Technological and informational frames: explaining age-related variation in the use of patient accessible electronic health records as technology and information

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Isto Huvila
Department of ALM, Uppsala University, Uppsala, Sweden and Information Studies, Åbo Akademi University, Turku, Finland
Åsa Cajander
Department of Information Technology, Uppsala University, Uppsala, Sweden
Jonas Moll
Örebro University School of Business, Örebro, Sweden
Heidi Enwald
Information Studies, University of Oulu, Oulu, Finland and Information Studies, Åbo Akademi University, Turku, Finland
Kristina Eriksson-Backa
Information Studies, Åbo Akademi University, Turku, Finland, and
Hanife Rexhepi
School of Informatics, University of Skövde, Skövde, Sweden

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Abstract

Purpose – Data from a national patient survey (N = 1,155) of the Swedish PAEHR "Journalen" users were analysed, and an extended version of the theory of technological frames was developed to explain the variation in the technological and informational framing of information technologies found in the data.

Design/methodology/approach – Patient Accessible Electronic Health Records (PAEHRs) are implemented globally to address challenges with an ageing population. However, firstly, little is known about age-related variation in PAEHR use, and secondly, user perceptions of the PAEHR technology and the health record information and how the technology and information–related perceptions are linked to each other. The purpose of this study is to investigate these two under-studied aspects of PAEHRs and propose a framework based on the theory of technological frames to support studying the second aspect, i.e. the interplay of information and technology–related perceptions.

Findings – The results suggest that younger respondents were more likely to be interested in PAEHR contents for general interest. However, they did not value online access to the information as high as older ones. Older respondents were instead inclined to use medical records information to understand their health condition, prepare for visits, become involved in their own healthcare and think that technology has a much potential. Moreover, the oldest respondents were more likely to consider the information in PAEHRs useful and aimed for them but to experience the technology as inherently difficult to use.

Research limitations/implications – The sample excludes non-users and is not a representative sample of the population of Sweden. However, although the data contain an unknown bias, there are no specific reasons to believe that it would differently affect the survey's age groups.

Practical implications – Age should be taken into account as a key factor that influences perceptions of the usefulness of PAEHRs. It is also crucial to consider separately patients' views of PAEHRs as a technology and of the information contained in the EHR when developing and evaluating existing and future systems and information provision for patients.

Social implications – This study contributes to bridging the gap between information behaviour and systems design research by showing how the theory of technological frames complemented with parallel informational frames to provide a potentially powerful framework for elucidating distinct conceptualisations of (information) technologies and the information they mediate. The empirical findings show how information and information technology needs relating to PAEHRs vary according to age. In contrast to the assumptions in much of the earlier work, they need to be addressed separately.

Originality/value – Few earlier studies focus on (1) age-related variation in PAEHR use and (2) user perceptions of the PAEHR technology and the health record information and how the technology and information–related perceptions are linked to each other.

Keywords e-health, Information seeking behaviour, End users, Technology, Theoretical concepts

Paper type Research paper

1. Introduction

Patient Accessible Electronic Health Records (PAEHRs) are implemented to meet multiple healthcare challenges, including those relating to ageing populations, information access and patient empowerment. Earlier studies of PAEHRs have investigated attitudes towards an eventual introduction of PAEHRs (Petersson and Erlingsdóttir, 2018) and later on, attitudes and practices of individuals with experience of using such services (Moll *et al.*, 2018; Rexhepi *et al.*, 2018; Bell *et al.*, 2019). So far, there are, however, relatively few comprehensive investigations of the age-related differences in experiences relating to PAEHRs, even if multiple studies show that age is a central factor that influences PAEHR use (Crameri *et al.*, 2020). A parallel research gap, which is especially pertinent to older adults, relates to studies that make a distinction between experiences of PAEHRs as *technology* of accessing information and experiences with the electronic health record (EHR) *information* itself (cf. Huvila *et al.*, 2016; Hirvonen *et al.*, 2020). Even if negative attitudes, low self-efficacy and technology problems can lead to problems in accessing information (Pourrazavi *et al.*, 2020), technology and information–related needs and desires are distinct issues (Huvila *et al.*, 2016). Earlier research shows that the health and health information needs change and increase (Huvila *et al.*, 2018) with age, while the propensity to adopt new technologies changes (Birkland, 2019) and sometimes decreases (Hong and Cho, 2016; Keränen *et al.*, 2017; Vorrink *et al.*, 2017; Pourrazavi *et al.*, 2020). These two gaps point to a critical need for comprehensive comparative research on age-related variation in PAEHR usage and a better theory-informed

analytical understanding of the differences and their underpinnings from the perspective of framing or perceiving PAEHRs as a distinct form of technology and as a source of a specific type of health information.

Considering that the user–technology–information nexus is not pertinent only to PAEHRs, this article has a two-fold aim. First, it provides novel insights into how the use and perceptions of information in PAEHRs and PAEHRs as a technology vary across age groups. Second, in more general terms, it adds to our understanding of how perceptions of information content and information technologies are intertwined but distinct to each other and proposes an analytical framework to explain these differences. The framework builds on Orlikowski's and Gash's (1994) notion of technological frames of reference, broadening its scope from technology (see the critique of Gal and Berente, 2008) to information by making a distinction between users' technological frames (TF) and informational frames (IF) of reference.

The study addresses two research questions: (RQ1) how the theory of technological frames can be used and complemented to explain the variation of perceptions of technologies and information they are conveying (such as PAEHRs and medical record information) in different user groups and (RQ2) how such an extended framework can be applied to analyse how the preferences and use of, respectively, PAEHR and PAEHR information, differ between younger adults (under 51 years old), older adults (51–66 years old), and elderly (older than 66). The analysis is based on analysing data from a country-wide online survey of patients ($N = 1{,}155$) who have accessed the Swedish national PAEHR *Journalen*.

2. Literature review

2.1 Patient accessible electronic health records

In 1997, the region of Uppsala, Sweden, started a series of projects to provide patients access to their medical records online. A comprehensive PAEHR system was launched in 2012 when all region residents, from 18 years of age, gained online access to their medical records. In 2015, the local system was migrated to a national service platform to enable nationwide access to the service. Today, all 21 self-governing regions in Sweden offer access to medical notes covering all healthcare professions and all public and private providers connected to the system and have agreed to give access to the notes. Due to different administrative decisions, individual regions provide access to information to a varying extent. This makes it difficult for the users to know what information is accessible and especially what remains inaccessible.

