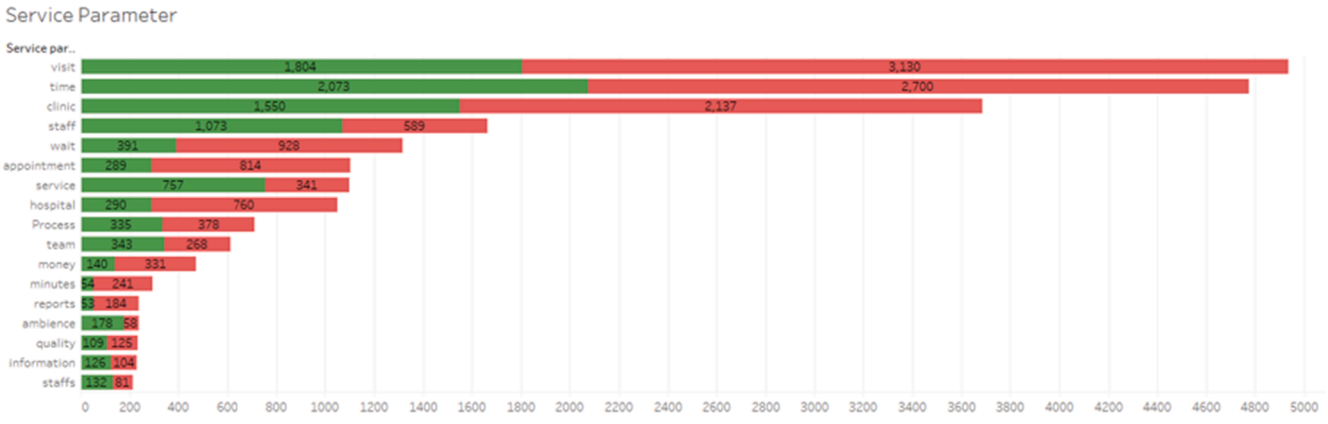

Fig. 6d. Aspects classified under Service Parameters.

interaction will vary easily depending on how the doctor is responding and taking into consideration of one's problem. Sometimes even if the doctors just allow the patients to keep on explaining their problem, the patient feels relieved because of the thought that the problem is properly conveyed to the expert. The third cluster consists of parameters involving the Doctor's Knowledge and experience, which is one important parameter involved in the successful delivery of online medical care. Patients' needs or expectations are grouped in one cluster and that involves a problem of the patient, feelings of the patient, needs of the patient, and so on. Taking into consideration online medical consulting and the satisfaction of customers, it can be clearly understood that the first cluster i.e. medical treatment parameters will depend on

