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Outcomes of Digital Nursing Schedules: A Systematic Literature Review

Abstract. The purpose of this literature review was to identify the evidence on the outcomes of digitalisation of schedules in nursing. Data were gathered from CINAHL, Medline, Cochrane Library, PubMed, ScienceDirect, JSTOR and SpringerLink electronic databases. Seventy-four relevant literature items were identified. Ten studies published between 2015 and 2024 were evaluated and critically analysed using the JBI Critical Appraisal Checklist: four systematic literature reviews, three quasi-experimental studies, two case studies, and one qualitative descriptive study. The literature on electronic schedules in nursing reports on a variety of positive and negative impacts on nurses, patients and healthcare organisations. The introduction of electronic schedules in nursing is has mainly positive consequences, because if appropriately implemented, it leads to better patient health outcomes and increased job satisfaction among nurses. However, the developments in the field are ongoing and more research on that topic is needed before a firmer conclusion can be reached.

Key words: digitalisation, nursing, roster, staffing and scheduling.

Izidi digitalnih urnikov v zdravstveni negi: sistematičen pregled literature

Povzetek. Namen pregleda literature je bil opredeliti dokaze o izidih digitalizacije urnikov v zdravstveni negi. Podatke smo zbrali iz elektronskih podatkovnih zbirk CINAHL, Medline, Cochrane Library, PubMed, ScienceDirect, JSTOR in SpringerLink. Identificirali smo 74 relevantnih enot literature. Deset raziskav, objavljenih med letoma 2015 in 2024, je bilo ovrednotenih in kritično analiziranih z uporabo kontrolnega seznama za kritično oceno JBI. Vključili smo štiri sistematične preglede literature, tri kvazi-eksperimentalne študije, dve študiji primera in eno kvalitativno opisno raziskavo. Literatura o elektronskih urnikih v zdravstveni negi poroča o različnih pozitivnih in negativnih učinkih na medicinske sestre, paciente in zdravstvene ustanove. Uvedba elektronskih urnikov v zdravstveni negi se je večinoma izkazala kot pozitiven ukrep, ki ob ustreznem izvajanju vodi k boljšim zdravstvenim izidom pacientov in večjemu zadovoljstvu medicinskih sester pri delu. Obravnavano področje se še razvija in za bolj zanesljive sklepe bodo potrebne nadaljnje raziskave.

Ključne besede: digitalizacija, zdravstvena nega, urnik, razporejanje kadra.

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Introduction

Scheduling refers to the allocation of time and people to perform a defined activity and involves assignment of nurses to shifts, under constraints of time, efficiency, and cost.[1] The array of constraints linked to nurse scheduling issues is extensive, encompassing at least the following: maximum (minimum) days on, maximum (minimum) hours, personal preferences, number of consecutive free days and consecutive shifts, balancing the workload among personnel and nurses who should or should not work together.[2] The potentially negative effects of shift work can cause disturbed circadian rhythms in employees, and several adverse psychological and physical changes.[3] These impact on neuro-behavioural and physiological functioning, on psychomotor performance[4,5] and menstrual regularity,[6] interfering with sleep quality and duration,[7] raising burnout and dissatisfaction at work,[8] emotional exhaustion and decreased self-esteem[9] and increasing cardiovascular disease-related mortality,[10] the risk of developing Type 2 diabetes[11] and fatigue.[12] Adverse consequences include decreased staff satisfaction, increased turnover among nursing personnel, diminished hospital performance, and ultimately, a negative impact on patient experience.[13]

It has been reported that ward nurses spend more than one working day per month manually coordinating and revising the schedule.[14] Recently, digital (i.e. electronic, computerised) scheduling has developed rapidly. It involves the use of computer software to manage information about shifts, annual leave, sickness absence, task details and the workspace of each staff member.[15]

The omnipresence of computer and smartphone applications raises the question of why nursing has not yet completely moved to electronic scheduling in this era of digitalisation. Hence, the aim of our study was to identify evidence on the outcomes of electronic scheduling in hospital nursing through a literature review. The objective was to contribute scientific evidence that could help nurse leaders to replace paper-based work with electronic software to generate schedules, if feasible. We posed the following research question: Does empirical evidence support the notion that electronic scheduling in hospital nurses yields more favourable outcomes compared to paper-based scheduling methodologies?

Methods

Search methods

Using a systematic search strategy to review the literature, we searched the CINAHL, Medline, Cochrane Library, PubMed, ScienceDirect, JSTOR and SpringerLink electronic databases. We used the following search terms: (1) nursing, (2) software, (3) roster, (4) personnel staffing and planning (5) hospitals. We limited our search to the peer-reviewed articles in English language. We made a preliminary check of selected search terms within PubMed using MESH Terms.

