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Physicians' Experiences on EHR Usability: A Time Series from 2010, 2014 and 2017

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Abstract. The interest towards monitoring and guiding the development of healthcare information systems on a national level is increasing. In this paper, we report results from the three cross-sectional surveys on physicians' experiences on usability of their electronic health record (EHR) systems in Finland. The research question was: How have physicians' experiences on usability of their EHR systems evolved between 2010 and 2017? The data consists of responses to six usability statements from Finnish physicians working in public healthcare centres and hospitals. Among physicians working in healthcare centres, results between 2010 and 2017 show change for the worse. Among their colleagues in hospitals, results indicate slight improvement only in the domain of ease of use of the systems. In general, contrary to general expectations, the results do not show improvements between the years 2010, 2014 and 2017. In the future, we will continue the monitoring work in Finland on a national level from the viewpoint of physicians and other professional groups.

Keywords. usability, physician, satisfaction, electronic health record, survey

1. Introduction

For several years, usability of electronic health record (EHR) systems has remained a timely topic of research [e.g. 1-5]. Factors of EHR usage, such as technical problems associated with time pressure, separated statistical documentation and difficulties in reading of nursing record, affect physicians' work well-being [2]. Recent surveys have found that physicians experience overall dissatisfaction with their EHRs [1,6]. In addition, literature calls for purposeful and thoughtful design of the systems in order to capitalize on the powerful potential of the EHR systems towards better patient care [7].

In Finnish public healthcare, EHR coverage reached 100% in 2010 [8,9]. Efforts to improve usability of the currently used EHR systems are considered important and are even mentioned in the national Information Strategy for Social and Health Care 2020 [10]. National surveys on e-health implementation and use, EHR usability as well as experienced benefits and challenges from the physicians and nurses viewpoints' have been carried out to monitor and guide the development of healthcare information systems

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[11]. The first survey on physicians' experiences on EHR usability in Finland was conducted in 2010 [12,13]. Next cross-sectional surveys were conducted in 2014 and 2017 [1,14]. In 2017, a similar study with nurses took place [15].

In this paper, we report results from the three cross-sectional surveys for physicians. The research question is: *How have physicians' experiences on usability of their EHR systems evolved between 2010 and 2017?* Six usability statements, which have been identical in all surveys, were selected for the analysis. The focus of the presented analysis is on public healthcare hospitals and healthcare centres. In 2016, there were 20,970 working-age (<65 years) physicians living in Finland; 70% were working in the public sector [16].

2. Related Research

EHR systems with good usability have been reported to decrease the number of errors, help to improve patient safety, support efficient work and thereby allow the clinicians more time with their patients [17]. Typical EHR usability problems related to interface design include violation of natural dialog, control consistency, effective use of language, effective information presentation, customization principles, lack of error prevention, minimization of cognitive load and feedback [18]. Designing EHR user interfaces is particularly challenging because of a wide range of complex information needs in different healthcare contexts, user requirements arising from over 50 physician specialties as well as needs and requirements from other user groups including nurses, pharmacists and therapists [19].

The number of usability studies is increasing. According to a recent review, the most frequent evaluation method is survey; many studies have a summative study objective and are performed late in the EHR system design cycle [20]. Follow-up or long-term monitoring studies on development of EHR systems' usability, however, seem to be scarce [1]. Our earlier study on Finnish physicians' experiences on EHR usability has shown, that between 2014 and 2010 the overall satisfaction [1] had not improved considerably. On a scale 1-7 the average of the ratings varied from 3.2 to 4.4.

3. Materials and Methods

In this study we utilized the usability-focused questionnaire designed in 2010 [12,13] to gather follow-up data and to find out to what extent the situation regarding usability from the physicians' viewpoint has changed between years 2010 and 2017. The procedure of the study was similar in years 2010, 2014 and 2017: The data was gathered from February to March [14] and the invitation to the web-based survey was e-mailed to all working-age physicians in Finland. Table 1 describes the study population.

