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Understanding Changes in Radiotherapy Practices Over a Decade: Integrating Treatment Data and Perspectives of Staff in Leadership Positions

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Abstract

Background

Radiotherapy (RT) with the growing demand, has gone through many transitional challenges that tested RT departments' coordination and adaptability. This study aims to understand how RT staff in leadership roles experienced changes in treatment availability, workflows, and operational dynamics over the last decade.

Methods

A total of 13 staff members with formal or informal leadership positions participated in the study. The interviews were conducted during 2024, and the participant group consisted of oncologists, oncology nurses/radiation therapists, and medical physicists with leadership roles within the studied time period between 2015 to 2024. We also extracted a quantitative dataset for the same period to investigate if these data coincided with the reported events.

Results

The thematic analysis based on Braun and Clarke's approach, resulted in a total of 27 unique codes with 9 sub-themes and 3 overarching themes from all 13 interviews. More than half of the interviewees reported issues relating to resource conditions and operational dynamics. Quantitative data over the years suggested that departmental delays reduced from 12 weeks to 7 weeks, however, all interviewees still highlighted recurring issues with staffing organization during the same years.

Conclusion

Quantitative data reflected improvements from digitization and new treatment techniques, while qualitative findings highlighted the contribution of leadership initiatives for overall improvements in the RT workflow. The qualitative analysis provided additional insight into factors related to departmental challenges beyond those usually captured by quantitative metrics.

Introduction

Radiotherapy (RT) is known to be one of the most technically evolving domains in healthcare and it has seen major treatment-related changes over the last two decades [1]. Considering the rapid changes, the RT process must account for different kinds of transitions without limiting the availability of treatments and maintain the treatment quality. For

instance, re-introduction of new fractionation schedules (e.g. for prostate and breast cancers), and new delivery techniques (e.g. VMAT) have reduced patient workload on machines [2, 3]. However, this puts more pressure on the RT staff to handle preparatory tasks before RT can commence and to manage increased patient throughput. Oncology Information

systems (OIS) used to store all RT data including patient, treatment and fractionation related information has drastically evolved over the years with vast databases, treatment planning integration and other scalability variations. [1, 4]. Unforeseen situations like COVID-19 have also impacted RT work practises. All these situations have come with transitional challenges that tested RT departments' coordination, adaptability and resilience worldwide [1, 5].

Understanding how various technological or other advancements in RT have been experienced and managed within departments is crucial in adapting to future situations [3, 6, 7]. There are many contextual situations which may be handled in real-time and, therefore, are not reflected in historical quantitative RT data. Additionally, pieces of information about workflow changes over time may not be routinely documented. In the RT setting, qualitative factors can strengthen quantitative OIS data by providing an additional perspective on the past and current work practices possibly leading to better work management [8, 9]. However, despite the rapidly changing environment, there is limited qualitative research in RT that explores staff experiences and how major transformations impact the workflows, staffing conditions and if these are reflected in common RT metrics such as patient throughput or waiting times [9, 10]. In our opinion, qualitative aspects and quantitative data can bolster each other to help understand effects of RT changes in a wider perspective.

Our aim was to increase understanding of how staff in leadership positions experienced changes in RT over time and to what extent these qualitative aspects are reflected in patient volumes and department capacities. We especially want to identify key factors that significantly influence working conditions with respect to treatment availability, workflow changes, and operational dynamics over the past decade.

Methods and materials

This article is written in accordance with the Consolidated Criteria for Reporting Qualitative Research (COREQ) checklist [11]. Details on how the different criteria are met are reported in Appendix 1.

Department characteristics

The study setting is one of the large RT departments in Sweden with two geographically separated sites treating approximately one fifth of all patients undergoing RT in Sweden yearly, corresponding to around 5000 patients [12]. There are around 130 RT professionals involved in the daily operations of the department and during the studied period (2015 to 2024), 10–13 linacs were operational and actively used for patient treatments. Note that at the studied hospital, the RT department is a sub-division of the oncology department, however, medical physics is not. Regardless of organisational belonging, all RT professionals work in close collaboration and share responsibility for the hospital's RT services. A total

of 15 formal leadership positions and about twice as many informal leadership positions are engaged in the daily RT operations. Formal leadership positions (FL) in this context are officially designated employments with recognized authority and defined responsibilities. Informal leadership positions (IL) include diagnosis-specific leads, treatment unit coordinators, designated medical physicists, and modality-specific leads for external-beam RT, brachytherapy, or in some situations where staff were assigned additional responsibilities without holding a formally appointed leadership employment.

Priorly known major events in the last decade included: start of patient care pathways, COVID-19 and transition from manual handling of referrals to a paperless digital workflow during a large-scale improvement project. Note that before 2019, the two sites operated individually and handled treatments separately. In 2019, they were merged with respect to workflows, OISs and operational coordination. For this reason, overall departmental statistics are only available after 2019 as some of these data were handled separately before.