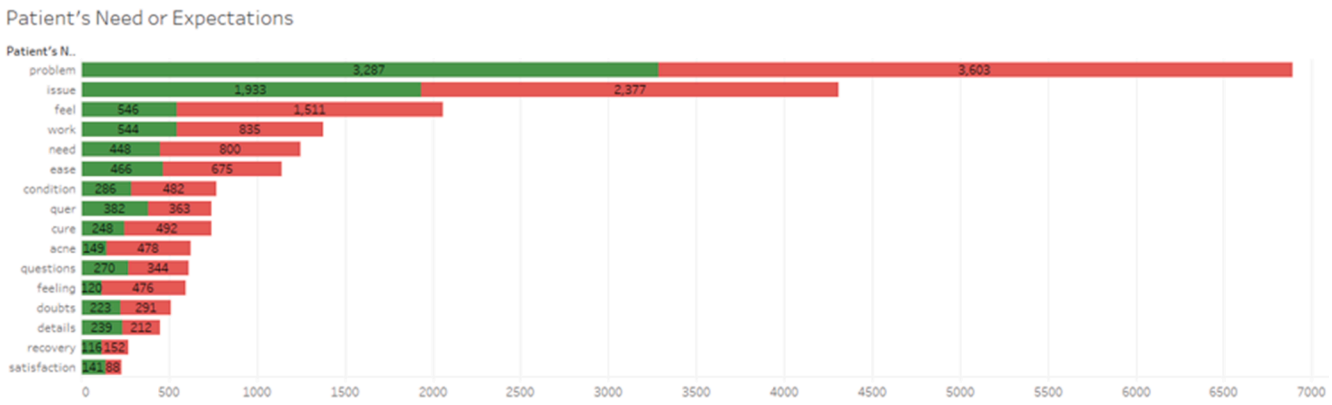

Fig. 6e. Aspects classified under Patient's Need or Expectations.

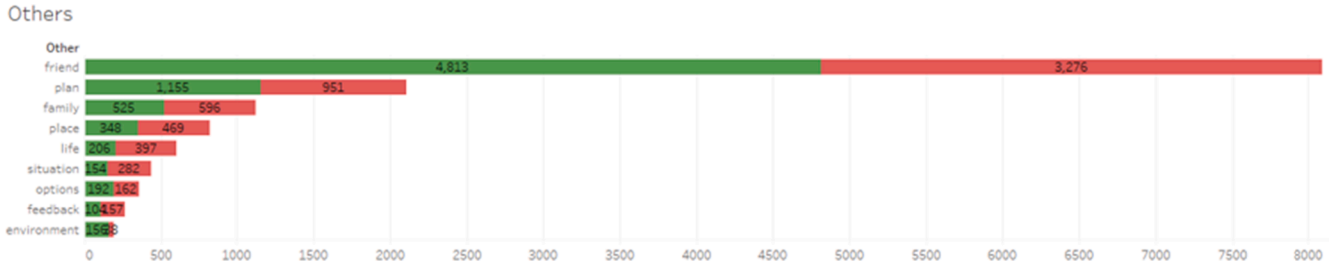

Fig. 6f. Aspects classified under Others.

the disease, while the last cluster of patient needs or expectations will keep on exploding further. Thus, restricting the online medical service providers or doctors to focus more on the remaining two clusters i.e. doctors' behavior and doctor knowledge or experience for improving the quality of the services that are provided to the customers.

In India, online doctor consultation is still not an option for many patients. They prefer physical interaction through offline mode. However, with the massive population e-consultation with doctors is the only way to deliver fast and affordable healthcare services. Computer literacy and proficiency are ways to make a patient feel comfortable. Some hospitals offer a video chat facility about their transactional process and allow patients to use online mode for consultation. These initiatives may help improve the perceived attitude towards online doctor consulting which has a positive impact on patient satisfaction (Ng & Luk, 2019; Sughra et al., 2021).

6. Conclusion and limitations of the study

Although the e-healthcare service provided by doctors is great support for patients, not adequate research has been done to classify the sentiments of patients on the doctor's online services. To address this research gap, we classify the sentiments and identified the aspects from the online reviews to explore the impact of the online e-healthcare service on patient satisfaction.

This paper shows that sentiments of the patient's feedback can be considered a reflection of patient satisfaction. Our results indicate that the quality of online doctor services and the patient's satisfaction level can be improved through a proper information systems-based response mechanism to reduce the anxiety level of the patient, at the very first interaction.

As the core expectation of a patient is to receive a quality health service, empathetic behavior plays a vital role. The doctor needs to understand the patient and give sufficient time to listen to the patient with conscientious attention. This builds patients' trust in their medical practice, will do positive word of mouth and marketing for the doctor, leading to exponential gains in long term. The doctors who are patient listeners and who respond to queries of patients' post-interaction obtain a more patient rating on satisfaction level. Further, another learning from the study is to the Medical Council of India and those involved in designing curricula for the medical fraternity to include the identified aspects in the course. Government can do benchmarking on some of the aspects so that the genuine platforms of online medical consulting flourish further taking care of the requirement of the masses.