Quality appraisal

After further review of the articles' PICO consistency (P – population, I – intervention, C – comparative intervention, O – outcomes), the selected articles were critically appraised using the following JBI Critical Appraisal Tools: Cohort Studies; Systematic Reviews and Research Syntheses; Quasi-Experimental Studies; and Case Reports.[16] Lastly, only the articles published between 2015 and 2024 were included into the final selection.

Content analysis

We conducted a qualitative content analysis of the included studies. Both authors performed the analysis using Microsoft® Excel.

Results

Search outcomes

Using the search strategy with Boolean operators, we found 19,814 hits, which were analysed according to the phases shown in Figure 1. In the first round of abstract screening, we eliminated studies that were not in line with the purpose of our research, and the duplicates. A total of 3,594 articles met the initial inclusion criteria for the review; 74 articles were assessed for eligibility. The final selection comprised ten articles (four systematic literature reviews, three quasi-experimental studies, two case studies, and one qualitative descriptive study).

Synthesis

We identified 140 codes, which were grouped into three substantive themes (Table 1):

1. characteristics of nurse schedules,
2. electronic scheduling positive outcomes, and
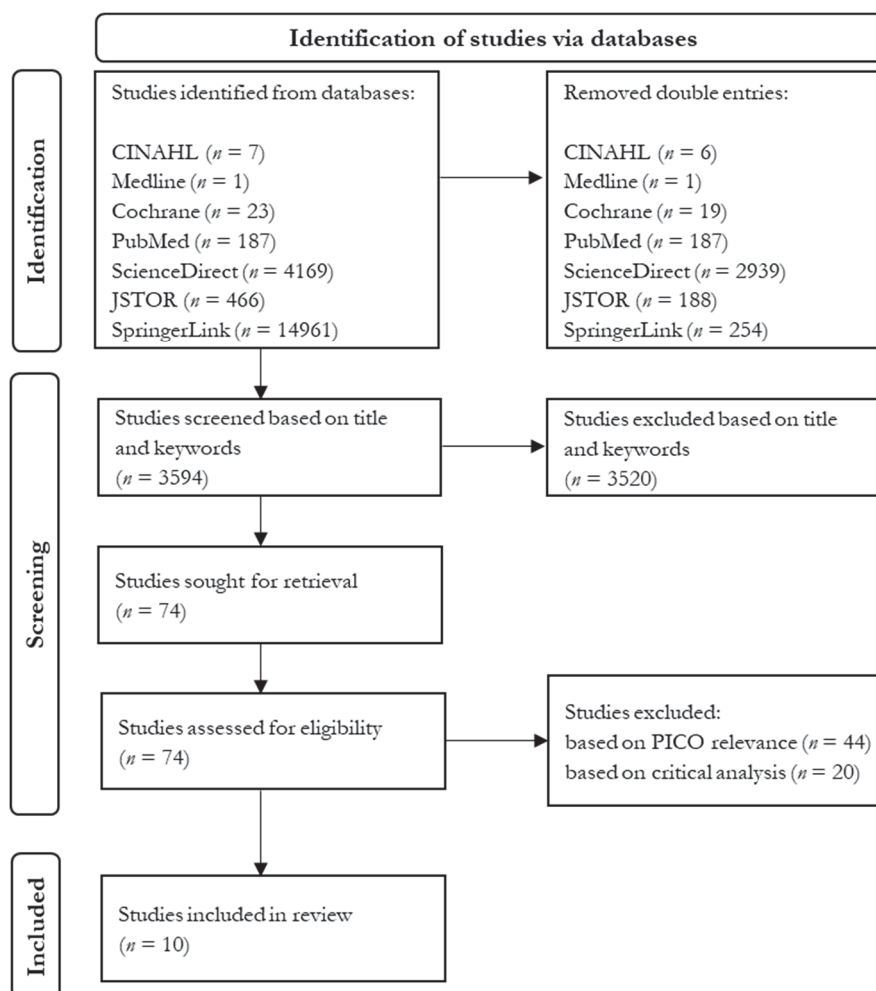3. electronic scheduling negative outcomes.

Figure 1 Flowchat based on the PRISMA methodology.[17]

Table 1 Detected themes and subthemes associated with electronic scheduling.