Study design and data collection strategy

Seventeen staff members from the studied department were invited to participate according to on their expertise of RT practices and formal/informal leadership role during the past decade. Interviewees held professional positions as oncologists, medical phycisists or oncology nurses with more than 15 years of work experience in RT. Note that the duties of radiation therapists (RTT) in Sweden are mainly carried out by oncology nurses. In this work, this profession is therefore, referred to as oncology nurse/RTT since RTT is the recognized identifier internationally. As a group, study participants were selected by purposive and snowball sampling. They were identified based on their professional role and experience to collectively provide comprehensive insights about the RT process, i.e. patient inflows, medical decisions, scheduling and planning of RT, techniques and equipment for treatment delivery, as well as staffing, and governance. The research group has also previously conducted research in this area and related fields. [13-16]. All interviewees were approached in August 2023 by e-mail with information about the research project. Participation was voluntary and and all participants provided informed consent. Interviews were conducted at the workplace premises between January 2024 to December 2024. No one except the interviewer and the interviewee was present at any of the interviews.

The data collection was based on semi-structured interviews and were conducted by a senior medical physicist with around 20 years of experience working in RT (CAM). The interviewer worked in the same department as the participants at the time of interviews, and had a pre-existing professional relationship with most interviewees. Each participant was interviewed once following an interview guide developed specifically for this study and has not been published elsewhere (English-language version included in **Appendix 2)**. Content validity of the interview guide was established through expert review by a senior medical physicist at the RT department (JL) and an senior researcher in the field (CO). All interviews (length: 60 to 70 minutes) were conducted and documented in Swedish (field notes and audio recordings) and translated to English. Participants were invited to review results before publication. English translations were cross-checked with their Swedish originals during analysis to avoid any

translational gaps in the reporting of results. All interview questions were open ended and focused mainly on technical, organizational, and treatment-related events and their percieved impact on working conditions at the studied RT department. Questions about any other significant observations including experiences during the COVID-19 pandemic period were also asked. All interviewees were asked a same set of general questions and, depending on their professional role and RT experience, they were also asked tailored questions relating to a) cancer-diagnose-specific treatments, b) leadership and c) daily operations. Collected demographic characteristics of participants were restricted to professional role and expertise at the studied department.

Data analysis

We primarily used a deductive thematic analysis approach following the Braun and Clarke approach to investigate the qualitative dataset [17]. It involved identifying patterns in the data that are guided by existing theoretical concepts, frameworks, or specific research questions [17]. Our interview questions were structured around pre-identified areas, but participants were allowed to raise additional relevant perspectives beyond these predefined areas.

Four researchers (MG, CO, FS, and JL) worked on the interviews together through a process of data familiarisation, code generation (analysis units, meaning units, codes) followed by theme formulation (sub-categories, categories) to agree on identified patterns (Figure 1).

Our coding frame was iteratively developed based on analysis units and meaning units and subsequently adjusted through comparing and re-evaluating each other's findings. Interview themes were created based on different common codes identified from the interviews and were refined given their context within the findings from each interview. This also aided in maintaining a reflexive approach through a continuous process of questioning previous assumptions and discussing each other's perspectives [18, 19].

Statistics

Descriptive statistics were used to summarize the findings from the qualitative semi-structured data as well as from the quantitative data (described below). We used open-source and proprietary software tools (Excel, Microsoft Copilot [Licensed]) to assist in data handling and analysis. A detailed description of the use of Copilot AI is provided in the Acknowledgements section.

Qualitative Dataset

Frequencies of individual codes and themes were calculated to assess their relative impact on the overall RT workflow. Unique codes were also calculated per interview to identify information-rich interviews. When possible, identified qualitative findings were labelled with the point(s) in time when they occurred.

Quantitative dataset

Quantitative RT data was extracted from the OIS ARIA (Varian Medical Systems, Inc., Palo Alto, CA, U.S.A) for the hospital´s two geographically separated RT sites. The data were extracted for the period spanning from 2015 to 2024 (joint statistics after the merging of the two sites in 2019) which corresponded to the events mentioned in the interviews. The data included information on patient referrals (referral date, treatment start date), diagnoses (ICD-10 codes), and treatment (intent and number of fractions). This dataset was used to evaluate if qualitative findings appeared in the quantitative data and further compare potential patterns across both datasets.

Average number of fractions and number of referred patients by diagnosis and in total were calculated per year using mean values with standard deviations or median values with range depending on distribution of data. Calculations of delays in days were made using referral date and actual start dates of patients.

Finally, the qualitative and quantitative findings were presented together in a timeline figure, combining relevant aspects from the qualitative dataset with major technical, organizational and treatment related events during respective years to understand whether reported experiences coincided with extracted quantitative data [19].

