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Antecedents and impacts of behavioral adaptation of electronic medical records

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Abstract

Considering time constraints and staff shortage in health care oblige, EMR systems have to fit perfectly with the workflows, with interpersonal communication and with data needs. In this perspective, this study questions whether computer self-efficacy and personal innovativeness of health staff enhance their capacity to adapt the electronic medical records system to the tasks to be performed and does this adaptation behavior entail increased personal benefits for the physician and an improved medical decision-making. Although personal innovativeness proves to be an antecedent of behavioral adaptation of electronic medical records (EMR), which on its turn favors perceived personal benefits, the research question cannot be answered positively. This research reveals nevertheless that two settings are interesting for further research: EMR adaptation behaviors in emergency departments and the relation between the use of EMR by less qualified staff and care effectiveness.

Key terms

Electronic medical records, personal innovativeness, computer self-efficacy, facilitating conditions, task-technology adaptation, decision-making effectiveness, perceived personal benefits.

Summary

This research focuses on a very specific context of information systems: the electronic management of medical records. The research question of this study is : do computer self-efficacy and personal innovativeness of health staff enhance their capacity to adapt the electronic medical records system to the tasks to be performed and does this adaptation behavior entail increased personal benefits for the health staff and an improved decision-making effectiveness ? Personal innovativeness reflects one's willingness to try out any new technology (Agarwal & Prasad, 1998: Sun, 2012) while *Computer self-efficacy* is the degree to which an individual believes that he or she has the ability to perform a specific task or job using the computer (Venkatesh, 2008). The adaptation of the workflow of health staff to the EMR system and how they lead to efforts to make the functionalities of the EMR system make fit to their needs is labeled in this study as "behavioral adaptation of EMR". The research model also hypothesizes that facilitation conditions, access to support services, enhances the effect of computer self-efficacy on behavioral adaptation.

For each of these constructs, indicators have been identified through a literature research. These indicators have been formulated as statements in a questionnaire and the respondents have given their agreement with each statement in a 7-point Likert scale. The survey collected 133 valid responses. For descriptive and analytical purposes, some general information questions have been re-encoded in maximum 4 categories. For re-encoded variable "qualification", the results show that 38% are staff with less than a bachelor's degree, 44% have a bachelor's degree and 17% are medical doctors. For re-encoded variable "institution type", results show that 33,8% of the respondents work in a university or specialized hospital, 30,8% in a general hospital, 25,6% in a health facility outside a hospital and 9,8% in home care or non-medical facility. All respondents use the EMR and 46% of the respondents for more than 5 years.

Through the technique of partial least square of structural equation models (PLS-SEM), the hypothetical relations of the research model have been assessed. Personal innovativeness affects positively behavioral adaptation and behavioral adaptation affects positively the perception of perceived personal benefits, but no mediation effect could be detected of BHA on the relation between personal innovativeness and perceived personal benefits. As for the control variables, results showed that working in an emergency ward is significantly related to behavioral adaptation. This raises the hypothesis that work pressure induces adaptation. Qualification is significantly related to decision-making effectiveness, but in a negative sense, meaning that less qualified staff perceive that the use of EMR affects DME positively. This raises the hypothesis that access to medical data offers this staff the opportunity to adapt their counselling and increases their credibility. Although some relations of the research model are significant, the research question has not been confirmed. We point two related factors. First the array of respondents and the institutions they work in are very heterogenous which is due to the limited contact opportunities during the COVID-19 crisis. Second, behavioral adaptation and decision-making effectiveness have different meanings for different health workers and in different professional environments.

The observation of significant direct effects of the independent variable, facilitating conditions on decision making effectiveness and on perceived personal benefits let suppose that there is a mediator not included in the model. We conclude that this study was mainly a rich source for further questioning and research.

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1. Introduction

1.1. Background

The present study makes part of ongoing research on the factors that contribute to the meaningful use of electronic medical records[1] (EMR) in a hospital setting. An EMR is defined as a digital repository of patient data on a patient's health, history, medical conditions, tests and treatments, medications, demographic information, and more (Otto & Nevo, 2013). A meaningful use of EMR relates to the achievement of a set of significant improvements in health care (Blumenthal & Tavenner, 2010).

A first requirement for this achievement is to have the assets. Personal traits like personal innovativeness and computer self-efficacy and facilitating conditions are assets for change management, this means adaptation of behaviors. Indeed, individuals who are likely to adopt IT innovations earlier than others and feel confident with the tool can serve as key change agents and opinion leaders to facilitate further diffusion of a new technology (Agarwal et al., 1998). *Personal innovativeness* reflects one's willingness to try out any new technology (Agarwal & Prasad, 1998: Sun, 2012). *Computer self-efficacy* is the degree to which an individual believes that he or she has the ability to perform a specific task or job using the computer (Venkatesh, 2008). *Facilitating conditions* are an external factor referring to the individual perceptions of the availability of technological and/or organizational resources (i.e., knowledge, resources, and opportunities) that can remove barriers to system use (Venkatesh, Morris, Davis & Davis, 2003). These include guidance, specialized instruction and assistance such as helpdesk support.

The introduction of a new technology in a work environment is often a disruptive event where each individual has to cope with this new situation. This also occurs in the context of health care, when an electronic medical record (EMR) system is introduced. Physicians engage in individual efforts to make the information systems work and easy to use or engage in a workaround, i.e. a bypass of a recognized problem or limitation in the system (Park, Yunan & Rudkin, 2015). For a physician, looking for an optimal fit of the EMR system with his consultation practice may be motivated by the fact that this will make him more effective in clinical decisions and that in the end, he acquires personal benefits like status or interesting assignments.

1.2. Problem statement

The challenge of management boards of hospitals is to decide on relevant IT investments that impact performance. Despite potential benefits, the adoption of EMR has been slow (Otto et al., 2013). The actual use of these IS in hospitals is considered to be subordinate to offering relief from suffering (Venkatesh, Zhang & Sykes, 2011) and encoding is often delayed or omitted in the health care context. Venkatesh also evokes the reluctance of doctors to use electronic IS as the EMR because they perceive this as undermining their power and autonomy and perturbing communication with patients. So often workarounds and medical clerks are used in EMR filling to address imperfect task technology fit of EMR (Park et al., 2015). Interventions to raise use rates like trainings may in themselves be a source of loss of scare resources (Venkatesh & Bala, 2008). Considering the time constraints in health care and the strong interpersonal interactions among peers, it is crucial to understand how to promote on-the-job learning (Venkatesh et al., 2011). To do so, it is necessary to identify the factors that affect adaptation behaviors of EMR in clinical practice.

[1] A lot of references use the term « electronic health record» In this research the term electronic medical record is used which, in a hospital setting, can be considered as equivalent

1.3. Research objective and questions

This research has focused on the individual as the unit of analysis and more precisely on health staff. From this perspective, the central research question is : does computer self-efficacy and personal innovativeness of health staff enhance their capacity to adapt the electronic medical records system to the tasks to be performed and does this adaptation behavior entail increased personal benefits for the health staff and an improved decision-making effectiveness ? This research intended to provide a theoretical explanation and statistical evidence for these relations.

1.4. Motivation and relevance

For vendors of EMR systems it is key to take into account the existing or optimized workflow (Vishwanatha, Singh & Winkelstein, 2010) in the system configuration and in device conception. In order to preserve good doctor–patient verbal and non-verbal contact, they can for instance propose ergonomic handheld devices and vocal encoding (Guo, Chen & Mehta, 2017; Fleischmann, Duhm, Huppert, Brandt, 2015). Interoperability with external data (Kohli & Tan, 2016), graphs and tables of clinical parameters and links with decision making applications can support clinical decision-making. With these options doctors may consider EMR systems no longer as a threat but as an opportunity to acquire competitive advantage. New status relations may emerge with their peers. For hospital boards and administration, understanding the motives of resistance and workarounds, documenting the (rearranged) workflows, enquiring on the effect of backup resources and identifying the informal peer-to-peer knowledge sharing processes (Kohli & Kettinger, 2004), is highly valuable for the requirement setting of the EMR system and the support measures. This research contributes into addressing these needs.

1.5. Main lines of approach

In section 2 of this report, the reader will get understanding of the theoretical background and evidence that leads to the research hypothesis and the research model. In section 3, first, the constructs of the model will be operationalized through indicators. Second, the methods of collecting the indicators in a sample population are exposed and third, the approach for validation and analysis is presented. For each of these topics, bibliographic references and references to annexes are provided. In section 4, the author reports the way the field research has been implemented and how flaws in data quality have been managed. Descriptive statistics of the data the characteristics of the respondents and the trends of the expressed perceptions. Data analysis with SmartPLS 3 checks the validity of the measurement model and estimates the predictive power of the path model. Section evaluates each of the hypotheses of the research and considers the research results from a theoretical and practical perspective. The theoretical perspective demonstrates the added value with respect of existing literature. The practical perspective shows how different stakeholder can take benefit of this research. Where evidence cannot be provided or theory is lacking, orientation for further research is given.

2. Theoretical framework

2.1. Research approach and implementation

The objective of this section is to build a research model on the basis of theory and evidence provided in extant literature. This conceptual reflection starts with documenting the theoretical basis of the construct “behavioral adaptation of an IS” and then puts this construct in the context of an electronic medical record (EMR) system. This approach has led to a broad understanding of the technological,

social, cognitive and emotional drivers that play in use and adaptation of an IS and in particular an EMR system. Next, the literature research has focused on the theory and facts that support the predictive relations of behavioral adaptations of EMR with two dependent variables, personal benefits and decision-making effectiveness and with two independent variables, personal innovativeness and computer self-efficacy, in general, and in the medical care context. Appendix A provides the keywords for the queries and the relevant articles the queries provided. The next section provides the results of this screening.

2.2. Results and conclusions

2.2.1. Theoretical background

The construct of behavioral adaptation evolved from different theories. In coping theory, (Bala & Venkastesh, 2016) a disruptive event, like the introduction of an IT system, provokes adaptation behaviors that are the result of a primary appraisal of opportunity and threat and a secondary appraisal of a possibility to control. Four types of behavior adaptations may be come out from this double appraisal: exploration to innovate, exploitation, exploitation to revert, and avoidance. Coping of individuals may also be classified in three categories of adaptation related to the IT induced changes (Wu, Choi, itong & Chang, 2017, pp 792-795): (i) cognitive adaptation, the way users motivate themselves to solve the problems that arise, (ii) affective adaptation, the way users attempt to restore their emotional stability, and (iii) behavioral adaptation, the way users change the functionalities to personal preferences and modify operational procedures to take full advantage of a new IT system. The coping model of user adaptation (CMUA), further categorizes these adaptation behaviors as (i) incorporate adaptations of IT (e.g., changing features of an IT), (ii) work (e.g., modifying procedures and routines), and (iii) self (e.g., adjusting personal habits) (Beaudry and Pinsonneault 2005), Given the complexity of an IT, it is possible that employees undertake multiple adaptation behaviors concurrently in a given context of IT implementation (Bala & Venkatesh, 2015). In adaptive structuration theory applied at the individual level (Schmitz, Teng & Webb, 2016), the characteristics of the technology and the tasks and the characteristics of the individual (affect, experience) both contribute in molding the technology. During the structuration episodes, the adaptation of the technology and the adaptation of the tasks may lead to added value (customization, incremental improvements, structural adaptations of tasks and new functionalities) and hence an integration between workflow and technology (Bowens, Frye & Jones, 2010), a fit between the individual, the IT system and the tasks to be performed (Barki, Titah & Boffo, 2007) and ultimately task performance outcomes and social status. The resulting Task-technology fit (TTF) is the degree to which a technology assists an individual in performing his or her portfolio of tasks. TTF is the correspondence between task requirements, individual abilities, and the functionality of the technology. (Goodhue & Thompson, 1995).

