Implementing clinical decision support for primary care professionals – the process

Tiina Kortteisto[1,2], Jorma Komulainen[3], Ilkka Kunnamo[4], Marjukka Mäkelä[5], Minna Kaila[6]

[1] School of Health Sciences, University of Tampere, Tampere, Finland, [2] Pirkanmaa hospital district, Tampere, Finland, [3] Current Care Guidelines, Finnish Medical Society Duodecim and National Institute of Health and Welfare, Helsinki, Finland, [4] Duodecim Medical Publications Ltd., Helsinki, Finland, [5] Finnish Office for Technology Assessment at National Institute for Health and Welfare, Helsinki, Finland, [6] Hjelt Institute, University of Helsinki, Helsinki, Finland

Tiina Kortteisto, School of Health Sciences, FI-33014 University of Tampere, Tampere, FINLAND. Email: tiina.kortteisto@uta.fi.

Abstract

We describe the process of putting into practice a computer-based clinical decision support (eCDS) service integrated in the electronic patient record, and the actual use of eCDS after one year in a primary care organization with 48 health care professionals. Multiple methods were used to support the implementation. The actual use was measured by means of a questionnaire and statistical data. The implementation process consisted of three successive training rounds and lasted for 18 months. After 12 months the reported actual use of the eCDS functions was diverse. The study indicates that successful implementation of eCDS requires time and repeated supportive input. Primary care professionals need time and training for adapting eCDS in their daily routine. In addition, the eCDS content should be tailored to fulfil different professionals' information needs in primary care practice.

Keywords: clinical decision support, electronic patient record, guideline, implementation, information technology, primary care, reminder

Introduction

Implementing information technology (IT) into clinical practice is challenging [1,2] because of the required changes to everyday work processes [3]. In this paper, 'implementation' means specified activities to put a computer-based clinical decision support (eCDS) service into health care professionals' practice [4]. We used two handbooks [5,6] to plan both a top-down and a bottom-up implementation process in one primary health centre.

Although eCDS service can improve professionals' performance and even patient outcomes [7,8], evidence is still scarce on how well an eCDS service works in primary care or in settings where a variety of clinical areas need to be covered [9,10]. We recognized that both positive and negative effects on workflow have to be considered [11,12].

Here we report on a feasibility study of an eCDS for professionals in primary health care. Aims are to describe the implementation process and its outcome: the actual use of eCDS after 1 year. In addition, we discuss issues for successful implementation. Our working hypothesis was that the automatic integrated eCDS would not require very active support for use [13].

Study context

In 2008, a new computer-based decision support service [14,15] was integrated for the first time into one of the three main electronic patient record (EPR) systems in Finland [16,17]. We identified seven primary care organizations that used this EPR system and applied three inclusion criteria: 1) stable use of the EPR system, 2) inclusion of laboratory measurements in the system, and 3) core patient information recorded by the professionals themselves, e.g. diagnoses and medications. The health centre in Sipoo met with all criteria and agreed to participate.

In June 2009 the eCDS service was introduced into clinical practice in Sipoo. It has four functions: 1) patient-specific, automatic reminders based on decision support rules linking clinical guideline recommendations with individual patient data, 2) guideline links based on patient diagnosis, 3) drug interaction alerts based on the patient medication list, and 4) ability to run all decision support rules on defined patients in the EPR appointment schedule in a virtual health check (VHC). The eCDS was shown and updated on computer to physicians, nurses and other professionals on opening the patient record, entering a new diagnosis or prescribing a drug.

Implementation strategy

Our implementation strategy consisted of two components; top-down and bottom-up. The former was managed together with the researchers and the key stakeholders of the health centre and the latter based on incremental processes by using professionals as a departure point (see Figure 1). The top-down component was a rational process of training the professionals in educational meetings before introducing the eCDS system [5]. We also assessed the professionals' attitudes by using theory-of-planned-behavior model [18] and job-related factors [19] throughout the implementation process. The key stakeholders were the chief physician, the chief nurse, the chief information officer and the EPR adviser who acted between researches and professionals to support the implementation.