Results

Interviewee characteristics

Of the initially approached 17 staff members of the studied RT department, 13 consented to participate and were interviewed, while four declined participation due to lack of time. Of the 13 interviewees, eight were oncologists, three were oncology nurses/RTTs, two were medical physicists (Table 1). Out of all, 54% (n=7 [5 oncologists, 2 oncology nurses/RTTs) had formal leadership positions. Remaining 46% (n=6 [3 oncologists, 1 oncology nurses/RTTs, 2 medical physicists]) had informal leadership positions within the studied department during the years 2015 to 2024.

Table 1: Description of interviewee characteristics including profession, leadership role and expertise.

Interviewee Number	Profession	Type of Leadership Role	Expertise
Interviewee 1	Oncologist	Formal	Head of oncology including RT with strategic operational insights
Interviewee 2	Oncology nurse/RTT	Informal	Daily operations
Interviewee 3	Oncologist	Formal	Cancer-diagnose* specialist; group leader of oncologists or oncology nurses/RTTs† at the RT department
Interviewee 4	Oncologist	Formal	Cancer-diagnose* specialist; group leader of oncologists or oncology nurses/RTTs † at the RT department
Interviewee 5	Oncologist	Formal	Cancer-diagnose* specialist; group leader of oncologists or oncology nurses/RTTs † at the RT department
Interviewee 6	Oncologist	Informal	Head of oncology including RT with strategic operational insights
Interviewee 7	Oncologist	Informal	Cancer -diagnose* specialist
Interviewee 8	Oncologist	Informal	Cancer-diagnose* specialist
Interviewee 9	Oncology nurse/RTT	Formal	Group leader of oncologists or oncology nurses/RTTs † at the RT department
Interviewee 10	Medical Physicist	Informal	Daily operations‡
Interviewee 11	Oncology nurse/RTT	Formal	Daily operations
Interviewee 12	Oncologist	Formal	Cancer-diagnose* specialist
Interviewee 13	Medical Physicist	Informal	Daily operations‡

*primary expertise in one tumour group (breast, lung, prostate) or in gynaecological cancers; †heads of oncology where the RT department is included covered the years 2017 and onwards (n=2); group leaders of the RT department covered the years from 2015 and onwards for oncologists (n=3) and for oncology nurses/RTTs (n=1); ‡primary expertise in either treatment-related or measurement-/equipment-related aspects of medical physics.

Findings

Together, all interviews generated a total of 27 unique codes (Figure 2). The thematic analysis resulted in three overarching themes – **1. Workflow alterations, 2. Organizational alterations, 3. Technological**

alterations. Some interviews had a high level of thematic richness related to a single category, *e.g.* interviewee 13 with 18 quotes and 8 unique codes related to technical changes. On the other hand, some interviews led to fewer or repetitive codes due to shorter interview length or limited topic coverage, *e.g.* interviewee 1 with 10 quotes and 2 unique codes, out of which 40% codes were related to patient scheduling issues.

Across all interviews, the most frequently appearing codes belonged to the sub-theme “Staffing and resource constraints”. Codes such as “Operational dynamics,” “Staffing conditions”, and “Resource conditions” appeared in over 60% of interviews, indicating their significance to interviewee experiences (Table 2). “Staffing organization” was the only code that appeared in every interview (100%) with a total of 17 references indicating the concerns related to staffing situations.

Table 2: Most frequently appearing codes with respective number of interviewees mentioning them, total references per code, and contributing professional groups (leadership roles indicated) across themes from 13 interviews covering events during 2015 to 2024, sorted by frequency of the codes.

No.	Code	Number of interviewees mentioning the code		Total references	Interviewee profession	Theme
1	Combined efforts	6	46%	9	Oncologists (FL)	Organizational alterations
2	Pandemic effects	6	46%	7	Oncology nurse/RTT (FL), Oncologists (FL), Medical Physicist (IL)	Organizational alterations
3	Queue issues	6	46%	9	Oncology nurse/RTT (FL)	Organizational alterations
4	Treatment technique changes	7	54%	16	Oncologists (IL), Medical Physicist (IL)	Technology alterations
5	Operational dynamics	8	62%	15	Oncology nurse/RTT (IL), Oncologists (IL)	Organizational alterations
6	Resource conditions	9	69%	18	Oncology nurse/RTT (FL), Oncologists (FL), Medical Physicist	Organizational alterations
7	Staffing conditions	9	69%	12	Oncologists (FL), Medical Physicist (IL)	Organizational alterations
8	Staffing organization	13	100%	17	Oncology nurse/RTT (FL), Oncologists (IL), Medical Physicist (IL)	Organizational alterations

Abbreviation: FL - Formal Leadership, IL - Informal Leadership.

Refer to supplementary material part 2 for details and references on all 27 codes.