For the analyses, we selected the respondents from public hospitals and healthcare centres. User responses to the six usability related statements identical in all three surveys were selected for this study. The themes of the statements were related to (1) Technical quality - responsiveness of the system, errors in use and their reflections on patient safety (2) Ease-of-use - success of user interface design and system support for routine tasks and (3) Benefits (Table 2). The five-point Likert scale answers 'Fully agree' and 'Somewhat agree' were combined to form the category 'Agree'. Similarly, the answers 'Fully disagree' and 'Somewhat disagree' were combined to form the category

'Disagree'. The means were calculated from the 5-point Likert-scale answers. Analysis of variance (ANOVA) and Bonferroni's post-hoc tests were used to compare results between 2010, 2014 and 2017. All statistical analyses were carried out with SPSS software version 22.0 (SPSS Inc., Armonk, NY).

Table 1. Study population.

Year	Sample (N)	Sample (n)	of which public hospital (%)	of which healthcare centre (%)	Total response rate (%)
2017	18 326	4 018	49	27	22*
2014	18 257	3 781	46	24	21*
2010	14 411	3929	50	23	27**

*In 2014 and 2017 the sample (N) contains all members of the Finnish Medical Association with valid e-mail address (N). The register did not contain information on who is in clinical work. Though targeted to clinicians, the response was calculated from all physicians, including those not in clinical work.

**In 2010 the sample (N) contained those Finnish Medical Association members, who reported being in clinical work and who had a valid e-mail address. The response rate was calculated from physicians in clinical work.

Table 2. Domains studied and measures used.

Domain	Measure
Technical quality	Q1 = The system responds quickly to inputs.
	Q2 = Faulty system function has caused or has nearly caused a serious adverse event for the patient.
Ease of use	Q3 = The arrangement of the fields and functions is logical on computer screen.
	Q4 = Terminology on the screen is clear and understandable (for example titles and labels).
	Q5 = Routine tasks can be performed in a straightforward manner without the need for extra steps using the systems.
Benefits	Q6 = Information systems help in preventing errors and mistakes associated with medication.

4. Results

The results on physician's experiences on usability of their EHR systems in years 2010, 2014 and 2017 are presented in three parts:

- Summary of 'Agree' responses to six usability statements from physicians working in healthcare centres (Figure 1)
- Summary of 'Agree' responses to six usability statements from physicians working in hospitals (Figure 2)
- Mean opinion scores on a scale from 1 (or 'Fully disagree') or 5 (or 'Fully agree') and comparison of the scores between healthcare centres and hospitals (Table 3).

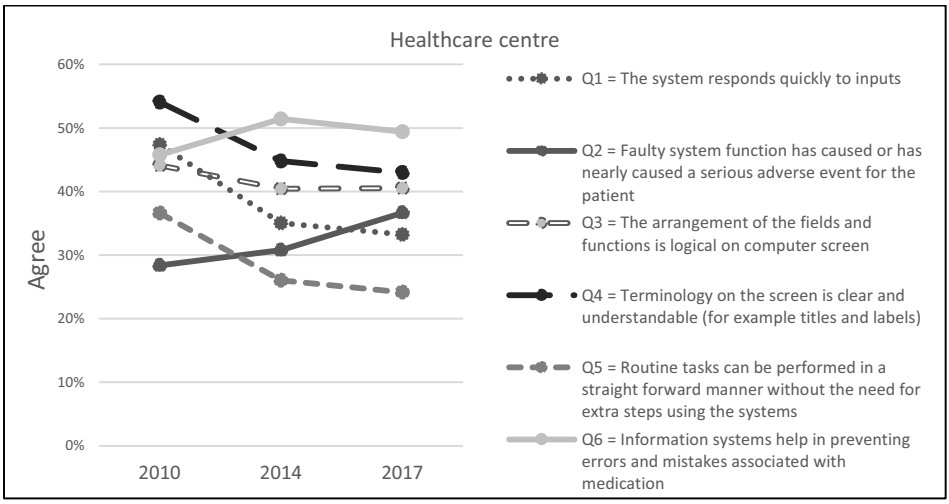


Figure 1. Summary of 'Agree' responses to six usability statements from physicians working in healthcare centres: Changes between 2010, 2014 and 2017.

