Evaluation Framework for Personal Health Records:
Microsoft HealthVault vs. Google Health

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Abstract

Personal health records (PHR) is a technology for managing the information playing field in healthcare. With multiple vendors competing on this relatively new market, an evaluation framework for end-user feature comparison can provide a foundation for system adoption decisions. Also it can serve as a starting point for requirements analysis for new systems. In this work we elicit a list of 25 end-user features, which in our view are necessary for a successful PHR implementation. We provide rationale for their inclusion as well as suggestions towards their realization. Using Microsoft HealthVault and Google Health, we test the suitability of our framework for evaluating the current two largest commercial PHR platforms.

1. Introduction

Overcoming the high degree of information asymmetry between buyers and sellers has long been considered the central problem in the design of a well-functioning health services system [7]. The doctor-patient relationship is an example of a principal-agent arrangement [11], that is particularly characterized by information asymmetries [44]. Although, patients know more about their symptoms than doctors do, it is the doctors who are experts on causes, prognosis and effectiveness of treatments. For this reason a patient is often compelled to delegate much of their freedom of choice in treatment, referral and hospitalization to a physician. For a physician, the easiest way to justify such delegation is to give a socially prescribed "best" treatment of the day, which, while saving the patient's money, often compromises quality [1]. In addition, patients, who do not fully understand the decisions taken on their behalf, their health status and their therapeutic options express poor compliance with prescribed care, delay seeing physicians until major symptoms transpire and often resort to "alternative medicine" [48].

Giving the patients access to their medical records is one way to manage such an information playing field. The Federal Health Insurance Portability and Accountability Act of 1996 (HIPAA) stipulates that patients have a right "to see and get copies of their records, and request amendments" [41], although it does not specify the exact manner in which the access is to be given. Few patients have so far taken advantage of this right [40], as in most cases this would require them to visit medical record departments of caregivers in order to obtain paper copies of their electronic health record (EHR) [20]. Moreover, since patients often receive care from multiple healthcare providers with their data dispersed over providers' (electronic) record systems [49], several such visits might be necessary.

While the conventional EHR systems are oriented towards the information needs of healthcare professionals and are institution-specific, personal health record (PHR) systems are centered on the patient. PHR systems are not intended to replace the EHR, but rather to complement them [33], giving the patient a hand at managing their own health care and being part of a seamless healthcare solution [42]. The Personal Health Working Group (PHWG) of the Markle Foundation defines PHR as following [34]:

"An electronic application through which individuals can access, manage and share their health information, and that of others for whom they are authorized, in a private, secure, and confidential environment"

Multiple PHR systems exist, which differ in their design approaches, business models and licensing and several evaluative studies of concrete PHR implementations are available [10, 20, 23, 27, 29,

43]. In this work we develop criteria for the evaluation of PHR systems from the standpoint of their users (Chapter 2) and apply it to the two largest PHR players (Chapter 4) – Google Health and Microsoft HealthVault.

2. Evaluation Criteria

By conducting a literature review[1] we identified a number of characteristics that any successful PHR implementation will likely possess. This chapter classifies them and provides rationale for their inclusion. First, we examine the essential issues of information access and personal control. Although, these features are at the core of any PHR system, its success will also be influenced by the optional services it may offer, which we discuss further.

2.1. Patient Information

Issues regarding collection, management and access to medical information fall into this category.

Patients prefer more information to less [51] and they are interested in reading their medical records when offered such chance [40, 41], therefore:

1. Patients should be able to access and view their medical records through a PHR system

Ideally, the whole medical history should be available to the patient. This presumes aggregating data from multiple medical institutions. Furthermore a case can be made for including additional relevant documents (e.g. those of the immediate relatives or dependents) or excluding some documents possessing which can be harmful to the patient [20].

2. Information in the PHR should be up-to-date

Either medical professionals should be able to edit the documents in the PHR directly, and/or an integration framework (which relies on established standards [46]) to keep EHR and PHR documents in sync should exist.

More than half the patients have difficulties understanding vocabulary and meaning of their records [41], hence:

3. Medical information should be presented in a cognitively accessible way

A major challenge in the area of health information services is the transformation of medical terminology in an understandable language [31]. Since medical competences of physicians and patients differ dramatically, so do record representations each considers understandable and useful. This calls for providing different document views for medical professionals and laymen and/or context-based views.