Organizational alterations

This theme contained sub-themes and codes which demonstrated varied opinions by the staff about scheduling issues, staffing levels, resource conditions, and operational transformations over the years. Interviewees had expertise in different parts of the RT workflow, demonstrating diverse aspects of the issues faced. Approximately 70% of interviewees reported reported how staff shortages and extra workload either were not routinely documented or were difficult to retrive from current records. When the queues grew during 2020 (COVID-19 pandemic and paperless workflow implementation), the workload was managed by staff working overtime on a last-minute task-completion basis or by shifting from originally designated responsibilities or tasks. Formal leadership expressed that they also missed a

standardized approach to manage these pressed situations. Some interviewees specifically said that documenting such events would allow for analysis of historical delays and queue buildups, supporting a deeper understanding of the underlying cause of such issues. Selected example quotes are presented below with interviewee details and the corresponding code(s) for each quote.

Wrong work prioritization *"Doctors in FL positions spend a ton of time in meetings and review rounds, and contouring gets squeezed into little time slots, leading to more workload and overtime"* ***Interviewee 1 (Oncologist, FL)***

Staffing conditions *"Whenever there was a staff shortage, they'd pull administrative personnel onto clinical work. The machines were running all the time. At one point, I was on machine X for five weeks straight."* ***Interviewee 2 (Oncology nurse/RTT, IL)***

Staffing organization *"We went through a lot of leadership changes. We had multiple interim managers before X took over. Leadership instability really affected the team, especially when the workload was already so heavy and everyone was working overtime."* ***Interviewee 2 (Oncology nurse/RTT, IL)***

Staffing conditions *"We also scheduled extra clinics to handle uneven referral inflows. This was not specifically documented in the [OIS] data"* ***Interviewee 5 (Oncologist, FL)***

According to four oncologists and one oncology nurse/RTT (2 FL, 2 IL), the paperless workflow implementation (2018-2020) also played an important role in terms of delays.

Organizational issues, digital booking routines *"For a time, it was chaotic [to go fully paperless]—we had both paper and paperless patients running in parallel. Very confusing. During that time, we had built up a queue of 400 patient referrals. When we went live with the digital booking system in 2020, we made a hard decision: patients who were already in treatment stayed on paper, but from that date forward, everything was paperless."* ***Interviewee 4 (Oncologist, FL)***

Technical alterations

This theme contained codes mainly related to major technological transformations during 2015 to 2024. For example, equipment related issues and upgrades, software changes, resource conditions, and treatment technique changes within the department. Approximately 67% of the codes within this theme were generated from interviews with oncologists. Overall, technical changes arose constantly throughout the decade demonstrating ongoing advances in technology in terms of both software and treatment planning systems.

Equipment change *"New techniques always require more resources. […] New technologies during this time [years: 2020-2022] include newer CT scanners, a PET-CT, and an in-house MRI, which helps with target delineation but also brings new demands."* ***Interviewee 13 (Medical Physicist, IL)***

Treatment technique changes *"RT with protons was a resource-intensive activity even though it has been introduced because of lower risk but still requires double treatment plans."* ***Interviewee 5 (Oncologist, FL)***

Software changes *"DoseCheck software simplified the quality assurance process. Previously we used an Excel tool that was cumbersome. It saved time for us and improved quality."* ***Interviewee 9 (Oncologist nurse/RTT, FL)***

Workflow alterations

This theme encompassed the most diverse inputs in terms of issues and events across the entire RT workflow, including prioritization, scheduling, delays, and interdependencies between process stages. All 13 interviewees contributed to this theme, capturing various important events across the RT workflow. For example, oncology nurse/RTT interviewees reported that hypofractionation treatments cleared up the schedule to make room for more time on the treatment machines. On the same topic, medical physicist interviewees reported that new machines required less time for service which also resulted in more room for treatments.

Patient scheduling issues *"SVF (Standardized care pathways) changed a lot in terms of the overall workflow. We pre-booked time slots in the schedule to reduce lead times for patients from specific diagnosis groups"* ***Interviewee 1 (Oncologist, FL)***

Medically motivated priorities *"There are still some delays within different processes, so we need to have a better flow to prioritize and sort patients. I prioritize a lot manually. It's not visible in any kind of digital description in the system, but I do."* ***Interviewee 8 (Oncologist, IL)***

Workflow adaptations *"Booking referrals and scheduling might have been affected by the transition from Elekta to TrueBeam machines"* ***Interviewee 13 (Medical Physicist, IL)***

Treatment related changes *"It was a big difference when we went from Clinac to TrueBeam. Because back then, service was one day a month at the Clinacs, so twelve days a year that was service. While TrueBeam initially had four 1.5-day services"* ***Interviewee 13 (Medical Physicist, IL)***

Quantitative dataset

From the extracted quantitative dataset, averaged mean total patient referrals per year between 2015 to 2024 were 5114 (Figure 3). During the year 2020, the number of referrals and total fractions decreased by 18% and 8% respectively compared to the year 2019 (until Q3). The quantitative data indicated that the observed change coincided with the outbreak of COVID-19. In 2020, the average delay for a patient was 12 weeks, across all cancer diagnoses. Delays observed in the subsequent years reduced successively to 7 weeks in 2024 (and to 6 weeks in 2025, data not shown). Over time, the reductions coincided with the implementation of the paperless workflow. Along with that, two new linacs were added in 2020 and a linac utilization tool with production focus was introduced at the department in 2021 [20]. Refer to supplementary material table 1 for other notable events.