Categories ($n = 24$)	Studies (in alphabetical order)
Theme 1: Characteristics of nurse schedules human factors influencing scheduling – manual scheduling – roster rescheduling requests – professional judgement as a scheduling method – characteristics of nurse scheduling – shift rescheduling	Clark et al. (2015)[18] Griffiths et al. (2020)[19] Leung et al. (2022)[20] O'Connell et al. (2024)[21] Soomro et al. (2018)[22] Turunen et al. (2020)[23]
Theme 2: Positive outcomes of digital scheduling improved supervision through digital scheduling – improved scheduling through electronic rostering – positive effects of digital scheduling – positive impact of scheduling on patient health outcomes – increase in nurse satisfaction – decrease in nurse sickness absence – improved sleep – improved staff productivity – improved work processes – decrease in conflicts due to scheduling – positive impact on work–life balance – flexibility of electronic schedules	Baniulyte et al. (2023)[24] Clark et al. (2015)[18] Griffiths et al. (2020)[19] Karhula et al. (2020)[25] Leung et al. (2022)[20] O'Connell et al. (2024)[21] Shiri et al. (2021)[26] Soomro et al. (2018)[22] Turunen et al. (2020)[23] Wynendaele et al. (2021)[27]
Theme 3: Negative outcomes of digital scheduling negative aspects of digital scheduling – negative impact of digital scheduling on patients – negative impact of digital scheduling on nurses – decline in morale and motivation due to ineffectiveness of the schedule changes – unnecessary adjustments – insufficient knowledge of schedule management	Baniulyte et al. (2023)[24] Griffiths et al. (2020)[19] O'Connell et al. (2024)[21]

Discussion

The objective of our study was to ascertain empirical evidence concerning the effects of digital scheduling within hospital nursing contexts. Nursing schedules possess significant characteristics that exert influence over the scheduling process, allocation of time, and eventual outcomes.[21] Schedules are constantly changing, are characterised by high volatility and unreliability, and demand significant time from the lead nurse, who must navigate diverse interests while adhering to regulations.[18] Prior to the formulation of the definitive schedule, nurses submit their preferences and requests to their manager regarding the schedule. This participative way of coordinating schedules is typical in nursing and has a positive effect on employees' sense of control over their own working time, as they have a choice of when and how many hours they work.[23] On the other hand, there are also disadvantages of participative scheduling; the most notable is the dynamics of the relationship between the lead nurse who sets the schedule and her subordinates. Another disadvantage is the reduced fairness of the schedule.[27]

With the development of informatics in nursing and the advancement of modern technologies, handwriting a schedule on paper is considered an obsolete practice.[20] The implementation of digital scheduling systems in nursing is associated with several beneficial outcomes. Firstly, it enhances the supervision of work processes, leading to improved efficiency and quality of work. Additionally, digital scheduling results in higher schedule quality and flexibility.[25,28] Digitalised scheduling correlates with reduced sick leave, heightened nurse satisfaction, decreased scheduling conflicts among employees, improved sleep patterns among healthcare workers, and prevention of burnout.[25] Moreover, it enhances productivity and saves time. Ultimately, digital scheduling positively influences patient health outcomes by improving efficiency and quality of care.[21]

Nevertheless, the literature highlights certain adverse outcomes associated with digital scheduling, such as a worsened relationship between the lead nurse and her coworkers.[27] Evidence also suggests that the implementation of digital scheduling software should be gradual, and not sudden,[22] otherwise there is likely to be more staff illness and consequential absence.[24] These problems could be, at least in part, attributed to the nurses' general difficulties with adapting to changes. The factors for successfully implementing a digitalised scheduling system in a healthcare

organisation include proper policy and compliance during system implementation, technical support, proper leadership, sound goals and objectives, gradual implementation, evidence of the advantages offered by the new system, support from upper (senior) management and strong communication between all levels of staff. Nurses should be properly trained in working with the new system, otherwise there will be more dissatisfaction and cynicism among the employees, which could be avoided.[19]

Despite predominantly positive outcomes, there seems to be an ambivalent relationship between nursing and digital nursing technologies.[29] The decision of the nurses to use new technology systems is related to their perception that adopting new behaviours is relevant to their job and could improve their performance and advance the quality of care.[28]

Study limitations

The studies included were not overly comparable due to the utilisation of diverse methodologies across various healthcare settings with differing professional levels and roles within the healthcare sector. A more strategic approach would involve concentrating research efforts and clearly defining the type of electronic scheduling system (e.g. participatory or automated) under scrutiny.

Conclusion

The volume of literature about electronic scheduling is vast and offers many different insights in its outcomes for patients, nurses and healthcare organisations. The implementation of electronic scheduling represents a key step in the digitalisation of nursing. While this measure has yet to be adopted in many healthcare settings, evidence suggests it mainly leads to positive outcomes and should therefore be seriously considered for integration into nursing practice.

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