PAEHRs have also been introduced in many other countries. Common for many of these systems is that they enable patients to access, control and share health information as they choose (Mamra *et al.*, 2017). In Europe, the development has been especially rapid in the Nordic-Baltic region, for example, in Estonia, Denmark (Rahbek, 2013), Norway (Zanaboni *et al.*, 2020) and Finland (Jormanainen *et al.*, 2019). In the US, the pioneering Open Notes initiative started around 2010 (Delbanco *et al.*, 2012; Walker *et al.*, 2019). Studies of PAEHR use suggest improved doctor–patient communication, adherence, understanding of the medical condition, healthcare delivery and better preparation for healthcare appointments (Moll *et al.*, 2018; Walker *et al.*, 2019). In parallel to reported benefits, healthcare workers, have voiced critique (Alander and Scandurra, 2015). In particular, physicians have been concerned that PAEHRs will cause patients distress, confusion and increase professionals' workload (Grünloh *et al.*, 2018; Klein *et al.*, 2015).

2.2 Age, PAEHR, health information and technology use

A recent systematic review on older adults' views on e-health services (Hirvonen *et al.*, 2020) indicates that existing research on older adults as e-health service users focuses on social uses

and health management rather than personal information management. User experiences, the purposes and benefits of e-health services or their long-term value for people are rarely investigated. E-health is unlikely to impact the target group unless it is actually used (Rockmann and Gewald, 2016). Research on PAEHR use has been conducted on patients with different conditions, for example, in oncology (cf. Gerber *et al.*, 2014; Rexhepi *et al.*, 2018) and psychiatry (O'Neill *et al.*, 2019). Also, the impact of demographic factors such as age (Huvila *et al.*, 2016) has been studied to a certain extent. Nevertheless, studies explicitly comparing different groups, e.g. related to age, are still relatively scarce.

In general, age is a strong indicator of differences in use of information and communication technology (ICT). Despite the growing use of the internet, older adults are still falling behind younger adults (Hong and Cho, 2016). The gap in technology adoption between younger and older individuals might diminish but not disappear completely in time (Charness and Boot, 2009). Older adults have different attitudes towards and reasons for using technologies (Birkland, 2019). According to a review by Ma *et al.* (2015), older adults have a positive attitude towards using ICTs. However, life changes, such as retirement, might affect access to and attitudes toward technology (Birkland, 2010). In some studies, the use of new technologies in ICT has been found to decrease by age (Heart and Kalderon, 2013; Keränen *et al.*, 2017; Vorrink *et al.*, 2017), while in others (e.g. Halmdienst *et al.*, 2019), the age effect did not apply to specific attitudes towards health-related ICT devices. In contrast, Heart and Kalderon (2013) confirmed that older age, especially together with poorer health, decreased adoption of healthcare-related ICT. Lee *et al.* (2011) found that barriers to use were perceived differently among pre-seniors (50–64 years), young–old (65–74 years) and older-old (75 years or over). The older-old had most difficulties with technology use. Based on the findings, Lee et al. emphasise that seniors' needs should be considered according to their age groups.

In the context of PAEHRs, one of the few examples that compares age groups is Nurgalieva *et al.* (2020), who report that older patients share the content of their PAEHRs more frequently. Similarly to this study, also others have investigated age differences concerning specific activities or issues. Middle-aged (40–59 years) and older people (60–85 years) have been compared on their ability to use a personal health record system (Taha *et al.*, 2013). Papoutsi *et al.* (2015) studied public views on security and privacy of electronic health records showing some differences between age categories. Also, studies on the adoption of mobile health services show differences between youth (18–49 years) and elderly (50 years and above) (Guo *et al.*, 2016) as well as middle-aged (40–59 year-olds) and older (60+) (Deng *et al.*, 2014).

ICT use and digital inequality have been linked to the older adults' social well-being (Ihm and Hsieh, 2015). E-health is ideally positioned to empower older adults and support their well-being. There are, however, possible obstacles to use due to problems with physical health and cognition, differences in literacies, including health literacy, digital literacy and numeracy and attitudes towards technology (Berkowsky and Czaja, 2018; Enwald *et al.*, 2017). Also, older adults often face challenges when searching online health information. Bol *et al.* (2016) found that adults 65 years or older needed more time to read online health messages to recall as much information as younger ones. Also, Sanchiz *et al.* (2017) found lower cognitive flexibility in information processing among those aged 60 or over. Furthermore, cognitive function and health literacy are related (Kobayashi *et al.*, 2015), and e-health literacy scores might decrease with older age (Tennant *et al.*, 2015).

3. Theory

In 1994, Orlikowski and Gash introduced the concept of technological frames of reference (TF) to instigate socio-cognitive perspective into the field of information technology research

(Orlikowski and Gash, 1994). Orlikowski and Gash defined TF as *"structures or mental models that are held by individuals"* and proposed further that the TFs are also *"assumed to be shared by a number of individuals"*. The concept of TF is understood in a wide sense as *"not only the nature and role of the technology itself, but the specific conditions, applications, and consequences of that technology in particular contexts"* (p. 178). In their definition, TFs concern assumptions, expectations, and knowledge that people use to understand technology. Congruence and incongruence of TFs refer to how well (or badly) TFs of different stakeholder groups (e.g. developers and users) of technologies align with each other. Incongruence can lead to skepticism, conflicting expectations and resistance to the use of technologies (Orlikowski and Gash, 1994). Orlikowski and Gash (1994) presented three general types of TFs: (1) the nature of technology – what the technology is; (2) technology-in-use - how it is used to create various changes in use and (3) technology strategy – why it was introduced. They suggest these three frames as a starting point, and further, that it might be possible to identify others. Since then, various new TFs have been introduced (c.f. e.g. Bartis, 2007; Davidson and Pai, 2004; Iivari and Abrahamsson, 2002; Olesen, 2014a, b).

