Hype Cycle for Digital Care Delivery Including Telemedicine and Virtual Care, 2020

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Initiatives: Healthcare and Life Science Digital Transformation and Innovation

This Hype Cycle tracks digital innovations for optimizing and transforming healthcare provider care delivery capabilities. It will inform healthcare provider CIOs' digital care strategies and roadmaps and ensure the informed calibration and risk management of their application portfolios.

Analysis

What You Need to Know

Healthcare provider CIOs can use this Hype Cycle to assist them in gauging and selecting technologies required to fulfill their HDOs' DCD vision and roadmap. Across the globe, technologies that enable digital care delivery (DCD) have been front and center of health delivery organization's (HDO's) tactical response to COVID-19. Unprecedented demand for healthcare services and the urgent need to protect healthcare workers and consumers from unnecessary exposure to the virus provided the necessary conditions to accelerate and scale adoption of digitally enabled models of care. In a matter of weeks, traditional barriers, including regulatory restrictions, funding models and clinician resistance, fell away paving the way for providers to deliver care outside of the four walls of the hospital, unrestricted by geographic location.

Over the coming months, healthcare provider CIOs will have to review the effectiveness of initial tactical solutions and update or develop their long-term strategic approach to DCD. As vendors respond to the increased volume of feedback and market opportunities, associated with rapid deployment of their solutions, we expect to see a rapid maturation of the technology underlying many of the innovation profiles aligned to this Hype Cycle.

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The Hype Cycle

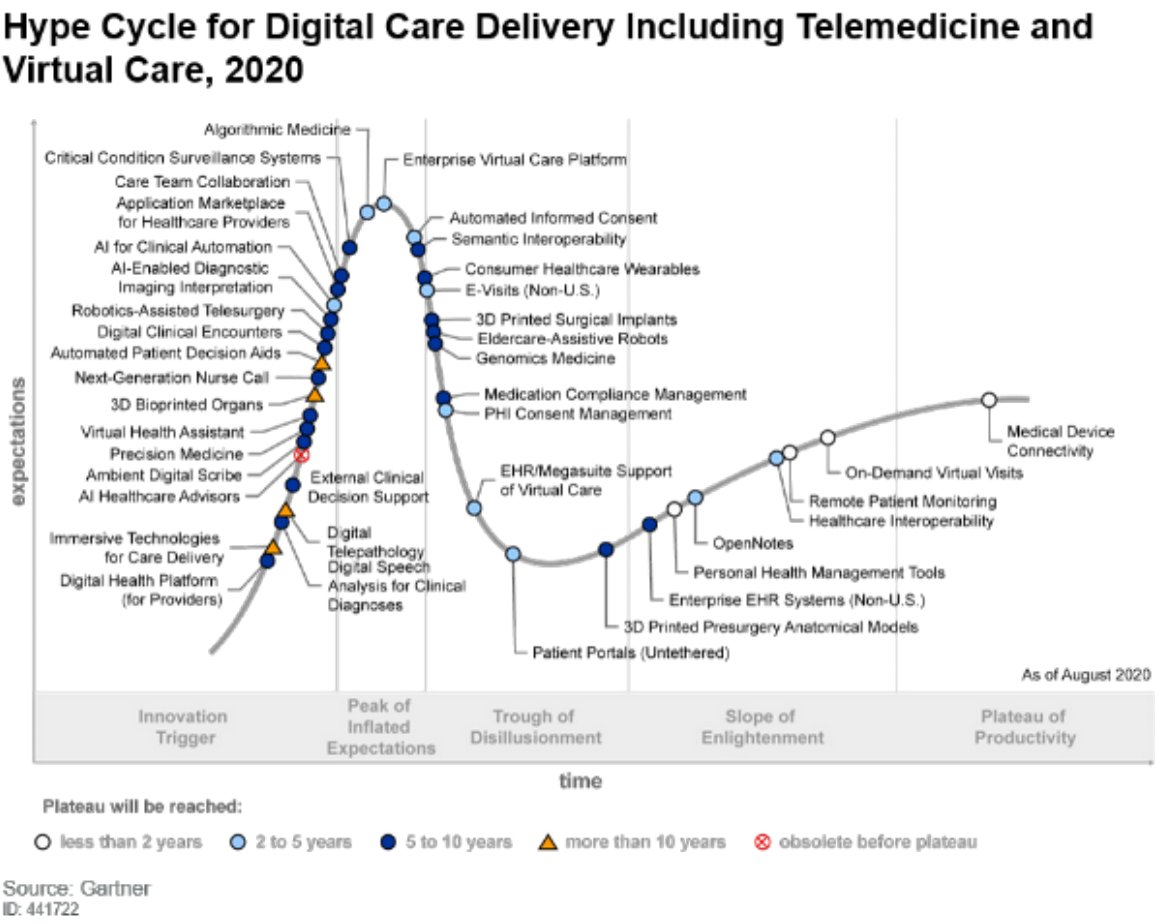
The Hype Cycle for DCD covers a broad range of technologies that enable the HDO to optimize and transform clinical care delivery. Advanced analytics, AI, and virtualization of care streamline and transform clinical workflows while reducing unwarranted variations in data capture and decision making. As a result, clinicians and patients are empowered to engage more effectively together, health outcomes are improved, and clinical efficiency is increased.

Innovation profiles supporting the virtualization of care, including virtual health assistants, enterprise virtual care platforms and consumer healthcare wearables, have catapulted forward in 2020. We also see both remote patient monitoring and on-demand virtual visits edging toward the Plateau of Productivity, and we predict both will reach the plateau within the next two years. We believe that the value of care virtualization for many conditions and care pathways will be enduring. However, we expect the pendulum to swing back slightly over the next 12 months as the hype dies down and reality sets in. We expect HDOs to work to address issues that arise as a result of rapid deployment of these technologies as well as refine the clinical use cases to which they are applied. In order to ensure long-term sustainability and scalability, HDOs will push venders for greater interoperability of solutions to enable effective integration within core clinical workflows.

This year, we introduce two innovation profiles to the DCD Hype Cycle:

- Ambient digital scribe — Responding to clinician burnout associated with EHR use and documentation, this profile describes an emerging group of solutions that are designed to automate the clinical documentation process associated with a clinical encounter.
- Digital health platform (DHP) — This is an emerging architectural approach that enables HDOs to adapt to the rapid pace of changing customer demands, industry dynamism, disruption and partner capabilities through the composition of packaged business capabilities. It represents a significant shift away from the monolithic, EHR-centric application portfolio.

Figure 1. Hype Cycle for Digital Care Delivery Including Telemedicine and Virtual Care, 2020



Source: Gartner
ID: 441722

The Priority Matrix

The Priority Matrix is a companion to the Hype Cycle that maps the benefit of a specific innovation to its time to maturity. We create the matrix directly from the benefit rating and the time-to-plateau values for each innovation. The Priority Matrix summarizes two key Hype Cycle take-aways:

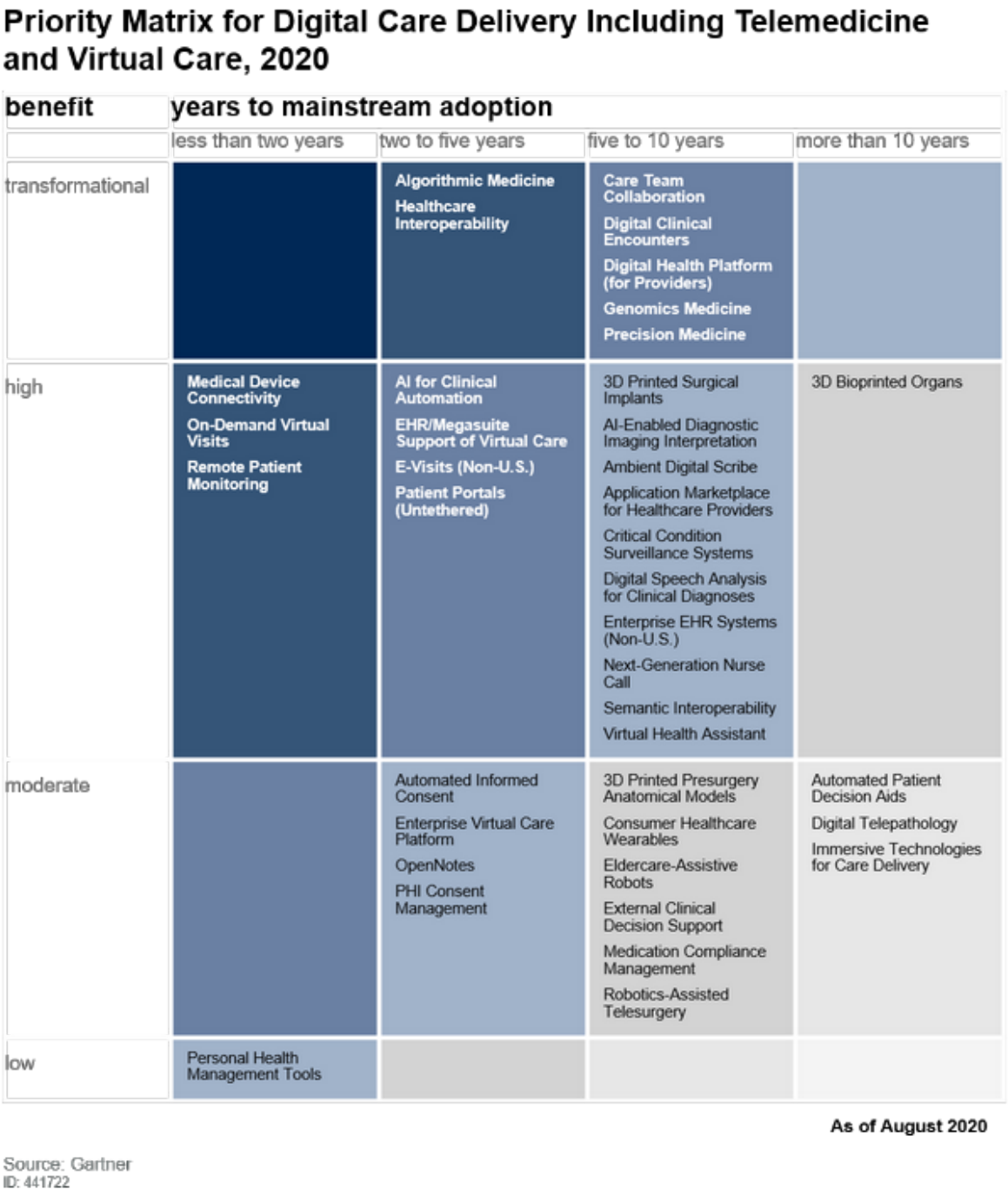
- How much value will a particular innovation provide?
- When will the innovation be mature enough to deliver that value at a manageable risk?

Investments that have a high potential impact and a more advanced level of maturity are located up and to the left in the Matrix. Those that have lower benefit and a longer time to value are situated in the Priority Matrix's lower right-hand sections. Because of wide, country-specific variation in adoption of the technologies included on this Hype Cycle, we have chosen to position profiles to reflect their most advanced status.

Innovations that leverage AI capabilities and those that support virtualization of care feature highly in the profiles that Gartner believes will deliver high or transformational benefits, the majority of which will take longer than two years to reach mainstream adoption. In order to capitalize on the maturation of these technologies, healthcare provider CIOs should focus their attention to planning initiatives for the next five years on these innovation profiles, as they promise the greatest clinical and operational impact.

We have designated the new digital health platform (for providers) innovation profile as having transformational benefit. Building out the packaged business capabilities enabled by the DHP will be critical for healthcare providers and their ability to rapidly respond to changing business requirements. While the time to mainstream adoption remains five to 10 years away, CIOs should start to prepare now for the evolution of the DHP. Familiarize yourself with the underlying concepts of the composable enterprise, and align procurement of new technologies to include requirements that will support your organization's efforts to build packaged business capabilities.

Figure 2. Priority Matrix for Digital Care Delivery Including Telemedicine and Virtual Care, 2020



Source: Gartner
ID: 441722

Off the Hype Cycle

In a continuing effort to respond to the changing dynamics shaping the course of specific technologies we feature in the digital care delivery Hype Cycle, we have renamed the following profiles:

- 3D bioprinted organ transplants is now 3D bioprinted organs.
- Algorithmic marketplace for healthcare providers is now application marketplace for healthcare providers.
- Remote medical monitoring is now remote patient monitoring.

On the Rise

Digital Health Platform (for Providers)

Analysis By: Mike Jones; Sharon Hakkennes

Definition: The digital health platform is an architectural approach that enables a healthcare provider to nimbly adapt their business and operating model in response to external disruption and change in business strategy. The DHP creates packaged business capabilities (PBCs) by refactoring functionality from internal and ecosystem partner applications. These PBCs can be used by nontechnical end users to streamline care delivery, prioritize resources and deliver positive health experiences and outcomes.

Position and Adoption Speed Justification: Healthcare providers have experienced the limitations of a monolithic, EHR-centric application portfolio. The well-intended but ultimately siloed nature of this architecture has successfully amassed massive data but also stifled innovation and slowed the pace of digital transformation. HDO CIOs' and executives' frustrations are exacerbated by the selective or restrictive attempts at interoperability by vendors, dubious application usability, and a bloated total cost of ownership (TCO).

The sudden disruption of the COVID-19 pandemic has woken up the leadership of every business to the existentially critical importance of business resilience. In healthcare this has exposed significant gaps in EHR capabilities related to adapting and scaling new ways of working like integrated virtual care. To compensate, the vast majority of providers have adopted solutions outside the EHR to respond.

The digital health platform approach will help remove the existing technological barriers and unleash the full power of digital innovation and transformation (see "The EHR Megasuite Oligopoly Will Result in Less Differentiation and Innovation — and Higher Total Cost of Ownership").

The end result is a composable enterprise (CE), defined as an organization that designs its business models, technology, organization and partnership ecosystems in a modular manner, so that it can safely and rapidly change (recompose) at any moment of need. Composable enterprise imposes a model of application design that imagines applications as experiences assembled by or for its users from packaged business capabilities (PBCs). PBCs are composed of purchased applications, internally developed capabilities, and partner capabilities chosen by the provider without vendor interference or data blocking.

The DHP approach is emerging rapidly as number of leading vendors in this space have released powerful cloud native capabilities to create personalized application experiences. This will break the stronghold of monolithic vendors and circumvent EHR vendor controlled application marketplaces.

Examples include:

- Microsoft “Virtual Rounding” capability using Teams
- Salesforce SaaS capabilities such as critical care resource management tools (Thrive Health/Traction) and COVID-19 care management and engagement (Theon)
- Better’s Platform, which provides a vendor-neutral, federated health data repository as well as low-code tools enabling health professionals to quickly build apps to support care processes

We have positioned this emerging profile early on the Hype Cycle to reflect maturity and market penetration. Despite being classified as “emerging,” we expect this Innovation Profile to rise swiftly up and over the peak wit “emerging,” we expect this Innovation Profile to rise swiftly up and over the peak within the next three years as new visionary platform entrants, regional interoperability regulation (e.g., ONC Ruling) and flexible cloud-first procurement frameworks (e.g., UK Digital Marketplace) will require incumbent vendors to adapt. We believe this profile will reach maturity and mainstream adoption within the next decade, and earlier for some organizations that are prepared to take bold moves toward reducing the investment in core EHR products that do not deliver full value or remain closed to this approach.

User Advice: The dynamic experience of the composable enterprise will become the prevailing architecture, integration and delivery model for healthcare digital innovation.

The CIO must:

- Align digital and IT strategy with existing business strategy through the power of people from clinical, business and IT backgrounds in the form clinical informatics fusion teams (see “Fusion Teams: A New Model for Digital Delivery”).
- Take appropriate actions on vendor sourcing across the current and future enterprise application portfolio (see “Healthcare Provider CIOs: Use Scenario Planning to Determine the Durability of Your EHR Megasuite Relationship”).

- Drive technology and data architecture decisions and organizational models that redefine the relationship between the business and IT.
- Modernize legacy applications toward the PBC model.

The hyperscale solution providers and channel partners along with a swelling open platform movement within the industry will lead to many monolithic solutions becoming marginalized as providers seek more nimble, cost-effective, and scalable digital capabilities that resonate with business and IT leaders.

Business Impact: The digital health platform will enhance and improve many areas of the healthcare provider business. Depending on the digital ambition and scope of each organization or ecosystem, the DHP will typically enable new digital clinical and business capabilities across consumer engagement, care delivery, real-time healthcare operations, and health analytics including precision medicine and health.

The benefit to the business is the ability to rapidly adapt to changing business requirements/capabilities supporting both optimization and transformation activities. It heralds a new era where clinical and consumer capabilities are driving the technology as opposed to today where the technology (and vendors) are somewhat dictating what the next set of business and consumer capabilities are.

Benefit Rating: Transformational

Market Penetration: 1% to 5% of target audience

Maturity: Emerging

Sample Vendors: AWS; Better; Google; InterSystems; Microsoft; Optum; Philips Healthcare; Salesforce

Recommended Reading: "Future of Applications: Delivering the Composable Enterprise"

"The Applications of the Future Will Be Founded on Democratized, Self-Service Integration"

"Traditional Intranets Are Dead — Modern Intranets Are Alive and Well: Part 2"

"Innovation Insight for Packaged Business Capabilities and Their Role in the Future Composable Enterprise"

"Healthcare CIO Top Actions for 2020"

Immersive Technologies for Care Delivery

Analysis By: Pooja Singh; Mike Jones

Definition: Immersive technology for care delivery is the application of virtual reality (VR) and augmented reality (AR) technologies to provide patients and clinicians with an ability to experience, practice and prepare for real clinical interactions. It has applications in medical education, preparing patients for treatment, clinical event simulation (e.g., surgical planning), improving the patient experience, clinical diagnostics and treatment.

