Patient-centric portable health record exchange: A feasibility study

Audrey Ozols1,2, MBA; Eugene Luskin3,4, BA; Paul Buehrens5,6,7, MD

1 VYRTY Corporation, Redmond, WA, United States
2 Arizona State University, Tempe, AZ, United States
3 VYRTY Corporation, Redmond, WA, United States
4 University of Haifa, Haifa, Israel
5 VYRTY Corporation, Redmond, WA, United States
6 Lakeshore Clinic, Kirkland, WA, United States
7 Case Western Reserve University School of Medicine, Cleveland, OH, United States

Corresponding Author:
Audrey Ozols, MBA
VYRTY™ Corporation
17371 NE 67th Court, #206
Redmond WA 98052
United States
Phone: 1 888 918 9789
Email: ato@vyrty.com

Abstract
Background: Patient medical records contain important information for healthcare professionals to make the right decisions that provide efficient care and optimize quality patient outcomes. Electronic health record (EHR) systems are now the standard to document patient health information. However, the exchange of patient protected health information remains a challenge due to the lack of connectivity across hundreds of different EHR systems.

Objective: The aim of the study is to describe the implementation of a secure and EHR-agnostic portable patient medical record technology, and to describe initial user experiences.

Methods: We developed the VYRTY™ solution, a HIPPA compliant and secure medical record card and reader that allows for user authentication, patient authentication, data capture, data storage, and documentation sharing that works with any EHR system. Storage of all patient medical records is encrypted on the VYRTY™ card allowing safe patient transportation of medical records. Physician activation was phased in over the first 5 months of the one-year pilot. Patient enrollment was voluntary and was complete within 8 months from start of the pilot. Physicians uploaded medical record documents from their EHR by using the print function. Patients that were referred shared their VYRTY™ card with the receiving physician for downloading of medical records. The exchange of medical records was recorded by the VYRTY™ system and personal interviews were conducted and recorded to assess user experience.

Results: One hundred and ninety-four patients participated out of 200 enrolled, while 23 physicians actively participated out of 45 enrolled. Patients utilized their VYRTY™ cards 49% of the time, and physicians downloaded documents 51% of the time during the 1-year pilot period. Participating physicians found VYRTY™ easy to use and their patients were very satisfied with the convenient portability of their medical records.

Conclusions: VYRTY™ was implemented successfully and found to be easy to use by physicians and patients. Using the VYRTY™ system gave patients their own medical records to share with other providers, which effectively solved the problem of exchanging health information between different EHR systems.
**Keywords:** patient medical records, interoperability, health information exchange, health records, electronic health records, electronic medical records, mobile health record, mobile medical record

**Introduction**

Care coordination depends on the timely sharing of relevant patient health record information in order for physicians to deliver optimal care and informed treatment decisions. In the United States, there are currently about 684 different electronic health records systems (EHR) in use, and most with very limited health information exchange (HIE) systems connecting all of these disparate EHRs. [1] In cases where there is a functioning HIE system, physicians find it cumbersome and time consuming, only to discover partial or often times inaccurate patient health record information. [2] The results of this disconnected health information highway are apparent with recent studies confirming only 15% of physicians actively use HIE systems. [3] To compound the lack of HIE utilization, the incomplete content, workflow disruption, and difficulty accessing HIE content makes it nearly impossible for physicians to reliably have the right information, at the right time, in order to deliver the right care for their patients. [4]

To help address this problem, we test piloted a novel patient-centric portable medical record technology at Evergreen Health Partners in Kirkland, Washington starting November 2015 and ending December 2016. Multi-specialty provider organizations participating included Cascade Heart Clinic, Evergreen Cardiology, ProOrtho, Puget Sound Gastroenterology, Advanced Family Medicine, Evergreen Internal Medicine, and Lakeshore Clinic. The VYRTY™ system was used to connect patients and providers across 8 different EHR systems by using a secure platform which enabled patients to transport their own, and complete medical records using a card.

