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Adoption of Interorganisational ICT in Primary Care

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[2]NIVEL – The Netherlands Institute for Health Services Research, P.O. Box 1568, 3500 BN Utrecht, The Netherlands, r.verheij@nivel.nl Efficient and effective collaboration among health care providers is of great importance.

Interorganisational ICT can enable and facilitate this collaboration, but the adoption of such information systems is still sparsely analysed. In this paper we describe the results of a survey among 49 GP practices in The Netherlands held in 2009 and 2010, which were queried on their adoption of different types of interorganisational ICT, such as the exchange with out-of-hours services and with other primary and secondary care providers. It appears that the adoption of interorganisational ICT is not significantly related to personal or organisational characteristics of the GP practice, nor to characteristics of their patient population. What is related, is the type of GP software package the practice uses.

INTRODUCTION

As is the case in many developed countries, The Netherlands will face a sharp increase in demand for health care services in the coming years, whereas supply is becoming limited at the same time [1], [2], [3]. Efficient and effective collaboration among health care providers is one way of limiting the consequences of these two trends. Collaboration and information sharing in health care services are of great importance [4] and a trend in many countries, especially in The Netherlands [5], [6], [7]. ICT can facilitate this (e.g. [8], [9], [10], [11]), and many initiatives are undertaken in the health care sector [12], [13]. Especially interorganisational ICT (also termed 'chain digitisation' [14]) is relevant in this respect. In a meta-study on exchanging health information of primary care practices, Fontaine et al.
[13] reviewed over 60 studies on this topic, showing that the main benefits are more efficient workflow, improved quality of care, cost savings and increased revenue. Likewise, the OECD indicates that ICT implementation in health care leads to benefits in four, interrelated categories [12]: (1) increased quality of care (and efficiency), (2) reduced costs of clinical services, (3) reduced administrative costs, and (4) enabling entirely new modes of care. The OECD also describes however, that reaping these benefits is not straightforward, as there is a lack of commonly defined and consistently implemented standards and concerns about privacy and confidentiality.
General practitioners (GPs; family doctors) play a central role in the Dutch health care system, being the gatekeeper for health services [5], [15]. As the medical and administrative tasks of GP practices increase in number, variety and complexity, ICT has become more and more important for GPs to execute the required patient care and to comply with the requirements of health care insurers, governments and other stakeholders. The Netherlands is a frontrunner in the use of electronic patient records (EMR) in GP practices in comparison with other European countries [5], [15]. Next to this, other types of ICT are emerging in the GP practice. For example, there are e-mail consultations, internet-based health applications, websites of GP practices, e-mail communications with other health care organisations and laboratories, and so on.

Despite all these developments, the adoption of (new) interorganisational ICT in primary care appears to diffuse slowly and is confronted with many problems [6], [16], [17]. Barriers often mentioned are costs, security and privacy issues, but also liability, political leadership, sceptics, and technical barriers [13]. Adoption barriers and problems are generally assumed to be more prominent in smaller primary care practices [18].

The starting point of this paper is to increase the understanding of interorganisational ICT adoption in primary care, in particular GP practices, building upon existing ICT adoption studies. Within the medical domain, there are not many empirical studies performed so far in primary care [13]. Both Fontaine et al. [13] and Chismar & Wiley-Patton [19] explicitly call for additional research on the effects of physicians' characteristics on information technology adoption "across specialties, disciplines, geographic boundaries, and cultures" [19]. By having more insight into how ICT can contribute to the much-needed benefits in the health care sector, managers and policy makers can be supported in their search for 'buttons and levers' that can improve the successful uptake of ICT and innovations in this sector.

The main research question of this paper is twofold: (1) what is the level of interorganisational ICT adoption of GP practices in The Netherlands, and (2) what are the determinants of this level of adoption? The structure of the remainder of this contribution is as follows. First, through reviewing earlier studies, we classify and define a number of factors that potentially influence the adoption of interorganisational ICT by GPs. Next, we describe how we measure both this adoption and its (potential) determinants, through the survey dataset available. In the results section, we first describe the level of interorganisational ICT adoption among the sample of GPs, and consequently test if the factors are indeed related to the adoption level. To conclude the paper, limitations of this work are discussed and suggestions for future research endeavours are given.