Patients prefer to give the doctor information about their health problem, relative to not giving this information [51], therefore:

4. Patients should be able to edit their medical records, annotate them or in the least request the responsible medical professionals to make corrections for them

It may in fact be argued whether giving patients an opportunity to edit their medical records is desirable. While being able to do so certainly empowers the patient and motivates him for a greater involvement with the system, it can also easily lead to the deterioration of the quality of the medical records, thus reducing the motivation on part of physicians to use them. Also, the question arises who shall be liable for the incorrect information [49]. In fact only 35% of those surveyed by Pyper et al. said they would like to be able to add information to their health records while 29% expressed concerns over information correctness [40]. A mixed approach may be feasible; where patients can edit certain types of documents they have sufficient knowledge of (such as symptoms or OTC medication use) with other documents amendable on request.

5. PHR should be technically accessible

A PHR system would be of little use to a patient if it requires exotic technology or significant configuration and maintenance effort. Since most patients want to be able to view their PHR at a physician's office (56,3%), home computer (47,1%) or in a walk-in medical center (23,7%) [40], appropriate architectural arrangements need to be developed (e.g. web-based/standalone clients). Also, the needs of the disabled have to be addressed (e.g. through screen readers, alternative input paths).

2.2. Personal Control

This section deals with patient's control of how their medical information is used. Since digitizing

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[1] To identify relevant articles, selected journals in the field of medical informatics were examined by a full-text electronic search on selected keywords like "electronic health records (EHRs)", "personal (private) health records (PHRs)", "electronic medical records (EMRs)" and "personally controlled health records (PCHRs)". This search identified a total of 179 articles. The titles and abstracts of each article were examined as to relevance for this research (i.e. the article appeared to be concerned with, or relevant to, the topic electronic health records). This process generated 38 articles for in-depth review. In an effort to broaden the search beyond the original set of journals, following a snowball sampling technique [17], cited works of potential interest in those 38 articles were analyzed which yielded an additional set of 29 articles. Hence, a total of 66 articles were reviewed in-depth.

medical information involves various risks [47], the issues of access control, confidentiality and security are the main area of concern for the patients [25, 40, 53]. Here the emphasis should be placed on balancing robust security with the ease of access, as perfect security is incompatible with perfect utility or even may be life-threatening at times [34, 54]. Essential characteristics of a PHR system are:

6. Each individual should control access to their PHR

Everyone wishing to view a patient's record needs to acquire their consent first. Ideally, the record "owner" has to be able to grant rights to perform particular actions on individual documents or groups of documents to individuals or groups for a defined period of time. Technical means for information exchange are required. Special provisions for minors and the mentally incapable are needed. This presumes a secure environment exists, which offers secure authentication, authorization, communication and storage [53].

7. A possibility for an emergency access should exist

In case of emergency, getting the right information to the right person at the right time is vital. For this, a mechanism to temporarily override security rules in certain situations should exist [34].

8. An individual should know who accessed their account and what actions were performed

This can be done by the means of making the audit trail available to the patient [6, 25, 34].

3.3. Additional services

Patients may be resistant adopting new technology unless its benefits perceivably exceed the costs. Hence, additional features expected by patients might facilitate PHR adoption.

9. Capturing cost information

Cost consciousness and transparency are at the focus of healthcare reforms [14]. To address them on the patient side, a PHR system could offer the ability to track and manage healthcare costs throughout the application, or at least support patients in their interactions with insurance companies, for instance through direct queries to review insurance claims status [43].

10. Document printing

Since 35% of patients would like to see their records not on a computer screen but rather printed out [40], they should be able to either print documents from the PHR system directly or export them to a format such as PDF for subsequent printing. Such printed documents can also be taken along during a visit to a physician, who otherwise might not be able to view them digitally [43].

11. Secure messaging

Patients perceive email communication with their healthcare professionals not only as a more convenient and faster than telephone, but also as increasing their access to healthcare. Also, some patients find this form of communication to be less intimidating than face-to-face conversations [8]. Therefore secure messaging is a generally accepted function of many PHRs [25].

12. Prescription refills

A growing number of patients are interested in being able to request prescription refills online [15]. It is a frustrating repetitive process [3], which could be automated by the means of PHRs [43, 49]. Doing so would reduce clinics' call volume and give staff members more time to serve patients with urgent needs [45].

13. Appointment scheduling

Lessened appointment difficulties increase patient satisfaction [38], while failure in getting an appointment in an appropriate time is cited as the main reason for changing doctors [37]. Automated appointment scheduling functionality has been suggested for PHR systems [25, 48].

