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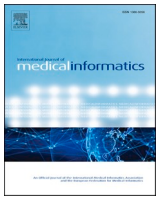

Health information system support for collaboration between physicians and registered nurses: National cross-sectional user experience surveys from 2010 to 2023

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ABSTRACT

Background: In addition to storing patient data, health information systems (HISs) should advance continuity and quality of care by supporting collaboration between physicians and registered nurses (RNs). Our aim was to study how physicians and RNs experience this support and how the situation has evolved from 2010 to 2023.
Methods: Nationwide usability-focused cross-sectional surveys were conducted among Finnish physicians in 2010, 2014, 2017, and 2021 and RNs in 2017, 2020, and 2023. For this study, we selected respondents (1807–2555 physicians and 1126–1950 RNs) working in public sector wards and outpatient clinics and using the six largest electronic health record (EHR) system brands. Eight statements related to collaboration were analyzed by professional group and study year.
Results: Although both professional groups rated HIS support for collaboration and information exchange between physicians and RNs relatively positively (42–69% agreed), their experiences had not improved much over the years. Continuity of care was considered good by 34–54% of physicians and 51–58% of RNs. Half of respondents were dissatisfied with the readability of nursing documentation (52–56% of physicians and 30–37% of RNs) and support for noticing new orders (40–46% of physicians and 26–36% of RNs). Only 7–30% of all respondents felt that patient summary views provided by EHR systems helped to form an overall picture of the patient's situation; however, the proportion did improve over the years.
Conclusions: HISs were considered to better support collaboration among their own professional group than between physicians and RNs. As reviewing patient information forms a basis for decision making and high-quality care, EHR development should not only focus on ordering and documentation tools but also on securing multiprofessional utilization of data. Indeed, the varied needs of professional groups should be recognized in the early stages of the development process.

1. Introduction

Fluent communication between physicians and registered nurses (RNs) improves patient outcomes and quality of care [1,2], for example, by increasing patient satisfaction [3], shortening lengths of stay [4], and enhancing patient safety [2,5]. Interventions such as checklists, team training, work shift evaluation programs, and shared documentation templates have been shown to improve communication [6,7]. Consequently, one of the central goals in the development of health information systems (HISs) is to enhance collaboration and information exchange, for example, by displaying patient data documented by various professional groups in an easily readable and comprehensible format, even for complex patients with several comorbidities [8].

Although the delivery of modern healthcare is increasingly dependent on care coordination in teams and allocation of tasks, only a few studies have focused on the experiences of physicians and RNs on HIS

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Table 1
The questions and statements included in the study.

Question: How well do you consider that HISs support collaboration and information exchange between various parties?
Response options: Very well, fairly well, neither well nor poorly, rather poorly, very poorly, feature not available, not willing to respond
Physicians: Among physicians in your own organization
RNs: Among RNs in your own organization
Between physicians and RNs
Question: Use the following statements to assess how the information systems you use support physicians'/nurses' work.
Response options: Fully agree, somewhat agree, neither agree nor disagree, somewhat disagree, fully disagree, feature not available, not willing to respond
HISs help to ensure continuity of care.
It is easy to obtain necessary patient information using the EHR system.
The patient's current medication list is presented in a clear format.
The EHR system generates a summary view that helps to form an overall picture of the patient's situation.
The information on the nursing record is in an easily readable format.
Physicians: The EHR system monitors and notifies when the orders given to nurses have been completed.
RNs: The EHR system supports reacting to and finding physicians' orders.

support for collaboration [8–10]. These studies suggested that HISs may create "an illusion of communication," i.e., professionals may assume that their documentation is read and reacted upon by others [9,11]. Healthcare data standards and terminologies, such as the International Classification of Diseases (ICD-10), Systematized Nomenclature of Medicine – Clinical Terms (SNOMED-CT), and Clinical Care Classification (CCC), have been developed to standardize the content and structure of documentation and consequently to ensure that the information reaches the intended recipients in a meaningful, appropriate, and unchanged format [12–14]. Although standardized nursing documentation makes daily nursing care transparent and thus supports quality, safety, and continuity of care [15], organizations must select which standards to use [16].