Building on how Orlikowski and Gash see technology in TFs, we suggest that information can be conceptualised using a similar approach. Similarly to how TFs can be seen as *"structures or mental models that are held by individuals"*, it is possible to conceive *informational frames* (IF) as structures or models held by individuals that concern assumptions, expectations and knowledge they use to understand information (i.e. in a broad sense what is informative). IFs extend the original narrow focus of the theory from technology (criticized e.g. by Gal and Berente, 2008) to cover information (content) as a parallel, but often disregarded (Hirvonen *et al.*, 2020), aspect of the social context of e-health use. Like TFs, also IFs can be shared by several individuals (as e.g. in Olesen, 2014a, b, cf. Gal and Berente, 2008) and compared to each other to investigate the congruence or incongruence of frames within a group or between different groups of individuals. Further, even if the data we have analysed in the present study represent a snapshot of individuals, the analysis and age-related variation suggest that IFs like TFs (e.g. in Olesen, 2014a) change in time. Analogously to TFs, we suggest that IFs can also be categorised according to parallel domains (in Table 1) to those proposed for TFs (Orlikowski and Gash, 1994), including (1) the

Technological frame		Informational frame	
Technology-in-use	People's understanding of how the technology will be used on a day-to-day basis and the likely or actual conditions and consequences associated with such use	Information-in-use	People's understanding of how the information will be used on a day-to-day basis and the likely or actual conditions and consequences associated with such use
Technology Strategy	People's views of why (their) organization acquired and implemented the technology, including their understanding of the motivation or vision behind the adoption decision and its likely value	Information strategy	People's views of why the information was created and acquired, including their understanding of the motivation or vision behind the adoption decision and its likely value
Nature of Technology	People's images of the technology and their understanding of its capabilities and functionality	Nature of information	People's images of the information and their understanding of its capabilities and functionality

Source(s): Developed on the basis of Orlikowski and Gash (1994, pp. 183–184)

Table 1. Technological frames and information frames

nature of information (what information is, in an ontological sense); (2) information-in-use (how it is used to create various changes in use) and (3) information strategy (why it was introduced). Further, similarly to how Orlikowski and Gash suggest that the three original TFs are only examples, it is conceivable that additional IFs can be identified.

The rationale behind IFs is to introduce a comprehensive framework for explicating assumptions, expectations and knowledge that people use to understand technologies and information within one framework. Earlier research has on several occasions emphasised that although preferences, the usefulness of and perspectives to information and information technologies (whether digital or non-digital) are tightly intertwined, technology and "content" are two different matters (e.g. Blandford and Attfield, 2010; Fidel, 2012). We argue that elucidating informational and technological frames together provides a useful perspective to technology and content, quoting Orlikowski and Gash (1994, p. 174), "for explaining and anticipating actions and meanings that are not easily obtained with other theoretical lenses". The proposed framework complements approaches that have focussed on describing how information and technologies are entwined in practices and activities, including practice and activity theories, sociomateriality (Allen *et al.*, 2019) and, for instance, the concept of information worlds (Jaeger and Burnett, 2010). In contrast to approaches focussing on elucidating the respective roles of information and technologies separately, concurrent analysis of the two from parallel perspectives can help to see congruencies, incongruencies and links between views related to information and technology that risk remaining invisible if studied in isolation.

4. Methods and material

4.1 Participants and data collection procedure

The analysis investigates material gathered through a national online survey of patients who have accessed the national PAEHR (Journalen) in Sweden. The survey was based on an anonymous self-completion questionnaire. It was distributed on the login page of Journalen meaning that everyone who logged in the system (open at the time for everyone of 18+ of age with a Swedish personal identity number) were included in the study. The study was ethically approved by the Regional Ethical Review Board in Uppsala (EPN 2016/129). The data were collected between June and October 2016. The total number of responses was 2,587 (response rate of 0.61%, 2,587/423141 of individuals who logged in the system during the survey period), of which $N = 1{,}155$ responses were included in this study, leaving out incomplete data for the analysed questions.

4.2 Survey instrument

The survey questions focussing on attitudes, experiences of use, usage of information, information content, security, personal health and demographics, were developed based on a literature review and earlier studies related to Journalen including Huvila *et al.* (2015), Rexhepi *et al.* (2018), Grünloh *et al.* (2016) and Scandurra *et al.* (2015). A comprehensive description of the development of the survey instrument and a descriptive overview of the non-age-group specific survey results, left out from this paper because of the lack of space, is presented in Moll *et al.* (2018) together with a copy of the survey instrument. Five-point Likert-like-scale questions from all categories mentioned above, except security, were chosen for analysis to provide a basis for assessing the respondents' attitudes towards PAEHR information and technology, and further, to investigate whether the different views could be framed and explained in terms of TFs and IFs.

4.3 Analysis

The data were analysed in SPSS 25.0 with Kruskal–Wallis tests, with a 95% confidence interval to investigate how the group of respondents labelled as older adults (294/

1,155 = 25% of respondents), born between 1950 and 1964 (by the time of data collection between 51 and 66 years old) differ from those born after 1965 (i.e. younger than 51 by the time of data collection) labelled as young (695/1,155 = 60%), and those born before 1949 (older than 66 when the data were collected) labelled as elderly (166/1,155 = 14%). Hence, years of age was used as a grouping variable in the analysis. The categorisation was based on an earlier observation of the significance of the transitory period of older adulthood (Huvila *et al.*, 2018, cf. e.g. Bol *et al.*, 2016). Older adults form a category of individuals with a long life experience, who are still active in their life, either working or recently retired, but already anticipating or experiencing changes in their healthcare needs. Two-way MANOVA was used to investigate the effect of work experience in the healthcare sector (binary question yes/no), and of suffering of chronic conditions (multiple choice questions with options covering cancer, psychiatry, high blood pressure and diabetes).

5. Results

5.1 General findings

70% (805 of 1,155) of the respondents were female and 30% (350 of 1,155) male. 74% (777 of 1,155) had at least secondary- or upper-secondary-level education. Three percent (34 of 1,155) had no formal education. 71% had a chronic condition (825 of 1,155), and 46% worked or had previously worked in healthcare (531 of 1,155).