Discussion

RT has undergone substantial transformations in recent years, driven by technological and clinical advances. This study provides an in-depth perspective on the effects of such changes by increasing the understanding of how qualitative factors can add insights to existing quantitative data trends. Results from 13 interviews with staff in leadership positions (FL/IL) from a modern large RT department in Sweden highlighted persistent issues with staffing organization for oncology nurses/RTTs, oncologists, and medical physicists during the last decade. Furthermore, around two thirds of the interviewees also reported issues relating to resource conditions and operational dynamics. On the other hand, introducing tools such as production planning, hypofractionation for the two largest diagnosis groups, and other leadership efforts helped to improve various parts of the RT workflow to increase patient throughput as well as reduce delays. Together with the qualitative findings, quantitative OIS data from the corresponding years indicated an overall improvement, with average delays across all cancer diagnoses decreasing from 12 to 7 weeks.

Today, operational predictions in healthcare are mainly based on quantitative metrics to anticipate periods of high demand and to manage resources. Previous qualitative studies have, however, highlighted that routine data may not fully reflect the realities of clinical practice [21-23]. Periods of staff overtime or increased workload may not be directly conveyed by numeric data, yet this may influence how workflows are managed [24]. In this study, although OIS data revealed that number of fractions and patient delays reduced after COVID-19 at the studied RT department, staff still reported operational issues and workload stress. The reduction in numbers coincided with two major events where hypofractionation was introduced for the two largest diagnosis groups (breast cancer and prostate cancer) and where a paperless workflow was introduced. Existing work in RT has typically used specific factors like fractionation time, resource/LINAC utilization, and patient throughput that contribute to long waiting time [25, 26]. These studies also acknowledge that multiple organisational and technical factors change constantly in RT and that their results not fully take those in account. In summary, quantitative studies pinpoint measurable inefficiencies in specific parts of the workflow [27, 28]. From our analysis and existing literature, it is evident that overall efficiency is also influenced by external factors, ongoing technological adaptations and external events [29]. Consistent with previous literature, from a team-level perspective we found that coordination, workload distribution, and communication among the staff, can play a pivotal role when the overall demand increases [30]. Qualitative data in such situations can uncover communication breakdowns, decision bottlenecks or major structural issues and additionally assist in planning how to practically accommodate the demand in terms staffing structures or resource planning.

Qualitative methodologies are not commonly used to identify areas for efficiency improvements in RT. A focused PubMed search was conducted on the 12th September 2026 using a combination of terms related to radiotherapy, qualitative research, workflow inefficiencies, staff experiences. This search resulted in only six articles since 2010 on this topic. Of these, only one was of relevance for the work presented here. This study was from UK and explored how extended working hours for RTT:s affected

work life and patient delays [31]. The authors found that extended working hours did impact the work life balance but not patient delays. In contrast to our study, the UK study only considered one professional group. Given the multidisciplinary nature of RT, the same workflow may be perceived completely different depending on profession or role. In our opinion, inputs from multiple professional groups are needed to get a complete overview of the workflow. Nonetheless, qualitative studies in wider hospital workflow settings outside RT are well researched and have identified specific strategies to improve patient flows, illustrating that qualitative findings can directly inform system-wide improvements [29, 32, 33]. Examples have identified actionable insights such as implementing patient flow focused structure, developing hospital wide checklists, and investing in digital tools leading to measurable improvements [33]. Solutions like these may offer reference points for exploring how such methods might be translated to the RT setting. Our study presents an approach to understand various challenges that are experienced and managed by the RT staff in their day-to-day work. Agreeing with the few studies addressing qualitative aspects [25, 26], exploring effects by RT related changes need to acknowledge the whole departmental perspective.