While only every tenth U.S. hospital used electronic health record (EHR) systems in 2010 [17], in Finnish public healthcare, EHR coverage had reached almost 100 % already by 2007 [18]. Until the recent years, Finnish physicians' notes have mostly been free text structured under a few nationally defined headers. Diagnoses are coded with ICD-10, and SNOMED-CT is only recently being translated into Finnish. Computerized physician order entry (CPOE) was introduced into Finnish EHR systems from 2000 to 2010 [19]. Physicians are expected to order inpatient medications discretely, but other orders are often transcribed from free text by RNs or secretaries into scheduling, laboratory orders, and nursing tasks. Until the mid-2010 s, many EHRs did not assist nurses in noticing new orders nor did they enable documenting reactions to the given orders. A national nursing documentation data structure adapted from the CCC (Finnish Care Classification [FinCC]) was introduced at the beginning of the 2000 s [20,21]. Vital signs, laboratory tests, diagnostic imaging studies, and medications are ordered and documented utilizing discrete structures and nomenclatures.

The aim of this research is to study how Finnish physicians' and RNs' experiences of EHR and HIS support for collaboration in clinical work has evolved over a 13-year period. The research questions are:

- What kind of experiences did physicians and RNs have regarding HIS support for collaboration, information exchange, and continuity of care in clinical work?
- How did these experiences evolve over a 13-year period?

2. Methods

2.1. National cross-sectional surveys

National cross-sectional surveys on end-user experiences of HISs were conducted among Finnish physicians in 2010, 2014, 2017, and 2021 [22–25] and RNs in 2017, 2020, and 2023 [26–29]. There were 3929, 3781, 4018, and 4683 respondents, respectively, for the physician surveys and 3607, 3610, and 2970, respectively, for the RN surveys. The RN survey was modified from the validated usability-focused web-based questionnaire (National Usability-Focused HIS Scale [NuHISS]) developed for physicians [30]. For the physician survey, the individual email links were sent by the Finnish Medical Association (FMA) to all physicians under 65 years of age and currently living in Finland. The email addresses were obtained from the register of the FMA, which contains more than 90 % of all physicians' email addresses (n = 19,142 in 2021). For RNs, the surveys were sent to all nurse members, including RNs, midwives, and public health nurses, of the Finnish Nursing Association, the National Association of Health and Welfare Professionals, and the National Professional Association for the Interests of Experts and Managers in Healthcare who had provided an email address (n = 58,276 in 2020).

2.2. Ethics

According to the national ethical instructions for research, the studies did not require ethical approval [31]. The autonomy of research subjects was respected, there was informed consent, no harm was possible for the subjects or their confidentiality, and research data were protected. The researchers were not able to identify individual respondents. However, as the data for the RN studies were collected by a national authority (Finnish Institute for Health and Welfare [THL]), ethical approval was provided by its institutional review board (9/2016§744; THL482/6.02.01/2020; THL/634/6.02.01/2023§928).

Table 2
Respondent demographics.

	Physicians				RNs		
	2010	2014	2017	2021	2017	2020	2023
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
Age group							
<35 years	341 (14)	427 (24)	517 (25)	631 (25)	356 (19)	370 (19)	162 (14)
35–44 years	664 (27)	392 (22)	464 (22)	719 (28)	403 (21)	431 (22)	262 (23)
45–54 years	844 (34)	505 (28)	557 (27)	598 (23)	577 (30)	594 (30)	338 (30)
>54 years	631 (25)	446 (25)	556 (27)	589 (23)	544 (29)	555 (28)	364 (32)
Principal environment of EHR use							
Inpatient	771 (31)	406 (22)	439 (21)	534 (21)	1178 (62)	1028 (53)	565 (60)
Outpatient	1733 (69)	1401 (78)	1662 (79)	2021 (79)	722 (38)	922 (47)	461 (40)
Experience of use of current EHR in years							
<1 year	223 (9)	162 (9)	151 (7)	849 (33)	121 (6)	521 (27)	144 (13)
1–3 years	610 (24)	280 (16)	287 (14)	838 (33)	221 (12)	449 (23)	346 (31)
> 3 years	1654 (66)	1358 (75)	1652 (79)	861 (33)	1534 (81)	980 (50)	638 (56)
Total (n)	2504	1807	2101	2555	1900	1950	1126

Data are presented by professional group and study year. Percentages do not add up to 100 % due to ~ 1 % not having responded to these questions.

