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Listening to Internal Voices: Unveiling Healthcare Employee Satisfaction Through Big Data Analysis of Online Feedback

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Abstract

Purpose: Healthcare online feedback is widely used to improve service quality. This study aims to explore the determinants and evolving dynamics of healthcare employee satisfaction as reflected in employee-generated content.

Design/methodology/approach: This study analyzes structured (numerical ratings) and unstructured (textual feedback) data from over 300,000 online employee reviews of 9,103 U.S. healthcare organizations. Using topic modeling, it identifies key satisfaction and dissatisfaction factors and examines their variations across job roles and tenure lengths, with a particular focus on the impact of the COVID-19 pandemic.

Findings: Our analysis reveals that job satisfaction determinants vary by role and tenure. During the initial phase of the COVID-19 pandemic, satisfaction temporarily increased due to a heightened sense of purpose and strong peer relationships. However, as the crisis persisted, satisfaction declined due to mounting stress, staff shortages, irregular shifts, and inadequate compensation.

Practical implications: These findings can guide healthcare organizations in developing targeted management strategies to enhance employee satisfaction and retention.

Originality/value: This study offers a novel perspective on healthcare online feedback by analyzing large-scale employee reviews from the service provider's standpoint, providing valuable insights into workplace experiences. Additionally, it contributes to employee satisfaction research by examining its dynamic changes across different phases and role-specific variations.

Keywords: Employee Satisfaction; Online Reviews; Covid-19; Big Data; Topic Modelling

1. Introduction

Online feedback from digital platforms and social media has gained increasing recognition as a tool for healthcare improvement. Such feedback is valued for its potential to enhance the transparency and accountability within healthcare systems (Mazanderani *et al.*, 2021). Recent studies (Dhakate and Joshi, 2023; Wang *et al.*, 2024; Zaman *et al.*, 2021) have leveraged patients' online reviews to assess their experience and offer insights for improving service quality. While patient feedback provides valuable perspectives, less attention has been given to internal feedback from healthcare employees, who are directly involved in service delivery. Understanding employees' viewpoints can help identify their needs and enhance job satisfaction, ultimately enhance healthcare outcomes.

Employee dissatisfaction and its impacts (e.g., burnout, stress) lead to higher turnover rates, absenteeism, and mental health problems among healthcare professionals (Cooper *et al.*, 2018). This can put extra pressure on healthcare systems due also to shortage of qualified professionals that makes any staff replacement particularly hard (Kroezen *et al.*, 2015). A consequence is also a negative impact on the quality of care provided to patients (Kang *et al.*, 2019). Therefore, understanding the factors that influence healthcare professionals' satisfaction/dissatisfaction is important.

Measuring healthcare employees' satisfaction is challenging, as it fluctuates with resource constraints and external shocks like the COVID-19 pandemic (Baskin and Bartlett, 2021). Traditional methods, such as surveys, often fail to capture these real-time changes (Stamolampros *et al.*, 2019). In contrast, online feedback from healthcare employees provides a valuable means of identifying the factors that drive satisfaction and dissatisfaction, offering insights into employees' evolving needs. Despite its potential, research on how employee satisfaction changes over time remains limited. Job roles and responsibilities also vary across positions and evolve with tenure, leading to shifts in employee heterogeneity (Li *et al.*, 2024). However, these variations have received little attention in existing studies. Addressing these gaps is crucial for developing targeted strategies to enhance employee satisfaction and retention.

The objective of this study is to understand the determinants and dynamics of healthcare employee satisfaction as revealed by employee user generated content. To achieve this, we analyse the structured and unstructured forms of online feedback shared from over 300,000 employees for 9,103 healthcare organizations in the U.S. Specifically, we explore the following research questions:

RQ1: What key factors influence employee satisfaction and dissatisfaction in the healthcare sector?

RQ2: How have these factors evolved during the COVID-19 pandemic?

RQ3: How do these factors vary across different job roles and organizational tenure?

The contributions of this study are as follows. First, it expands existing healthcare research by exploring online feedback from an internal stakeholder perspective, contrasting with previous studies that primarily focused on external patient feedback. This approach provides longitudinal insights into employee experiences, particularly during pressures such as COVID-19 pandemic. Second, it advances traditional employee satisfaction research (Aiken *et al.*, 2002; Lu *et al.*, 2019) by using real-time online reviews to capture dynamic and immediate insights into healthcare workers' well-being, overcoming the limitations of traditional survey and interview methods. Unlike cross-sectional data, which fails to track changes over time (Stamolampros *et al.*, 2019), this method captures the complexity and evolving nature of healthcare work environments.

2. Literature Review

2.1 Employee satisfaction in healthcare

Employee satisfaction encompasses individuals' attitudes and beliefs toward their workplace (Saari and Judge, 2004). Low employee satisfaction in healthcare organizations is important as it may result in high turnover rates that can strain organizational resources and, at the same time, compromise the quality of provided patient care (Bae *et al.*, 2010). Among other negative consequences, the departure of

healthcare professionals will result in an increased workload for the remaining staff, which may further fuel dissatisfaction and create a new cycle of turnover (Aiken *et al.*, 2002).

Drawing on Herzberg's Two-Factor Theory (1959), employee satisfaction is the outcome of both intrinsic and extrinsic factors (Herzberg *et al.*, 1959). In the healthcare context, employees frequently cite low wages, limited benefits, and high work intensity as sources of dissatisfaction (Castle *et al.*, 2007), whereas opportunities for professional growth and recognition are key drivers of satisfaction (Morgan *et al.*, 2013). Work-life balance is another critical aspect for healthcare professionals (Kelly *et al.*, 2020). Because of the long working hours and shifts, healthcare employees find it challenging to balance their work obligations and their personal lives. Effective workload management and flexible scheduling are tools that organizations sometimes use to improve employee satisfaction and reduce employee turnover intentions (Groenewegen and Hutten, 1991; McNall *et al.*, 2009).

Leadership and organizational culture can also influence, to some extent, the employee satisfaction of healthcare professionals. Good leadership increases employee engagement and reduces turnover, while poor leadership results in dissatisfaction and burnout (Labrague *et al.*, 2018). Healthcare organizations that prioritize employee well-being are environments where employees feel valued (Goldman and Tabak, 2010). Such organizations achieve reduced turnover and increased patient outcomes (Chang *et al.*, 2009). Transformational leadership can motivate individuals and align their values with the organizational goals affecting employee engagement, motivation and satisfaction (Lu *et al.*, 2019). On the other hand, the more focused on task management transactional leadership may result in lower satisfaction.

Beyond organizational and individual factors, satisfaction is also influenced by broader environmental events. The COVID-19 pandemic, as an unprecedented external shock, significantly altered the work conditions of healthcare professionals (Baskin and Bartlett, 2021). During COVID-19, healthcare professionals faced with several new job stressors. For example, the increased workload due to the increased demands for health services led to many cases of emotional exhaustion. Workplace safety also played a

crucial role in satisfaction due to personal protective equipment (PPE) shortages and inadequate safety protocols. To better understand how such large-scale disruptions shape employee satisfaction, this study draws on event system theory (Morgeson *et al.*, 2015), which conceptualizes events as discrete, discontinuous occurrences characterized by novelty, disruptiveness, and criticality. Events with greater intensity along these dimensions exert stronger and more lasting effects on employees' attitudes and behaviors. Within this framework, COVID-19 is viewed as a high-intensity organizational event, profoundly reshaping work routines, risk perceptions, and employee expectations in the healthcare industry.

Although employee satisfaction in healthcare has been widely studied, most research relies on traditional surveys and interviews, overlooking the rich insights available in employees' online shared experiences. Additionally, while some studies compare satisfaction levels before and during COVID-19 (Barili *et al.*, 2024; Baskin and Bartlett, 2021), few have examined long-term trends that include the post-pandemic recovery phase. It remains unclear whether the factors influencing employee satisfaction during the crisis have fundamentally shifted or reverted to pre-pandemic patterns. In this study, COVID-19 is treated not merely as a temporal event but as a representative large-scale public health disruption that provides broader insights into how healthcare employees respond to and recover from major external shocks. To address these gaps, this study analyzes large-scale online feedback to capture dynamic changes in satisfaction over time, incorporating both structured and unstructured data. Furthermore, it examines variations across job roles and tenure lengths, providing a more nuanced understanding of employee heterogeneity.

2.2 Online review in healthcare

Similar to how consumers share feedback on products and services through online reviews, an increasing number of individuals now use digital platforms to evaluate and share their healthcare experiences (Mazanderani *et al.*, 2021). In the healthcare sector, online reviews serve as a valuable source of information, enabling patients to make informed decisions, exercise choice, and exert greater control over their care (Shah *et*

al., 2021). Moreover, such feedback fosters greater transparency and accountability within healthcare systems while contributing to service improvement in a cost-effective manner. Recognizing these benefits, academic research on healthcare-related online reviews has grown in recent years, exploring their role in patient decision-making, healthcare provider reputation, and quality assessment.

