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Nursing informatics competence profiles and perceptions of health information system usefulness among registered nurses: A latent profile analysis

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Abstract

Aims: To identify different nursing informatics competence (NIC) profiles in nurses, examine the factors associated with profile memberships and examine the associations of the derived profiles with the nurses' perception of the usefulness of a health information system (HIS).

Design: A cross-sectional study.

Methods: A sample of 3610 registered nurses responded to a nationwide survey in March 2020. A latent profile analysis was performed to identify NIC profiles based on three competence areas: nursing documentation, working in digital environment, and ethics and data protection. A multinomial logistic regression was carried out to examine the associations of demographic and background variables with the profile membership. Linear regression analyses were carried out to examine the association between the profile membership and perceived HIS usefulness.

Results: Three NIC profiles were identified and labelled as low, moderate and high competence groups. A younger age, recent graduation year, sufficient orientation and high-rated proficiency as an HIS user were associated with nurses belonging to a high or moderate competence group relative to a low competence group. Competence group membership was associated with perceived HIS usefulness. The high competence group consistently expressed the highest usefulness of the HIS and the low competence group the lowest.

Conclusion: Tailored training and support should be provided for nurses with different levels of informatics competence, thereby facilitating their ability to respond to increasingly digitalized work. This could contribute to higher usefulness of the HIS in terms of supporting the nurses' work tasks and promoting the quality of care.

Impact: This was the first study exploring latent profiles of informatics competence in nurses. Insights from this study are useful for nursing management to identify

No patient or public contribution.

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different competence profiles of their employees, provide support and training to meet their needs, and promote the successful use of an HIS.

KEYWORDS

competence, electronic health records, health information system, informatics, latent profile analysis, nursing

1 | INTRODUCTION

Today, an integral part of nurses' work is related to the use of a health information system (HIS). In recent years, and especially, since the COVID-19 pandemic, nurses have been required to adopt digital services as part of patient care (Dykes & Chu, 2021; Rouleau et al., 2017) and learn how to guide patients in using digital services (Schwamm et al., 2020). The use of various forms of HIS and documentation in electronic health records, for example in a hospital context, take up a significant portion of the daily working time (Baumann et al., 2018) and nurses are increasingly expected to take on the role of overseers who ensure that digital options for health-care services meet the needs of patients (ENRF, 2021). To perform all the technology-related tasks and use the HIS successfully, it is a known prerequisite for nurses to have adequate competence in nursing informatics (Hübner et al., 2019; Tiger, 2020).

Nurses make up one of the largest group of HIS end-users, so thus play a central role in achieving the intended HIS objectives, such as enhanced efficiency, productivity, information flow and quality of care (Buntin et al., 2011). The perceived usefulness of an HIS is seen as one of the key factors for the success of its implementation, and if systems fail to support work and meet user needs, the intended benefits are also likely to be missed (Gagnon et al., 2012; Sebetci, 2018). To improve user satisfaction and the perceived usefulness of information systems among nurses, the focus has largely been on the usability and technical functionality of the systems (Lin, 2017; Staggers et al., 2018). Meanwhile, a more person-centred approach focusing on end-user attributes, such as competence, has received less attention. Therefore, this study focused on identifying and examining different levels of informatics competence of nurses and its potential association with the perceived usefulness of an HIS in the nurses' work.

2 | BACKGROUND

Nursing informatics is defined as 'the speciality that integrates nursing science with multiple information management and analytical sciences to identify, define, manage, and communicate data, information, knowledge, and wisdom in nursing practice' with the aim of improving efficiency and the quality of care (Tiger, 2020). There is some variation concerning the defined core dimensions of nursing informatics competence (NIC), but the suggested combinations have included skills that are required in using information and

communication technology to deliver care and skills related to information and knowledge management (i.e. nursing documentation) (Kleib & Nagle, 2018). In Finland, nursing documentation is based on a nationwide and standardized nursing process model and terminology (Finnish Care Classification) and nurses use classifications for documenting nursing diagnoses, planned and delivered nursing interventions, and nursing outcomes (Kinnunen et al., 2021; Liljamo et al., 2021). In addition to these requirements, skills related to ethics and data protection have been increasingly highlighted as a part of NIC (Hübner et al., 2019). Previous studies have found that age, educational level, type of work environment, received training, and length of clinical and HIS user experience are associated with the nurses' informatics competence (Kleib & Nagle, 2018; Khezri & Abdekhoda, 2019; Kinnunen, Heponiemi, et al. 2019).