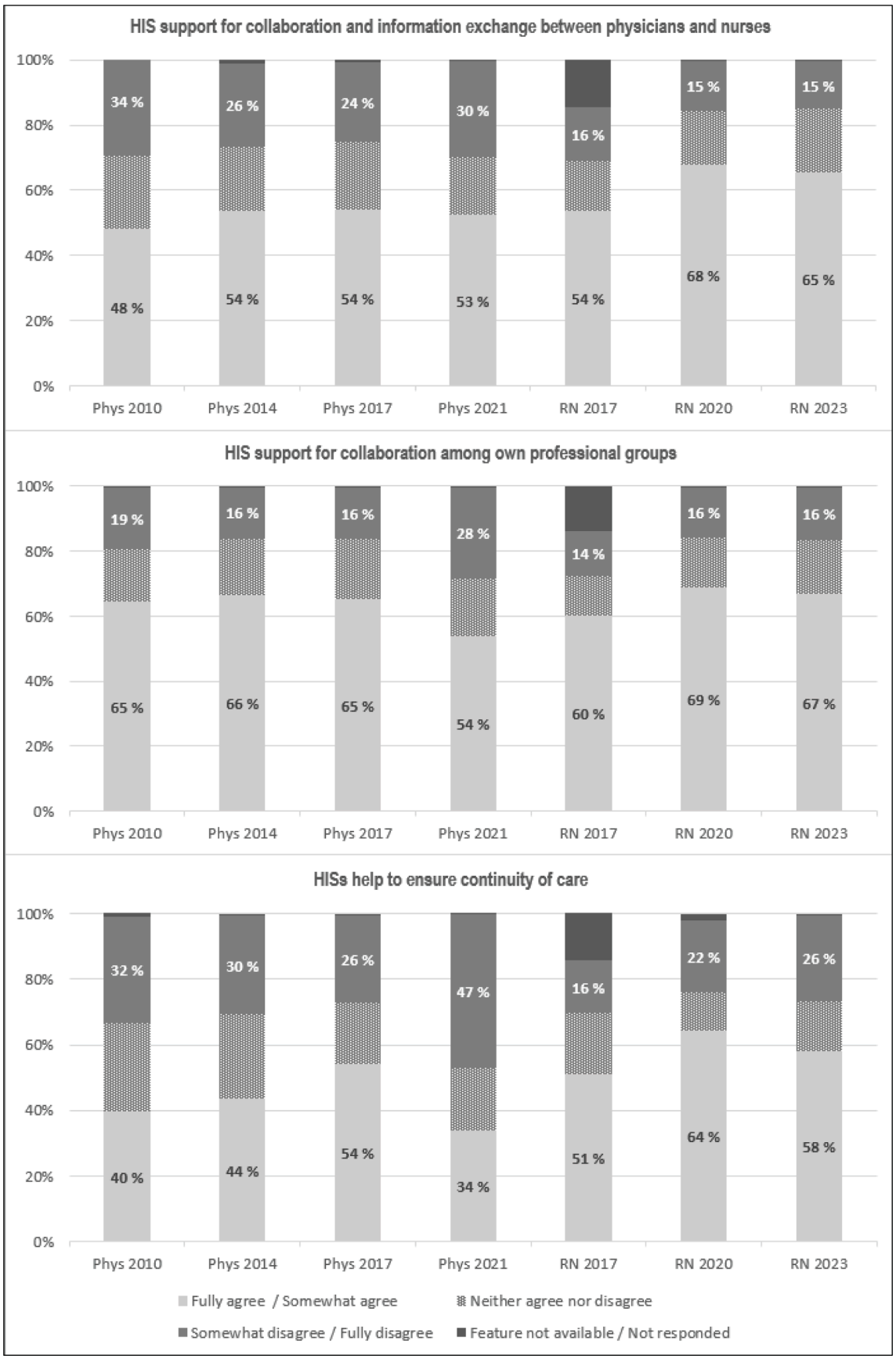

Fig. 1. Responses to three statements concerning HIS support for collaboration and information exchange and continuity of care.