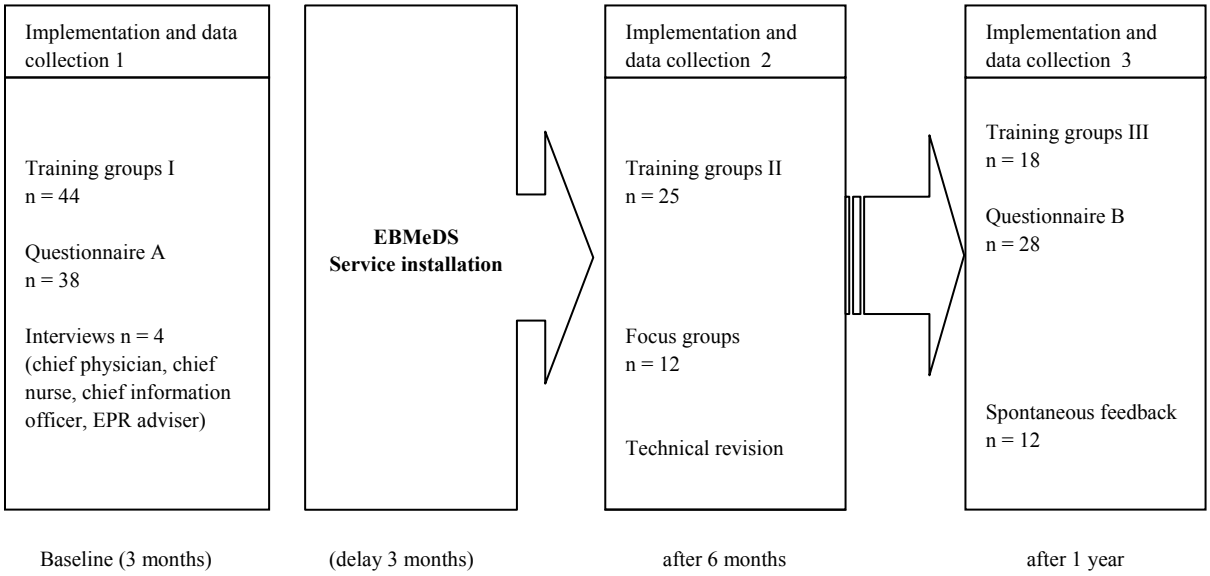

Figure 1. Process of the clinical decision support service implementation with number of participants in each round.

The bottom-up component was a participation model where professionals were encouraged to engage in developing the eCDS through feedback while using the service. The professionals were considered as key actors in a formative process and implementation was seen as a step-by-step process depending on commitment to using the eCDS [5,6].

Data collection

Key stakeholders' interviews

The four key stakeholders (chief physician, chief nurse, chief information office and EPR adviser) were individually interviewed (by TK) in March 2009. A semi-structured questionnaire was emailed beforehand; its questions had been piloted in a previous study [20]. The questionnaire for the chief physician and nurse included specific questions (number of questions in parenthesis) on the number and turnover of professionals (3), use of house-rules based on professionals' agreements of clinical guidelines (4), general use of clinical guidelines (2) and use of the EPR system (7) with some background questions. The form for the information officer and the EPR adviser asked about IT equipment (2), use of the EPR system (6), and use of IT in general (2).

Professionals' opinions

Professionals' opinions were collected in multiple ways, and informed written consent was obtained of all participants. First, five interactive training sessions were organized in January and February 2009. After presenting the eCDS service, 44 participants were encouraged to discuss expectations and fears toward use of eCDS. We re-ran these training sessions with discussions of the experiences of eCDS in February 2010 in four groups (25 participants), and in September 2010 in five groups (18 participants).

Second, the vendor added a feedback channel within the EPR system after the first training session, providing the professionals with an easy way to give spontaneous feedback to researchers during the implementation process. Feedback via personal email was also encouraged.

