Emerging Technologies in Healthcare

A White Paper

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Introduction

This white paper highlights a range of healthcare information technologies – either emerging or in place today – that are significantly transforming how healthcare services are delivered. Social media communication is a proven, ever-growing medium for patient-to-patient and provider-to-patient interaction in today’s highly connected world. Emerging tools for care coordination, population health and disease management are becoming essential to the ubiquitous pursuit of quality improvement. Mobile applications also are becoming fundamental facilitators of patient and family engagement, provider-to-provider communication and telehealth. Finally, healthcare has become the focus for cutting-edge computer science, where speech recognition, natural language processing and cognitive computing are coming together through artificial intelligence to tackle “big data” and improve medical knowledge and care delivery.

Social Media

Patients are trending towards a social media preference in healthcare, and providers have yet to fully answer the call. For example, one-third of American adults are using social spaces as a natural habitat for health discussions; 51% of patients say they would feel more valued as a patient through digital health communication; 45% of people said social media would affect their choice of provider; 61% of people would trust information posted by providers on social media – and yet only 26% of hospitals in the U.S. participate in social media. The physician community is now beginning to realize the “tremendous opportunity and power” social media represents as a tool to connect with patients and strengthen and preserve the physician-patient relationship.

Tools and Usage

Social tools, when paired with the use of personal health records, can be valuable in monitoring chronic disease. Online communities enable members to support one another and communicate with providers. They also contain knowledge that can be mined for public health research, building a sense of community and facilitating a population-oriented approach to health research. Social media can also quickly and easily direct patients to educational materials online, leading to more informed and prepared patients, which further increases engagement in their health care.

Facebook: Used to help understand population health and communicate with patients when conventional communication forms fail. Kaiser used Facebook during a blackout as an "early-warning network" to update patients; this approach was described as "essential and great customer service."

Twitter: Used to communicate activities, advice, tips and updates, to study the market to discern who is highly "followed," to better understand the public's perception of an organization, and to serve as a reliable and popular source to understand what patients are talking about.
Other representative social media tools include: CureLauncher.com, TU Analyze (app) via TuDiabetes.org, BANT (app), Caring Bridge (caringbridge.com), PatientsLikeMe.com and internal social networking.

Care Coordination

Effective care coordination leads to improved patient outcomes. Although caregivers themselves primarily accomplish care coordination, health IT tools can be useful facilitators. Technologies that facilitate complete physician access to patient information and support open, fast communication are essential to the development of a coordinated care model – not just within a single health system but with providers across different organizations as well. These bridges of communication enable everyone involved in a patient’s care to work as a team.

Tools and Usage

EHR: A comprehensive and robust electronic health record creates seamless care when all departments, physicians and other health professionals share access to it. The EHR also enables patients to connect with their care teams.

Patient Registries: Aggregating, cataloging and flagging patient data through disease registries serves to:

- Enable all clinical team members to collaborate and compare patients to others at the organizational, national and international levels to better understand diseases and improve care;
- Enable tracking and monitoring of individual patients as well as entire populations; and
- Determine how small changes in care pathways can have a significant impact on outcomes.

Remote Care: The transition of patient care outside of typical settings lends itself not only to increasing the accessibility of care but also making it more patient- and family-centered, continuous, collaborative and compassionate. Patients can be monitored and cared for in their homes with their current health information measured and transmitted real-time to clinicians and automatically uploaded to their patient record.
Personal Health Record (PHR): This represents a web-based platform – ideally integrated with a delivery system’s EHR – for patients to input their health information remotely where caregivers anywhere can access it, at any time.

**87% of providers polled in a recent KLAS study state that they plan to implement a PHR in the next 5 years.**

### Portals

Information sharing via portals – across or outside an enterprise – can make delivery organizations more efficient while also serving patients. There are two basic types of portals: 1) patient portals enabling provider-to-patient communication (supporting e-messaging and e-visits), e-prescribing and patient access to their medical records; and 2) provider portals enabling caregivers to communicate, refer patients and facilitate care coordination. Portals enable communication and information access from anywhere at any time and are viewed as vital to the future of healthcare delivery.

An essential aspect of portals is that they enable patients to view their medical record, which they desire but have not historically been able to. In general, 76-86% of people polled in national health studies expressed interest in having Internet access to their health information, yet only 7% had experience doing so. With access to their information, patients become more engaged in their healthcare, leading to improved outcomes and quality of care.

### Tools and Usage

**My Health Manager** (Kaiser Permanente portal): Kaiser has developed a portal that links the entire organization’s EHR (HealthConnect) with their PHR (My Health Manager) enabling patients to view information and communicate with clinical staff. Benefits of the technology include:

- Patients who use the technology are 2.6 times more likely than non-user patients to remain Kaiser members.
- In 2012, there were 116 million visits to the website, 88 million My Health Manager sign-ons, 32 million test results viewed, 13.4 million emails sent, 12 million prescriptions filled (over 30% of all fills) and 3 million appointments booked (more than doubling 2008 statistics), all resulting in 7-10% fewer office visits and 14% fewer telephone contacts.
- Patients who book appointments online are found to be more likely to keep them.
- E-messaging is associated with improved effectiveness of care for chronically ill patients. Diabetes control and screening improved 4.9 percentage points; cholesterol control improved 6.5 percentage points and screening improved 5.3; and blood pressure control improved 3.2 percentage points.