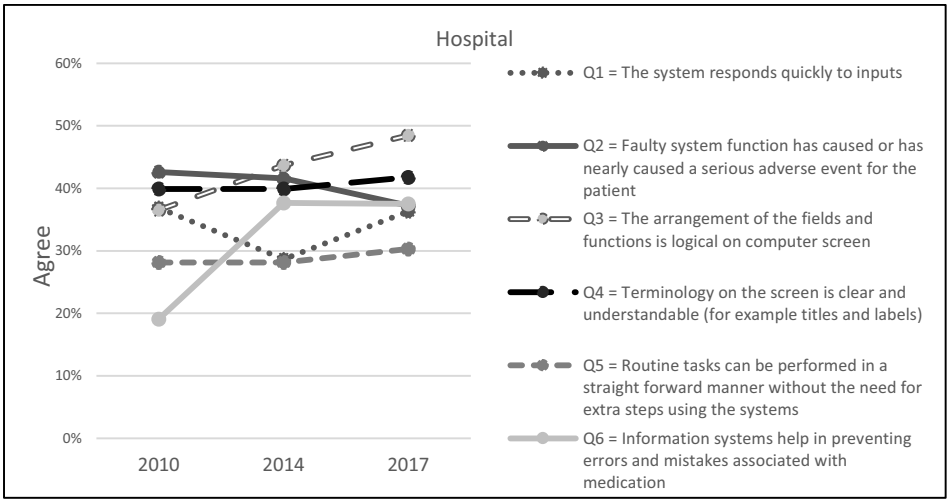


Figure 2. Summary of 'Agree' responses to six usability statements from physicians working in hospitals: Changes between 2010, 2014 and 2017.

Table 3. Comparison of physician's mean opinion scores with scale from 1 (or 'Fully disagree') or 5 (or 'Fully agree') for six usability statements between healthcare centres and hospitals in 2010, 2014 and 2017.

Year	2010	2014	2017	p between 2010 and 2014	p between 2010 and 2017	p between 2014 and 2017
Q1 The system responds quickly to inputs						
Healthcare centre	3.09	2.73	2.66	<0.001	<0.001	0.548
Hospital	2.82	2.58	2.77	<0.001	0.617	<0.001
Q2 Faulty system function has caused or has nearly caused a serious adverse event for the patient						
Healthcare centre	2.82	2.78	2.88	1.000	0.673	0.199
Hospital	3.24	3.07	2.94	<0.001	<0.001	0.006
Q3 The arrangement of the fields and functions is logical on computer screen						
Healthcare centre	3.02	2.84	2.84	0.004	0.005	1.000
Hospital	2.81	2.95	3.07	0.001	<0.001	0.006

Q4 Terminology on the screen is clear and understandable (for example titles and labels)						
Healthcare centre	3.28	3.02	2.96	<0.001	<0.001	0.835
Hospital	2.93	2.90	2.96	0.980	1.000	0.248
Q5 Routine tasks can be performed in a straight forward manner without the need for extra steps using the systems						
Healthcare centre	2.75	2.42	2.29	<0.001	<0.001	0.084
Hospital	2.50	2.47	2.53	1.000	1.000	0.338
Q6 Information systems help in preventing errors and mistakes associated with medication						
Healthcare centre	3.01	3.12	3.03	0.130	1.000	0.276
Hospital	2.32	2.82	2.84	<0.001	<0.001	1.000