Third, questionnaire A was distributed in April 2009. After one reminder, 38 out of 45 professionals (84%) responded; 10 physicians, 24 nurses, and 4 others. Data were collected similarly with Questionnaire B in September 2010, and 28 professionals (62%) responded; 9 physicians, 14 nurses, and 5 others. Questionnaires had six background questions, seven EPR system questions, ten specific theory-of-planned-behavior questions [21], and two job-related questions used previously [22]. The theory-based attitude factor based on theory-of-planned-behavior was an intention of behavior compounded of three items: 'If patient's blood glucose is elevated, I intend to guide or I want to guide or I am expected to guide her or him toward exercise and management of weight.' The respondent rated each item on a seven-point scale: 1 = absolutely disagree, 2 = disagree, 3 = probably disagree, 4 = neither disagree nor agree, 5 = probably agree, 6 = agree, 7 = absolutely agree.

We added into questionnaire B three questions on the use of the eCDS service (automatic reminders, guideline links, and VHC); four questions concerning the service's capacity and quality; three questions concerning the perceived usefulness and ease of use of eCDS according to the technology acceptance model [23]; and one background question related to response to the first survey. Here we report results concerning the use of the eCDS service.

Focus groups

In January 2010 we convened three focus groups with the help of the chief officers [24]. We aimed at involving as many physicians as possible, with at least one representative from preventive care, nurse practice, physiotherapy, and the two inpatient wards. Six physicians, five nurses and one physiotherapist participated in two profession-specific groups and one multidisciplinary group.

Technical revision

Six months into the study a technical adviser of the eCDS company visited the health centre to check the functioning of the local service, mainly because of the absence of feedback from the professionals. This was organized with the chief physician in December 2009.

Statistical data

We gathered statistical data on the usage of guideline links from the log file of the Finnish professional health portal, Terveysportti.

Analyses

Descriptive analyses of quantitative data were performed with SPSS for Windows, version 15.0. Mann-Whitney's non-parametric test was used for measuring changes in professionals' attitude and job-related factors between questionnaires. Qualitative data (focus groups, interviews and feedbacks) were analyzed by categorizing professionals' opinions for positive or negative towards the use of eCDS functions and eCDS guidance.

Results

The implementation process lasted for 18 months (Figure 1). At baseline, the stakeholders reported that professionals used clinical guidelines via the Finnish professionals' health portal (www.terveysportti.fi), and the use of EPR system was stable but EPR function was occasionally slow. Therefore, the installation of the eCDS was delayed until June 2009, when a new server was installed. The professionals did not express fear or doubt toward eCDS in the first training sessions (Table 1).

Table 1. Characteristics of the target participants in the health centre.

Participant role	Number of participants	Details
Key stakeholder	4	Chief medical, chief nurse and chief IT[a] officer and EPR[a] adviser
Primary care physician	15	4 turnovers during the study
Primary care nurse	24	Ward nurses, general practice nurses-, and public health nurses
Other professionals	9	Physiotherapists, head nurses, and psychologist

[a]IT = information technology, EPR = electronic patient record.

All respondents (Questionnaire A) reported opening the patient record prior to (84%) or at the latest during (16%) the patient visit, enabling them to receive reminders at the point of care. The physicians (n = 10) used ICD-10 diagnosis classifications, and wrote prescriptions and referrals using structured forms. Thus the eCDS service was able to operate as planned. The professionals had a positive attitude toward eCDS based on their highly positive intention to apply the specific eCDS reminder on elevated fasting blood glucose in patient care. The median score of the compounded intention factor was 20 points (range 9-21) for each profession group remaining at same level to the end of study (Table 2).

Table 2. Changes in attitude and job-related factors between questionnaire A and B: Mann-Whitney's non-parametric test.

	Questionnaire A			Questionnaire B			
	Med	Range	Mean ranks	Med	Range	Mean ranks	p-value
Attitude factor (theory-of-planned-behavior)							
Intention of behavior	20	9-21	32.0	20	17-21	34.5	0.59
Job-related factors							
Authority	12	7-15	32.0	13	10-15	35.5	0.45
Job demand	10	5-14	38.4	8	4-12	25.4	0.01
Skills	14	11-15	31.8	14	11-15	35.9	0.37
Busy practice	15	9-20	40.1	11	4-17	22.8	<0.001
Lack support	5	2-9	33.1	4	2-8	32.9	0.98
IT problems	6	2-9	28.4	5	2-7	23.1	0.20

At six months, focus groups reported only limited use of eCDS. The guideline links were used most, regardless of the professional background. One physician had no experience with eCDS use. Physicians discussed practical problems with the EPR such as slowness, though this was unrelated to eCDS. The three-month delay from learning about the eCDS to starting to use it was a significant barrier to use in all groups.