In general, the respondents were fairly satisfied with their health (mean 3.11, SD 1.193 on a five-point scale). They considered it a very good idea to read medical records online (mean 4.78, SD 0.595). They were also highly confident that they understood most of the medical record's content (mean 4.51, SD 0.756).

The most prominent reasons to use PAEHRs online were to get an overview of one's own health or condition (mean 4.62, SD 0.767), to recapitulate a visit (mean 4.40, SD 0.942), to get more involved in (one's own) healthcare (mean 4.23, SD 1.050), and general interest (mean 3.74, SD 1.243). The respondents were most inclined to seek information by themselves, e.g. on the internet (mean 4.30, SD 0.984) and ask healthcare staff during their next visit (mean 4.05, SD 1.084) if they did not understand something in their medical record. The most significant implications of being able to read their medical records were that the respondents considered that they felt better informed (mean 4.65, SD 0.668), thought that it improves communication between them and healthcare professionals (mean 4.29, SD 0.924), that they will be able to understand their health or condition better (mean 4.25, SD 0.971) and that they felt safer (mean 4.25, SD 0.951).

The respondents were generally optimistic about the usefulness of the suggested information services based on the information found in their medical record (see Table 2 for alternatives). Only the ability to write their own comments in the text of the record (mean 3.39, SD 1.406), the ability to communicate with healthcare in the patient portal (mean 2.01, SD 1.1210) and the ability to block access to the medical record information, with mean 3.06 and standard deviation of 1.435, scored below 3.5 on the five-point scale.

Elderly respondents worried less about their health compared to older adults and young respondents (Table 3). The difference was significant between the elderly and older adults ($X^2(2) = 6.666, p < 0.05$). Otherwise, there were no statistically significant differences between the groups on how they perceived their health or how often they thought about it.

The effects of working in healthcare and having chronic conditions were studied using MANOVA. Due to the large group size (500+ in both cases), non-homogeneity of covariance matrices (significant Box's test $p < 0.001$) of the dependent variables could be omitted (Allen and Bennett, 2008). Multivariate normality of the data was assumed based on using the Shapiro–Wilks test of normality on each individual dependent variable. No multicollinearity

Statements	Chi-square	Sig.	Mean rank (Kruskal-Wallis) Young (n = 695)	Older adult (n = 294)	Elderly (n = 166)
How important is it for you to have access to the following information which is wholly or partly based on information contained in Journalen?					
Referral (content and how it is handled in care)	19.494	0.000	553.80	634.64	579.01
List of all prescribed pharmaceuticals	2.395	NS			
Overview of all vaccinations	2.260	NS			
Results of tests	8.396	0.015	565.54	608.73	575.74
Overview of all healthcare contacts	5.914	NS			
Being able to read record entries from psychiatry	10.443	0.005	589.68	590.60	506.77
Being able to read all types of record entries	4.974	NS			
Ability to order and manage medical certificate and other certificates	21.897	0.000	585.97	610.69	486.74
Ability to point out errors I find in the record	22.042	0.000	544.46	634.75	601.55
Ability to write own comments to text in Journalen	9.976	0.007	556.66	627.91	578.96
Contribute with information on health, e.g. by providing health declaration for next visit	8.164	0.017	591.80	580.47	515.84
Contribute with information of self-testing or monitoring at home	1.156	NS			
Contribute information about expectations for the healthcare visit	6.061	0.048	562.11	617.31	572.92
Ability to contact healthcare electronically and ask questions about medical record	14.593	0.001	552.10	633.62	587.95
Ability to communicate electronically with other patients	2.115	NS			
Ability to block certain medical records from access by other medical staff	5.596	NS			
See which care units and staff groups have been in Journalen (see log data)	7.557	0.023	581.43	601.74	521.60
Ability to access information and manage services for my children	109.441	0.000	653.61	497.25	404.45

Table 2.
Importance of the contents of the medical record

Statements	Chi-square	Sig.	Mean rank (Kruskal-Wallis) Young (n = 695)	Older adults (n = 294)	Elderly (n = 166)
My health is very good	5.201	NS			
I am very worried about my health	6.666	0.036	577.61	607.94	526.63
I often think about my health	5.819	NS			

Table 3.
Questions about health

was detected by examining variance inflation factors. Besides, no outliers were detected by examining Malahanobis distances.

According to the analysis, there were no statistically significant interaction effects between age categories and respondents work experience in healthcare ($F(188, 2090) = 1.057$, $p = 0.292$; Wilks' $\Lambda = 0.834$), age categories and respondents chronic conditions ($F(188, 2090) = 0.952$, $p = 0.663$; Wilks' $\Lambda = 0.848$), or the three ($F(188, 2090) = 1.098$, $p = 0.182$; Wilks' $\Lambda = 0.828$) on the combined dependent variables. The analysis proceeded with examining the main effect of age categories.

5.2 Differences between the young, older adults and elderly

The findings on significant differences and similarities are reported below according to the five surveyed themes: (1) reasons for reading medical record (Table 4), (2) contents of the medical record (Table 5), (3) the meaning of reading medical records (Tables 2 and 6), (4) usability of the Journalen system (Table 7) and (5) online e-health services and information (Table 8).

5.2.1 Reasons for reading medical record. Young respondents were most likely to read their medical record online for general interest (young versus elderly $X^2(2) = 4.742$, $p < 0.001$; young versus older adults $X^2(2) = 4.487$, $p < 0.001$) but least likely to use it for getting an overview of personal medical history and treatment (young versus elderly $X^2(2) = 2.657$, $p < 0.05$; young versus older adults $X^2(2) = 2.959$, $p < 0.01$), to prepare for a visit (young versus elderly $X^2(2) = 4.261$, $p < 0.001$; young versus older adults $X^2(2) = 4.455$, $p < 0.001$.) and to become more involved in one's own healthcare (Young vs. Elderly $X^2(2) = 3.907$, $p < 0.001$; Young vs. Older Adults $X^2(2) = 3.870$, $p < 0.001$).

