



Original Article/Research

Digital national waiting time information system - View of Finnish public oral healthcare managers

Riitta Söderlund*

Information Systems Science, University of Turku, Turku, Finland



ARTICLE INFO

Keywords:

Care guarantee
Information system
Public healthcare
Public reporting
Survey
Waiting time

ABSTRACT

Objectives: The study evaluated the digital national waiting time information system from the point of view of oral healthcare managers in Finland in 2021. The information system (IS) was implemented in 2014, primarily to monitor waiting times in public healthcare. The system reported the information on realised waiting times on the Internet.

Methods: We gathered the data using a cross-sectional survey. Evaluating the system was based on a modified IS success model with the dimensions of information quality, system quality, individual impact and organisational impact. We used convenience sampling when including in the study managers working in public primary oral healthcare in the spring of 2021.

Results: The managers (n = 97) perceived it as easy to access the waiting time information on one website, but they evaluated the information as low quality. The information on realised waiting times supported them in the management of current waiting times to a minor degree. The managers associated the information inaccuracy in the national system with dental nurses' poor data entry in electronic patient ISs in oral healthcare organisations. The inaccuracy meant that waiting time monitoring data was not valid.

Conclusions: Our modified IS success model was sufficient to ascertain that poor information quality likely influenced the effectiveness of managers in information-driven waiting time management. Information must be relevant and accurate to promote the success of ISs. Further research is required to explore how to improve the design of national ISs from the point of view of different stakeholders in healthcare.

Public interest summary

Waiting times to access non-urgent care are often long in countries with publicly funded healthcare. Thus, maximum waiting times are set and monitored. As for Finland, there was a digital national information system to monitor realised waiting times in 2021. We evaluated the information system (IS) from the point of view of public primary oral healthcare managers. The system increased transparency in healthcare. It reported the waiting time information publicly on one website. The managers evaluated the information as low quality. The information on realised waiting times was not relevant to managing current waiting times. The information was also inaccurate. The managers associated the inaccuracy with dental nurses' poor data entry in electronic patient ISs in oral healthcare organisations. The inaccuracy meant that waiting time monitoring data was not valid. The results emphasise the importance of good-quality information for the success of ISs. Participatory design of national ISs is required.

Introduction

Waiting times to access care are often long, especially in countries with publicly funded healthcare [1]. It is essential to reduce waiting times to improve the quality of healthcare [2]. Combining appropriate maximum waiting times with demand- and supply-side interventions and regular waiting time monitoring have been successful approaches to reducing waiting times [3]. When care-quality information is reported publicly, transparency in healthcare increases; healthcare payers can confirm the care quality of healthcare providers, providers can benchmark their quality against other providers, and clients can choose a high-quality healthcare provider [4].

Monitoring and reporting waiting times require good-quality waiting time data. Relevance, availability and accuracy are key quality aspects of statistical data [5]. Statistical data, like other data, evolves during its life cycle [6]. Gathered data is stored, processed and presented in different forms for various purposes. Several issues, such as data entry

* Corresponding author at: Unit of Information Systems Science, University of Turku, 20014 Turun yliopisto, Finland

E-mail address: riitta.soderlund@utu.fi.

<https://doi.org/10.1016/j.hlpt.2024.100900>

Available online 16 August 2024

2211-8837/© 2024 Fellowship of Postgraduate Medicine. Published by Elsevier Ltd. This is an open access article under the CC BY license (<http://creativecommons.org/licenses/by/4.0/>).

errors and system irregularities, challenge data evolution.

The relevance of the waiting time for a particular purpose depends on how the waiting time is defined and measured. As it is a period between a starting point and an endpoint, we must define these points so that the waiting time is relevant to the intended purpose. All healthcare providers should use equal definitions for a designed purpose, as without this, comparisons are challenging [7,8]. In primary care, the variation in waiting time definitions is minor, and the waiting time has been defined as the time taken to get an appointment to see a healthcare professional [8].

There are three possibilities for waiting time measurement in the passage of time [9]. Retrospective measures describe 'completed waits', meaning the realised waiting times of patients already treated. The two other measures describe prospective waiting times. One is for 'ongoing waits', meaning the waiting times of those on the waiting list, and the other is for 'expected waiting time', meaning an estimate of the future waiting time for a new patient. For policy-makers, realised waiting times are important from the point of view of the overall effect on welfare, but policy-makers also need information on current performance [10]. Healthcare organisations often have various internal waiting time measures [11].

As statistical figures, the mean, median, number of patients waiting, number of patients waiting by population, and number of patients waiting within a certain time interval have been calculated [9]. To present organisations' performance data simply, colour symbols have been suggested as one solution. They are challenging, as they do not explain differences and variations [12]. Similarly, a single statistical key figure is inadequate for designing policies to tackle waiting times [13].

When national authorities monitor waiting times, they must rely on information acquired from healthcare organisations. There is speculation that self-reported information may be biased [14,15]. Investments in information systems (IS) have been made to get data to control the behaviour of organisations [16]. Data extracted automatically from electronic patient ISs did not guarantee the validity of the waiting time registry in Sweden because of the misconceptions underpinning the waiting time reporting system [17]. Data accuracy may be poor if the knowledge and understanding of the used codes is improper [18]. Persons who document and process data must perceive reporting as meaningful. They must have the right skills for these tasks, and they should receive feedback [19]. In addition, poor system usability affects data entry. In Denmark, medical secretaries considered the structure of a new system module confusing for their tasks [20].