During the technical revision in December 2009, automatic reminders and guideline links worked as planned, but two problems in the local eCDS service function were discovered. First, the drug database interaction alerts did not work; hence there were no drug interaction warnings. This problem was fixed in April 2010. Second, the EPR-based feedback channel was imperfectly introduced in workstations. This procedure was more thoroughly covered in the training in February 2010.

After one year, 13 of 28 respondents reported utilizing automatic reminders often or sometimes, and 11/28 reported using guideline links; only one physician had tried the VHC (Table 3). One third of the nurses had never used automatic reminders. The actual use of guideline links was low based on the statistical data (Table 4). The opinions of the job-related factors between the questionnaires varied a lot. Two factors; job demand indicating high work load and busy practices had significantly decreased in the follow-up (Table 2). Other job-related factors (authority, skills, lack support and IT problems) had not significantly changed during the implementation process.

Table 3. Reported actual use of clinical decision support functions after 1 year.

	Physicians n = 9	Nurses n = 14	Others n = 5	Total n = 28
Automatic reminders				
Often or sometimes	4	8	1	13
Seldom or not at all	5	6	4	15
Guideline links				
Often or sometimes	3	7	1	11
Seldom or not at all	6	7	4	17
Virtual Health Check				
Often or sometimes	0	0	0	0
Seldom or not at all	9	14	5	28

Table 4. Actual use[1] of guidelines via eCDS compared with physicians' database use via Terveysportti.

	eCDS	Physicians' database
At baseline (June 2009)	9	550
After 6 months (January 2010)	24	524
After 1 year (September 2010)	11	1464

[1] Number of text files opened per month.

All twelve spontaneous feedbacks (ten via feedback channel and two via email) came from physicians. Issues reported were: too sensitive cut point for reminders, lack of structured recording for smoking status (causing inaccurate reminders), irritating drug interaction and contraindication alerts, and false alerts on LDL cholesterol measurements caused by code mismatch. Physicians considered the drug interaction and contraindication reminders useful for prescribing, whereas these were not at all useful for nurses and physiotherapists. The double medication warning was found to be irritating, triggered repeatedly but unnecessarily because of inaccurate and outdated medication lists.

Discussion

Main results

Reported actual use of the eCDS service functions after one year was varied despite applying top-down and bottom-up implementation strategy. Nearly half of the respondents said they at least sometimes utilized the patient-specific automatic reminders, less than half reported using the guideline links, and only one physician had tested the VHC function. The actual use of guideline links based on statistical data was extremely low during the implementation process.

Our optimistic working hypothesis 'the automatic integrated eCDS would not require very active support for use' was proven false. Since the initial aim of the implementation was maximum use of eCDS among the professionals, the implementation process appears incomplete and less than satisfactory. There may be various explanations for this, e.g. that the suggestion of eCDS implementation came from researchers, not from within the organization. Furthermore, the research group designed and managed the implementation process. The basis for implementation was good, though; professionals had a positive attitude toward use of eCDS, and the eCDS service was able to operate as planned. However, in reality, professionals had not been ready for changes in their working habits, and the eCDS service was not quite fully operational in real world; hence real implementation of eCDS did not take place [4].

Surprisingly, links to the previously familiar guidelines did not function as planned. Again, there are several explanations. First, the code for diagnosis (or reason for encounter) for the consulting patient was often recorded after the consultation, when the patient had already left, and the guideline link appeared too late. Second, there were more than one guideline links (i.e. too many) depending on the patient's list of diagnoses. One had to click several times to access the recommendations or the evidence supporting it. Hence the requirement of automation based on Kawamoto's review [13] was not realized. Furthermore, offering links to full guidelines at the point of care may not be the best timing, as indicated by increasing access to the guideline library via Terveysportti (Table 4). Clinicians are busy and may not have time to go through the guidelines at that moment.