Based on existing knowledge, different user characteristics may play a role in the perceived usefulness of an HIS and its successful adoption (Aldosari et al., 2018; Hadji et al., 2014; Kahouei et al., 2014). According to the widely utilized Technology Acceptance Model (TAM; Davis, 1989), the successful use of an HIS can be predicted by the perceived ease of use and perceived usefulness of the system, the latter of which has a significantly stronger connection to usage. The model also assumes that the ease of use is associated with the perceived usefulness, which many recent studies seem to support (see a review Roudi et al., 2022). The perceived usefulness of an HIS can be defined as a subjective belief of users about how the use of the system will benefit the achievement of work objectives in practice (Wakefield et al., 2007). When the usefulness of an HIS is perceived to be high, users see the system as contributing to their work performance, and this creates a positive attitude towards the use of the system and consequently may foster positive clinical outcomes (Holden & Karsh, 2010; Hsiao et al., 2011). However, multiple recent studies have reported nurses' dissatisfaction with the usefulness of information systems due to aspects such as poor usability related to documentation or workflow support (De Leeuw et al., 2020; Howe et al., 2018; Kaipio et al., 2020).

Little research has been conducted on the possible link between the level of nurses' informatics competence and the perceived usefulness of healthcare information systems, even though adequate competence in nursing informatics has been highlighted for promoting positive nursing outcomes from both an organizational and patient perspective (Darvish et al., 2014; Lin et al., 2014). Moreover, previous studies have mainly utilized a variable-centred approach and focused on the associations between informatics competence and different factors for the overall sample (e.g. Kinnunen, Heponiemi,

et al., 2019). With this perspective, the possible differences between different subgroups have remained obscure. By taking a more person-centred approach, such as a latent profile analysis (LPA), certain differences between subgroups could be identified (Muthén & Muthén, 2000; Williams & Kibowski, 2016). LPA is a method, which analyses the heterogeneity of the studied population by identifying latent groups from the sample with the same type of response for selected continuous variables (Williams & Kibowski, 2016). LPA would allow for a better understanding of potentially different competence profiles of nurses, which would be particularly important to provide more individualized and efficient support and training, as it has been shown that commonly used 'one-size-fits-all' training may not be well suited for the development of digital work-related skills (De Leeuw et al., 2020).

3 | THE STUDY

3.1 | Aim

The aim of this study was threefold: (1) to explore the different NIC profiles of Finnish registered nurses, (2) to examine the factors associated with belonging to a certain profile and (3) to examine how each of the derived profiles is associated with the perception of HIS usefulness (general HIS benefits, HIS support for nursing documentation and HIS support for work performance).

3.2 | Design

Using cross-sectional data, an exploratory LPA was conducted. Additionally, factors associated with the NIC profile membership and potential differences in the perceived usefulness of HIS between the profiles were tested.

3.3 | Participants and data collection

A nationwide electronic survey for nurses (including registered nurses, midwives and public health nurses under the age of 65) was conducted in Finland in the spring of 2020 (Saranto et al., 2020). The survey is part of ongoing national monitoring and evaluation of social welfare and healthcare information system services, and its development, implementation and piloting has been reported elsewhere (Hyppönen et al., 2018; Kinnunen, Hyppönen, et al., 2019; Saranto et al., 2022). An email link to a questionnaire was sent by the Finnish Nurses' Association, Tehy (Finnish Association of Health and Social Care Professionals) and the National Professional Association (TAJA) to all the nurses with an available email address ($n=58,276$). The sample represented 72% of the eligible population (Saranto et al., 2020). Altogether, 10,094 respondents followed the link and 3911 (35.8%) submitted their questionnaire responses. After removing those respondents who had not worked as nurses for a long time

and therefore did not consider themselves suitable to participate ($n=301$), 3610 nurses were finally included in the analyses.

3.4 | Ethical considerations

The study followed good research practices based on the principles of research integrity (ALL European Academies, 2017). Ethical approval for this study was provided by The Finnish Institute for Health and Welfare (THL/482/6.02.01/2020). The cover letter informed the nurses about the study, stated that participation was voluntary, and that answering the survey would be interpreted as informed consent.

3.5 | Measures

The measures/items used to measure informatics competence and perceptions of HIS usefulness are presented in full in [Appendix 1](#). A brief overview of the measures is provided in the paragraphs below.