Concerning public oral healthcare, to the best of our knowledge, there are no extensive studies on public waiting time monitoring and reporting ISs. Our study evaluated the success of the digital national waiting time IS from the point of view of public oral healthcare managers in Finland in 2021. The Finnish healthcare system is mainly publicly funded. Maximum waiting times for non-urgent public primary care were set in law in 2005 [21]. A digital national IS was implemented in 2014 to monitor waiting times [22]. The system reported the information on realised waiting times publicly on the Internet. A major reform of public health and social services was upcoming in 2023, and one of its objectives was to improve access to public primary care [23]. We were interested in whether the digital national IS supported public primary oral healthcare in waiting time management. The research questions are as follows: 1) How do oral healthcare managers perceive the digital national waiting time IS? 2) How do oral healthcare managers perceive different waiting time measures?

Public primary oral healthcare and the digital national waiting time IS

The Finnish health system is a combination of tax-funded services and private services. In oral healthcare, the role of private services is significant. Private-sector dentists provide almost half of adult visits [24]. The number of dentists working in public services is around four for every 10,000 members of the population [24]. As everyone is entitled to public services, waiting times for public primary oral healthcare

have not been reasonable. The waiting time refers to the period from assessing the need for treatment in telephone triage to an appointment with a dentist [25].

In 2021, when the study data was gathered, municipalities had a duty to organise public healthcare services. The state supported the organisation by paying central government subsidiaries to municipalities. The Healthcare Act [25] defined the services provided and the maximum waiting time for non-urgent care, which was six months in primary oral healthcare. A major reform of public health and social services was upcoming in 2023 meaning that the wellbeing services counties organise public health and social services [23]. Amongst other things, the reform aimed to improve the availability and accessibility of public primary services. Different forms of reform have been planned since 2005. Politicians have debated the role of private sector services and freedom of choice. The Healthcare Act has supported, within the limits of resources, some possibilities regarding choice, such as choosing the public service organiser, the service unit and the dentist.

The Healthcare Act has required each healthcare organiser to report its waiting times for non-urgent care on its website and to update this information every four months. Reported prospective waiting times have been based on the first or third available non-on-call dentist appointment time or an estimate [26].

To monitor realised waiting times, all public primary oral healthcare organisations submitted data to the Finnish Institute for Health and Welfare (hereafter the Institute) [27,28]. Since 2014, data has been submitted in encrypted electronic form from electronic patient ISs to the systems of the Institute [22], preferably daily in strictly defined content [29]. The content was transactional-level data regarding each contact, an assessment of the need for treatment, and the booking, cancellation and appointment for a client. To access care, a nurse assessed the need for treatment of a client who had contacted the telephone triage, and an appointment time was booked if needed. The data on these transactions was documented in electronic patient ISs automatically or manually by dental nurses.

The systems of the Institute processed the data for aggregated summary reports to be reported publicly on its website. New information was published once a month. In spring 2021, the information was presented with the numbers of clients within six categories. The categories for realised waiting time for non-urgent care were 0, 1–3, 4–21, 22–90, 91–180 and more than 180 days. The information was also classified by area of regional state administrative agency, province, service organiser and service unit.

Materials and methods

To evaluate the success of the digital national waiting time IS from the point of view of public oral healthcare managers, we carried out a cross-sectional survey in 2021. The Ethics Committee for Human Sciences at the University of Turku approved the study proposal in February (Permit 7/2021). This ethical permit required the participants to provide informed consent to participate in the study. Applications for research permits were also submitted to 135 public primary healthcare organisers in March 2021. Of these, 52 % had a small population base of up to 20,000 people. We obtained permits from 105 organisers; 54 % had a large population base of more than 20,000 people.

The research design originally included gathering data from every oral healthcare manager working in the public primary sector in Finland in the spring of 2021. As not all 135 public primary healthcare organisers approved the research permit, managers were included in the study using convenience sampling. The number of managers of the 105 healthcare organisers included in our study was 159. Nonprobability sampling decreases the validity and credibility of study results, but the method is suitable for exploratory research to ascertain whether a problem exists [30].

We adapted the theoretical framework (Fig. 1) from the original IS success model of DeLone and McLean [31] and the IS-impact

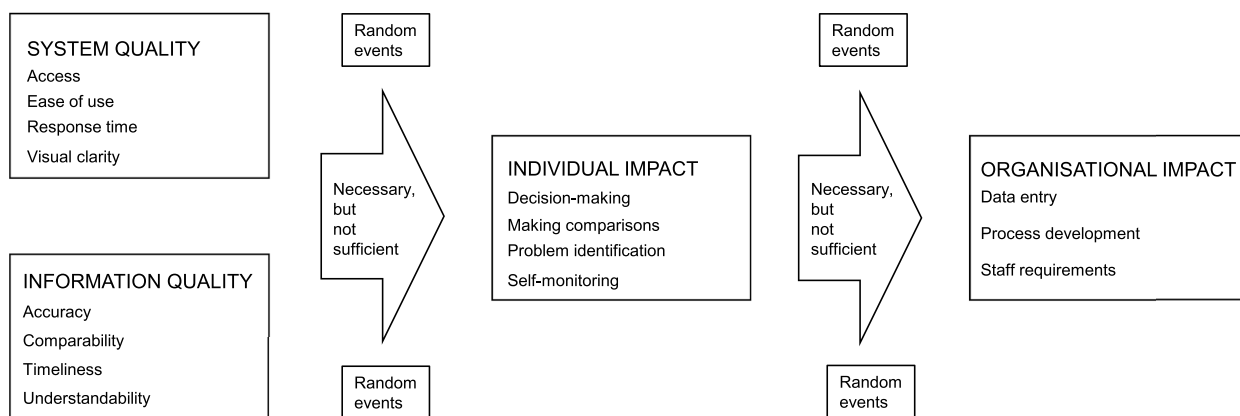


Fig. 1. The IS success model modified after [31,32].

measurement model of Gable et al. [32]. DeLone and McLean based their model on a literature review and concluded that there is no single IS success measure, but rather many such measures. The measures are classified into six categories: system quality, information quality, use, user satisfaction, individual impact and organisational impact. The categories are interrelated and interdependent, forming an IS success model. Gable et al. [32] re-conceptualised the concept of IS success as a formative, multidimensional index. It has four dimensions in two halves: the quality half and the impact half. The quality half consists of system quality and information quality, and the impact half consists of individual impact and organisational impact. System quality is a measure of the system's performance from a technical perspective. Information quality refers to the quality of the IS outputs. Individual impact measures the extent to which the IS has influenced the effectiveness of key users. Organisational impact refers to the extent to which the system has promoted improvement in organisational capabilities and results. Gable et al. considered these four dimensions necessary and sufficient for the IS-impact measurement model. We also decided to include four dimensions – system quality, information quality, individual impact and organisational impact – in our model, to keep it concise. Different modified IS success models have been used a lot for evaluating the success of health information technology [33–35].