5.2.2 Contents of the medical record. The young respondents were least likely to consider that the medical records contain too much technical language. The difference was significant in comparison to the elderly ($X^2(2) = 2.502$, $p < 0.05$). The young were also least inclined to think that the medical records should be written more comprehensible (young versus elderly $X^2(2) = 3.753$, $p < 0.005$; young versus older adults $X^2(2) = 2.555$, $p < 0.05$). Moreover, they were the least confident that they understand the most of the test results ($X^2(2) = 3.213$, $p < 0.01$) and referral information ($X^2(2) = 3.005$, $p < 0.01$) reported in the medical record with a significant difference to the elderly.

The older adults were least likely to ask anonymous questions via the public health portal www.1177.se to seek clarifications if they had not understood something in their medical record. The difference between them and the young was significant ($X^2(2) = 2.417$, $p < 0.05$).

Statements	Chi-square	Sig.	Mean rank (Kruskal-Wallis) Young ($n = 695$)	Older adult ($n = 294$)	Elderly ($n = 166$)
Mostly general interest	34.402	0.000	622.33	522.29	491.05
To get an overview of my medical history and treatment	12.785	0.002	556.23	608.71	614.74
To get an overview of my relatives' medical history and treatment	4.367	NS			
Because I am not sure if I got the right care	1.168	NS			
To follow up what has been said during a healthcare visit	5.200	NS			
Because I suspect inaccuracies	2.544	NS			
To prepare for my healthcare visit	30.668	0.000	535.27	635.75	654.61
To become more involved in my care	24.400	0.000	542.50	624.17	644.86

Table 4. Reasons for reading medical records

Statements	Chi-square	Sig.	Mean rank (Kruskal–Wallis) Young (n = 695)	Older adult (n = 294)	Elderly (n = 166)
I understand most of what is in the medical records	3.413	NS			
I think that the medical records contain too much technical language	6.352	0.042	566.19	573.01	636.31
I think that the medical records should be written more comprehensible	16.994	0.000	548.09	605.98	653.69
I understand most of the test results	10.765	0.005	557.01	588.85	646.68
I understand most of the log list	5.005	NS			
I understand most of the referral function	11.994	0.002	552.45	605.81	635.70
The content in the record reflects the information I think that healthcare has about me	4.456	NS			
There is information about me that is missing in the record which I think should be there and that the staff should know	2.015	NS			
What would you do if you see something in Journalen you do not understand?					
Contact the current healthcare unit via phone	5.463	NS			
Ask medical staff at the next visit	0.281	NS			
Ask a medically trained person, e.g. via phone on 1,177	0.257	NS			
Ask an anonymous question via www.1177.se	6.200	0.045	596.10	542.88	564.41
Ask someone who I know personally, in family or among acquaintances	64.526	0.000	639.75	470.83	509.27
Look for information myself, e.g. via Internet	8.365	0.015	598.61	543.49	552.82
Use social media, e.g. discussion forums	0.906	NS			
Do nothing	18.811	0.000	599.03	512.14	606.62

Table 5. Understanding the contents of the medical record

They were also least likely to seek clarification by themselves (with a significant difference to the young $X^2(2) = 2.645$, $p < 0.05$), to do nothing (young versus older adults $X^2(2) = 4.132$, $p < 0.001$; elderly versus older adults $X^2(2) = 3.220$, $p < 0.005$), and to ask their relatives. In contrast, the young were the most likely to do so (young versus elderly $X^2(2) = 4.649$, $p < 0.001$; young versus older adults $X^2(2) = 7.473$, $p < 0.001$).

With a significant difference to the young respondents, the older adults were more inclined to consider that referrals ($X^2(2) = 4.415$, $p < 0.001$) and test results ($X^2(2) = 2.894$, $p < 0.02$) are important. In contrast, the elderly were least likely to think that the possibility to order and manage medical certificate and other certificates (young versus elderly $X^2(2) = 4.074$, $p < 0.001$; older adults versus elderly $X^2(2) = 4.528$, $p < 0.001$), and information about mental health (young versus elderly $X^2(2) = 3.127$, $p < 0.01$; older adults versus elderly $X^2(2) = 2.813$, $p < 0.02$) would be important. With a significant difference to the young, they also thought that the possibility to add comments to the text of the medical record ($X^2(2) = 3.158$, $p < 0.005$) and to write information about expectations for the healthcare visit ($X^2(2) = 2.458$, $p < 0.05$) is important. Older Adults were also most positive to the possibility of communicating electronically with other patients – with a significant difference to the young ($X^2(2) = 3.794$, $p < 0.001$).

Statements	Chi-square	Sig.	Mean rank (Kruskal-Wallis) Young (n = 695)	Older adult (n = 294)	Elderly (n = 166)
It improves communication between medical staff and me	35.395	0.000	536.59	623.15	671.39
It leads to improvements in health and social care	11.566	0.003	553.60	603.59	634.83
It improves my understanding of my condition	11.897	0.003	556.68	590.71	644.73
It makes me feel safe	2.450	NS			
It makes me feel informed	4.546	NS			
It leads to that I can take care of my health better	36.027	0.000	534.39	622.39	681.34
It leads to that I can take care of my relatives' health better	1.966	NS			
It is essential that I am able to actively participate in decisions about my or my relatives' health	25.294	0.000	539.18	631.55	645.67
For my own documentation	11.777	0.003	556.02	591.14	646.74
It has no relevance	3.495	NS			
I discuss the content of Journalen with medical staff	10.636	0.005	553.81	604.75	631.89

Table 6. The meaning of reading medical records

The young respondents were least inclined to consider it important to be able to point out errors in the medical record (significant difference to the older adults $X^2(2) = 4.521, p < 0.001$) but most likely to think that adding notes about one's own health is useful (significant difference to the elderly $X^2(2) = 2.853, p < 0.02$).

Older adults and young were more inclined to think that it is important to be able to access log lists to see which professionals had accessed their medical record information (significant difference between the elderly and older adults $X^2(2) = 2.709, p < 0.05$). The young were the most and the elderly least likely to consider that accessing children's medical record information is important (young versus elderly $X^2(2) = 9.143, p < 0.001$; older adults versus. elderly $X^2(2) = 3.030, p < 0.01$; older adults versus young $X^2(2) = 7.125, p < 0.001$).

