Effects of User Participation in the Development of Health Information Systems on Their Evaluation Within Occupational Health Services

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Abstract. Information management and the usability of health information systems (HIS) are important for the development of HIS in occupational health services. User participation in the HIS development process has been shown to contribute to the success of an HIS. The purpose of this study was to analyze how user participation in HIS development affected evaluation of the success of HIS. The success was assessed on the basis of the DeLone and McLean Information Systems (IS) Success Model. The study was conducted within occupational health services and the data (n=210) was analyzed with quantitative methods. The results showed that users participating in the HIS development process assessed the success of the HIS as better than those that had not taken part in the development. This difference could be seen in all seven dimensions of the DeLone and McLean IS success model but was statistically significant only for System Quality and Intention to Use. The results also showed that the users that had participated in the HIS development process also used the HIS more often and more extensively than those that had not participated in the development. The results indicate that user participation in the development process positively influences their assessment of the HIS and increases their active use of the IS. However, more research is needed to determine the long-term effects of using participatory design in HIS development.

Keywords. Occupational Health Services, Information Systems, Health Information Systems, Participatory Design

1. Introduction

Progress in eHealth and health information systems (HIS) development has been prominent in the World Health Organization (WHO) member states. However, there are still barriers to overcome before eHealth and HIS can be fully integrated into healthcare. One of the barriers is that systems are mostly developed separately, causing an additional burden in data utilization, and poor quality of data. There is also a need to develop systems that better support the health professionals in their work [1]. According to health professionals, HIS do not support the users in their daily work and the users are concerned about their technical functionality (e.g. slowness and system crashes) [2-4].

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Nurses also reported having to document the same information several times [4]. In a national Finnish survey, 55 % of nurses stated that they had not participated in HIS development, and only less than 10 % assessed that they had participated significantly in development processes. At the same time the nurses claimed that the development of the HIS did not meet their requirements [4]. The physicians agreed with this, as only 10 % of them reported that their suggestions on electronic patient records (EPR) development had been implemented [5]. Thus, it appears that users, either health professionals or citizens, should participate actively in the development of HIS.

Participatory information system (IS) design aims to combine technical development processes and end users' knowledge of the substance. Participation strengthens users' positive attitudes towards the development process, as they can affect the development of the IS they are using. Participation also increases commitment to use the IS [6]. Internationally, health professionals have been interested in participating in the development of HIS [7-8]. The results of participatory HIS design have also been successful [7-11].

There is a clear need for participatory HIS design and for understanding its effect on the success of IS. The earlier literature describes research using participatory design in HIS development in hospitals and clinical contexts [7-11]. The objective of this study was to investigate how participation in the HIS development process affects the evaluation of the success of HIS in Finnish occupational health services. The research question was "How does the evaluation of the HIS success of the participating users differ from that of non-participating users?".

2. Methods

This cross-sectional study was conducted in June 2019 using an electronic survey to evaluate the success of HIS. The assessed HIS was developed for the use of occupational health services for information management and analysis. The information obtained is further used in occupational health care to promote health and work ability. The HIS was developed in cooperation with occupational health professionals, using participatory design in the development process.

The data were collected from occupational health professionals (physicians, health nurses, physiotherapists, and psychologies) in Finland. A total of 252 of 1124 professionals returned the questionnaire, of whom 243 gave their informed consent. After excluding the responses of non-users, the data consisted of 210 completed questionnaires. In this study we used the DeLone and McLean IS Success Model as the framework to assess the HIS, as its seven dimensions describe the systems technical quality (system quality, information quality and service quality) as well as the user aspect (use, intention to use and user satisfaction) and the benefits of using the IS (net benefits) [12]. The DeLone and McLean IS Success model is also widely used in the assessment of HIS, mostly in hospitals [13-17]. The dimensions were operationalized in order to analyze users' assessment of HIS used in occupational health services. The questionnaire consisted of fifteen statements, which were based on the dimensions of the DeLone and McLean IS success model [5] and assessed on a 5-point Likert-scale. In addition, there were basic background questions including a question about participation in the development process. In this study, we utilized validated statements from previous studies [13-17]. The evaluations of respondents that had participated in the development process were compared to the evaluations of the respondents that had not taken part in

the development. The data were analyzed using the Independent samples Mann-Whitney U-test. U-values and p-values are presented along with mean, median and standard deviation. A p-value lower than 0.05 was considered statistically significant. The data was collected, maintained, and reported following the good research practices and ethical principles of the Finnish Advisory Board on Research Integrity [18].

3. Results

Half of the respondents (n=104) had worked from one to ten years in the occupational health services, 44 % (n=93) over 11 years, and only 6 % (n=13) for less than one year. Of the respondents, 70 % (n=146) were occupational health nurses and 13 % (n=28) occupational physicians. 11 % (n=24) of the respondents had participated in the development of the HIS. The users that had participated in the HIS development were more active users of the HIS, as 38 % of them used the HIS weekly and 25 % daily, whereas of the non-participating users 27 % used HIS weekly and only 1 % daily (Table 1). The participating users also used the HIS more extensively than the regular users, as they used on average five of the nine sections of the HIS compared to the four sections used by the non-participating users.