The original IS success model [31] is both a variance and a process model [36]. We used the assumptions of a process model [37]. Process models assert that the outcome can happen only under necessary conditions, but it may also fail to happen. Thus, system and information quality are necessary, but are not sufficient antecedents for individual impacts. Furthermore, individual impacts are necessary for organisational impacts, but chance and random events play a role. Altogether, the impacts found are likely to occur under some conditions and unlikely under others.

We included 15 attributes in our modified IS success model, to measure its four dimensions. For the dimension of organisational impact, we had three attributes, and we had four for the other dimensions. For system quality and information quality, we chose attributes commonly used in their assessments [31]. The attributes for system quality were access, ease of use, response time and visual clarity. For information quality, the attributes were accuracy, comparability, timeliness and understandability. For individual and organisational impact, the attributes were modified for the context of waiting time management. Modifying attributes for study contexts is paramount for successful evaluations [38]. Thus, for the attributes of individual impact, we chose decision-making, making comparisons, problem identification and self-monitoring. Individual impact means impacts on oral healthcare managers in the studied context. Organisational impact was evaluated by data entry, process development and staff requirements. Data entry is an essential capability of a healthcare organisation. We cannot discuss the quality of something if we have not documented that thing

[5]. In the attribute data entry, we included dental nurses' IS instructions, helpdesk activities, leader support for nurses and orientation of nurses.

In our study, there was one question for each attribute except the attribute of data entry (see Appendix A). This had four items. We also asked about the waiting time information accuracy in the system concerning the respondent's organisation, and possible extra views on waiting time information in oral healthcare. We had six questions about managers' perceptions of different waiting time measures in waiting time monitoring. The questionnaire also included questions on the backgrounds of managers and questions for other studies, such as the importance of publishing waiting times for clients.

The questionnaire was pretested before distribution to ensure its clarity and comprehensiveness. We gathered the data using the software Webropol Survey & Reporting, version 3.0. The questionnaire was accessed through an open Internet link to allow anonymous responses.

We sent the Internet link to the contact persons of the oral healthcare organisations at the beginning of May 2021. The persons were named for this task in the approved research permits. Reminders to respond were sent at the end of May. We had informed oral healthcare managers that it would be possible to reply to the questionnaire until 11 June. On 2 June, the Institute updated its waiting time website referred to in the survey, and we had to close our survey on that date. We sent a message about this to the oral healthcare organisations the next day.

In statistical analyses, we used the software IBM SPSS Statistics for Windows, version 28.0.0.0. In SPSS, cases in which data on a variable was missing were excluded from analyses. Because the study was to ascertain whether a problem exists, using convenience sampling, the attributes were not combined into four indexes, with one for each dimension. Instead of the indexes, we used boxplots to illustrate the locality and spread of these attributes. We gathered most of the data using a 5-point Likert scale (strongly disagree=1, disagree=2, neither agree nor disagree=3, agree=4, and strongly agree=5) or another ordinal rating scale (not at all=1, slightly=2, moderately=3, very=4, and extremely=5). The relationships between the categorical variables were studied using contingency tables and Chi-Square statistics [39].

Results

Descriptive statistics of the oral healthcare managers

Of the 159 managers potentially participating in the study, 98 answered our questionnaire, which was a response rate of 62%. One of the managers did not provide informed consent to participate in the study. Thus, the number of managers included in the analysis was 97. There was also a minor data loss because not all the managers answered all the questions. The number of respondents answering the different structured questions varied from 90 – 96. The number of valid responses

(n) is reported separately for each question.

Of the managers (n = 96), 60 % had a licentiate degree in dentistry, 20 % were specialist dentists, and 20 % had other qualifications. For example, eight were dental hygienists. As managers (n = 93), 40 % had worked for five years or less, 16 % from 6 – 10 years, and 44 % longer than ten years. Of the managers (n = 95), 50 % worked in an organisation with a small population base of up to 20,000. Of the specialist dentists, three out of four worked in an organisation with a large population base. There was no association between working years in management positions and the organisation’s population base.

Managers’ perceptions of the digital national system

The oral healthcare managers’ perceptions of the success of the digital national waiting time IS are presented in Fig. 2. Of the success dimension of organisational impact, the figure illustrates only the attribute data entry with its four items. In addition, 33 % of the managers answered that process development had been started in their organisation because their waiting times had been longer than in other organisations, based on the waiting time information in the national system (n = 96). Similarly, 22 % of the managers answered that the information had been used to justify the need for additional resources (n = 96).

In response to the question ‘The waiting time information published on the website of the Finnish Institute for Health and Welfare is accurate for the organisation I manage’, 52 % of the managers responded positively (n = 90). Of these, 60% managed oral healthcare organisations with a small population base. The difference between the manager groups was statistically significant ($\chi^2 = 5.560$; $df=1$; $p = 0.018$). Furthermore, the managers who considered the waiting time figures in the system to be accurate for the organisation they managed, in general, perceived the information accuracy in the system to be higher than did the managers who considered the figures in the national system concerning their organisation to be inaccurate ($\chi^2 = 25.646$; $df=3$; $p < 0.001$).