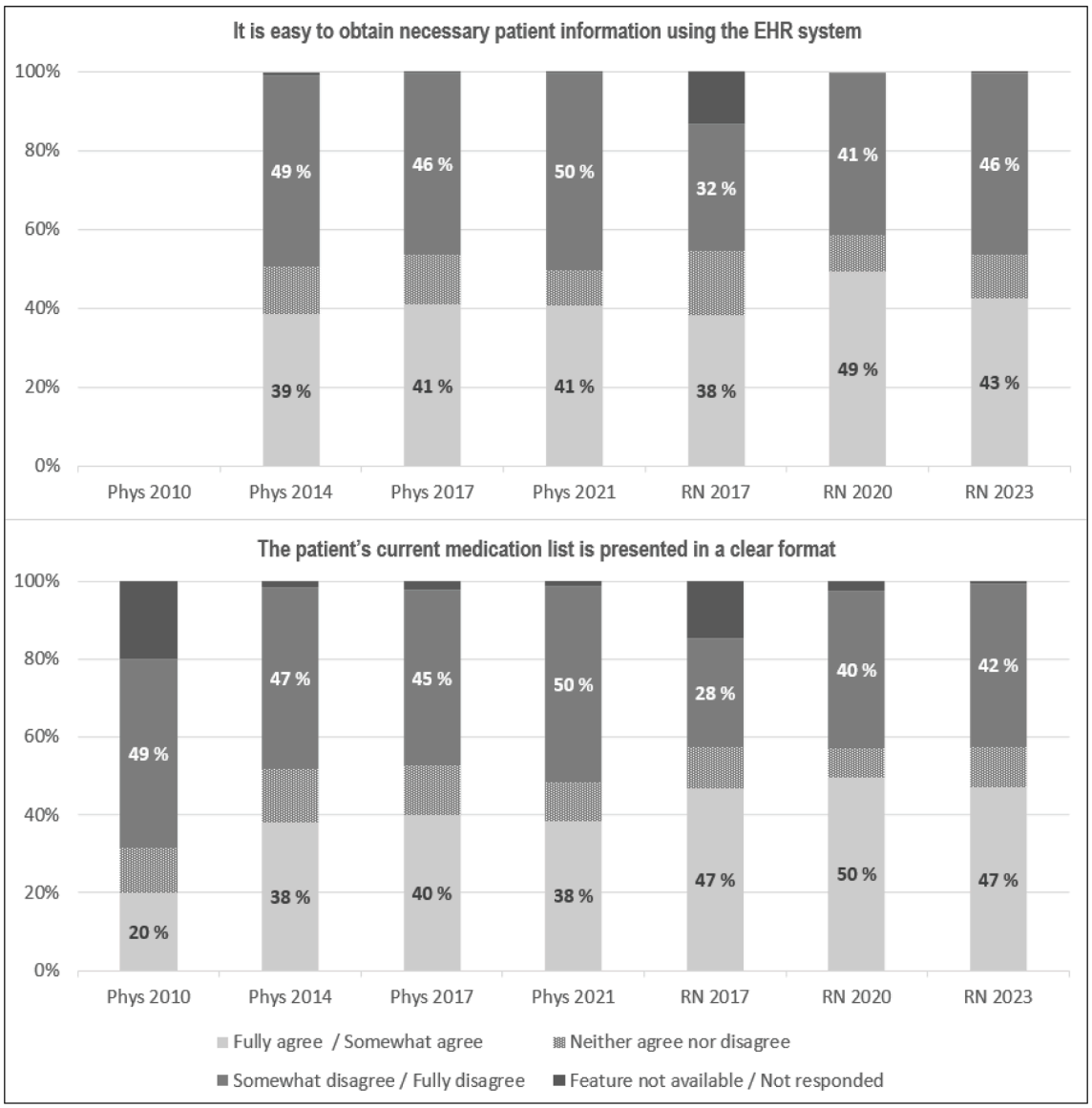

Fig. 2. Responses to the statements about ease of obtaining patient information and clarity of patient medication lists in the EHR system. The statement on ease of obtaining patient information was not included in the 2010 physician questionnaire.

2.3. Selection of data

For this study, we selected physicians and RNs working in public sector hospital and health center wards and outpatient clinics. Most hospitals have a variety of ancillary HISs for operating theaters, intensive care units (ICUs), emergency departments, and labor and delivery units. Physicians often use several of these, but RNs mainly work in one environment. In the physician survey, the EHR brand name was referenced as the "main EHR," but for RNs, the brand names of ancillary HISs were also included. To overcome this inconsistency, we only included respondents using the six largest public sector EHR brands. We excluded private sector respondents because although the private sector is responsible for one-third of outpatient visits to physicians in Finland, the variety of services is narrower, and practically all inpatient care is provided in the public sector. In addition, the roles of private sector physicians and RNs differ considerably from those in the public sector.