5. Discussion and Conclusions

In this paper, we report Finnish physicians' experiences with the usability of currently used EHR systems and changes in their perceptions between 2010 and 2017 based on their responses to six usability statements. Overall, the results indicate that the situation has not improved. Among physicians working in healthcare centres, the mean opinion scores for nearly all statements between 2010 and 2017 showed change for the worse. However, in the responses of physicians working in hospitals ease of use had slightly improved: usability of the use interfaces (Q3 and Q4) concerning the arrangement of the fields and functions on screen as well as terminology, and system support for routine tasks (Q5). In general, the results indicate that the physicians working both in hospitals and in healthcare centres experience that the systems inadequately support their everyday work: both the portion of agree responses and the given mean opinion scores can be considered as low. Contrary to general expectations, the results do not indicate improvements between the years 2010, 2014 and 2017.

Our results suggest that the implementation of National Health Information Services (Kanta) i.e. national centralized patient data repository and electronic prescription since 2014 has not yet met its goals: enhancing continuity of care, patient safety and health care productivity. The six measures on technical quality, ease of use and benefits show no improvement during the follow-up period - in fact, there has been a slight decrease in technical quality and ease-of-use. The Kanta-service integration with the EHR-systems has been a complex technical operation, generating new operating procedures and screens, and also impacted overall speed and benefits of use. Another explanation for the lack of improvements between the years of study may be the EHR system vendors constantly lagging behind in configuring and developing their systems to support the constantly increasing requirements of physicians' daily work.

For the purposes of monitoring of the development of EHR systems and eHealth in a national level, survey is a suitable tool for gathering self-reported data from a large group of participants, benchmarking systems and pinpointing problems and successes. Other usability evaluation methods are needed for detailing usability problems and design improvements [21].

This article is part of a larger research project, which started in 2009 when we developed the first version of the national usability-focused questionnaire for physicians. The project has grown to cover nurses and has become part of eHealth strategy implementation in Finland [10]. Currently, we are developing a similar questionnaire for social care workers. The monitoring of development of healthcare IT systems in Finland from the viewpoint of different professional groups continues, as will international research collaboration to work towards comparable results between countries.

References

[1] J. Kaipio, T. Lääveri, H. Hyppönen, S. Vainiomäki, J. Reponen, A. Kushniruk, E. Borycki, J. Vänskä. Usability problems do not heal by themselves: National survey on physicians' experiences with EHRs in Finland, *Int J Med Inform* **97** (2017), 266-281.

[2] S. Vainiomäki, A.M. Aalto, T. Lääveri, T. Sinervo, M. Elovainio, P. Mäntyselkä, H. Hyppönen. Better usability and technical stability could lead to better work-related well-being among physicians, *Applied Clin Inform* **8**(4) (2017), 1057-1067.

[3] L.C. Roman, J.S. Ancker, S.B. Johnson, Y. Senathirajah. Navigation in the electronic health record: a review of the safety and usability literature. *J Biomed Inform* **67** (2017), 69-79.

[4] R.M. Ratwani, E. Savage, A. Will, R. Arnold, S. Khairat, K. Miller, R.J. Fairbanks, M. Hodgkins, A.Z. Hettinger. A usability and safety analysis of electronic health records: A multi-center study. *JAMIA* **25**(9) (2018), 1197-1201.

[5] N.V. Oliveros, T.G. Caro. A continuous usability evaluation of an electronic medication administration record application. *J Eval Clin Pract* **23** (2017), 1395-1400.

[6] T. Davis. *Creating the EMR advantage. KLAS Reports 2017, Performance report*. Available: https://klas research.com/images/landing-pages/collaborative/Creating-the-EMR-Advantage-Executive-Overview.pdf (referenced September 18th, 2018)

[7] V.M. Vaughn, J.A. Linder. Thoughtless design of the electronic health record drives overuse, but purposeful design can nudge improved patient care. *BMJ Qual Safety* (2018).

[8] J. Reponen, M. Kangas, P. Hämäläinen, N. Keränen. *Tieto- ja viestintäteknologian käyttö terveydenhuollossa vuonna 2014. Tilanne ja kehityksen suunta. [In English: Use of information and communications technology in Finnish health care in 2014. Current situation and trends.] Raportti 12/2015*. Terveyden ja hyvinvoinnin laitos, Helsinki, Finland, (2015).