Managers’ perceptions of different waiting time measures

Fig. 3 presents how the managers perceived different realised and ongoing waiting time measures.

Table 1 presents the associations between the managers’ perceptions

of different waiting time measures and the population base entitled to oral healthcare provided by the organisation the person managed.

Managers’ extra views on waiting time information in oral healthcare

Of the managers, 37 answered our open-ended question about whether they had anything else to say about waiting time information in oral healthcare. The answers referring to reasons for the inaccurate waiting time information in the national system could be associated with the characteristics of individuals, tasks and technology. The respondents considered that assessing the need for oral treatment was an overly complicated process, especially for dental nurses who rarely worked in telephone triage or were recent graduates. Data entry was also considered challenging. Data entries were made incorrectly or remained unfinished. The software and instructions frequently changed, and up-to-date user instructions for using the electronic patient IS were lacking. The managers could not check the data transferred from their systems to the national system. Knowledge of how the statistical information formed did not exist. There was curiosity as to why CE-certified electronic patient software did not work.

Discussion

We evaluated the success of the digital national waiting time IS in Finland in 2021. The system was implemented in 2014 primarily to monitor the care guarantee in public primary healthcare. The system reported the information on realised waiting times publicly on the Internet. A major reform in Finnish health and social services was upcoming in 2023. One of its objectives was to improve access to primary oral care. The study evaluated the national IS from the point of view of public oral healthcare managers in managing waiting times. We gathered the data for our explorative study using a cross-sectional electronic survey. We used convenience sampling. As a theoretical framework, we used a modified IS success model with four dimensions: system quality, information quality, individual impact and organisational impact [31, 32]. The study results indicated that the information quality in the system was poor. The national authorities confirmed with the inaccurate information in the system that realised waiting times in public oral healthcare were according to the law. To the oral healthcare managers, the information in the national system was neither accurate nor relevant in managing current waiting times. To a minor degree, they used the

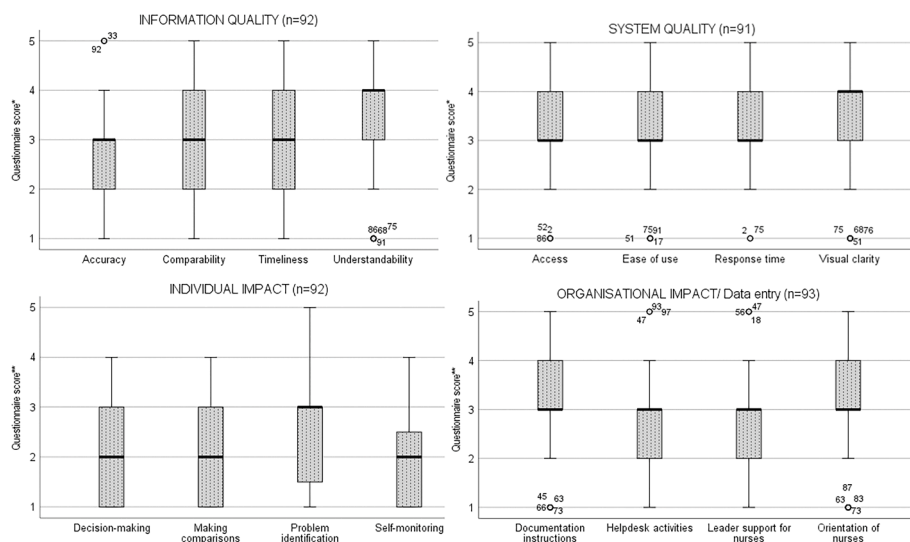


Fig. 2. Managers’ perceptions of the success of the digital national waiting time information system. (Questionnaire score*: 1=Strongly disagree, 2=Disagree, 3=Neither agree nor disagree, 4=Agree, 5=Strongly agree; Questionnaire score **: 1= Not at all, 2=Slightly, 3=Moderately, 4=Very, 5=Extremely).

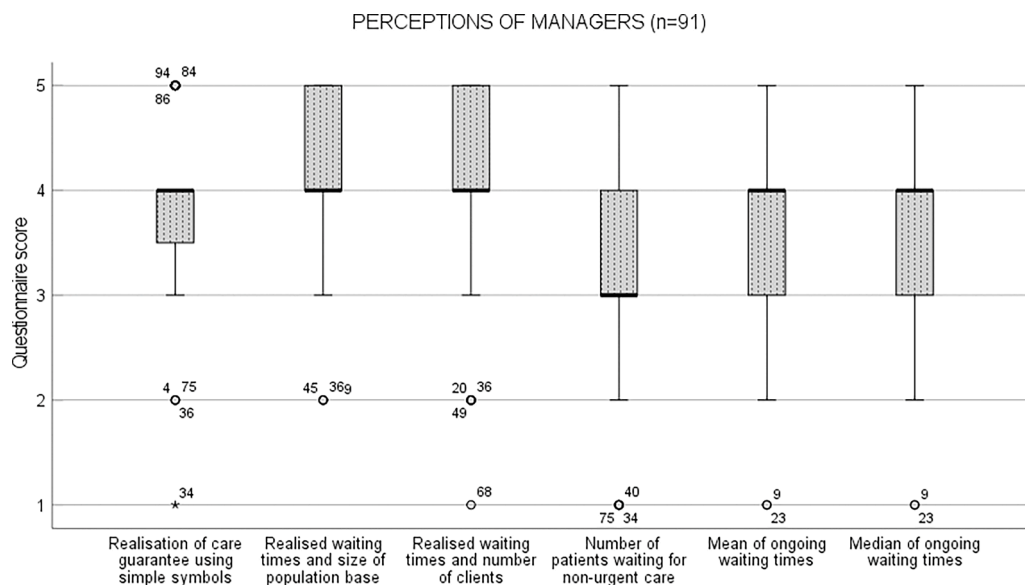


Fig. 3. Managers' perceptions of different waiting time measures. (Questionnaire score: 1=Strongly disagree, 2=Disagree, 3=Neither agree nor disagree, 4=Agree, 5=Strongly agree).