Position and Adoption Speed Justification: VR has had a significant impact on several industries as a means of engaging consumers and professionals in a more immersive experience for a range of use cases (e.g., in increasing the safety of assembly line processes in car manufacturing). The adoption of VR solutions in HDOs is starting to show signs of promise with real-world examples and clinical evidence emerging of small-scale and innovative applications, such as:

- Reducing anxiety and preparing cancer patients for treatments by virtual walk-through. It also provides an alternative point of focus for patients during unpalatable treatments such as chemotherapy, and as an alternative form of pain management.
- Gamification for children undergoing surgery to engage them and help manage their anxiety toward upcoming procedures. See the CHARIOT program by Stanford Children's Hospital.
- Improve success rate of intravenous injections by projecting a patient's veins on the skin to quickly locate the optimal injection site for the procedure.
- Treating exaggerated fears (phobias), post-traumatic stress disorder (PTSD), social anxieties and psychosis.
- Helping patients rehabilitate themselves after a stroke by providing a means of focusing on rehabilitation activities and applying motivational techniques. See "Immersive Virtual Reality for Stroke Motor Rehabilitation."
- Effectively treating pain management, eating disorders, and cognitive and motor rehabilitation in hospitalized patients (a 2017 review of 2,024 citations). See "Virtual Reality and Medical Inpatients: A Systematic Review of Randomized, Controlled Trials."

AR and VR are combining in novel ways for use cases. VR headsets like Oculus Rift or HTC VIVE offer fully immersive experiences, and AR headsets like Microsoft HoloLens or Magic Leap allow the overlay of virtual objects onto the real world to create mixed reality experiences. Surgical Theater's patient-specific 360-degree CT/MRI/DTI allows patients and surgeons to step into a virtual reality reconstruction of a patient's anatomy for presurgical education and planning. Surgeons at St Mary's Hospital in the Imperial College Healthcare NHS Trust are using HoloLens to look inside patients before they operate on them. For example, surgeons can see a projection of blood vessels, bones and muscles overlaid on the patient's leg, along with annotations providing operational guidance enabling more-precise procedures.

Despite early innovations demonstrating significant outcomes, we believe the rate of adoption will be relatively slow. Efforts, so far, have been on a small scale, depend on expensive technology, and lack a sufficient body of evidence on clinical effectiveness and cost-effectiveness necessary for publications to publish. Consequently, investment rationale can be difficult to quantify.

We have positioned it early in the Innovation Trigger phase on the Hype Cycle. With a few exceptions (e.g., "experiential" VR and medical education), the use for direct patient care is mostly still being piloted and evaluated primarily in academic or specialist centers.

User Advice: Actively follow academic literature and the clinical community's acceptance and adoption of these technologies to help determine how quickly you can integrate these innovations into practice. Engage your early adopters in following the international consensus on best practices for the development and testing of VR treatments to bring rigor into research for patients, providers, payers and regulators to assess the validity of VR treatments. See "Recommendations for Methodology of Virtual Reality Clinical Trials in Health Care by an International Working Group: Iterative Study." The U.S. FDA conducted a public workshop in March 2020 for discussing evaluation needs, gaps and approaches for VR and AR in medicine.

Where clinicians are interested in piloting solutions, the HDO should do this within a tightly scoped and controlled "innovation" pilot that evaluates the results in terms of patient or clinician benefit, and experience and ease of integration into clinical workflows. As this technology is in the early stage of hype, seek reference site confirmation that the vendor has, in fact, achieved the benefits claimed.

Ensure commercial terms, data privacy and security are evaluated where patient- or clinician-identifiable information is traversing or being stored in a vendor cloud environment.

Business Impact: This technology is currently relevant in a small number of specific applications. Typically, these will be focused on providing an alternative (preevent) clinician or patient experience for an event they will later experience in the real world. In this regard, the aim is often to develop familiarity with that event and reduce anxiety or provide educational material.

The benefit rating is moderate, as there are now over 2,000 citations to study use cases and benefits. However, the use cases covered are generally more experiential and educational in nature, with small sample sizes. This may change in the future as the strength of the evidence improves and case studies are published with independently verified results.

Benefit Rating: Moderate

Market Penetration: Less than 1% of target audience

Maturity: Emerging

Sample Vendors: KindVR; Medtronic (Touch Surgery Labs); Microsoft; MindMaze; Surgical Theater; Virtually Better; VR Education Holdings

Recommended Reading: "Top 10 Strategic Technology Trends for 2019: Immersive Experience"

"How Virtual Assistants, Immersive Experiences and Robots Will Impact Your Organization"

"Predicts 2019: Healthcare Providers Must Embrace Digital Transformation"

"Top 10 Strategic Technology Trends for 2020: Multiexperience"

"Healthcare Business Driver: Medical Innovations in Therapy, Diagnosis and Care Delivery"

Digital Speech Analysis for Clinical Diagnoses

Analysis By: Sharon Hakkennes; Sachin Dev

Definition: Digital speech analysis for clinical diagnoses evaluates an individual's linguistic variables and vocal cues such as pitch, tone, pauses, word choices, speech rate and volume in order to noninvasively detect clinical abnormalities and behavioral health conditions. Solutions range from algorithm-based apps to platform-based technologies relying on AI and natural language processing (NLP).

Position and Adoption Speed Justification: The characteristics of our voice and the word choices we make can be evaluated to accurately detect a growing list of clinical conditions. This includes behavioral health issues (including depression, psychosis, dementia and PTSD), Parkinson's disease, cardiovascular disease and, more recently, lung disease. Startup companies and researchers are leveraging technologies to find ways to detect abnormalities sooner and less invasively. These language-based assessment systems often use artificial intelligence and machine learning to analyze speech patterns and codify voice biomarkers. The solutions analyze biomarkers such as subtle changes in pitch, rate of speech and hoarseness to suggest a diagnosis.

Early work has been very impressive and, while these solutions are not yet on many provider CIOs' radar, we believe that before very long these solutions will be ubiquitous. For example, evaluating conversations in real-time for patterns to detect risk, including the potential for suicide or of developing psychosis. COVID-19 is elevating the awareness of the technology and its potential value with recent announcements by several vendors currently developing solutions using speech analysis for the diagnosis and remote monitoring of patients with COVID-19, like CORDIO MEDICAL, Vocalis Health and Telling.ai with Allegheny Health Network. Overtime we predict that technologies to enable speech analysis for clinical technologies will become embedded as a core capability of healthcare chatbots and virtual health assistants.

These solutions can reduce the reliance on highly specialized clinicians and thereby improve early diagnosis and treatment of what could potentially be very debilitating illnesses. There is also the potential, with careful regard to regulatory constraints and privacy implications, to have these solutions run in the background during appointment scheduling calls or during any clinical encounter. In this way, diagnoses can be made much earlier — perhaps even before the patient or clinician becomes concerned. Despite impressive early results and the obvious potential of these solutions, more proof of clinical effectiveness and clarity on regulatory approval are required before there can be widespread adoption.

For 2020, this innovation profile has jumped from the position from post-trigger 15% (2019) to post-trigger 40%, primarily due to clinical interest in specific use cases and cohorts (e.g., mental health conditions, COVID-19), the increasing number of vendors and solutions, along with recently published pilot work indicating the hype is increasing.

User Advice: Provider CIOs need to work with clinical leaders and CDOs, CNIOs and CMIOs to understand these solutions and to identify potential use and business cases. Specialty physicians and speech language pathologists will have heightened interest. Given the very early nature of the solutions, all but the most aggressive academic medical centers should proceed cautiously. Start with small pilot projects to demonstrate both efficacy and practicality of using these tools. Involve risk management early in any decision to implement these solutions, to consider ethical, medical, legal and social issues — even in a pilot phase.

Business Impact: Digital speech analysis can provide significant clinical benefits by allowing for more accurate, rapid and earlier detection of disease and by freeing valuable clinical time. However, it is possible that using software in place of highly trained professionals can result in lower payments, especially if clinician signoff becomes unnecessary. Legal ramifications of the systems missing or making an incorrect diagnosis must be factored into any business case.

Benefit Rating: High

Market Penetration: Less than 1% of target audience

Maturity: Emerging

Sample Vendors: Canary Speech; Clarigent Health; CORDIO MEDICAL; Sonde; Telling.ai; Vocalis Health; Winterlight Labs

Recommended Reading: "Healthcare Business Driver: Medical Innovations in Therapy, Diagnosis and Care Delivery"

"Solution Path for Building an Effective Technical AI Strategy"

"Understand the Value of AI for Healthcare Delivery Organizations"

Digital Telepathology

Analysis By: Mike Jones

Definition: Digital telepathology permits the remote viewing and manipulation of digitized laboratory specimens for clinical purposes. Digital telepathology is based on digital pathology — the creation of a digital specimen by using microscopic array technology to produce a 3D representation of the slide for remote viewing and automated image analysis.

Position and Adoption Speed Justification: Telepathology has shown promise by permitting hospitals to take advantage of specialist expertise located elsewhere, without the need for the physical transfer of specimens and slides. Digital telepathology goes one step further (not just providing access to digital images of parts of slides or remote control of a microscope) by allowing an entire slide to be digitized, and thus, made fully available at a remote site.

Canada and the European Union (EU) now permit use of digital telepathology for primary diagnosis. This builds on the U.S. Food and Drug Administration (FDA) approval of the first system for one "whole slide imaging" device for primary diagnostic use in 2017. (Whole slide imaging enables the digitization of entire tissue slides and is a necessary first step for a wide array of digital diagnostic and advanced analytical tools to enter the field of pathology.) This should accelerate adoption. Recent evidence now indicates steady adoption for secondary diagnosis is below 20% for U.S. labs, with use for primary diagnosis still at around 1% (from Clinical Lab Manager, March 2020).

Aside from regulatory constraints, other barriers include cost and prodigious data storage requirements. A typical digital slide can be 500 MB after a 30-to-1 compression. Moreover, because hospitals are typically required to retain the glass slides, digital telepathology does not free up space for other uses (as picture archiving and communication system [PACS] did for radiology departments).

User Advice: Leading-edge healthcare delivery organizations (HDOs), especially academic medical centers, should explore the potential of digital telepathology for remote diagnosis, as well as for research and education. CIOs should evaluate new entrants on the basis of total cost of ownership (TCO), data compliance (e.g., HIPAA, GDPR) and likely ROI when implemented in their lab and clinical environments. Most digital pathology manufacturers can support a HIPAA-compliant solution by encrypting PHI-sensitive metadata such as slide label, hospital, patient, case and specimen information.

Business Impact: Once digital telepathology is more widely adopted, it is likely to be of high value in:

- Helping HDOs provide more accurate and more efficient diagnoses

- Facilitating second opinions and training
- Using the expertise of pathologists more effectively
- Outsourcing pathology readings to pathologists in lower-cost locations (as has been done with radiology)

However, telepathology will not provide the cost savings that PACS and teleradiology have delivered by eliminating film processing and storage. Therefore, the overall benefit rating of telepathology is moderate.

Benefit Rating: Moderate

Market Penetration: Less than 1% of target audience

Maturity: Emerging

Sample Vendors: Inspirata (Omnyx); Leica Biosystems; MetaSystems; Meyer Instruments; Philips; Roche

Recommended Reading: "Healthcare Innovation Trends: Transforming Care Delivery"

"Healthcare Innovation Trends: Reinventing Hospital Operations and Administration"

"Healthcare Provider CIO Guide to the Industry's Technology Innovation Trends"

"Healthcare Innovation Trend: Advancing Medical Science"

"Business Drivers of Technology Decisions for Healthcare Providers, 2020"

External Clinical Decision Support

Analysis By: Sharon Hakkennes; Mike Jones

Definition: External clinical decision support (CDS) involves the use of third-party solutions integrated into a clinical workflow that contextualizes patient-specific information. This supports timely, evidence-based, clinical decision making and reduces unnecessary variations in care. Solutions augment an EHRs' CDS functionality and include clinical rules, alerts and reminders aligned to evidence-based clinical guidelines, order sets and care plans.

Position and Adoption Speed Justification: The capability of rendering external CDS as interoperable, actionable content within the clinical workflow of an electronic health record (EHR) is designed to change the way evidence-based care is practiced. Relying on a third party to provide and update the evidence basis for CDS is much simpler and less labor-intensive than HDOs developing and integrating content within the EHR rule engine. External CDS solutions provide more up-to-date rules and, therefore, higher-quality clinical care, as well as free up clinical and IT staff for other important work.

Early stand-alone CDS solutions were unsuccessful as they existed outside of the normal clinical workflow as referential content and, not often utilized. Solutions today have greatly improved, with many CDS vendors having now built out capabilities to integrate with the core EHRs. Although challenges with semantic interoperability and availability of adequate workflow engines to manage CDS for order sets and care plans remain. Poorly implemented solutions impede adoption due to factors such as low clinician trust in the CDS, alert fatigue and inappropriate alerts.

For example, MEDITECH provides its clients with real-time diagnostic imaging appropriateness use criteria (AUC) to comply with Centers for Medicare & Medicaid Services (CMS) requirements. This CDS mechanism supports the provider to access an electronic portal to access the AUC and consult a qualified Clinical Decision Support Mechanism (CDSM).

In the U.S., changing reimbursement models are fueling uptake of CDS solutions. For example, as of 1 January 2020 the Centers for Medicare & Medicaid Services (CMS) issued diagnostic imaging appropriateness use criteria (AUC) that include a qualified Clinical Decision Support Mechanism. Based on increasing adoption in the U.S. we advance this profile from post-trigger 25% in 2019, to post-trigger 45%. Adoption in other regions and countries is lower, impacted by the limited supply of external CDS solutions, clinical workflow integration options, and the proprietary nature of the content. We also observe wide variation in the degree of autonomy many health providers have, even under government-funded health systems, to standardize care and reduce unwarranted variation. More uses cases with demonstratable clinical and business benefits will be required to accelerate adoption across all geographies.

User Advice: CIOs, CMIOs and CNIOs should:

- Work collaboratively with clinical leaders to formulate policies to determine priority indications to use external CDS. Initial efforts should be focused on support of patient safety, regulatory requirements or conditions for payment, especially those that might change frequently. These can be the most difficult task for HDOs to track and keep up to date.
- Evaluate your EHR's capabilities and vendor roadmap for linking to external decision support solutions. Review the HL7 CDS Hooks specification 1.0 STU release (April 2019). Pay attention to how actionable the CDS is, and how it enhances decision making within the clinical workflow.
- Establish quantitative, as well as qualitative, metrics to determine if external CDS is effective, including adherence to CDS and its impact on patient outcomes.
- Evaluate emerging solutions which extend CDS across the care continuum, including postacute care, ambulatory, home health, hospice, behavioral health, care transitions and virtual care.

Business Impact: Today, HDOs need to keep abreast of new evidence-based content (or purchase it) and then implement new rules or modify existing rules within their EHRs. Often, CDS rules are incorporated during initial EHR implementation and not reexamined for lengthy periods of time. The ability to utilize external CDS rules and integrate this clinical content into the EHR rule engine significantly simplifies HDOs' ability to maintain the currency of their CDS content and to implement evidence-based standardized care. Ultimately, this improves clinical outcomes and reduces the cost to deliver this care.

Benefit Rating: Moderate

Market Penetration: 1% to 5% of target audience

Maturity: Emerging

Sample Vendors: Change Healthcare; EBSCO Health; Elsevier (Clinical Solutions); Hearst Health; IBM Watson Health (Truven Health Analytics); Stanson Health; Wolters Kluwer

Recommended Reading: "Healthcare Provider CIOs: Build Clinical Informatics Leadership to Succeed in Digital Clinical Transformation"

"Gartner's Update to the Enterprise EHR Generation Model"

"Best-Practice Framework for Realizing Healthcare Provider Value Across the EHR Life Cycle"

AI Healthcare Advisors

Analysis By: Laura Craft; Mike Jones

Definition: Artificial intelligence (AI) healthcare advisors enhance human performance on cognitive tasks such as diagnostic or therapeutic decisions as collaborators or substitutes, and ultimately support the clinician in diagnosing and treating disease. AI healthcare advisors ingest data in real time, examine it and augment it with a complex combination of AI techniques such as natural language processing, deep neural nets and machine learning. AI healthcare advisors make probabilistic recommendations with respect to diagnosis and treatment.

Position and Adoption Speed Justification: We have designated this profile obsolete before plateau. This change reflects the maturing role of AI in healthcare, as new and more-relevant technologies have been introduced that encompass the value and use case reflected in this obsolete profile. Those new technologies include AI for diagnostic interpretation, precision medicine, precision health and genomics medicine.

User Advice: CIOs and chief medical informatics officers (CMIOs) should expect sustained marketing. There will continue to be new applications and many startups eager to establish themselves. Be prepared to help educate executives, and evaluate when and how they — particularly the chief medical officer — should get involved. The Gartner research referenced below can help define and explain both the importance and the long path to value.

Innovative medical research and healthcare delivery center leaders should continue to explore AI healthcare advisors and consider teaming with (or investing in) platform or content development:

- Look to your core clinical systems and clinical content providers to lay out how they will incorporate or commercially leverage healthcare advisors and cognitive computing in their business models and architectures.
- Become the expert in making sure that your enterprise has high-quality training data available — which will be valuable no matter how quickly AI progresses.

- Assess organizational readiness and resource investment alignment to deliver on key strategies that will sustain long-term clinical and financial outcomes when determining involvement in the adoption of AI healthcare advisors.

