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Exploring Nurse Perspectives on AI-Based Shift Scheduling for Fairness, Transparency, and Work-Life Balance

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Abstract

Introduction

Work-life balance (WLB) is critical to nurse retention and job satisfaction in healthcare. Traditional shift scheduling, characterised by inflexible hours and limited employee control, often leads to stress and perceptions of unfairness, contributing to high turnover rates. AI-based scheduling systems offer a promising solution by enabling fairer and more transparent shift distribution. This study explored the perspectives of nurse managers, permanent nurses, and temporary nurses on the perceived fairness, transparency, and impact on work-life balance of AI-based shift scheduling systems.

Methods

A qualitative study design was used, with focus group (FG) interviews conducted between May and June 2024. The sample consisted of 21 participants from different healthcare settings, including acute hospitals, home care services and nursing homes in German-speaking Switzerland. The interviews were analysed using the knowledge mapping method, which allowed for a visual representation of key discussion points, highlighting consensus among participants. The focus group discussions revolved around five main themes, such as experiences with current scheduling systems, expectations of AI-based scheduling, and its potential advantages and disadvantages.

Results

Participants reported that current scheduling practices often lacked fairness and transparency, leading to dissatisfaction, particularly among permanent nurses. While temporary staff appreciated the flexibility in their schedules, permanent nurses expressed a desire for more autonomy and fairness in shift allocation. AI-based scheduling has the potential to improve shift equity by objectively managing shifts based on pre-defined criteria, thereby reducing bias and administrative burden. However, participants raised concerns about the depersonalisation of scheduling, emphasising the need for human oversight to consider the emotional and contextual factors that AI systems may overlook.

Conclusion

AI-based scheduling systems could offer significant benefits in improving fairness, transparency and work-life balance for caregivers. However, the integration of these systems must be accompanied by careful consideration of the human element and ongoing collaboration with healthcare professionals to ensure that the technology is aligned with organisational needs. By striking a balance between AI-driven efficiency and human judgement, healthcare organisations can improve nurse satisfaction and retention, ultimately benefiting patient care and organisational efficiency.

1 Introduction

Good work-life balance (WLB) is critical for nurse retention and job satisfaction in healthcare [1]. Lack of WLB is a leading cause of nurse attrition, with contributing factors including shift work, long hours, and rigid scheduling [2–4]. Shift scheduling plays a pivotal role in WLB as it dictates the structure and flexibility of nurses' working hours [5, 6]. Research indicates that when nurses have limited control over their shift schedules, they experience increased stress and lower job satisfaction, often feeling a mismatch between professional obligations and personal needs, which can lead to perceptions of unfairness [7–9]. Furthermore, the scheduling practices for permanent nurses can be influenced by the interpersonal dynamics between employees and supervisors, with favoritism or strained relationships sometimes resulting in unfair workload distribution [10, 11].

Incorporating nurses' preferences into scheduling can enhance perceptions of organizational justice by accommodating individual requests for shifts and time off and by fairly distributing weekend shifts relative to employment levels [7, 12, 13]. This can be seen among nurses with temporary contracts, who often have greater autonomy over their schedules, leading to higher satisfaction with their WLB [14, 15].

To address these challenges, AI-based algorithms are promising solutions for creating fair and transparent shift schedules. These systems can process large volumes of data by incorporating multiple factors, including unplanned absences and individual preferences, which are often too complex for manual scheduling [16, 17]. By making objective decisions based on predefined criteria, AI can reduce the risk of bias and ensure a more equitable distribution of shifts [16, 18, 19]. Unlike traditional scheduling methods, AI algorithms can continuously learn and adapt, offering dynamic and flexible scheduling that aligns with both staff needs and organizational demands [7, 19, 20].

Given these potential benefits, integrating AI-based scheduling tools in nursing could significantly enhance fairness and transparency in shift planning, thereby improving nurse satisfaction and retention [21]. However, for these systems to be effective, it is crucial to involve healthcare professionals in their development and implementation through a collaborative co-creation process [22, 23]. This ensures that the technology is user-friendly, tailored to the needs of end users, and effectively addresses the challenges of shift scheduling in nursing.

The aim of this study was to explore the perspectives of nurse managers, permanent nurses, and temporary nurses on fair, transparent, and participatory shift scheduling, including the perceived advantages and disadvantages of AI-based scheduling.