[9] J. Reponen, M. Kangas, P. Hämäläinen, N. Keränen, J. Haverinen. *Use of information and communica tions technology in Finnish health care in 2017. Current situation and trends.* Terveyden ja hyvinvoinnin laitos (THL). National Institute for Health and Welfare (THL). Report 5/2018. Helsinki, Finland (2017). (In Finnish with English abstract). Available: https://www.julkari.fi/bitstream/handle/10024/136278/URN_ISBN_978-952-343-108-9.pdf?sequence=1&isAllowed=y (referenced Sep 18th, 2018)

[10] Ministry of Social Affairs and Health. *Information to support well-being and service renewal. eHealth and eSocial Strategy 2020*. Edita Prima, Helsinki (2015). Available at: http://urn.fi/URN:ISBN:978-952-00-3548-8 (referenced September 18th, 2018)

[11] H. Hyppönen, P. Hämäläinen, J. Reponen. *E-health and e-welfare of Finland. Checkpoint 2015.* National Institute for Health and Welfare (THL), Report 18/2015, Helsinki, Finland, 2015. Available at: http://urn.fi/URN:ISBN:978-952-302-563-9 (referenced September 18th, 2018)

[12] J. Vänskä, J. Viitanen, H. Hyppönen, M. Elovainio, I. Winblad, J. Reponen, T. Lääveri. Lääkärien arviot potilastietojärjestelmistä kriittisiä. *Finnish Med J* 50-52, **65** (2010), 4177-4183. (In English: Doctors critical of Electronic Patient Record systems)

[13] J. Viitanen, H. Hyppönen, T. Lääveri, J. Vänskä, J. Reponen, I. Winblad. National questionnaire study on clinical ICT systems proofs: Physicians suffer from poor usability. *Int J Med Inform*, **80**(10) (2011), 708-725.

[14] P. Saastamoinen, H. Hyppönen, J. Kaipio, T. Lääveri, J. Reponen, S. Vainiomäki, J. Vänskä, Lääkärien arviot potilastietojärjestelmistä ovat parantuneet hieman. *Finnish Med J* **34**(73) (2018), 1814-20. (In English: Slight positive changes in physicians'assessments of electronic health record systems).

[15] H. Hyppönen, T. Lääveri, N. Hahtela, A. Suutarla, K. Sillanpää, U-M. Kinnunen, O. Ahonen, E. Rajalahti, J. Kaipio, T. Heponiemi, K. Saranto. Kyvykkäille käyttäjille fiksut järjestelmät? *FinJeHeW* **10**(1) (2018), 30-59.

[16] Finnish Medical Association. *Physicians in Finland – Statistics on physicians and the health care system 2016.* Available at: https://www.laakariliitto.fi/site/assets/files/1268/ll16_tilasto2016_net1_170114.pdf (referenced on September 18th, 2018)

[17] M. Zahabi, D.B. Kaber, M. Swangnetr. Usability and safety in electronic medical records interface design: a review of recent literature and guideline formulation. *Human factors* **57**(5) (2015), 805-834.

[18] R. Pereira, J. Duarte, M. Salazar, M. Santos, A. Abelha, J. Machado. Usability of an electronic health record. In *Industrial Engineering and Engineering Management (IEEM)*, IEEE International Conference (2012), 1568-1572.

[19] J. L. Belden, R. Grayson, J. Barnes. Defining and testing EMR usability: principles and proposed methods of EMR usability evaluation and rating, *Healthc Inf Manag Syst Soc* (HIMSS) (2009).

[20] M.A. Ellsworth, M. Dziadzko, J.C. O'Horo, A.M. Farrell, J. Zhang, V. Herasevich. An appraisal of published usability evaluations of electronic health records via systematic review. *JAMIA* **24**(1) (2016), 218-226.