In the post-adoptive phase of a electronic health records system, behavioral adaptation relates to the efforts of health staff (in time and energy) (i) to change the functions of the EMR system to fit their work (e.g. customization of disease modules, integration with other IT systems in the hospital), (ii) to change routine work processes to make them better fit with the EMR system (e.g. bedside consultation of EMR) or (iii) for recommending changes to the EMR system (Wu et al, 2017, p 809). Given the external constraints imposed on technological adaptations of EMR (privacy, classification standards), EMR users will exploit task adaptation to a greater extent than technology adaptation (Weigel, Hall & Landrum, 2009). A concrete example of an IT adaptation in the context of electronic medical records is the use of EMR on tablets during bedside decision-making (Caligtan, Carroll, Hurley, Gersh-Zaremskic & Dykes, 2012). This adaptation is a way to control the threat of reduced interpersonal contact during bedside consultation. Following coping theory, we can say that the first appraisal of threat of reduced

interpersonal contact and the opportunity of extended graphic interpretations leads to a second appraisal of exploration-to-innovate of the EMR tool on a tablet. From this literature review, it is clear that the professional environment will orient the type of adaptation that is feasible

2.2.2. Formulation of hypotheses

The question arises how the construct of behavioral adaptation (BHA) of an IS (here the EMR) can be related to 2 output latent constructs, perceived personal benefits (PPB) and decision-making effectiveness (DME). Barki (Barki et al. 2007, p189) has listed three benefits that are considered as personal benefits : (i) Knowledge gained using this system will be helpful to me with other systems in the future, (ii) Using this system allows to be more efficient at my job, (iii) Knowing how to use this system makes me more marketable. Perceived personal benefits must be distinguished from performance gains**,** related with ease of use, usefulness of the IT system, fit with the way of working, compatibility with all aspects of work, becoming a skillful user which lead to organizational benefits. A distinction must also be made with cognitive and affective benefits like the sense of personal accomplishment, personal growth, personal satisfaction, self-esteem and job satisfaction, i.e. the affective reactions toward the job and work environments, (Staples, Wong & Seddon, 2002, Bala et al., 2016). In other words, perceived personal benefits may be considered as returns for the self, quasi quo returns on investment. In Barki's model of the construct of ISURA (information system use related activities) (Barki et al. 2007), task technology adaptation is significantly related to perceived personal benefits. From this, it is extrapolated that:

> **(H1) behavioral adaptation of EMR (BHA) positively affects perceived personal benefits (PPB).**

Case studies show that clinical decisions are affected by the adaptive use of EMR. For instance, viewing medical history via EMR systems reduces the number of possibly redundant admissions (Ben-Assuli, Shabtai & Leshno, 2013). Also, mobile applications support collection and analytics of real-time critical care data (Vankipuram, Vankipuram, Ghaemmaghami & Patel, 2017) and provide easy access to clinical decision support systems and patient management systems, which improves decision-making for patient care. (Mickan, Atherton, Roberts, Heneghan & Tilson, 2014), Including the patient during the exchange of patient information results in improved accuracy and promotes safe patient-centered care (Caligtan et al., 2012). So, a technological adaptation (e.g. the use of bedside handheld computers) and a behavioral adaptation (e.g. the combination of bedside consultation and EMR information processing) may increase the accuracy of a clinical decision. Based on these arguments, the hypothesis is formulated that:

> **(H2) Adaptation behavior of increasing the task-technology fit of the Electronic Medical Record system (BHA) will positively influence the clinical decision-making effectiveness (DME)**

Next arises the question which independent variables predict the variance of behavioral adaptation of EMR. In social Cognitive Theory (SCT) computer self-efficacy is associated with high levels of affect and lower levels of anxiety toward computer use. The relationship extends to adaptation usage, where the affective arousal associated with growing self-efficacy motivates more interaction with the technology (Compeau, Higgins & Huff, 1999). Research of Schmitz confirms that technology-specific computer self-efficacy has a positive association with exploitive technology adaptation (Schmitz et al., 2016). Prior research affirms the influence of computer self-efficacy on behavioral intention on EMR use in particular (Aggelidis & Chatzoglou, 2009), Mobile Health care Systems (MHS) self-efficacy has strong indirect impact on healthcare professional behavioral intention (Wu, Wang & Lind, 2007). Mobile IT/IS appears to be more compatible with health care professionals' existing values, previous experiences

and practice needs, so they will feel more comfortable and confident in using MHS and this will result in higher perceptions of MHS self-efficacy. Based on this argument, the hypothesis is formulated that:

(H3) Computer Self-efficacy (CSE) positively influences an adaptation behavior of increasing the technological fit of the Electronic Medical Record system (BHA)

In the planned behavior theory (an extension of the theory of reasonable action), Intentions to perform behaviors of different kinds and hence actual behavior can be predicted with high accuracy from attitudes toward the behavior (i.e. the degree to which a person has a favorable or unfavorable appraisal of the behavior in question), subjective norms (i.e. the perceived social pressure to perform or not to perform the behavior), and perceived behavioral control. Perceived behavioral control is the perception that some internal or external conditions constrain the users' behavior. Internal controls may include the person's ability to perform the intended behavior (e.g. self-efficacy), while external control refers to the availability of external resources needed to perform that behavior (e.g. facilitating conditions). People may intend to perform a given behavior but lack the external resources needed to do so. Thus, the availability of specific resources (facilitating conditions) favor internal control (self-efficacy), (Bhattacherjee, 2012, p 31; Ajzen, 1991). So, as CSE is a given internal factor of control and FCO is a variable external factor of control, the variation of FCO is expected to moderate the influence of CSE on behavioral adaptation. This leads to the hypothesis that:

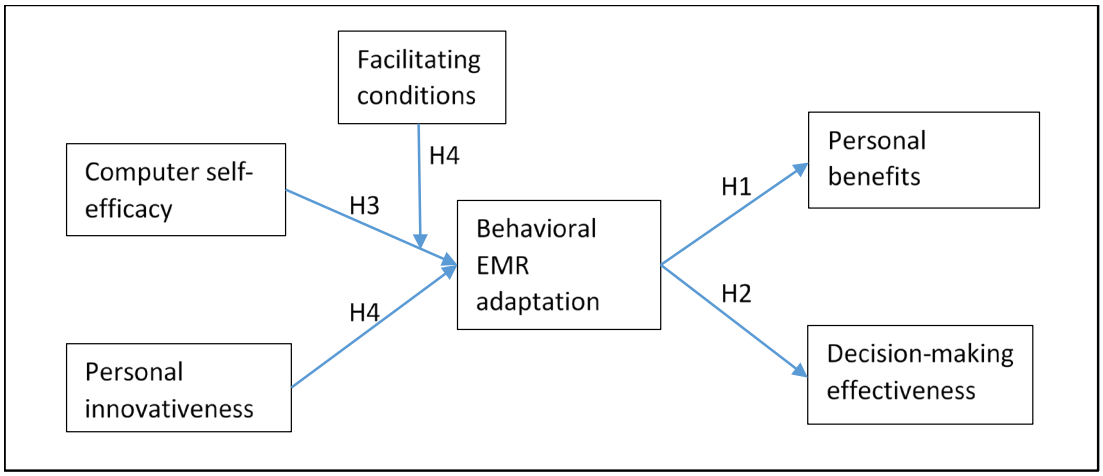
(**H4) Facilitating conditions (FCO) enhance the influence of computer self-efficacy (CSE) on the behavioral adaptation of the EMR system (BHA)**

Personal innovativeness (PI) helps identify individuals who are likely to adopt IT innovations earlier than others and who can serve as key change agents and opinion leaders to facilitate further diffusion of a new technology. Personal innovativeness expresses the risk-appetite of certain individuals and not in others (Agarwal, 1998). In the framework of the technology acceptance model, personal innovativeness has been proven to be an antecedent of perceived ease of use (Lua, Yaob & Sheng, 2005). In Canadian Medical Practices, personal innovativeness had a significant effect on the behavioral intention to adopt EMR (Cocosila & Archer, 2016). Individuals that that are keen of experimenting with new software, will also be in the front line to propose adaptations in workflows, business rules and user experience. This is supported by Sun (2012) who identifies in post-adoptive systems use, three antecedents of Adaptive System Use (novel situations, discrepancies, and deliberate initiatives) and two moderators (personal innovativeness in IT and facilitating conditions). This moderating effect evokes that these factors are correlated with adaptation behavior. From theory and evidence in other IS, we can hypothesize that:

(**H5) Personal innovativeness (PIN) positively affects an adaptation behavior of increasing the technological fit of the Electronic Medical Record system (BEH)**

Figure 1 represents graphically the hypothetical relationships between the constructs in a path model. A path model is a diagram that is used to display visually the hypotheses and variable relationships (Hair, Tomas, Hult, Ringle & Sarstedt, 2017, p11). In this model, two independent variables related to personal traits, computer self-efficacy (H3) and personal innovativeness (H5), are supposed to enhance the propensity of physicians to improve the compatibility of the EMR system with their workflows. According to H4, an extrinsic factor, facilitating conditions, moderates positively, the effect of CSE on adaptation behaviors. EMR behavioral adaptation affects according to H1 and H2 two dependent variables, the perception of personal benefits of physicians and medical decision-making effectiveness.

Figure 1. Path model



This research also checks the effect of specific control variables.

3. Methodology

3.1. Conceptual design

In the "research onion" (Saunders, 2016, p. 124, fig. 4.1), the outer circle refers to the research philosophy, the successive inner circles represent the approach of theory develop-ment, the research methodology, the research strategy, the time horizon and finally the techniques and procedures. This research relies on the philosophy of objectivism and positivism. Positivism implies that only facts and numbers are acceptable knowledge, deductions are value-free, and conclusions contribute to law-like generalizations for causal relationships and predictions (Saunders, Lewis & Thornhill, 2016, p 136). This research is further based on a deductive approach. The hypotheses are formulated on the basis of logic and evidence-based theory. Data collection is used to evaluate these hypotheses. Corrobo-ration of the hypotheses contribute to theory development (Saunders et al., 2016, p 146). This research is due to provide statistical evidence for the research hypotheses in figure 1. If the relationships between the constructs are statistically significant, they must have a logical or theoretical explanation.

3.2. Measurement and indicators

While constructs are conceptualized at the theoretical (abstract) plane, variables are operationalized and measured at the empirical (observational) plane. (Bhattacherjee, 2012). To measure the constructs, indicators are required. A literature review and an in-group validation have provided the validated indicators for the respective latent variables. For Behavioral Adaptation of EMR (BHA), five indicators that estimate the effort spent for adaptation are based on the research of Barki (Barki et al., 2007) and Wu (Wu et al. 2017). For Perceived Personal Benefits, the research of Barki (Barki et al 2007) provides 3 indicators. For Decision-making effectiveness, indicators are rare in the bibliography. The research of Cao (Cao, Duanb & Cadden, 2019) provides 3 indicators. Research on computer self-effectiveness refer to the 10 standard indicators of Compeau (Compeau & Higgins, 1995). Agarwal (in Agarwal & Karahanna, 2000) provides 4 indicators that are used for the measurement of the construct of personal innovativeness. For facilitating conditions, Venkatesh (in Vnekatesh, Morris, Davis, & Davis, 2003) provide 3 indicators. Table 26 in Appendix A list these indicators. All indicators are reflective, i.e. they are a representative sample of all the items available in the conceptual domain of the construct (Hair et al. 2017, pp 46-47). All these indicators are measured with a 7-point Likert scale. As stated in section 2.2.1., the measurement of behavioral adaptation has to take into account the professional environment. This is measured with two control variables: (i) type of institution where the respondent uses the EMR, (ii) the responds works (also) in the emergency department. For the interpretation of the dependent variables, the diversity of qualification level needs to be taken into account as a control

variable. For the description of the sample, the indicators age, sex, qualification, the type of institution where the respondent uses EMR, the regularity of the use of EMR and the number of years the respondent uses the EMR have been selected.

3.3. Data collection

For the data collection, a cross-sectional survey has been designed. Data collection has been ensured with questionnaires addressed to a sample of health staff in a large array of institutions. Given the COVID-19 context, restricting direct contacts, the snowball sampling method has been used. In snowball sampling (Bhattacherjee, 2012, p.70) a few respondents that match the inclusion criteria are identified and asked to recommend others they know who meet the inclusion criteria for the questionnaire filling. For inclusion, the criterion is that the subjects are health workers that use EMR. In the questionnaire, the indicators are reformulated as a statement. The respondent is asked to indicate his or her degree of agreement with each statement using a 7-point Likert scale from “strongly disagree”, to “strongly agree.” The questionnaire is formulated in Dutch and is self-administrated. In order to verify the completeness, wording, and appropriateness of the instrument, testing interviews has led to modification of the wording in an iterative way up to the point of accepting content validity.

The data collection took 58 days and 136 responses have been collected. The mean duration of the survey was 12.77 minutes, with outliers of 4 minutes and 62 minutes. As only fully filled questionnaires could be submitted, no responses had missing data. Every respondent was assigned an ID number by the system. These ID numbers depend on the time of submitting but do not start at 1 and they are not subsequent. So, the ID numbers extended from 76 to 1208. The original ID numbers have been maintained in the data processing.

For the questions on general information, the respondents had to tick 1 option, presented as a description in text. For each option a code has been assigned. These codes are presented in appendix C. With IBM Statistics SPSS version 26, these text data have been converted in numerical data.

For the questions on the perception of the respondents on each construct, a 7-point Likert scale has been used. The possible options in text of this Likert scale have been re-encoded as follows:

Table 1. Re-encoding of the Likert scale options

Text	Numerical value
Fully disagree	1
Disagree	2
Somehow disagree	3
Not disagree – not agree	4
Somehow agree	5
Agree	6
Fully agree	7

In order to check for non-engagement, the standard deviation was measured in excel for the numerical Likert scale selections of each respondent. Reponses with ID number 257 and 286 had a standard deviation of 0 and were excluded. Response with ID number 759 had a standard deviation of 0.33. This respondent filled different selections for the first question and then continued to select “not disagree, not agree” for all the following questions. This response was also excluded. These three cases also had a very low survey duration of 4 minutes. No respondent declared that (s)he never works with an EMR, so no exclusion was done on the basis of that criterion.

3.4. Data analysis

For the descriptive statistics of the respondent characteristics SPSS v.26 has been used. The outputs have been copied to MS Excel for the production of graphics. In the following step, the validity of the measurement model has been assessed with the Partial Least Square variant of Structural Equation Models. PLS-SEM is suitable for social research as sample sizes can be small, the goal is prediction testing, and it fits for complex models (Hair et al., p xiii). The reliability of the indicators, i.e. the difference between the true value and the measured value, was tested with Cronbach's alpha, composite reliability index, and outer factor loadings. The convergence validity of the reflective indicators, i.e. whether they are really representative of the construct is measured with Average Variance Extracted (AVE). Indicators with outer loadings of <0.4 have been eliminated. Discriminant validity, i.e. whether indicators of a construct do not express the variance of another construct was checked by comparing the outer factor loadings of the indicators with the cross-loadings. This has been done in a similar way for the square root of the AVE of the indicators (Hair et al., 2017, p122). This allowed the validation of the measurement model.