2 Method

2.1 Design

To gain insight into the perspectives of nursing leaders and permanent and temporary nurses on fair and reliable AI-based scheduling, the authors utilised a qualitative design by conducting focus group (FG)

interviews between May and June 2024. This qualitative approach facilitates an engaging discussion environment in which participants' viewpoints can be explored and collectively debated for relevance and alignment. FGs can yield a shared understanding and multiple perspectives on a topic [24]. To analyze the focus group interviews, the research team employed a Knowledge Mapping method [25]. This involved documenting the most important discussion content and reviewing it with the participants at the end of the focus group sessions. As a content-analytical method, Knowledge Mapping is well-suited for graphically presenting focus group results, with key findings visualized through clusters [25]. The COREQ checklist (Consolidated Criteria for Reporting Qualitative Research) was employed as the basis for the description of the study [26].

2.2 Study sample and Recruitment

The authors utilized a convenience sampling method to recruit permanent and temporary nurses from diverse sectors, including acute hospitals, home care services, and nursing homes in the German-speaking regions of Switzerland. The roles of various nurses were included in order to gain a comprehensive perspective. In addition to nurses, nursing leaders are recruited to represent their perspectives and associated challenges and experiences. The diverse selection of participants allows for a thorough understanding of the current situation and specific needs and challenges within different sectors of the healthcare system. For recruitment purposes, potential participants received a flyer detailing the aim, procedure, conduct, and benefits of the focus group interviews. Interested participants were registered directly with the research team.

2.3 Data collection

The CRSS (corresponding German acronyms lead to SPSS) method was employed in the formulation of the interview key questions. CRSS stands for "Collecting", "Reviewing", "Sorting", and "Summarizing" [27]. Three interview guides were developed: one for nurse managers, one for permanent nurses, and one for temporary nurses. The semi-structured questionnaires were designed by two researchers and reviewed for content and applicability by two other researchers. The guidelines for permanent nurses consist of the following five main topics, which are particularly relevant for fair and participatory scheduling: (1) experiences with current scheduling, (2) importance of fair and participatory scheduling, (3) requirements of scheduling for work-life balance, (4) expectations of AI-based scheduling, and (5) added value of AI-based scheduling. Each key issue was composed of to 3–4 specific questions to keep the discussion dynamic (Fig. 1). The two guidelines for temporary nurses and nurse managers included minor adjustments to the wording. For example, in the main topic "Expectations of AI-based shift scheduling," the moderator posed the question "What do you expect from AI-based fair and participatory shift scheduling? The focus of the discussion in the focus group interviews was to understand the concepts of fairness and participation in the context of work scheduling and the potential added value of AI-based Work scheduling.

The focus group interviews were conducted online using Microsoft Teams [28] by two researchers from the project team. The online survey was chosen because nurses from different regions of German-

speaking Switzerland participated, and travelling would have been too far. This allowed for a better planning of the interviews. During the interviews, one project member visualised the participants' statements on Padlet for each vital issue so that the participants could see them.[29] Central statements were arranged around one of the five main themes. Before switching to the next theme, the moderator assessed together with the participants the extent to which the summarizing visualization adequately represented various aspects of the discussion (consensus building). In addition to the visualized summary, the focus group interviews were digitally recorded to better discuss ambiguities in the interpretation of the visualization during subsequent analysis.

2.5 Analysis

In the knowledge mapping approach, data analysis begins during focus group interviews when statements are summarized and visualized. To ensure the correct interpretation of the statements, participants were asked to review the statements by topic [25]. The researcher compiled individual visualizations for each topic into a single padlet to identify thematic clusters that were considered particularly important or frequently mentioned by the participants. These clusters were then given greater weight in the written summary for each topic. The creation of an FG illustration map can be compared to the summarization method used in content analysis [25] because the collected material is reduced to its essential content.

3 Results

The interviews lasted between 40 and 90 minutes. A total of 21 nurses participated in four focus group interviews. Most participants were female (95%, n = 20) and had an average age of 34 years (SD = 11.6). In addition, 100% of the participants worked (66%, n = 14). In terms of care settings, most participants worked in an acute care hospital (33%, n = 7), followed by home care services (28%, n = 6), retirement, nursing homes (5%, n = 1); (24%, n = 5), managers, and temporary staff (10% (n = 2). Detailed information on participants' characteristics is presented in Table 1. The responses are presented according to the five themes and topics depicted in Fig. 1.