Research on online reviews in healthcare has primarily developed along two main streams. The first stream focuses on understanding the factors influencing patient satisfaction. One approach within this stream treats structured ratings as proxies for patient satisfaction and employs regression analysis to identify key determinants, such as recommendations (Wang *et al.*, 2024), operational efficiency (Ko *et al.*, 2019), and online physician service delivery (Yang *et al.*, 2015). Another approach utilizes text-mining techniques to analyze unstructured patient reviews, extracting factors contributing to satisfaction and dissatisfaction (Shah *et al.*, 2021), conducting sentiment analysis (Zhao *et al.*, 2023), and identifying key attributes of service quality (Zaman *et al.*, 2021). The second stream examines various characteristics of online healthcare reviews, including biases in physician ratings (Kordzadeh, 2019) and the perceived helpfulness of patient reviews (Feng *et al.*, 2022). These research streams highlight the growing interest in leveraging online feedback to enhance healthcare services.

Although online reviews in healthcare have been extensively studied, existing research primarily focuses on the perspectives of service recipients—external stakeholders such as patients. However, limited attention has been given to the perspectives of service providers, particularly healthcare employees, whose satisfaction is a critical determinant of service quality. This gap is especially relevant in the context of the COVID-19 pandemic, which has placed unprecedented strain on healthcare systems, underscoring the need to assess the well-being and concerns of medical staff (Baskin and Bartlett, 2021). While employee online reviews have been recognized as valuable sources of insight in other industries (e.g., Stamolampros *et al.*, 2019; Wu *et al.*, 2024), they remain underexplored in healthcare research. Addressing this gap, the present study analyzes both structured (numerical) and unstructured (textual) data from

employee online reviews, providing a comprehensive understanding of healthcare employees' experiences.

3. Methodology

3.1 Data Collection

We developed a web crawler in Python to retrieve employee online reviews from US healthcare workers on the Glassdoor platform. The study focused on the "Health Care Services & Hospitals" sector, as classified by Glassdoor. This sector includes hospitals, clinics, nursing homes, and in-home care services. The final sample comprised of 9,595 U.S.-based organizations and a total of 1,124,971 employee reviews. Each review contains numerical ratings (e.g., overall rating, CEO approval) and unstructured textual positive feedback (Pros) and negative feedback (Cons). The dataset also has reviewer details, such as years of experience, job title, employment status, and work location.

The study focuses on healthcare workers providing direct services, such as doctors, nurses, midwives, personal care assistants, and allied healthcare professionals (e.g., psychologists, radiologists). As a result, reviews from non-healthcare roles (e.g., customer service, software engineers) were excluded. To identify relevant reviews, job titles were tokenized and sorted by frequency. A manual screening process identified 308 healthcare-related keywords (e.g., Nurse, Medical, Therapist) appearing at least 10 times. This resulted in a dataset of 492,684 reviews from 9,365 companies between May 2008 and October 2023. Data from former employees were also excluded due to challenges in assessing the specific timing of their employment and how their job attributes changed, particularly regarding COVID-19. The final dataset includes 307,193 reviews from 9,103 companies and a description of the dataset is found in Table 1.

To illustrate how employee online reviews effectively capture the impact of COVID-19 on healthcare workers, we compared the proportion of COVID-19-related reviews with the number of new cases over time. COVID-19-related reviews were

identified by checking for keywords directly associated with COVID-19[1], while new case data were sourced from the Centers for Disease Control and Prevention (CDC) reports. As shown in Figure 1, the trend of COVID-19-related reviews goes together with the number of new cases. Notably, in January 2022, reported cases in the U.S. peaked, after which the frequency of reviews mentioning COVID-19 has shown a declining trend. In May 2023, the CDC ceased publishing the latest case counts[2], and the frequency of reviews mentioning COVID-19 plateaued.

3.2 Topic modeling

This study uses Structural Topic Modeling (STM) (Roberts *et al.*, 2016) to identify job attributes. STM builds on the traditional Latent Dirichlet Allocation (LDA) model by integrating covariates into the topic estimation process, offering a more context-sensitive analysis (Saeed *et al.*, 2024). Unlike LDA, which assumes consistent topic and word frequency across all documents, STM allows for correlations between topic distributions and adjusts covariates' influence on both word prevalence and topic distribution within individual reviews. This is useful since reviews may vary by job characteristics (e.g., position, years of experience).

The STM analysis in this study consists of three main steps: (a) text preprocessing, (b) determining the optimal number of topics, and (c) topic interpretation and labeling. These steps are described in detail below:

Step 1: Text Preprocessing

We followed standard preprocessing steps used in text analysis (e.g. Singha et al., 2023). First, we removed punctuation and numbers. Next, we removed stop words (such as "the", "an", etc.,) along with a few custom stop words (e.g., "company"). Additionally, we applied named entity recognition (NER) to trace and exclude non-informative entities such as company names and locations. Then we used part-of-speech (POS) tagging to kee p only the most informative word types (nouns, verbs, and adjectives). After preprocessing, all words were lemmatized to their base forms (e.g.,

[1] Terms used were covid-19, covid, pandemic, epidemic, virus, coronavirus, sars-cov-2, outbreak, social distancing, lockdown, herd immunity

[2] https://www.cdc.gov/mmwr/volumes/72/wr/mm7219e1.htm

"learning" was converted to "learn"). Finally, to further reduce noise, we kept only words that appeared in more than ten reviews. The final vocabularies consisted of 3,983 terms for the Pros corpus and 5,726 terms for the Cons corpus.

Step 2: Determining the Optimal Number of Topics

In this study, we consider features related to both the review text and employee characteristics as covariates. To estimate the model, we fit the data using the following general model:

$$Prevalence_{ij} \sim \beta_0 + \beta_1 Rating_i + \beta_2 Tenure_i + \beta_3 Categoy_i + \beta_4 Time_i + \varepsilon_i \quad (1)$$

Where $Prevalence_{ij}$ is the prevalence of topic j in review i, $Rating_i$ is the overall rating of the review, $Tenure_i$ is the employee's working year, $Categoy_i$ is a categorical variable indicating job title category, and $Time_i$ is the specific time of the review, with May 2008 as the starting point, measured as the number of months since then. ε_i represents the standard error.

Although STM is an unsupervised machine learning method, we still need to specify the number of topics. Currently, there is no standard answer for determining the "appropriate" number of topics (Schmiedel *et al.*, 2019). Generally, three criteria can be used to evaluate the performance of topic models (Roberts *et al.*, 2014; Symitsi *et al.*, 2021): (1) held-out likelihood, which measures how well the candidate topic numbers explain the overall variability in the review corpus; (2) semantic coherence, which assesses the co-occurrence frequency of prominent words within topics; (3) exclusivity, which evaluates the frequency of topic vocabulary used in other topics. We used the *stm* package in R to estimate several models ranging from 6 to 20 topics. The results (Figure A) indicate that the model with 14 topics performs best in both the pros and cons corpora, as it achieves the highest held-out likelihood relative to its semantic coherence and exclusivity.

Step 3: Topic Interpretation and Labeling

After creating the topics, we need to understand and interpret them. This is done by analyzing the words that appear in the topics and reading indicative reviews. To identify the core words for each topic, we have employed the Frequency-Exclusivity (FREX) measure. FREX is a weighted harmonic mean that estimates rankings based on

the exclusivity and semantic coherence of the words. Specifically, the FREX calculation for word v in topic k is as follows:

$$FREX_{k,v} = \left(\frac{\omega}{ECDF\left(\beta_{k,v}/\sum_{j=1}^{k}\beta_{j,v}\right)} + \frac{1-\omega}{ECDF(\beta_{k,v})}\right)^{-1} \quad (2)$$

where ω represents the exclusivity weight, typically set to 0.7 to favor exclusivity, and β denotes the topic-word distribution. ECDF refers to the empirical cumulative distribution function.

Topic labels were assigned following established procedures in prior STM-based research (e.g., Schmiedel *et al.*, 2019; Tonidandel *et al.*, 2022). We first identified the most representative words for each topic using the FREX metric and examined representative reviews with the highest topic loadings to interpret the underlying meaning. Subsequently, two human resource experts independently reviewed the representative words and documents for each topic and discussed their interpretations until consensus was reached on the final labels. For each topic, we estimated the expected proportion by averaging the loadings of each review in the topic solution across all reviews in the final corpus. Figure 2 presents the data analytics procedure. Tables 2 and 3 present the estimated topic solutions, the words with the highest FREX scores, and their corresponding labels and proportions.

4. Results

4.1 Topic Solution

Employee review platforms (e.g. Glassdoor, Indeed) use predefined rating scales to measure overall satisfaction and satisfaction with aspects such as work-life balance, and compensation. While predefined scales are important, they can miss new or unexpected factors that also shape employee experiences. Textual analysis methods like topic modeling let themes arise naturally from the text. This approach can reveal thematic topics employees feel are important but not covered by standard scales. This is particular important in unprecedented conditions like the recent pandemic. For example, topic modeling might capture concerns of the employees during the pandemic about PPE shortages.