3.5.1 | Nursing informatics competence

NIC was measured with 17 items that were divided into three previously identified and utilized core competency areas (Kinnunen, Heponiemi, et al., 2019): (1) nursing documentation (nine items, e.g. documentation of planned nursing interventions), (2) working in a digital environment (six items, e.g. basic IT skills) and (3) ethics and data protection (two items, compliance with data protection and data security principles in daily work). The participants were asked to evaluate the question: 'How well have you mastered the following skills required by information systems?' on a four-point scale (ranging from 1 = weak to 4 = excellent). Cronbach's alphas (α) for the three subscales were 0.93, 0.86 and 0.82, respectively.

3.5.2 | HIS usefulness

Three different perspectives were used to assess the usefulness of HIS: (1) perception of general HIS benefits, (2) how well the HIS supported the documentation of nursing care and (3) how well the HIS supported work performance. The perceived usefulness and benefits related to HIS use have previously been studied among physicians (Viitanen et al., 2011) and the measures/items have been further applied to the work of nurses (Hyppönen et al., 2018). The measures related to HIS support for documentation and work performance include items that, in addition to the perceived usefulness, deal with the perceived ease of use. This choice was supported by the significant association between ease of use and usefulness (Rouidi et al., 2022), as the original TAM model has demonstrated (Davis, 1989). We also observed acceptable internal consistency of the used items (Cronbach's alphas shown below).

1. General HIS benefits were measured by asking the participants to evaluate the benefits and disadvantages of the HIS. The nine items (e.g. the HIS helps prevent medication errors, $\alpha=.79$) were rated on a five-point scale (1=fully disagree - 5=fully agree). Two items with negative wording were reverse coded so that a higher number indicated more positive outcome.
2. HIS support for nursing documentation was asked about with nine statements (e.g. the information system generally supports documentation of nursing work, $\alpha=.88$) and answered with five-point scale (1=fully disagree - 5=fully agree).
3. HIS support for work performance was assessed by asking the question 'How do the information systems you use support carrying out your duties?' Seven items (e.g. the HIS makes it easy get the necessary information about the patient, $\alpha=.74$) were rated on a five-point scale (1=fully disagree - 5=fully agree).

All three measures also included the answer option 'I cannot say', which was coded as missing.

3.5.3 | Demographic and background factors

Demographic and background information of the participants included age, gender (1=men, 2=women, 3=some other, 4=do not want to answer), graduation year (1=1974-1990, 2=1991-2005, 3=2006-2020) and work environment (1=Inpatient ward, 2=Outpatient ward, 3=Emergency care, 4=Home care/social services, 5=Operation and intensive care, 6=Other). Due to the low number of respondents who had expressed their gender as 'some other' ($n=7$) or 'don't want to answer' ($n=14$), they were coded as missing so that large differences in group size would not bias the analyses.

On a five-point scale (ranging from 1=fully disagree to 5=fully agree), the participants were also asked to rate whether they had received sufficient orientation on working methods required for the implementation of a new HIS (recoded into 1=insufficient orientation, 2=sufficient orientation). This question also included the answer option 'I cannot say', which was coded as missing.

Finally, the survey included questions on length of experience with the current HIS (1=<6 months, 2=6-11 months, 3=1-3 years, 4=3-6 years, 5=over 6 years) and the perceived proficiency as an HIS user (response options ranging from 1=beginner to 5=highly experienced).

3.6 | Data analysis

There were a high number of missing values in some of the informatics competence items (ranging from 1.3% to 50.6%). A significant portion of the missing values were explained by the answer option 'my organization does not require this competence', which was coded as missing for the analysis. This response option was most often chosen for questions related to the use of Finnish Care

Classifications in nursing documentation, which is not yet used in all healthcare organizations.

We used multiple imputation procedures with a chained equations method to impute missing data (White et al., 2011) using the 'mice' R-package (Van Buuren & Groothuis-Oudshoorn, 2011). This method is recommended over single imputation methods because it is able to handle different variable types, takes into account the random variation in the imputation process and fills in the missing values by simple random sampling with replacement from the observed values (White et al., 2011). Large-scale simulation studies have shown that analyses using multiple imputation methods are generally less biased than complete-case analyses in the presence of missing values (Lee & Carlin, 2010). Altogether, five imputed datasets were generated. The imputation model included all the variables used in this study.

We applied LPA to construct NIC profiles based on three competence areas: nursing documentation, work in a digital environment, and ethics and data protection using the 'tidyLPA' R-package (Rosenberg et al., 2019). LPA is an analytic strategy that attempts to identify subgroups within a heterogeneous population based on the differences in the level and shape of specific profile indicators (Williams & Kibowski, 2016). It is characterized as a person-centred approach that allows understanding how certain sets of variables vary between and within individuals and how this modifies outcomes (Ma, 2021; Muthén & Muthén, 2000). In this study, the LPA approach enabled identifying the informatics competence of characteristically different subpopulations of nurses and further examined their experiences on the usefulness of the information system.