This work benefits from a long study period at a large modern RT department experiencing both stability and variability of events over time. The analysis explored perspectives from multiple RT professions, providing a broad representation of backgrounds and experiences. However, the long study period may have introduced recall bias, as less significant changes in clinical practice, daily procedures, or other contextual factors may have been forgotten over time although together could have influenced some of the observed outcomes. The transcribed interviews were analysed independently by researchers who were not involved in the interview process. However, it is also important to note that the interviewer's pre-existing professional relationship with participants may have influenced their responses, representing a potential source of bias. The established relationships built on professional trust and may for this reason also have facilitated more candid, in-depth discussions than with an unknown interviewer. Also supporting the trust perspective, only one participant asked to reviewed the results before the publication process. All ambiguites in transcripts could be resolved in the research group and there was no need to consult neither the interviewer nor the interviewees for clarifications. By design, this study was subjective and depends on individual staff perspectives at a single institution. In addition, the participants being oncologists were overrepresented in the sample set, accounting for almost half of the participants, potentially overrepresenting certain views. This should be considered when interpreting or generalizing the results nationally and internationally. Finally, the sample size was limited to 13 of the 17 initially selected and approached RT professionals. However, no substantially new themes emerged in the later three interviews suggesting that data saturation was achieved with the available participants.

Conclusion

In conclusion, we found that incorporating RT staff perspectives provided insights into day-to-day workflow events over the years that were not fully captured in routine RT data. Our analysis identified repetitive topics associated with patient waiting times and departmental delays. Notably, organizational challenges were consistently described by all interviewed professions and showed limited change over

time, highlighting the need for further evaluation of underlying factors, improved documentation and use of peripheral data such as for staff shortage and organizational standards even when an RT department is operating in a stable state. While individual quantitative or qualitative strategies provide valuable insights, combining both perspectives offers a more comprehensive understanding of RT workflows [19]. Importantly, our findings suggest that integrating staff-driven insights is essential when introducing new techniques and routines in order to support a resilient RT process. Future research could build on this work to identify how qualitative workflow insights can be systematically incorporated into decision support tools for isolated tasks as well as on a systemic level to enable more context-aware and practically applicable decision-making in RT.

Declarations

Ethical approval and consent to participate

All participants received information regarding the objectives of this work and data handling procedures. Written informed consent was obtained by email from all participants for both participation and publication. To ensure confidentiality, all transcripts were pseudonymized, and any identifying information was removed.

The data in this study was handled in accordance with relevant ethical guidelines and the Declaration of Helsinki. The work in this study was approved by the Regional Ethical Review Board and Swedish Ethical Review Authority in 2019 (Registration Numbers: 841-16, T640-17, 2022-02683-02).

Consent for publication

Not applicable.

Availability of data and materials

The COREQ checklist is provided in Appendix 1, and the interview guide is available in Appendix 2. The interview data are not publicly available due to participant confidentiality and privacy considerations.

Competing Interests

The authors declare that they have no competing interests.

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Authors contributions

MG, JL, and CO contributed to the conceptualization of the study. CAM conducted the interviews and prepared the interview transcripts. MG, CO, and JL performed the primary analysis and translations of the transcripts. MG, JL, FS, and CO contributed to the thematic analysis, including the development and refinement of codes, sub-themes, and themes. MG and CO drafted the manuscript. MG, JL, and CO contributed to the interpretation of the findings and critical discussion. All authors reviewed and approved the final manuscript.

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The authors declare the use of generative AI in the interview analysis process. According to the GAIDeT taxonomy [34], the following tasks were delegated to generative AI tools under full human supervision: (1) Generating Swedish to English translations of all interviews (2) Proofreading English transcripts. The generative AI tool used was Co-pilot (GPT-4) [Licensed for research use]. Responsibility for the content of the final manuscript lies entirely with the authors.