The unique VHC function was new in the software, and may require more workflow changes than the other eCDS functions, indicating a need for even more thorough introduction and training, while the functionality of the software should be developed to show the reminders automatically, without clicks by the user. Adequate training has been associated with favorable assessments of eCDS [25].

Even though the sample is small and differences not statistically significant, it is interesting that one third of the nurses did not utilize the automatic reminders at all, and that there was no spontaneous feedback from other professional groups than physicians. It seems that the eCDS implementation for nurses and other professionals was even more a failure than that for physicians. The physiotherapists considered the guideline links useful, but not the content of the automatic reminders. This is in line with previous evidence that information does need to be tailored for each profession [26-29].

An IT-based intervention and the actual functioning of its components in a local environment need to be thoroughly tested and followed up, particularly during initial installation. The implementation of one specific eCDS function, drug interaction alerts, only became possible after the technical revision several months into the implementation. After that, it was possible for physicians to optimize the patient's medication list on the basis of the alerts triggered. The physicians considered this function important but in some cases as too sensitive or irrelevant, e.g. in

case of alerts for the warfarin–paracetamol combination. They wished they could control and tailor the service by blocking alerts, a factor that has previously been found to facilitate the use of eCDS among Finnish physicians [30].

Overall, the professionals did not report of any problems directly related to eCDS service hampering their work, and the attitude toward eCDS remained as positive as in the beginning. Furthermore, some positive changes in the working environment, e.g. in professionals' opinions of job demand and busy practice, happened during the implementation although not necessary related in the eCDS. Therefore, we can speculate that the implementation process is still going on among the professionals.

Strengths and limitations

The main strengths of the study are the use of two-way implementation strategy and multiple methods. This enabled us to retrieve a multitude of different types of data from many professionals. Our choices were based on the implementation research literature [2,4-6] and an understanding of the complexities of implementing an IT intervention successfully in health care [31,32]. Had we not planned an evaluation study, we could have missed the shortcomings of the implementation process, and deemed the eCDS as unimplementable. The purpose was to increase understanding of the implementation process as a feasibility phase of the evaluation study of eCDS [33].

Limitations include the dropouts between surveys and the scarcity of spontaneous feedback. One methodological limitation could be the descriptive nature of the analyses, the practical reason for this being the small number of participants. Half of the respondents were different in the two surveys, or some did not remember responding to the previous questionnaire, so related samples -tests could not be used [34]. This was a case study where a new eCDS service was tested for the first time in practice, which limits the generalization of the results to other settings. However, the target health centre represents an ordinary middle-size public primary care organization, where all professionals, physicians, nurses, and physiotherapists alike participated in the study.

Self-assessment of performance is known to be more optimistic than actual performance [35]. Our statistical data on using guidelines indicate this very well. The automatically triggered reminders, emerging on the left side of the screen, may have been difficult to notice; one physician reported this. Moreover, the reminders did not necessitate any activity by the professionals, with the exception of drug interaction alerts on prescribing, which had to be removed by clicking. The interface of the EPR system and the functionality of the reminders need to be enhanced to make the reminders more noticeable. These features in the eCDS usability and workflow integration are critical to successful implementation [36].

Conclusions

This study reaffirms that successful implementation of eCDS into clinical practice requires time and active effort. Even automatic and context-specific reminders need active implementation actions and repeated promotion for professionals, since reminders necessitate adjustments in the behavior of professionals. Clinicians do need time to learn to use the eCDS in their daily routine. For guideline-based reminders among primary care professionals, the content and function should be edited to respond to the information needs of different professional groups in primary care practice. The study group concluded that professionals should record reasons for encounter by using a structured classification already during the encounter to benefit from the guideline links.

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PÄÄTÖKSENTUKI - tutkimuksen kysely Sipoon terveyskeskuksessa 2009

Hyvä vastaaja,
Kiitos päätöksestäsi vastata kyselyymme! Kysely sisältää Mediatri-potilaskertomusjärjestelmän käyttöä, potilaiden hoitoa sekä työtä koskevia kysymyksiä, joista suurin osa sisältää monivalintavaihtoehtoja. Vastaamiseen kuluu aikaa noin vartti. Otamme myös mielihyvin vastaan palautetta. Vastaa kysymyksiin valitsemalla vain yksi vaihtoehto, jollei ohjeissa toisin mainita.