The appropriate number of latent NIC profiles was estimated based on the Akaike information criterion (AIC), the Bayesian information criterion (BIC) and entropy (Ferguson et al., 2020; Tein et al., 2013). Lower AIC and BIC values indicated a better model fit, whereas larger entropy values (preferably close to 1) indicated a more accurate classification. Entropy values >0.80 indicated highly discriminating latent classes (Ferguson et al., 2020; Tein et al., 2013).

After determining the number of optimal LPA profiles, we used a multinomial logistic regression to examine the associations between the demographic and background variables with the NIC profile membership. Finally, multivariable linear regression analyses were used to examine the association between the profile membership and perceived (a) HIS benefits, (b) HIS documentation support and (c) HIS work performance support in separate models, adjusted for age and gender. Assumptions of linear regression (i.e. linearity, normal distribution of residuals) were met.

All statistical analyses were conducted using R 4.1.1 and R-Studio version 2022.02.2. The Strengthening the Reporting of Observational studies in Epidemiology guidelines were followed in the reporting of the study (Appendix 2).

4 | RESULTS

Characteristics of the participants ($N=3610$) are presented in Table 1. The study participants were predominantly women (92.5%) and their

TABLE 1 Characteristics of the participants.

	N	%
Gender		
Men	250	7.3
Women	3340	92.7
Graduation year		
1974–1990	547	15.1
1991–2005	1498	41.5
2006–2020	1565	43.4
Work environment		
Inpatient ward	1269	35.1
Outpatient ward	1149	31.8
Emergency care	242	6.7
Home care/social services	370	10.2
Operation and intensive care	414	11.5
Other	166	4.6
Orientation received		
Insufficient	1895	52.5
Sufficient	1715	47.5
Experience with current HIS		
<6 months	623	17.3
6–11 months	368	10.2
1–3 years	824	22.8
3–6 years	480	13.3
Over 6 years	1315	36.4
Proficiency as HIS user		
Beginner	106	2.9
Weak	223	6.2
Moderate	807	22.3
Experienced	1454	40.3
Highly experienced	1020	28.2
	Mean	SD
Age	45.7	10.9
Nursing informatics competencies (scale 1–4)		
Nursing documentation	2.79	0.64
Work in digital environment	2.60	0.65
Ethics and data protection	3.07	0.67
HIS benefits (scale 1–5)	2.93	0.72
HIS nursing documentation support (scale 1–5)	2.96	0.92
HIS work performance support (scale 1–5)	2.81	0.89

Abbreviation: HIS, health information system.

age ranged from 22 to 67 years (mean 45.7 years). The graduation years ranged from 1974 to 2020 (median 2002) and the majority of the nurses either worked in inpatient or outpatient wards (66.9%). Slightly less than half (47.5%) of the nurses indicated that they had received sufficient orientation in the changing work methods required

for the implementation of information systems. Every third participant had more than 6 years of experience with the current HIS and the majority considered themselves either experienced (40.3%) or highly experienced (28.2%) as HIS users. Nurses evaluated their nursing informatics competencies as good, mean ranging from 2.60 (work in digital environment) to 3.07 (ethics and data protection).

4.1 | Nursing informatics competence profiles

According to information criteria AIC and BIC, a four-class solution showed the best model fit for the NIC profiles (Table 2). The entropy value was larger in the three-class solution compared to four-class solution. Because the AIC and BIC reduction was shown to be less when the number of profiles changed from three to four than from two to three, it was concluded that the three-class solution was better and allowed a clearer distinction between different competence profiles (Tein et al., 2013). When tested with non-imputed data for comparison purposes, the results in terms of information criteria favoured the three-class solution, and the means of the informatics competencies of the different profiles roughly corresponded to the results of the imputed data (the differences in the means between the datasets ranged from 0.01 to 0.12).

Figure 1. presents the means of the nursing informatics competencies for the three profile groups. The first group with clearly the lowest mean values (ranging from 1.79 to 2.15) was labelled the 'low competence group' ($n = 430/11.9\%$), the second group representing the highest mean competencies (ranging from 3.05 to 3.87) was labelled the 'high competence group' ($n = 1000/27.7\%$). The competency means for the third groups were in the middle (ranging from 2.52 to 2.75) and therefore were labeled as 'moderate competence group' ($n = 2181/60.4\%$).