For this study, we selected eight statements from the surveys that related to HIS support for collaboration and information exchange between physicians and RNs (Table 1). The questionnaires as well as research data are available online [32].

2.4. Analysis

Analyses were carried out with SPSS 28 (IBM Corp, Armonk, NY). For a five-point Likert scale assessment, fully agree and somewhat agree were combined into agree, and somewhat disagree and fully disagree were combined into disagree. Response options of feature not available and not willing to respond were combined into one group.

3. Results

3.1. Study population

Respondent characteristics by professional group and study year are presented in Table 2. In the latest survey, the physician respondents were younger and RN respondents older than in the earliest surveys; also, the years of experience using EHRs was shorter than in the earlier surveys. The EHR use environments remained similar throughout the study years.

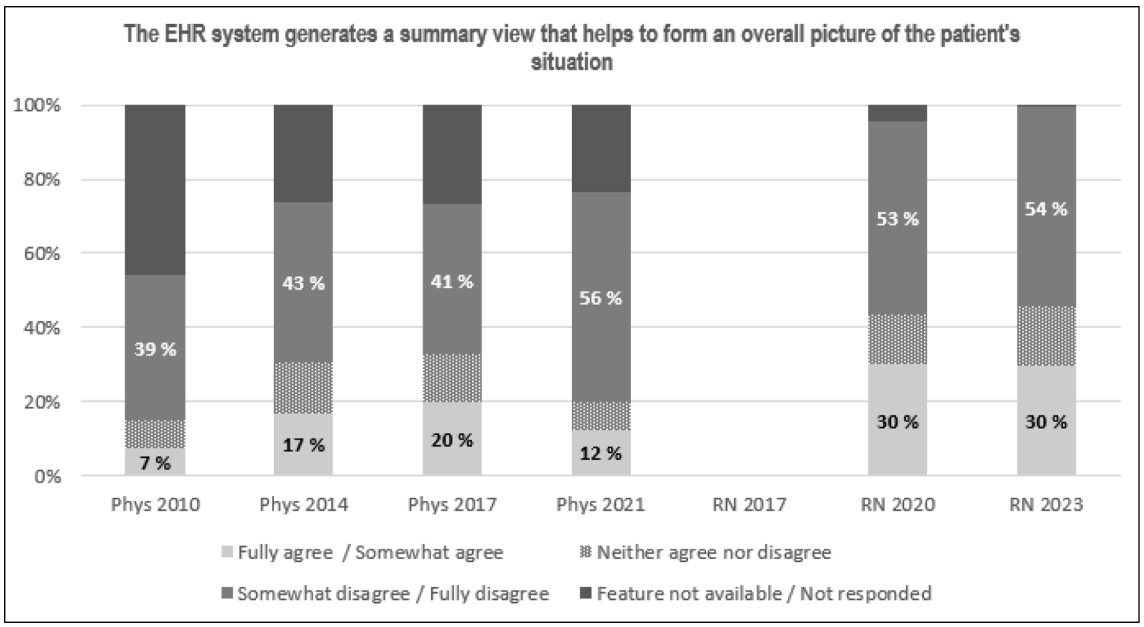

Fig. 3. Responses to the statements about the EHR system generating summary views of a patient's current situation (the statement was not included in the 2017 RN questionnaire).

3.2. User experiences of HIS support for collaboration

The results by professional group and study year are presented in Figs. 1–4 and Appendix A.

During the study years, the proportions of physicians and RNs satisfied with HIS support for collaboration and information exchange within the same organization and among the members of their own professional group remained relatively stable (60–69 % agreed), with the exception of the latest physician survey, in which only 54 % agreed with the statement (Fig. 1). Concerning HIS support between professional groups, RNs were more content than physicians. In 2017, 54 % of RNs gave positive assessments, but in later surveys, the proportion was 68 % in 2020 and 65 % in 2023. In 2010, 42 % of physicians agreed with the statement, and in later surveys, the rate increased to 54 % in 2017 and 53 % in 2021. Similarly, RNs were more satisfied than physicians with HIS support for continuity of care: the proportion of satisfied nurses increased from 51 % in 2017 to 64 % in 2020 and 58 % in 2023, whereas for physicians, the rate increased from 40 % in 2010 to 54 % in 2017, but decreased to 34 % in 2021.