Table 1
Sample of focus group interviews.

Setting	Profession	Number (%)
Acute hospital	Nurses	7(33)
	Nurse assistant with formal education	2(9.5)
	Management	4(19)
Home care services	Nurses	2(9.5)
	Nurse assistant with formal education	3(14)
	Management	1(5)
	Commercial Assistant	1(5)
Retirement and nursing homes	Nurses	1(5)

3.1 Experiencing current Work Scheduling

Work scheduling in healthcare presents significant challenges for both leadership and staff, particularly in high-pressure environments, such as intensive care units (ICUs). For leaders, scheduling is a critical and resource-intensive management task that requires careful coordination to maintain the operational efficiency. In ICUs, scheduling is highly structured and adheres to predefined shift patterns, whereas in general wards, transparency is ensured through standardized processes without special regulations. However, maintaining fairness in the shift distribution remains a persistent challenge. Planning is often complicated by fluctuating team requirements, which vary monthly based on target work hours.

Absence management, particularly for long-term sick leaves, is partially managed through manual processes. Shifts are documented on paper, allowing the staff to sign up for the available shifts they can cover. By contrast, short-term absences are addressed through direct contact with employees who are notified by phone. Many institutions employ an anonymous system to manage these last minute adjustments, although such methods may lack the flexibility and efficiency required for optimal scheduling outcomes. This is especially required in home care services, where the rate of fluctuations is high and necessitates flexibility from employees.

According to participants from the acute hospital, fixed days off and leave requests were respected, and efforts were made to ensure that employees had two consecutive days off. Nevertheless, sometimes nurses have only one day off, which is often insufficient for adequate recovery. In private home care services, it is difficult to grant two consecutive days off, in certain situations. Recovery time often falls short, despite the consideration of leave requests. Transparency regarding work scheduling is unclear. Although the rules are the same for everyone, it is not entirely clear to nurses how the planning comes about. A Swiss hospital demonstrated that allowing employees to self-schedule does not necessarily enhance satisfaction, as it often results in the same individual taking undesirable shifts.

Temporary employees often have the flexibility to create their own work schedules, whereas permanent staff must align their personal lives with a fixed timetable. However, it is essential for temporary staff to remain adaptable as this fosters collaboration and increases the likelihood of being scheduled. Key traits of temporary workers include spontaneity and willingness to cover shifts when needed. Temporary employees can opt for either freelance or floater contracts. Freelancers communicate their availability directly to management, whereas floaters have their schedules planned on a short-term basis. Preferences were considered and accommodated when feasible.

3.2 Requirements for Work Scheduling

A growing demand for flexible, transparent, and equitable shift distribution has emerged in interviews with supervisors and employees. Prioritizing individual needs and fostering clear communication is essential for improving workplace satisfaction and efficiency. Participants expressed a preference for regular working days and shifts, which enhanced their work-life balance. Additionally, childcare considerations must be integrated into scheduling when employee preferences are considered. Options for 12-hour shifts should be available because some hospitals have successfully implemented models with both 12- and 8-hour shifts, particularly on weekends. This approach fosters patient continuity, while providing employees with greater flexibility. However, discussions continue regarding the potential drawbacks of 12-hour shifts, such as difficulties in maintaining the concentration. Nevertheless, the participants welcomed the opportunity to choose their preferred shift model.

Employees in home care services desire the right to two consecutive days off, an equitable distribution of shifts (including night shifts), and the consideration of personal preferences. Balanced work-life balance is essential, and overtime can be compensated for. At least two weekends per month should be free and shifts should be adjustable to personal needs. Work schedules should be finalized for approximately a month in advance.

To promote a more adaptable work environment, initiatives should include flexible starting times, continuous pay, unpaid leave, and the ability to transition between departments. There should be clear rules for distributing weekend and other shifts.

3.3 Fair and Participatory Work Scheduling

Engaging employees, acknowledging personal preferences, ensuring transparency, and facilitating regular communication enhances satisfaction and efficiency according to the participants. Consistent meetings and feedback mechanisms are vital to align work schedules with individual needs. A fair scheduling approach considers employee preferences and promotes equitable distribution of early, late, night, and weekend shifts, prioritizing stability by accommodating requests and minimizing shift changes. Additionally, the equitable allocation of weekend shifts and balanced shift distributions is crucial. Shift swaps between team members should also be permitted.