4.2 | Factors associated with belonging to a certain NIC profile

The nurses' age, graduation year, orientation received and proficiency as an HIS user were associated with belonging to the high competence group (second profile) compared to belonging to the low competence group (first profile) (Table 3). The relative risk ratio for a 1 year increase in age was 0.96. In other words, for every increase of 1 year in age, the relative risk of belonging to the high competence versus low competence group decreased by 4%. The relative risk of belonging to the high competence versus low competence group was on average 3.1 times greater for nurses who had graduated within the past 15 years compared to those who had graduated before 1990. Those who had received sufficient orientation had a 3.2 times greater relative risk and those who were highly experienced HIS users had an 18 times greater relative risk of belonging to the high competence versus low competence group compared to their counterparts.

Similarly, age, graduation year, orientation received and proficiency as an HIS user were associated with belonging to the moderate

competence group (third profile) compared to low competence group (first profile) (Table 3). The likelihood of belonging to the moderately competent group versus the low competence group was indicated by a risk ratio of 0.97. Nurses who had graduated within the past 15 years compared to those who had graduated before 1990 had 2.07 times greater relative risk of belonging to the moderate competence versus the low competence group. Moreover, those who had indicated they had had a sufficient orientation had a 2.34 times greater relative risk and those who were highly experienced HIS users had 1.21 times greater relative risk of belonging to the high competence versus low competence group compared to their counterparts.

Thus, based on the above results, the low competence group seemed to include more nurses with a higher age, a later year of graduation, a weaker orientation to the use of the HIS, and a lower perceived proficiency as an HIS user, compared to the high or moderate competence groups.

4.3 | Associations of the NIC profiles with the perception of HIS usefulness

The results of the associations between belonging to a certain competence group and the three outcomes indicating HIS usefulness are

TABLE 2 Information criteria for the latent profile analysis.

Number of profiles	AIC	BIC	Entropy
1	21,604.314	21,641.465	1.000
2	19,750.976	19,812.893	0.669
3	18,640.514	18,727.198	0.915
4	18,470.286	18,581.737	0.755
5	18,661.043	18,797.261	0.512

Abbreviations: AIC, Akaike information criterion; BIC, Bayesian information criterion.

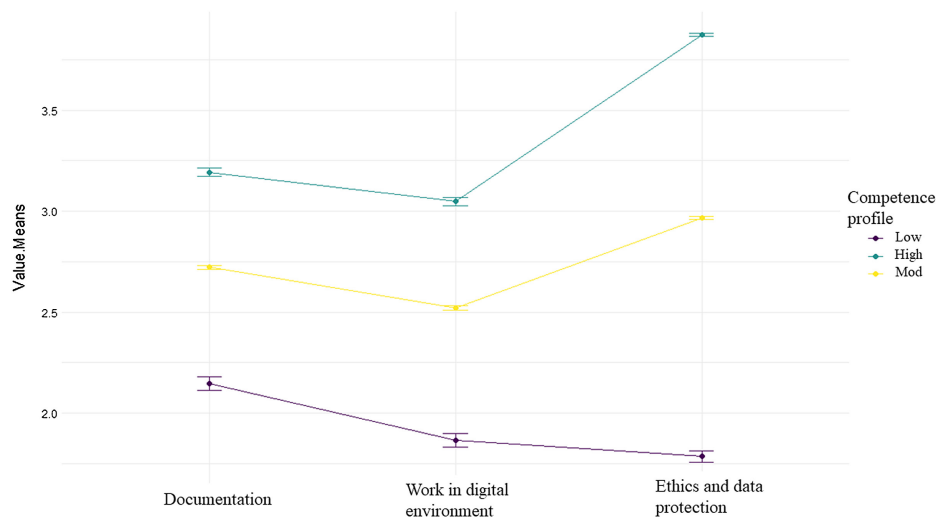


FIGURE 1 Means for the three nursing informatics competence profiles.

presented in Table 4. The competence group was shown to be associated with the perceptions of general HIS benefits, how well the HIS supported nursing documentation and how well it supported work performance. Nurses in the high competence group consistently expressed the highest HIS benefits (mean 3.10, SD 0.77) and perceived the highest HIS documentation support (mean 3.14, SD 0.99) and support for work performance (mean 2.96, SD 0.94). Nurses in the moderate competence group also expressed significantly higher HIS benefits (mean 2.91, SD 0.67), documentation support (mean 2.81, SD 0.86) and work performance support (mean 2.95, SD 0.85) compared to the low competence group (mean 2.65, SD 0.69; mean 2.5, SD 0.88; and mean 2.56, SD 0.92, respectively).