14. Reminders

Research suggests that computer-based reminders are more effective than the manual reminding systems [9] and 77% of consumers are interested in getting email reminders from their doctors about appointment and other medical procedures [45].

15. Notifications

Patients may be interested in receiving notifications (e.g. per email) about changes in their medical records or new messages. Mechanisms for automatically monitoring data and raising exceptions are needed [19].

16. Educational information

Relevant health educational resources can be automatically linked to key terms or phrases in the patient's record [20] to help the patient understand unknown medical vocabulary [41]. Also, a (context-based) help system should be available.

17. Support groups

Patients place high value on internet support groups and make use of health information acquired through participation in such groups [22]. More than two thirds of cancer patients surveyed by Leimeister et al. stated they want to communicate more with

other patients [30]. Studies on the medical merits of online support groups report results ranging from encouraging [32] to inconclusive [13], hence an inclusion of support group functionality to a PHR system should be evaluated.

18. *Device integration*

The popularity of remote monitoring devices such as bathroom scales, glucometers, and blood pressure cuffs is growing. Such devices deliver their greatest value when they are interfaced to PHR and the information collected is interested and acted upon by physician [2].

19. *Decision support*

Online decision support systems are popular with patients [24]. Computer-based decision support systems and decision aids were shown to improve physician's performance [16], improve knowledge, stimulate decision-making and reduce anxiety on the part of the patient [36].

20. *Filing referral requests*

PHR systems can be used for referral management. Such approach proved to be beneficial both to patients and providers [52].

21. *Medicine information*

Since information on medications taken by the patients is stored in the PHR, information on the possible medication incompatibilities and side-effects could be provided to the patient.

22. *Address book*

Patients may be interested in searching for and browsing contact information of medical professionals and institutions.

23. *Quality comparisons*

Quality of care that clinicians and institutions delivered historically is a kind of information, which is valued by patients [50]. Additionally, patients should be given opportunity to rate their care providers.

24. *Localization*

The benefits of presenting information in languages that patients and physicians understand are self-evident.

25. *Searching*

Since records are stored over the periods of years or even decades, they can be expected to get rather big. In this case a search function can reduce the time needed to find information in the record significantly.

3. PHR Players Selection

During the research we identified a number of PHR providers: e.g. CapMed.com[2], Caregiver Alliance Web Services[3], CEND-PHR[4], Collaborative Family Health Record[5], Dossia[6], FollowMe[7], Google Health[8], HealthAtoZ[9], iHealthRecord.com[10], Indivo[11], LifeOnKey[12], Med Alert e-Healthkey[13], MedCommons[14], Microsoft HealthVault[15], MiVia[16], MyGroupHealth[17], MyHealtheVet[18], MyHIN[19], MyMedicalRecords.com[20], Myphr.com[21], Patient Gateway[22], PatientSite[23], RecordsForLiving.com[24], Revolution Health Group[25], Shared Health Clinical Health RecordTM[26], VitalChart[27].

This list is based on U.S.-oriented and Internet-based PHRs and it does not contain any claim to completeness. These listed PHR providers offer their services at little or no cost but their respective motivations, backgrounds and focuses differ. This is caused by the underlying business models: some PHR suppliers are employer sponsored (e.g. Dossia, which is among others sponsored by Wal-Mart, BP and AT&T), some are insurance sponsored (e.g. Shared Health Clinical Health RecordTM, which is sponsored by the BlueCross BlueShield Association), some are provider sponsored (e.g. MyHealtheVet, which is sponsored by the United States Department of Veterans Affairs) and some PHRs are independent products (e.g. Google Health, Microsoft HealthVault or Indivo, which are developed by for-profit oriented companies or non-profit oriented open scientific projects).

[2] http://capmed.com/
[3] http://www.prosocialapp.com/,
http://www.thesmartphr.com/09/index.html
[4] https://www.solventus.com/aquifer/cend/cendcontainer.aspx
[5] http://www.careevolution.com/index.html
[6] http://dossia.org/
[7] http://www.followme.com/index.html
[8] https://www.google.com/health
[9] http://www.myoptumhealth.com/portal/
[10] http://www.ihealthrecord.com/
[11] http://indivohealth.org/
[12] http://www.lifeonkey.com/
[13] http://www.medicalert.org/home/Homegradient.aspx
[14] http://www.medcommons.net/
[15] http://www.healthvault.com/Personal/index.html
[16] https://www.mivia.org/
[17] http://www.ghc.org/mygrouphealthpromos/onlinesvcs.jhtml
[18] http://www.myhealth.va.gov/
[19] http://www.myhin.org/
[20] http://mymedicalrecords.com/
[21] http://myphr.com/
[22] https://www.patientgateway.org/
[23] https://www.patientsite.org/
[24] http://recordsforliving.com/
[25] http://www.revolutionhealth.com/
[26] http://www.sharedhealth.com/home/index.jsp
[27] http://www.vitalchart.com/