Tables 2 and 3 present the topic solutions for the positive and negative feedback. The extracted topics largely align with the key determinants of employee satisfaction identified in prior research (e.g., Castle *et al.*, 2007; Hood and Patton, 2022; Morgan *et al.*, 2013), while also uncovering several additional, less-examined aspects, including rest period disruptions, equipment and resource availability, hiring process and unrealistic performance expectations. These findings provide valuable insights into the factors that drive employee satisfaction and dissatisfaction in healthcare organizations. The results in Table 2 show that the **work environment** (12.67%) and the **co-worker relations** (9.37%) are the most frequently discussed topics in positive feedback. This is followed by **company culture** (9.24%), **benefits and perks** (7.68%) and **job security and job role** (7.55%). Finally, **skill development** (6.65%) and **work support** (7.08%) are prominent.

Table 3 shows the most common sources of dissatisfaction, with **pay and salary** (10.16%) leading the list. This is followed by **career development** (9.88%) and **company culture** (9.23%). Other concerns include **staff shortages and long shifts** (8.93%), **management trust** (7.69%), and **rest period disruptions** (7.64%). Additionally, **organizational communication** (5.84%) highlights how poor communication from leadership adds to employee frustrations.

4.2 Determinants of employee satisfaction and dissatisfaction

To further understand the determinants of employee satisfaction and dissatisfaction, we examined how topic prevalence varies with employees' overall satisfaction ratings. Using the STM framework, we estimated the marginal effects of satisfaction on topic prevalence. This method models the expected proportion of each topic as a function of the overall rating, allowing us to explore how the prominence of specific topics systematically changes across different satisfaction levels.

Figure 3 displays the marginal effects of overall ratings on the topics discussed. The longer the distance of a topic from the dotted zero-effect line, the more pronounced the change in the proportion of that topic within the overall corpus, with 95% confidence intervals shown. The upper section of Figure 3 shows that as overall ratings

increase, positive topics such as **work environment, co-worker relations, company culture, and work support** become more prevalent. That means that employees who give higher ratings highlight in their textual feedback organization that are characterized by a supportive work environment, strong relationships with colleagues, and a positive organizational culture. In other words, these are the factors that lead to high satisfaction when present. The lower section of Figure 3 highlights the negative topics. **Company culture** and **management trust** along with the **high turnover and safety concerns** are the topics that are found on the left of the relevant graph. This means that when these topics are more prevalent in negative feedback, they have a more pronounced negative effect on overall satisfaction.

4.3 Impact of the COVID-19 pandemic

4.3.1 Rating comparison in pre-pandemic, early pandemic, and late pandemic periods

To better understand the impact of COVID-19 on healthcare workers, we categorize the pandemic period into three phases: Pre-COVID-19 (January 2018–February 2020), Early-COVID-19 (March 2020–January 2022), and Late-COVID-19 (February 2022–2023). March 2020 is considered the start of the pandemic, as case numbers began to rise sharply that month and terms such as “COVID-19,” “COVID,” and “pandemic” first appeared in employee reviews. As shown in Figure 1, the frequency of these terms peaked in January 2022 and then gradually declined, mirroring the broader external case trends and marking the shift toward a new normal. Because the pre-pandemic period (2008–2020) spans over a decade, we focused on the most recent pre-pandemic years (2018–2020) to ensure temporal balance and comparability with the pandemic and post-pandemic phases, following prior studies that adopted a similar approach (Chen *et al.*, 2025).

The analysis looks at employee ratings during the different stages of the pandemic covering the years from 2018 to 2023. As shown in Table 4 and Figure 4, a clear trend stands out: healthcare worker satisfaction increased at the start of the pandemic but dropped sharply after May 2020. In the early days of the pandemic, satisfaction

increased. This can be explained because healthcare workers were seen as essential frontline workers. This public and government recognition and appreciation have increased employee morale by giving workers a sense of pride and purpose. Also, healthcare jobs offered more job security compared to other industries that were laying people off. The crisis also brought healthcare workers closer together, strengthening the sense of camaraderie. However, after May 2020, satisfaction started to drop. The initial boost in morale faded as healthcare workers faced the reality of working in high-pressure situations for an extended period.

Reviews that mention COVID-19, as shown in Table 4, tend to have much lower ratings across all categories. The results in Section 4.1 emphasize the dual impact of COVID-19 on healthcare employees. While some positive aspects, such as teamwork, were enhanced, the pandemic also exacerbated frustrations related to pay, workload, management communication, and career development. These findings suggest that while healthcare workers came together during the crisis, the pandemic amplified existing challenges in the sector.

4.3.2 Topic comparison in pre-pandemic, early pandemic, and late pandemic periods

Section 4.3.2 offers an in-depth analysis of how the COVID-19 pandemic influenced the distribution of both positive and negative feedback topics in healthcare employee reviews. The findings highlight that the pandemic reshaped the priorities and concerns of healthcare workers during that period.

Looking at the data in Table 5, it is clear that topics about the **work environment** and **co-worker relations** became more common during both the early and later stages of the pandemic. Even with the added stress and heavier workloads, healthcare workers seem to really appreciate the support they get from their coworkers. This highlights how important teamwork and mutual support are during tough periods. Interestingly, however, there was a slight decline in employees' views of the **company culture** during the pandemic, indicating some dissatisfaction with how the organization responded to the crisis.

In terms of tangible support, topics like **benefits and perks** saw a significant

increase in positive feedback. This can be explained of the introduction of hazard pay and additional incentives provided to healthcare workers. Conversely, areas like **job security and job role** and **equipment and resources** experienced declines, reflecting the uncertainties and resource shortages that characterized much of the pandemic response. Work support also saw a drop, suggesting gaps in organizational backing.

Table 6 demonstrates a significant increase in negative feedback related to **pay and salary**, **staff shortage and shifts**, **turnover and safety concerns**, and **organizational communication** during the pandemic. These findings highlight the pressure healthcare workers faced during the pandemic, as they had to contend with long hours, heavy patient loads, and poor communication from management.

The sharp increase in dissatisfaction with pay and workload is particularly striking, suggesting that while some employees appreciated hazard pay or bonuses, as shown in the positive text, many felt that these efforts did not adequately reflect the risk and effort required during the crisis.

Another major area of concern was **staff shortages and shifts**, which saw a sharp increase from 7.4% pre-COVID-19 to 9.8% during the early pandemic and further to 10.4% in discussions explicitly mentioning COVID-19. These issues highlight the challenges caused by increased demand for healthcare services in the healthcare systems, which left employees feeling overburdened and unsupported. The increase in dissatisfaction with **organizational communication** indicates again a problem with clear and effective communication during the critical periods. Employees likely felt frustrated by inadequate guidance regarding safety protocols, resource allocation, and shifting responsibilities during the pandemic.

4.4 Topic variations by job title

Section 4.4 examines the variations in positive and negative feedback topics based on the job roles. This allows to reveal how specific job functions shape employee satisfaction and dissatisfaction. The results, presented in Tables 7 and 8, provides a more nuanced understanding of the distinct challenges and positive experiences faced by different categories of healthcare workers, particularly during the pre-COVID-19,

early-COVID-19, and late-COVID-19 periods.

Across all job categories—Allied Health Professionals, Direct Patient Care Providers, Healthcare Administration and Support, and Healthcare Technicians—the **work environment** and **co-worker relations** consistently are the most discussed topics in the positive feedback, regardless of the period. This suggests that a supportive and collaborative work atmosphere is universally valued in healthcare organizations.

However, there are notable variations in the emphasis placed on different topics by job role. **Allied Health Professionals** (e.g., radiologists, therapists) consistently rated **work support** (P7) highly, both before and during COVID-19. Their roles often require collaboration with multiple clinical teams and depend heavily on adequate technical and administrative support, which directly influences their perceived satisfaction. **Direct Patient Care Providers** (e.g., nurses, doctors) placed a higher emphasis on **work environment** (P1) across all periods, particularly during the pandemic, reflecting their close patient contact, exposure to infection risks, and reliance on safe and well-managed clinical setting. **Healthcare Administration and Support** staff strongly emphasized **company culture** (P3), particularly during the pre-pandemic, as their satisfaction tends to be shaped by management practices, communication transparency, and perceived organizational fairness. **Healthcare Technicians** (e.g., lab technicians, equipment operators) placed greater weight on **job security and job role** (P5) in their positive feedback, consistent with their relatively routine and skill-based positions, where stability and clear task definitions are key determinants of satisfaction.