2. THEORY

The existing studies on GPs and their adoption (and use) of interorganisational ICT define different groups of characteristics/determinants. Most studies are based on literature or cases (also see Chiasson et al. [20] for an overview). A number of studies that can be mentioned are:

- Wainwright & Waring [21], who focused on innovation, task, individual, environmental, and organisational factors;
- Topacan et al. [22] studied the influence of user characteristics, service characteristics, ease of use, social factors, usefulness, and facilitating conditions;
- Schaper & Pervan [23] addressed the importance of the technological, individual, and implementation context;
- MacGregor et al. [24] studied whether organisational characteristics could explain the differences between rural and urban practices;
- Evans et al. [25] looked at practice characteristics, in particular the number of diabetes-educated staff;
- Tsiknakis & Kouroubali [26] applied a specific framework to study "socio-organisational-technical factors that influence IT adoption in the healthcare domain", including the 'fit' between task, technology and individual factors;
- In a multi-site case study on the introduction of shared electronic records, Greenhalgh et al. [27] identified explanatory determinants on the micro level ("material properties of the technology, individuals' attitudes and concerns, and interpersonal influence"), the meso level (organisational antecedents, readiness, and operational aspects of implementation), and the macro level (institutional and socio-political forces influence the course of the introduction process).

If we look at the more general literature on ICT adoption and use by organisations, there are many studies as well that address different types of determinants and conditions [8], [21], [28]. In order to overcome the lengthy debate on which determinants are in fact the most important, or which general factors can be 'transferred' or 'translated' to the domain of GP practices and interorganisational ICT, for this research we propose a more general approach. We depart from the framework by Tornatzky and Fleischer [29], which can be considered as a generic and commonly accepted model to, first, classify ICT adoption determinants of organisations. Following this classification, we then define a number of determinants that can be assumed to be of importance for the adoption of interorganisational ICT in GP practices. This approach

enables us to link it with the specific survey dataset available on Dutch GPs – which will be described in the next section.
In the 1990s, Tornatzky and Fleischer developed their generic framework for the adoption and implementation process of technological innovations [29]. They describe three groups of determinants (or: explanatory variables) that influence this process: 1. the technological context, 2. the organisational context, and 3. the environmental context.
This classification of determinants has become commonplace in IS research (e.g. [8], [30], [31], [32], [33]) and is also in concordance with [34], [35] who indicate the importance of an integrated sociotechnical approach for a health informatics initiative to be effective. This threefold classification also matches [36], who developed a theoretical framework representing the main stages of innovation processes, based on several theories and models. In total, they identified 50 determinants of innovations in health care, based on a systematic review of the literature. These were classified in four categories: (1) characteristics of the socio-political context, (2) characteristics of the organisation, (3) characteristics of the adopting person (user), and (4) characteristics of the innovation. These four categories can be well mapped on the three context types of Tornatzky and Fleischer: the technological context being similar to the characteristics of the innovation, the environmental context resembling the characteristics of the socio-political context, and the organisational context matching with both the characteristics of the organisation and the person, as the majority of GP practices are very small (micro) organisations consisting of one or two persons.
In the next section, we describe how the classification of Tornatzky and Fleischer can be applied to variables in a dataset based on a repeated survey among Dutch GP practices in 2009 and 2010.

3. DATA AND MEASUREMENTS

3.1 The LINH Survey

In this study we use data from practices participating in The Netherlands Information Network of General Practices (LINH). This network consists of a representative panel of around 80 GP practices in The Netherlands, evenly distributed across the country. The network and panel have been set up by The Netherlands Institute for Health Services Research (NIVEL) and IQ Healthcare. It is funded by the Ministry of Health, Welfare and Sports (VWS). In 2009, 84 GP practices participated; for other years this number is more or less the same; panel drop-out is kept to a minimum to safeguard the possibility to conduct longitudinal studies at patient level.
LINH started in 1992, recording only referrals of GPs and then gradually developed into a system recording all patient contacts and all interventions within the connected practices, including diagnoses.
Currently the LINH database holds (cumulative) information about more than three million patient years, and longitudinal data on morbidity, prescribing, laboratory measurements, and referrals of about 350,000 individuals. This patient data is the key source of LINH, to develop and maintain a high quality longitudinal database on morbidity and GP care in The Netherlands, and to use this database for health services research and quality of care research. Data are extracted twice a year from the electronic medical records (EMR) used in the practices to file patient information. This extraction is approved by the GP and is executed by a custom-made application. Participating GPs receive feedback reports, comparing their own practice with the LINH average. They also receive a modest financial compensation.
Next to the patient data extractions, all LINH practices are surveyed on a yearly basis. The aim of this survey is to monitor the use of the feedback information provided, registration and EMR issues, whether data exchanges with other health care providers occur and digital linkages with pharmacists exist, and other items that are relevant in a certain year.