For leaders of home care services, it is important to ensure a balanced mix of patient cases so that the same person does not always handle complex cases. The workload and start times should be evenly

distributed to ensure fairness, particularly in this context.

3.4 Requirements for AI in Work Scheduling

The requirements for AI in work scheduling are particularly related to time savings and flexible accommodation compared with existing planning systems. AI-assisted scheduling should cater to diverse employee preferences and needs, including specific requests, such as avoiding late shifts on Wednesday evenings or maintaining a 40% workload despite a 50% employment status. Additionally, the system must incorporate factors such as experience and education levels, and account for supervisory roles and specialized responsibilities beyond direct patient care. Effective management of fluctuating monthly and annual balances is essential, as is the efficient overtime administration. The system should also facilitate the tracking of student supervision days. Moreover, corrections and individual adjustments should be easily implemented, along with the ability to find replacements for short-term absences.

AI should act as a neutral entity to promote team dynamics and be equipped with all the necessary information to enable optimal work scheduling. Therefore, a basic plan that can be corrected as needed is desirable. AI should be able to store work scheduling information from previous weeks and use it to distribute clients accordingly. All participants expected AI to save time for managers, allowing them to focus more on their teams and patients rather than planning.

3.5 Perceived Advantages and Disadvantages of AI-Based Work Scheduling

The implementation of AI-based work scheduling has significant potential in various healthcare sectors including acute hospitals, home care services, and nursing homes. The main advantages include higher planning accuracy and efficiency, reduction in planning errors and administrative burdens, and fairer distribution of shifts. These optimizations result in increased available time for patient care, higher employee satisfaction, and improved working conditions, characterized by transparency and fairness. However, there are various challenges associated with this context, including dependence on technology and the loss of human elements such as emotional responses and potential acceptance issues among employees.

Perceived advantages:

Implementing AI in work scheduling has a range of benefits for participating leaders. First, it enables more precise and efficient planning, leading to significant improvement in the quality of work schedules. Owing to its ability to make changes and adjustments quickly and easily, high flexibility is ensured. Task and shift assignments are made based on employees' qualifications and experiences, thereby increasing efficiency. Another significant advantage is the substantial time savings and error reduction achieved by the use of AI.

AI can act as a neutral entity for participating employees, reducing the emotional burden on those responsible for planning. Decision-making is based on objective data and algorithms, which increases

the objectivity of planning. Thoughtful and efficient planning can positively influence team dynamics.

Perceived disadvantages:

Participating employees expressed that a schedule that fully accommodates all individual needs and preferences will not be available, and there are always discrepancies. The ability to consider individual requests may be limited, leading to restrictions in personalization. Additionally, the use of technical systems results in high dependency, which can cause difficulties, particularly during technical failure. Participants also noted that the system can only function as well as the data input into it, which must always be current and accurately evaluated according to the employees.

For leaders, the potential loss of human aspects in planning is disadvantageous. The current burden on employees may not be reflected by AI. Leaders see the work schedule as an important management tool that allows them to plan differently according to non-objective considerations such as emotional distress. Human intuition and the understanding of individual needs cannot be fully replaced by AI. Despite the use of AI, the responsibility for work scheduling remains with human planners as they need to input information for AI. The efficiency of AI is significantly dependent on the precision and completeness of data. While trust in AI generally exists, as it is seen as more objective, it must be well-designed and user-friendly.

All participants agreed that control over work scheduling should remain in human hands despite the use of AI. Final decisions and responsibilities remain with human planners, as they can review everything again to ensure that the schedules align with all relevant criteria important for the department. Furthermore, it is crucial to ensure that AI is programmed and trained to implement the principles of fair and effective work scheduling, without neglecting human needs. This ensures a balanced and high-quality scheduling.

4 Discussion

The findings of this study provide a nuanced understanding of the perspectives of nurse managers, permanent nurses, and temporary nurses regarding fair, transparent, and participatory shift scheduling.The participants' statements emphasise the research on of work scheduling on WLB, job satisfaction, and nurse retention. Participants highlighted the need for flexibility, regular working days, and consideration of personal preferences, including childcare, and the ability to engage in personal activities. These aspects are crucial for improving WLB and reducing burnout, which is consistent with studies showing that inflexible and inconsistent scheduling contributes to high turnover rates [30].