Due to the relative similarity of their architecture, target markets and business models, two products offered by the major PHR suppliers were chosen for the current survey: Google Health and Microsoft HealthVault.

3.1. Google Health

Google, one of the most used search engines on the web[28], extended their public services on May 21, 2008 by a personal health information service named Google Health. The launch followed a two-month trial at the Cleveland Clinic in which estimated 1,500-10,000 patients participated [21]. Google describes its product as a PHR "but also a bit of a different model" which in addition to offering a place to store, manage and share one's health information also provides a directory of online services to act on this information on a daily basis [18]. Such platform strategy means patients will be able to automatically import their records, prescription history and test results, interact with services and tools such as appointment scheduling, prescription refills and wellness tools by the third-party providers as they are added to the directory. Google Health is based on open standards (Continuity of Care Record for data exchange, SOAP for the web-services interoperability), provides a development API, programming libraries and test infrastructure. Although not a HIPAA covered entity, Google guarantees it will protect the privacy of the information by giving a person complete control over it utilizing privacy policy and practices developed in collaboration with the Google Health Advisory Council[29]. To this end Google Health features no advertising. Google Health is oriented towards the U.S. as the third-party services are not available outside of it.

3.2. Microsoft HealthVault

Launched on October 4, 2007, Microsoft's HealthVault is a platform for sharing medical data [5], aimed both at patients and health professionals. HealthVault consists of two distinct products – an electronic repository for health data and a specialized search engine for health information on the World Wide Web, both free to users [12]. HealthVault is sometimes described as "PayPal for health information" [4, 5, 28] for being able to store and to share medical information at the discretion of its owner as well as for utilizing similar security features. HealthVault stands out from the other PHR

providers by an extensive partner network particularly in the area of medical and fitness devices. Microsoft plans to make money by placing ads next to the HealthVault search results. Similarly to Google Health, Microsoft offers an open API and a SDK including libraries for .NET, Java and Ruby. Microsoft HealthVault is U.S.-centered as it can only be used from inside the U.S. and cooperates with U.S. hospitals, physicians and pharmacies.

4. Evaluation

In this section we examine, how well Google Health and Microsoft HealthVault fulfill the characteristics of an idealized PHR system as defined earlier. As both products are new, there were no peer-reviewed sources our evaluation could draw on; therefore it is based on current documents that are accessible on the Internet[30] as well as our own experiences with these services. The findings are summarized in Table 1. The numbers and descriptions of characteristics correspond to how they are defined in Chapter 2. Comments are provided for clarification.

4.1. Analysis and Interpretation

A distinctive feature of both Google Health and Microsoft HealthVault is the fact that they are not simply PHRs, but also platforms with open APIs that offer technical infrastructure for third party vendors to build their applications upon. This has significant implications for the evaluation. On the one hand, the end-user features offered by the system proper are important in the short run (i.e. for building a solid user base), while on the other, the attractiveness of the platform from the view of the partners and developers gains importance in the medium to long run, since it is in the network effects and synergies possible in the marketplace that the greatest value for the customer can be created. There is no reason for Microsoft or Google to offer every conceivable feature themselves as long as no architectural or legal barriers for the third party service providers exist in

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[28] http://siteanalytics.compete.com/google.com/?metric=uv
[29] http://www.google.com/intl/en-US/health/about/ghac.html

[30] Google Health evaluation is primarily based on the data obtained from the Support web site (http://www.google.com/support/health/), Partners directory (https://www.google.com/health/directory), API reference (http://code.google.com/apis/health/) and HIPAA page (http://www.google.com/intl/en-US/health/hipaa.html). Microsoft HealthVault evaluation relies on the Help and FAQ pages (https://account.healthvault.com/help.aspx), Web Application Directory (http://www.healthvault.com/personal/websites.html?type=application), HealthVault Factsheet (http://www.microsoft.com/presspass/events/healthvault/docs/HealthVaultFS.doc) and MSDN resources (http://blogs.msdn.com/healthvaultfaq/, http://blogs.msdn.com/familyhealthguy/)

Table 1. Evaluation results.