5.2.3 The meaning of accessing own patient information. Young respondents were least likely to consider that reading medical records helps to improve communication with medical staff (young versus elderly $X^2(2) = 5.158, p < 0.001$; young versus older adults $X^2(2) = 4.113$, $p < 0.001$) that it would help them to take better care of their health (young versus elderly $X^2(2) = 5.328, p < 0.001$; young versus older dults $X^2(2) = 3.959, p < 0.001$) or that it would be essential for their ability to actively participate in decisions on their own or their relatives' health (young versus elderly $X^2(2) = 3.808, p < 0.001$; young versus older adults $X^2(2) = 4.101$, $p < 0.001$). In comparison to the elderly ($X^2(2) = 2.992, p < 0.01$), they were, however, less inclined to believe that it leads to improvements in health and social care or that it would improve their understanding of their condition ($X^2(2) = 3.348, p < 0.005$). In comparison to the elderly, the young were also less likely to discuss the contents of their medical record with healthcare staff ($X^2(2) = 2.812, p < 0.05$) and to keep their patient information for own documentation ($X^2(2) = 3.330, p < 0.005$). In contrast, no significant differences were observed between the young and older adults.

5.2.4 Usability of the Journalen system. Older adults were most and the young least likely to use Journalen regularly ($X^2(2) = 3.200, p < 0.005$). The elderly were most likely to consider that they would need personal technical support to use Journalen (young versus elderly

Statements	Chi-square	Sig	Mean rank (Kruskal-Wallis) Young (n = 695)	Older adult (n = 294)	Elderly (n = 166)
I think I want to use Journalen regularly	10.489	0.005	558.61	618.37	587.65
I think that Journalen is more complicated than it needs to be	4.247	NS			
I think that Journalen is easy to use	1.485	NS			
I think I would need personal technical support to use Journalen	14.116	0.001	563.75	575.74	641.64
I think that the various functions in Journalen work well together	4.279	NS			
I think there are many elements in Journalen that are not consistent	2.167	NS			
I think that most people could learn to use Journalen fairly quickly	14.937	0.001	597.73	577.83	495.70
I think that Journalen is difficult to use	1.205	NS			
I feel very safe and secure (about what I do) when I use Journalen	4.283	NS			
I need to learn quite a lot before I can start using Journalen	11.262	0.004	569.69	563.57	638.32
I as a user of 1,177.se find it difficult to find the link to Journalen	3.262	NS			
As far as I can judge, I think that Journalen generally maintains a high level of security	0.368	NS			
I trust that only authorized medical staff is accessing my medical records in Journalen	5.163	NS			
It is good that I as a patient am able to take part in the log list and see who has accessed my patient information	8.697	0.013	578.69	604.16	528.77

Table 7. Usability of the Journalen system

$X^2(2) = 3.752$, $p < 0.01$; older adults versus elderly $X^2(2) = 2.825$, $p < 0.02$) that they need to learn a lot before they can start using Journalen (young versus elderly $X^2(2) = 3.157$, $p < 0.01$; older adults versus elderly $X^2(2) = 3.060$, $p < 0.01$) and least likely to consider that they would soon learn to use the system (young versus elderly $X^2(2) = 3.865$, $p < 0.001$; older adults versus elderly $X^2(2) = 2.768$, $p < 0.02$). Older adults were also most inclined to think that the possibility to access the log list is a good function (significant difference older adults versus elderly $X^2(2) = 2.947$, $p < 0.02$).

5.2.5 Online e-health services and information. Young respondents differ from the other groups in that they were less likely to consider that access to online medical records is a positive reform (young versus older adults $X^2(2) = 3.758$, $p < 0.0001$; young versus elderly $X^2(2) = 3.072$, $p < 0.01$), and in comparison to older adults, that access to Journalen is good for them ($X^2(2) = 3.639$, $p < 0.0001$). They were also most inclined to compare information from different sources (significant difference to the Elderly; $X^2(2) = 3.256$, $p < 0.01$) and least likely to suffer from information overflow (young versus older adults $X^2(2) = 2.980$, $p < 0.01$; young versus elderly $X^2(2) = 2.799$, $p < 0.02$).

5.3 Summary

According to the findings, the young respondents were more likely to be interested in the PAEHR for general interest. In contrast, the two other groups were inclined to read medical

Statements	Chi-square	Sig.	Mean rank (Kruskal-Wallis) Young (n = 695)	Older adult (n = 294)	Elderly (n = 166)
I think that, in general, access to online medical records is a positive reform	3.336	0.000	555.81	611.22	612.06
I believe that access to Journalen is good for me	1.559	0.006	564.46	612.13	574.24
I would consider to change healthcare providers to get one that gives me access to Journalen	3.745	NS			
It is important to be informed about health issues	5.988	NS			
I like to get health information from a variety of sources	2.976	NS			
I compare the health information I have received from various sources	12.065	0.002	601.77	558.69	512.68
It is easy to determine in what situations I need health information	3.145	NS			
I know where to seek health information	2.233	NS			
I apply health related information to my own life and/or that of people close to me	0.261	NS			
Health related terminology and statements are often difficult to understand	5.805	NS			
It is easy to understand the medicinal package inserts, labels or prescription	1.572	NS			
I get way too much information about health	13.494	0.001	550.16	616.11	627.07
I do not want to think about health issues	0.022	NS			
I can influence my own health	1.619	NS			

Table 8.
Online e-health services and information

records to understand their own health condition, prepare for visits and become more involved in healthcare. The two older groups were also most likely to think that reading their EHR leads to concrete benefits and activities. The young considered further that they understood least the content of their medical records. It is too difficult to read and should be made more comprehensible. In contrast, the older respondents were primarily concerned of the difficulty of using the Journalen system and navigating information overflow. For their part, older adults were least likely to seek clarification by themselves if they failed to understand something but simultaneously least likely to do nothing. In contrast, with only a few exceptions, they scored the highest on how they ranked the importance of accessing different types of information and services in the PAEHR, except for using the system for their children and contributing information about their health.