The negative feedback topics also varied significantly by job role, reflecting different sources of dissatisfaction. **Allied Health Professionals** consistently reported high dissatisfaction with **career development** (N2), which remained the top negative topic across all periods. This may be due to limited advancement opportunities and professional recognition compared to physicians or administrative leaders. **Direct Patient Care Providers** expressed increasing dissatisfaction with **pay and salary** (N1) during the pandemic, with this topic becoming the most significant source of negative feedback in both early and late COVID-19 periods. **Healthcare Administration and Support** staff reported increased dissatisfaction with **work/life balance** (N5), likely

due to heightened coordination demands and administrative burdens during crisis response. **Healthcare Technicians** were particularly dissatisfied with **rest period disruptions** (N7) throughout the periods, reflecting the demanding and often unpredictable nature of shift-based technical work.

4.5 Topic variations by organizational tenure

Section 4.5 analyses how healthcare employee satisfaction and dissatisfaction vary based on organizational tenure. To achieve this, we categorize employees into short-tenure (less than one year), mid-tenure (one to five years), and long-tenure (more than five years). The results from Tables 9 and 10 highlight employees' different priorities and concerns as they spend more time within their healthcare organizations. The results also indicate that employees with different tenures exhibit relatively consistent changes in job attributes across different stages of the COVID-19 pandemic. For convenience, the numbers reported in the following discussion refer to the early covid-19 stage but the differences are reflected in all periods as seen from the relevant tables.

Across all tenure groups, the **work environment** consistently ranks as the top positive topic, with higher emphasis from short-tenure employees. Short-tenure employees (0.133) rate their work environment slightly higher than mid-tenure (0.127) and long-tenure (0.123) employees, which suggests that newcomers tend to view their workplace more positively. Over time, however, as employees gain more experience, and exposure to the demanding and high-pressure nature of healthcare work, they may become more critical of their work environment.

Similar to the work environment, employees with shorter tenures (0.102) tend to place more value on positive **co-worker relations** than those with mid- (0.092) or long tenures (0.081). This highlights the importance of early-stage social integration in healthcare settings, where effective teamwork and peer support are crucial for coping with intense workloads and emotionally demanding situations. As employees settle into their positions and gain autonomy, their reliance on peer support may naturally diminish.

Long-tenure employees (0.095) emphasize **benefits and perks** more than their short-tenure (0.073) and mid-tenure (0.084) counterparts. In healthcare organizations,

financial and non-financial benefits provided by the organization become more important to employees over time, likely as they take on greater responsibilities or reach life stages where benefits (e.g., retirement plans, healthcare packages) have a more substantial impact on their personal lives.

Employees with shorter tenures tend to focus more on **skill development** and **job tasks** compared to those with longer tenures. This suggests that newcomers are more engaged with their clinical or administrative responsibilities and are eager to build competence in their roles. As employees stay longer in the organization, they may perceive fewer opportunities for growth or role expansion, which could explain why these areas become less important over time.

Regarding negative feedback (Table 10), dissatisfaction with **career development** is also more pronounced among long-tenure employees (0.107) compared to short-tenure (0.096) and mid-tenure employees (0.099). This suggests that employees who have served in the same healthcare organization for extended periods might feel that promotion opportunities are limited within hierarchical structures, leading to frustration and reduced motivation.

Interestingly, dissatisfaction **with staff shortages and shifts** is higher among short-tenure employees (0.098) and decreases with tenure (0.092 for mid-tenure, 0.084 for long-tenure). This indicates that newcomers are more frustrated with irregular schedules and heavy workloads, possibly due to the adjustment difficulties and physical strain typical in healthcare occupations.

Dissatisfaction with **work-life balance** follows a similar trend, being more pronounced among short-tenure employees (0.092) and decreasing among mid- (0.085) and long-tenure employees (0.082). New employees may struggle more with the demanding nature of healthcare work, particularly balancing their professional and personal lives. Over time, more experienced employees may have found ways to manage these challenges more effectively.

5. Discussion

This study offers new insights into healthcare employee satisfaction by using

employee online reviews, a dynamic and overlooked data source for understanding employees' perceptions and experiences in the healthcare setting. Through the integration of large-scale textual and structured data, our analysis identifies both enduring and evolving determinants of employee satisfaction within the healthcare industry. Guided by Herzberg's two-factor theory and event system theory, the findings contribute to a deeper understanding of not only what drives healthcare employees' satisfaction and dissatisfaction but also how these drivers evolve under external disruptions such as the COVID-19 pandemic.

First, this study finds that a supportive work environment and strong peer relationships are crucial for healthcare workers, especially during high-stress periods. This finding is consistent with existing literature emphasizing the significance of interpersonal relationships and a strong organizational culture in managing the emotional demands of healthcare work (Hood and Patton, 2022; Morgan *et al.*, 2013). The prominence of peer support in online reviews suggests that coworker relations may be more critical for mitigating burnout than previously recognized. This supports Herzberg's (1959) two-factor theory, which underscores that intrinsic motivators like recognition and teamwork are vital for employee satisfaction.

Second, our findings demonstrate that the heightened emphasis on work environment and peer support during COVID-19 further underscores the role of relational factors as buffers against stress. This aligns with event system theory, which posits that the influence of external events is dynamic rather than static, evolving in response to the intensity and trajectory of the event over time (Kiefer et al., 2024; Lin et al., 2021). The study also reveals increased dissatisfaction with workload and limited career development opportunities, reinforcing prior research on the demanding nature of healthcare work (Richardsen and Burke, 1991). Literature suggests that heavy workloads and inadequate career progression contribute to burnout and turnover (Castle *et al.*, 2007), as evidenced by negative feedback during the pandemic. Moreover, the study highlights growing dissatisfaction with leadership communication during the crisis, consistent with research emphasizing the critical role of clear and transparent leadership in maintaining employee trust and morale (Lin et al., 2011; Nielsen et al.,

2009). The spike in negative feedback about management communication highlights the need for adaptable leadership strategies, extending existing leadership theories to emphasize transparency and responsiveness during emergencies. Beyond these well-established factors, the analysis also points to several operational aspects of employee experience, such as equipment and resource availability, unrealistic performance expectations, and lack of performance feedback. These issues are often subsumed under broader constructs like workload or leadership in prior survey-based research but emerge as distinct dimensions of employee experience in employees' narratives.

Third, the study reveals both shared and role-specific patterns of satisfaction and dissatisfaction, underscoring the contextualized nature of healthcare work. Across all job categories, a supportive work environment and strong peer relationships were consistently emphasized in positive feedback, reinforcing prior research on their critical role in job satisfaction (Gross *et al.*, 2021). At the same time, differences emerged in role-specific concerns. For example, Allied Health Professionals valued work support, while Direct Patient Care Providers prioritized the work environment, particularly during COVID-19. Dissatisfaction drivers also varied: Allied Health Professionals cited career development, Direct Patient Care Providers increasingly criticized pay during the pandemic, Healthcare Administration staff struggled with work-life balance, and Healthcare Technicians faced rest period disruptions. These differences illustrate how event intensity and relevance varied by role, aligning with Event System Theory's emphasis on how the strength of an event's impact depends on its proximity and significance to individuals' job functions (Morgeson *et al.*, 2015).

Finally, the findings reveal tenure-based variations in healthcare employee satisfaction and dissatisfaction, offering new insights into how workplace experiences evolve over time (Chen *et al.*, 2011). Employees across all tenures show consistent shifts in job attributes during different COVID-19 stages. Short-tenure employees report higher satisfaction with their work environment and peer relationships, reflecting the importance of social integration and support (Laschinger *et al.*, 2013). Over time, however, long-tenure employees placed more emphasis on extrinsic hygiene factors such as pay and benefits, while expressing growing dissatisfaction with limited

advancement opportunities. This progression reinforces Herzberg's two-factor distinction between motivators that initially attract employees and hygiene factors that sustain long-term retention. Furthermore, applying event system theory helps explain why pandemic-induced disruptions affected tenure groups differently, showing that new employees struggled more with workload and adaptation while experienced employees faced stagnation in growth opportunities amid organizational instability.

6. Implications and conclusions

6.1 Theoretical contributions

This study's findings contribute to the existing literature in three aspects. First, this study contributes to the healthcare online feedback literature by uncovering the value of content generated by healthcare employees. While prior research (e.g., Dhakate and Joshi, 2023; Wang *et al.*, 2024; Zaman *et al.*, 2021) has primarily focused on external patient feedback as a means to improve healthcare service quality, limited attention has been given to the perspectives of internal service providers. By extracting key determinants of both satisfaction and dissatisfaction from employee online reviews, this study provides nuanced insights into the factors shaping healthcare workers' experiences. These findings offer a complementary perspective to patient evaluations, emphasizing the importance of addressing employees' concerns to ultimately enhance organizational performance and service quality.