Table 1
Managers' perceptions of different waiting time measures by the size of the population base of their organisation (%).

Manager's perception	Realisation of care guarantee using simple symbols		Realised waiting times and size of population base		Realised waiting times and number of clients	
	A*	B**	A*	B**	A*	B**
Strongly disagree, disagree, neither agree nor disagree	28.3	19.6	30.4	8.5	28.3	12.8
Agree	47.8	58.7	50.0	55.3	52.2	46.8
Strongly agree	23.9	21.7	19.6	36.2	19.4	40.4
Total%	100.0	100.0	100.0	100.0	100.0	100.0
N	46	46	46	47	46	47
Chi-Square statistics	$\chi^2=1.285$; $df=2$; $p=0.526$		$\chi^2=8.191$; $df=2$; $p=0.017$		$\chi^2=6.227$; $df=2$; $p=0.044$	

Manager's perception	Number of patients waiting for non-urgent care		Mean of ongoing waiting times		Median of ongoing waiting times	
	A*	B**	A*	B**	A*	B**
Strongly disagree, disagree, neither agree nor disagree	57.8	43.5	42.2	34.8	51.1	36.2
Agree	35.6	45.7	51.1	54.3	37.8	53.2
Strongly agree	6.7	10.9	6.7	10.9	11.1	10.6
Total%	100.0	100.0	100.0	100.0	100.0	100.0
N	45	46	45	46	45	47
Chi-Square statistics	expected cell count less than 5 in 33%		expected cell count less than 5 in 33%		$\chi^2=2.381$; $df=2$; $p=0.304$	

A* Population base of up to 20,000.

B** Population base of more than 20,000.

information to compare the waiting times between different organisations, as the information was easy to access on one website. The managers associated the information inaccuracy with dental nurses' improper data entry in electronic patient ISs in their organisations. Reasons for improper data entry stem from individual, task and technology characteristics. Our modified IS success model was sufficient to

ascertain that poor information quality likely influenced managers' effectiveness in information-driven waiting time management.

The manager respondents represented all public primary oral healthcare organisations quite well. The proportions of the manager respondents in relation to the population bases of organisations provided no or low bias. Organisers with a small population base participated in the study less than organisers with a large population base. In addition to managerial tasks, many oral healthcare managers did clinical work, usually more in small organisations. The more clinical work managers did, the less time they had for managerial tasks and waiting times.

We considered the digital national waiting time IS as a public care quality reporting IS [4]. Waiting time to access non-urgent primary oral healthcare refers to care quality, and waiting time management refers to care quality improvement. The studied national system reported information on realised waiting times of all public primary oral healthcare organisations on one website. Transparency increased. It was quite easy for the managers to access the website. The waiting time definition was unambiguous. For the managers, information relevance problems were associated with waiting time measurement over the passage of time. Relevance was compromised as the system provided retrospective information for monitoring purposes, and information on prospective waiting times would have been needed for managing current waiting times.

The oral healthcare managers' evaluations on the relevance of the waiting time information in the national system with the attributes of comparability and timeliness varied a lot. The point of view of evaluation explains the variation. Retrospective waiting time information published once a month is timely for observing which organisations' maximum waiting times were according to the law, but not timely and relevant for current waiting time management. Waiting time information without other information is not relevant for analysing reasons for waiting time differences between organisations. The information is relevant for comparing realised waiting times between public oral healthcare organisations.

The information quality was poor, but the increased transparency enabled managers in information-driven waiting time management to a minor degree. The managers compared waiting times between public oral healthcare organisations and used the information to justify process development and staff requirements. As the managers could not check the waiting time data transferred from the electronic patient ISs to the systems of the Institute, the website offered them the possibility to check

the information in the system for the organisation they managed. Inaccuracies in the information were easy to notice. At the time of the study, the reports presented waiting time information with numbers of clients within six different waiting time length categories. The category of 0 meant no waiting time to access non-urgent care. When the number of clients in this category was large, it was probably wrong. In practice, this number in most organisations was zero. Furthermore, it was easy to find the small total number of all clients in all categories in a monthly report. The problems related to improper and lacking data entry. About half of the managers answered that the waiting time information in the system was inaccurate for the organisation the person managed. They were more often from large rather than small organisations.

The managers associated the information inaccuracy with dental nurses' poor data entry in electronic patient ISs in telephone triage when assessing the need for treatment. The complicated assessment task with poor usability of electronic patient ISs led to improper data entry. In particular, the skills of novice dental nurses and nurses who rarely worked in telephone triage were not enough. The technology characteristics were poor. The software was frequently updated, and the user instructions for electronic patient ISs were not up-to-date. To improve data entry, oral healthcare organisations had begun to improve the orientation of dental nurses for telephone triage tasks and to elaborate user instructions.

The managers' perceptions of presenting waiting time measures in the national system varied somewhat depending on the population base of the organisation the person managed. The managers from large organisations perceived it as more important to present realised waiting times in proportion to the size of the population base or the number of clients. They wanted the reporting to be fair; the proportional share was quite different if 20 clients had waited for access to non-urgent care longer than 180 days in a large rather than in a small organisation. The managers considered presenting realised waiting times in the system as more important than presenting ongoing waiting times, although managing current waiting times is based on prospective waiting times. Perhaps the managers did not want to reveal the current waiting times to others. There was no statistical difference between the manager groups. The managers were perhaps pleased that they had confirmed to the national authorities that their organisations' retrospective waiting times were according to the law, based on the information. The upcoming reform might have incentivised managers to improve information quality. The general interest in waiting times grew. Even a layman might wonder about the information quality in some cases.