MEDIATRI POTILASKERTOMUSJÄRJESTELMÄN KÄYTTÖ

Arvioi potilaskertomusjärjestelmän käyttöä normaalin työsi eri vaiheissa:

1. Kun työskentelen vastaanottotyössä, avaan potilaskertomuksen ja potilastiedot

    1. ennen potilaan tuloa
    2. vastaanoton kuluessa
    3. vastaanoton jälkeen
    4. vain tarvittaessa
    5. en työskentele vastaanottotyössä

2. Käytän diagnoosikoodeja (voit valita useamman vaihtoehdon)

    1. en käytä
    2. käytän ICD 10
    3. käytän ICPC
    4. käytän muuta luokitusta, mitä_____

3. Kirjoitan lääkemääräykset tietokoneella

    1. aina
    2. joskus
    3. en koskaan
    4. en kirjoita lääkemääräyksiä

4. Teen lähetteet tietokoneella (jos et tee lähetteitä, siirry kohtaan 5.)

    * laboratoriolähete
        1. aina
        2. joskus
        3. en koskaan
    * röntgenlähete
        1. aina
        2. joskus
        3. en koskaan
    * lähete erikoissairaanhoitoon tai konsultaatiopyyntö
        1. aina
        2. joskus
        3. en koskaan

5. Osastotyössä terveyskeskuksen sairaalassa käytän kierrolla sähköistä potilaskertomusjärjestelmää

1. aina
2. joskus
3. en koskaan
4. en työskentele osastotyössä

6. Työyksikössäni on sovittu, että lääkitystietojen ylläpito sähköisessä potilaskertomuksessa on

1. lääkärin tehtävä
2. hoitajan tehtävä
3. ei ole sovittu kenenkään tehtäväksi
4. en osaa sanoa

7. Kommentteja Mediatri -potilaskertomusjärjestelmän käytöstä

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POTILAIDEN HOITO

Seuraavat kysymykset koskevat niiden potilaiden hoitoa, joilla on paastoverensokeri koholla. Ympyröi jokaisesta väittämästä se numero, joka vastaa parhaiten omaa käsitystäsi asiasta. Jos et itse osallistu ko. potilaiden hoitoon, arvioi miten toimisit/kokisit, jos osallistuisit.

8. Potilailla, joiden paastoverensokeri on koholla, opastus painonhallintaan ja liikuntaan on minusta

haitallista	1	2	3	4	5	6	7	*hyödyllistä*
mielekästä	1	2	3	4	5	6	7	*turhauttavaa*
turhaa	1	2	3	4	5	6	7	*tarpeellista*

9. Potilaiden, joiden paastoverensokeri on koholla, opastaminen painonhallintaan ja liikuntaan on minulle

helppoa	1	2	3	4	5	6	7	*vaikeaa*

10. Jos potilaan paastoverensokeri on koholla, on hyvä opastaa häntä painonhallintaan ja liikuntaan

täysin eri mieltä 1 2 3 4 5 6 7 *täysin samaa mieltä*

11. Katson, että opastus painonhallintaan ja liikuntaan on mahdollista niiden potilaiden kohdalla, joiden paastoverensokeri on koholla

täysin eri mieltä 1 2 3 4 5 6 7 *täysin samaa mieltä*

12. Minusta opastus painonhallintaan ja liikuntaan on välttämätöntä niiden potilaiden kohdalla, joiden paastoverensokeri on koholla

täysin eri mieltä 1 2 3 4 5 6 7 *täysin samaa mieltä*

13 Jos potilaan paastoverensokeri on koholla, haluan opastaa häntä painonhallintaan ja liikuntaan

täysin eri mieltä 1 2 3 4 5 6 7 *täysin samaa mieltä*

14. Minulta odotetaan, että opastan painonhallintaan ja liikuntaan potilaita, joiden paastoverensokeri on koholla

täysin eri mieltä 1 2 3 4 5 6 7 *täysin samaa mieltä*

15. En voi vaikuttaa siihen, opastetaanko painonhallintaan ja liikuntaan potilaitani, joilla on paastoverensokeri koholla