Second, this study contributes to the literature on healthcare employee satisfaction (Lu *et al.*, 2019; Morgan *et al.*, 2013) by providing a dynamic and holistic perspective. Prior research has seldom explored the evolution of employee satisfaction in response to external shocks over time. While some studies have compared satisfaction levels before and during COVID-19 (Barili *et al.*, 2024; Baskin and Bartlett, 2021), they primarily focus on specific job attributes or single occupational groups. Moreover, few studies have explored long-term trends that extend into the post-pandemic recovery phase. By analyzing changes in satisfaction across three distinct COVID-19 periods, this study provides a comprehensive view of how key determinants of employee

satisfaction have either undergone lasting transformations or returned to pre-pandemic patterns. These insights enhance the existing body of knowledge by providing a deeper understanding of the evolving nature of employee experiences in healthcare settings under external disruptions.

Finally, this study contributes to the employee satisfaction literature (Chang *et al.*, 2009; Saari and Judge, 2004) from a methodological perspective by employing text-mining techniques to analyze large-scale online feedback, integrating both structured and unstructured data. In contrast to traditional self-reported survey methods commonly used in prior research, this approach enables longitudinal monitoring of satisfaction trends and uncovers variations across different job roles and organizational tenure. To this extent, the study introduces a novel methodological perspective for studying employee satisfaction, offering a scalable and data-driven alternative to conventional approaches.

6.2 Managerial implications

This study provides actionable insights for healthcare human resource managers, emphasizing the value of employee online reviews as a real-time and complementary workforce analytics tool. When coupled with text-mining techniques, these reviews enable organizations to detect emerging concerns and track shifts in employee sentiment across time. Managers should therefore establish continuous monitoring mechanisms on platforms such as Glassdoor to identify satisfaction drivers and early warning signals of dissatisfaction.

The results reveal that work environment, peer relationships, and organizational culture are the strongest positive contributors to satisfaction, while dissatisfaction primarily arises from inadequate compensation, limited career development, and workload intensity. To address these issues, healthcare organizations should adopt targeted, evidence-based interventions that directly respond to employees' concerns. For example, when dissatisfaction is linked to staffing shortages or scheduling pressures, introducing flexible shift systems, redistributing workloads, and expanding support staff can reduce fatigue and enhance fairness perceptions. In cases where

compensation inequity or pay opacity undermines morale, increasing pay transparency, benchmarking salaries, and communicating reward criteria clearly can strengthen trust and organizational commitment.

The findings further demonstrate that healthcare employee satisfaction is sensitive to external shocks such as the COVID-19 pandemic. During high-stress periods, the significance of a supportive work environment and strong peer relations intensifies. Managers should therefore prioritize initiatives such as psychological support programs, team-based debriefings, and enhanced communication routines to alleviate stress and sustain employee morale under pressure.

Finally, the study highlights important heterogeneity across job roles and tenure groups, suggesting that management practices must be tailored rather than uniform. New employees benefit most from effective onboarding, mentorship, and work–life balance support, which facilitate early integration into demanding healthcare environments. Long-tenured employees, in contrast, require career renewal opportunities—such as leadership training or rotational assignments—to prevent stagnation and maintain motivation. Meanwhile, direct patient care providers may value workload redistribution and adequate staffing, whereas administrative staff may prioritize transparent communication and cultural alignment.

By explicitly linking managerial actions to the specific factors that drive satisfaction and dissatisfaction, healthcare organizations can design differentiated and data-informed human resource strategies. These strategies not only enhance employee well-being and retention but also contribute to sustainable improvements in patient care quality.

6.3 Limitations and Future Directions

This study is not free of limitations. One major limitation is the potential for selection bias on platforms like Glassdoor, where employees who are either highly satisfied or highly dissatisfied are more likely to leave reviews. This can skew the data towards extreme opinions, which may limit the generalizability of our findings, as more moderate viewpoints could be underrepresented. However, there are evidence to

support that the "give-to-get" policy followed by such platforms eliminate such biases (Marinescu *et al.*, 2021). Furthermore, the sample used in this analysis is large, meaning that even if there was some bias, it still represents a significant portion of the overall population, making it difficult to disregard. Another limitation of the dataset is that it lacks demographic information (e.g., gender, age, race) about the reviewers, limiting our ability to explore how different groups might experience satisfaction differently.

Our study focused on reviews from current employees, which ensured real-time insights but excluded feedback from former employees, potentially overlooking valuable perspectives, especially those related to turnover. Including former employees' reviews could provide a more comprehensive view of satisfaction and its link to turnover.

Finally, as the study focused on U.S.-based healthcare workers, the findings may not fully apply to healthcare systems in other countries, where policies and cultural factors differ. Expanding future research to include former employees, diverse demographic data, and international contexts would enhance our understanding of employee satisfaction in healthcare.

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Table 1 Sample characteristics.

Category	Number of reviews	Percent (%)
Review period		
Before March 2020	85,993	27.99
March 2020 and after	221,200	72.01
- Mention Covid-19 terms	6,664	2.17
- Early-Covid-19 (March 2020 – January 2022)	108,305	35.26
- Late-Covid-19 (After January 2022)	112,895	36.75
Job title		
Allied Health Professionals	17,136	5.58
Direct Patient Care Providers	234,544	76.35
- Nursing Staff	85,901	27.96
- Other Healthcare Roles	140,761	45.82
- Physician	7,882	2.57
Healthcare Administration and Support	14,866	4.84
Healthcare Technicians	40,647	13.23
Working year		
Missing	118,043	38.43
Less than one year	59,580	19.39
More than one year but less than three years	46,315	15.08
More than three years but less than five years	36,568	11.90
More than five years but less than eight years	23,044	7.50
More than eight years but less than ten years	10,970	3.57
More than ten years	12,673	4.13
Total number of reviews	307,193	100

Source: Authors own work

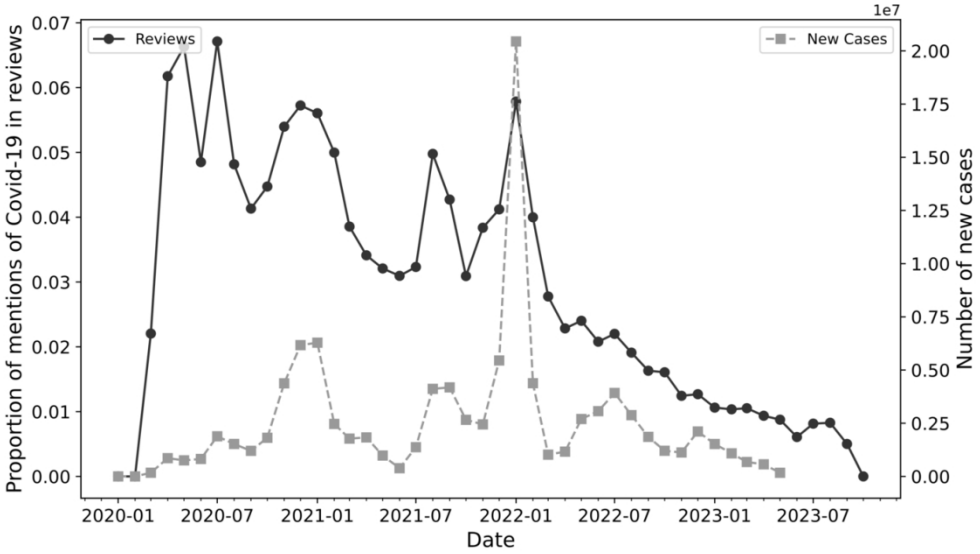

Figure 1. Proportion of reviews mentioning Covid-19 in different periods and new cases
Source: Authors own work

239x140mm (150 x 150 DPI)