3.2 Measurement of the Dependent Variables: Adoption of Interorganisational ICT by GPs

In the 2009 and 2010 survey, the respondents were asked to answer a number of questions regarding their interorganisational ICT adoption, the focus of this study. Although the number of items within the survey was limited, they cover different types of interorganisational ICT that GP practices can use within the Dutch primary care system.
The selected survey items (verbatim question quoted) and their answer categories are coded as a ‘cumulative’ ICT maturity scale (from ‘low’ to ‘high’) and can be considered as ordinal (rank) but not interval variables. They are summarised in Table 1, including their frequencies.

In both years, about 75% of the practices approached completed the questionnaire (n=62 in 2009, n=69 in 2010). In total, 49 practices completed the questionnaire in 2009 as well as in 2010. To maximise our base for analysis, we perform cross-sectional analyses using the 2009 and 2010 dataset in parallel, i.e. using the dataset that contains the same 49 practices in 2009 and 2010. Doing so, we are also able to analyse the change scores of the 49 practices between 2009 and 2010.

[TABLE 1].

From Table 1 we can derive that for all three items, GP practices hold proportionally 'higher' scores in 2010 compared to 2009.

As a next step we explore if the item scores are intercorrelated, as they can be seen as indicators of a common latent factor, i.e. the level of interorganisational ICT adoption by (Dutch) GP practices. Below are the results of Spearman's rho correlations (as all three variables are measured at an ordinal level) calculated between the 3 items, both for the 2009 and 2010 dataset.

[TABLE 2].

The results show that the items are mostly positively correlated, but for no pair of items is the Spearman's rho correlation significant ($p>.10$). This indicates that the items probably address different aspects of (interorganisational) ICT systems and functionality. Given these results, we chose not to add or aggregate them into one factor or scale. At the same time, we have no specific reason to exclude one of the items. The fact that the items are not intercorrelated does not imply that they are invalid or unreliable as indicators. Hence for further analysis, each item is used as a separate dependent variable.

3.3 Measurement of the Independent Variables: Determinants of Interorganisational ICT Adoption by GPs

In this section we present the data and measurements to measure the potential determinants of interorganisational ICT adoption by GP practices through our dataset available, applying the three dimensions of the Tornatzky and Fleischer model presented earlier.

With regard to the *technological context* we define the type of EMR system used by the GP practice as the main determinant. EMR systems are a typical example of product software, which is provided by a limited number of vendors and used by many users/organisations [37]. Although EMR systems for GP practices basically aim to support the same primary processes of patient recording, diagnosing, prescribing, referring and billing, they do differ in their functionalities, in particular with regard to external communication and interaction with other systems (i.e. their interorganisational functionalities, cf. [14]), making it a potential determinant.

The *organisational context* is defined in this study by four characteristics of the practice and its GPs. First, we define age and gender as potentially important, following the propositions set and validated by Rogers [38] and Venkatesh et al. [39]. In case there were several GPs, the average age and the proportion of women within the GP practice were used, which are identified in other studies among health practitioners as well [40], [41]. Next, we select the GP practice size as indicator by the number of GPs employed (including GP self-employed), as the scale of processes and activities is naturally of relevance for the extent to which practices actually need to exchange information with other organisations (cf. [42]). This includes if a GP practice is part of a health centre or not, which can typically influence decisions with regard to supporting and facilitating functions such as ICT. The fourth characteristic we take into account is the amount of practice experience of the GP (measured in years). It should be noted that we only assessed the experience of the responding GP here.

Third and final, the *environmental context* in this study is defined by the patient population of the practice in terms of their size and their age distribution. This context is expected to determine the relative workload a GP practice is dealing with. The average patient age is potentially important, as elderly care is mostly chronic care, which in The Netherlands is organised in chains, which drives the need for interorganisational ICT [6].

The descriptive statistics of the determinants as present in the 2009 and 2010 dataset are presented in Table 3. With regard to the technological and organisational context variables, no changes have been reported between 2009 and 2010.