Business Impact: Gartner predicts that the AI ad smart machine era will be the most disruptive in the history of IT. Given advances in genomics, immunotherapy, sensors and so many other major innovations on a similar time trajectory, disruption will hit healthcare — and especially its already overstressed physicians — very hard. Eventually, these advances will redefine what it means to be a physician and a patient. Many smart machine uses will be controversial for years to come. We believe the greatest impact of AI healthcare advisors may be on medical diagnosis error, which is the leading cause of medical malpractice claims and the cause of 80,000 to 100,000 significant injuries or deaths annually in the U.S. alone.

Enhancing, or sometimes displacing, the foibles of human performance with smart machines offers the prospects of dramatically impacting the nature and structure of organizations and how they achieve competitive advantage. However, HDO leaders should also note that there is new risk and danger from broken algorithms and failure to follow or document variance from AI healthcare advisors. Make sure there is an effective strategy for vetting and validating the applications and putting it into practice.

Benefit Rating: High

Market Penetration: Less than 1% of target audience

Maturity: Emerging

Sample Vendors: 2bPrecise; Enlitic; Genospace; IBM Watson Health; NantHealth

Recommended Reading: "Emerging Applications of AI for Healthcare Providers"

"Understand the Value of AI for Healthcare Delivery Organizations"

"How We Will Work in 2028"

"Healthcare Payer CIOs — Get Ready for the Age of Smart Machines"

"Healthcare Provider CIOs: Get Ahead of AI Innovation With Strong AI Governance"

Ambient Digital Scribe

Analysis By: Sharon Hakkennes

Definition: Ambient digital scribes are intelligent documentation support systems that leverage speech recognition, natural language processing (NLP), artificial intelligence (AI) and machine learning (ML) to automate documentation of the spoken aspects of a clinical encounter. These solutions use ambient listening and speech recognition technology to convert captured audio to text. Relevant information from the clinical encounter is extracted and summarized before being uploaded to the EHR.

Position and Adoption Speed Justification: To combat the challenges with EHR documentation, many HDOs have employed scribes to chart patient encounters in real time, either in person or off-site (i.e., virtual scribes). Scribes require considerable training and are costly. Ambient digital scribes replace these human scribes with technology, taking over the role of documenting clinical notes in the EHR from the clinician. Many solutions also include virtual assistant technology, deploying voice user interfaces for navigation of the EHR during a consultation. Some solutions are augmented with additional nonverbal information from sensors in the clinical environment such as cameras to capture information from the physical exam. In the future, functionality will be extended to include AI enabled clinical decision support capabilities (e.g., prompting clinicians to seek further information, suggesting potential provisional diagnosis, a prompt to order a specific test).

This is a new Innovation Profile for the 2020 Hype Cycle. The technology is still very much in its infancy, with all currently available solutions relying on a quality check process that is performed remotely by a human before the note is presented to the clinician for review and signoff. However, we are introducing this technology at the trigger/peak mid-point of the Hype Cycle, as first generation products are now commercially available in the U.S.

As with all NLP-based solutions, achieving a high-quality output is dependent on access to significant volumes of high quality, context specific, annotated data for training. The underlying models must be trained specialty by specialty, specific to language spoken and global variations in healthcare delivery models. Today’s solutions are limited to ambulatory settings and it will be some years before they will be able to overcome the additional challenges (such as background noise) associated with the busy acute environment. For these reasons we believe that it will take between five and 10 years for the technology to achieve mainstream adoption.

User Advice: As most of the research and development of ambient virtual scribes is currently occurring in the U.S. solutions are not yet available on a global scale. As such, the advice for CIOs outside of the U.S. is to actively monitor the market as the technology continues to evolve over the coming years and new solutions emerge across other geographies.

In planning to implement this technology CIOs should:

- Actively engage with CMIO/CNIO and clinical leaders to evaluate the technology and identify potential areas for implementation. Start with discrete specialty areas to run "proof of concepts," using lessons from early trials to scale over time.
- Develop a robust evaluation framework including both operational and clinical measures to evaluate the efficacy of the solution. Ensure these KPIs are aligned with organizational operational and strategic goals and include quality of care measures.

Enable robust discussion and debate with legal, clinical and operational leaders around the potential privacy, ethical and legal consequences of deploying ambient virtual scribe solutions. Develop policies and processes that deal with issues of consent, data ownership, retention and secondary use.

Business Impact: Ambient digital scribes will reduce clinical time spent on documentation, increase the timeliness of documentation, and have the potential to improve the completeness and accuracy of clinical notes. In doing so, these solutions address issues of clinician burnout and increase the time available for clinicians to spend with patients, improving engagement. In addition, these solutions will support the move to value-based care models, which rely heavily on clinical documentation to identify gaps in care and inform shared savings payments.

Benefit Rating: High

Market Penetration: Less than 1% of target audience

Maturity: Emerging

Sample Vendors: DeepScribe; Mutuo Health Solutions; Nuance Healthcare; Robin Healthcare; Saykara

Recommended Reading: "Innovation Insight for Natural Language Processing for Healthcare Provider CIOs"

"Healthcare Provider CIOs Take a 3-Pronged Approach to Tackle Physician Burnout"

"Best-Practice Framework for Realizing Healthcare Provider Value Across the EHR Life Cycle"

Precision Medicine

Analysis By: Sachin Dev; Mike Jones

Definition: Precision medicine seeks to improve health outcomes by precisely diagnosing and treating a disease condition or its prevention. It leverages individual factors of the disease, such as physiology and genomic indicators, and patient factors, such as social determinants of health and lifestyle. Precision medicine technology orients this data in context for clinical diagnosis and treatment protocols — thus integrating EHR, PHM, disease genomics, labs, images, treatment protocols and other digital data sources.

Position and Adoption Speed Justification: Many technology components contribute to precision medicine and its enablement. We focus positioning of this technology on its visibility in clinical practice and its more robust forms in complex disease treatments (for example, cancer, requiring more-extensive analytical support to match treatments and patients to achieve the best outcome). Technologies include integration of various sources of disease and patient data, the analytics to bring precision insights to clinical diagnosis and treatment, and bridging of clinical decisions into care delivery.

The promise and vision of precision medicine will sustain its pursuit. Technological advancements, research advances and product innovations are driving the pace. The field is gaining new insights into disease origins, which drugs work in which patients, which therapies are effective given an individual patient's profile, and how various diseases respond to efforts to combat them. We also observe transitions from custom approaches to more-scalable platform-based approaches integrating the data, analytics, and diagnosis and treatment decision making.

Gartner has observed scalable use of precision medicine in oncology, while other areas of medicine are closely following the development on additional approved diagnostic and therapeutic use cases in their respective field. Additionally in 2019, FDA approved 11 new molecular entities (NME) bringing the total of approved NMEs to 44 since their first approval in 2014. While we observed some great advancement this year, the ongoing challenges continue to exist with the speed of new scientific discoveries beyond oncology. These challenges include technology adoption, cost and reimbursement of genomic sequencing, EHR integration and managing the volume of data required to truly deliver precision medicine. Therefore, we cautiously advance genomics medicine to trigger-peak midpoint. Similarly, with the recent advancement in precision medicine and the level of interest that Gartner has observed in 2019, we also amend our forecast of time to mainstream adoption from more than 10 years to five to 10 years.

User Advice: Top executives, medical and service line leaders in life sciences, and executives in healthcare delivery and health insurance must all stay engaged with the advances under the precision medicine umbrella. Precision medicine relies on effective, efficient and actionable patient data collection and the analysis and assessment of that data to arrive at a precise diagnosis and treatment. For CIOs, chief medical informatics officers (CMIOs), and other IT and clinical informatics leaders, precision medicine has a succession of IT needs for its support:

- Socialize and adopt a forward-looking healthcare analytics architecture. CIOs must lead the move toward the enterprise architecture, workflow and decision support design, and new partnerships that enable precision medicine analysis and recommendations for medication prescribing and cancer care.
- Prepare your architecture to accept a diverse array of patient information sourced from genomics, mobile apps and devices, wearables, patient-reported data, social determinants of health, and other sources. Pay particular attention to situations where chronic conditions drive unique data points, medication effects and healthcare preferences. Consider engaging a data broker or medical hub partner to collect and standardize clinical data from patient wearables and home devices. All of these platforms will ultimately be extended to capture the data needed and transformed into real-time use for precision medicine. Early experiences in cancer and certain chronic conditions will build the medical collaboration and competence for future precision medicine. Similarly, CIOs should seek vendors that provide precision platforms built on open technology and aid cognitive support at point of care.

- Build on analytics capabilities in AI and its governance. AI in healthcare will use precision medicine datasets across millions of patients to suggest diagnoses and treatments over time. Avoid underestimating the time to build clinicians' trust in AI processes.

Business Impact: Precision medicine technologies provide a manageable context to align the scientific, genomic and phenotypical data, and other data about the disease and patient to enable precision medicine at scale. This enables the systemic use of information in care delivery processes, integrated with EHR and other tools within the care delivery workflow, and would enable the primary benefits of precision medicine. This transformation should yield significantly reduced incidences of medical diagnosis error, reduction in treatment variability, and ultimately, reduced total cost of care. It should improve population health and further emphasize predictive and preventive actions. Precision medicine is needed to transform central medical decision making to mass personalization of consumer healthcare engagement, which will drive the entire engine of healthcare delivery by 2030.

Benefit Rating: Transformational

Market Penetration: 1% to 5% of target audience

Maturity: Emerging

Sample Vendors: 2bPrecise; BC Platforms (GeneVision); IBM Watson; Orion Health; Philips Healthcare; Syapse; Tempus

Recommended Reading: "A Digital Literacy Charter Paves the Way for Healthcare Provider CIOs' Workforce Transformation"

"Maverick* Research: Coming Soon — Radical Disruption to Life Expectancy, or Not?"

Virtual Health Assistant

Analysis By: Laura Craft

Definition: Virtual health assistants (VHAs) enable patients to have clinically relevant encounters, in place of ones with a human clinician, by using advanced AI capabilities. VHAs incorporate a broad range of use cases for specific digital encounters including chronic condition management, medication compliance, and health and wellness routines.

Position and Adoption Speed Justification: Like the virtual assistants for consumer engagement that are growing rapidly, VHAs are specific to the complexities of health and medical care. They guide the patient through daily activities needed to remain compliant with health and medical needs. The interaction is often initiated by the VHA to remind the patient to perform an activity — such as taking a glucose or blood pressure reading, weigh in, or take a medication. As VHAs mature they will be able to initiate a conversation and pick up moods using sentiment analysis, which will be critical for behavioral health. The data and information collected is remotely monitored often in command or virtual care monitoring centers, can trigger alerts, recommend actions and a remote encounter with the appropriate clinician if needed. In addition to providers, VHAs are also being marketed to payers who use the VHA for symptom triage and service location. They are also being used in clinical trials to collect real-world data on patients.

Last year, we introduced this profile right at the Innovation Trigger. This positioning reflected the interest in by HDOs around VHAs, the potential they offer for improved health maintenance, and the small number of startups gaining some traction. Throughout 2019 and early 2020, we saw VHAs gaining more use (such as Babylon and Sensely in the U.K.) and then the COVID-19 crisis radically accelerated application, adoption and benefit. VHAs have become a popular alternative way to symptom check and prediagnose COVID-19 and COVID-19 risk. Due to the increase interest and adoption we move this profile to trigger-peak midpoint and have modified the benefit rating from moderate to high. We continue to expect this to be a rapidly maturing technology capability and now project VHAs to reach the Plateau of Productivity on the earlier side of five to 10 years.

User Advice: Since the market is still largely being incubated by startups and academic medical centers, the best advice for CIOs is to monitor the market.

We suggest:

- Actively engage clinicians in understanding the technology and seeking the right opportunity to introduce a virtual personal health assistant (VPHA) to a specific patient population. Early prototypes can yield valuable insight into broader usage and rollout.
- Counter any resistance by having a robust plan (training, awareness), and ensure their workforce that the technology is to augment their job, not take it away,
- Monitor the direction of the electronic health record (EHR) vendors and their intersection with the personal health record.

- Consider the regional privacy regulation for their country when piloting on live patients. For example, how and where do the apps collect, store, and reuse data as many of these will be cloud and mobile device enabled.

Business Impact: VHAs will be one piece of the healthcare delivery organizations' (HDOs') digital-care delivery strategy. VHAs will be used to help manage patients with chronic conditions or other types of illnesses such as cancers. The ROI will be measured by improved patient adherence to care plans, elevated outcomes, lower cost and fewer adverse/unplanned events. VHAs may also be used to ensure patients are directed toward the lowest cost provider of care when needed or treated at the right location at least.

The main benefits will be:

- Increased productivity and "time to care" for clinicians because of automation.
- Real-time insight into patients' vitals, activities, behaviors and moods for more immediate interventions.
- More engaging ways for patients to receive healthcare advice and guidance in relation to their condition or treatment regime.
- A more positive "people-literate" tactile consumer experience for many administrative and transactional tasks that are essential for medication and care plan compliance.
- Improved outcomes because of the above and reduced costs associated with noncompliance in chronic and acute conditions (e.g., admissions and ED attendances avoided).

Benefit Rating: High

Market Penetration: 1% to 5% of target audience

Maturity: Emerging

Sample Vendors: Avaamo; Babylon; Medocity; Openstream; Orbita; Sensely; Verint Next IT

Recommended Reading: "Emerging Applications of AI for Healthcare Providers"

"Maverick* Research: Endangered! How Technology Will Cause Extinction of the Primary Care Tier of Medicine"

"Healthcare Provider CIOs: Bridge the Virtual Care Divide Between Provider- and Consumer-Directed Care"

"The Digital Care Delivery Framework for Healthcare Provider CIOs"

3D Bioprinted Organs

Analysis By: Sharon Hakkennes; Pooja Singh

Definition: 3D bioprinted organs are living tissue products that function like human organs. Product components include imaging data, design software and 3D printing (3DP) devices. The two main opportunities for these are in life science research and development (R&D) and human transplants. The latter is the subject of this profile.

Position and Adoption Speed Justification: There is a broad array of current and potential 3D bioprinting applications with very different challenges and many different adoption time frames. The creation of human-transplantable organs is one of medical 3DP's biggest dreams.

There are many complexities that need to be overcome in the quest to creating human transplantable organs. These include:

- How to test how well the organs will integrate in the body (avoiding rejection issues) and how to test and prove the long-term viability and effect of the organs.
- Complex regulatory, ethical and adoption issues.
- Finally, profound potential business and funding impacts will arise when all the other challenges are finally conquered.

Over time, more advanced/different types of 3DP technology is emerging, designed specifically for printing of organs, not adapted from off-the-shelf commercial 3DP technology. Notable developments over the last year include:

- In 2019, scientists from Carnegie Mellon University successfully bioprinted collagen scaffolds capable of replicating the structure and function of human tissues and organs using a specially developed hydrogel. Using this technology, they were able to print functional heart components including heart valves and ventricles. Collagen is the most prevalent protein in human tissue, and thus being able to bioprint it effectively is essential in the 3DP of organs.
- Building on their 2016 work, in the last year the Wyss Institute has developed a vascularized proximal tubule model which comprises of independently perfusable tubules and blood vessels printed adjacent to one another within an engineered extracellular matrix.
- Researchers at the University of Washington and Rice University have created a new open-source bioprinting technology that enables the creation of complex vasculature called stereolithography apparatus for tissue engineering (SLATE).

Despite these developments the profile has remained unchanged from last year as the viability, real-world availability for use in humans and adoption rates of actual organ products are still highly speculative.

User Advice: This area is more a major emerging life science technology than "classic" healthcare IT. Given this, the advice to most healthcare provider CIOs, CMIOs, and medical leaders is to monitor advances in 3D bioprinting and other technologies; identifying potential use cases as the technology evolves.

CIOs supporting life science companies and academic medical centers that lead in these investigations must support R&D efforts to develop 3D bioprinting techniques. Early instantiations of 3D bioprinting organ transplants are likely to be delivered by remote manufacturing services. CIOs must be prepared to support exchanges of design parameters (patient and imaging data transmitted in a different context), unique tracking in the supply chain and documenting transplanted custom organ data of a different nature in the EHR associated with this scenario.

Business Impact: Implants of inert polymers and metals are regularly performed today. We expect that simple 3D bioprinted tissue grafts will be next, followed by complex tissue regeneration. The ability to build new and precisely personalized human tissues substantially expands the array of therapeutic options for a wide range of patient injuries and diseases. Bioprinted organs using the patient's own cells are hoped to have the benefit of avoiding the rejection of implanted/transplanted tissue, and the costs of a lifetime of anti-rejection drugs. Many of the emerging use cases are for limited or rare scenarios. However, in aggregate over time, the total impact on medicine is transformational.

There is an additional — indeed earlier — market for the production of tissues and organs for life science research and development. This business is providing some of the needed early revenue for startups targeting human tissue and organ 3D bioprinting.

Benefit Rating: High

Market Penetration: Less than 1% of target audience

Maturity: Embryonic

Sample Vendors: 3D Bioprinting Solutions; Allevi; Organovo; Prellis Biologics; Regenovo Biotechnology; Wake Forest Institute for Regenerative Medicine; Wyss Institute

Recommended Reading: "Predicts 2019: 3D Printing Accelerates, While 4D Printing Is Getting Started"

"Maverick* Research: Being Human 2040 — The Life of the Architected Human in a More-Than-Human World"

Next-Generation Nurse Call

Analysis By: Barry Runyon

Definition: As its name implies, nurse call (aka call light) systems are primarily for patients to communicate with nurses in case of discomfort, pain or emergency. Nurse call is also used for nurses to communicate with one another, and with physicians and care team members. Next-generation nurse call is about using modern mobile point-of-care solutions and bedside multimedia to deliver nurse call capabilities versus conventional nurse call. New nurse call capabilities will surface as a care teams place new demands on conventional nurse call.

