# Information Technology Trends Impacting Health Care: Artificial Intelligence (AI), Cloud Computing, Advanced User Experience/Interfaces, and Big Data and Analytics

Information technology continues to evolve at an increasing rate. Four of the major trends currently underway are addressed in this white paper:

- Artificial Intelligence
- Cloud Computing
- Advanced User Experience/Interfaces
- Big Data and Advanced Analytics

All of these trends currently impact, or will impact health care from both provider and payer perspectives. It is important to note that there is significant synergy among these technologies; they are often used together to achieve an optimal solution.

## Artificial Intelligence (AI)

**AI is the usage of computer systems to perform tasks that require a level of perceived intelligence.** A distinguishing feature and common use of AI systems - versus "traditional" computer systems - is the ability to perform certain sophisticated tasks without necessarily requiring programming.  Common uses are:

- Diagnostic, advisory and planning assistance
- Speech recognition and synthesis
- General pattern recognition, often across large and diverse data sources
- Natural language understanding and language translation
- Image analysis
- Robotics

AI techniques, massive parallel computing, and specialized processors have evolved to the point where AI usage is now practical and beneficial for a wide variety of applications. As its capabilities continue to expand, widespread usage in the near future is inevitable.  AI has the potential to significantly increase the quality of health care while decreasing overall costs.  Advanced diagnostic assistance across a range of medical disciplines, intelligent real-time patient monitoring, automated member assistance for health insurance, call center augmentation, etc. are health care related areas that will be positively impacted.  An organization that identifies and addresses appropriate opportunities can gain significant competitive advantage.

AI is a new paradigm that requires new techniques and skills for providing solutions. For these AI based solutions, the focus shifts from traditional programming to the capture and representation of knowledge that can be leveraged by a range of underlying algorithms depending on the use case.  AI usage impacts education and training, solution development methodology, and software and hardware infrastructure.  Due to specialized software and hardware, AI solutions are often cloud based; several cloud vendors offer APIs (application programming interfaces) for common AI related tasks such as speech recognition, natural language understanding, and sentiment analysis.

**A first step is to identify opportunities that lend themselves to an AI based solution with a positive cost/benefit impact.** As with any new technology, early success fosters further usage and a broader awareness of the impact of AI on an enterprise.

## Cloud Computing

Cloud computing involves the use of remotely distributed computing resources – hardware and software – over the Internet.  These resources are typically managed by vendors, known as "cloud providers," that specialize in cloud computing.  Cloud computing is distinguished from traditional on-premise computing for which organizations host and manage their own resources.

**Different forms of cloud computing are classified as services; while there are many additional types of specialized services, the following are the most commonly referenced cloud services:**

| IaaS - Infrastructure as a Service | PaaS – Platform as a Service | SaaS – Software as a Service |
|---|---|---|
| IaaS is the most basic, and least abstract cloud service; it provides virtualized computing resources (CPUs, memory, storage, operating systems, networking, etc.) that can be quickly provisioned and configured.  IaaS provides the most flexibility of cloud services since any type of software can be deployed; however, it also requires the most technical expertise relative to system configuration and software deployment. | PaaS is a further abstraction of IaaS; it enables the direct development and execution of custom applications without having to initially perform lower level system configuration and software deployment as required with IaaS.  APIs (application programming interfaces) are provided for access to a variety of pre-configured application servers, database software, and networking capabilities. | SaaS is the highest level of abstraction and easiest to use since it doesn't require any custom development as required with PaaS; a software vendor provides its application for direct usage via the Internet.  SaaS applications typically provide both a user interface and an API for programmatic access to the application's functionality. |

When used appropriately, significant cost savings can be achieved since "cloud providers" can leverage economies of scale that can be difficult for an organization to match on-premise.  Just as important as cost savings, the time to provision, install and configure new hardware/software solutions can be dramatically reduced to meet rapidly evolving business requirements.  Therefore, an organization should objectively evaluate cloud computing opportunities for both cost and agility competitive reasons.

Security, reliability, performance, and vendor support need to be addressed for any use of cloud services; depending on the situation, these considerations could be either positively or negatively impacted when compared with an on-premise solution.

An organization may effectively use a combination of cloud services (IaaS, PaaS, SaaS and various specialized services) depending on its range of computing and business requirements.  Also, a "hybrid" deployment model – where on-premise and cloud computing resources are jointly used – is often required by large enterprises.

Identifying and pursuing cloud computing opportunities via an organized, collaborative effort across an enterprise – both business and information technology areas - is an effective way for an organization to realize significant benefit from this rapidly evolving technology.