6. Young, older adults and elderly as users of electronic health records

The findings show differences and similarities between the age groups in their use of EHRs and attitudes. In the following, the theory of technological frames extended with the notion of informational frames is used as a framework for explicating the characteristic perspectives of each age group, i.e. what is their view of the use and usefulness, what are their assumptions

of the underpinning strategies and nature of Journalen (PAEHR) as a technology and EHR as a type of information. Instead of testing the validity of the theory by measuring TFs or IFs of the respondents in the survey, the theory of Orlikowski and Gash (1994) and the technological frames included in the original study with their corresponding informational counterparts were used as an analytical lens to make sense of the variation in attitudes towards information (content) and PAEHR technology investigated in the survey.

6.1 Young

Young (Table 9) are most likely to use the EHR system for general interest rather than for a specific need. At the same time, they are least likely to consider that the online access or PAEHR system to EHR information is a positive development. In their technological frame, a PAEHR unfolds as a system they use independently together with many other technologies (technology-in-use). It is not developed for that specific group (technology strategy) even if it as a whole is a good idea (nature of technology). In contrast to older age groups, they are not worried that the system would be difficult to learn or use but are more concerned with not understanding the contents, i.e. information.

The young are most likely to read their EHR for general interest (information-in-use) rather than for a specific purpose like receiving an overview of medical history, to prepare for visits and to get more involved in care. The information written in technical language is not directed to them (information strategy). It is merely one type of information they encounter in their everyday life (nature of information). They form the most proactive group concerning seeking and comparing information from different sources in case they would not understand something, for instance by asking anonymous questions online via 1177.se, asking others or searching by themselves – probably partly because they feel that they do not know everything but at the same time lack regular contact with healthcare. Overall, in their technological and informational frames, they feel competent to seek information (in general) and use the PAEHR system but are not proficient in understanding medical information and terminology.

6.2 Older adults

Older adults (Table 10) are in a life stage where they have begun to anticipate the increasing need for more information about their health and are prepared to seek help if they have not understood something. As a whole, they are largely positive about PAEHRs as a technology and EHR information. In their technological frame, the system is potentially beneficial for them (technology-in-use). It might have been developed for them to help them with their changing health information needs (technology strategy). PAEHR is for them a technology with a lot of potential (nature of technology). From an informational perspective, the

Table 9. Technological and informational frames of the Young relating to PAEHRs

Technological frame		Informational frame	
Technology-in-use	Using independently, together with other online sources	Information-in-use	Using for general interest
Technology strategy	Developed for someone else	Information strategy	Written for someone else (difficult to understand, not so many benefits)
Nature of technology	Positive idea in general	Nature of information	A part of the flood of health information; not suffering from information overload

information in the EHR is potentially useful, especially in the future. Therefore, it would be important to determine what it means if something is difficult to understand (information-in-use). In par, the older adults can consider that the information has been made available to them to exploit (information strategy) and consider it essential for them by its nature (nature of information). They are least likely to do nothing if they do not understand something but most inclined to want to use Journalen regularly and think that it is good. The impression of the trust in the usefulness of the technology is further supported by them being the most likely group to believe that the log list function can be useful.

6.3 Elderly

The elderly (Table 11) were most likely to see multiple benefits with PAEHRs and understand the information in EHRs. Within their technological frame, Journalen is likely to be difficult to learn or use both for them (technology-in-use) and for others to the extent that not everyone finds it easy to learn (technology strategy), and they themselves would need technical support. Considering the generally negative view of its usability, their pessimism might extend to the level of the nature of Journalen as a technology. In contrast, in their informational frame, the elderly seems to consider EHR information useful for specific purposes (information-in-use) rather than general interest (cf. young). This group is the most confident regarding their capability to understand EHR contents, but probably because it is only one source of health information for them (information strategy), they are least likely to seek clarifications if they do not understand something (nature of information) and explicitly compare information from different sources but are most likely to get too much health information.

Technological frame		Informational frame	
Technology-in-use	Useful for accessing information I need	Information-in-use	Potentially useful for me, especially in the future. If I do not understand something, I need to find out what it means
Technology strategy	Could have been developed for me	Information strategy	Information has been made available for me
Nature of technology	A technology with a lot of potential	Nature of information	Essential information for me now and in the future

Table 10. Technological and informational frames of the Older Adults relating to PAEHRs

Technological frame		Informational frame	
Technology-in-use	Difficult but possible to learn to use, need support in use	Information-in-use	Useful for several specific purposes
Technology strategy	Not developed for everyone to use easily	Information strategy	A useful additional source for relevant health information
Nature of technology	Technology that is inherently difficult to use	Nature of information	A part of the flood of health information. If I do not understand something, I can obtain the information from other sources

Table 11. Technological and informational frames of the Elderly relating to PAEHRs

7. Discussion

7.1 Differences between the young, older adults and elderly

The present findings support the idea that PAEHRs have multiple potential benefits (e.g. Gerard *et al.*, 2017; Moll *et al.*, 2018; Walker *et al.*, 2019). The analysis shows, however, that the experienced benefits vary between age groups and confirm earlier observations that age significantly influences PAEHR use (Crameri *et al.*, 2020) and e-health adoption in general (e.g. Keränen *et al.*, 2017; Lee *et al.*, 2011; Vorrink *et al.*, 2017). The new findings are beneficial considering that age is an easily measurable factor and straightforward to use to guide the development of PAEHR technologies and information. Echoing the reminder of Rockman and Gewald (2016) that e-health services have no impact if they are not used, the present findings show that is it apparent that much work still needs to be done to help older adults and elderly, who have positive attitudes but doubts about their skills, to use PAEHRs in practice.