We carried out the study in 2021. In 2014, IS investments were perhaps made to get good-quality data to control oral healthcare organisations' waiting times, as there was speculation that self-reported information may be biased. At least that was what had been done elsewhere [14,15,16]. Our study results and the results from Sweden [17] prove that data extracted automatically from electronic patient ISs does not guarantee the quality of the waiting time information. As in previous literature, our study results indicate that proper data entry is essential for data to evolve into accurate information [18,20]. The right skills and feedback are important for proper data entry [19]. In addition, information system vendors should be required to do more in terms of system usability.

The ISs in public Finnish healthcare will probably evolve during the health and social services reform. In any case, proper data entry is essential for the success of an IS. To improve IS investment profitability, a system should be designed to process relevant information for various purposes whenever it is possible. The data in the national system could have been processed for prospective and retrospective waiting time measures. Perhaps the design of a national IS would be better if a participatory system design was used. Further research is required to explore how to improve the design of national ISs from the point of view of different stakeholders in healthcare.

Limitations of the study

This study is not without limitations. Firstly, the convenience sampling decreased the validity and credibility of the study results. The challenge with convenience sampling is that the study participants might have an exceptionally positive or negative view of the studied issue. In the study, the manager respondents represented oral healthcare organisers with different population bases quite well. The perceptions of managers were not necessarily associated with the organisers' population bases. Secondly, we cannot verify causality between quality and impact issues in a cross-sectional study. Thus, it is only likely that inaccurate information helped managers in problem identification and in starting to improve data entry in their organisations. Finally, it is unlikely that we have included in our study all the attributes associated with the success of the digital national waiting time IS.

Conclusions

The study evaluated the success of the digital national waiting time IS from the point of view of oral healthcare managers in Finland. The system had been implemented primarily to monitor realised waiting times in public healthcare. The system increased transparency in healthcare, as waiting time information was reported publicly on one website. A modified IS success model was sufficient to ascertain that poor information quality likely influenced oral healthcare managers' effectiveness in information-driven waiting time management. The information on retrospective waiting times in the system was not relevant to managers' decision-making. The system supported them in management only to a minor degree, but enough to find inaccuracies in the information. Such inaccuracies were associated with dental nurses' improper data entry in electronic patient ISs in oral healthcare organisations. Perhaps the design of national ISs would be better if a participatory system design was used.

Funding

None.

Conflict of interest statement

The author reports there are no competing interests to declare.

Ethical approval

The Ethics Committee for Human Sciences at the University of Turku approved the study proposal in February 2021 (Permit 7/2021). This ethical permit required that eligible participants were 18 years or older. In addition, the participants had to provide their informed consent to participate in the study. Each manager was asked to provide informed consent at the beginning of the electronic questionnaire as the Ethics Committee required.

Acknowledgements

The author thanks the Finnish public primary healthcare organisers for enabling the study.

Appendix A

This appendix includes the study questions to evaluate the success of the digital national waiting time information system. The questions were for oral healthcare managers in public primary healthcare in Finland in the spring of 2021. The questionnaire was in Finnish. For this appendix, we translated the questions into English. The survey was conducted using the software Webropol Survey & Reporting, version 3.0.

I have understood the information I have received about the study and I want to participate in the study.

Yes

1. Degree

Licentiate of Dentistry
Specialist Degree in Dentistry
Other, what

2. I have worked in management positions in oral healthcare

less than 12 months.

1–5 years.

6–10 years.

more than 10 years.

3. The population base of the health centre I manage

Less than 10,001

10,001–20,000

20,001–30,000

30,001–70,000

More than 70,000

The National Institute for Health and Welfare gathers waiting time data from public oral healthcare for monitoring purposes and publishes this retrospective waiting time information on its website.

Information on realised waiting times of individual visits to oral healthcare is published, for example, on the page https://sampo.thl.fi/pivot/prod/ft/avo/hpaasysth01/summary_sthrapo2.

In my opinion, the website of the National Institute for Health and Welfare publishing oral healthcare information is

4. easy to access.

Strongly disagree

Disagree

Neither agree nor disagree

Agree

Strongly agree

5. Its response times are short.

Strongly disagree

Disagree

Neither agree nor disagree

Agree

Strongly agree

In my opinion, the oral healthcare waiting time information on the website of the National Institute for Health and Welfare is

6. timely.

Strongly disagree

Disagree

Neither agree nor disagree

Agree

Strongly agree

7. easy to understand.

Strongly disagree

Disagree

Neither agree nor disagree

Agree

Strongly agree

8. accurate.

Strongly disagree

Disagree

Neither agree nor disagree

Agree

Strongly agree

9. In my opinion, the website of the National Institute for Health and Welfare publishing oral healthcare waiting time information is visually clear.

Strongly disagree

Disagree

Neither agree nor disagree

Agree

Strongly agree

10. In my opinion, the oral healthcare waiting time information on the website of the National Institute for Health and Welfare enables comparisons.

Strongly disagree

Disagree

Neither agree nor disagree

Agree

Strongly agree

11. In my opinion, the website of the National Institute for Health and Welfare publishing oral healthcare waiting time information is easy to use.

Strongly disagree

Disagree

Neither agree nor disagree

Agree

Strongly agree

12. The National Institute for Health and Welfare website that publishes oral healthcare waiting time information has been useful to me in decision-making to manage my organisation.

Not at all

Slightly

Moderately

Very

Extremely

13. The National Institute for Health and Welfare website that publishes oral healthcare waiting time information has made it easier for me to self-monitor access to non-urgent care at my organisation.

Not at all

Slightly

Moderately

Very

Extremely

14. The National Institute for Health and Welfare website that publishes oral healthcare waiting time information has led me to evaluate data entry in our organisation when the need for treatment is assessed.