## Advanced User Experience and Interfaces

This topic addresses a broad range of interactions between people and computer systems such as:

Advanced Conversational User Interfaces (CUI) such as chatbots and personal assistants

Mobile-centric design

Enhanced IVR (interactive voice response) capabilities

Enhancements to traditional graphical/touch user interfaces

Virtual and Augmented Reality

Recent advances in artificial intelligence are having a significant impact on certain types of user interactions, especially those that leverage speech recognition/synthesis and natural language understanding; the accuracy and sophistication of the interaction is continuing to be significantly enhanced, primarily due to recent enhancements in machine learning.

**From a general user experience perspective, users now expect to interact with computer systems on their terms: any device (mobile phone, tablet, laptop, TV), anytime and anywhere.** From a mobile perspective, users expect their context, such as location, to be leveraged when they approve; e.g. a "medical provider search" application is expected to automatically locate providers within the user's proximity.  Most importantly, mobile interactions need to provide a high quality user experience: performant and functional with an emphasis on simplicity as dictated by small screen sizes.

Recent advances in user interface techniques and technology are providing new and innovative ways for organizations to interact with customers, business partners, and employees.  These capabilities have a myriad of uses, such as:

- Better customer self-service while also reducing call center costs
- Novel approaches for customer attraction/retention
- Immersive training; e.g., via virtual reality

The effective use of new forms of user engagement and interfaces requires a re-examination of the existing user experience that an enterprise provides for its customers, business partners, and employees.  Furthermore, new skills are needed from both "user experience design" and technology development/implementation perspectives; e.g., the design of an advanced chatbot for customer interaction has many additional considerations beyond a traditional graphical user interface.

## Big Data and Advanced Analytics

**Big Data is a general term for data that has some or all of the following characteristics, referred to as the three V's, which distinguish it from traditional structured data:**

| Volume | Variety | Velocity |
|---|---|---|
| The most obvious distinguishing feature of "big data" is the massive amount of data being handled that may far exceed - often by multiple orders of magnitude - what is typically processed by traditional applications. | The data can be in a wide variety of formats that may be unstructured (e.g., textual documents), semi-structured, or structured such as traditional relational databases; it may also be non-textual data such as images, video, audio, etc. | The rate at which data is ingested often far exceeds that of a typical application; e.g., capturing detailed, real-time medical sensor data requires a massive amount of data for each patient to be processed and potentially stored. |

Dramatic advances and cost decreases in computing power and storage, along with evolving powerful new open source software now enables cost-effective and valuable analyses of massive volumes of data. It also provides an opportunity to re-evaluate the architecture/implementation of some aspects of costly, proprietary traditional data warehouse computing approaches.

While there are many types of "Advanced Analytics," an emerging trend is the cross-disciplinary usage of artificial intelligence and "big data" techniques. For example, machine learning is a common form of AI that is used for identifying patterns and trends across large and diverse sources of data.

A key consideration, depending on situational requirements, is whether data should be analyzed "in motion"; i.e., analyzed as it is being ingested from the original source versus just "at rest" (after it has been stored). "In motion" processing of data can provide several advantages:

- Time sensitive events and trends can be identified in near real-time.
- The amount of data that needs permanently stored may be reduced via advanced filtering and/or summarization.

An enterprise faces many challenges with "Big Data" and Advanced Analytics:

- Properly securing multiple occurrences of data in a range of formats
- Ensuring the integrity of the data: tracking its origin, transformations, and summarization
- Setting up the necessary infrastructure that may involve a wide range of software and supporting hardware; note that cloud based solutions are rapidly evolving to meet this need
- Acquiring and/or developing the required skills: setting up and maintaining the data repositories, ability to leverage sophisticated analytics software, and maintaining the underlying computing environment

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## Summary

**While each of these trends is having a major impact, the synergistic effect is much more significant:**

Artificial Intelligence is increasingly permeating Advanced Analytics and Advanced User Interfaces, along with many other aspects of computing.

Cloud Computing is facilitating the use of advanced Artificial Intelligence, and Big Data and Advanced Analytics, by providing an efficient computing platform for these resource intensive technologies.

Health Care companies that recognize and take the necessary action on these major technology trends can enhance their ability to compete, differentiate, increase customer experience, improve quality and speed delivery of services.

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## About HM Health Solutions

**HM Health Solutions (HMHS)** was formed in March 2014, as a subsidiary of Highmark Health. HMHS enables health plans to achieve top-line revenue growth, reduce costs and gain economies of scale.

The HMHS Enterprise platform leverages state-of-the-art cloud technology to support a comprehensive suite of offerings. HMHS offers expertise in multiple product lines, including Medicare, Medicaid, commercial, and individual business. Our industry-leading expertise in people, process and platforms deliver measurable results while increasing customer engagement. *For more information, visit www.hmhs.com.*

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