Subsequently the path model has been assessed. In order to estimate the predictive capability of the structural model, a number of metrics are processed. Significance and relevance of the relationships of the path model and the level of predictive power (explained variance of endogenous latent variables) have been measured with the path coefficients. With bootstrapping, significance levels (p values) of each relation and the explained variance (R^2) of the dependent latent variables have been estimated (Hair et al., p 207). The effect and relative impact on R^2 of omitting an exogenous construct from the model are checked with the f^2 size (Hair et al., 2017, p 200).

The research model (Figure 1), hypothesized that the construct "EMR behavioral adaptation" is a mediator between the independent variables (PI and CSE) and the dependent variables (PPB and DME). The mediating effect is the indirect effect of the mediator construct on the relationship between independent and dependent variable. The mediator explains this relationship. If this mediating effect is not significant, there is eventually only a direct effect (Hair et al., 2017 pp 227-242).

In section 2.2.2. it was hypothesis 4 states that facilitating conditions (FCO) have a positive moderating effect on the relation between the constructs CSE and BHA, this means that a positive variation of FCO will increase the strength of the relation CSE-BHA and explains the heterogeneity in the data (Hair et al., 2017 pp 243). The control variables of the respondents are also tested for a correlation with the endogenous constructs, BHA, PPB and DME.

3.5. Reflection with regard to ethical aspects

Ethical considerations arise at all stages of the research. In the design phase, the use of confidential and sensible data must be avoided. As the research does not consult any electronic medical record, there has been no possibility to interfere with data protection rules of patients. The COVID-19 context was particularly delicate for that. The direct contacts of the research team members were hesitant to forward the questionnaire to colleagues knowing that they were extremely stressed. During data collection, no pressure was exerted on possible participants and the importance of the research has not been exaggerated

With regard to the subjects of the research, health staff members, the data protection regulation (GPDR) requires the anonymization of the subjects. The original data that contain the personal identifiers must be kept in a safe place by an appointed data protection manager and carefully destroyed. This must ascertain that no subject of the survey can be identified by any means. The researcher must show his objectivity during the analysis of the results. Debriefing of the research

should be respectful. Caution must also be given that the conclusions of the research cannot be used to decisions that disadvantage a category of people in this case hospital physicians (Saunders et al. p 260-261).

4. Results

4.1. Characteristics of the respondents

The numerous categories of the general questions are not suited for use as control variable. The actual qualification and the education level have been re-encoded in a new variable with an ordinal scale:

1: care professional with secondary school qualification or post-secondary education without bachelor
2: care professional with bachelor diploma in a medical domain,
3: medical doctor.

Based on these 3 categories for qualification, the most frequent qualification is bachelor in a medical domain and represents 44,4% of the respondents. Medical doctors represent 17,3% of the respondents.

Table 2. Type of qualification of the respondents

Qualification		N	%
1	No bachelor qualification	51	38,3
2	Bachelor qualification in medical care	59	44,4
3	Qualified as medical doctor	23	17,3
	Total	133	100,0

As for the institutions, there was a need to re-encode the categories in 4 groups with an ordinal scale of decreasing medical specialization:

1: University or specialized hospital
2: General hospital
3: institution for nursing and medical care outside hospital,
4: non-medical institution or home care

Medical facilities outside hospital include general practitioners, care organizations, revalidation centra, GGD[2], GGZ[3]. Non-medical facilities include care for handicapped persons. The most frequent institution where the respondents work are university hospitals and general hospitals.

Table 3. Type of institutions where the respondents use the EMR

	Frequency	Percentage
University hospitals	45	33,8
General hospitals	41	30,8
Health facilities outside hospital	34	25,6
Non-medical facilities and home care	13	9,8
Total	133	100,0

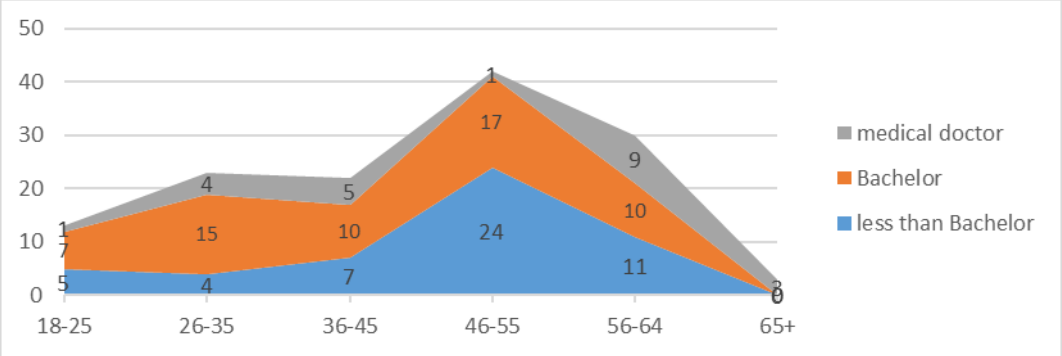
These institutions are located for 80,5% in the Netherlands and 18% in Belgium. The respondents worked in a large array of departments, none of them being predominant. It is further observed that 15% of the respondents also worked in an emergency ward. For further analysis of this variable, it has

[2] Gemeentelijke gezondheidsdienst
[3] Geestelijke gezondheidszorg

been re-encoded as follows: 0 = do not work in emergency department, 1 = works in emergency department.

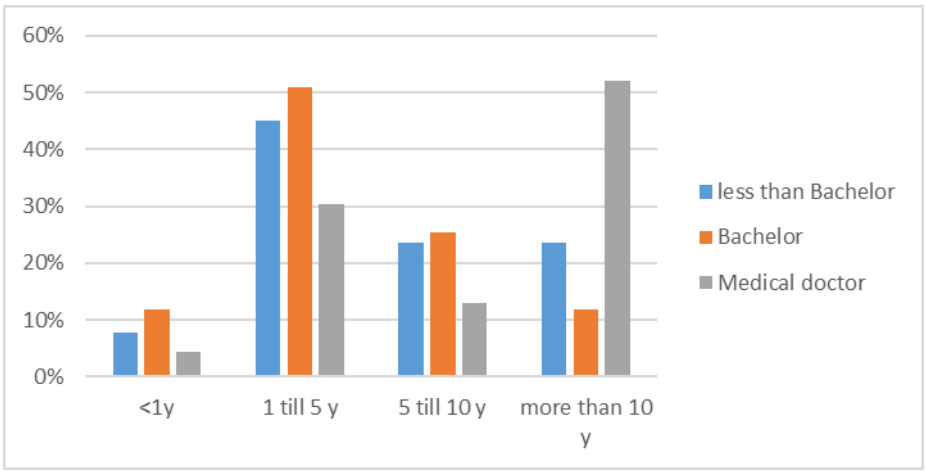
The female gender is predominant with 72,2% of the respondents. The age of the respondents is distributed in a normal way with the mode in the 45-55 range (with 31.6 %). The excess kurtosis of the age distribution is -0.867. This distribution is platykurtic, this means that the tails of the Gauss curve are thinner (Westfall, P.H., 2014). This is consistent with the normal age range of professional activity (26-64). The skewness of the distribution is negative (-0.344) which means that the left tail of the Gauss curve is longer. This left tail is mainly composed of bachelors (nurses) which is also consistent with reality.

Figure 2. Distribution of age related to levels of qualification



The results show that 85% of the respondents use the EMR every working day and this is similar among the three qualification groups. It also appears that 46% of the respondents are experienced EMR users (use EMR for 5 years or more). And surprisingly, 48% of the less qualified staff are experimented users.

Figure 3. Distribution of duration of the use of EMR related to levels of qualification



4.2. Assessment of the measurement model

This section presents for each construct, the statements used in the questionnaire to express the indicators, the frequencies of the Likert scale selections for these statements, the assessment of the consistency reliability and for the entire model, the discriminant validity of the indicators.

4.2.1. Personal innovativeness

The construct of Personal innovativeness (PI) has been measured in the questionnaire with 4 statements (see Appendix 3, for the full questionnaire)

PI1	If I hear about a new information technology, I look for ways to implement my tasks with it
PI2	In general, I hesitate to try out new information technologies
PI3	Among my colleagues, I am the first to experiment with new information technologies
PI4	I like to experiment with new information technologies

PI2, which expresses a negative trend, has been recoded inversely and becomes PI2R. Consequently, there is a coherence among the indicators of personal innovativeness. PI3 has the lowest mean (1,63). This indicator is the most challenging indicator for personal innovativeness

Table 4. Descriptive statistics for personal innovativeness

Personal innovativeness	PI1	PI2R	PI3	P4
median	5,00	5,00	4,00	4,00
mean	5,07	4,75	4,17	4,26
standard deviation	1,29	1,64	1,63	1,65
variance	1,67	2,69	2,64	2,71

Figure 4. Distribution of Likert scale selections for personal innovativeness

The Internal consistency reliability, i.e. the correlations between the observed indicator variables is measured with Cronbach alpha and composite reliability (CR), the former being more conservative than the latter. The check of convergent validity, i.e. the demonstration that a measure correlates positively with alternative measures of the same construct is measured with the Average Variance Extracted (AVE). The construct reliability parameters provide acceptable results and all indicators are maintained.

Table 5. Consistent reliability statistics for personal innovativeness

Personal Innovativeness	normal	sample
Cronbach's alpha	>0.8	0,830
Composite reliability	>0.7	0,882
Average Variance Extracted	>0.5	0,653

4.2.2. Computer self-efficacy

The construct of Computer self-efficacy (CSE) has been measured in the questionnaire with 10 statements (see appendix C)

	I could implement my task in the EMR with sufficient self-confidence if ...
CSE1	... also, if nobody was around to let me see how to do it
CSE2	... also, if I never had used before a similar software package
CSE3	... if I have only the software manual as a reference

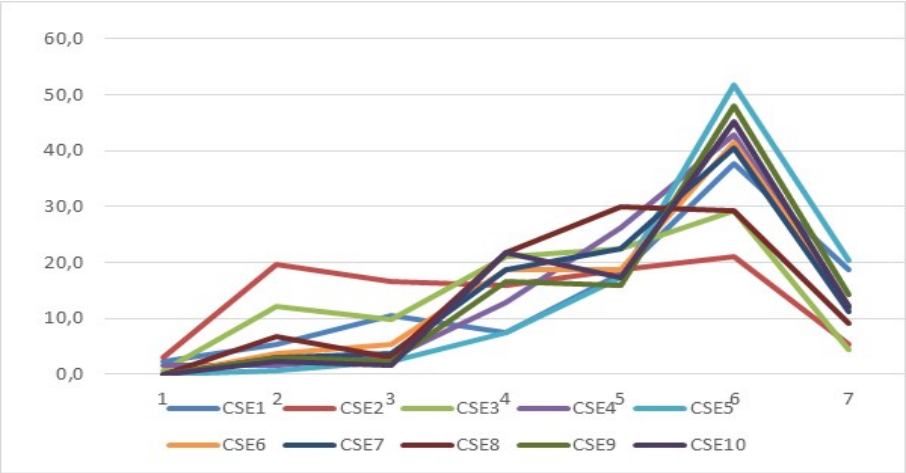
CSE4	… if I could look with somebody before, I try it myself
CSE5	… I I could ask somebody for help if I get stuck
CSE6	… If somebody else had helped me to start
CSE7	… If I had a lot of time to complete my task in the EMR
CSE8	… If I only had the inbuilt help function form my assistance
CSE9	… If somebody was around to show me how I have to do it
CSE10	… if I had earlier used similar packages for the same kind of work

For computer self-efficacy, the respondents agree or fully agree with the statements, except for CSE2, which is obviously the most challenging condition. For CSE5 with a median of 6, the standard deviation is low with 0.98.

Table 6. Descriptive statistics for computer self-efficacy

Computer self-efficacy	CSE1	CSE2	CSE3	CSE4	CSE5	CSE6	CSE7	CSE8	CSE9	CSE10
median	6,00	4,00	5,00	6,00	6,00	6,00	6,00	5,00	6,00	6,00
mean	5,22	4,12	4,59	5,38	5,78	5,25	5,28	4,99	5,47	5,38
standard deviation	1,56	1,65	1,46	1,18	0,98	1,26	1,18	1,27	1,17	1,13
variance	2,43	2,73	2,12	1,40	0,96	1,58	1,40	1,61	1,37	1,28

Figure 5. Distribution of Likert scale selections for computer self-efficacy



The analysis of the consistent reliability parameters provides low Composite Reliability (CR) and Average Variance Extracted. Indicators CSE1, CSE2, CSE3, CSE7, CSE8 have an outer loading of <0.4 and have to be deleted. The outer loading of CSE10 is < 0.7 and can be deleted if deletion implies an increase of CR and increases AVE to >0.5 (Hair et al., 2017, p114). Table 7 shows that also without the deletion of indicator CSE10, CR and AVE are acceptable and hence CSE10 has not been deleted.