The general trends in the findings can be linked to typical immediate needs (or the lack thereof) in the age groups. Older individuals are more likely to have medical conditions (as in Greenberg *et al.*, 2017; Sakaguchi-Tang *et al.*, 2017) and more complex personal medical histories, forthcoming visits to healthcare or immediate interest to be involved in their own healthcare. Also, the differences in how particular age groups perceived difficulties in understanding their medical record information can plausibly be linked to how people in different ages experience and interpret medical information about themselves. Similarly to earlier findings (e.g. Archer *et al.*, 2011; Deng *et al.*, 2014; Hong and Cho, 2016; Lee *et al.*, 2011), the elderly respondents were least confident of their technical skills. However, as a whole, our findings suggest that technology adoption in different age groups is a more complicated question than that of attitudes or technical skills. One possible explanation to earlier contradictory findings of differences between age groups is undoubtedly a mismatch between general attitudes and expectations (e.g. Ma *et al.*, 2015). However, it can also depend on how well a particular technology matches specific user group's informational needs, wants and skills. According to the findings, older adults are largely positive about both PAEHRs as a technology and EHR information. In contrast, the elderly are pessimistic about PAEHR technology – although thinking that the possibility to access medical record *information* online is a positive reform that they would likely benefit from (cf. e.g. Kim *et al.*, 2009; Zanaboni *et al.*, 2020). In this sense, the age group–specific findings provide strong evidence for a broadening of the focus from technology acceptance and adoption only as the contents of EHRs and the PAEHR technology need to be considered in tandem but separately from each other when information is developed, tailored and delivered (i.e. technology) to different age groups.

7.2 Technological and informational frames

Apart from the empirical results on the differences between the three surveyed age groups, another key implication of this study relates to the use of the theory of *technological frames* (TF) (Orlikowski and Gash, 1994) and its extension with *informational frames* (IF) as means to systematise the understanding of the overlap and differences in how people conceptualise technologies and (informational) content, differently but in parallel to each other. IFs extend the original theory beyond technology (cf. Gal and Berente, 2008). The analysis with TFs and IFs shows that the three age groups' technological and informational frames differ, illustrating the fact that the framing of technologies (e.g. PAEHR) differs from how the age groups conceive the information it is used to mediate and deliver (e.g. EHR). The young respondents considered PAEHR as a positive idea. However, they did not think that EHR information would play a particular role for them in any specific sense. Simultaneously, they considered that the technology and the contents were developed for someone else. Older adults were more inclined to believe that the EHR information was made available for them

and could benefit from it. Their attitude towards PAEHRs was positive even if they were unsure if it would work for them. In contrast, the elderly strongly doubted their ability to master the technology. However, they were mostly very confident of the usefulness of EHR information and their ability to benefit from it. The findings indicate what Orlikowski and Gash (1994) described as incongruence between the different stakeholder groups' frames that can explain a part of the experienced anxieties and relative dissatisfaction with the PAEHR technology and EHR information. Distinguishing TFs and IFs showcases also that potentially harmful incongruence may stem from misalignment of TFs concerning IFs within a single group. This underlines the relevance of studying the incongruence of frames within groups, as suggested by Young *et al.* (2016) or smaller groups within larger ones. The simultaneous, fairly high level of satisfaction shows, however, that incongruence between the TFs and IFs of different user groups does not necessarily lead to problems if the frames are not, as Khoo (2001) suggests, completely incommensurate but at least somehow hospitable (cf. Huvila, 2009) enough to each other. From the (in)congruence perspective, future studies describing patients' TFs and IFs together with those of healthcare professionals, healthcare management and systems developers will undoubtedly be interesting and useful for complementing the present understanding of how their views align or collide. Similarly, as Davidson and Pai (2004) suggest, it could be useful to inquire into the development and change of frames – not only of TFs but of TFs together with and in concerning to IFs. Moreover, the present analysis conducted on quantitative data should be complemented with more in-depth qualitative inquiries.

As a whole, the analysis shows that the combined framework of TFs and IFs complements approaches that have focussed on describing how information and technologies are entwined in practices and activities, including practice and activity theories, sociomateriality (Allen *et al.*, 2019) and, for instance, the concept of information worlds (Jaeger and Burnett, 2010). The different (in)congruencies between TFs and IFs highlight the broader sociotechnical or in this study more precisely the *information-technological* (i.e. pertaining to information *and* technology) nature of information technologies. Addressing technology and information (content) in parallel to each other (cf. Hirvonen *et al.*, 2020) helps to identify and underline discrepancies, similarities and links between the information and technology–related views that otherwise risk to remain invisible or indistinct from each other if they are studied in isolation or assumed to be subordinate to each other. Young *et al.* (2016) suggest solving incongruencies between specialist communities by engaging in perspective-taking and inconsistencies between communities by focussing on perspective-making. While working with such broad non-specialist groups as age groups that only to a limited extent qualify as communities, much of the responsibility of making and taking perspectives and facilitating the activities falls on experts who are envisioning, developing, deploying and promoting technologies and providing information. The diversity of perspectives to PAEHRs between groups and the two types of frames identified in the analysis suggests the need for both – understanding and taking the perspectives of different stakeholder groups of PAEHRs and making them support effective use of technologies and their capabilities to convey information.

7.3 Limitations

When interpreting the present findings, certain limitations need to be taken into account. Because the survey was available only for those who logged in to the Journalen system, the sample excludes non-users. Further, even if the survey population is broad, it is not a representative sample for Sweden or other countries. However, although the data contain an unknown bias, there are no specific reasons to believe that it would differently affect the survey's age groups.

8. Conclusions

This study contributes to bridging the gap between information behaviour and systems design research by showing how the theory of technological frames complemented with the explication of the parallel *informational frames* can provide a potentially powerful framework for elucidating distinct conceptualisations of (information) technologies and the information they mediate. There is room for future research to elaborate and investigate further into different types of informational frames and the concept in relation to technological frames and research on the parallel implications of how people conceptualise information and (information) technologies.

The empirical findings show how information and information technology needs relating to PAEHRs vary according to age. In contrast to the assumptions in much of the earlier work, the present study and its findings stress the vital importance of addressing these needs separately in the research of patient attitudes and experiences and the development, deployment and promotion of new systems and services. Future research on technological and information frames in different age groups is still needed to expand on current findings and refine the present understanding of how frames change during people's life-course.

In practice, the analysis suggests that much of the variation can be explained as a function of actual and anticipated health information needs and how information and technology are respectively experienced as useful or problematic. Successful tailoring of information services such as PAEHRs requires parallel but separate consideration of the use and perceptions of technologies and the content they are designed to deliver. Content does not come with the technology – they come together and need equal attention.

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Corresponding author
Isto Huvila can be contacted at: isto.huvila@abm.uu.se