Not at all

Slightly

Moderately

Very
Extremely

15. The National Institute for Health and Welfare website that publishes oral healthcare waiting time information has made it easier for me to compare access to non-urgent care in my organisation with other organisations.

Not at all
Slightly
Moderately
Very
Extremely

16. The waiting time information published on the website of the Finnish Institute for Health and Welfare is accurate for the organisation I manage.

Yes
No

17. The orientation for dental nurses to use the patient information system when assessing the need for treatment has been increased in our organisation in recent years.

Not at all
Slightly
Moderately
Very
Extremely

18. Our oral healthcare organisation has invested in documentation instructions to be used when assessing the need for treatment in recent years.

Not at all
Slightly
Moderately
Very
Extremely

19. Helpdesk activities to support dental nurses in using the patient information system when assessing the need for treatment has been developed in recent years.

Not at all
Slightly
Moderately
Very
Extremely

20. In recent years, our oral healthcare organisation's managers have supported dental nurses who work on assessing the need for treatment more than before.

Not at all
Slightly
Moderately
Very
Extremely

21. We have made efforts to speed up access to care by developing processes. The development work has started because, based on the waiting time information on the National Institute for Health and Welfare website, the realised waiting time for oral healthcare at our health centre has been longer than in other health centres.

Yes
No

22. We have made efforts to speed up access to care by increasing staff resources. The additional resources have been justified by the fact that, based on the waiting time information on the National Institute for Health and Welfare website, the realised waiting time for oral healthcare at our health centre has been longer than in other health centres.

Yes
No

23. The National Institute for Health and Welfare website should use simple symbols to present the information on whether access to oral healthcare is provided by law.

Strongly disagree
Disagree
Neither agree nor disagree
Agree
Strongly agree

The information on realised waiting time for non-urgent oral healthcare on the National Institute for Health and Welfare website should also be presented in proportion to

24. the population of health centres.

Strongly disagree
Disagree
Neither agree nor disagree
Agree
Strongly agree

25. the number of oral healthcare clients at health centres.

Strongly disagree
Disagree
Neither agree nor disagree
Agree
Strongly agree

Waiting for treatment means that an assessment of the need for treatment has been made and an appointment has been given.

The National Institute for Health and Welfare website should present information by health centre on

26. how many people are waiting for non-urgent oral healthcare on the last day of the month.

Strongly disagree
Disagree
Neither agree nor disagree
Agree
Strongly agree

27. what the mean waiting time for non-urgent oral healthcare is on the last day of the month.

Strongly disagree
Disagree
Neither agree nor disagree
Agree
Strongly agree

28. what the median waiting time for non-urgent oral healthcare is on the last day of the month.