#	Description	Google Health Rating	Google Health Comment	Microsoft HealthVault Rating	Microsoft HealthVault Comment
Patient Information					
1	Patients should be able to access and view their medical records through a PHR system.	3	Create and edit one or more profiles.	3	Create and edit one or more profiles. Concept of "custodianship"[31].
2	Information in the PHR should be up-to-date.	3	Data exchange through CCR and GData. Upload documents directly to the profile. Interoperability with a number of EHR systems. Third-party services for a worldwide paper-based data import. Automatic update. API for Java, .NET, Ruby, Python etc.	3	Data exchange through CCR and CCD. Upload documents directly to the profile. Choose which part of the uploaded document to integrate in profile. Third-party services for a worldwide paper-based data import. API for .NET, Java and Ruby.
3	Medical information should be presented in a cognitively accessible way.	2	Graphing capability for visualizing their medical test information. Easy navigation. Patients and doctors share the same view.	2	Graphing capability for basic data types. Over-use of medical terminology. Patients and doctors share the same view.
4	Patients should be able to edit their medical records, annotate them or in the least request the responsible medical professionals to make corrections for them.	3	User created documents can be edited and annotated; those acquired through subscriptions can be deleted only.	3	All documents can be edited, annotated and deleted.
5	PHR should be technically accessible.	3	Web-based and mobile clients available. Built-In spoken output available. Supports W3C ARIA for interoperability with screen readers.	3	Web-based and mobile clients available. Key shortcuts for accessibility.
Personal Control					
6	Each individual should control access to their PHR.	3	Per-profile sharing through the "Share this profile" function.	3	Per-profile and per-datatype sharing through the "Add record" function.
7	A possibility for an emergency access should exist	1	Feature not present.	2	Integration with health service providers (e.g. MyVitalData, Metavante Emergency HealthManager).
8	The individual should know who accessed their account and what actions were performed.	3	Every time data is added to a user's profile, the user is updated with a 'notice' on the main page of their profile. Users can see their full list of notices at any time. Activity report.	3	HealthVault logs each time a record is written, changed or read. Users can view an audit trail in their HealthVault account at any time. Change history sorted by date, person, account, program available.
Additional Services					
9	Capturing cost information	2	Only through the integration with insurance companies (e.g. Blue Cross).	2	Only through the integration with insurance companies (e.g. Aetna).

[31] http://blogs.msdn.com/familyhealthguy/pages/the-healthvault-nickel-tour.aspx

10	Document printing	3	Print either in compact wallet format or the full PDF format.	2	Simple print view.
11	Secure messaging	1	Feature not present.	1	Feature not present.
12	Prescription refills	2	Integration with pharmacies (e.g. Walgreens, Longs Drug).	2	Integration with service providers (e.g. RelayHealth, Allscripts ePrescribe).
13	Appointment scheduling	2	Integration with health service providers (e.g. Quest Diagnostics).	2	Integration with service providers (e.g. RelayHealth).
14	Reminders	2	Integration with service providers (e.g. Health Butler) and Google Calendar.	2	Integration with service providers (e.g. Aetna Personal Health Record).
15	Notifications	1	Feature not present.	3	Email notification that information is available to add to the record.
16	Educational information	2	Reference information is available (not from a trusted source). No context-based help.	1	Feature not present.
17	Support groups	1	Feature not present.	1	Feature not present.
18	Device integration	1	Work underway trough the Continua Health Alliance.	3	Multiple devices available through the HealthVault Connection Center and the "Works with HealthVault" program.
19	Decision support	1	Feature not present.	1	Integration with health service providers (e.g. Heart Profilers).
20	Filing referral requests	1	Feature not present.	2	Integration with service providers (e.g. RelayHealth).
21	Medicine information	3	With drug interactions. No side effects.	2	Integration with service providers (e.g. Allscripts ePrescribe).
22	Address book	3	Both address book and contact search.	1	Feature not present.
23	Quality comparisons	1	Feature not present.	1	Feature not present.
24	Localization	1	Feature not present.	1	Feature not present.
25	Searching	1	Feature not present.	1	Feature not present.
Legend: 1 – not available 2 – partially available 3 – fully available					

meeting the unsatisfied market demands. Hence it is important to make a distinction between features that can, or cannot be outsourced. For instance a missing "Medication interactions and side-effects" functionality can be easily offered by third-party provider as opposed to a missing "Search" feature, therefore being less of concern at least in the long run. One more thing to consider though is that, while using Microsoft HealthVault and Google Health is free for users, third-party services often are not.