The proportion of physicians and RNs satisfied with the ease of access to essential patient information remained generally stable throughout the study timepoints: between 38 % and 49 % agreed (Fig. 2). RNs were more satisfied than physicians with the presentation of the patient's current medication list: between 47 % and 50 % of RNs versus 20 % and–40 % of physicians agreed with the statement across the study years (Fig. 2). In 2010, only 20 % of physicians were content with the presentation of medication lists, and 20 % found that the feature was not available at all. In 2014, the proportion of satisfied physicians had increased to 38–40 %; in 2021, only 1.4 % stated that the functionality was not available.

Concerning the statement about the EHR system generating a summary view of a patient's current situation, the proportion of those agreeing remained low: between7 and 20 % for physicians and 30 % for RNs) (Fig. 3). In the later surveys, over half of the respondents disagreed with the statement: 53 % of RNs in 2020; 56 % of physicians in 2021, and 54 % of RNs in 2023. Across both respondent groups, the proportion of respondents who indicated that the functionality did not exist decreased over the 13-year period (from 38 % to 9 %).

Across the period of studies, more than half of the physicians (52–56 %) disagreed with the statement that the information on nursing records was presented in an easily readable format, compared to 30–37 % of RNs (Fig. 4). Fewer than half of the RNs (38–47 %) reported that EHRs supported them to find and react to physicians' orders. Concerning the statement "The EHR system monitors whether the orders given to RNs have been completed," the proportion of satisfied physicians remained relatively unchanged between 2010 and 2017 (28 % in 2010, 11 % in 2014, and 21 % in 2017) (Fig. 4). The statement was not included in the 2021 physician survey.

4. Discussion

HISs are not only intended to be used as documentation tools for the storage of patient information, but they should also support collaboration and information exchange between various professional groups, which in turn is a prerequisite for continuity of care and the high-quality treatment of patients. We studied physicians' and RNs' experiences of HIS support for collaboration in clinical work and how their experiences evolved. To our knowledge, this is the first study to monitor the user experiences of the two major healthcare professional groups on a national level over multiple timepoints (2010–2023).

4.1. Main findings

In our study, RNs were more satisfied than physicians with HISs' support for continuity of care. Accurate and complete clinical data are needed to ensure the continuum of treatment between various professional groups, care teams, and organizations [33]. In general, physicians have a greater responsibility for ensuring continuity of care than RNs; they send and handle referrals, order medications, and make decisions about examinations as well as starting and ending outpatient and inpatient care episodes [10]. Information from other organizations—mainly documented by other physicians—is often critical in this process. By contrast, particularly in specialized care, nurses focus on information documented during the same care episode [15]. However, RNs are often responsible for communicating plans and treatment instructions to the patient. These findings underline the importance of developing EHR functionalities—including patient engagement platforms—that prevent care gaps during transitions [34,35].