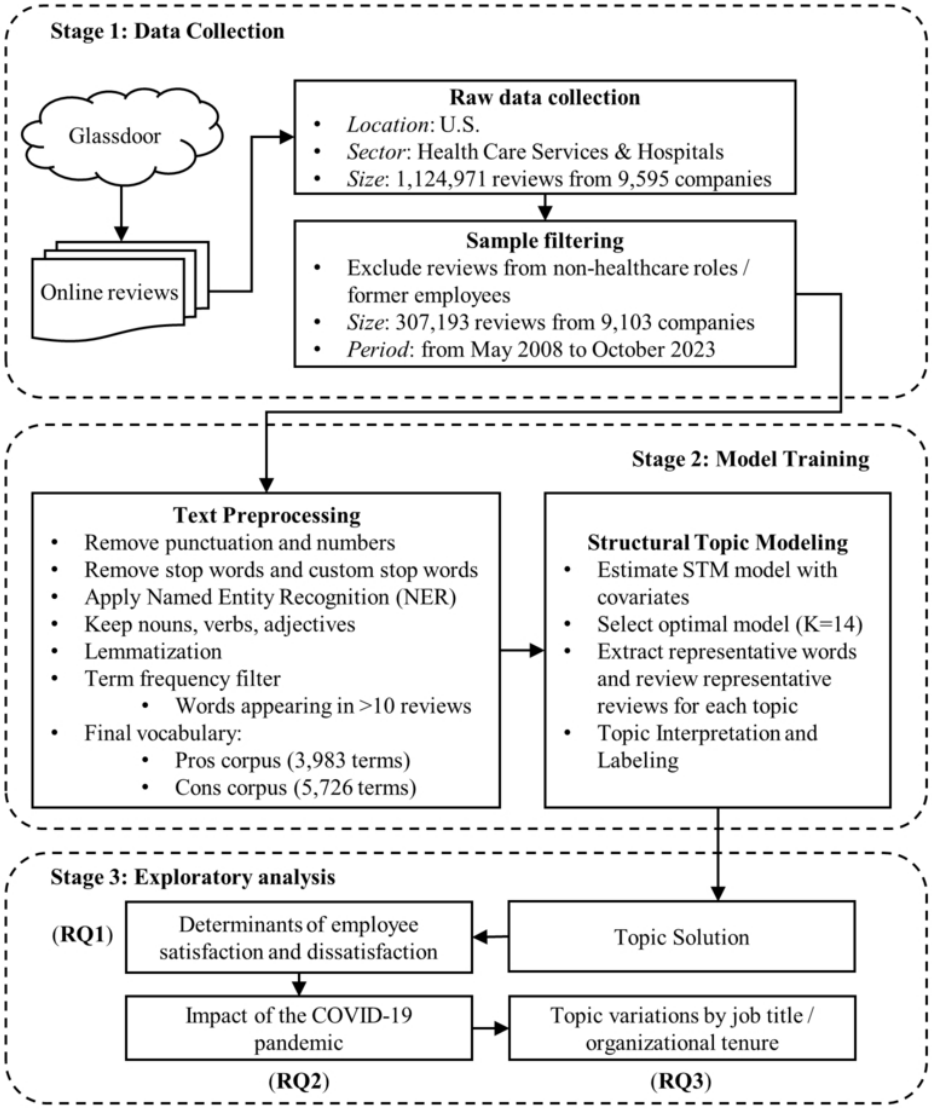

Figure 2. Data analytics procedure
Source: Authors own work

140x160mm (150 x 150 DPI)

Table 2 Topic solution for positive feedback

Topic#	Topic Label	Top 7 FREX Words	Prop. %
P1	Work Environment	management, wonderful, player, environment, atmosphere, relaxed, upper	12.67%
P2	Co-worker Relations	friendly, nice, staff, helpful, supportive, clean, awesome	9.37%
P3	Company Culture	mission, value, member, sense, culture, respect, passionate	9.24%
P4	Benefits and Perks	reimbursement, room, tuition, package, retirement, benefit, home	7.68%
P5	Job Security and Job Role	job, security, easy, like, enjoy, kid, elderly	7.55%
P6	Equipment and Resources	hospital, ratio, population, small, trauma, town, teaching	7.34%
P7	Work Support	support, provide, education, quality, practice, high, continue	7.08%
P8	Skill Development	gain, resume, skill, advance, career, exposure, student	6.65%
P9	Hiring Process	hire, grad, door, interview, answer, process, orientation	6.58%
P10	Pay and Scheduling	scheduling, pay, starting, salary, paycheck, flexible, micromanagement	6.04%
P11	Work/Life Balance	balance, coworker, location, health, mobility, pto, decent	6.00%
P12	Health and Insurance	sick, union, okay, wage, bill, convenient, commute	5.50%
P13	Shift Compensation	shift, pick, extra, money, remote, night, available	5.19%
P14	Workplace Amenities and Social Events	food, site, cafeteria, coffee, party, event, direct	3.12%

Source: Authors own work

Table 3 Topic solution for negative feedback

Topic #	Topic Label	Top 7 FREX Words	Prop. %
N1	Pay and Salary	low, competitive, salary, pay, compare, average, wage	10.16%
N2	Career Development	growth, opportunity, grow, development, room, upward, advancement	9.88%
N3	Company Culture	favoritism, upper, concern, unprofessional, accountable, touch, bullying	9.23%
N4	Staff Shortage and Shifts	short, staffed, shortage, float, flexible, load, night	8.93%
N5	Work/Life Balance	balance, life, love, pace, fast, friendly, remote	8.39%
N6	Management Trust	right, question, know, reason, talk, promise, let	7.69%
N7	Rest Period Disruptions	client, lunch, mind, session, cancel, break, pharmacy	7.64%
N8	Turnover and Safety Concerns	ratio, turnover, nurse, unsafe, patient, acuity, poor	7.41%
N9	Vacation Time	busy, vacation, con, negative, pro, time, hectic	6.05%
N10	Organizational Communication	communication, lack, department, great, organization, tough, improve	5.84%
N11	Parking and Location	parking, park, distance, travel, campus, location, city	5.32%
N12	Health and Insurance	insurance, health, retirement, deductible, benefit, package, understaffed	4.97%
N13	Unrealistic Expectations	expectation, unrealistic, little, workload, performance, unorganized, disorganize	4.30%
N14	Lack of Performance Feedback	experience, position, feedback, feel, field, open, direction	4.19%

Source: Authors own work

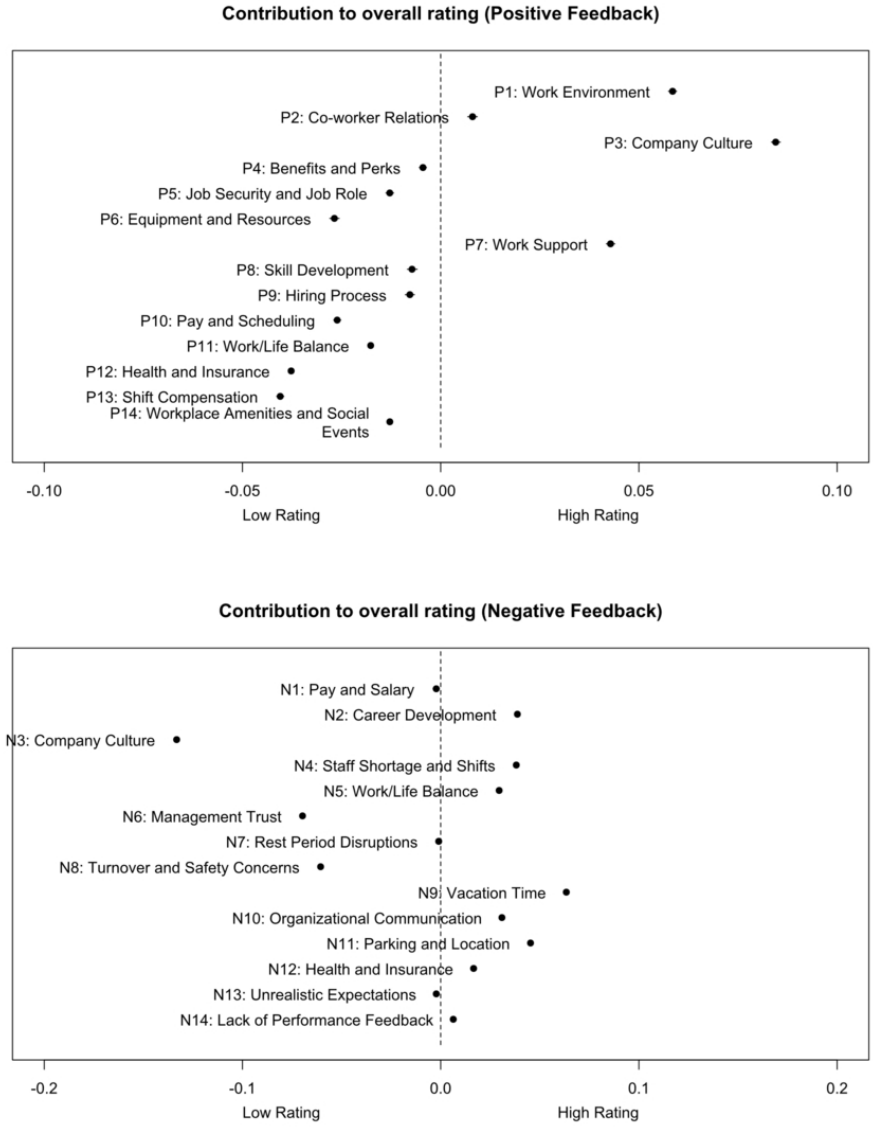

Figure 3. Marginal effects of overall rating (low to high) for the topic distribution of positive (upper) and negative (lower) aspects of the review text
Source: Authors own work

160x191mm (150 x 150 DPI)

Table 4 Job aspects rating comparison

	All Sample			Covid-19 Sample	
	(1)	(2)	(3)	(4)	(5)
	Pre-Covid-19	Early-Covid-19	Late-Covid-19	No Mention Covid-19	Mention Covid-19
Overall Rating	3.73	3.73 [n]	3.72 [n]	3.73	3.53*
Career Opportunities	3.62	3.66*	3.67*	3.67	3.54*
Compensation and Benefits	3.52	3.52 [n]	3.47*	3.50	3.35*
Senior Management	3.36	3.34*	3.33*	3.34	3.13*
Work/Life Balance	3.61	3.54*	3.56*	3.56	3.37*
Culture Values	3.74	3.72*	3.70*	3.72	3.53*

Note: * indicates that the values are significantly different from the previous value based on t-test analysis (i.e., comparisons between Early-Covid-19 and Pre-Covid-19, Late-Covid-19 and Early-Covid-19, and Mention Covid-19 and No Mention Covid-19) at the 0.5 significance level; conversely, [n] indicates no significant difference. Data excludes pre-2018 records. Since the Diversity & Inclusion Rating first appeared in September 2020, we have not included changes to that rating.