4.2. Patient Information

Both Microsoft HealthVault and Google Health serve as online repositories for the personal health information and offer creating and managing multiple profiles. HealthVault has the concept of custodianship – a parent can be the custodian of their child and view who accessed the record, audit/history information and designate certain elements of the record as private. Custodianship is transferrable and is key to building a lifetime-valuable record. Information exchange between systems is facilitated by the adherence to the medical document standards. Here HealthVault takes the lead by supporting both Continuity of Care Record (CCR) created by the ASTM and Continuity of Care Document (CDR) created by HL7, while Google Health supports only a subset of CCR. Both HealthVault and Google Health have well-documented APIs with both vendors officially supporting .NET and Google additionally Java, Ruby, Python etc. Further, unofficial toolkits for both systems exist. While with HealthVault it is possible to import data from a local file directly by uploading it, Google Health cannot parse uploaded files and requires using additional (paid) services which convert both electronic and paper-based records and integrate them into profile. HealthVault

offers a "reconciliation" feature for a more convenient process of integration of data from the external sources into own record. Hereby, the user can select individual data items and preview their updated record or undo such a data import. A further difference is that Google Health prohibits editing imported documents while HealthVault allows the user to do so. Regarding technical accessibility, both systems are Web-based, Google Health offers spoken output and screen reader support, while HealthVault provides key-shortcut support throughout the application. The issue of cognitive accessibility is a more complex one. Both systems feature rich AJAX-based interfaces with some graphing capabilities, but neither offers different views for patients and doctors as we suggested. There are substantial differences in the UI composition and navigation concepts. Overall, users prefer Google Health's interface to that of the HealthVault due to straightforward navigation, simpler language, quick information entry, visible confirmation and multiple search tools. Conversely HealthVault gets praised for deeper level of information entry and more efficient flow [39].

4.3. Personal Control

For both systems, records can be accessed only after authentication and authorization. With regard to authentication, HealthVault is more flexible by offering sign-in with login/password combination of a Windows Live ID account or an account from a number[32] of OpenID providers, as well as utilizing other security devices such as Information Cards, client-side certificates or physical tokens [35]. In contrast, Google only offers a sign-in with a Google's own account. In both cases, the user is authorized automatically to view and edit the account he created himself. Also, it is possible to share one's record or to add an additional profile. However, with Microsoft HealthVault one can specify precisely which data types the user is to be authorized to view, while with Google Health sharing is on the profile level. Both Microsoft HealthVault and Google Health offer audit trails and change history views which are filterable by different criteria. While neither service offers build-in emergency access to the record, there are third-party (paid) services available for HealthVault.

4.4. Additional Services

Features that fall into this category are mostly the ones that can be more readily offered by the partner service providers. The ones that cannot are document printing, notifications, localization and search as they require an indiscriminate access to all the data stored in the record. Here Google Health has richer features with regards to printing (both wallet-sized and full-sized format). Surprisingly, neither Google Health nor HealthVault offer the user capability to search within their records. Similarly both have user interfaces available only in English. We expect, that given sufficient demand, the other missing features such as referral requests, secure messaging or quality comparisons will be eventually offered through the partner network.

5. Summary

In this work we elicited a list of 25 end-user features which in our view are necessary for a successful PHR implementation. Or analysis was based on a literature review – that is we tried to forecast what consumers will demand of PHR systems based on their general preferences for related services. So far our suggestions overlapped reasonably well with the first attempts to empirically quantify the utility of different PHR aspects [39] as well as with other theoretic frameworks [26]. We proceeded by evaluating two major PHR service providers: Microsoft HealthVault and Google Health against our feature list. This evaluation pointed already to the limitation of our framework – since both PHR products are also extendible platforms, whose functionality from the standpoint of the end-user depends on how he is willing to configure it and for what additional services to pay, no definite statements as to what system offers richer functionality can be made. However, our framework also covers features which can be the limiting architectural factors for the platform as a whole, particularly in the areas of patient information and personal control. Also, we've uncovered some patterns as to which functions are likely to be outsourced to the partners and which are likely to be done in-house. Furthermore, we have identified some unexpected functionality gaps such as the lack of full-profile search or secure messaging with both PHR providers.

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