Strongly disagree
Disagree
Neither agree nor disagree
Agree
Strongly agree

29. Is there anything else you would like to say about waiting time information in oral healthcare?

References

- [1] Or Z, Cases C, Lisac M, Vrangbæk K, Winblad U, Bevan G. Are health problems systemic? Politics of access and choice under Beveridge and Bismarck systems. *Health Econ Policy Law* 2010;5(3):269–93.
- [2] Institute of medicine and committee on quality of health care in America. *Crossing the quality chasm: A new health system for the 21st century*. Washington, DC: National Academies Press; 2001.
- [3] OECD. *Waiting times for health services: next in line*. oecd health policy studies. Paris: OECD Publishing; 2020.
- [4] Cacace M, Ettelt S, Brereton L, Pedersen JS, Nolte E. How health systems make available information on service providers: Experience in seven countries. *Rand Health Q* 2011;1(1):11 [cited 3 May 2024]. Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4945218/>.
- [5] Sundgren B. Documentation and quality in official statistics [Internet]. In: *International Conference on Quality in Official Statistics*. May 14–15; 2001 [cited 30 April 2024]. Available from: https://www.researchgate.net/profile/Bo-Sundgren/publication/267862808_Documentation_and_Quality_in_Official_Statistics/links/55a55f8d08ae81aec91352f2/Documentation-and-Quality-in-Official-Statistics.pdf.
- [6] Liu L, Chi LN. Evolutional data quality: A theory-specific view [Internet]. In: *Proceedings of the Seventh International Conference on Information Quality (ICIQ-02)*. November 8–10. Cambridge, Massachusetts, USA: MIT Campus; 2002 [cited 30 April 2024]. Available from: <http://mitiq.mit.edu/ICIQ/Documents/IQ%20Conference%202002/Papers/EvolutionalDataQualityAThorySpecificView.pdf>.
- [7] Siciliani L, Moran V, Borowitz M. Measuring and comparing health care waiting times in OECD countries. *Health Policy (New York)* 2014;118(3):292–303.
- [8] Martin S, Siciliani L, Smith P. Socioeconomic inequalities in waiting times for primary care across ten OECD countries. *Soc Sci Med* 2020;263:113230.
- [9] Viberg N, Forsberg BC, Borowitz M, Molin R. International comparisons of waiting times in health care - Limitations and prospects. *Health Policy (New York)* 2013; 112(1–2):53–61.
- [10] Dixon H, Siciliani L. Waiting-time targets in the healthcare sector: How long are we waiting? *J Health Econ* 2009;28(6):1081–98.
- [11] Stoop AP, Vrangbæk K, Berg M. Theory and practice of waiting time data as a performance indicator in health care. A case study from the Netherlands. *Health Policy (New York)* 2005;73(1):41–51.
- [12] Anhoj J, Hellesøe A-MB. The problem with red, amber, green: the need to avoid distraction by random variation in organisational performance measures. *BMJ Qual Saf* 2017;26(1):81–4.
- [13] Dimakou S, Dimakou O, Basso HS. Waiting time distribution in public health care: empirics and theory. *Health Econ Rev* 2015;5:25.
- [14] Siddins MT, Boland J, Mathews B, Swanborough P. Achieving waiting list reform: A pilot program integrating waiting time, category and patient factors. *Aust Health Rev* 2012;36(3):248–53.
- [15] Vrangbæk K, Østergren K, Birk HO, Winblad U. Patient reactions to hospital choice in Norway, Denmark, and Sweden. *Health Econ Policy Law* 2007;2(2):125–52.
- [16] Eisenhardt KM. Agency theory: An assessment and review. *Acad Manage Rev* 1989; 14(1):57–74.
- [17] Ebbevi D, Hasson H, Lönnroth K, Augustsson H. Challenges to ensuring valid and useful waiting time monitoring – a qualitative study in Swedish specialist care. *BMC Health Serv Res* 2021;21:1024.
- [18] Thiru K, de Lusignan S, Hague N. Have the completeness and accuracy of computer medical records in general practice improved in the last five years? The report of a two-practice pilot study. *Health Inform J* 1999;5(4):224–32.
- [19] Elg M, Kollberg B. Conditions for reporting performance measurement. *Total Qual Manag Bus Excel* 2012;23(1):63–77.
- [20] Bossen C, Jensen LG, Udsen FW. Evaluation of a comprehensive EHR based on the DeLone and McLean model for IS success: Approach, results, and success factors. *Int J Med Inform* 2013;82(10):940–53.
- [21] Finlex Data Bank [Internet]. Laki kansanterveyslain muuttamisesta 17.9.2004/855. [Act for changing the public health act 17.9.2004/855.]. Available from: Laki kansanterveyslain muuttamisesta 855/2004 - Säädökset alkuperäisinä - FINLEX ®. Finnish. 2022.
- [22] Mölläri K, Saukkonen S.-M. Avohilmon laatuprosessi. [Quality process of avohilmo.] Helsinki: Terveyden ja hyvinvoinnin laitos; 2020. [cited 16 Oct 2022]. Available from: <https://yhteistyotilat.fi/wiki08/display/JULAVLA/4+Ohjeistus>. Finnish.
- [23] Kangas O, Kallioma-Puha L. ESPN Flash Report. 2022.
- [24] Sotkanet.fi. Tilastotietoa väestön terveydestä ja hyvinvoinnista. [Statistical information on welfare and health.]. Helsinki: The Finnish Institute for Health and Welfare; 2024. 2005–2024. [cited 5 May] Available from: <https://sotkanet.fi/sotkanet.fi/index>. Finnish.
- [25] Finlex Data Bank [Internet]. Health Care Act 31.12.2010/1326. [cited 15 Oct 2022]. Available from: <https://www.finlex.fi/en/laki/kaannokset/2010/en20101326>.
- [26] Söderlund R. Signalling waiting times to citizens on public oral healthcare providers' websites. *Acta Odontol Scand* 2023;81(7):517–27.
- [27] Finlex Data Bank [Internet]. Laki Terveyden ja hyvinvoinnin laitoksesta 31.10.2008/668. [Act on Institute for Health and Welfare 31.10.2008/668.]. [cited 15 Oct 2022]. Available from: Laki terveyden ja hyvinvoinnin laitoksesta 668/2008 - Ajantasainen lainsäädäntö - FINLEX ®. Finnish.
- [28] Finlex Data Bank [Internet]. Laki sosiaali- ja terveydenhuollon asiakastietojen sähköisestä käsittelystä 9.2.2007/159. [Act on electronic processing of client data in healthcare and social services 9.2.2007/159.]. Available from: laki sosiaali- ja terveydenhuollon asiakastietojen... 159/2007 - Säädökset alkuperäisinä - FINLEX ®. Finnish. 2022.
- [29] Häkkinen P, Mölläri K, Saukkonen A-M, Väyrynen R, Mielikäinen L, Järvelin J. Hilmo - Sosiaali- ja terveydenhuollon hoitoilmoitus 2020: määritellyt ja ohjeistut voimassa 1.1.2020 alkaen: ohjeus 7/2019. [Hilmo - Social and healthcare treatment notice 2020: definitions and instructions: valid from 1 January 2020: guidance 7/2019.] helsinki: terveyden ja hyvinvoinnin laitos; 2019. [cited 14 sep. 2022.]. Available from: <https://www.julkari.fi/handle/10024/138288>. Finnish.
- [30] Henry GT. *Practical sampling*. Newbury Park, Calif: SAGE; 1990.
- [31] DeLone WH, McLean ER. Information systems success: The quest for the dependent variable. *Inf Syst Res* 1992;3(1):60–95.
- [32] Gable GG, Sedera D, Chan T. Re-conceptualizing information system success: The IS-impact measurement model. *J Assoc Inf Syst* 2008;9(7):377–408.
- [33] van der Meijden MJ, Tange HJ, Troost J, Hasman A. Determinants of success of inpatient clinical information systems: A literature review. *J Am Med Inform Assoc* 2003;10(3):235–43.
- [34] Keikhosrokiani P, Mustaffa N, Zakaria N, Abdullah R. Assessment of a medical information system: the mediating role of use and user satisfaction on the success of human interaction with the mobile healthcare system (iHeart). *Cogn Technol Work* 2019;22(2):281–305.
- [35] Bianchi P, Trimigno M. How does information system success come about in inter-organisational networks of public services? *Public Money Manag* 2021;41(3): 236–45.
- [36] 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.
- [37] Markus ML, Robey D. Information technology and organisational change: Causal structure in theory and research. *Manag Sci* 1988;34(5):583–98.
- [38] Petter S, DeLone W, McLean ER. The past, present, and future of "IS success". *J Assoc Inf Syst* 2012;13(5):341–62.
- [39] van der Ark LA, Croon MA, Sijtsma K, van der Ark LA, Croon MA, Sijtsma K. Statistical models for categorical variables. New developments in categorical data analysis for the social and behavioral sciences. quantitative methodology series. Mahwah, NJ: Lawrence Erlbaum Associates; 2005. p. 1–14.