Position and Adoption Speed Justification: Nurse call systems can be wired or wireless; can interface with IP phones, pagers, smartphones, communication badges, location services, staffing, on-call and scheduling systems. Other features include master consoles, pull stations and corridor lights. Nurse call, as it stands today, is not uniquely positioned to meet the needs of evolving care delivery models and patient experience expectations. Real-time healthcare system (RTHS) solutions such as clinical communication and collaboration (CC&C), interactive patient care (IPC), and alarm and notification platforms are converging to assume nurse call responsibilities, as well as augmenting conventional nurse call.

As hospitals evolve to real-time health systems (RTHSs), their workflows will be less and less defined by the specific category of software or platform they implement or limited by an individual vendors' vision or product roadmap. Rather, they will be more defined by rapidly emerging care delivery requirements and consumer expectations.

States in the U.S. require hospitals and long-term care facilities to implement nurse call systems in order to be licensed. In the U.S., nurse call systems are certified against the provisions of UL 1069, the "Standard for Hospital Signaling and Nurse Call Equipment," and hospitals require their nurse call systems to be UL 1069 listed. While the intent of UL 1069 certification is to ensure nurse call system user safety and reliability, it has also served to limit competition and innovation. New mobile communication and collaboration platforms that do not fall under this certification requirement have begun to redefine this space by satisfying nurse call requirements without being labeled nurse call systems. Industry certifications will no longer keep legitimate competition and innovation at bay.

Nurse call capabilities are essential to the success of the RTHS. Conventional nurse call systems are heavily adopted and do not appear on this Hype Cycle per se. This profile was introduced in 2016 and was positioned early in the Hype Cycle as it represented alternative ways of satisfying nurse call requirements. We did not expect this profile to move quickly, given UL 1069 certification requirements and the dominance of conventional nurse call vendors. As it evolved, this profile chronicled the emergence of a new ecosystem of technologies and systems that began to compete with traditional nurse call vendor platforms, and indeed augment them. There is now evidence that traditional nurse call vendors have begun to reinvent themselves as more open, mobile and collaborative systems. We advanced this profile again this year due to the point of care innovations introduced by clinical communication and collaboration (CC&C) and interactive patient care (IPC) vendors that augment, improve upon or replace conventional nurse call capabilities. Recent advances in interoperability technology and open API mandates by ONC auger well for this convergence.

User Advice: Healthcare provider CIOs and nursing leadership should:

- Assess next generation nurse call ability to satisfy patient and care team communication requirements versus delivering conventional nurse call capabilities.
- Delay refreshing your nurse call system until you have a firm grasp on your patient and care team communication requirements and new care delivery models.
- Investigate functional alternatives to nurse call, such as interactive patient care, CC&C, and alarm and notification platforms, or a combination of these RTHS solutions.
- Examine nurse call vendor roadmaps. Look beyond legacy nurse call vendors to determine whether nurse call requirements can be satisfied in other ways.

Business Impact: With the advances in CC&C, interactive patient care, alarm and event notification platforms, location and condition sensing, and medical device connectivity platforms, other less costly and more agile ways will continue to emerge to satisfy nurse call requirements. Nurse call's position within the healthcare provider environment will be increasingly challenged as RTHS technologies evolve to accommodate new care delivery models. Conventional nurse call requirements will be increasingly satisfied by the convergence of RTHS solutions' capabilities.

Benefit Rating: High

Market Penetration: Less than 1% of target audience

Maturity: Emerging

Sample Vendors: Amplion; Critical Alert; GetWellNetwork; Hillrom; PerfectServe; Vocera

Recommended Reading: "All Care Team Collaboration Systems Are Nurse Call Systems"

"Innovation Insight for Care Team Collaboration"

"Market Guide for Clinical Communication and Collaboration"

"Healthcare Provider CIOs: Shift Interoperability Strategy From Moving Data to Orchestrating Workflow"

Automated Patient Decision Aids

Analysis By: Mark Gilbert

Definition: Automated patient decision aids (APDAs) are software-based complex interactive systems that use computational logic and AI to help patients make better-informed health decisions and improve the congruence between the patient's decisions and their personal values. These aids may include triage, diagnostic and treatment options, end-of-life choices, and first-pass genetic counseling.

Position and Adoption Speed Justification: Empowering patients to become more engaged in their own care by providing information, decision tools and support is more important than ever. APDAs contribute to shared-decision-making processes by improving a patient's knowledge and their accuracy of risk perceptions. They also increase the congruency between evidence-based medicine and a patient's care choices.

The precursor to APDAs are patient decision aids (PDAs). PDAs are tools used to inform patients about alternative treatments along with their benefits, risks and costs. PDAs are effective at improving the decision process and the quality of decisions (see "Decision Aids for People Facing Health Treatment or Screening Decisions"). Today, there are over a hundred different published PDAs (see "Alphabetical List of Decision Aids by Health Topic") with several resources available to guide HDOs like "Mayo Clinic" and the "Ottawa Patient Decision Aid Research Group." Informing patients and making them part of their health decisions is now considered a basic human right within many countries (see "Liberating the NHS: No Decision About Me, Without Me"). Unfortunately, most PDAs lack automation and require considerable guidance, support and coaching by physicians and healthcare professionals (HCPs) in order to support individual decision making.

Automated decision aids are designed to augment PDAs by providing the ample amounts of guidance, support and coaching a patient needs to make an informed decision. At a minimum, APDAs can speed up decision making by narrowing choices to the two or three critical issues that need to be discussed with a physician or a healthcare professional (HCP). The APDA uses cognitive AI or insight of the patient, gained from patient history or from interactive questionnaires, to establish an understanding of the values, needs and constraints of the patient. It then provides the patient with access to evidence-based insight, probabilities and scenario analysis personalized to reflect the unique needs of the patient. The APDA educates patients and enable them to be ready and able to make a decision during their brief interactions with their physicians or HCPs.

Positioning on this Hype Cycle is based on demonstrated outcomes from decision aids and the emergent state of automation within PDA adoption. Although decision aids have broad benefit for engaging and empowering patients, we continue to only see slow progress along the Hype Cycle for automated APDAs. In 2020 we are seeing commercialization of APDAs for primary care (see Babylon Health and Ping An Good Doctor). Websites and patient portals are adding interactivity and personalization to enable patient-led decision making (which increases by up to 35% according to researchers from the "University of California San Francisco." (See "User-Friendly Decision-Making Tools Help Older Adults Make Choices for Future Medical Care.") However, the use of robust AI-driven APDA integrated within a clinical pathway is still experimental. Barriers to adoption include relatively immature products, healthcare providers' competing priorities, payment issues and legal concerns. Patient barriers include a lack of trust in automated systems, lack of personalization and perceptions about quality. Today the systems remain more of a research interest, rather than a commercial interest.

User Advice: Healthcare CIOs should be aware of automation taking place around the edges of patient decision aids. We advise mainstream and late adopters to wait for these products to mature. We expect patient decision aids will continue to be deployed as stand-alone systems. However, we believe that mass adoption is dependent on the automation resulting from tightly linking the decision aids with enterprise electronic health record systems and care management systems.

- Be supportive of short-term trials. Use the pilots to explore adoption challenges, for example, coaching clinicians on how to use APDAs and how to communicate with patients during discussions of their informed preferences.
- Be prepared to determine when the maturity of APDA products has passed a minimum threshold that merits investigation of an enterprise solution.

Business Impact: Automated patient decision aids help improve patient engagement, loyalty and empowerment. Use of the aids reduce variability in care, improve outcomes, and increase the satisfaction of patients. Research has demonstrated patients active in shared decision making resulted in 5.3% in cost savings, 12.5% less inpatient admissions and 21% fewer heart problems (see D. Veroff, A. Marr and D. E. Wennberg's "Enhanced Support for Shared Decision Making Reduced Costs of Care for Patients With Preference-Sensitive Conditions"). Other studies have shown patient decision aids help patients reach a decision faster, resulting in quicker treatment. For these reasons, we estimate a moderate benefit from the technology.

Benefit Rating: Moderate

Market Penetration: 1% to 5% of target audience

Maturity: Embryonic

Sample Vendors: EBSCO Health; Health Dialog; Healthwise; Optum; Wolters Kluwer; Emmi

Recommended Reading: "Create Connected Care Pathways That Bridge Consumer and Healthcare Provider Activities"

"Healthcare Provider CIOs: Bridge the Virtual Care Divide Between Provider- and Consumer-Directed Care"

"The Digital Care Delivery Framework for Healthcare Provider CIOs"

Digital Clinical Encounters

Analysis By: Mike Jones; Sharon Hakkennes

Definition: Digital clinical encounters are semiautomated patient encounters that include the use of a combination of clinical protocols and algorithms to facilitate history taking, diagnosis, prescribing, and documentation. The encounter leverages the latest evidence-based clinical knowledge to reduce clinicians' direct involvement prior to their review of the captured and analyzed content for clinical governance and oversight.

Position and Adoption Speed Justification: Epidemiological factors and clinician shortages have made access to care — especially primary care — one of the major challenges facing the healthcare industry. One way to address this problem is to help clinicians to become more efficient and, whenever possible, automate certain steps in the care process. The efficiency and accuracy is created when the digital clinical encounter solution collects clinical information from the patient through the use of a progressive sequence of evidence-based clinical questions whereby patient responses can lead to more selective and detailed questions. The result is a diagnosis and a recommended treatment plan that a clinician can then review, modify when necessary and sign. The system then sends a complete encounter note to the clinician's EHR. Today, these systems are starting to become available, although there is not a large number of providers using them. Current systems are designed for low-acuity primary care visits; however, our expectation is that this will expand to include other types of encounters, including specialty-specific ones. Workflow typically takes place in patient facing app or embedded within an EHR patient portal.

Adoption has been sporadic but interest in these solutions is growing globally (e.g., the use of Sensely, Babylon, and Doctorlink apps across the U.K. with expansion into in other regions during 2020).

More recently with COVID-19 the key barriers to adoption which included concerns about clinical and scientific accuracy, legal and compliance risks, payments and cultural acceptance have been met head on with the urgent demand for workable remote care solutions.

We have advanced this technology toward the Peak of Inflated Expectations due to increases in AI capabilities and use cases within healthcare in general and for this particular use case to help solve demand and access issues in many health systems globally. We expect market penetration to be achieved within the next decade and quite possible nearer five years in some regions where national or regional solutions are being piloted (e.g., NHS, Canada).

User Advice: HDO CIOs, CMIOs should:

- Educate patient, clinicians and other stakeholders of the benefits of digital clinical encounters. Consider running marketing and educational campaigns aimed at the community and the clinicians to increase receptivity and adoption.
- Create a pilot program starting with encounter types that are common and where the diagnosis and treatment are straightforward based on clinical history.

- Measure the pilot success by quantifying patient satisfaction and selecting those digital encounters for expansion that patients like.
- Work with risk and compliance management to minimize potential medicolegal ramifications.

Business Impact: Digital clinical encounter solutions are transformational systems (delivered in the form of patient and clinician facing apps, or within a patient portal) that can substantially increase both patient and clinician satisfaction, and deliver high-quality care. They have the potential to direct patients away from unnecessary emergency room visits and can improve access for encounters that require in-person visits. By automating select encounters, clinicians can focus on more complicated encounters that demand more time and attention, and that will better utilize their skills. Clinicians currently using these systems have reported that the time it takes to gather and review patient information, confirm a diagnosis, select treatment options and document the encounter can take less than two minutes.

During the COVID-19 pandemic, the care automation tools described herein have helped managed the surge in demand for screening patient healthcare concerns on coronavirus infection risk and symptoms. Some of the sample vendors listed below have offered their solutions free for a trial period to help with the pandemic. There is currently high demand for this type of solution as health systems enter the recovery phase of their postpandemic service redesign.

Benefit Rating: Transformational

Market Penetration: 1% to 5% of target audience

Maturity: Emerging

Sample Vendors: Babylon; Bright.md; Doctorlink; Intellivisit; Sensely

Recommended Reading: "Business Drivers of Technology Decisions for Healthcare Providers, 2020"

"Understand the Value of AI for Healthcare Delivery Organizations"

"Healthcare Provider CIOs: Get Ahead of AI Innovation With Strong AI Governance"

"Survey Analysis: Healthcare Providers — Measure Your Readiness for the Expanding Role of AI"

"Toolkit: Board-Ready Slides for Your Digital 'Healthcare Without Walls' Initiative"

Robotics-Assisted Telesurgery

Analysis By: Sharon Hakkennes; Mike Jones

Definition: Robotics-assisted telesurgery is defined as a surgical procedure carried out by a human surgeon from a distance utilizing surgical robotic technology, high-bandwidth telecommunications and shared visual interactive presence. Robotics and software steady the surgeon's hand movements and translate them into the movements of a remote robot.

Position and Adoption Speed Justification: Robotics-assisted telesurgery remains a nascent application, predicted to reach mainstream adoption within 10 years, possibly sooner in some clinical scenarios, such as cardiac stenting, prostrate, kidney and bladder removal, and tumor excision. Because of technology cost and known risks, including the lack of fully developed training programs and standard operating protocols (including for equipment maintenance), healthcare delivery organizations (HDOs) can be reluctant to pursue telesurgery. Telesurgery across jurisdictional boundaries may involve complex negotiation around funding and medicolegal liability. Telesurgery will need further study of its safety and more proof of value to build medical advocacy and stakeholder support. For some years to come, the use of telesurgery will be limited to specific clinical conditions, remote areas, military theaters and surgical emergencies in which it is infeasible to bring the surgeon and patient to the same location.

The location of the surgeon is the crucial difference between robotics-assisted surgery and telesurgery. Robotics-assisted telesurgery seeks to virtually create the presence of a remote surgeon at the patient's operating table, using a robot, with an on-site surgical team available to take over manually in case a problem occurs. In robotics-assisted surgery, the surgeon is present in the operating room or nearby suite with the patient and operates using a console that is directly connected to the remote surgical device, with real-time transmission of data.

Early efforts are promising. In 2019, the Apex Heart Institute in India successfully performed remote robotics-assisted percutaneous coronary intervention on five patients with coronary artery disease with the surgeon located 20 miles away from the patient. However, a major barrier to broader adoption of telesurgery has been latency, the time delay in transferring auditory, visual and even tactile feedback between the two distant locations, often attributed to network reliability, routing, congestion and overload. The implementation of 5G technology with its low latency, high reliability and high bandwidth has the potential to address these challenges. In 2019, doctors in China successfully performed brain surgery on a patient with Parkinson's disease, inserting a stimulation device from almost 1,900 miles away using a 5G network. 5G networks have also been used in Italy to perform laser microsurgery from 15 kilometers away on a synthetic larynx and in the U.S. to perform remote coronary procedures over from approximately 3000 miles away.

The pace of global implementation of 5G networks as well as both real and perceived legal and security risks and barriers will continue to keep robotic telesurgery's progress at a slow pace. The lack of tactile feedback (haptics) has been another limitation as has coordinating logistics between the surgeon operating the remote system and the surgical site team with the patient. Augmented and virtual reality tools are emerging for presurgical planning to address these challenges.

User Advice: HDO CIOs and business and clinical leaders:

- Explore robotics-assisted telesurgery largely in the context of a research study, or in use cases where surgical resources are limited, interventions require extreme urgency, travel is extremely difficult, and the technology can be deployed and supported, such as military theaters.
- Keep an eye on the expanding vendor landscape for minimally invasive robotics-assisted surgery and interventional cardiology, watching for indications that the technology is advancing.
- Evaluate the medicolegal implications and risks that telesurgery poses, including standards for training programs and clinical protocols.
- Evaluate the communications infrastructure that will be necessary to enable telesurgery, including high-speed 5G communication networks with less latency and jitter; reliable power; and smaller, lighter and more-efficient telesurgery robots.

Business Impact: Despite the many barriers and limitations, robotics-assisted telesurgery holds substantial long-term promise. The purpose and value are to bring treatment to any area where the needed surgeon/specialist is not locally available. The largest-scale benefit would be for patients and facilities in more rural areas, small community hospitals and clinics, where particular skills are not available and where the cost or transport delay is prohibitive. Government military and space exploration arms have interest in this solution for battlefield/urgent scenarios and provisioning healthcare during prolonged space travel.

Benefit Rating: Moderate

Market Penetration: 1% to 5% of target audience

Maturity: Emerging

Sample Vendors: Intuitive; Medrobotics; Medtronic; Siemens Healthineers; Stryker; Titan Medical; TransEnterix; Verb Surgical

Recommended Reading: "Healthcare Business Driver: Medical Innovations in Therapy, Diagnosis and Care Delivery"

"Innovation Opportunities Will Be Enabled as 5G Evolves Through 2025"

AI-Enabled Diagnostic Imaging Interpretation

Analysis By: Sachin Dev

Definition: AI-enabled diagnostic imaging interpretation uses deep learning techniques, machine learning and categorization technology on very large sets of medical images in order to create workflows and algorithms that allow for faster and more accurate readings. AI-enabled interpretation can be applied to many radiological procedures such as X-ray studies, magnetic resonance imaging (MRI) exams and computed tomography (CT) scans.

Position and Adoption Speed Justification: Several vendors are now leveraging deep learning techniques and categorization to provide diagnostic support for imaging specialists. While CT and MRI have been the primary modalities, we have observed use cases emerge in other areas such as mammography (including 3D tomosynthesis), fundus imaging (of the eye), ultrasound, and echocardiography. AI-enabled solutions can also be used to prescreen large numbers of images, helping clinicians prioritize their workloads and redirecting their attention to the images that are most clinically relevant.

While these solutions can increase imaging throughput, one major issue still to be addressed is the financial effect. Would payments fall if imaging specialists are aided or even replaced by computer systems? Similarly important considerations are demonstrable proof of accuracy and possible legal ramifications. At some point, it might be considered malpractice to not use these systems, which begs the question of who will take the responsibility when an AI system inevitably makes a mistake.