**Methods**

The VYRTY™ solution has three major components: the VYRTY™ patient card, the VYRTY™ reader, and the VYRTY™ RFID user badge. To access a patient’s medical information, a physician simply inserts a patient card into the reader and taps their user badge across the top. The VYRTY™ software application automatically opens and the patient’s documents are immediately accessible. (Figure 1)

Figure 1. The VYRTY™ solution

---

The VYRTY™ patient card contained an embedded memory chip. An identity module was used for storage of the security certificates to authorize the encryption and decryption of documents. The memory chip was also used for off-line storage of actual medical documents. The three-factor authentication process of the VYRTY™ solution combined with off-line storage provided a secure environment for patient health information exchange, making it practically unhackable. A more detailed description of VYRTY’s security features can be found in Table 1.
The Evergreen Health Partner (EHP) pilot tested the viability of VYRTY™ cards and VYRTY™ readers as a solution for the portability and accessibility of a patient's electronic medical record across any EHR system and between unique points of service. VYRTY™ cards were distributed to 200 patients over the test pilot period. VYRTY™ readers were distributed to 45 participating providers, which included fifteen minutes of in-service training. Patients were randomly selected and on-boarded by their primary care physicians, which included signing of a consent form and photo ID.

The primary objective of the Evergreen Health Partners pilot was to test the feasibility of electronic medical record exchange between different EHR systems and points of service. This included physician uploading of EHR generated medical records and downloading of exchanged EHR generated documents by a different provider. A record exchange was defined as one unique physician medical record upload, followed by one unique physician download or viewing, and was dependent upon the patient using their VYRTY™ card to enable the exchange. Each medical record exchange was counted as only one unique exchange between independent providers, even if the patient had multiple documents or if the receiving physician accessed those patient documents multiple times.

Participating physicians were enrolled starting in November 2015, and all 45 participants were fully trained and on-boarded by April 2016. Physicians added consenting patients at will starting in November 2015 until June 2016, when patient enrollment reached 200. After the initial physician encounter, patients carried VYRTY™ cards with uploaded medical records to the receiving physician, where documents were then downloaded and viewed. There was no other training or communication for patients after the provider enrollment encounter.

Utilization and demographic data was collected using the VYRTY™ system, while provider interviews were conducted and recorded to report usability, satisfaction, and patient experience.

<table>
<thead>
<tr>
<th>Security features</th>
<th>VYRTY Solution implementation</th>
</tr>
</thead>
<tbody>
<tr>
<td>User authentication</td>
<td>Requires user badge with embedded security certificates which are cross-referenced by the VYRTY™ reader to ensure the user is registered and authorized to access the VYRTY™ System.</td>
</tr>
<tr>
<td>Payload security</td>
<td>A VYRTY™ Patient Card contains two embedded chips inside of it, an identity module chip for storage of the security certificates used to authorize the encryption and decryption of documents, and a memory chip used for the storage of actual medical documents.</td>
</tr>
<tr>
<td>Audit trail</td>
<td>Logs user access to patient information</td>
</tr>
<tr>
<td>Data encryption</td>
<td>Temporarily stores records in encrypted area across multiple servers. Records are encrypted with public patient’s key and optionally with public key(s) of organizations that are authorized for immediate data access. Data is temporarily stored on (multiple) servers until (1) it is committed to patient’s card and (2) access time frame is over.</td>
</tr>
<tr>
<td>Off-line data storage</td>
<td>No permanent storage of patient health information in on-line database. All records stored on individual encrypted VYRTY™ card.</td>
</tr>
<tr>
<td>Optional anti-tampering mechanism</td>
<td>Encryption motherboard has built-in anti-tampering</td>
</tr>
</tbody>
</table>
mechanisms that will physically short-circuit in the event of malicious interface.

Secure VYRTY Reader data transmission
Requires transmission of patient health information using encrypted VYRTY™ reader. Temporary completion servers store randomly selected ‘pieces’ of encrypted files which are automatically deleted whenever they are reassembled onto a card while it is inside a VYRTY™ reader.