AI-based work scheduling offers several advantages that address the challenges identified in the traditional scheduling methods. Participants emphasized the increased planning accuracy, efficiency, and fairness associated with AI, which aligns with the literature on AI's potential to enhance operational efficiency and reduce errors [31]. AI's capacity to handle large datasets and make objective decisions can minimize biases and improve perceptions of fairness, supporting the finding that AI promotes more

equitable scheduling [32]. The AI's ability to save time for nurse managers, allowing them to focus more on patient care and team management, was particularly valued.

Despite these advantages, the participants expressed concerns about the potential loss of human elements in planning. AI may not fully capture the nuanced understanding of individual employee needs and current workloads that human planners can provide. This concern is echoed in the literature, where the depersonalization and rigidity of AI systems have been noted as significant drawbacks [33]. The participants emphasised the importance of maintaining human oversight to ensure that AI decisions are aligned with departmental needs and values. Furthermore, they highlighted the necessity for a balanced approach that combines AI efficiency with human intuition. In planning, the human factor is of particular importance, as it encompasses both decision-making power and an empathetic understanding of individual circumstances. This suggests a dual role for human planners, who should oversee the technical aspects and provide emotional and contextual insights that AI cannot currently offer [34, 35].

The participants also recognise technical challenges and the dependency on accurate, up-to-date data. The efficiency and effectiveness of AI systems are highly dependent on the quality of the input data, and any inaccuracies or outdated information can lead to suboptimal scheduling decisions. This finding emphasizes the need for continuous data monitoring and updates to maintain AI performance [36].

Interestingly, while participants desired a technology that matches their preferences and outputs a schedule, there seems to be a limited awareness of AI's potential to dynamically adapt to changing requirements and integrate additional decision-making information. This highlights a potential gap in the understanding of AI's capabilities, suggesting that more education and demonstration of AI's adaptive features could enhance its acceptance and perceived value among healthcare staff [37–39].

The notion of fairness in scheduling also came under scrutiny. While AI can create equitable schedules based on predefined rules, questions remain about whether these rules themselves are fair. For instance, allowing employees to work only on specific days, such as Mondays and Tuesdays, can be seen as both fair and unfair, depending on the broader context and organizational needs. These subtleties highlight the importance of involving staff in defining what fairness means within their specific setting, rather than imposing a one-size-fits-all solution [7, 40]. Therefore, it is essential to use context-specific training data. For instance, training an AI model with hospital data does not ensure fairness in home care services or nursing homes.

Strengths and limitations

The study used focus groups and knowledge mapping to collect different perspectives and ensure a structured and transparent analysis. The diversity of the sample and the use of semi-structured questionnaires encouraged dynamic discussions. However, generalisability is limited due to the convenience sample and online implementation, and potential biases due to moderation and

visualisation may influence the results. In addition, clustering may simplify complex views, resulting in loss of important details.

Implications for Practice

The findings of this study have several practical implications for healthcare organizations implementing AI-based shift-planning systems. It is of utmost importance that nurses are involved in the planning and implementation phases to guarantee that the system meets the needs and preferences of this group of people. Through training and ongoing support, nurses familiarize themselves with new technology and integrate it smoothly into their workflow.

It is also important to ensure that AI systems are regularly updated with accurate data. Moreover, it is crucial to provide information and training regarding the functionality of AI-based work planning and its potential applications. This will facilitate an understanding of how technological efficiency can replace the human elements of planning.

Future Research Directions

Further research should be conducted to examine the long-term effects of integrating AI in shift scheduling on aspects such as work-life balance, job satisfaction, and retention. It would be beneficial for future studies to investigate the specific features of AI systems that contribute the most to perceived fairness and transparency, as well as the optimal methods for involving staff in the development and implementation process.

Furthermore, it would be beneficial to investigate the psychological impact of relying on AI for scheduling, including any potential stress or relief experienced by the staff. In addition, further research should be carried out on what exactly human means and what is needed for planning to better understand what AI should do or whether there are other ways of doing this.

5 Conclusions

This study highlights the perceptions of current scheduling systems and the perceived potential of AI-based systems to improve work-life balance, job satisfaction, and fairness within the nursing profession. Although challenges and limitations exist, the benefits of increased accuracy, efficiency, and transparency may be significant. By involving nurse professionals in the development process and maintaining a balance between technology and human oversight, AI can be a powerful tool for optimising shift scheduling in healthcare settings.