Regulatory agencies are cautiously evaluating various technology solutions on a case-by-case basis. A large majority of regulatory approvals globally allow solutions that augment clinicians' decision making, as opposed to completely automating the process for establishing diagnosis. Considering the success with lung imaging analysis during the COVID-19 pandemic along with multiple vendor approvals granted by FDA to use AI-enabled imaging analysis, we move this technology closer to the Peak of Inflated Expectations this year.

User Advice: Healthcare provider CIOs should work with clinical leaders in the imaging specialties and risk management to carefully evaluate and determine the speed and priority of adoption. As these solutions increase the productivity, speed, accuracy and consistency of imaging study diagnostics, they also spread the capacity for interpretation and real-time action beyond the walls of any HDO. These solutions may also help to alleviate the projected severe and growing shortage of imaging specialists. Adoption may initially be highest in regions or countries with very few radiologists and with low regulatory barriers.

Regulatory clearance may be required in some countries, including solutions defined as AI-enabled diagnostic support software (DxSS). Those HDOs that are already experiencing shortages of imaging specialists or long lag times between study completion and final interpretation should consider piloting some of these solutions sooner rather than later. Be prepared to address cultural acceptance by both patients and clinicians and concerns about the efficacy of these solutions and transparency of the algorithms. Draft a business case that considers possible payment and revenue issues. For example, will there be a reduction in payments for computer-aided diagnoses?

Business Impact: AI-enabled diagnostic imaging interpretation solutions aid clinical decision making by improving image reading accuracy and augmenting clinician productivity.

By aiding image diagnosis, the incidence of missed or inaccurate diagnoses should decrease. Furthermore, these solutions can help and build virtual and remote capacity to combat the growing shortage of imaging specialists. This in turn should lead to improved clinical outcomes, increased patient satisfaction and enhanced brand loyalty.

Benefit Rating: High

Market Penetration: 1% to 5% of target audience

Maturity: Adolescent

Sample Vendors: Aidoc; Arterys; DiA Imaging Analysis; Enlitic; GE Healthcare; HealthMyne; MaxQ AI; Qure.ai; Siemens Healthineers; Zebra Medical Vision

Recommended Reading: "Emerging Technologies and Trends Impact Radar: Artificial Intelligence in U.S. Healthcare Delivery Organizations"

"Survey Analysis: Healthcare Providers — Measure Your Readiness for the Expanding Role of AI"

AI for Clinical Automation

Analysis By: Sharon Hakkennes; Mike Jones

Definition: AI for clinical automation is an umbrella profile for solutions that leverage technology to assist clinicians with routine, standardized and often-repeated tasks to streamline workflow, increase productivity and improve the quality of care. Clinical automation is accomplished using EHR and third-party-sourced data that is incorporated within clinical workflows across the care continuum.

Position and Adoption Speed Justification: Care delivery is replete with routine and often-repeated tasks or circumstances that are ideally suited for automation. EHR vendors have begun to address simple automation use cases such as conversational AI, clinical documentation and other tasks using AI-enabled multichannel virtual assistants and APIs to permit third-party products to drive automation. Other solutions leverage AI capabilities such as natural language processing and machine learning and can automate and delegate routine repetitive tasks such as prescription refill requests, diagnostic triage and results management. The goal is to leverage diverse data sources, including ambient sensors and publicly available data with clinical content and context to alleviate the burden on clinicians of performing actions with known and repeatable outcomes. Heightened complaints about the usability of EHRs contributing to clinician burnout has generated more interest in these solutions, and is driving increasing interest and adoption.

We continue to expect these solutions to rapidly evolve as concerns about accuracy, legal risks, payments and cultural acceptance are addressed. Internationally, adoption will be dependent on maturity of EHR and other third-party-sourced data.

User Advice: Successful implementation of clinical automation will require both change management and highly effective clinical governance. For certain clinical automation use cases, the adoption of algorithms or even “prepared” content may require clinical workflow and cultural adaptation. Automation can take the form of algorithmic medicine where both diagnosis and treatment can be suggested by the system, and the effectiveness of interventions evaluated by the system.

CIOs should work with CMIOs, CNIOs and other clinical leaders to:

- Find highly repetitive tasks that may be suitable for automation like patient flow and throughput management.
- Identify clinical conditions that have sufficient high-quality evidence base for diagnosis and treatment that would make them appropriate for AI-enabled clinical automation (for example, sepsis detection and prevention; central line infections; and pressure injuries).
- Assess the current and planned automation and algorithm capabilities of your EHR and look for third-party solutions that augment the EHR.
- Ensure all implementations of automation solutions include a framework for the evaluation of the effectiveness of these solutions. In addition to tangible measures of quality and efficiency, these frameworks should include measures of clinician experience and satisfaction.

Business Impact: In a recent survey by Stanford University medical physicians, residents and students estimated that as much as one-third of their work will be automated by technology in the future. Automating routine, standardized clinical tasks will drive improvements in clinical and business processes across a number of different areas:

- Clinical automation improves satisfaction of patients, physicians, nurses, and the entire clinical care team; it lowers the cost of care while providing improved outcomes.
- This type of automation can converge diverse datasets to scan for multiple clinical findings and patient specific factors, enable accurate real-time case prioritization, triage and throughput management.
- It can help address the significant problems of clinician shortages and EHR impacts on productivity and burnout. By helping to standardize care and ensuring that clinicians can more easily access vital information at the point of care, clinical automation can decrease time to diagnosis and treatment, and improve the quality of care.
- Furthermore, automation can help to counter the tendency of time-pressured clinicians to feel too busy to take all possible steps to find and review critical information.
- Automation can reduce unnecessary or duplicate tests, improve patient safety and care transitions and reduce preventable medical errors.
- Clinical automation will improve productivity, care delivery performance, clinician and patient satisfaction, and become a critical contributor to delivering on the promise of EHRs.

Benefit Rating: High

Market Penetration: 1% to 5% of target audience

Maturity: Emerging

Sample Vendors: 3M Health Information Systems; healthfinch; Note Swift; Nuance; Sopris Health; Suki; UiPath

Recommended Reading: "Scale Automation in Healthcare Using a Center of Excellence"

"Understand the Value of AI for Healthcare Delivery Organizations"

"Survey Analysis: Healthcare Providers — Measure Your Readiness for the Expanding Role of AI"

"CIOs Need to Expand Their Perspective on Clinical Data and Analytics Change Efforts or Plan to Fail"

"Healthcare Provider CIOs: Get Ahead of AI Innovation With Strong AI Governance"

Application Marketplace for Healthcare Providers

Analysis By: Mike Jones; Sharon Hakkennes

Definition: An application marketplace is a PaaS or SaaS solution that facilitates the authoring, publication, distribution and consumption of reusable digital products and services. Application marketplaces can operate at an organization level — to support internal sharing of prebuilt applications and algorithms — or be deployed across an ecosystem (e.g., by EHR vendors to their customers), operating as a distribution channel for third-party developers.

Position and Adoption Speed Justification: We have renamed this profile from 2019 (previously "Algorithmic Marketplace for Healthcare Providers") to encompass the concept of packaged applications in addition to algorithms. In recent years there has been a rapid acceleration in the use of apps and advanced algorithms in clinical practice and operational workflows, as well as a growing number of channels to procure them.

Megasuite vendors, digital giants and enterprise analytic platforms are adding app libraries and advanced analytics on top of their foundational platforms. The Substitutable Medical Applications and Reusable Technologies (SMART) App Gallery is an open-standards-based platform built from systems that, together, allow for access authorization and application execution of independent code that can access HDO-based FHIR resources, typically EHR-controlled medical records. The apps within the gallery are created by developers, commercial and internal to HDOs, and are compatible with any EHR vendor's environment from a single codebase. Apervita provides a marketplace where clients can share and market their analytic tools to other clients using the platform. To date, it has onboarded over 2,500 hospitals to its platform. And, in May 2020, Orion Health was awarded funding by the New Zealand government to deliver a national algorithm hub solution for healthcare organizations.

Data access APIs are the foundation of application marketplaces. While EHR vendors have traditionally relied on specific, proprietary APIs within their application marketplaces, over recent years there has been a steady increase in the implementation of open APIs based on the FHIR standard. As adoption of FHIR-enabled APIs continues to increase across the industry in the coming years, the pool of third-party developers of apps will grow exponentially. As a result, the number and availability of marketplace apps and algorithms will increase, driving up quality and reducing costs.

User Advice: CIOs, CDOs, CNIOs and CMIOs should:

- Lead enterprise awareness of the marketplace potential and investigation of the advantages that the application marketplace offers. Develop a strategy for how the HDO can leverage and benefit from the app, algorithm and analytics open market and understand how this aligns with or alters relationships with current vendors. Be aggressive about this — marketplaces offer huge opportunity to accelerate innovation in the HDO.
- Extend your application and information governance policies to ensure apps and algorithms acquired through application marketplaces meet clinical, infrastructure, support, privacy and security requirements and standards

Business Impact: There is potential for the application marketplace to be disruptive and radically change the nature of the current market for healthcare application and analytic vendors and how HDOs invest in packaged business capabilities.

The availability of advanced clinical algorithms (e.g., diagnostic or treatment regime models) via an open marketplace opens up access for many HDOs that do not have the in-house skills or large training datasets. Using a marketplace, HDOs have the ability to select the apps and algorithms best-suited to their needs without being tethered to a single vendor's library, multiple vendors or internal development costs. This can also significantly accelerate HDOs' analytic agenda with much faster time to deployment and value.

Application marketplaces provide HDOs with quick, low implementation effort solutions that close gaps in EHR functionality. In application areas where EHRs lack capabilities, these independent app solutions enable innovation and even revenue opportunities. Apps provide the opportunity to customize the EHR experience, improving adoption and clinician engagement.

Benefit Rating: High

Market Penetration: 1% to 5% of target audience

Maturity: Emerging

Sample Vendors: athenahealth; Allscripts; Apervita; Cerner; Epic; Nuance; Orion Health; Salesforce; SMART Health IT; VigiLanz

Recommended Reading: "Unleash the Innovative Potential of EHR App Extensions to Advance Healthcare Delivery"

"Five Best Practices to Apply Before Committing to a Healthcare Provider Data Monetization Initiative"

"Governance and Change Management for a Pace-Layered Application Strategy"

"Healthcare Provider CIOs: Get Ahead of AI Innovation With Strong AI Governance"

Care Team Collaboration

Analysis By: Barry Runyon

Definition: Care team collaboration (CTC) is a healthcare provider IT ecosystem characterized by the convergence of new and existing point-of-care solutions, interoperability middleware, location and condition sensing technologies, and real-time analytics. Enabled by advances in mobility, interoperability and operational intelligence, CTC improves transitions of care, clinical outcomes, care coordination, and, in turn, the patient experience.

Position and Adoption Speed Justification: Care coordination and transitions of care challenges are well-understood in the industry and are the source of workflow friction and consumer and patient frustration. A new care team collaboration (CTC) IT ecosystem has materialized to overcome persistent care coordination challenges, transitions of care and more demanding patient experience expectations. Demanding transitions of care expectations and measures are contributing to the need for an IT ecosystem of situationally aware and interoperable middleware and point-of-care IT solutions that foster care team collaboration within and beyond the inpatient setting, including virtual care.

Point-of-care solutions such as clinical communication and collaboration (CC&C), interactive patient care (IPC), nurse call, and alarms and notifications platforms are converging to form a comprehensive care team collaborative ecosystem. Contact (or call) centers are joining this mix and will integrate more tightly with these systems to meet new consumer and provider expectations. The next-generation contact center integrates with care team collaboration technologies, consumer/patient engagement systems and CRM.

Location and condition sensing, Internet of Things (IoT) technologies, and other real-time health system solutions will provide the patient context and operational intelligence necessary for this emerging IT collaborative to effectively address persistent care coordination problems.). A new vendor landscape has begun to emerge from this IT ecosystem over and the various participants will compete for platform status. In 2018, a notable CC&C vendor, PerfectServe, acquired Telmediq, a competing CC&C platform. The PerfectServe acquisition activity also included CareWire and Lightning Bolt Solutions, to provide patient engagement and on-call scheduling capabilities respectively. In March of 2019, nurse call vendor Hillrom acquired Voalte, another CC&C vendor. In 2019, Critical Alert, a nurse call vendor, completed its acquisition of Sphere3, a mobile rounding and patient experience vendor, with the strategic intent to form an integrated patient communication and experience management platform — essentially a CTC platform.

This profile has been positioned this year to reflect the momentum of M&A activity of the recent past and new opportunities to share data and work at the point of care. We expect CTC platforms to continue to evolve quickly, with time to plateau closer to five than 10 years. These platforms will decrease the healthcare providers' dependence on the very large clinical vendors whose product roadmaps and capacity for innovation do not always aligned with the needs of the healthcare provider or the interests of the consumer and patient. CTC's geographic scope is global, although most CTC activity has occurred in the U.S.

User Advice:

- Adopt care team collaboration as a critical patient care delivery initiative and technology program by promoting it as a broad set of related technologies that must tightly interoperate in order to deliver their full, collective potential.
- Increase enterprisewide situational awareness surrounding the patient and provider by implementing pervasive real-time location and condition-sensing services.

- Improve care coordination and transitions of care by equipping care teams with mobile clinical communication and collaboration tools that interoperate with other core components of the care team collaboration ecosystem.

Business Impact: Care coordination is the purposeful organization of patient care activities among two or more participants (including the patient and the family) to facilitate the delivery of care. Coordinating care involves marshaling care team members and other resources to complete required patient care tasks outlined in a care plan. Care coordination is accomplished by the timely exchange of patient information and other operational intelligence surrounding the patient among care team members.

Healthcare provider CIOs will need to look beyond conventional patient management solutions to the new CTC IT ecosystem to satisfy more demanding consumer and patient experience, expectations, and new industry measures of care coordination and transitions of care. CTC benefits can include improvements in:

- Actionable metrics captured at the point of care
- Care coordination
- Care quality
- Competitive positioning
- Customer satisfaction
- Enterprise key performance indicators
- IoT and smart device integration
- Nurse and care team morale
- Nurse toil levels
- Patient experience
- Patient safety
- Regulatory compliance
- Reimbursement
- Staff utilization

- Transitions of care measures
- Workflow intervention and orchestration

Benefit Rating: Transformational

Market Penetration: Less than 1% of target audience

Maturity: Emerging

Sample Vendors: Amplion; Bernoulli; Critical Alert; GetWellNetwork; Hillrom (NaviCare Nurse Call); PerfectServe; Spok; Vocera

Recommended Reading: "Five Key Principles for Hospital Facility Planning in the Digital Age"

"Innovation Insight for Care Team Collaboration"

"Healthcare Provider CIOs: Overcome COVID-19 Challenges With Real-Time Health System Technology"

At the Peak

Critical Condition Surveillance Systems

Analysis By: Pooja Singh; Mike Jones

Definition: Critical condition surveillance systems monitor clinical data from the electronic health record (EHR), medical devices and diverse data sources in real time. They are monitoring for signs that a patient may be slipping toward a significant clinical decompensation that could be life-threatening or warrant urgent transfer to a higher level of care. Surveillance can also be applied to multiple patients, as in the early detection of a hospital-acquired infection such as MRSA. Such systems provide alerts to multidisciplinary responsible providers.

Position and Adoption Speed Justification: Advanced healthcare provider organizations are already calculating early-warning scores based on vital signs, clinician charting and laboratory results in their megasuite EHRs. We have seen an upsurge in the market of dedicated surveillance software in the past year, primarily driven by the fact that EHRs alone cannot handle all complex algorithms. More recently, during COVID-19, we have seen a few stand-alone surveillance system vendors adding capabilities such as discharge readiness to help health systems manage the increase in patient flow during the pandemic. Although both EHR-based and stand-alone surveillance systems are currently in use, it is likely that, over time, these dedicated surveillance systems will achieve superior results. By leveraging condition-specific algorithms, machine learning and AI, in concert with real-time predictive analytics and notifications, these systems will become better predictors of clinical deterioration.

Clinical surveillance systems enable the real-time healthcare system by increasing situational awareness and facilitating early intervention. Widespread acceptance of these systems will require a better signal-to-noise ratio to reduce false positives. Cloud-based machine learning on large and complex datasets, with diverse and often disparate clinical and nonclinical data sources, is starting to show superior predictive ability.

Various clinical studies and hospitals implementing these solutions have reported reductions in year-over-year mortality, sepsis mortality and hospital-acquired sepsis cases, along with reductions in cost per sepsis case.

We have moved the technology positioning further up the peak, driven by the pressure on hospitals to manage critical care delivery with their current capacity of the existing workforce, and compelling evidence of improved outcomes. Mainstream use will be between five and 10 years.

User Advice: Healthcare provider CIOs should partner with CMIOs, CNIOs and clinician leaders to:

- Evaluate the capability of dedicated surveillance vendors, and compare this with what they can accomplish in their own EHRs.
- Render the clinical data repository (i.e., an EHR or multiple health record systems) capable of real-time data ingestion into the critical condition surveillance platform.
- Track the false-positive alert rates in their own critical surveillance continuously, and examine the system for the ability to adjust the weighting and scoring of the embedded algorithms. This is a two-edged sword, as customized scoring may improve the signal-to-noise ratio, but may require time-consuming clinical testing.
- Ensure that acute care facilities have high-functioning rapid response teams, with capability to monitor response time and outcomes.
- Engage nurses, physicians, pharmacists and pathologists to evaluate the benefits of surveillance systems by tracking sepsis and mortality rates, antimicrobial resistance, unplanned transfers to the intensive care unit, and hospital length of stay.