täysin eri mieltä 1 2 3 4 5 6 7 *täysin samaa mieltä*

16. Kollegoitteni mielestä minun tulisi opastaa painonhallintaan ja liikuntaan potilaitani, joilla on paastoverensokeri koholla

täysin eri mieltä 1 2 3 4 5 6 7 *täysin samaa mieltä*

17. Jos potilaan paastoverensokeri on koholla, opastan häntä painonhallintaan ja liikuntaan

täysin eri mieltä 1 2 3 4 5 6 7 *täysin samaa mieltä*

TYÖ

Tässä osassa selvitetään työhösi ja työtyytyväisyyteesi liittyviä tekijöitä.

18. Miten hyvin seuraavat väittämät kuvaavat nykyistä työtäsi? Valitse mielipidettäsi parhaiten kuvaava vastausvaihtoehto kussakin väittämässä.

	täysin eri mieltä	jokseenkin eri mieltä	ei samaa eikä eri mieltä	jokseenkin samaa mieltä	täysin samaa mieltä
a. Voin tehdä paljon itsenäisiä päätöksiä työssäni	1	2	3	4	5
b. Minulla on paljon sananvaltaa omiin töihini	1	2	3	4	5
c. Minulla on hyvin vähän vapautta päättää, miten teen työni	1	2	3	4	5
d. Työni vaatii erittäin kovaa työntekoa	1	2	3	4	5
e. Minulta edellytetään kohtuutonta työmäärää	1	2	3	4	5
f. Minulla ei ole tarpeeksi aikaa saada töitäni tehdyksi	1	2	3	4	5
g. Työni vaatii pitkälle kehittyneitä taitoja	1	2	3	4	5
h. Työni vaatii, että opin uusia asioita	1	2	3	4	5
i. Työssäni saan tehdä paljon erilaisia asioita	1	2	3	4	5

19. Kuinka usein kukin alla mainittu asia on selvästi häirinnyt, huolestuttanut tai rasittanut sinua työssä viimeisen 6 kk:n aikana?

	erittäin harvoin tai ei koskaan	melko harvoin	silloin tällöin	melko usein	erittäin usein tai jatkuvasti
a. Jatkuva kiire ja tekemättömien töiden paine	1	2	3	4	5
b. Liian vähän aikaa työn tekemiseen kunnolla	1	2	3	4	5
c. Henkilökunnan määrällinen riittämättömyys	1	2	3	4	5
d. Työn pakkotahtisuus	1	2	3	4	5
e. Konsultointimahdollisuuksien puute	1	2	3	4	5
f. Yksintyöskentely	1	2	3	4	5
g. Muuttuvat sähköiset tietojärjestelmät	1	2	3	4	5
h. Hankalat, huonosti toimivat tietotekniset laitteet/ohjelmat	1	2	3	4	5

TAUSTATIEDOT

Taustatiedot sinusta ja työstäsi ovat tärkeitä, joten vastaa siksi huolellisesti myös näihin kysymyksiin.

20. Sukupuoli

1 mies
2 nainen

21. Ikä

_____vuotta

22. Ammatti

1 lääkäri
2 sairaanhoitaja
3 terveydenhoitaja
4 fysioterapeutti
5 muu, mikä _____

23. Kuinka kauan olet toiminut ammatissasi?

1 alle vuoden
2 1-10 vuotta
3 yli 10 vuotta

24. Työni on potilaiden hoitamista

1 pääosin
2 noin puoleksi
3 jonkin verran
4 ei ollenkaan

25. Arvioi omaa tietoteknistä osaamistasi. Osaamiseni on

1 erittäin hyvä
2 hyvä
3 keskitasoinen
4 melko huono
5 huono

26. Muita kommentteja kyselystä

_____
_____
_____
_____
_____
_____

Lämmin kiitos vastauksistasi!