Table 7. Consistent reliability statistics for computer self-efficacy

Computer self-efficacy	normal	All indicators	Del CSE1, CSE2, CSE3, CSE7, CSE8	+ Del CSE10
Cronbach's alpha	>0.8	0,744	0.857	0.866
Composite reliability (CR)	>0.7	0,492	0.896	0.907
Average Variance Extracted (AVE)	>0.5	0,299	0.636	0.710

Table 8. Outer loadings of the indicators of computer self-efficacy

CSE1	-0.401	CSE6	0.772
CSE2	-0.560	CSE7	0.108
CSE3	0.011	CSE8	-0.050

CSE4	0.766	CSE9	0.779
CSE5	0.682	CSE10	0.498

4.2.3. Facilitating conditions

The construct of Facilitation conditions (FCO) has been measured in the questionnaire with 4 statements (see appendix C)

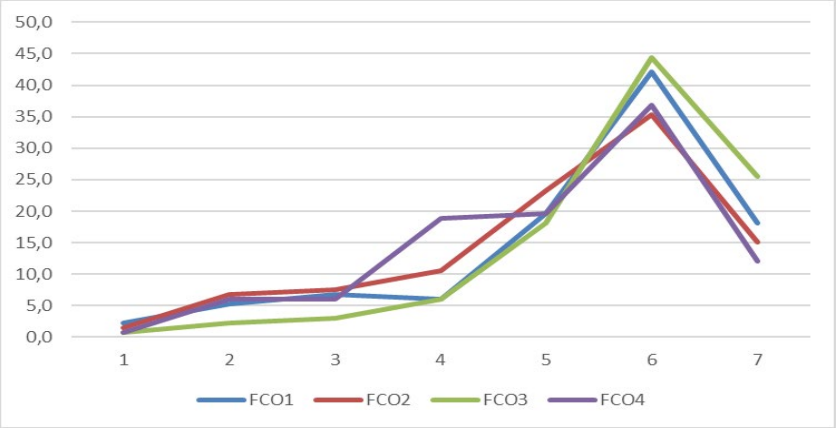
FCO1	Assistance (for instance online instructions, introduction course etc.) were for me available for the EMR system
FCO2	Specialized instructions related to the EMR system were for me available
FCO3	There was a specific person (or group) available for assistance in case of problems with the EMR
FCO4	There was an instruction note in case of extension or adaptation of the system

For the facilitating conditions respondents agree or fully agree with the 4 statements.

Table 9. Descriptive statistics for Facilitating conditions

facilitating conditions	FCO1	FCO2	FCO3	FCO4
median	6,00	6,00	6,00	5,00
mean	5,34	5,14	5,74	5,09
standard deviation	1,49	1,49	1,20	1,40
variance	2,21	2,21	1,44	1,95

Figure 6. Distribution of Likert scale selections for Facilitating conditions



The analysis of the consistent reliability parameters provides acceptable results and all indicators are maintained

Table 10. Consistent reliability statistics for Facilitating Conditions

Facilitating conditions	normal	sample
Cronbach's alpha	>0.8	0,854
Composite reliability	>0.7	0,889
Average Variance Extracted	>0.5	0,687

4.2.4. Behavioral adaptation

The construct of Behavioral adaptation (BHA) of the EMR has been measured in the questionnaire with 5 statements (see Appendix C)

	I invested efforts (in time and energy)
BHA1	… to change the functionalities of the EMR so that they are mora adapted to my work environment

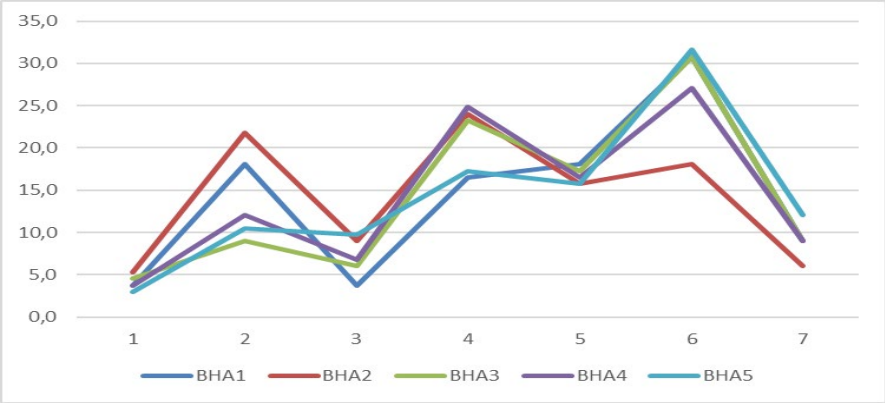
BHA2	… to change my tasks so that they accord better with the EMR system
BHA3	… so that the EMR system and my tasks are in harmony
BHA4	… to propose changes in the EMR system or through changes in the configurations
BHA5	… and I use now the EMR system in a different way than when I started to work with it

Respondents had diverse opinions on the statements on behavioral adaptation with a low frequency of "somehow agree". The adaptation of the tasks to make them more compatible with the EMR is the most challenging adaptation, while a change in the way an EMR is used, is the most accepted statement

Table 11. Descriptive statistics for Behavioral Adaptation

behavioral adaptation	BHA1	BHA2	BHA3	BHA4	BHA5
median	5	4	5	5	5
mean	4,56	4,02	4,68	4,56	4,75
standard deviation	1,74	1,70	1,61	1,63	1,66
variance	3,04	2,88	2,60	2,66	2,75

Figure 7. Distribution of Likert scale selections for Behavioral Adaptation



The analysis of the consistent reliability parameters provides acceptable results and all indicators are maintained

Table 12. Consistent reliability statistics for Behavioral Adaptation

Personal Innovativeness	normal	sample
Cronbach's alpha	>0.8	0,838
Composite reliability	>0.7	0,885
Average Variance Extracted	>0.5	0,606

4.2.5. Decision-making effectiveness

The construct of Decision-making Effectiveness (DME) has been measured in the questionnaire with 3 statements (see Appendix C)

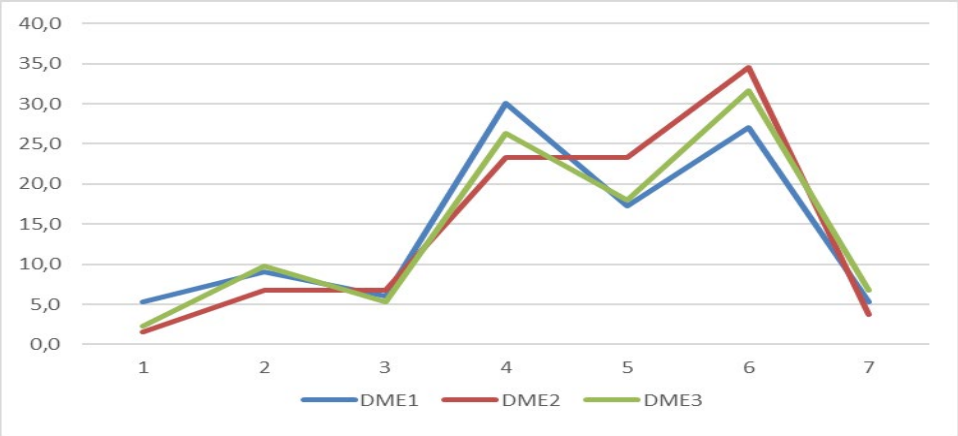
	Through the use of EMR, I am more competent than my colleagues in
DME1	… to react quickly to a change in the status of a patient on the basis of data of the EMR
DME2	… to take the right decisions on the basis of real time date of the EMR
DME3	… to involve the patients better in their therapy

Respondents had no opinion or agreed with these statements on decision-making effectiveness. There is a high variation of this opinion on DME1, which may be related to the context of the respondents. See section 4.5.3. for an assessment of the control variables.

Table 13. Descriptive statistics for Decision-making Effectiveness

Decision making effectiveness	DME1	DME2	DME3
median	4,00	5,00	5,00
mean	4,47	4,79	4,70
standard deviation	1,56	1,35	1,49
variance	2,42	1,82	2,23

Figure 8. Distribution of Likert scale selections for Decision-making Effectiveness



The analysis of the consistent reliability provides acceptable results and all indicators are maintained

Table 14. Consistent reliability statistics for Decision-making Effectiveness

Decision making effectiveness	normal	sample
Cronbach's alpha	>0.8	0,834
Composite reliability	>0.7	0,895
Average Variance Extracted	>0.5	0,740

4.2.6. Perceived personal benefits

The construct of Perceived Personal Benefits (PPB) has been measured in the questionnaire with 3 statements (see Appendix C)

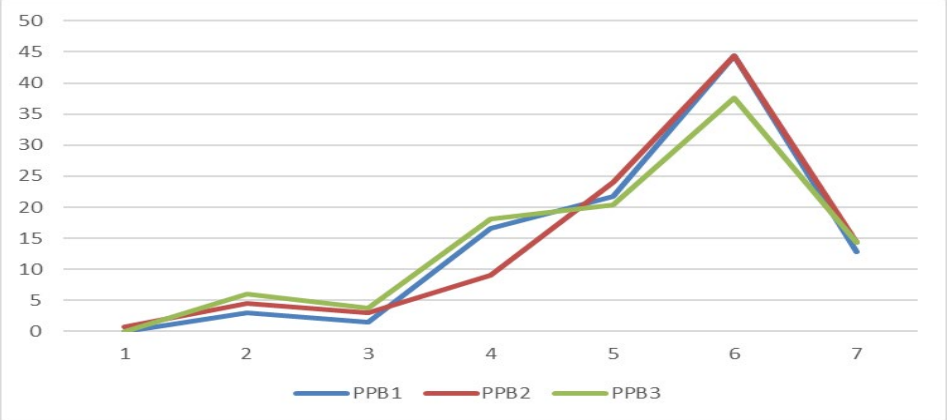
	Through the use of EMR
PPB1	… I acquired knowledge that will be useful for other systems in the future
PPB2	… I can work more efficiently
PPB3	… I increase my professional chances

Respondents agree with the 3 statements in a congruent way but less for PPB3, where 27,9% of the respondents disagree or have no opinion

Table 15. Descriptive statistics for Perceived Personal Benefits

Perceived Personal Benefits	PPB1	PPB2	PPB3
median	6,00	6,00	6,00
mean	5,41	5,41	5,23
standard deviation	1,136	1,262	1,335
variance	1,290	1,593	1,782

Figure 9. Distribution of Likert scale selections for Perceived Personal Benefits



The analysis of the consistent reliability parameters provides acceptable results and all indicators are maintained

Table 16. Consistent reliability statistics for Perceived Personal Benefits

Personal Innovativeness	normal	sample
Cronbach's alpha	>0.8	0,753
Composite reliability	>0.7	0,857
Average Variance Extracted	>0.5	0,667

4.2.7. Overall convergent Validity and reliability and discriminant validity

The analysis above shows that the measures of internal consistency, convergent validity and reliability (CA, CR and AVE) respect the rules of thumb for reflective measurement models (Hair, 2017 p122). These measures are summarized in table 17

The Formel-Lacker criterion checks the discriminant validity, i.e. the extent to which a construct is distinct from other constructs. This criterion is respected when the square root of the AVE (in bold in Table 17) is greater than highest correlations with other constructs (figures left and under the SQR AVE). This criterion is respected for the measurement model.

Table 17. internal consistency, convergent validity and discriminative validity of the measurement model

	BHA	CSE	DME	FCO	PI	PPB	Acceptance criterion
BHA	**0.777**						SQR AVE > Outer loadings
CSE	-0.152	**0.798**					
DME	0.160	0.037	**0.853**				
FCO	0.191	-0.066	0.245	**0.831**			
PI	0.242	-0.187	0.032	0.017	**0.808**		
PPB	0.282	0.008	0.421	0.282	0.142	**0.816**	
CA	0,838	0.857	0,834	0,854	0,830	0,753	>0.8
CR	0,885	0.896	0,895	0,889	0,882	0,857	>0.7
AVE	0,606	0.636	0,740	0,687	0,653	0,667	>0.5

For discriminant validity, an indicator's outer loadings should be higher than all its cross loadings with other constructs. In table 18 it is shown that this criterion is respected.

Table 18. Comparison of outer loadings of each construct with the cross loadings of all other constructs

	BHA	CSE	DME	FCO	PI	PPB
BHA1	**0.799**	-0.151	0.148	0.129	0.154	0.158
BHA2	**0.786**	-0.204	0.069	-0.012	0.125	0.139
BHA3	**0.820**	-0.164	0.199	0.179	0.154	0.282
BHA4	**0.796**	-0.154	0.162	0.166	0.239	0.232
BHA5	**0.686**	-0.197	0.058	0.137	0.231	0.232
CSE4	-0.118	**0.766**	0.071	-0.035	-0.177	-0.001
CSE5	-0.100	**0.682**	-0.078	-0.064	-0.096	-0.053
CSE6	-0.164	**0.772**	0.102	-0.024	-0.156	0.028
CSE9	-0.122	**0.779**	0.112	-0.036	-0.241	-0.001
CSE10	-0.076	**0.498**	0.083	-0.064	-0.023	0.063
DME1	0.107	0.150	**0.835**	0.145	0.101	0.290
DME2	0.201	0.077	**0.956**	0.235	0.015	0.442
DME3	0.075	-0.054	**0.781**	0.163	0.034	0.315
FCO1	0.186	0.024	0.188	**0.803**	0.014	0.239
FCO2	0.179	-0.016	0.254	**0.821**	0.014	0.335
FCO3	0.129	-0.085	0.171	**0.850**	0.023	0.149
FCO4	0.090	0.020	0.148	**0.842**	0.022	0.181
PI1	0.264	-0.232	0.042	0.019	**0.829**	0.094
PI2R	0.085	-0.119	0.078	0.132	**0.685**	0.065
PI3	0.148	-0.294	-0.022	-0.081	**0.827**	0.058
PI4	0.196	-0.294	0.059	0.034	**0.878**	0.212
PPB1	0.252	-0.050	0.315	0.191	0.155	**0.846**
PPB2	0.177	0.066	0.410	0.241	0.015	**0.765**
PPB3	0.243	0.026	0.333	0.203	0.149	**0.837**

Taking into account the deletion of 5 indicators of CSE and based on these different checks it is concluded that the measurement model respects the criteria of a reflective measurement model.