Business Impact: Intervening early on for deteriorating patients can dramatically improve their survival and impact HDOs' safety and mortality outcomes. As more patient observations are captured and integrated, we can expect that detection algorithms will continue to refine and generate reliable alerts in a timely manner for rapid response to worsening patient status. Vendor products may have the advantage of previous clinical trials with peer-reviewed findings. In the absence of direct comparison with stand-alone surveillance platforms and with the extra expense, some HDOs may try to get most of the benefits by configuring rules in their EHRs to calculate early-warning scores leading to clinician alerts.

Benefit Rating: High

Market Penetration: 1% to 5% of target audience

Maturity: Emerging

Sample Vendors: Bernoulli; Excel Medical; Jvion; Medical Informatics; PeraHealth; Royal Philips; VigiLanz

Recommended Reading: "Understand the Value of AI for Healthcare Delivery Organizations"

"The Digital Care Delivery Framework for Healthcare Provider CIOs"

"CIOs Need to Expand Their Perspective on Clinical Data and Analytics Change Efforts or Plan to Fail"

"Healthcare Provider CIO Strategies for Scaling Digital Care Delivery"

"Healthcare Provider Command Centers Advance Real-Time Digital Care to Improve Efficiencies"

Algorithmic Medicine

Analysis By: Sachin Dev; Sharon Hakkennes

Definition: Algorithmic medicine enables intelligent clinical decision support by using insights and rules built from clinical guidelines, evidence-based best practices and other clinical data repositories to accurately draw "expert-level" medical diagnosis and treatment decisions.

The use of machine learning (ML), rule-based algorithms and artificial intelligence (AI), along with predictive abilities in algorithmic medicines, augments clinicians' activities by recommending diagnoses such as diagnostic image interpretation or specific treatment protocols.

Position and Adoption Speed Justification: Adoption of algorithmic medicine is fitfully proceeding in many areas including readmission predictions, sepsis surveillance and the use of alerts in command and control center dashboards (especially in ICUs). Algorithmic systems are being used to make simple diagnoses, complete required clinical documentation and aid in improving clinical quality, often by decreasing time to diagnose and standardizing care delivery. Some electronic health record (EHR) vendor solutions now offer built-in clinical decision support, thereby easing and increasing adoption. We expect the introduction of new use cases will continue to grow as more algorithms are developed and proven to be effective in augmenting clinical decision support. There is already ample evidence of machine-learned predictive models outperforming traditional methods and models. However, there remain numerous barriers that will need to be addressed. These include regulatory issues, payment concerns, medicolegal issues (for example, who will be held responsible when an algorithm is "wrong" or when will it be considered malpractice to not use an algorithm) and necessary cultural changes. In contrast with these barriers, we see the COVID-19 pandemic bringing many new use cases (like lung imaging analysis and COVID-19 treatment algorithms) to light that will help speed acceptance of algorithmic medicine generally.

In light of increased interest and usability of algorithmic medicine during the COVID-19 pandemic, and with growing number of FDA-approved algorithms in medicine, we move this profile further to the Peak of Inflated Expectations. We also expect algorithmic medicine to reach mainstream adoption in less than five years.

User Advice: CIOs and chief medical informatics officers (CMIOs) should:

- Implement strong AI governance. Lead awareness of the potential benefits of algorithmic medicine and the state of the market.
- Address any potential negative biases. This could include concerns about accuracy of the algorithms, fears about the "black-box" nature of some algorithms, alarm about medicolegal ramifications and unease on the part of both clinicians and patients regarding the impersonal nature of these kinds of interactions.
- Use the clinical governance framework of the healthcare delivery organization (HDO) to assist in the evaluation of clinical algorithms and to help drive adoption of algorithmic medicine. Engage your CMIO and chief nursing informatics officer (CNIO).

Work with risk management to understand and eventually mitigate any legal ramifications of either using, or failing to use, algorithmic medicine.

Business Impact: Algorithmic medicine has the potential to radically change the delivery of clinical care. In the short term, clinical algorithms can speed time to decisions and make clinicians more efficient. In the long term, use of algorithms can considerably augment a clinician's activities by drawing "expert-level" clinical decision support. This allows clinicians to prioritize and focus on urgent, emergent and more complex situations much earlier in the care delivery process. In addition, algorithmic medicine has great potential to help reduce healthcare waste and avoid duplicate tests and unnecessary diagnostic studies by standardizing diagnostics and treatment protocols.

Benefit Rating: Transformational

Market Penetration: 5% to 20% of target audience

Maturity: Adolescent

Sample Vendors: Cerner; Epic; IBM Watson Health; Intellivisit; Jvion; Stanson Health; VigiLanz

Recommended Reading: "Gartner's Update to the Enterprise EHR Generation Model"

"Healthcare Provider CIOs: Build Clinical Informatics Leadership to Succeed in Digital Clinical Transformation"

"Scaling Virtual Care Requires a New Look at Its Enabling Architecture"

"Healthcare Provider CIOs: Get Ahead of AI Innovation With Strong AI Governance"

Enterprise Virtual Care Platform

Analysis By: Sharon Hakkennes; Mike Jones

Definition: Enterprise virtual care platform solutions represent a set of IT capabilities and related services that enable augmentation and substitution of conventional face-to-face care delivery. Enterprise virtual care platforms enable delivery of care where the clinician is not in the same physical location as the patient, either synchronously (i.e., in real time) or asynchronously. They achieve this through a variety of capabilities that fall under three core categories virtual visits, remote monitoring and clinical encounter automation.

Position and Adoption Speed Justification: Enterprise virtual care platforms enable HDOs to provide a broad range of virtual care services to enhance patient experience, branch into new populations and service lines, and transform service delivery efficiency under alternative payment models. Current platforms offer a functionality that complements or is not available in existing EHR megasuite offerings, and EHR integration is a key success factor for an efficient clinical workflow. A number of EHR vendors are now offering APIs to enable integration with stand-alone virtual care vendor platforms in recognition of customer needs and demands for integration (e.g., integration for video capability, clinical documentation and payer information).

The technical need for an enterprise platform to help enable the delivery of virtual care and telemedicine at scale is clear. Today, there are multiple large and small vendors competing in this relatively nascent market with a wide array of functionality. Our expectation is that over time, there will be a coalescence of both vendors and functionality (similar to American Well acquisition of Avizia in 2018 and Aligned Telehealth in 2019; Teladoc Health's 2019 acquisition announcement of MédecinDirect and 2020 acquisition of InTouch Health).

Globally, virtual care has been at the forefront of the HDOs' response to the COVID-19 pandemic. In a matter of weeks, it has moved from a model of care to be delivered some years in the future to an immediate action for today. In their initial response to the crisis, HDOs scaled existing solutions or rapidly deployed new solutions to support delivery of virtual services for both inpatient and ambulatory care. Many HDOs have compromised on functionality and integration in order to deploy these solutions quickly.

We believe that many of the changes in funding models and clinical acceptance of virtual delivery services will endure post-COVID-19. As a result, as HDOs move from the initial respond phase to recovery, CIOs will need to develop a long-term strategic approach for virtual care for their organization and align technology solutions to this strategy. Reassessing the sustainability and scalability of stand-alone solutions deployed in response to COVID-19 will be an essential step in this process.

In response to the global use of virtual care services associated with COVID-19, we have jumped the position this year from approximately midway between the Innovation Trigger and the peak. The main barriers to adoption of clinician cultural norms, agreement on payment models and regulatory issues that we have previously described have been broken down. From here, the slide down to the Trough of Disillusionment will occur quickly, as clinicians become frustrated with the work arounds associated with rapidly deployed solutions, uncertainty around long-term reimbursement models arise and proving return on investment in financially constrained environments is challenged. Our prediction of time to plateau remains at two to five years. Allowing time for the technology to continue to mature and HDOs to develop their medium to long term strategic plan for virtual care.

User Advice: HDOs seeking to build on the momentum for delivering virtual care services realized as a result of COVID-19 should:

- Develop a vision and roadmap for enterprise virtual care in their organization with a supporting strategic case that looks at the whole clinical service portfolio. Consider expanding service models to explore new markets, including direct-to-consumer options to justify the requirement for, and investment in, a virtual care platform.
- Review and determine use cases, including existing HDO virtual care offerings, that can be migrated or integrated into an enterprise platform.
- Consult with clinical leaders to understand their perspectives of how this can improve care, and address change issues at an organizational and specialty level before implementing the platform. Work through how the platform will be used to facilitate improvements in efficiency, quality, safety and experience.
- Ensure sufficient resources are given to change management, EHR interoperability and workflow integration, patient and consumer engagement, and addressing each specialty on its own merits.
- Discuss virtual care plans with payers to ensure coverage in terms of payment, and data integration needs.
- Request comprehensive API capabilities from the EHR vendor with regards to integration of data and functionality for scheduling virtual care visits, calling video and other device integration functionality, and bidirectional handling of patient-related clinical and administrative data.

- Review the capabilities and preferred reseller/vendor endpoints in terms of commercial terms and conditions, quality of peripherals offered, and existing infrastructure that may be compatible or needs replacement over time. Ensure compatibility with existing medical device integration and network policies to help with value for money and minimize implementation costs and risks.

Business Impact: The target audience for these platforms includes HDOs that provide a range of care offerings in a range of settings (such as an accountable care organization) or are looking to expand into new business lines in response to market opportunities or customer expectations. The expected impact is on frontline care delivery across a range of clinical specialties and care settings (home, clinic, hospital). From a clinician's perspective, it offers opportunities for improved productivity and revenue. For HDOs, it offers opportunities in new markets, improved customer engagement and satisfaction, and improved care outcomes. For patients, it offers a more flexible model of seeking and receiving better care experience, and better health and well-being outcomes.

Benefit Rating: Moderate

Market Penetration: 5% to 20% of target audience

Maturity: Adolescent

Sample Vendors: American Well; Babylon; GlobalMed; InTouch Health; Royal Philips; Teladoc Health; Vivify Health; Zipnosis

Recommended Reading: "Healthcare Provider CIOs: Bridge the Virtual Care Divide Between Provider- and Consumer-Directed Care"

"Scaling Virtual Care Requires a New Look at Its Enabling Architecture"

"Best-Practice Exemplar: Palvelukeskus Helsinki Scales Innovation in Virtual and Digital Care Delivery"

"Adopt This Decision Framework for Virtual Healthcare Delivery"

"Master These Proof Points to Create a Sustainable Virtual Care Roadmap"

Automated Informed Consent

Analysis By: Mike Jones

Definition: Automated informed consent solutions are used to ensure that patients (or their proxies) are provided with the necessary educational material regarding the benefits, risks and alternatives to diagnostic tests or therapeutic procedures necessary to make an informed decision whether to proceed or not. These solutions provide more than a digital record of a legally required signed consent form; advanced solutions include a measure of patients' comprehension of the information provided.

Position and Adoption Speed Justification: For ethical and legal reasons, clinicians are obligated to review the benefits, risks and alternatives to diagnostic tests or medical procedures with their patients. There are some issues with informed consent as it is practiced today by many HDOs. Informed consent content is often not understandable — and an explicit form of consent is not always acquired from the patient before treatment. Even after reviewing and signing a consent form, many patients can still struggle to fully understand key information about the risks, benefits and alternatives of their proposed treatment or procedure.

The standard practice has been in the hands of clinicians to determine how the information is best conveyed. As a result, informed consent remains largely a paper-intensive process and replete with content, version control and compliance issues. Many current practices require manual scanning of completed consents into the electronic health record. The main challenges to a more effective consent process include:

- Lack of clinician time
- Patient language and cultural issues
- Special patient circumstances and human factors (such as IQ, stress and timing)
- Patient's lack of awareness that they can refuse the procedure or delay the decision, and the ramifications of such a decision
- Clinician's inability to detect a patient's lack of comprehension
- Physician concerns about the ramification of providing too much information

Automated informed consent solutions allow HDOs to standardize the informed consent process and help with clinical workflow efficient by assigning important educational material to patients. These solutions, often delivered within mobile apps and via tailored videos and forms, make it easier to give patients access to the information they need in order to make decisions, and to record the consent alongside or within the health record. There are still few fully automated informed consent implementations, but given its importance to compliance, patient safety, and the patient's experience, automated informed consent will likely routinely replace more manual approaches over the next five years. Awareness will increase as more solutions come to market and healthcare providers share their experiences.

Where GDPR or similar citizen-focused consent requirements are to be automated, these solutions will need to:

- Provide individuals with tailored privacy information on the collection and use of their personal health data. This will include data and guidance on the purposes for processing their personal data and retention periods for that personal data, and who it will be shared with.
- Provide updated privacy information to those individuals at each time new data is collected from them.
- Obtain feedback on the effectiveness of the manner by which consent is obtained (ease of use, easy to understand, transparent)
- Have the ability to withdraw consent at any time, and the details of any transfer of data to another region or agency.
- Offer the individuals an easy route to seek further advice and raise a concern.

User Advice: HDO CIOs should work with risk management, health information management, clinical and business leaders to:

- Establish an enterprisewide list of diagnostics, treatments, procedures and situations that require a patient's informed consent.
- Map current practices and consider new use cases and process flows to better understand the potential impact of automating the informed consent process, as well as providing information necessary for effective assessment of available software solutions.

- Evaluate and pilot informed consent software solutions for their capability to integrate with the consumer engagement platforms and the EHR, including any patient portals or mobile health apps for personal health records.

Business Impact: Automated informed consent solutions can engage patients in their own care, leading to improved patient safety, better outcomes and improved patient satisfaction. This, in turn, can result in lower incidents of malpractice claims. In some regions, consent management has become a mandatory requirement to meet new legislation on privacy and data protection for citizens (for example, GDPR in Europe).

Benefit Rating: Moderate

Market Penetration: 1% to 5% of target audience

Maturity: Adolescent

Sample Vendors: Emmi; Philips; Rati-Fi; Telesofia Medical

Recommended Reading: "Market Guide for Consent and Preference Management"

"Business Drivers of Technology Decisions for Healthcare Providers, 2020"

"The Evolution of Healthcare Consumer Engagement Hub Architecture"

"Healthcare Provider CIO Strategies for Scaling Digital Care Delivery"

Semantic Interoperability

Analysis By: Mike Jones

Definition: Semantic interoperability in healthcare is evidence when two or more information systems can exchange and process business and clinical information with an unequivocal and common understanding. They do this without the need for the participating systems to have prior knowledge of how the information will be used. This profile covers the technologies and working groups that support this end objective.

Position and Adoption Speed Justification: For many HDOs, government agencies and regulators to achieve semantic interoperability, disruptive forces are required to force the industry to tackle the variability in vendor approaches. In the last 12 months, there have been two key disruptive forces — the finalization of the ONC ruling and COVID-19 (see COVID-19 Interoperability Alliance) — that have increased the reliance on rapid clinical information sharing and exposed the shortfalls of many proprietary EHR information exchange mechanisms.

These come on the back of an industrywide shift that has been occurring over the last three years, including:

- The U.S. HHS/ONC Trusted Exchange Framework and Common Agreement (TEFCA) Second Draft
- Care Connect and INTEROPen
- Progress with Health Level Seven International's (HL7's) Clinical Information Modeling Initiative, to develop a single curated collection of information models
- HIMSS international efforts to redefine interoperability (first time since 2013) in the context of optimizing the health of individuals and populations, including foundational, structural, semantic and organizational.

Today, most efforts to address the silos of health data across HDOs focus mainly on the messaging standards between systems. They avoid the issue of common underlying clinical and business archetypes leading to brittle, expensive, and limited forms of healthcare information exchange and interoperability. While common vocabularies exist (SNOMED, LOINC, RxNorm), and professional clinical organizations have long mandated their use, the task of fully applying these standards within the underlying proprietary data schemas of many EHRs has been variable.

Gartner has positioned this profile after the peak to reflect the wide acknowledgment that is needed across the industry, but to also reflect the journey that is still required for semantic interoperability for longitudinal care record adoption. In some regions, industry regulation or changes to primary legislation to put data control and access rights in the hands of the consumer are deemed necessary to create the conditions for change. This adds urgency to the case for more open and royalty-free forms of interoperability (see "The State of Privacy and Personal Data Protection, 2019-2020").

User Advice: CIOs should undertake a number of actions to address lack of semantic interoperability:

- Develop a deeper understanding of the interoperability needs of your HDO by taking an outside-in view of how patients, clinicians and your HDO as a business would benefit from improved access to and ability to share EHR data
- Form a clear vision and roadmap for what you want to achieve with semantic interoperability, and address questions of data ownership, control and oversight at the outset of your journey.
- Focus on the specific use cases that will yield the greatest business value.
- Revisit existing commercial agreements with your EHR vendor, and explore the current and future roadmap for providing interoperability capability that is open, comprehensive in content, and in line with your current requirement gaps and anticipated future needs.

When procuring new systems capability, insist on open APIs that are published on publicly available resources, have freely accessible documentation, are available free of charge to enable testing, and have transparent commercial arrangements for further development and use. Licenses for usage of open APIs by a receiving system should ideally be royalty-free, perpetual, nonexclusive and transferable.

Business Impact: Typically, the integrated care pathways that span a network of providers are most in need of semantic interoperability. Use cases include:

- End-of-life care
- Complex care pathways such as cancer and mental/behavioral health
- Packages of health and social care where there are multiple care needs
- Health information exchange for care management and care coordination
- Urgent or emergency care (e.g., when ambulances attend to patients and need access to their primary or hospital care record for information on current medicines, known allergies or previous adverse reactions)

The main business areas that will be impacted will be initial and onward referral, discharge, triage and care coordination (sometimes referred to as care pathway orchestration) and where a health organization needs to exchange information (e.g., external diagnostic providers).