5 | DISCUSSION

This study explored different NIC profiles of nurses, then examined factors associated with belonging to a certain profile, and finally, tested the associations of the derived profiles with the nurses' perceptions of HIS usefulness. Based on our knowledge, our study is the first utilizing a person-centred approach to examine the competence of nurses in informatics and the potential outcomes of different competence levels. Moreover, LPA provided the opportunity to identify some cut-off values based on statistical analyses between the nurses' different informatics competence levels, which were more rigorous than levels defined on an arbitrary basis (i.e. what is considered to be high, moderate or low competence) (Williams & Kibowski, 2016).

In this study, we were able to distinguish three NIC profiles. These profiles differed mostly in the mean scores of the three competence areas assessed (nursing documentation, working in a digital environment, and ethics and data protection) but did not show different combinations of (high/low) competence areas in different profile groups much. The profiles of high, moderate and low informatics competence all showed similar patterns, in which the nurses

TABLE 3 The association between individual characteristics of the participants ($N=3610$) and latent nursing informatics competence profile membership. The relative risk ratios and 95% confidence intervals (95% CI) from the multinomial logistic regression.

Reference: low competence group (1)	Independent variables	Relative risk ratio	95% CI	p-Value
High competence group (2)	Age	0.96	0.95–0.98	<.001***
	Gender			
	Male	1		
	Female	0.99	0.62–1.6	.28
	Graduation year			
	1974–1990	1		
	1991–2005	1.55	1.08–2.23	.19
	2006–2020	3.13	1.93–5.10	<.001***
	Work environment			
	Inpatient ward	1		
	Outpatient wards	1.19	0.88–1.60	.25
	Emergency care	1.54	0.85–2.79	.15
	Home car/social services	1.05	0.69–1.60	.83
	Operation and intensive care	1.18	0.79–1.76	.41
	Other	2.01	1.04–3.92	.04*
	Orientation received			
	Insufficient	1		
	Sufficient	3.23	2.46–4.24	<.001***
	Experience with current HIS			
	<6 months	1		
	6–11 months	1.12	0.69–1.83	.64
	1–3 years	1.30	0.87–1.96	.20
	3–6 years	0.92	0.58–1.47	.73
Over 6 years	0.89	0.60–1.31	.56	
Proficiency as HIS user				
Beginner	1			
Weak	1.44	0.60–1.31	.42	
Moderate	2.51	1.14–5.56	.02*	
Experienced	5.18	2.35–11.41	<.001***	
Highly experienced	18.0	7.92–40.91	<.001***	
Moderate competence group (3)	Age	0.97	0.96–0.99	<.001***
	Gender			
	Male	1		
	Female	1.26	0.81–1.95	.29
	Graduation year			
	1974–1990			
	1991–2005	1.24	0.92–1.67	.16
	2006–2020	2.07	1.37–3.15	<.001***
	Work environment			
	Inpatient ward	1		
	Outpatient wards	1.37	1.05–1.79	.02*
	Emergency care	1.73	1.01–2.99	.05*
	Home car/social services	1.07	0.74–1.56	.71
Operation and intensive care	1.01	0.71–1.45	.94	
Other	1.83	1.00–3.36	.05*	

TABLE 3 (Continued)

Reference: low competence group (1)	Independent variables	Relative risk ratio	95% CI	p-Value
	Orientation received			
	Insufficient	1		
	Sufficient	2.34	1.83–3.00	<.001***
	Experience with current HIS			
	<6 months	1		
	6–11 months	1.27	0.83–1.94	.26
	1–3 years	1.40	0.99–2.00	.06
	3–6 years	1.01	0.67–1.50	.98
	Over 6 years	1.12	0.83–1.63	.37
	Proficiency as HIS user			
	Beginner	1		
	Weak	0.34	0.83–2.45	.23
	Moderate	0.76	1.17–3.25	.06
	Experienced	0.86	1.41–3.95	<.001***
	Highly experienced	1.21	1.91–5.90	<.001***

Note: Values indicate the relative risk for each category compared to the reference category for belonging to the given competence group versus reference competence group (low competence).

Abbreviation: HIS, health information system.

* $p < .05$; ** $p < .01$; *** $p < .001$.

TABLE 4 Multivariable linear regression analyses for the association of nursing informatics competence profiles and the perceived usefulness of health information system (HIS).