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Figures

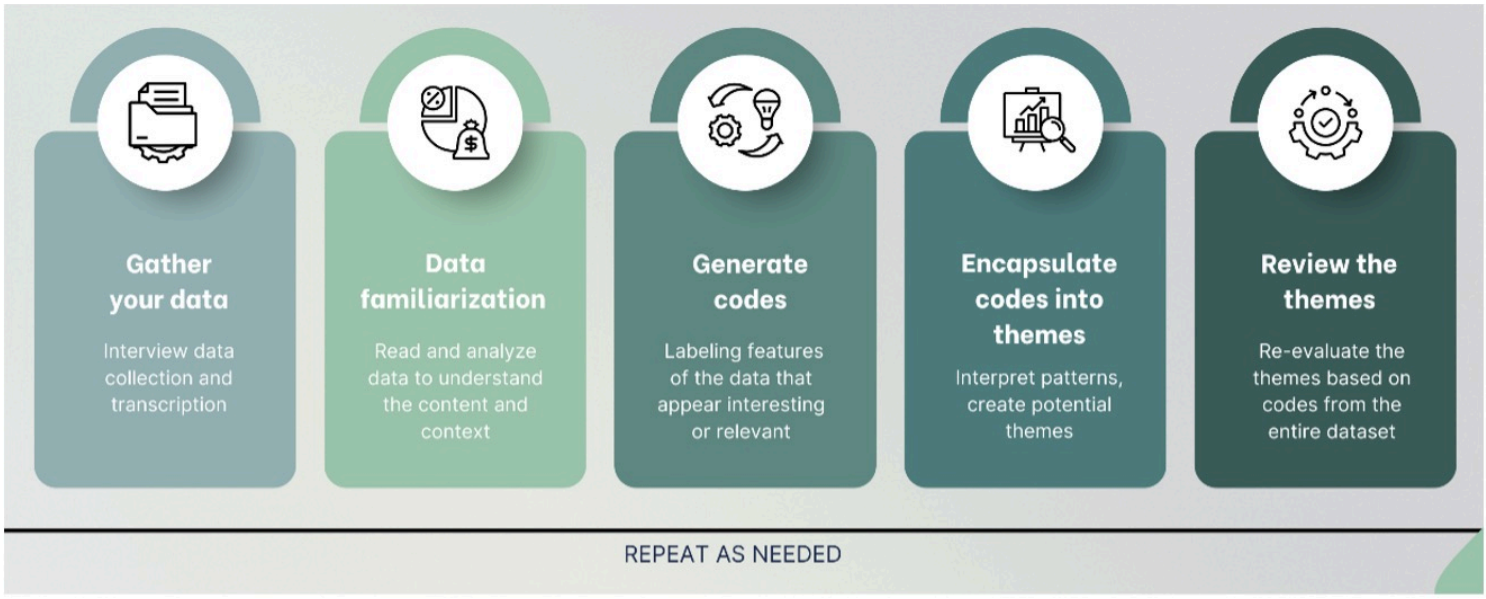


Figure 1

Five key steps to perform thematic analysis for interview data.

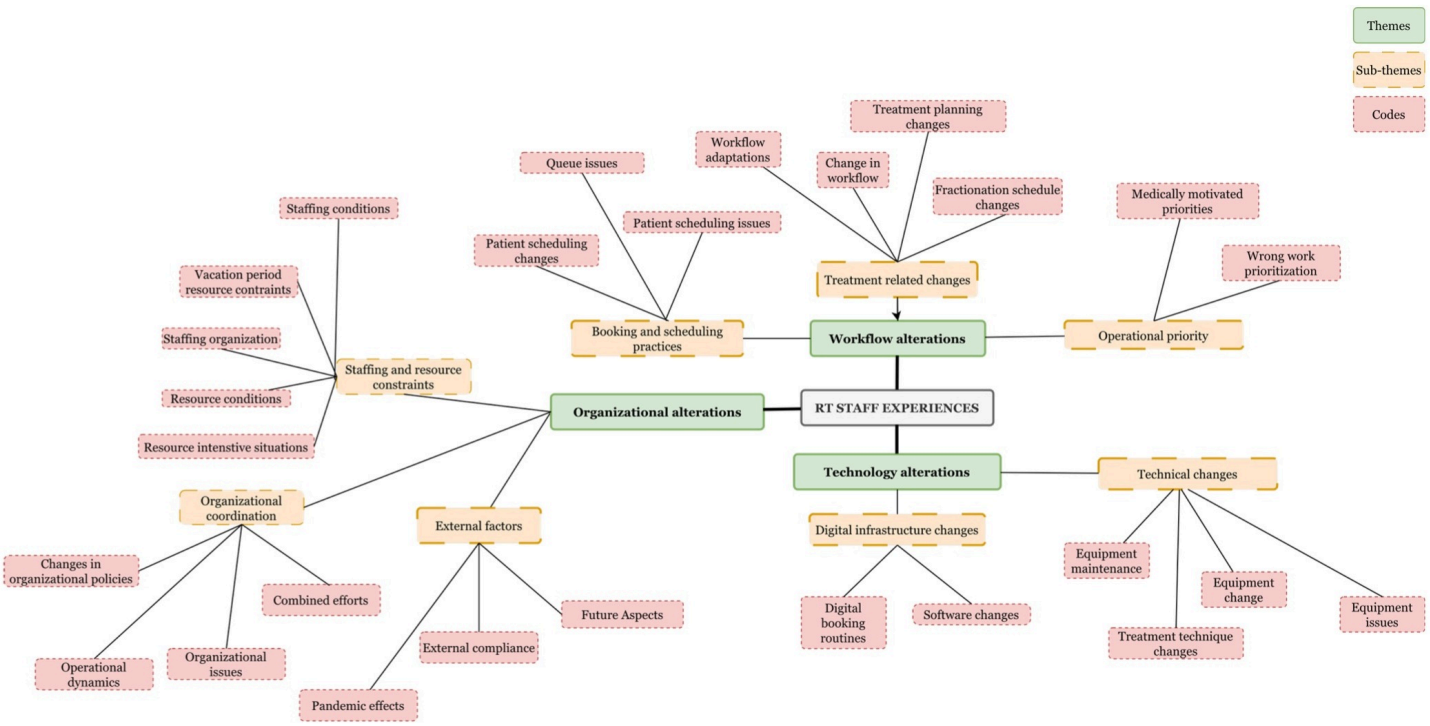


Figure 2

Visual description of the identified sub-themes and codes within thematic domains of organizational, technical and workflow related changes identified across 13 interviews with RT staff covering events from 2015 to 2024.