Benefit Rating: High

Market Penetration: 5% to 20% of target audience

Maturity: Adolescent

Sample Vendors: Better; CommonWell Health Alliance; DIPS; IHE; Marand; openEHR; The Sequoia Project; Tieto

Recommended Reading: "Market Guide for Health Information Exchange Platforms"

"Healthcare Provider CIOs: Shift Interoperability Strategy From Moving Data to Orchestrating Workflow"

"Healthcare Provider CIOs Need a Strategic Approach to Interoperability as the Industry Shifts"

"7 Critical Domains of a Successful Healthcare Provider Interoperability Strategy"

Consumer Healthcare Wearables

Analysis By: Mike Jones

Definition: Consumer healthcare wearables refer to the use of consumer-grade devices as recommended by a clinician to inform and track compliance with a prescribed treatment plan. They are separate from the use of medical-grade devices for the purposes of clinical diagnosis, treatment and monitoring.

Position and Adoption Speed Justification: Wearable electronic devices are designed to sense the human body or the environment around the wearer. Most can wirelessly send information to a smartphone or computer, but it could also be sent to the cloud or connected to an Internet of Things (IoT) platform. They have embedded intelligence such as a microcontroller or digital signal processor and, increasingly, will incorporate AI capabilities to assist with treatment protocol management and alerting

Healthcare delivery organizations' (HDOs') use of lower-cost consumer wearables is expected to grow alongside that of medical-grade remote monitoring devices for the following reasons:

- They offer an engaging user interface and user experience to help drive self-management and compliance with HDO-prescribed lifestyle regimens.
- They are offered at an affordable price point.
- They can help differentiate the HDO through improved patient engagement and experience.
- They can provide an additional source of data for case managers to check in with patients to see how they are coping with their treatment regimens or to respond to periods of inactivity.
- They can provide an incentive to patients to change behaviors.

The speed of adoption will depend on proof of effectiveness and the cost and ease of integration of such devices into clinical workflow and analytics capabilities. Platforms in this space now offer a means for HDOs, insurers, pharma/life sciences companies, government agencies and the vendors of EHRs and enterprise virtual care clinical platforms to offload the complexity and risk of managing numerous device types and protocols. More recently, there has been a heightened awareness and interest in home-based monitoring for patients in the COVID-19 vulnerable risk category.

There is a range of wearables available in this space at different levels of maturity and application by the HDO. These include:

- Wristband-style devices (e.g., Garmin, Fitbit, Apple Watch and Samsung) for measuring exercise patterns and intensity
- Consumer-grade blood pressure (BP) monitoring devices
- Pulse-oximeters — vital for measuring lung efficiency and a leading indicator of COVID-19 progress in the body
- Sleep monitoring and brainwave monitoring
- Clothing that senses blood flow and respiratory rates

We see this information being visible to the clinician through consent and data-sharing mechanisms controlled by the patient. In many cases, the data will sit outside the EHR, reside on the patient's smart device or in the cloud, and be integrated into clinical workflow.

Recent announcements include Apple Watch Series 5, incorporating FDA-approved ECG and an integrated heart rate app for continuous monitoring, along with menstrual cycle monitoring capability.

User Advice: CIOs should:

- Evaluate the application and effectiveness through peer-reviewed case studies, focusing on applications for lifestyle, rehabilitation, and patient engagement and retention.
- Discuss the potential and socialize the concept of use of these devices within clinical practice through the chief medical informatics officer/chief nursing informatics officer (CMIO/CNIO) in order to determine the most appropriate forms of monitoring and tracking.
- Ensure piloting takes place in a tightly scoped project with clear metrics for measuring clinical and patient feasibility, and be sure to consider the issues of ownership of data and consent to collect and use data.
- Be aware of security/data protection requirements of your region where this information is traversing the cloud environment of the vendor platform that aggregates and presents the information.

Business Impact: Consumer-grade wearables offer HDOs the opportunity to use lower-cost wearables as a complement to medical-grade remote-monitoring devices. This will lower the costs of monitoring patients, while improving clinical outcomes through the additional data generated by the devices.

The expected benefits for the HDO of wearables for digital care delivery include:

- Greater compliance with prescribed lifestyle regimens
- Differentiation in the market because of focus on services that deliver better user experience and increased customer intimacy

- An ability to monitor effectiveness of a prescribed lifestyle and exercise regimen at a relatively low cost per user when compared to medical-grade monitoring equipment

We have assessed the benefit rating as medium, as evidence of both clinical- and cost-effectiveness is growing. Also, there is currently no market-leading platform to capture, analyze and present the data from multiple devices to a clinician in a meaningful way.

Benefit Rating: Moderate

Market Penetration: 5% to 20% of target audience

Maturity: Early mainstream

Sample Vendors: Alphabet; Apple; Fitbit; Garmin; Google; iHealth; Omron Healthcare; Panasonic; Samsung; Validic

Recommended Reading: "Master These Proof Points to Create a Sustainable Virtual Care Roadmap"

"Prepare for Aging Epidemic by Extending Your Virtual Care Strategy to Support Aging in Place"

"Forecast Analysis: Wearable Electronic Devices, Worldwide"

"Business Drivers of Technology Decisions for Healthcare Providers, 2020"

"Healthcare Provider CIOs: Bridge the Virtual Care Divide Between Provider- and Consumer-Directed Care"

E-Visits (Non-U.S.)

Analysis By: Mike Jones

Definition: An e-visit is an asynchronous, technology-enabled, structured, secure, nonurgent, remote consultation between a patient and a provider, where a pre-existing relationship exists. These encounters are well-defined and narrow in scope, and they can include triage, simple urgent or chronic disease care, prescriptions, and patient education. They are usually delivered through a patient portal, most often tethered to an EHR.

Position and Adoption Speed Justification: With a primary driver to increase access to affordable healthcare services and providers, the growing acceptance of online services had led to a steady increase in interest in e-visits by healthcare providers, patients, payers and governments outside the U.S. At the onset of the COVID-19 pandemic, that modest appetite transformed overnight into a critical requirement to sustain patient care for many patients whose care could not simply be put on hold.

E-visits in the U.S. has already matured beyond the Plateau of Productivity, and positioning of this technology profile after the peak reflects a much greater demand in 2020 in the overall non-U.S. market. While EHR adoption is still lower outside of the U.S. some non-U.S. EHRs, especially those designed for primary care, have recently added e-visit functionality. Once EHR adoption and reimbursement issues are addressed — and many are now in place following emergency COVID-19 policy — patients and providers will need to manage the significant cultural change of replacing face-to-face interactions beyond the pandemic. Initial data during March and April 2020, based on U.S. claims for telehealth, indicated a 35-fold increase in virtual care consultation in the main states affected by COVID-19 infection. It is not clear yet just how much of this shift will be retained in the longer term. However, at time of publication, many healthcare providers were considering virtual care as a more permanent option for many clinical specialties, particularly those for chronic disease management and rehabilitation.

This year we identify the Time to Plateau as two to five years. We had expected it to be closer to the five-year mark in 2019. We expect 2020 will reduce that somewhat closer to two years, as many benefits have been proven in a short time frame.

Adoption will increase worldwide once payments for a broader array of e-visits become more common and permanent, and healthcare payers and providers accept e-visits as a cost-effective substitute for certain types of face-to-face consultation.

User Advice: Once EHR and portal solutions fully support e-visits and clinicians are appropriately reimbursed, we expect e-visits will likely become as ubiquitous as office visits and phone calls. Healthcare delivery organization (HDO) CIOs need to evaluate vendor capabilities and, when applicable, need to work with clinical and administrative leaders to help ensure that their e-visit solutions are well-publicized and run efficiently. Furthermore, it will be necessary to configure scheduling systems to set aside regular time slots for e-visits, rather than just squeeze them in between regular patients or after hours.

To increase patient satisfaction and decrease risks, HDO chief medical informatics officers (CMIOs) should help set expectations with patients, provide guidance on the use of e-visits, and create and enforce policies. These policies include ensuring that healthcare consumers understand what is appropriate for an e-visit and what turnaround time they can expect. To this end, HDOs should consider using response-time SLAs with clinicians. Clinicians must recognize that the messages will be considered a part of the legal medical record. Clinicians should also be correctly compensated for e-visits. At the very least, if the number of encounters is a performance metric, then clinicians should receive appropriate credit — likely, it will be some fraction of a traditional visit, because an e-visit should take less time and effort.

Business Impact: A well-implemented e-visit program can reduce costs, increase patient satisfaction and engagement, increase care access, improve care coordination, enhance brand loyalty and improve clinician productivity.

Benefit Rating: High

Market Penetration: 20% to 50% of target audience

Maturity: Early mainstream

Sample Vendors: Allscripts; Attend Anywhere; Cambio; Cerner; Doctorlink; Epic; Tieto

Recommended Reading: "Healthcare Provider CIOs: Bridge the Virtual Care Divide Between Provider- and Consumer-Directed Care"

"Healthcare Providers: Combat COVID-19 With Virtual Care"

"Scaling Virtual Care Requires a New Look at Its Enabling Architecture"

"Prepare for Aging Epidemic by Extending Your Virtual Care Strategy to Support Aging in Place"

"Business Drivers of Technology Decisions for Healthcare Providers, 2020"

"Master These Proof Points to Create a Sustainable Virtual Care Roadmap"

Sliding Into the Trough

3D Printed Surgical Implants

Analysis By: Pooja Singh; Mike Jones

Definition: This technology covers the use of 3D printing (3DP), tissue engineering and spacer technology to replace existing medical implant approaches and create new, specialized ones. The method matches each patient's unique shape to a surgical implant. It creates a 3DP design from computed tomography (CT) scans and magnetic resonance images (MRIs), and uses proprietary algorithms to print the implant and offer individualized surgical guides and/or instruments.

Position and Adoption Speed Justification: Incorporating 3DP into the design, manufacture and implementation of implants of all types is gaining advocates and market awareness within the medical community, as more successes are publicized. Commercial vendor healthcare business units have formed, as prestige research institutions invest in the technology. Though 3DP printed medical implants and services are becoming more common, they still lag behind the volume of traditional procedures.

While material science is starting to ramp-up in this space, different microstructures, materials, meshes and chemistries are going into the implants themselves. While this complexity adds to the technology's capabilities, it also makes it more difficult to translate it into practice. The approval process to allow implantation of personalized prosthesis has been waived for emergency patient situations; however, it still a complicated and tedious process. Payer endorsement and reimbursement is an even trickier topic because of the highly customized approach. Physicians report that insurance is covering hips and knees at the same rate as traditional implants, with the caveat that the patient may have to pay for scans for the design rather than for diagnosis. Regional 3DP creation/distribution centers are developing with appeal for smaller markets.

We have positioned it over the peak on the Hype Cycle based on an increase of mainstream healthcare provider's interest, vendor investments, growing awareness and expanded vendor support. We anticipate that 3DP use cases will continue to expand, such as 3D printed prosthetics, and technology capabilities will evolve for years. Note that presurgery anatomical models are on a faster adoption trajectory, and the overlap of vendors means that healthcare providers will be increasingly exposed to implants and tools as integrated solutions. Mainstream use will be between five and 10 years.

User Advice: 3DP is an expanding area with a wide range of current, emerging and visionary medical uses and users, and a need for an enterprisewide orchestration leader. Assign one of your clinical IT leaders (for instance, the CMIO) to investigate the state of the art by teaming with researchers and surgeons to create a strategic roadmap and governance approach. Early leaders have created 3D printing innovation labs where technologies can be acquired for pilots across multiple use cases. Recognize that along with 3D implants that are specifically vetted and approved for use in your health system, anyone with a 3D printer and a blueprint, not just registered companies, could print their own devices. An increasing number of CIOs also bear responsibility for clinical engineering and biomedical technicians. CIOs and IT leaders can also assist in identifying and negotiating 3DP and imaging vendor relationships for on-site technology and manufacturing suppliers.

Continue to monitor regulatory guidance within your own jurisdiction and others, as the vendor community is working across boundaries. Guidelines written by national regulators have been accompanied by ISO and ASTM guidelines, with efforts to grow adoption of global standards for 3D printing of medical devices. The U.S. FDA regulates 3D printed instruments, implants and prosthetics under its Center for Devices and Radiological Health (CDRH)

There are currently two classes of 3D printed medical devices. In the first class, manufacturers have to prove that the final medical device product is substantially equivalent to a product that is already on the market. The second class requires premarket approval for devices deemed at a higher risk, given there is nothing similar to it on the market. Health Canada issued guidance for vendors manufacturing 3DP medical devices in April 2019. The European Union has largely followed the FDAs advice, and governance is found in Medical Devices Regulation 2017/745. The Chinese FDA (CFDA) issued draft guidance on for 3DP device approval in March 2018.

Business Impact: 3D printing of implants is a transformative technology poised to have a disruptive impact to medicine and the large business of traditional implants. Hip and knee replacements are among the most common hospital procedures around the world — more than 1 million are performed annually just in the U.S., and around 160,000 per year in England and Wales. Leveraging 3DP technology for 3D-printed implants and related items (such as precise and personalized models, instruments and surgery plans) has increased 3DP's importance. We have rated the value at high because of the potential impact on the core business of healthcare providers, improved patient outcomes and increased accuracy of the personalized anatomical models that underpin these implants.

Benefit Rating: High

Market Penetration: 1% to 5% of target audience

Maturity: Emerging

Sample Vendors: 3D Systems; Conformis; Embody Orthopaedic; Lithoz; Materialise; Stratasys

Recommended Reading: "Market Guide for 3D Printer Manufacturers"

"Predicts 2019: 3D Printing Accelerates, While 4D Printing Is Getting Started"

"Hype Cycle for 3D Printing, 2019"

"Top 10 Strategic Technology Trends for Manufacturing Industries: 3D Printing"

Eldercare-Assistive Robots

Analysis By: Mark Gilbert

Definition: Eldercare-assistive robots are self-deterministic/smart machine caregivers designed to help individuals achieve a self-sustaining life by helping them move around, performing caregiving tasks and providing companionship. This profile includes caregiver support, psychological support (motivation and companionship), and healthcare delivery services/therapeutic support for observations, monitoring, coaching or emergency action.

Position and Adoption Speed Justification: R&D for eldercare-assistive robotics continues to make determined progress. Major drivers are the functional limitations of a growing aging population and shortages of skilled and home workers to care for them. According to the World Bank, 8.9% of the world's 7.6 billion people were aged 65 and older in 2018. By 2050 1.6 billion or 17% of the total population of 9.4 billion will be 65 and older (see "Market Insight: Understanding Disruption Opportunities in Elderly Care, a Rapid Growth Market Catalyzed by Aging"). This aging population trend is especially prevalent within European and Asian countries. According to the International Federation of Robotics, the market for social robots is expected to grow 29% annually from 2019 and 2022, while demand for rehab robots is projected to grow 45% per year over the same time period.

At the same time, there is a global shortage of healthcare workers. The World Health Organization forecasts a global shortfall of 18 million healthcare workers by 2030. These trends all combine to fuel interest in robotics as a supplement to meet the increasing demand for caregiving. Because of the heightened imbalance of elderly to younger citizens and the national commitment to robotics in Japan, we look to that country as a bellwether of how these technologies may play out. There, robots have been assimilated into the daily lives of elderly citizens and have helped them extend their ability to age in place.

Currently available/announced personal assistant robots for the home fall into four groups:

- Household/daily care assistant robots
- Physical assistant robots
- Multipurpose standstill (or static) personal assistance robots (PARs)
- Multipurpose movable (or moving-capable, nonstatic) PARs

All of these product groups have potential relevance for the healthcare and related personal needs of elderly people. The most integrating are AI and sensing technologies (see: "Top 10 AI and Sensing Technology Capabilities for Personal Assistant Robots in 2020").

In 2020, we continue to classify the benefit as moderate until more use cases are documented and value is demonstrated at scale. New products, investments and accelerating innovations continue to power the technology's slow progress along the Hype Cycle past the Peak of Inflated Expectations. We continue to see use cases that can provide an immediate material benefit to healthcare. We expect the first wave of eldercare assistive robots will reach the Plateau of Productivity within five to 10 years.

User Advice: CIO actions should reflect the fact that the use of robotics is inevitable. Their use will include an expanding portfolio of healthcare and socially assistive applications. Accordingly, CIOs should take the following actions:

- Leading-edge healthcare delivery organizations (HDOs) should begin experimentation in the use of robots within proven use cases (companionship) and as more use cases become viable.

- Government social welfare programs should encourage innovation, use case development and participation in trials.
- As assistive robots reach functional ability and viable price levels, leading-edge health system CIOs should prepare for mobile robots to appear as new endpoints in healthcare IT networks. Moreover, they may eventually be represented in IT systems as "virtual" human/provider end users of IT, with unique identifiers, workflows and information needs, as well as being unique devices with specific deployment and support requirements.

Business Impact: Eldercare-assistive robots can have a material impact on the quality of life and care received by elderly individuals. Japan is currently testing robots within:

- Patient transfer assistance — Wearable and nonwearable devices to power-assist picking up patients
- Mobility assistance — Walking assistance devices like exoskeletons or robotic transportation
- Communications — Therapy, sympathy, companionship and medical adherence

We foresee robots will someday be an essential part of delivering home healthcare. They will address worker shortages, decrease delivery costs of healthcare services, and improve quality of life and service for users and caregivers. Assistive robot applications will impact functions that directly supplement the healthcare and social service labor force, or provide innovative, new healthcare and personal services. Nevertheless, while the ultimate impact could be high in the future, we rate the likely early emerging uses as of moderate value today.