General HIS benefits	β	95% CI	p-Value
Low competence group	Ref.		
High competence group	0.44	0.35–0.52	<.001***
Moderate competence group	0.26	0.18–0.33	<.001***
<i>Adjusted R-squared: 0.036</i>			
HIS documentation support			
Low competence group	Ref.		
High competence group	0.57	0.47–0.67	<.001***
Moderate competence group	0.39	0.29–0.48	<.001***
<i>Adjusted R-squared: 0.032</i>			
HIS work performance support			
Low competence group	Ref.		
High competence group	0.47	0.67–0.57	<.001***
Moderate competence group	0.31	0.22–0.40	<.001***
<i>Adjusted R-squared: 0.022</i>			

Note: All three models adjusted for age and gender. Values are linear regression coefficients, their 95% CI and p-values.

*** $p < .001$.

systematically rated their competence in nursing documentation higher compared to their ability to work in a digital environment. However, the distinguishing factor for the profiles was the competence related to ethics and data protection. Nurses in both high and

moderate competence groups considered it clearly as their strongest competence area, whereas the group with low competence assessed their ability to manage ethics and data protection lower than their ability to work in a digital environment. Given the highly central role that nurses play in ensuring that data protection principles are fully implemented as part of patient care (Spencer & Patel, 2019), this considerable skills gap among certain nurses is concerning and requires further attention.

When examining the factors associated with nurses belonging to specific NIC profile, we found that the higher the nurses age and the earlier the graduation year, the higher the risk of nurses belonging to a group with low informatics competence. Based on earlier studies, the finding on the association between age and informatics competence was expected (Kleib & Nagle, 2018; Khezri & Abdekhoda, 2019; Kinnunen, Hyppönen, et al., 2019); however, previous research has also suggested that different graduation years, and thus possible differences in undergraduate nursing curricula, may play a more pivotal role in a nurse's informatics competence than age (Kaihlainen et al., 2021). In Finland, based on the harmonization of education and training at the European level, nursing informatics has been included in the nursing curriculum for several years (Ahonen et al., 2018; Kinnunen, Hyppönen, et al., 2019) and its importance is also reflected in the Finnish nurses' strategy of digital social and healthcare services (Ahonen et al., 2021). Although a great effort has been made in recent years towards the development of informatics education for nurses, global concerns have still been raised about the shortcomings in the integration of nursing informatics into nursing curricula and lack of shared competency standards (Forman et al., 2020; Peltonen et al., 2019). The urgent need

to address inconsistencies in informatics education and identifying ways to structure the training for nurses both at undergraduate and professional level is still current and internationally well recognized (Kleib et al., 2022; Reid et al., 2022). According to our findings, we should be especially concerned about those nurses whose undergraduate education did not include any nursing informatics and whether they have received sufficient continuing education to meet the demands of the constantly digitalizing healthcare services.

This study also found, as expected, that nurses who had had insufficient orientation to adapt to the changes in work required by healthcare information systems, such as new documentation and other work practices, were at the highest risk of belonging to the low competence group. Unfortunately, the direction of association cannot be determined due to the cross-sectional nature of our study. Insufficient orientation could be one of the reasons for the poor assessment of one's own competence or, conversely, low competence may lead to perceptions of insufficient orientation. Anyhow, the result highlights the importance of orientation and more individualized training on HIS use with consideration to what is sufficient for different users. Thus, different competence levels should be taken into account in the planning and implementation of training (De Leeuw et al., 2020; Nadav et al., 2021). Determining what and how much orientation and support should be provided is the responsibility of nursing management and requires them to have the ability and tools to assess the competence of their employees (Laukka et al., 2020). HIS training should involve evidence-based techniques, such as empathy and encouragement, which could improve both capabilities and motivation to use the systems effectively (Virtanen et al., 2021). Providing appropriate HIS training would not only improve the nurses' competencies but could also contribute to their well-being and even prevent mistakes (Heponiemi et al., 2021).

Another interesting finding was that while the actual length of the HIS user experience, whether it was a few months or many years, was not associated with belonging to any NIC profile, the nurses' perceived experience as an HIS user (proficiency) was in turn most strongly connected to different NIC profiles. Those who considered themselves as the most experienced HIS users were up to 18 times more likely to belong to the high competence group than to the low competence group. Thus, it seems that instead of the HIS user experience that can be measured in time, the nurses' own views of the gained experience, and potentially the type of experience, may be more central to their ability to manage different aspects of information management in their work. This finding also indicates that even if an HIS has been used for several years, it cannot automatically be assumed to be reflected in the users' competence levels. However, conflicting findings have also been presented, as some studies have reported associations of the time spent with an HIS (Khezri & Abdekhoda, 2019), or years of experience (Elsayed et al., 2017), with the informatics competence of nurses.