Declarations

Ethics approval and consent to participate

The local Ethics Committee from the University of Applied Science in Bern confirmed that the study did not require full ethical review and did not fall under the Swiss Federal Law on Human Research. The study was voluntary for all participating companies and employees, and all participants were free to stop completing the questionnaire at any time.

Consent for publication

Not applicable.

Availability of data and materials

Competing interests

The authors declare that they have no conflicts of interest.

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Authors' contributions

MG and JSB designed the questionnaire, recruited participating companies, and collected the data. MG and FJR analyzed the data. CG and MS contributed substantially to data interpretation. MG, FJR, and JSB wrote the manuscript. CG and MS have provided feedback on the manuscript and have assisted with its finalisation. All authors have read and approved the final manuscript.

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Tables

Table 2 is available in the Supplementary Files section.

Figures

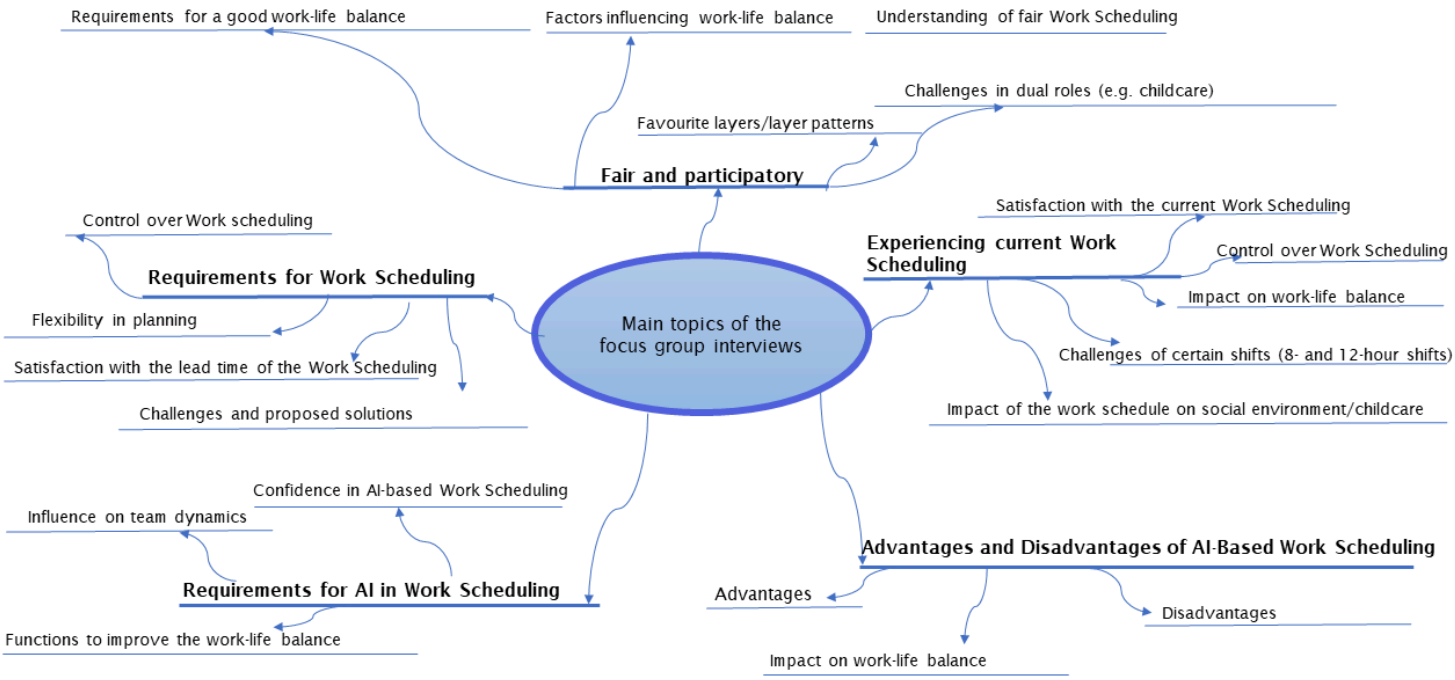


Figure 1

Main topics of the interview guideline

Supplementary Files

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- Table2.docx