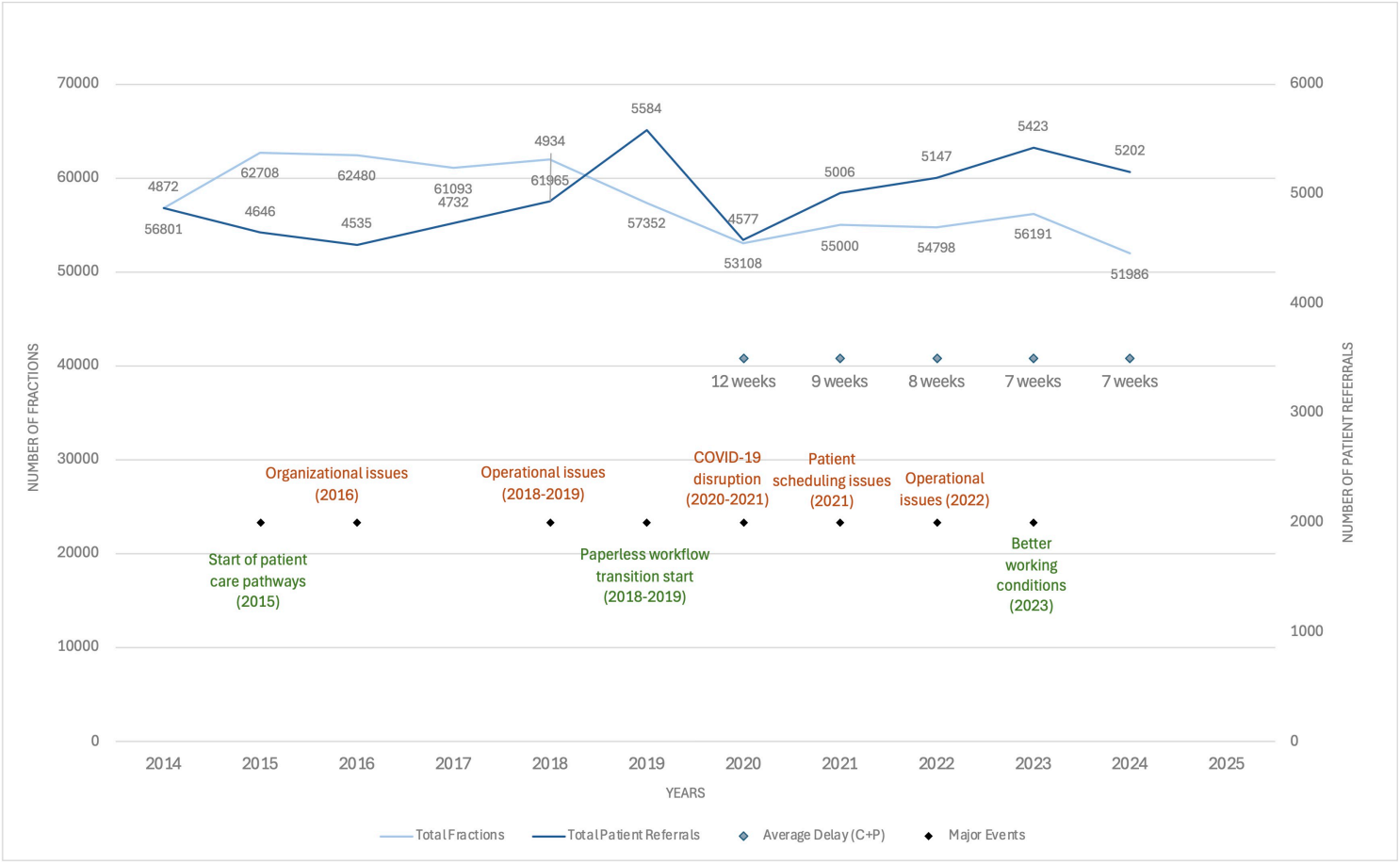


Figure 3

Temporal overview of qualitative and quantitative aspects during 2015-2024 visualizing total fractions and patient referrals per year with corresponding major events at the studied RT department and averaged patient delays in weeks per year.

Abbreviations: C- curative treatment intent, P- palliative treatment intent.

Note that – Overall delay statistics were only available after 2018, following the OIS integration of the department's two geographically separated sites.

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- SupplementaryMaterial.docx
- Appendix2InterviewGuide.docx
- Appendix1COREQCHECKLIST.docx