Multiple levels of data access
3-way authentication (patient’s card, doctor’s RFID card, VYRTY™ reader)/offline local (encrypted) data storage – full access (may depend on provider)

Table 1. Security features implemented to make VYRTY™ solution secure and Health Information Portability and Accountability Act (HIPPA) compliant

Results
During the pilot period a total of 458 unique EHR generated records were successfully uploaded by physicians to patient VYRTY™ cards, and 262 unique exchanges of those health records were securely received by different physicians using eight different EHR systems.

Out of 200 enrolled patients 194 activated their VYRTY™ cards. Twenty-three out of 45 enrolled physicians were active health exchange participants. Ten physicians represented nearly 90% of the health information exchange volumes. (Figure 2) Thirty-six percent of providers actively uploaded medical documents while 51% (95% CI, 0.37-0.65) viewed exchanged medical documents.

Figure 2. Top 10 provider utilization patterns

Ninety-six out of 194 activated patients had their medical documents viewed by a different physician, which represents a 49% (95% CI, 0.42-0.56) patient rate of health information exchange. Primary care physicians uploaded a majority of patient medical records, accounting for 90% of all new document uploads, followed by cardiology, orthopedics, and gastroenterology. Sixty percent of medical records downloaded were viewed by primary care, followed by cardiology (29%), orthopedics (9%), and gastroenterology (2%).

Forty-eight percent of receiving physicians viewed one unique patient medical document per encounter, while 39% viewed 2 to 4 unique documents, 11% viewed 5 to 9 documents, and less than 2% viewed 10 or more unique documents.
A majority of participating patients were male, 141, between 20-100 years of age, with a median age range of 50-59. The active participant age range reflects the demographics of the participating physician practices and the random nature of enrollment.

Physician participants reported the VYRTY™ solution fit easily into existing workflows and saved physician and staff time compared to established medical record sharing processes. The three-factor security feature was also reported as highly important to both the physician and patient. Participating physicians reported their patients were satisfied with the VYRTY™ card and were enthusiastic to have control of their own medical records. [5]

**Discussion**
This was the first feasibility test pilot for the patient centric HIE VYRTY™ solution. VYRTY™ technology successfully exchanged patient medical records across multiple, and disparate EHR systems, achieving our primary objective. Although physician use of exchanged health information was only 51%, we found this utilization level to be high considering the national average referral rate is 30% [6], plus there were no mandatory requirements or financial incentives for physicians to participate in the pilot. Furthermore, the 51% HIE physician usage rate with the VYRTY™ system exceeds recently reported National HIE physician usage rates by 36%. Some factors that may have contributed to this high physician utilization rate include VYRTY’s easy fit into existing physician workflows, simple for physicians to learn and use; about 15 minutes, bidirectional sharing of records between specialists and primary care, and patient enthusiasm to engage their physicians with their own medical records card.

Overall patient utilization of VYRTY™cards for health information exchange was 49% (of all participating patients) during the pilot period but considering the physician exchange rate of 51% (meaning only 51% of participating patients have seen more than one physician during pilot timeframe), patients actually used their VYRTY™ cards for their documents transfer between physicians 96% of the time given the frequency of receiving physician encounters.

The acceptance and utilization of the VYRTY™ card by patients is more than four times that of Australia’s “MyHealthRecord” SMART phone medical record App (21%). [7] Some possible explanations for this difference include use of a card system rather than phone application, physician initiated uploading and downloading of medical record documents, and simplicity of the VYRTY™ solution reducing time and effort required by the patient.

Further analysis of the EHP pilot showed that primary care physicians initiated the upload of most EHR documents, while specialists downloaded more EHR documents than they uploaded. This is no surprise, at it follows normal US practice patterns placing primary care as the medical home lead for patients.

Interestingly, most physicians viewed only a select few EHR documents with one type being physician notes. According to a recent HIE systematic review by AHQR, the lack of physician notes to set the context in the patient’s medical record file is one of the barriers to physician use of HIE. [8] The VYRTY™ solution offers inclusion of physician notes, and therefore this may be a reason it was selected more often than other types of documents for viewing.

Patients and physicians reported that the security features of the VYRTY™ solution was important and the three-factor authentication process to ensure security of patient health information did not interfere with office workflows or the ease of VYRTY™ card use by patients. Recent publications confirm the importance of health information privacy as one of the barriers to patient use of HIE portals. [9] Next generation versions of the VYRTY™ solution will take security into great consideration, especially in light of recent security breaches with cloud-based storage such as with Experian.