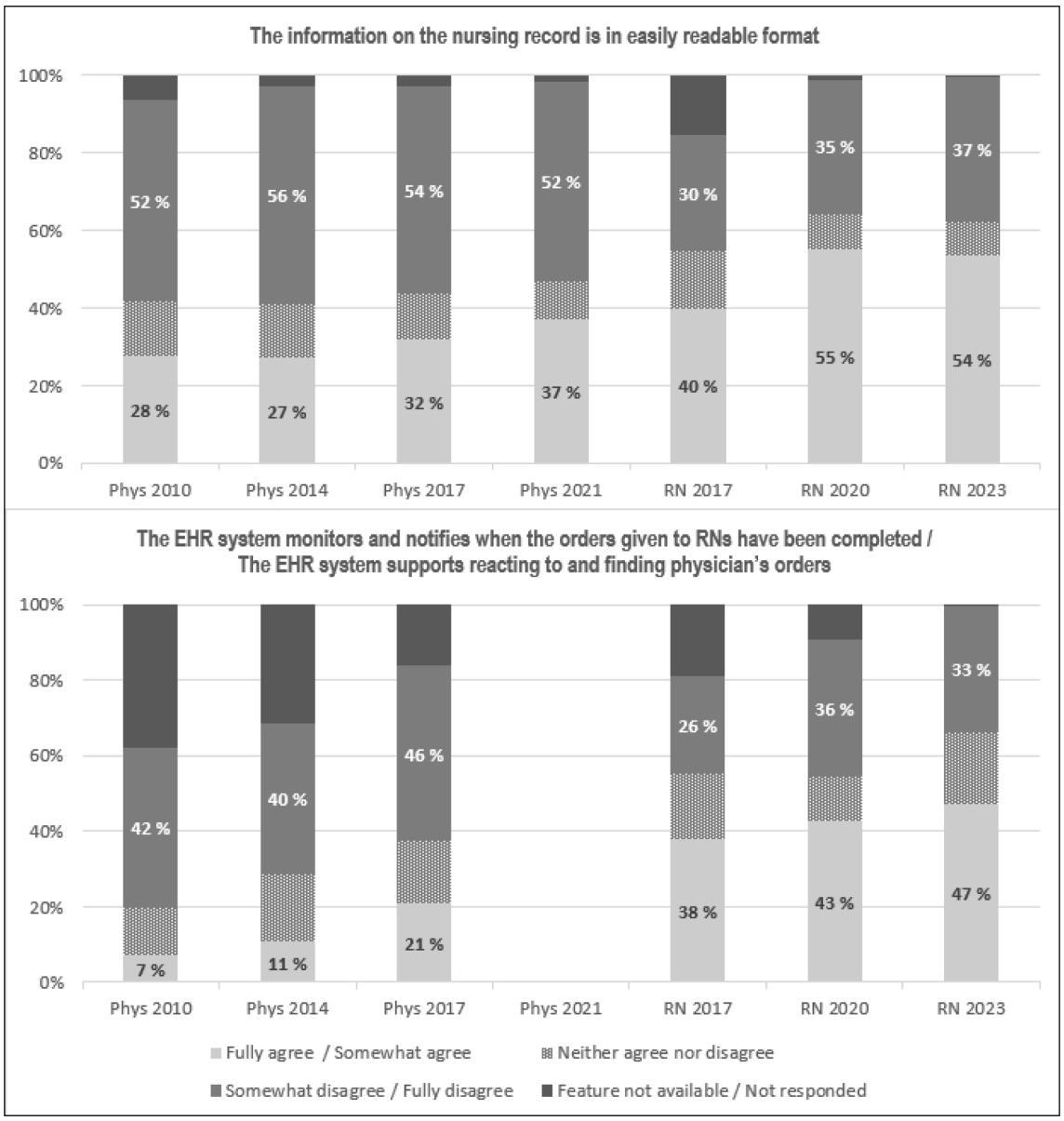

Fig. 4. Responses to the statements about the readability of the nursing record information and the EHR systems' support for reacting to and finding orders. The statement about system support for reacting to and finding orders was not included in the 2021 physician questionnaire.

The overall proportions of satisfied RNs and physicians were particularly low for EHR summary views; however, the proportion of physicians reporting that the functionality did not exist decreased from 46 % in 2010 to 24 % in 2021. Summary views created by EHRs facilitate accessibility to patient data and results [36]. Interestingly, among outpatient clinicians with one year of experience using a novel EHR, Vos et al. [37] found that specialty- and discipline-specific user interfaces were felt to restrict the mutual understanding of patient data. However, carefully built disease-specific summary views or dashboards have been found to reduce time spent searching for essential information as well as the number of mistakes made [38–40]. As pointed out by Lloyd et al. [10], most EHRs have been designed as data collection tools rather than collaboration tools. Indeed, apart from ancillary information systems, such as those designed specifically for ICUs, dashboards showing patients' nursing documentation, vital signs, and laboratory results together with medications were lacking or inadequate until the mid-2010 s; professionals were required to search for relevant information from various parts of the EHR. Moreover, agreed-upon data structures are not used appropriately, thus preventing full utilization of documented data [41]. Only in recent years has more focus been given to the development of review and summary functionalities [39,42]. Moreover, EHR documentation and review functionalities have been developed separately for physicians and RNs, ignoring the needs for interprofessional collaboration and their differing information requirements [43].

Our respondents considered EHR support for collaboration and information exchange to be better among their own professional group than between physicians and RNs. Half of physicians did not find nursing documentation easily readable, while a third of RNs held the same view. Additionally, other researchers have found physicians criticizing EHRs' support for collaboration [10,21,37] and preferring face-to-face communication [44,45]. From an RN perspective, standardized nursing documentation makes daily care more transparent, supports continuity of care, and enhances patient safety [15]. However, even the largest hospital and health center in Finland do not use FinCC, and even among users, the documentation practices may vary [15,21,25,26,41,45,46]. Less than half of the RNs reported EHRs supporting reacting to and finding physicians' orders. Although CPOE has

been used for years, physicians' orders may also appear in notes, as unstructured free-text orders, or even given orally [47]. After recent EHR implementations, unfamiliarity with new tools and a lack of workflow walkthroughs before implementation have been shown to disrupt physician–RN communication [45,48,49]. EHRs should also support RNs with noticing new orders, even if given outside regular rounds or directly after appointments [47].