Source: Authors own work

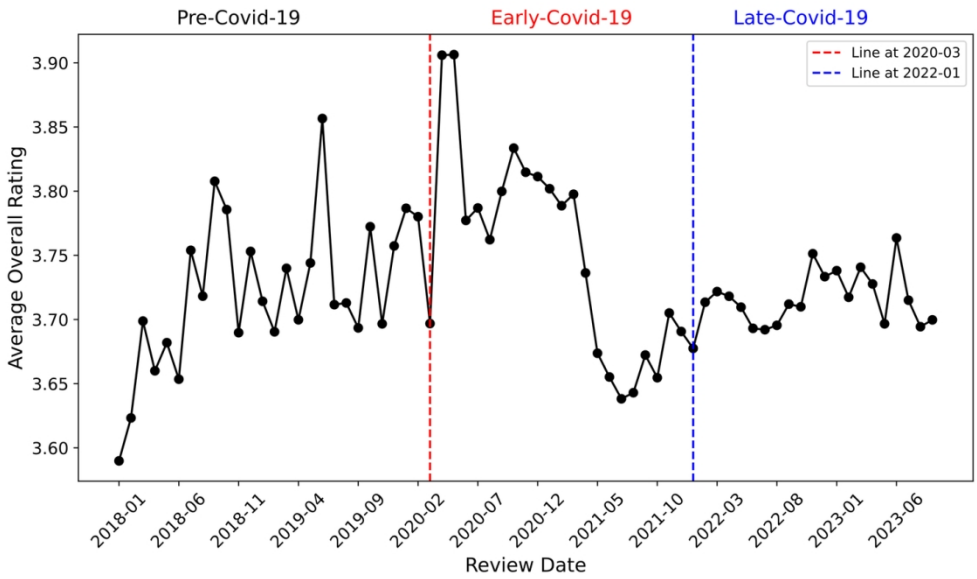

Figure 4. Trends in average employee ratings across Pre-, Early-, and Late-COVID-19 periods
Source: Authors own work

254x154mm (150 x 150 DPI)

Table 5 Topics of positive feedback distribution

		All Sample			Covid-19 Sample	
		Pre-Covid-19	Early-Covid-19	Late-Covid-19	No Mention Covid-19	Mention Covid-19
P1	Work Environment	0.116	0.131*	0.130*	0.131	0.117*
P2	Co-worker Relations	0.087	0.098*	0.094*	0.096	0.089*
P3	Company Culture	0.098	0.091*	0.089*	0.090	0.094*
P4	Benefits and Perks	0.071	0.082*	0.077*	0.079	0.075*
P5	Job Security and Job Role	0.087	0.070*	0.072*	0.071	0.075*
P6	Equipment and Resources	0.078	0.073*	0.070*	0.071	0.079*
P7	Work Support	0.081	0.067*	0.067*	0.067	0.077*
P8	Skill Development	0.068	0.067*	0.065*	0.066	0.065n
P9	Hiring Process	0.075	0.060*	0.064*	0.062	0.068*
P10	Pay and Scheduling	0.052	0.063*	0.064*	0.064	0.059*
P11	Work/Life Balance	0.052	0.063*	0.064*	0.063	0.058*
P12	Health and Insurance	0.053	0.055*	0.056*	0.056	0.054*
P13	Shift Compensation	0.047	0.050*	0.057*	0.054	0.054n
P14	Workplace Amenities and Social Events	0.035	0.029*	0.030*	0.030	0.035*

Note: * indicates that the values are significantly different from the previous value based on t-test analysis (i.e., comparisons between Early-Covid-19 and Pre-Covid-19, Late-Covid-19 and Early-Covid-19, and Mention Covid-19 and No Mention Covid-19) at the 0.5 significance level; conversely, n indicates no significant difference.

Source: Authors own work

Table 6 Topics of negative feedback distribution

		All Sample			Covid-19 Sample	
		Pre-Covid-19	Early-Covid-19	Late-Covid-19	No Mention Covid-19	Mention Covid-19
N1	Pay and Salary	0.081	0.104*	0.115*	0.110	0.094*
N2	Career Development	0.102	0.098*	0.097*	0.098	0.093*
N3	Company Culture	0.095	0.093*	0.090*	0.091	0.090n
N4	Staff Shortage and Shifts	0.074	0.098*	0.094*	0.095	0.104*
N5	Work/Life Balance	0.080	0.087*	0.084*	0.086	0.081*
N6	Management Trust	0.098	0.066*	0.071*	0.068	0.083*
N7	Rest Period Disruptions	0.086	0.072*	0.073*	0.072	0.082*
N8	Turnover and Safety Concerns	0.071	0.076*	0.075*	0.075	0.079*
N9	Vacation Time	0.063	0.061*	0.059*	0.060	0.060n
N10	Organizational Communication	0.055	0.061*	0.058*	0.060	0.056*
N11	Parking and Location	0.056	0.052*	0.052n	0.052	0.049*
N12	Health and Insurance	0.049	0.050*	0.049*	0.050	0.047*
N13	Unrealistic Expectations	0.043	0.043*	0.043 n	0.043	0.041*
N14	Lack of Performance Feedback	0.047	0.039*	0.041*	0.040	0.042*

Note: * indicates that the values are significantly different from the previous value based on t-test analysis (i.e., comparisons between Early-Covid-19 and Pre-Covid-19, Late-Covid-19 and Early-Covid-19, and Mention Covid-19 and No Mention Covid-19) at the 0.5 significance level; conversely, n indicates no significant difference.

Source: Authors own work

Table 7 Top positive feedback topics by job role at different periods of the pandemic

Topic#	Period	Allied Health Professionals	Direct Patient Care Providers	Healthcare Administration and Support	Healthcare Technicians
Topic1	0	P7 (0.150)	P1 (0.117)	P3 (0.129)	P1 (0.113)
	1	P7 (0.129)	P1 (0.132)	P1 (0.142)	P1 (0.128)
	2	P7 (0.129)	P1 (0.131)	P1 (0.143)	P1 (0.127)
Topic2	0	P1 (0.107)	P3 (0.100)	P1 (0.125)	P5 (0.096)
	1	P1 (0.121)	P2 (0.100)	P3 (0.123)	P2 (0.099)
	2	P1 (0.119)	P2 (0.096)	P3 (0.120)	P2 (0.094)
Topic3	0	P3 (0.095)	P2 (0.089)	P5 (0.091)	P9 (0.089)
	1	P3 (0.090)	P3 (0.092)	P4 (0.086)	P5 (0.082)
	2	P3 (0.088)	P3 (0.090)	P2 (0.083)	P5 (0.085)
Topic4	0	P5 (0.084)	P5 (0.085)	P7 (0.090)	P2 (0.086)
	1	P2 (0.085)	P4 (0.083)	P2 (0.085)	P4 (0.080)
	2	P2 (0.081)	P4 (0.078)	P4 (0.081)	P9 (0.077)

Note: The values 0, 1, and 2 in the Period column represent the Pre-COVID-19, Early-COVID-19, and Late-COVID-19 periods, respectively.

Source: Authors own work

Table 8 Top negative feedback topics by job role at different periods of the pandemic

Topic#	Period	Allied Health Professionals	Direct Patient Care Providers	Healthcare Administration and Support	Healthcare Technicians
Topic1	0	N2 (0.135)	N2 (0.101)	N2 (0.123)	N7 (0.108)
	1	N2 (0.134)	N1 (0.104)	N2 (0.122)	N1 (0.110)
	2	N2 (0.133)	N1 (0.115)	N2 (0.121)	N1 (0.118)
Topic2	0	N7 (0.100)	N6 (0.099)	N6 (0.099)	N6 (0.104)
	1	N1 (0.105)	N4 (0.101)	N5 (0.103)	N3 (0.099)
	2	N1 (0.116)	N4 (0.097)	N5 (0.099)	N3 (0.096)
Topic3	0	N1 (0.081)	N3 (0.095)	N3 (0.097)	N3 (0.101)
	1	N7 (0.082)	N2 (0.097)	N3 (0.094)	N4 (0.095)
	2	N7 (0.085)	N2 (0.096)	N1 (0.098)	N7 (0.095)
Topic4	0	N6 (0.081)	N7 (0.082)	N5 (0.092)	N1 (0.087)
	1	N3 (0.078)	N3 (0.093)	N1 (0.088)	N5 (0.094)
	2	N3 (0.073)	N3 (0.090)	N3 (0.089)	N4 (0.092)

Note: The values 0, 1, and 2 in the Period column represent the Pre-COVID-19, Early-COVID-19, and Late-COVID-19 periods, respectively.