Although there was enough utilization to prove VYRTY™ feasibility we learned that VYRTY™ utilization is significantly impacted by existing referral patterns, therefore future studies that measure patient outcomes and cost reduction will need to consider referral patterns and utilization volumes in order to achieve the critical mass necessary to observe significance. We also learned that executive leadership endorsement is essential to widespread uptake and utilization among physicians. We believe the physician document upload and exchange rates would have
been significantly higher with leadership endorsement of this pilot. The importance of executive leadership endorsement for HIE adoption is also noted in the recent HIE systematic review by AHRQ.

More studies are needed to assess behavioral and financial factors that impact utilization of VYRTY™ by both providers and patients across the care continuum. These contextual factors will be important to design future well-controlled studies to measure the impact VYRTY’s health record exchange solution may have on improving patient outcomes and reducing the overall cost of healthcare.

Limitations
There are several limitations to this study including the limitation to generalize results of a small sample, and subjective provider reported outcomes.

In this report, we describe the technology and provide feasibility results from initial users. The small sample may not be representative of all physicians or patients and could be biased in favor of more engaged physicians and patients, overstating the utilization and acceptance rates reported. Furthermore, the results may be biased because many pilot participants did not use the VYRTY™ system during the pilot period; they may simply not have appreciated the value of VYRTY™ or they may not have had a need or opportunity to use the system.

Patient utilization was limited by physician referral patterns and frequency of patient-doctor visits throughout the pilot period and therefore may not represent general population utilization patterns.

A variety of sociotechnical factors can influence a clinician’s and patient’s use of health information technology (HIT); including hardware and software, clinical content, human computer interface, policies, procedures, external rules, regulations, and system measurement and monitoring. [10]

A larger sample would be needed to generate statistically robust measures of usability and satisfaction. Demonstrating hard patient outcomes would require a powered, controlled trial.

Conclusion
The VYRTY™ solution enabled physicians to exchange patient health record information easily with other physicians using different EHR systems. Participating physicians found the VYRTY™ solution resulted in office efficiencies saving time, effort and associated costs.

Most importantly patients used their VYRTY™ card nearly 100% of the time, which demonstrates high patient acceptance of the VYRTY™ card.

Acknowledgements
We thank Raif Khassanov, Vladimir Abashyn, Eugene Kolker, Jacob Grinberg, Marc Snedden, Svetlana Luskin, Richard Quan Liu, Sergey Bezruchkin and multiple partners for their assistance with design and development of the portable patient medical record technology. We thank Tom Martin, Senior Vice President & Chief Strategy and Information Officer of EvergreenHealth, who sponsored the feasibility test of this technology. Generous funding for this project was provided by a grant from EvergreenHealth. We thank the following participants Cascade Heart Clinic, Advanced Family Practice, Lakeshore Clinic, ProOrtho, Evergreen Cardiology, Evergreen Internal Medicine, and Puget Sound Gastroenterology. The sponsor had no role in the design and conduct of the study; and collection, management, analysis, interpretation of the data; and preparation of the manuscript. Tom Martin and participating physician groups reviewed and approved the manuscript.

Author’s Contributions
Eugene Luskin and Paul Buehrens contributed to the design and development of the technology. Audrey Ozols and Eugene Luskin analyzed and interpreted the data. Audrey Ozols, Eugene Luskin, and Paul Buehrens drafted the manuscript. All authors revised the manuscript and approved the final version for publication.

Conflicts of Interest
Eugene Luskin serves as Chief Executive Officer and is an investor in VYRTY Corp. Paul Buehrens serves as Chief Medical Officer and is an investor in VYRTY Corp. Audrey Ozols serves as Chief Strategy Officer and is an investor in VYRTY Corp.
Jacob Grinberg, MD with Advanced Family Medicine is an investor in VYRTY Corp. Joseph Condon, MD with Cascade Heart Clinic is an investor in VYRTY Corp.