4.3. Analysis of the structural model

4.3.1. PLS-SEM path model

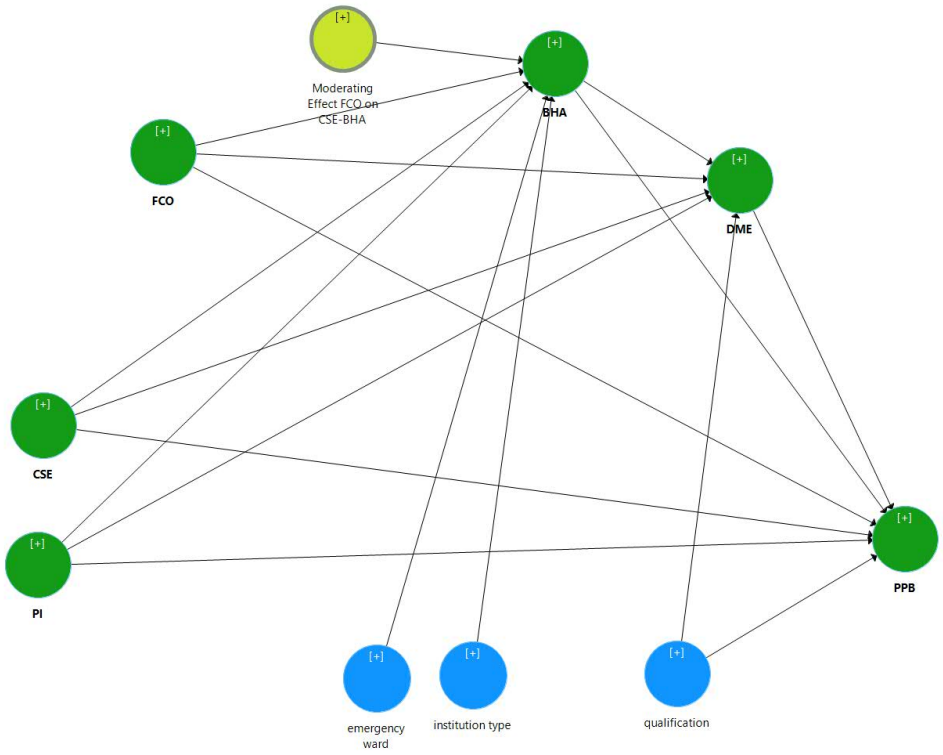
This study focused on the adaptation behavior related to an EMR system and has set the hypothesis that Behavioral Adaptation (BHA) is a mediator between the independent variables (PI and CSE) on one side and the dependent variables (PPB and DME) on the other side. The model also states that the independent variable Facilitating conditions enhances the relation between CSE and BHA. In order to check the effect of the professional work environment, two control variables i.e. institution and work in emergency department have been related to BHA. Two kind of benefits have been considered in the path model, decision-making effectiveness and perceived personal benefits. In order to understand whether this perception depends on groups, qualification has been assessed as a control variable.

The mediation analysis may reveal that direct and indirect effects coexist (Hair et al., 2017, p232). Direct effects could imply that there may be unidentified mediators. CSE, PI and FCO are cognitive and external assets. Logically, an asset can only generate a benefit through a behavior or practice. If a significative relation is identified between the independent variables CSE, PI or FCO at one hand and the dependent variables DME and PPB at the other hand, this would mean, that a mediator that

corresponds to a behavior or practice, has not been included in the model and this would be an alternative path. So, in order to assess the importance of these direct effects, the relations, PI->PPB, FCO->PPB and CSE->PPB, PI->DME, FCO->DME and CSE->DME have been added to to the path model. Moreover, benefits may reinforce each other. The preparation of the questionnaires raised the question how an EMR user who estimates that the use of EMR improves his real time decision making, would not also estimate that the use of EMR improve his career perspectives? In order to estimate positive effects between benefits, the path model takes into account the relation between decision making effectiveness affects and perception of personal benefits.

The hypotheses of this research, the direct effects, the control variables and the relation between benefits resulted in the following path model in SmartPLS® v3.

Figure 10. Hypothesized path model completed with alternative relations



4.3.2. Path assessment

The path coefficients allow a relative interpretation of the hypothesized relationships: if they tend to 1 or -1, they are stronger. T-statistics and p values assess their significance level. The 5 % significance level is achieved when t-value > 1.96 and p-value < 0.05. The effect of omitting an exogenous construct from the model is measured with the f^2 size. The f^2 size is small if > 0.02, medium if >0.15 and large if >0.35.

As table x shows, there is a significant relationship between personal innovativeness and behavioral adaptation and between behavioral adaptation and the perception of personal benefits. The effect of omitting an exogenous construct from the model the results show no effect for the relation between computer self-efficacy and behavioral adaptation and weak effects for the other relations. Bias corrected bootstrapping of 5000 samples and the Partial Least Squares Algorithm with 2000 iterations show a coherence between the path coefficient, the p-value and the f^2 size. Table 19 shows that there

is a significative effect for 2 relations of the research model, for 2 direct effects and for the relation between benefits.

Table 19. Statistics of the relations of the path model.

	Path coefficients	T-Statistics	P Values	f^2 -size	effect
H1: BHA -> PPB	0.184	2.268	0.023	0.041	Yes
H2: BHA -> DME	0.140	1.531	0.126	0.021	No
H3: CSE -> BHA	-0.104	1.042	0.297	0.012	No
H4: Moderating Effect FCO on CSE-> BHA	-0.032	0.335	0.738	0.001	No
H5: PI -> BHA	0.223	2.707	0.007	0.053	Yes
Direct effect: FCO->PPB	0.178	2.500	0.012	0.040	Yes
Direct effect: CSE->PPB	0.053	0.496	0.620	0.004	No
Direct effect: PI-> PPB	0.096	1.134	0.257	0.012	No
Direct effect: FCO->DME	0.202	2.270	0.023	0.046	Yes
Direct effect: CSE->DME	0.125	0.893	0.372	0.017	No
Direct effect: PI->DME	0.059	0.678	0.498	0.004	No
DME->PPB	0.313	3.295	0.001	0.117	Yes

The level of predictive power i.e. the explained variance of endogenous latent variables by the exogenous variables can be measured with the coefficient of determination (R^2 value). This is the squared correlation of actual and predicted values. If R^2>0.75 there is a substantial predictive power, if R^2> 0.5 a moderate predictive power and if R^2> 0.25 a weak predictive power. Table 20 presents the R^2 for three different path models. The first column presents the R^2 values of the research model as in figure 1. The second column takes into account the control variables and the third column take into account control variables and alternative relations as in figure 10. The predictive power of the research model is very low.

Table 20. Level of predictive power of the dependent variables

	R^2 research model	R^2 research model with control variables	R Square of completed model
BHA	0.104	0.138	0.136
DME	0.030	0.110	0.142
PPB	0.080	0.130	0.278

4.3.3. Mediation

An assessment has been made of the mediating effects according to the method of Hair (Hair et al., 2017: pp228-243). If the indirect effect is not significant and the direct effect is significant, then the effect is direct only. If the indirect effect is significant and the direct effect is also significant and the effect has the same direction, then there is a complementary partial mediation. To be valid the confidence interval may not include 0. The assessment shows that there is no direct or indirect of CSE on PPB, CSE on DME, PI on DME and of PI on PPB. This is shown in table 21

Table 21. Mediation assessment

Direct effect					Indirect effect					
Direct effect	Path C	Confidence interval		p	Indirect effect	Path C	Confidence interval		p	
CSE->DME	0.125	-0.192	0.354	0.383	CSE->BHA->DME	-0.015	-0.069	0.010	0.456	No effect
CSE->PPB	0.053	-0.141	0.256	0.618	CSE->BHA->PPB	0.016	-0.080	0.141	0.785	no effect
PI->DME	0.059	-0.107	0.223	0.492	PI->BHA->DME	0.031	-0.010	0.092	0.229	No effect
PI->PPB	0.096	-0.080	0.264	0.275	PI->BHA->PPB	0.069	-0.010	0.150	0.089	no effect

4.3.4. Effect of control variables

Three control variables have been assessed on their relationship with the dependent variables: 1) Institution type, 2) Work in emergency department and 3) Qualification. In Smart-PLS, the p-values for the hypothetical effects of these control variables are calculated. The relation between emergency department and BHA is significant. The relation between qualification and the decision-making effectiveness is significant but negative. This means that the lower the qualification the higher the perception that the EMR contributes to the decision-making effectiveness.

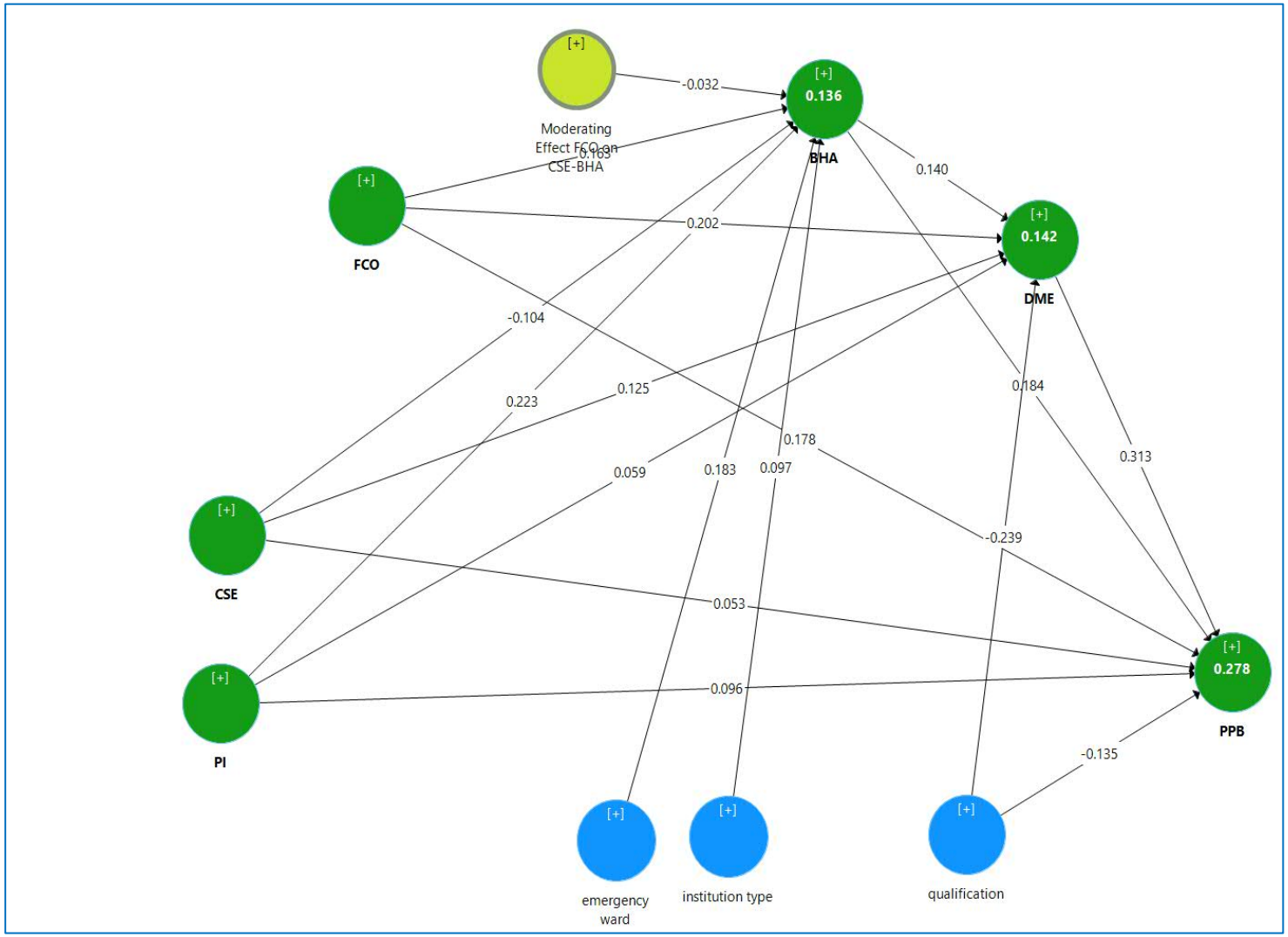
Table 22. Effects of control variables

	path coefficient	T Statistics	P Values	f^2 size
Institution type -> BHA	0.097	1.080	0.280	0.010
Emergency department ->BHA	0.183	2.519	0.012	0.037
qualification -> DME	-0.239	2.584	0.010	0.065
qualification -> PPB	-0.135	1.699	0.089	0.023

4.3.5. Path model synthesis

Figure 11 shows the path coefficients on the relations and the R^2 of the dependent variables taking into account the effect of control variables, direct relations and relations between dependent variables. This is the basis for the following discussion.

Figure 11. Path model with path coefficients and R^2 value



5. Discussion, conclusions and recommendations

5.1. Discussion

The research model is composed of three independent variables, 2 are personal traits, 1 is an external resource. These independent variables affect a practice/behavior. In the research model, this practice is the behavioral adaptation of EMR. and this behavior affect two dependent variables of the type benefit, decision-making effectiveness and perceived personal benefits.