**E-Visits:** Online patient-provider consultations via email, chat or video, are referred to as e-visits and are demonstrated to save time and resources. Telehealth is one example.
Mobile Health

Mobile health (mHealth) is bringing new technologies to healthcare and facilitating vast new ways of interacting and delivering healthcare. One challenge the mHealth sector still needs to address is the integration of mHealth into clinical workflows so that seamless exchange of data without data re-entry and loss of productivity becomes possible. Studies indicate that wireless mobile technologies can positively impact patient engagement, clinical outcomes and operational workflow in remote monitoring programs.

Tools and Usage

**Smartphone:** Mobile phones can provide real-time alerts, reminders, education and coaching, can be connected to medical devices and PCs to transmit information to providers, and can bring information and new capabilities to the patient, enabling them to provide self-care.

**Texting:** Real-time communication with parents about their child’s health can be utilized to educate and encourage behavior. For example, daily messages that alternate between symptom information and care knowledge improve both lung function and perceived quality of life in asthmatic children.

**iTriage:** This online forum provides context to individuals based on the medical information they provide (symptom, meds, etc.), then leads users to the closest and most appropriate provider.

Natural Language Processing (NLP) & Cognitive Computing

Natural Language Processing (NLP) is a computer science/artificial intelligence tool that can exist inside almost any text processing software application to understand, identify, record and extract information from written and/or spoken human language. By processing text directly with computer applications, delivery organizations can leverage the wealth of available patient information in clinical documentation to improve communication between caregivers, reduce the cost of analyzing clinical documentation, automate the coding and documentation improvement processes and extract information from physician notes (for reimbursement, outcomes quality, population health, for example). In essence, NLP does not require caregivers to change their workflow processes; instead it enables applications to work within the clinical narrative.

NLP, sometimes referred to as “computational logistics,” helps address the added complexity and coding overhead of ICD-10. Virtually every NLP technology on the market today is built according to the same essential principles and fundamental functionality, and advanced NLP is one of the essential architectural components behind IBM’s cognitive computing system, Watson. There are two general types of NLP: 1) “Rule-based,” where humans determine the rules in which a computer processes language; and 2) “Machine-learning,” where artificial intelligence is used by computers to
determine and remember patterns based on a set of examples. Systems using a combination of both approaches currently tend to obtain the best results, but the systems of the future, like cognitive computing, will focus on machine-learning.

Cognitive computing is a new era of computing that incorporates NLP, along with other computer science and artificial intelligence approaches to fuse human-like brain cognition with computers’ ability to access, retain and quickly analyze incredible amounts of unstructured data. Conventional computing requires human pre-written programming to function and the computer’s memory and processing are retained, while cognitive computing – still very much in development – aims to fuse computational memory and processing so a computing system can learn from experience and react to situations like a human brain would. This type of computer system learns as it is exposed to information and interacts naturally with people, ultimately extending what either man or machine could do on their own. Cognitive computing systems improve over time as they build knowledge and learn a domain – its language and terminology, processes, and preferred methods of interacting. Through interaction with humans, this new computer system can apply critical thinking to “big data” that exists within healthcare to help clinicians make more informed decisions in real-time.

Tools and Usage

“Text Analytics” / “Text Mining” / “Text Processing”: This newer form of NLP takes a broader approach than conventional NLP to extracting data elements from text. NLP expresses a specific approach, and text analytics is the general concept around extracting data from free-text data, where a wider, more generic net can be cast. Basically, algorithms are run to gather high-quality, usable information from text.

Knowledge Extraction (auto-coding of medical record data): A medical record “code” contains the meaning of what happened to a patient, so the NLP engine must be able to analyze patient data and extract knowledge from whatever related and relevant material it can access (lab reports, physician notes, and discharge summary reports for example). Patient data is typically de-identified for NLP analysis.

Speech Recognition (SR)

This technology represents the translation of spoken language into text at either the front-end or back-end of the clinical documentation process. In most instances, the use of SR within an EHR will not lead to the capture and storage of discrete data. New approaches utilizing front-end SR are being pursued to code data directly from speech and capture it within the EHR.
Tools and Usage

NLP Integration with SR (also referred to as Automatic Speech Recognition, or ASR): Verbal dictation is transcribed directly into structured physician notes and EHR templates as text and data. In one such example, Allscripts is working with M*Modal to integrate NLP into their ambulatory EHR system to convert voice to text and create discrete data elements for EHR templates, putting “problems, procedures, and medications into the correct fields.”

Front-end SR: On the front-end, the provider dictates into an SR engine, the recognized words are displayed as they are spoken, and the dictator is responsible for editing and signing off on the document. Front-end SR tools are now widely used in conjunction with EHRs.