Finally, this study found that nurses who belonged to high competence profile significantly reported the highest HIS usefulness. The higher the competence profile the nurse belonged to, the more the HIS was perceived to offer general benefits (e.g. prevention of medication errors, support for nursing decision-making), as well as to

support nursing documentation and other work performance. To our knowledge, there is very little previous research on the connection between user characteristics, such as informatics competence, and perceived usefulness of an HIS. Mainly, the basic ability of nurses to use a computer has been noted to correlate with perceived usefulness (Tubashat, 2018) and similar findings have been reported in studies with other healthcare professionals (Melas et al., 2011; Walston et al., 2014). Nevertheless, the information management skills needed in a nurse's job are much more complex and multidimensional than just the ability to use a computer. More studies are needed to support the results of our study on how the management of different informatics competence areas can affect the perceived HIS usefulness. Moreover, it would be useful to take a deeper look at the views of nurses on this topic by using qualitative methods. With the knowledge obtained, the successful adoption and use of HIS could be promoted.

5.1 | Limitations

A few limitations must be considered when interpreting the results of this study. As is typical in cross-sectional studies, we could not demonstrate a causal relationship or the direction of the association between the variables. In addition, all questions in the survey were based on nurses' self-assessment, so there is a possibility of response bias or common method bias. It is also possible that since some of the outcome measures dealing with HIS usefulness combined items related to usefulness and ease of use, it may have affected the associations of different competence profiles with these variables. When interpreting the results, the low explanatory power of the regression models must also be considered. The variation in the perceived HIS usefulness could be explained by many reasons, such as factors related to working conditions or the properties of the system in use, which were not examined in this study. There was also a small group of nurses (9%) among the respondents with managerial duties, whose use of the HIS might differ from other respondents. We did not adjust for these possible differences in the analyses, which may have influenced the results. It is also possible that the study may have left out those respondents who were not comfortable answering the electronic survey due to particularly weak skills or some other reasons. In particular, this may have reduced the number of nurses belonging to the low competence group. Furthermore, it should be noted that due to the nature of the profession, the sample of the study consisted largely of women. Finally, because Finland is ahead of many other countries in the digitalization and implementation of healthcare information systems, the generalizability of the results to other countries should be treated with caution.

6 | CONCLUSION

Based on a LPA, Finnish nurses could be divided into profiles of high, moderate and low informatics competence. Nurses in the high and moderate competence profile groups shared their strongest (ethics

and data protection) and weakest (working in digital environment) competence areas, from which the low competence profile group differed, especially in terms of their ethics and data protection skills, which were rated alarmingly low. It seems that older nurses, who have graduated at a time when the curriculum did not yet include nursing informatics, are at particular risk of belonging to the low competence profile. Moreover, those nurses with poor orientation to changing working methods and a low subjective assessment of their proficiency as users of information systems were at an increased risk of belonging to the low competence profile group. Special attention should be paid to further training and support for this group, so that these nurses could be better able to respond to increasingly digitalizing work, and complex nursing documentation and information security requirements. Finally, this study suggests that nurses' informatics competence may play a role in the perceived usefulness of an HIS in terms of how the HIS is perceived to support the nurses' work tasks and promote the safety and quality of care. The result strengthens the view of the importance of informatics competence for the successful use of healthcare information systems.

AUTHOR CONTRIBUTIONS

All authors have agreed on the final version and meet at least one of the following criteria (recommended by the ICMJE): (1) substantial contributions to conception and design, acquisition of data, or analysis and interpretation of data; (2) drafting the article or revising it critically for important intellectual content. **Anu-Marja Kaihlanen:** Conceptualization, methodology, formal analysis, writing – original draft, writing – review and editing, visualization. **Marko Elovainio:** Conceptualization, methodology, formal analysis, writing – review and editing, visualization. **Lotta Virtanen:** Conceptualization, writing – review and editing. **Ulla-Mari Kinnunen:** Investigation/data collection, writing – review and editing. **Tuulikki Vehko:** Investigation/data collection, writing – review & editing. **Kaija Saranto:** Investigation/data collection, writing – review and editing. **Tarja Heponiemi:** Conceptualization, writing – review and editing.

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No conflict of interest has been declared by the authors.

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DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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