So, the first question in this discussion is: to which extent do the independent latent variables, affect behavioral adaptation of EMR? The formulated hypotheses in this regard are the following:

Hypothesis 3, Computer Self-efficacy (CSE) positively influences an adaptation behavior of increasing the technological fit of the Electronic Medical Record system (BHA), is not confirmed. Contacts during the survey declared that EMR systems do not let space for technical adaptations and as such, a high level of computer self-efficacy is of little advantage for the adaptation of the EMR system. Park et al. (2015) report that individual clinicians respond to the immediate alteration in workflows caused by the EMR and that the organizational adaptations later mitigate the changes in healthcare quality. This means that adaptation is mainly a sociological phenomenon and hence does not benefit of computer skills.

Hypothesis 4, facilitating conditions (FCO) enhance the influence of computer self-efficacy (CSE) on the behavioral adaptation of the EMR system (BHA), is not confirmed. While computer self-efficacy is cognitive, facilitating conditions are an external resource for technological fit. From the previous reasoning it is clear that if the space for technological adaptation of EMR is limited and the adaptation is mainly sociological, facilitation conditions are of little advantage.

Hypothesis 5, Personal innovativeness (PI) positively affects an adaptation behavior of increasing the technological fit of the Electronic Medical Record system (BHA), is confirmed. Personal innovativeness expresses the risk-appetite of certain individuals and not in others (Agarwal, 1998) and hence is an antecedent for efforts to adapt workflows to the EMR system or to adapt functionalities of the EMR system to identified needs.

Second, are there control variables that are significatively related to the practice, i.e. the behavioral adaptation of EMR? The hypothesis is that the professional environment may stimulate behavioral adaptation. **Working in the emergency department** is significatively related to behavioral adaptation while the type of institution is not. This is clearly in line with the observations of Park et al. (2015). In the emergency department, there is a pressure to identify workarounds so that the use of EMR becomes compatible with the workflow. This is analogous to biological adaptation that is accelerated by environmental pressure.

Third, to which extent is the practice, here the behavioral adaptation of EMR, related to the benefits. This concerns 2 hypotheses:

Hypothesis 1, behavioral adaptation of EMR (BHA) positively affects perceived personal benefits (PPB), is confirmed. Adaptation of tasks and features of an EMR is an investment of time and energy and this study confirms that medical staff perceives a return on this investment for his competences, efficiency and career.

Hypothesis 2, Adaptation behavior of increasing the task-technology fit of the Electronic Medical Record system (BHA) will positively influence the clinical decision-making effectiveness (DME), has

not been confirmed. The literature that related this effect concerned the very specific condition where physicians use mobile applications that support collection and analytics of real-time critical care data and provide easy access to clinical decision support systems (Vankipuram et al., 2017). Considering the characteristics of the respondents, this working context was certainly not the context of the respondents.

Fourth, is there a mediated effect of the independent variables personal innovativeness and computer self-efficacy on the dependent variables? No, there is significant effect of personal innovativeness on behavioral adaptation of EMR and a significant effect of behavioral adaptation on perceived personal benefits but there is no mediated effect of personal innovativeness on perceived personal benefits.

Fifth, do we observe a direct relation between the independent variables, considered as assets and the benefits, which should indicate that there are unidentified practices or behaviors that mediate this relation?

The construct of Facilitating conditions is significatively related to decision-making effectiveness and also to perceived personal benefits. As a hypothesis for further literature and field research, the practice of active use of guidelines could play.

Sixth, are there control variables related to the benefits?

The survey revealed a significative but **negative relation between qualification** and the perception that the use of EMR leads to improved **decision-making effectiveness**. Indicator DME2, which refers to the advantage of EMR to make decisions on the basis of real time data has an outer loading of 0.956. Less qualified staff do not take medical decisions, but real time data may finetune the attitude they have towards a patient, or said inversely, the absence of data lets them in the dark on how to address a patient. A study on home care of rheumatologic patients (Van der Vaart, R., Drossaert, C.H., Taal, E., van de Laar, M., 2013) reports the following advantages of home care with access to the EMR (1) enhancement of patient participation in treatment, (2) increased knowledge and self-management, (3) improved patient–provider interaction, (4) increased patient safety, and (5) better communication with others.

The relation between **qualification and perceived personal benefits** is not significant but explains part of the variance of PPB as the R^2 value increases If the model takes into account this control variable (Table 22). It is also a negative relation, meaning that less qualified staff perceives more benefits. In other words, for less qualified staff, dispose of the information of the EMR makes them more reassured in their information share with patients and in their care decisions, the EMR allows them to update the EMR for certain parameters, EMR allows sharing trustworthy information with their patients and hence improve treatment adherence.

And seventh, do benefits reinforce one another?

Improved decision-making effectiveness through EMR use, affects positively the perception that the use of EMR results in personal benefits. What does this mean, taking into account that the sample is composed for 83% of non-medical staff? It means that if I perceive that I can offer more adapted care with the help of an EMR system, I also perceive that the EMR system makes me more credible and hence promotes me professionally. Research on the possible benefits of caregiving is important not only in its own right, but also because the ability to derive satisfaction, pleasure, or a sense of accomplishment (i.e., benefits/ gains) from the caregiving role may reduce feelings of burden and mitigate deterioration in caregiver mental and physical health (Koerner, S.S., Baete Kenyon, D., Shirai, Y. 2009)

5.2. Conclusions

Although some relations of the research model are significant, the research question has not been confirmed. There was no evidence of the mediating effect of behavioral adaptation between the independent and dependent latent variables. However this may be related to the charactheristics of the respondents. The array of respondents and the institutions they work in are very heterogenous which is due to the limited contact opportunities during the COVID-19 crisis. Health workers with different qualification working in different professional environments have different interpretations of behavioral adaptation and decision-making effectiveness.

However, when the analysis takes into account all alternative relations in the path model, it appears that the construct Perceived Personal Benefits (PPB) is a dependent variable for which 27.8% of the variance is explained by the other constructs of this model. There is a significant effect ($p<0.05$) with a small effect size ($f^2>0.02$) on PPB of 1) Behavioral adaptation, 2) Decision making effectiveness, 3) Facilitating conditions. As for the dependent variable Decision-making effectiveness (DME), 14.2 % of the variance is explained by the constructs of the model.

The observation of significant direct effects of the independent variable, facilitating conditions on decision making effectiveness and on perceived personal benefits let suppose that there is a mediator not included in the model, expressing a practice, that needs to be identified.

Even if the research question is not confirmed, this study reveals a number of recommendations for practice and further research. The added value of this research for the existing literature is mainly the effect of the selected control variables.

5.3. Recommendations for practice

The literature study provided examples where handheld devices can be used for bedside consultation (Caligtan et al. 2012). To be useful for immediate clinical decision, the software should be able to provide the dashboard of a patient in a few clicks, the dashboard should be adapted to the parameters required in a particular department and the doctor should be able to consult easily this dashboard before or during the visit. This means that the competence to configurate dashboards and to train doctors to use them should be available in the hospital. For home visiting health staff and staff in institutions for elderly or handicapped people, a simple dashboard on a mobile device would allow nursing or caring staff to convey adapted advice for diet, mobility or social activity and the encoding of parameters may orient a visiting doctor much more than a short consultation visit. So, hospitals and nursing organizations that negotiate an EMR package should insist on features that allow local configuration of dashboards and encoding templates. This would encourage the users to propose improvements and to get these improvements at short notice. This would allow to make the technology fit for the tasks at hand.

The Covid-19 crisis obliged general practitioners to consult patients with possible COVID-19 symptoms through phone calls. The EMR proved to be an essential tool to estimate whether the patient at the phone is at risk. The consultation of the EMR of a chronic patient as a task before the visit or the active checking whether the patient has to be called, are likewise adaptations of the workflow to the technology. The financing system should endorse these new workflows. In Belgium, during the COVID-19 lockdown, it took only some days to make a phone consultation acceptable for third party payment.

This research also learnt that decision-making effectiveness is still a vague construct. The measurement of the construct can be improved, and this is a precondition for the identification of the

correlated antecedents. It should be clear whether it involves a clinical or a nursing decision and the data collection should target a specific department.

The introduction of an EMR system for different kind of practitioners must take into account personal benefits. This is often sensible in a social sector, but nevertheless personal benefits are key for commitment and the discussion should not be avoided. This survey took the precaution to put the perception of personal benefits questions at the end of questionnaire and the questions focus on career development and not gains.

5.4. Recommendations for further research

This study was conducted during the COVID 19 crisis and the research team recruited respondents in a large array of qualification and services. This is an obvious weakness of the study for statistical purposes, but it is also a rich source of questioning for further research.

The study recruited three categories of respondents. First, for medical staff, there are several inhibiting factors to use EMR: the required investment, the encoding work and the lack of adaptation of the EMR outputs to their needs for clinical decision. At the level of the individual user there is little space for technological adaptation of the tool. Some committed users may be able to express their dashboarding needs and if they acquire these dashboards, they can use them to adapt their practices and improve their clinical decisions. Qualitative research is needed in order to understand what are the needs for technological adaptation. This should identify the expected improvements in terms of devices, personal configuration, navigation, workflows, dashboards, help functions and knowledge resources that allow them to take a maximum of professional benefit of the EMR for the decision making process.

The second group of users is nursing staff. For nurses, the EMR has become an essential tool to check prescriptions, to encode delivered treatment and to encode clinical parameters. Nurses don't take decisions, but they can identify alerts. Further qualitative research is needed in order to understand which features of the EMR and which practices of the nursing staff lead to an optimization of the alert identification and reporting.

The third group of respondents have no bachelor qualification and are often involved in home-based care or care for handicapped or elder people. The study revealed that this staff is also an experienced user of EMR. For home care, the access to clinical information on the patient is obviously an asset for appropriate communication with this patient. At the same time, the encoding of clinical or psychological parameters during home care is an asset for clinical decision making. Upcoming quantitative research that showcases the impact of mobile devices for EMR access during home care, on patient collaboration may lead to strategic decisions in home care organizations.

With regard to the structural equation modelling, this research, which looked at the antecedents of a benefit, provided some lessons lok

earnt. In order to facilitate management decisions and at the same time parsimonious models (Hair et al., p199) a management research could use 2 or 3 simple path models with the same and single benefit but with a variation of mediators, representing the practice/behavior that concurs to the benefit, or a variation of independent variables that impact this practice/behavior.

With regard to the control variables, it may be useful (i) to relate the practices/behaviors that have a mediator role in the path model to control variables that characterize the social, physical, professional environment of the respondent as this environment may exert a pressure to adapt or may exert a social control, (ii) relate the independent latent variables to demographic or sociological control variables, (iii) relate the dependent latent variable to a control variable that is supposed to influence the perception of the benefit.

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Appendices

Appendix A. Literature review

Table 23. Key literature for the construct of behavioral adaptation of EMR

Key words	**# articles**	**Most relevant articles**
Theory of planned behavior (TPB) – decomposed planned behavior (DTPB) + EMR	5	Ajzen, 1991 Bhattacherjee, 2012 Lai, 2017 Thompson, Compeau, Higgins, & Lupton, 2008 Cocosila & Archer, 2016
Technology acceptance model 3 (TAM) + medical/ health/ healthcare/ hospital	9	Venkatesh & Bala 2008 Holden & Karsh, 2010 Lai, 2017 Kim, Lee, Hwang & Yoo, 2016 Cocosila & Archer 2016 Aggelidis & Chatzoglou 2009 Abdekhoda, Ahmadi, Gohari & Noruzi, 2015 Gagnon, Ghandoura, Kengne, Simonyana et al, 2014
Unified Theory of Acceptance and Use of Technology (UTAUT)	3	Venkatesh, Morris, Davis, & Davis, 2003 Maruping, Bala, Venkatesh & Brown, 2017 Bhattacherjee, Davis, Connolly & Hikmet, 2018
Coping theory + health care IT Coping model of user adaptation (CMUA) User adaptation	4	Bala & Venkatesh, 2016 Bhattacherjee, Davis, Connolly & Hikmet 2018 Beaudry & Pinsonneault, 2005 Wu, Choi, Guo & Chang, 2017
Theory of human agency Social Cognitive Theory + computer	3	Bendura, 2002 Boudreau & Robey, 2005 Compeau, Higgins & Huff, 1999
Task-technology Fit (TFT)	2	Goodhue & Thompson, 1995 Zigurs & Khazanchi, 2008
Technology adaptation behavior	2	Beaudry & Pinsonneault 2005 Bala & Venkatesh, 2016
Adaptive structuration theory +EHR Adaptive system use (ASU) IS use-related activity	4	Schmitz, Teng, & Webb, 2016 Barrett, 2018 Sun, 2012 Barki, Titah & Boffo, 2007
Diffusion of innovation theory	2	Rogers, 2003 Jackson, Yi & Park, 2013

Table 24. Key literature for the constructs related to behavioral adaptation of EMR

Key words	**# articles**	**Most relevant articles**
Electronic health/medical record + decision	5	Ben-Assuli, Shabtai & Leshno 2013
Mobile/handheld information technology + EMR/EHR	4	Caligtan, Carroll, Hurley, Gersh-Zaremskic, Dykes, 2012
Clinical workflow + electronic health (medical) records	4	Aanestad & Jensen, 2016 Bowens, Frye, & Jones, 2010
Personal innovativeness + EMR	3	Agarwal & Prasad, 1998 Jackson, Yi & Park, 2013 Lu, Yaob & Sheng, 2005 Cocosila & Archer, 2016
Personal benefits	2	Staples, Wong & Seddon, 2002
Facilitating conditions +EMR	2	Venkatesh, Brown, Maruping & Bala, 2008 Cocosila & Archer, 2016

Table 25. Key literature for research methodology

Key words	**# articles**	**Most relevant articles/books**
Research social science		Bhattacherjee, 2012 Saunders, Lewis & Thornhill, 2017
Structural Equation model		Hair, Tomas, Hult, Ringle & Sarstedt, 2016 Cheung & Lau, 2008 Wong, 2019