[TABLE 3].

4. RESULTS

In this section we test the expectations that were formulated in the previous section, i.e. that the defined determinants are related to the different types of interorganisational ICT adopted by the GP practices. The basic test is performed by calculating Spearman's rho correlations between the dependent and independent variables, recognising the ordinal scale of the ICT adoption variables. To investigate the relationship between the type of EMR used by the GP practice and the adoption variables an ANOVA-test is applied. Table 4 shows the results.

[TABLE 4].

The results clearly indicate that none of the organisational (including person characteristics) or environmental context variables is related to the level of interorganisational ICT adoption by the GP practices. The Spearman's rho correlations are non-significant. However, the ANOVA-tests performed on the differences between the EMR systems (GP software packages) show some significant results.
In particular, the item on whether out-of-hours service employees can retrieve patient information from the GP's EMR system does significantly differ between the EMR systems, both in 2009 and 2010. In 2010, the use of the special referral module 'Zorgdomein' significantly differs between the different GP systems.

5. CONCLUSION AND DISCUSSION

In this paper we departed from the notion that the adoption of interorganisational ICT in primary care is considered as important and is advocated by different stakeholders. At the same time, the potential determinants for the uptake of ICT-based information exchange between GP practices are hardly investigated empirically. In this paper we present and use data collected among a sample of 49 GP practices in The Netherlands that participated in a survey in 2009 and in 2010. The data provide a unique opportunity to perform empirical analysis on the level of adoption of interorganisational ICT by GP practices and its potential determinants.
The survey data firstly show that GPs, between 2009 and 2010, have become more advanced in their exchange of information with GP posts, in using referral modules and chain digitisation applications or software. Then, based on the classification framework of Tornatzky and Fleischer [29], three types of determinants were investigated that are expected to have influence on interorganisational ICT adoption by GP practices. Most determinants appear to be not significantly correlated with the adoption variables, however. Both the 2009 and 2010 data show that gender, age and experience of GPs in a practice are not related to the level of interorganisational ICT adoption, nor is the size of their practice. Also, we did not find a relationship for the number of patients or their average age. Adoption levels did differ between the types of EMR systems the GPs have in place. Some GP practices are significantly better connected to out-of-hours service employees, who can retrieve patient information from the GP's EMR system, than other. Also, certain types of EMR systems used by the GP practices are significantly more involved in the use of special modules for referral to secondary care.
These results obviously trigger several new questions. If GPs that use certain types of EMR are more mature with regard to their external information exchange through ICT than others, it is obviously relevant to explore the exact reasons behind this result. This implies a more in-depth and comparative analysis of the functionalities of EMRs, which has not been performed on a scientific basis until now.
Also, a hypothesis worth testing is whether GP practices – with certain characteristics in combination with a certain EMR system – are frontrunners in the level of interorganisational ICT adoption. To test this hypothesis however, a larger sample size (number of GPs) is needed. Further data collection can enable this. Successive measurements among the current group of 49 practices can also be used to perform longitudinal data analysis. This enables a further exploration of the determinants behind interorganisational ICT adoption in GP practices, as clearly more and other variables may be of influence. This extended analysis could also include the matter of causality for the relationship between characteristics and adoption of interorganisational ICT adoption by GP practices.

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TABLES

Table 1 Descriptives of the 3 items measuring interorganisational ICT adoption by GPs in 2009, 2010 and the answers in 2009 and 2010 compared.

Item	Answer in 2009	Answer in 2010	Answer in 2010 compared to 2009
1. *Next to the LINH module, do you also use the 'Zorgdomein' application to register referrals to secondary care?* (yes=1, no=0)	• No: 67.3% • Yes: 32.7%	• No: 57.1% • Yes: 42.9%	• No in 2009 and in 2010: 57.1% • No in 2009, yes in 2010: 10.2% • Yes in 2009 and 2010: 32.7%
2. *Can the out-of-hours service employees retrieve patient information from your EMR system?* (yes=1, no=0)	• No: 79.6% • Yes: 20.4%	• No: 63.3% • Yes: 36.7%	• No in 2009 and 2010: 63.3% • No in 2009, yes in 2010: 14.3% • Yes in 2009 and 2010: 20.4%
3. *How are consultations recorded that are separately reimbursed in disease management programmes?* (in a chain information system=2, in our GP information system=1, not=0)	• Not: 26.5% • In our GP information system: 57.1% • In a chain information system: 16.3%	• Not: 20.4% • In our GP information system: 51.0% • In a chain information system: 28.6%	• Not in 2009 and 2010: 20.4% • In our GP information system in 2009 and 2010: 42.9% • In a chain information system in 2009 and 2010: 16.3% • Not (i.e. not or only in GP IS) in 2009, in a chain information system in 2010: 12.2%

Table 2 Results of Spearman's rho correlation analysis between the 3 items measuring interorganisational ICT adoption by GPs in 2009 and 2010.