Back-end SR (or deferred speech recognition): The provider dictates into a digital dictation system, the voice is routed through a speech-recognition machine, and the draft document is routed along with the original voice file to a human editor, where the draft is edited and finalized, minimizing the physician’s role in reviewing and editing the transcribed content.

Computer-Assisted Physician Documentation (CAPD): This emerging SR technology is intended to help physicians improve clinical documentation at the point of entry and accelerate healthcare organizations’ eventual transition to ICD-10. Clinicians will be able to use SR dictation to document patient encounters, preserving the unique patient story, while also incorporating relevant structured data. Automated prompts will be able to prompt physicians in real-time for additional information to help improve documentation and generate sufficient detail for ICD-9 and ICD-10 coding.

Wearable Sensing Technology & Remote Monitoring

Increased clinical evidence suggests the value of continuously capturing physiological data to manage chronic diseases and monitor patients post-hospitalization – and a growing number of medical devices are becoming wearable. By 2016, wearable wireless medical devices are projected to reach more than 100 million devices annually, with wearable sports and fitness-related monitoring devices representing 80% of that.

Remote monitoring has been found to lead to accountable care success: Essentia Health in Duluth, MN has been remotely monitoring congestive heart failure patients since 1998 as part of their heart failure monitoring program. Patients are reminded to weigh in each morning by a talking scale; the scale then sends its data to Essentia. The results of this program have concluded that daily electronic monitoring engages patients in their healthcare and helps accountable care organizations (ACOs) reduce 30-day hospital readmissions: no more than 2% of its heart failure patients are readmitted to hospitals within 30 days of discharge, compared with a national average of 25%.
Tools and Usage

Smart Textiles: Beyond bracelets and clip-on devices, sensors embedded into textiles are an emerging trend. Clothing made from smart textiles enable medical professionals to perform frequent and less costly health monitoring that can lead to more effective preventative care; this approach puts more information and control in the hands of patients.

Wearable Sensors / Remote Monitoring with Alert Signaling: These sensors stick to an individual like a Band-Aid, collect data, and wirelessly transmit a summary of the data to caregivers. Typically used in the home setting, the devices can measure a patient’s vitals then send readings to the user’s computer or cell phone as well as to caregivers; physicians can then automatically be alerted to changes in a patient’s condition, leading to more rapid intervention.

Patient and Family Engagement

A fundamental aspect to improving patient and family engagement is through an increased online presence in which providers and delivery organizations communicate with and engage patients at any time. By systematically and thoughtfully engaging patients online, a provider organization can become more relevant in the community. A byproduct of transitioning care to the home is engagement of the entire family in a patient’s care.

A general concern with information openness and transparency associated with patient/family engagement is patient privacy. For example, Boston Children’s is currently considering ways to manage patient engagement tools while addressing private adolescent matters like sexual history and use of birth control medication.

Tools and Usage

Many of the tools already described such as mobile/wireless technologies, patient portals and social media serve to increase patient and family engagement. Other tools have also shown to be very effective, including patient room entertainment, education and conferencing and even health videos.

Telehealth

Telehealth is the delivery of health-related services and information through telecommunication technologies, extending care delivery outside traditional provider walls. From a technical standpoint, it can be as simple as a phone conversation or as sophisticated as performing robotic surgery between different facilities in different locations. However, telehealth today is mostly thought of as wheeled robots with high-
quality video and audio communication capabilities enabling clinicians to accurately examine and consult patients from remote locations. This categorization of telehealth enables physicians to assist other physicians with patient care across distances, facilitating earlier-than-usual patient discharge and supporting quality care delivery in the home setting. Such an approach decreases the need, time and risks associated with patient transport, and “engages the whole family to participate in the care of the child,” as stated by the telehealth program developer at Boston Children’s Hospital. Although upfront investment in telehealth is perceived as high, long-term economic gains are projected via decreased hospitalization and overall improved care quality – particularly where organizations are at risk for the overall health of an entire population or community.

Tools and Usage

**Two-wheeled Robot with a Camera, Audio Equipment and a LCD Screen:** This is essentially a teleconferencing system on wheels for doctors to check in on their patients from afar. Physicians can move the robot, visually zoom, and converse with patients/parent real-time, providing consultation and even talking parents through a simple procedure like removing a temporary stent.

**Mobile Telehealth:** The Miami Pediatric Mobile Medical Clinic enables underserved local patients to consult with specialists from the University of Miami Health System, using UM's advanced telehealth program.

**Boston Children’s Hospital has begun using five $6K robots to send patients home much earlier than before and provide care remotely.**

Conclusion

From the low-tech phone call to the high-tech robot, technological tools designed to improve the accessibility and delivery of care, increase patient engagement, and lower the cost of treatment are being utilized everywhere. The use of social media and mobile devices in healthcare, in particular, are trending so quickly that providers are having to scramble to keep up with consumer demand. The tools are diverse and still evolving, and although each comes with its own risks, the benefits are clear. To stay competitive, healthcare providers will need to keep up with the latest technologies and invest in making them a part of their short and long-term strategies.
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