Table 1. Effect of participation in development on the use of HIS

	Participating Users (n=24)			Non-participating users (n=186)			Mann Whitney U-test	
	Mean	md	SD	Mean	md	SD	U-value	p-value
Activity of use	3.75	4.00	0.989	2.92	3.00	0.811	1207.50	<0.001***
Extent of use	4.92	5.00	1.976	3.93	4.00	1.773	1559.50	0.015*

*p < 0.05, ***p<0.001

The users that had participated in the development of the HIS also assessed the success of the HIS as better than the non-participating users (Table 2). Overall, participating users assessed all seven dimensions of the DeLone and McLean IS Success Model as more successful than non-participating users. The differences in System Quality and Intention to Use were statistically significant.

Table 2. Effect of participation in development on the success of HIS

	Participating Users (n=24)			Non-participating users (n=186)			Mann Whitney U-test	
	Mean	md	SD	Mean	md	SD	U-value	p-value
System Quality	2.96	3.00	0.78	2.58	2.33	0.76	1457.00	0.017*
Information Quality	3.18	3.67	1.03	3.00	3.00	0.84	1947.00	0.306
Service Quality	3.54	3.75	1.03	3.22	3.00	0.95	1839.00	0.152
Use	2.96	3.00	1.12	2.51	2.00	1.14	1727.00	0.062
Intention to Use	4.25	4.00	0.90	3.84	4.00	0.97	1680.00	0.028*
User Satisfaction	2.81	2.50	1.14	2.41	2.50	0.90	1801.00	0.117
Net benefits	4.25	3.33	1.06	3.02	3.00	0.90	1742.00	0.079

*p < 0.050, ***p<0.001

4. Discussion

The objective of this study was to reveal how participation in the development process affects the evaluation of the success of IS in the Finnish occupational health care environment. The results indicate that participation in the development process of the HIS resulted in more active and extensive use of the HIS. This supports the basic assumption of the participatory development process, which aims to increase commitment to the IS by providing the opportunity to affect its development [6].

The results of this study also indicate that the users that participated in the development process of the HIS assessed its success as better than did the non-participating users. This supports the conclusion of Tubaishat, who stated that the users that used the HIS more actively were generally more satisfied with the system than users not using HIS as actively [17]. Furthermore, Saghaeiannejad-Isfahani et al. reported that the developers of HIS assessed its success better than the users [14].

Although earlier research on HIS development using participatory design has not used the DeLone and McLean IS Success Model in evaluation of the development process, similar results of increased satisfaction of the participating users can be seen [8]. Therefore, this study confirms the earlier conclusions of successful HIS development with participatory design [7,11]. The use of the DeLone and McLean IS Success Model yields a broad view of the IS success, as its dimensions provide information about the success on a technical level as well as about the users' aspect and the benefits of the IS. Thus, the model appears to be suitable in assessing the success of an HIS development using participatory design.

The results of this study indicate that the use of participatory design in the development of HIS improves the success of HIS. However, there is a need to use it more widely and for a longer period in the development of HIS in order to tackle the challenges identified in earlier studies [4-5].

There are also some limitations to this study. First, the study was cross-sectional and described the assessment of the HIS only after its implementation and only at one moment. A longitudinal study would provide more information on the effect of the participatory design on the HIS development, as the non-participating users gain more experience with the HIS. Secondly, a longitudinal study with a predevelopment assessment would provide more information about the assessments of both groups of users and their attitudes towards the HIS and its development. Thirdly, the group of participating users was rather small compared to the non-participating users, and therefore more data is still needed to verify the results.

5. Conclusions

This study provides information on the effects of participatory design on HIS development in the context of occupational health services. The results indicate that participation of health professionals in the HIS development process helps to commit the users to the use of the HIS. The results also show that having the possibility to influence the development of the HIS results in better satisfaction with the success of the HIS, especially with regard to System Quality and Intention to Use the HIS.

References

[1] World Health Organization. Global diffusion of eHealth: Making universal health coverage achievable. Report of the third global survey of eHealth. World Health Organization, Geneve. 2016. Available from: http://apps.who.int/iris/bitstream/handle/10665/252529/9789241511780-eng.pdf?sequence=1 (accessed June 6, 2020).

[2] Kaipio J. Usability of electronic patient report. In: Vehko T, Ruotsalainen S, Hyppönen H, editors. E-health and e-welfare of Finland. Checkpoint 2018.National Institute for Health and Welfare Report 7/2019. National Institute for Health and Welfare, Helsinki; 2019. p.109–15. Available from: http://urn.fi/URN:ISBN:978-952-343-326-7 (accessed June 27, 2020).