Appendix B. Methodological information

Table 26. Measures for the constructs of the structural equation model

construct	type	code	Measure	reference
Behavioral adaptation of EMR	reflective	BHA1	Spending efforts (in time and energy) to change functions of the EMR system to fit the work	Wu, Choi, Guo, & Chang, 2017 p. 809) Barki, Titah, & Boffo, 2007, p189
		BHA2	Spending efforts (in time and energy) to change tasks so that they better fit the EMR system	
		BHA4	Spending efforts (in time and energy) so that the EMR and tasks fit each other	
		BHA4	Spending efforts in recommending changes to the EMR system	
		BHA5	Use the EMR in another way than when I started to work with it	
Personal benefits	reflective	PPB1	Knowledge gained using this system will be helpful to me with other systems in the future.	Barki, Titah, & Boffo, 2007, p189 Staples, Wong & Seddon, 2002, p128
		PPB2	Using this system allows me to be more efficient at my job	
		PPB3	Knowing how to use this system makes me more marketable	
Decision-making effectiveness -	reflective	DME1	Responding quickly to change	Cao, Duanb & Cadden, 2019, p 125
		DME2	Making real-time decisions	
		DME3	Understanding patients	
Computer self-efficacy	reflective		Can complete any particular task using the software	Compeau & Higgins, 1995 p 211
		CSE1	if there was no one around to tell me what to do as I go	
		CSE2	if I had never used a package like it before	
		CSE3	if I had only the software manuals for reference	
		CSE4	if I had seen someone else using it before trying it myself	
		CSE5	if I could call someone for help if I got stuck	
		CSE6	if someone else had helped me get started	
		CSE7	If I had a lot of time to complete the job for which the software was provided	
		CSE8	if I had just the built-in help facility for assistance	
		CSE9	if someone showed me how to do it first	
		CSE10	if I had used similar packages before this one to do the same job	
Personal innovativeness	reflective	PI1	If I heard about a new information technology, I would look for ways to experiment with it.	Agarwal & Karahanna, 2000, p210
		PI2	In general, I am hesitant to try out new information technology. (Reverse item)	
		PI3	Among my peers, I am usually the first to try out new information technologies	
		PI4	I like to experiment with new information technologies.	
Facilitating conditions	reflective	FCO1	Guidance was available to me for the use of the EMR system	Venkatesh, Morris, Davis, & Davis, 2003, p454
		FCO2	Specialized instruction concerning the EMR system was available to me	
		FCO3	A specific person (or group) is available for assistance with EMR difficulties	

Table 27. Checks related to the reflective measurement models

Rationale	**Test**	**Interpretation**
Check Internal consistency reliability, i.e. the correlations between the observed indicator variables	Cronbach's alpha	Conservative measure
	Composite reliability	0.60-0.90 is acceptable
Check indicator reliability, i.e. demonstrate that the associated indicators of a construct have much in common	Outer loadings	> 0.7 is acceptable If 0.4-0.7, delete if deletion implies increase CR and AVE>0.5 If < 0.4, delete indicator if deletion does not affect content validity
Check convergent validity, i.e. demonstrate that a measure correlates positively with alternative measures of the same construct	Average variance extracted (AVE) = grand mean value of the squared loadings of the indicators of a construct	> 0.5 is acceptable
Check discriminant validity i.e. the extent to which a construct is distinct from other constructs	Difference between each outer loading and each cross loading (correlation with other constructs)	Outer loading > all cross loadings with other constructs is acceptable
	Formell-Lacker criterion: Difference between SQR AVE and cross loading	SQR AVE must > each cross loading

Table 28. Checks related to the formative measurement models

Rationale	**test**	**Interpretation**
Assess the convergent validity, i.e. the extent to which a formative measure correlates with a reflective measure of the same construct.	Redundancy analysis: measure the strength of the path coefficient between $Y^{formative}$ and $Y^{reflective}$ (e.g. having a single item value)	Correlation > 0.70 is acceptable
Assess for collinearity issues between indicators as high correlation indicates a redundancy and may reverse the signs of the indicator less correlated with the construct	Toleration = the amount of variance of a formative indicator not explained by other indicators in the same block. $TOL_{xs} = 1-R^2_{x1}$ The variance inflation factor (VIF) = $1/TOL_{xs}$ $\sqrt{}$VIF = multiplication factor of standard deviation	If Toleration <0.2 or VIF > 5, a collinearity issue exists as the SD is multiplied by at least 2 Removal of that indicator or combining collinear indicators should be considered. Outer weights cannot be interpreted if not solved
Assess the significance and relevance of the indicators in order to estimate to which extent an indicator contributes to the content of a construct	Multiple regression between the indicator values and the latent variable scores Weight = relative importance of the indicator in the construct	Maximum outer weight = $\sqrt{n}$ where n is the number of indicators Low weight = weight is not significantly different from 0

Rationale	test	Interpretation
	Outer loading = bivariate correlation of each indicator and the latent variable score	If low weight but loading >0.5 retain indicator. If loading <0.5, and not significant consider theoretical impact of removing the indicator

Table 29. Checks related to the structural model

Rationale	test	Interpretation values
Assess the collinearity of constructs in order to decide to eliminate or merge them	Predictor construct's tolerance	<0.20 is acceptable
Assess significance and relevance of the relationships of the structural model through bootstrapping (5000 bootstrap samples)	Size path coefficients (hypothesized relationships) allow relative interpretation of relationships	strong relationship ≈ -1 (negative) or ≈ +1 (positive)
	Total effect = direct effect + product of mediating effects	?
	Significance path coefficients = bootstrap confidence interval	Significance level 5% ($p < 0.05$) or 1% ($p < 0.01$)
Assess the level of predictive power (explained variance of endogenous latent variables)	Coefficient of determination (R^2 value) = squared correlation of actual and predicted values. The number of exogenous constructs increases R^2	> 0.75 substantial > 0.5 moderate > 0.25 weak
Assess the effect of omitting an exogenous construct from the model	f^2 effect size= ratio between the difference of R^2 included and excluded and 1-R^2	0.02 = small effect 0.15 =medium effect 0.35 =large effect
Assess how well the model can predict the originally observed values	Predictive relevance (Q^2) through a blindfolding procedure. Omission distance D should be 5 to 10 but D/number observations <> integer	Q^2 > 0 for reflective endogenous construct means good predictive relevance of model Q^2<0 = low predictive relevance
Assess the relative impact on Q^2 of excluding a reflective endogenous construct	q^2 effect size = ratio between the difference of Q^2 included and excluded and 1-Q^2 for same omission distance D	0.02 = small effect 0.15 =medium effect 0.35 =large effect

Table 30. Checks related to the mediation effect

Rationale	test	Interpretation values
Check the type of mediation (full, partial competitive, partial complementary) or identify the non-mediation Check whether the mediator construct acts as a suppressor variable	Significance of indirect effect in path model (p_1 x p_2)	If indirect effect not significant: non-mediation but eventually there is a direct effect
	Significance of direct effect in path model, p_3	If significant indirect effect but no direct effect: full mediation If significant indirect effect and direct effect: partial mediation

Rationale	test	Interpretation values
	Sense of direct effect x indirect effects (p_1 x p_2 x p_3)	If sense positive: complementary partial mediation If negative: concurrent partial mediation > mediator is a suppressive variable > analyze the theoretical basis of the effects
Check the convergent validity of the indicators of the mediating construct	See table x	
Check for collinearity issues between mediator and related constructs	See table x + 2	

Table 31. Checks related to the moderating effects

Rationale	test	Interpretation values
Create the interaction term of a two-way interaction i.e. the combined construct CSE-FCO:	Orthogonalizing approach for creating the interaction term: First calculate product indicator = multiplication of each indicator of the exogenous latent variable with each indicator of the moderator. Then calculate the residual e in the equation "product indicator = sum of correlations of each indicator + e" and use e as indicator for the interaction term	Yields high prediction accuracy (minimizes estimation bias) and does not have an effect on the path coefficient of CSE-BHE
Estimate the effect of increasing or decreasing the moderator FCO variable on the direct relation CSE-BHE (two-way interaction)	Compare the p_1 in the relation CSE-BHE with the p_3 of the interaction term CSE x FCO Calculate the f^2 formula. (Hair et al., 2017, p 256)	If effect of the interaction term CSE x FCO on BEH is significant, we conclude that FCO has a significant moderating effect on the relation CSE-BEH If $f^2 > 0.005$ = small effect If $f^2 > 0.01$ = medium effect If $f^2 > 0.025$ = large effect
Check whether the mediation is moderated i.e. moderator variable (FCO) interacts with the mediator variable (BEH) such that the value of the indirect effect changes depending on the value of the moderator variable	Index of moderated mediation w = product of path coefficient of the mediation relations (CSE -> BEH-> PIN) + path coefficient of the relation interaction term CSE X FCO and BHA	If w is significant there is a moderated mediation

Appendix C. Questionnaire

Vragenlijst Onderzoek Elektronisch Patiënten Dossier (EPD)

Graag nodigen wij u uit deel te nemen aan het onderzoek naar het gebruik van het Elektronisch Patiënten Dossier (EPD-systeem) onder zorgprofessionals in ziekenhuizen en zorginstellingen.

Met dit onderzoek trachten wij een bijdrage te kunnen leveren aan de wetenschappelijke kennis over de relevante factoren die een rol spelen bij het effectief gebruik van het elektronisch patiëntendossier (EPD). In dit onderzoek wordt gebruik gemaakt van een vragenlijst die zich primair richt op artsen, verpleegkundigen of doktersassistenten in ziekenhuizen en andere zorginstellingen.

Het invullen van de vragenlijst is geheel vrijblijvend, en zal ongeveer 15 minuten in beslag nemen. Merk op dat om de vragenlijst te kunnen sturen, alle vragen moeten ingevuld zijn.

Voor dit onderzoek maken we gebruik van een beveiligde omgeving en de antwoorden op de vragen van de vragenlijst worden enkel en alleen gebruikt voor wetenschappelijk onderzoek en de afstudeerprojecten van zes Master studenten van de studie Business Process Management & IT van de Open Universiteit. Alle informatie zal met uiterste zorgvuldigheid en volledig anoniem worden behandeld.

Door de link https://limesurvey.ou.nl/index.php/676418?newtest=Ylang=nl te delen met collega's artsen en verpleegkundigen die met een elektronisch patiëntendossier werken draagt u in grote mate bij tot de wetenschappelijke waarde van dit onderzoek.

Wij danken u voor uw tijd en stellen uw bijdrage aan het onderzoek enorm op prijs. De resultaten van dit onderzoek zijn na afloop van het afstudeertraject opvraagbaar bij de onderzoekers:

Contactpersoon in België:	Dr. Bart Callewaert	(bartcallewaert@yahoo.fr)
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	William Tuk	(william_t86@hotmail.com)

Mochten er verder nog vragen zijn over de achtergrond van dit project, dan kunt u een e-mail sturen naar Associate Professor Rogier van de Wetering, de projectleider van dit onderzoek, via: rogier.vandewetering@ou.nl

Sectie A: Algemene vragen

1. **(GQ1)** Wat komt overeen met uw huidige kwalificatie	○ Gespecialiseerd arts (1) ○ Arts in opleiding specialisatie (2) ○ Huisarts/omnipracticus (3) ○ Arts in opleiding (4) ○ Verpleegkundige (5) ○ Doktersassistent(e) (NL) (6) ○ Long functie Analist/e (7) ○ Consultatiebureau assistent/e (8) ○ Anders (– nader te bepalen) ○ Verzorgende/ IG /3 (9) ○ Begeleider (10) ○ Verloskunde (11) ○ Verpleegkundige specialist (12) ○ Eerst Verantwoordelijke Verzorgende (EVV'er) (13) ○ Diëtist (14) ○ Therapeut (15) ○ Beheerder Patiëntendossier (16) ○ Manager (17) ○ Verpleegkundige in opleiding (18) ○ Helpende (19) ○ Paramedicus (20) ○ Woonassistente (21) ○ Anesthesiemdewerker (22) ○ Operatie assistent (23)
2. **(GQ2)** Wat is uw hoogst genoten opleidingsniveau?	○ Doctoraat (1) ○ Master (2) ○ Bachelor (3) ○ MBO /Opleiding A verpleegkundige(4) ○ Middelbare school (5) ○ Anders (6-na te bepalen) ○ Post HBO/ Cursussen (Universiteit) (6) ○ HBO (7)
3. **(GQ3)** In wat voor instelling werkt u met een EPD? *(Indien u in meerdere ziekenhuizen werkt, geef dan één keuze op, namelijk die waar u het meest met het EPD werkt.)*	○ Algemeen ziekenhuis (1) ○ Universitair Medisch Centrum (NL) (2) ○ Universitaire Ziekenhuis (BE) (3) ○ Specialistisch/ Top Klinisch ziekenhuis (4) ○ Militair ziekenhuis(5) ○ Verpleeg- verzorgings-behandel centrum(6) ○ Revalidatiecentrum(7) ○ GGD (NL)(8) ○ Huisartspraktijk(9) ○ Gehandicaptenzorg (10) ○ Thuiszorg/ kinderthuiszorg (11) ○ Ambulancezorg (12) ○ ZBC (Zelfstandig Behandel Centrum) (13) ○ Eigen praktijk (14) ○ GGZ (Geestelijk Gezondheidszorg) (15) ○ Wijkverpleging (16)