Source: Authors own work

Table 9 Distribution of positive feedback topics by tenure at different periods of the pandemic

	Job attributes	Period	Short-tenure	Mid- tenure	Long-tenure
P1	Work Environment	0	0.123	0.116	0.112
		1	0.133	0.127	0.123
		2	0.132	0.126	0.121
P2	Co-worker Relations	0	0.096	0.086	0.076
		1	0.102	0.092	0.081
		2	0.097	0.089	0.079
P3	Company Culture	0	0.100	0.097	0.110
		1	0.095	0.092	0.104
		2	0.094	0.091	0.100
P4	Benefits and Perks	0	0.063	0.071	0.079
		1	0.073	0.084	0.095
		2	0.069	0.079	0.091
P5	Job Security and Job Role	0	0.092	0.087	0.080
		1	0.077	0.071	0.065
		2	0.078	0.072	0.066
P6	Equipment and Resources	0	0.067	0.077	0.089
		1	0.065	0.074	0.082
		2	0.063	0.071	0.079
P7	Work Support	0	0.075	0.079	0.091
		1	0.067	0.069	0.077
		2	0.068	0.069	0.076
P8	Skill Development	0	0.069	0.069	0.063
		1	0.068	0.068	0.060
		2	0.066	0.065	0.060
P9	Hiring Process	0	0.087	0.074	0.062
		1	0.072	0.059	0.048
		2	0.076	0.061	0.051
P10	Pay and Scheduling	0	0.051	0.053	0.050
		1	0.059	0.062	0.061
		2	0.060	0.064	0.063
P11	Work/Life Balance	0	0.049	0.053	0.055
		1	0.058	0.064	0.067
		2	0.059	0.065	0.068
P12	Health and Insurance	0	0.050	0.054	0.053
		1	0.052	0.056	0.056
		2	0.052	0.057	0.058
P13	Shift Compensation	0	0.046	0.048	0.044
		1	0.049	0.052	0.049
		2	0.055	0.059	0.056
P14	Workplace Amenities and Social Events	0	0.034	0.035	0.035
		1	0.030	0.031	0.030

	2	0.030	0.031	0.031

Note: The values 0, 1, and 2 in the Period column represent the Pre-COVID-19, Early-COVID-19, and Late-COVID-19 periods, respectively.

Source: Authors own work

Table 10 Distribution of negative feedback topics by tenure at different periods of the pandemic

	Job attributes	Period	Short-tenure	Mid- tenure	Long-tenure
N1	Pay and Salary	0	0.078	0.084	0.077
		1	0.095	0.103	0.097
		2	0.101	0.113	0.108
N2	Career Development	0	0.097	0.101	0.112
		1	0.096	0.099	0.107
		2	0.096	0.098	0.105
N3	Company Culture	0	0.079	0.095	0.107
		1	0.082	0.098	0.109
		2	0.081	0.094	0.107
N4	Staff Shortage and Shifts	0	0.078	0.074	0.069
		1	0.098	0.092	0.086
		2	0.093	0.089	0.084
N5	Work/Life Balance	0	0.087	0.080	0.076
		1	0.092	0.085	0.081
		2	0.088	0.082	0.078
N6	Management Trust	0	0.099	0.098	0.099
		1	0.071	0.070	0.072
		2	0.077	0.075	0.076
N7	Rest Period Disruptions	0	0.098	0.086	0.073
		1	0.083	0.071	0.061
		2	0.086	0.073	0.062
N8	Turnover and Safety Concerns	0	0.063	0.072	0.074
		1	0.069	0.077	0.079
		2	0.067	0.076	0.079
N9	Vacation Time	0	0.072	0.062	0.059
		1	0.068	0.058	0.056
		2	0.066	0.057	0.053
N10	Organizational Communication	0	0.055	0.055	0.056
		1	0.060	0.060	0.061
		2	0.059	0.057	0.059
N11	Parking and Location	0	0.058	0.055	0.055
		1	0.053	0.051	0.051
		2	0.053	0.051	0.051
N12	Health and Insurance	0	0.049	0.050	0.050
		1	0.050	0.051	0.052
		2	0.049	0.049	0.051
N13	Unrealistic Expectations	0	0.041	0.043	0.043
		1	0.042	0.044	0.043
		2	0.043	0.044	0.043
N14	Lack of Performance Feedback	0	0.046	0.046	0.050
		1	0.040	0.040	0.044
		2	0.042	0.042	0.046

Note: The values 0, 1, and 2 in the Period column represent the Pre-COVID-19, Early-COVID-19, and Late-COVID-19 periods, respectively.

Source: Authors own work

Appendix

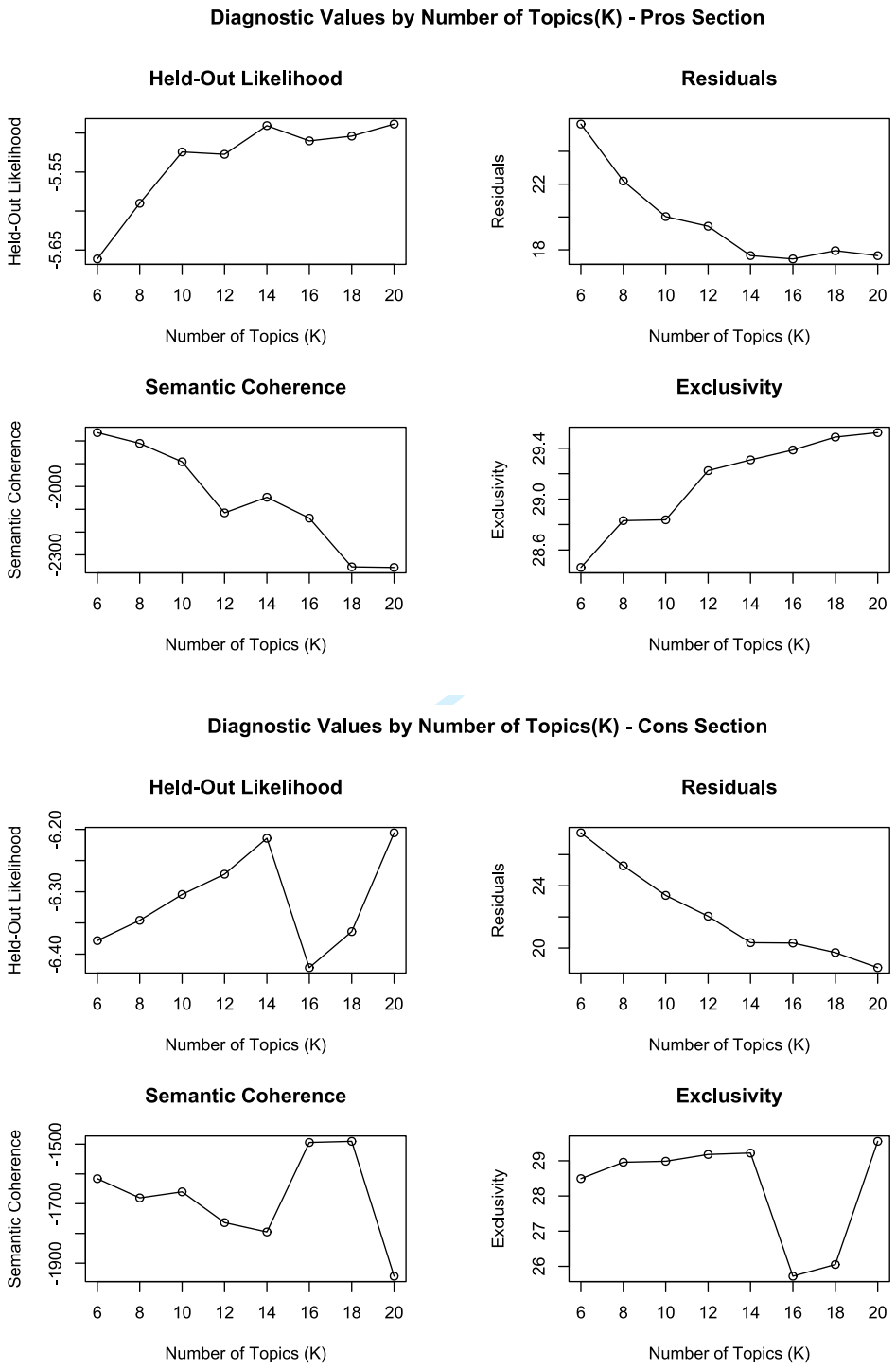

Figure A: The plot illustrates the diagnostic values in terms of held-out likelihood, semantic coherence, exclusivity and the residuals obtained for the full model. The best combination is achieved when the number of topics (K) is 14, as this provides the best relationship between the held-out likelihood and semantic coherence.

Source: Authors own work