[3] Hyppönen H. Usability of health information exchange and utility systems. In: Vehko T, Ruotsalainen S, Hyppönen H, editors. E-health and e-welfare of Finland. Checkpoint 2018.National Institute for Health and Welfare Report 7/2019. National Institute for Health and Welfare, Helsinki; 2019. p.115–21. Available from: http://urn.fi/URN:ISBN:978-952-343-326-7 (accessed June 27, 2020).

[4] Kinnunen U-M, Hyppönen H, Liljamo P, Saranto K. Nurses' experiences of health and social care information systems. In: Vehko T, Ruotsalainen S, Hyppönen H, editors. E-health and e-welfare of Finland. Checkpoint 2018.National Institute for Health and Welfare Report 7/2019. National Institute for Health and Welfare, Helsinki; 2019. p.130–47. Available from: http://urn.fi/URN:ISBN:978-952-343-326-7 (accessed June 27, 2020).

[5] Martikainen S, Kaipio J. Physicians' participation in the IT system development. In: Vehko T, Ruotsalainen S, Hyppönen H, editors. E-health and e-welfare of Finland. Checkpoint 2018.National Institute for Health and Welfare Report 7/2019. National Institute for Health and Welfare, Helsinki; 2019. p.125–6. Available from: http://urn.fi/URN:ISBN:978-952-343-326-7 (accessed June 27, 2020).

[6] Bansler J. Systems Development in Scandinavia: Three theoretical schools. Information Technology & People. 1988; 4(2), 117-33. doi:10.1108/eb022657.

[7] Reeder B, Hills RA, Turner AM, Demiris G. Participatory Design of an Integrated Information System Design to Support Public Health Nurses and Nurse Managers. Public Health Nurs. 2014; 31(2), 183–92. doi: 10.1111/phn.12081.

[8] Nelson SD, Del Fiol G, Hanseler H, Crouch BI, Cummins MR. 2016. A case report of refining user requirements for a health information exchange dashboard. Appl Clin Inform. 2016; 7, 22–32. http://dx.doi.org/10.4338/ACI-2015-07-CR-0091

[9] Urda D, Ribelles N, Subirats JL, Franco L, Alba E, Jerez JM. Addressing critical issues in the development of an Oncology Information System. Int. J. Med. Inform. 2013; 82, 398–407http://dx.doi.org/10.1016/j.ijmedinf.2012.08.001

[10] Pollack AH, Miller A, Mishra SR, Pratt W. PD-atricians: Leveraging Physicians and Participatory Design to Develop Novel Clinical Information Tools. Proceedings of AMIA Annu Symp. 2017 Feb 10; 2016:1030-9.

[11] Qin Y, Zhou R, Wu Q, Huang X, Chen X, Wang W, Wang X, Xu H, Zheng J, Qian S, Bai C, Yu P. The effect of nursing participation in the design of a critical care information system: a case study in a Chinese hospital. BMC Med. Inform. Decis. Mak. 2017 Dec; 17(1):165. doi: 10.1186/s12911-017-0569-3

[12] DeLone WH, McLean ER. The DeLone and McLean Model of Information Systems Success: A Ten-Year Update. J. Manag. Inf. Syst. 2003; 19(4), 9–30. https://doi.org/10.1080/07421222.2003.11045748

[13] Bossen C, Jensen LG, Udsen FW. Evaluation of a comprehensive EHR based on the DeLone and McLean model of IS success: Approach, results, and success factors. Int. J. Med. Inform. 2013; 82, 940–53.

[14] Choi JS, Yun SH, Kim D, Park SW. Impact of Doctors' Resistance on Success of Drug Utilization Review System. Healthc Inform Res. 2014; 20(2), 99–108. http://dx.doi.org/10.4258/hir.2014.20.2.99

[15] Saghaeiannejad-Isfahani S, Saeedbakhsh S, Jahanbakhsh M, Habibi M. Analysis of the quality of hospital information systems in Isfahan teaching hospitals based on the DeLone and McLean model. J Educ Health Promot. 2015 Feb; 4(5). doi: 10.4103/2277-9531.151883.

[16] Gaardboe R, Sandalgaard N, Nyvang T. An assessment of business intelligence in public hospitals. Int. J. Inf. Syst. Proj. Manag. 2017; 5(4), 5–18. doi**:** 10.12821/ijispm050401.

[17] Tubaishat A. Evaluation of Electronic Health Record Implementation in Hospitals. Comput Inform Nurs. 2017 Jul; 35(7):364-72. doi: 10.1097/CIN.0000000000000328.

[18] Finnish Advisory Board on Research Integrity (TENK). Responsible conduct of research and procedures for handling allegations of misconduct in Finland. Guidelines of the Finnish Advisory Board on Research Integrity 2012. Available from: http://www.tenk.fi/sites/tenk.fi/files/HTK_ohje_2012.pdf (accessed 3.7.2020).