In terms of the theoretical contribution our results encompass findings from e-services from healthcare literature and also contribute to them in the context of Indian patient behavior, where the patient may not be insured. Further, our study contributes to the information integration theory and signaling theory of online healthcare consultancy literature. Based on the information integration theory and signaling theory, our study adds to this study by investigating the positive effect of doctors' online services on patient satisfaction. Also, this paper contributes to the online healthcare consultancy literature by adding aspects that will help doctors and the medical fraternity to design an integrated solution for the patient for better overall satisfaction.

Although our study uses a sufficiently large dataset there remain some limitations. Our results are based solely on data collected from one website, and that was filtered for two metro cities which opens up the possibility that the findings are specific only to metro cities in India. Future research may include data from tier two and three cities, where currently consulting online doctors is not so prominent as of now. This will help the proper extension of our findings to larger contexts. Furthermore, due to variations in patients' age, gender, and earlier experience, the feedback is varied and so the patient satisfaction and identified aspects may be correspondingly diverse. Also, most importantly, the present study was limited to sentiment analysis of feedback or patient reviews from the online channel of medical consulting, whereas there are and will be many patients who do not provide feedback on the website. Given the way e-healthcare services are evolving with more involvement of customers and their reviews, an integrated framework may be developed with advanced analytical tools.

Table 3
Phrases from JMP Pro.

Phrase	Similar Phrases included in the Parent Phrase	Count
highly recommend	highly recommend, recommend dr, definitely recommend, highly recommended, strongly recommend, recommend this doctor, recommend the doctor, highly recommend dr, like to recommend, surely recommend, recommend this clinic	5582
root canal	root canal, canal treatment, root canal treatment, tooth extraction, tooth removal, dental problems, wisdom tooth extraction, tooth pain	3455
good experience	good experience, great experience, nice experience, experience with dr, experience with the doctor	2934
doctor is very friendly	doctor is very friendly, friendly doctor, doctor was very friendly, doctor was friendly, friendly and explained, doctor is friendly, friendly nature, lot of patience, soft spoken	2801
good doctor	good doctor, really good, experienced doctor, excellent doctor, nice doctor, great doctor, one of the best	2324
doctor explained	doctor explained, explained the problem, explained everything, explained the issue, explains the problem, explains everything, explained in detail, good explanation	2181
thank you doctor	thank you doctor, thank you so much, thanks to dr, thank u, thank you dr, thanks dr	1904
happy with the treatment	happy with the treatment, satisfied with the treatment, much satisfied	1226
visited dr	visited dr, met dr, visited the doctor, visited doctor	1180
wisdom tooth	wisdom tooth, well experienced, wisdom teeth	1022
waiting time	waiting time, long time, wait time	842
dental clinic	dental clinic, dental issues, dental treatment	839
feel comfortable	feel comfortable, much better, feeling better, experience was good	792
consulted dr	consulted dr, consulting dr	739
good treatment	good treatment, good results, take care	724
first time	first time, first visit	718
health issues	health issues, health issue	640
hair fall	hair fall	468
family and friends	family and friends, friends and family	386
hair loss	hair loss, hair transplant	330
root cause	root cause	326
x ray	x ray	290
taking treatment	taking treatment	256
treatment done	treatment done	247
thanks a lot	thanks a lot	238
related issues	related issues	235
really happy	really happy	220
made me feel	made me feel	212
overall experience	overall experience	209
understand the problem	understand the problem	194
time to explain	time to explain	188
severe pain	severe pain	188
skin problem	skin problem	183
well maintained	well maintained	166
back pain	back pain	161
laser treatment	laser treatment	161
good care	good care	159
good service	good service	159
best part	best part	152

CRediT authorship contribution statement

Nikhil Dhakate: Conceptualization, Writing – original draft and editing, Resources, Formal analysis, Software, Validation and Methodology. **Rohit Joshi:** Data Curation, Reviewing, Visualization, Methodology, Investigation, Supervision.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

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