4. **(GQ4)** Land van dit ziekenhuis	○ België (1) ○ Nederland (2) ○ Anders (3)
5. **(GQ5)** Op welke afdeling werkt u voornamelijk ? *(Geef de naam van de afdeling.)*	○ Algemene geneeskunde (1) ○ Algemene Inwendige Geneeskunde (2) ○ Anesthesiologie (3) ○ Apotheek (4) ○ Cardiologie (5) ○ Cardiothoracale Chirurgie (6) ○ Chirurgie (7) ○ Dermatologie (8) ○ Endocrinologie (9) ○ Geriatrie (10) ○ Infectieziekten (11) ○ Intensive Care Volwassenen (12) ○ Keel-, neus- en oorziekten (13) ○ Kindergeneeskunde (14) ○ Neonatologie (15) ○ Kl. Immunologie & Reumatologie (16) ○ Klinische Hematologie (17) ○ Klinische Oncologie (18) ○ Longziekten (19) ○ Maag-, darm en leverziekten (20) ○ Mondziekten-kaakchirurgie/Ziekenhuistandheelkunde (21) ○ Neurochirurgie (22) ○ Neurologie (23) ○ Nierziekten (24) ○ Oogheelkunde (25) ○ Orthopedie (26) ○ Plastische en Reconstructieve chirurgie (27) ○ Psychiatrie (28) ○ Revalidatie (29) ○ Spoedeisende hulp (30) ○ Urologie (31) ○ Vasculaire geneeskunde (32) ○ Verloskunde/Gynaecologie (33) ○ Anders, namelijk: ○ Consultatiebureau GGD (34) ○ Radiotherapie (35) ○ Dialyse (36) ○ Dagbesteding (37) ○ Dagbehandeling (38) ○ Gehandicaptenzorg (40) ○ Thuiszorg/Thuiszorgorganisatie) (41) ○ Forensische geneeskunde (42) ○ Centrum seksueel geweld (43) ○ Ambulancezorg (44) ○ Woonzorgcentrum (45) ○ Endoscopie (46)

	○ Alternatieve geneeskunde (47) ○ Diabeteszorg (48) ○ Jeugdgezondheidszorg (49) ○ Verpleeghuis (50) ○ Anders (leeg) (51) ○ Neurochirugie (52) ○ Pijncentrum (53) ○ Geriatrie (54)
6. **(GQ6)** Wat is uw functie op die afdeling?	- Arts Afdelings, kliniek of diensthoofd (1) - Verpleger diensthoofd, zorgcoordinator (2) - Arts solo or groeps huisartspraktijk (3) - Andere behandelende artsen (4) - Artsen analyse (radio medische analyse) (5) - Andere verzorgende verpleegkundige (6) -)Verzorger – assistent- stagiair (7) - Paramedisch (dietist etc) (8)
7. **(GQ7)** Werkt u daarnaast ook op een spoedopname ?	○ Ja (1) ○ Neen (2)
8. **(GQ8)** Hoe vaak voert u gegevens in het EPD in of consulteert u het EPD ?	○ Elke werkdag (1) ○ Meerdere keren per week (2) ○ 1x per week (3) ○ Minder dan 1x per week (4) ○ Nooit (5)
9. **(GQ9)** Hoe lang werkt u met het EPD?	○ Minder dan 1 jaar (1) ○ Tussen 1 jaar en 5 jaar (2) ○ Tussen 5 en 10 jaar (3) ○ Langer dan 10 jaar (4)
10.**(GQ10)** Wat is uw leeftijd?	○ 18-25 (1) ○ 26-35 (2) ○ 36-45 (3) ○ 46-55 (4) ○ 56-65 (5) ○ 65+ (6)
11.**GQ(11)** Wat is uw geslacht?	○ Man (1) ○ Vrouw (2)

Sectie B:

In hoeverre bent u het eens met de volgende stellingen over het gebruik van het EPD?

	Code vraag	(1) Volkomen mee	(2) Oneens	(3) Enigszins oneens	(4) Niet oneens/ niet	(5) Enigszins eens	(6) Eens	(7) Volkomen mee eens
Process complexity (PC) **Process complexity** verwijst naar de moeilijkheid, onzekerheid en onderlinge afhankelijkheid van de taken van een proces.								
In hoeverre bent u het eens met de volgende stellingen?								
De zorgverleningsprocessen op onze afdeling beslaan vaak meerdere functionele gebieden: ze zijn vaak multidisciplinair	PC1	0	0	0	0	0	0	0
We hebben vaak te maken met ad hoc, niet routinematige zorgverleningsprocessen	PC2	0	0	0	0	0	0	0
Over het algemeen hebben we een hoge mate van onzekerheid in onze zorgverleningsprocessen	PC3	0	0	0	0	0	0	0
Het merendeel van onze zorgverleningsprocessen zijn vrij complex	PC4	0	0	0	0	0	0	0
Information intensity (PII) **Information intensity** verwijst naar de hoeveelheid informatieverwerking die nodig is om de activiteiten van het zorgproces effectief te beheren**.**								
In hoeverre bent u het eens let de volgende stellingen ?								
Onze zorgverleningsprocessen vereisen een grote hoeveelheid informatieverwerking	PII1	0	0	0	0	0	0	0
Er zijn veel stappen in onze zorgverleningsprocessen die frequent gebruik maken van informatie	PII2	0	0	0	0	0	0	0
De informatie die wordt gebruikt in onze zorgverleningsprocessen moet regelmatig worden bijgewerkt	PII3	0	0	0	0	0	0	0
Informatie vormt een wezenlijk onderdeel van onze dienstverlening aan patiënten	PII4	0	0	0	0	0	0	0
Personal innovativeness (PI) **Personnel innovativeness** wordt gedefinieerd als een individuele eigenschap die de bereidheid weerspiegelt om een nieuwe technologie uit te proberen								
In hoeverre bent u het eens met de volgende stellingen?								
Als ik hoor over een nieuwe informatie technologie zoek ik naar manieren om mijn taken ermee proberen uit te voeren	PI1	0	0	0	0	0	0	0
Over het algemeen aarzel ik om nieuwe informatietechnologie uit te proberen	PI2	0	0	0	0	0	0	0
Onder mijn collega's ben ik meestal de eerste die de nieuwe informatietechnologieën uitprobeert	PI3	0	0	0	0	0	0	0

	Code vraag	(1) Volkomen mee	(2) Oneens	(3) Enigszins oneens	(4) Niet oneens/ niet	(5) Enigszins eens	(6) Eens	(7) Volkomen mee eens
Ik experimenteer graag met nieuwe informatietechnologieën	PI4	0	0	0	0	0	0	0
Computer self-efficacy (CSE) **Computer self-efficacy** kan worden beschouwd als de overtuiging dat men in staat is om een bepaald gedrag te vertonen. Het gaat niet om de vaardigheden die men heeft, maar om het zelfoordeel over wat men kan doen met de vaardigheden die men bezit								
In de onderstaande vragen wordt u gevraagd aan te geven welke omstandigheden u toelaten om een EPD-systeem correct te gebruiken**.** **Ik zou mijn taak in een EPD met voldoende zelfvertrouwen kunnen voltooien…..**								
…ook als er niemand in de buurt was om mij te laten zien hoe ik het moest doen	CSE1	0	0	0	0	0	0	0
… ook als ik nooit eerder een soortgelijk softwarepakket had gebruikt	CSE2	0	0	0	0	0	0	0
… als ik ten minste de softwarehandleidingen ter referentie had	CSE3	0	0	0	0	0	0	0
… als ik met iemand anders had kunnen meekijken voordat ik het zelf probeerde	CSE4	0	0	0	0	0	0	0
… als ik iemand om hulp kon vragen als ik vast kwam te zitten	CSE5	0	0	0	0	0	0	0
… als iemand anders me had geholpen om te beginnen	CSE6	0	0	0	0	0	0	0
… als ik veel tijd had om mijn taak met het EPD te voltooien	CSE7	0	0	0	0	0	0	0
… als ik ten minste de ingebouwde hulpfunctie had voor assistentie	CSE8	0	0	0	0	0	0	0
… als er iemand in de buurt was om mij te laten zien hoe ik het moest doen	CSE9	0	0	0	0	0	0	0
… als ik eerder vergelijkbare pakketten had gebruikt voor hetzelfde werk	CSE10	0	0	0	0	0	0	0
Facilitating conditions (FC) **Facilitating conditions** is de mate waarin een persoon van mening is dat er een organisatorische en technische infrastructuur bestaat om zijn of haar gebruik van een systeem, in dit geval de EPD te ondersteunen. Het wordt gebruikt om de externe ondersteuning te vertegenwoordigen die men kan krijgen van de werkomgeving								
In hoeverre bent u het eens met de volgende stellingen?								
Begeleiding (bijv. via online instructies, introductiecursus, etc.) was voor mij beschikbaar voor het gebruik van het EPD systeem	FCO1	0	0	0	0	0	0	0
Gespecialiseerde instructies met betrekking tot het EPD systeem waren voor mij beschikbaar	FCO2	0	0	0	0	0	0	0
Er is een specifieke persoon (of groep) beschikbaar voor hulp bij EPD-problemen	FCO3	0	0	0	0	0	0	0

	Code vraag	(1) Volkomen mee	(2) Oneens	(3) Enigszins oneens	(4) Niet oneens/ niet	(5) Enigszins eens	(6) Eens	(7) Volkomen mee eens
Er is een instructienota bij uitbreiding of aanpassing van het systeem	FCO4	0	0	0	0	0	0	0
Behavioral EMR adaptation (BHA) **Behavioral EMR adaptation** (EPD-gedragsaanpassingen) betreft de mate waarin gebruikers de functies van het EPD-systeem en taakprocedures aanpassen aan persoonlijke voorkeuren.								
In hoeverre bent u het eens met de volgende stellingen? Ik heb inspanningen (in tijd en energie) verricht:								
… voor het veranderen van functies van het EPD zodat deze afgestemd zijn op mijn werkzaamheden	BHA1	0	0	0	0	0	0	0
… om mijn taken te wijzigen zodat die beter bij het EPD-systeem passen	BHA2	0	0	0	0	0	0	0
… zodat het EPD en mijn taken in harmonie met elkaar zijn	BHA3	0	0	0	0	0	0	0
… om wijzigingen in het EPD-systeem voor te stellen of door de configuratie te wijzigen	BHA4	0	0	0	0	0	0	0
… en ik gebruik het EPD nu op een andere manier dan toen ik net ermee begon te werken	BHA5	0	0	0	0	0	0	0
Data Diagnosticity (DD) **Data diagnosticity** verwijst naar het ophalen van diepgaande en geavanceerde informatie uit gegevens om geldige en betrouwbare interpretaties en beoordelingen te maken.								
In hoeverre bent u het eens met de volgende stellingen? **De conclusies/eindresultaten waar ik bij het verwerken van informatie uitkom, zijn vaak**								
… geavanceerd, complex	DD1	0	0	0	0	0	0	0
… belangrijk, d.w.z. van algemeen belang	DD2	0	0	0	0	0	0	0
… creatief, nieuw	DD3	0	0	0	0	0	0	0
… relevant, nuttig	DD4	0	0	0	0	0	0	0
Decision-making effectiveness (DME) Het aanpassen van de functies van het EPD-systeem en taakprocedures aan persoonlijke voorkeuren kan eventueel de effectiviteit van de besluitvorming verbeteren**.**								
In hoeverre bent u het eens met de volgende stellingen? **Door het gebruik van het EPD, ben ik meer bekwaam dan mijn collega's in:**								
… snel reageren op verandering in de status van een patiënt op basis van de gegevens van het EPD	DME1	0	0	0	0	0	0	0
… het nemen van juiste beslissingen op basis van de real time gegevens van het EPD	DME2	0	0	0	0	0	0	0
… om patiënten beter te betrekken in hun behandeling	DME3	0	0	0	0	0	0	0
Perceived organizational benefits (POB)								

	Code vraag	(1) Volkomen mee	(2) Oneens	(3) Enigszins oneens	(4) Niet oneens/ niet	(5) Enigszins eens	(6) Eens	(7) Volkomen mee eens
Perceived organizational benefits zijn de voordelen voor uw instelling die u mogelijk acht door het aanpassen van de functies van het EPD-systeem en taakprocedures aan persoonlijke voorkeuren**.**								
In hoeverre bent u het eens met de volgende stellingen?								
Over het algemeen biedt het EPD systeem voordelen voor mijn organisatie	**POB1**	0	0	0	0	0	0	0
Het EPD verbeterde het functioneren / de processen van mijn organisatie	**POB2**	0	0	0	0	0	0	0
Het EPD verbeterde de prestaties van mijn organisatie	**POB3**	0	0	0	0	0	0	0
Perceived personal benefits (PPB) **Perceived personal benefits (persoonlijke voordelen)** die u mogelijk acht door het aanpassen van de functies van het EPD-systeem en taakprocedures aan persoonlijke voorkeuren.								
In hoeverre bent u het eens met de volgende stellingen ? Door het EPD te (kunnen) gebruiken:								
… heb ik kennis opgedaan die nuttig voor mij zal zijn bij het gebruik van andere systemen in de toekomst	**PPB1**	0	0	0	0	0	0	0
… kan ik efficiënter werken	**PPB2**	0	0	0	0	0	0	0
… vergroot ik mijn kansen op werkgebied	**PPB3**	0	0	0	0	0	0	0

Hartelijk dank voor uw tijd voor het invullen van deze vragenlijst.

Indien u over de resultaten van dit onderzoek wil worden ingelicht vul dan hieronder uw email adres in

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