Item[a]	Correlation with item 2	Correlation with item 3
1. *Next to the LINH module, do you also use the 'Zorgdomein' application to register referrals to secondary care?*	2009: –.03 2010: +.20	2009: +.04 2010: +.02
2. *Can the out-of-hours service employees retrieve patient information from your EMR system?*		2009: +.08 2010: +.16
3. *How are consultations recorded that are separately reimbursed in disease management programmes?*		

[a] The value coding is presented in Table 1.

Table 3 Descriptives of the defined determinants of interorganisational ICT adoption by GPs, based on Tornatzky and Fleischer and the LINH dataset available.

	Mean	Standard deviation	Minimum	Maximum	n
Technological context[a]					
Using EMR / GP software package A (%)	18.37				9
Using EMR / GP software package B (%)	12.24				6
Using EMR / GP software package C (%)	28.57				14
Using EMR / GP software package D (%)	30.61				15
Using EMR / GP software package E (%)	10.20				5
Organisational context					
Length of practice experience of the responding GP (in years)	15.27	9.78	0	33	49
Proportion of female GPs in the practice (%)	34.48	29.23	0	100	49
Average age of all GPs in the practice (years)	48.12	6.08	33	59	49
Size of the practice (1 GP=1, 2 GPs=2, 3 GPs or more=3, part of a health centre=4)	1.65	0.93	1	4	49
Environmental context					
Practice size (number of patients in 2009, 2010)	2009: 4,081 2010: 4,147	2009: 2,313 2010: 2,457	2009: 1,870 2010: 1,892	2009: 10,680 2010: 12,894	49
Average age of the patients (in 2009, 2010 in years)	2009: 48.65 2010: 48.71	2009: 4.75 2010: 4.69	2009: 36 2010: 36	2009: 56 2010: 57	49

[a] Names of the EMR / GP software packages are anonymised.

Table 4 Correlation and ANOVA-test results, testing the relationship between the defined determinants and 3 items measuring interorganisational ICT adoption by GPs.

Determinant	Interorganisational ICT adoption item[a]		
	Next to the LINH module, do you also use the 'Zorgdomein' application to register referrals to secondary care?	Can the out-of-hours service employees retrieve patient information from your EMR system?	How are consultations recorded that are separately reimbursed in disease management programmes?
Technological context (ANOVA-test, F-value, df=4)			
Using EMR / GP software package A (%)			
Using EMR / GP software package B (%)			
Using EMR / GP software package C (%)	2009: 1.50 2010: 2.47*	2009: 2.55* 2010: 4.63**	2009: 1.84 2010: 1.41
Using EMR / GP software package D (%)			
Using EMR / GP software package E (%)			
Organisational context (Spearman's rho correlation)			
Length of practice experience of the responding GP (in years)	2009: +.16 2010: +.08	2009: –.08 2010: –.02	2009: –.19 2010: –.08
Proportion of female GPs in the practice (%)	2009: –.08 2010: –.15	2009: –.04 2010: –.17	2009: –.09 2010: –.16
Average age of all GPs in the practice (years)	2009: –.07 2010: +.05	2009: +.09 2010: +.20	2009: –.21 2010: –.19
Size of the practice (1 GP=1, 2 GPs=2, 3 GPs or more=3, part of a health centre=4)	2009: +.24 2010: +.20	2009: –.09 2010: +.10	2009: +.06 2010: +.04
Environmental context (Spearman's rho correlation)			
Practice size (number of patients)	2009: +.25 2010: +.23	2009: +.03 2010: –.01	2009: +.03 2010: +.07
Average age of the patients (in years)	2009: +.00 2010: +.01	2009: +.00 2010: –.07	2009: +.04 2010: +.08

[a] The value coding is presented in Table 1.

*: p<.05; **: p<.01.