RNs were more content (between 47 % and 50 % agreement) than physicians (between 20 % and40% agreement) with the patient medication list functionalities; however, the proportion of those satisfied had not increased in the latest surveys. As updating medication lists is not solely a physician's responsibility in Finnish healthcare, it is likely that the lack of mutually agreed upon practices and roles in medication reconciliation and ordering processes has resulted in inaccurate medication lists. Despite all prescriptions being electronic since 2017 and centrally stored in the national prescription center [50], prescription lists are seldom updated when medications are discontinued or doses changed. As medication management is a key element in patient safety, it is evident that more attention should be given to these functionalities and work processes [47].

Although RNs gave somewhat more positive responses than physicians in all our surveys, the experiences of EHR support for collaboration had not improved much in either professional group over the years. One of the explanations is the implementation of a new EHR in the largest Finnish hospital district from 2018 to 2021, which has been heavily criticized, especially by physicians. Recent EHR implementations impact communications if all users are not familiar with the new workflows and tools [51]. Indeed, not only deficient EHR functionalities but also insufficient operational change management impact physician–nurse communication. Importantly, many studies suggest that only EHR enhancements, rather than electronic documentation, appear to facilitate interprofessional teamwork [9,48].

4.2. Evaluation of the study

The research spanned a period of more than 10 years. The survey statements remained practically identical and unchanged across studies to allow comparisons between professional groups and study years. The validated NuHISS survey instrument [30] has also been used internationally [10].

The response rates for RNs were relatively low (~5%) compared to physicians (~25 %), particularly for the 2023 survey. The respondents in all surveys represented the target population rather well [22,25,26,29], but it is naturally possible that those with particularly positive or negative experiences may have been overrepresented. The response rate for physicians is readily explained by the FMA having a long history of conducting various surveys among physicians, who may experience that their responses have an impact on FMA policies. RNs may generally feel that their views do not have an impact on organizational or national policies [51,52].

Although the NuHISS instrument has been validated [30] and each survey pilot tested with potential participants, some respondents may have understood statements differently, which is a typical challenge in survey-based research. For deeper understanding of role- and environment-specific challenges, observational studies and end-user interviews are needed. In addition, further analyses for various subgroups such as midwives, operating room nurses, and physician specialties are needed. Our aim is to continue monitoring HIS development on a national level and also gather comparable data between counties.

5. Conclusions

HISs were considered to better support collaboration among their own professional group than between physicians and RNs. As reviewing documented patient information forms a basis for decision making and high-quality care, EHR development should not only focus on ordering and documentation tools but also on securing multiprofessional utilization of data. Indeed, the varied needs of different professional groups should be taken into consideration in the early stages of the development process.

CRediT authorship contribution statement

Tinja Lääveri and Johanna Viitanen: Writing – review & editing, Writing – original draft, Visualization, Methodology, Investigation, Funding acquisition, Conceptualization. **Minna Mykkänen:** Writing – review & editing, Writing – original draft. **Ulla-Mari Kinnunen:** Writing – review & editing, Writing – original draft, Methodology, Data curation.

Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: Lääveri is employed by a publicly owned EHR software provider (a public limited company), but the employer did not provide any support, financial or otherwise, for the study. The employer also was not involved in the design of the study or the collection, analysis, and interpretation of the data. The other authors declare no conflicts of interest.

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Summary points

What was already known.

- Physicians and registered nurses (RNs) are dissatisfied with their health information systems (HISs).
- Documentation and review tools have been developed separately for physicians and RNs.
- Fluent communication between physicians and RNs improves patient outcomes and quality of care.

What this study added to our knowledge.

- HISs were found to better support collaboration among their own professional group than between physicians and RNs.
- Physicians' and RNs' experiences of HIS support for collaboration had not improved much over the years.
- The varied needs of different professional groups must be taken into consideration in HIS development.
- HIS development should not only focus on ordering and documentation tools but also on securing multiprofessional utilization of data.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ijmedinf.2024.105709.

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