Benefit Rating: Moderate

Market Penetration: Less than 1% of target audience

Maturity: Emerging

Sample Vendors: Aeolus Robotics; CT Asia Robotics; INF Robotics; KOMPAÏ robotics; NEC; PARO Robots; Seismic; SoftBank Robotics

Recommended Reading: "Forecast: IoT Enterprise Robots by Use Case, Worldwide, 2018-2028"

"Artificial Intelligence Trends: AI-Driven Robots"

"Maverick* Research: Being Human 2040 — The Life of the Architected Human in a More-Than-Human World"

"Artificial Intelligence Primer for 2019"

Genomics Medicine

Analysis By: Sachin Dev; Michael Shanler

Definition: Genomics medicine technology enables the use of genetic information for medical research and treatment (e.g., diagnosis, therapy, risk management). It is a component of precision medicine and focuses on leveraging genomic data and insights derived to treat patients. Technologies include gene sequencing, variance calling, high performance computing, artificial intelligence (AI)-informed risk assessment and clinical decision support.

Position and Adoption Speed Justification: Genomics medicine is an important advance in modern medical science, and its promise to improve health outcomes is driving its adoption among healthcare and life science organizations. The upstream technologies supporting research and gene sequencing data collection are well developed and yield increasing amounts of efficiency in genomics. However, technologies that use genetic information in clinical care delivery (such as those translating genetic information into actionable information) are still maturing but comparatively at a slower pace.

We position this innovation profile near the Peak of Inflated Expectation because of its variability in maturity across the broad domain of medicine. Also, considering the variations in maturity level for upstream technologies for genetic data collection and usability of genetic information in downstream care delivery, our current position represents an aggregate of both upstream and downstream technologies.

Health systems and life science organizations with notable success in genomics medicine demonstrate many genomic programs and studies to utilize the molecular level insights from genes to personalize treatments and improve healthcare outcomes. Technology and services related to genomics are steadily progressing as the cost of genomic sequencing continues to go down and as research has identified more practical uses in diagnosing and treating patients. For example, companion diagnostics is rapidly expanding in biopharma whereby an individual's receptivity for a specific medicine is measured by matching a specific genetic biomarker. Research in the field is investigating many other uses of the genomics ranging from genetic testing for rare and undiagnosed diseases, gene therapy, testing for treatment receptivity, precision cancer treatment and gene editing to "correct" for abnormalities, among others.

It has required decades of extensive research to translate genomic data into these beneficial practices. Progress proceeds at the pace of scientific discovery. It is equally challenging to make this knowledge actionable by physicians, as many are not well trained to incorporate an actionable insight from genomics within their workflows. Another major barrier responsible for slow adoption is the gap in the reimbursement model for these experimental therapies. These are significant barriers, and they hinder the development, clinical trial and regulatory approval of new tests, drugs and therapies. Bioethical issues also surface through the use of new technologies that make gene editing techniques like CRISPR possible. Pace of adoption will slow even further due to the complexity of discovery process with early innovations continuing to occur in oncology and genetic testing. Academics and oncology-focused organizations will continue to lead adoption again this year.

User Advice: Healthcare provider CIOs, CMIOs, and medical and population health leaders:

- Establish a surveillance process to stay updated with the practical use of genomics in diagnosis and treatment and the implications for IT. Initiate discussions with peers as to whether it is worth pursuing an in-house genomics center of excellence, or outsourcing this function.
- Architect an infrastructure, inclusive of outside services, that supports the acquisition, storage, collaboration and analytics requirements demanded by genomic datasets and therapy delivery.
- Evaluate your electronic health record (EHR) vendor for their plans to support genomics medicine needs. This includes the ability to record, store, secure and access genetic marker data from patients, and their ancestors and family members, within the individual patient's record.

- Understand that enhanced genomics decision support for diagnosis and treatment will likely come from a combination of traditional evidence-based content vendors, precision medicine platforms, government sources, genomics data banks and bioinformatics providers.

Life science CIOs and IT leaders:

- Outline business process, compliance, laboratory regulatory and IT implications when including genomics medicine disciplines for decisions about research, therapies and business opportunities, while ensuring patient privacy.
- Plan to provide data and analytics tools that support distributed innovation and data-driven hypothesis generation quickly and at scale.
- Understand the emerging technology needs to manage the cell therapy supply chain for newer treatments such as CAR T-cell therapy.

All healthcare and life science stakeholders:

- Determine how to service curating, analyzing and processing genomic data by modeling capabilities and resourcing to support in-house development, software-based or partner contract services.

Business Impact: The value of genomics medicine is clearly demonstrated in areas like creating accurate diagnosis tools, the development and application of better-targeted therapies for cancer and rare diseases, genetics-directed chemotherapy, prenatal care and genetic counseling. In the long term, the business and population health impact of genomics medicine will be substantial and an integral ingredient to the precision medicine movement. Researchers, life science companies, healthcare providers and consumers variously will require genomics raw sequencing data, analysis and recommendations from sequencing data, results integration with EHR system and therapy selection support. Information exchange is needed among scientists, providers, patients and families for collaboration and counseling. Increasingly, medication prescribing will be based on the presence or absence of enzymes suggested by genetic testing. Disease diagnosis and advising patients on managing health risks will rely more and more on genetic analysis. New genetic markers are constantly being discovered, requiring frequent reanalysis of patients' sequencing data.

Benefit Rating: Transformational

Market Penetration: 5% to 20% of target audience

Maturity: Adolescent

Sample Vendors: DNAnexus; Genedata; Helix; IBM Watson; Igenbio; Illumina (GenoLogics); L7 Informatics; NantHealth; Sema4; Seven Bridges

Recommended Reading: "A Digital Literacy Charter Paves the Way for Healthcare Provider CIOs' Workforce Transformation"

"Market Guide for Laboratory Informatics"

Medication Compliance Management

Analysis By: Mark Gilbert; Pooja Singh

Definition: Medication compliance management systems are designed to remind patients and clinical trial participants to take their medications on schedule by monitoring the act of taking a medicine as prescribed. These systems collect data from multiple sources and aggregate and present it to multiple entities (for example, individual patients, physicians, care teams and drug suppliers) that participate in the medication compliance process.

Position and Adoption Speed Justification: Medication compliance management systems can be used by provider organizations, healthcare payers, population health management programs, pharmaceutical companies and retail pharmacies, and for research and clinical trials. They are most important in clinical trials where noncompliance can lead to inaccuracies in observed efficacy or drug safety. They also play a role in chronic condition management and behavioral care where noncompliance can lead to worsening clinical status, readmissions, more emergency department visits and increased costs.

Medication compliance programs' adoption is expected to increase, aligned with the increased adoption of value-based care and digital clinical trials. This profile does not include medication compliance support services like calls, in-app messages or text messages initiated by care managers, or simple calendar-based refill reminders. Postpeak positioning is based on penetration in the U.S., which has higher adoption than we observe in other countries.

There are multiple ways to monitor and manage medication compliance, including patient portals, mobile phone apps, home TV messaging systems, text messages, electronic pill boxes programmed with a schedule, smart pill bottle caps and RFID-tagged smart pills. The various methods, or combination of methods, monitor compliance and alert the patient, family members or caregivers that the patient has failed to take the medication, or they notify the pharmacy that the patient needs a refill.

Despite the availability of multiple technologies and sponsorship by multiple sponsors, adoption of medication compliance systems is still limited to only a small percentage of patients — predominantly within clinical trials. Given this adoption rate, we estimate this technology's time to mainstream adoption to be five to 10 years.

Medication compliance is an increasingly popular use case for virtual nursing visits, particularly among the frail elderly.

User Advice: First, recognize the difference between compliance and adherence, and approach initiatives to improve compliance and adherence accordingly. "Medication adherence," as defined by the World Health Organization, is the degree to which the person's behavior corresponds with the agreed recommendations from a healthcare provider. Medication compliance management focuses on monitoring and enforcing a doctor's medication prescriptions. It does not address the causes that may prevent a patient from adhering to the prescription. For example, causes include being unable to afford the cost of the prescription, having an inability to fulfill the prescription due to lack of transportation, and decisions by the patient to stop taking the medicine — perhaps due to side effects.

These adherence gaps must be addressed through other capabilities like shared decision making, behavior economics, consumer persuasion analytics, medication reconciliation or online medication fulfillment. Some of the vendors listed include many of these adherence features and support services within their medication compliance products.

Payer, provider and life science CIOs:

- Assist the organization in investigating medication compliance management systems as useful tools to improve patient outcomes, lower costs and enable more-efficient resource utilization.
- Consider undertaking a pilot with a platform solution. Use pilot data as the basis for a larger rollout.

- Consider partnering with community pharmacists who have their own medication adherence programs.
- Provide patients with access to compliance tools, such as smart dispensers, digital medication calendars, online compliance history and mobile apps to improve regimen compliance.
- Provide the care team with compliance data to support educating patients on the importance of taking their medication as directed, potential risk factors, and guidance if side effects emerge.
- Investigate adding medication reminders to other mobile apps that you may be rolling out to patients.

Business Impact: Medication compliance management systems are designed to enforce patients taking their medications correctly. This can result in more efficient and effective use of medications, improved patient outcomes, and reduced costs due to fewer patient readmissions as poor medication compliance is a common reason for readmissions.

Compliance with medication is a critical determinant of the outcome of clinical trials. Compliance management will also be a critical part of risk-sharing contracts where a pharmaceutical company is paid based on outcomes from the medication. Compliance also has a material impact on the reduction of readmissions following a procedure.

Benefit Rating: Moderate

Market Penetration: 1% to 5% of target audience

Maturity: Adolescent

Sample Vendors: AdhereHealth; AdhereTech; AiCure; Cureatr; emocha Health; Information Mediary Corp. (IMC); Philips Healthcare; Propeller Health; Xhale

Recommended Reading: "Best-Practice Exemplar: Palvelukeskus Helsinki Scales Innovation in Virtual and Digital Care Delivery"

"Prepare for Aging Epidemic by Extending Your Virtual Care Strategy to Support Aging in Place"

"Healthcare Business Driver: Power Shifting to the Consumer"

"Best Practices for Reimagining Your Life Science Company as a Digital Business Technology Platform"

PHI Consent Management

Analysis By: Mike Jones

Definition: Protected health information (PHI) consent management is a system, process and set of policies for consumers to determine what health information they permit their care providers to access or exchange. It enables individuals to affirm participation in patient portals and health information exchanges (HIEs), and to establish and dynamically update granular PHI privacy, access and usage preferences.

Position and Adoption Speed Justification: Gartner predict that by 2022, half of the planet's population will have its personal information, which incorporates PHI, covered under local privacy regulations in line with the General Data Protection Regulation (GDPR), up from one-tenth today.

With the move to a more collaborative and citizen-centric care environment, it is more essential than ever to balance legitimate privacy concerns with the benefits of sharing PHI. The final ONC rule or 21st Century Cures Act supports patients' access to their EHI in a form that is convenient for patients. This means making it accessible through the adoption of standards and certification criteria and the implementation of information-blocking policies that support patient electronic access to their health information at no cost. The intention is that consumers have full transparency on how their electronic health information is being accessed, shared and used at all times and that EHR and other system vendors do not block access

Today, most consent management in healthcare is still done on paper, or in disparate systems of record such as the EHR or CRM. Consent management projects will be driven by a strong collaboration between those concerned with policy and those concerned with the technological implications. The privacy needs of HIEs, accountable care, and patient-centered healthcare movements will continue to drive industry interest in consent management going forward.

PHI consent management is now a key architectural building block for many HIE initiatives, and adoption will continue to increase in relevance.

In the U.S., PHI is a construct that is part of the HIPAA law. In other regions, PHI may be referred to as personal information or identifiable information as part of regional data protection legislation. We have seen this universal capability for consumer-directed consent of health data across the health and care ecosystem appear in many regional digital care strategies and target architectures in recent years.

User Advice: CIOs, CMIOs and CNIOs and those involved in privacy, security and compliance within HDOs and HIEs should promote policies to manage consent and limit the disclosure of PHI.

In the EU for example, the GDPR will effectively mandate this requirement for member states and their health organizations. They need to be asking what kind of consent management systems will be needed, and capture and enforce the dynamic preferences of their consumers and patients. HDO CIOs will also need to make their legacy systems more privacy-aware. Any participation in an HIE should be based on a clear understanding of the policies for consent management, including whether those policies will be enforced centrally by the HIE, or the enforcement is a requirement of the end subscriber.

Business Impact: Open and transparent exchange should enable the permitted use policies to be retained as PHI moves among healthcare entities. This means that the intended use policies, for which the disclosing HDO remains accountable, should not be overridden by downstream, less restrictive, permitted use policies in other entities. This will require HDOs to ensure that the “purpose of use” is built into their interoperability capabilities and that all business agreements between entities are compliant with varying patient preferences.

Most HIEs have implemented general opt-in or opt-out models — without these highly granular controls — based on federal and state level legislation. The benefit rating reflects the fact that, without effective PHI consent management, it will be difficult to scale the secondary use of health data for key high-value and transformational initiatives. These might include precision medicine, genomics medicine and the use of consumer/citizen-generated data, alongside clinical datasets for advanced analytical endeavors such as machine learning.

We predict that by 2025, 25% of U.S. HDOs will have implemented granular patient consent, but meaningful enforcement will remain a challenge.

Benefit Rating: Moderate

Market Penetration: 5% to 20% of target audience

Maturity: Adolescent

Sample Vendors: Deloitte; Global Public Inclusive Infrastructure (GPII); InterSystems; IQVIA; Jericho Systems; OneTrust; Optum; ZeOmega (HealthUnity)

Recommended Reading: "Healthcare Provider CIOs: Get Control of Patient Data Across All Partners"

"Healthcare CIOs: Prepare for Granular Patient Consent"

"Business Drivers of Technology Decisions for Healthcare Providers, 2020"

"Market Guide for Health Information Exchange Platforms"

"Cool Vendors in Privacy 2020"

"Healthcare Industry Hot Topic: Debating the U.S. ONC Interoperability and Information-Blocking Rule"

EHR/Megasuite Support of Virtual Care

Analysis By: Mike Jones

Definition: Electronic health record (EHR) megasuite support of virtual care is the set of capabilities included in the core EHR product suite to enable clinicians to deliver evidence-based virtual care to patients for asynchronous (e.g., e-visits) and synchronous (e.g., video visits) delivery models.

Position and Adoption Speed Justification: The functional requirements for care delivery — whether in person or virtual — include registration, scheduling, revenue cycle management (RCM), access to medical information, clinical assessments and decision support, workflow, documentation, display and computer-based provider order entry (CPOE). There are unique aspects to virtual care including the need for quick registration, clinician-patient mapping, urgent on-demand scheduling, queuing, virtual waiting rooms and remote digital measurement of vital signs and other clinical observations for clinicians, which need to be accommodated. Additionally, there may be connections to third-party virtual care delivery providers that emerge, which will demand specific requirements of the EHR (e.g., where a primary HDO contracts with a remote care provider to deliver certain services as part of a care pathway but retains a single EHR for that patient under the auspices of the primary HDO).

Today, most virtual care is delivered through a set of stand-alone specialty-specific telemedicine solutions with overlapping functionality (both between the solutions and the EHR megasuite), and is treated as distinct from conventional care. This is changing and ultimately virtual care will predominantly occur through the EHR megasuite with deep integration into a range of remote medical monitoring devices and video capability or via enterprise level virtual care platforms (e.g., American Well, Teladoc Health, Vivify)

If megasuite capabilities mature, the unique aspects of virtual care will not be great enough to warrant a complex mix of stand-alone systems. During COVID-19, a number of EHR vendors seemed unprepared and have struggled to deliver timely comprehensive virtual care capability, instead looking to integrate an increasing number of platforms for video conferencing (e.g., Zoom, Microsoft, Twilio).

Nontechnical barriers to virtual care in general, especially payments and cultural acceptance, continue to evaporate as providers and payers recognize the value in business model shift. More recently, COVID-19 has accelerated the transition for urgent care, primary care and routine elective outpatient work.

User Advice: Healthcare provider CIOs and their clinical counterparts should:

- Recognize that virtual care will become as ubiquitous as face-to-face encounters within the next three years, and they must be prepared for that eventuality.
- Work to ensure that their organizations have effective policies and procedures that, in part, set patient expectations, determine what is appropriate to deliver virtually, and decide how clinicians' time will be scheduled and accounted for to ensure that EHRs can be used to deliver virtual care efficiently and effectively.
- Work with their EHR megasuite vendors to ensure that these products provide the capabilities required.
- Assess interoperability of both EHR and virtual care vendors against open standards for real-time exchange of data to drive the administrative and clinical workflow toward seamless integration and plan their enterprise architecture data and technology layers accordingly.
- Consider how EHRs can also capture and integrate data provided by patients using virtual care modalities (e.g., IM, SMS, video/photo sharing) securely and where appropriate.

Business Impact: The transformation of healthcare to a pay-for-value model is changing the mode of care delivery to one that spans and integrates both face-to-face and full virtual care. For many HDOs it makes the most sense to use a foundation of the EHR for clinical care whenever possible, including the virtual care side of the delivery continuum if the EHR vendor can support this. However, not all EHR vendors are able to do this or do it well yet.

When all clinical care workflow is concentrated into a user-centric application experience (this appearing as a single "system" to the user), the likelihood of duplicated efforts and adverse events is greatly reduced. This highlights the importance of pervasive integration and interoperability with the EHR megasuite and the ability for CIOs to compose new digital business capabilities from the range of applications that sit within the application portfolio.

Benefit Rating: High

Market Penetration: 5% to 20% of target audience

Maturity: Adolescent

Sample Vendors: Allscripts; Cerner; Epic; MEDITECH; Philips Healthcare

Recommended Reading: "Healthcare Provider CIOs: Bridge the Virtual Care Divide Between Provider- and Consumer-Directed Care"

"Application Leaders: Master Composable Enterprise Thinking for Your Post-COVID-19 Reset"

"Prepare for Aging Epidemic by Extending Your Virtual Care Strategy to Support Aging in Place"

"Best-Practice Exemplar: Palvelukeskus Helsinki Scales Innovation in Virtual and Digital Care Delivery"

"Master These Proof Points to Create a Sustainable Virtual Care Roadmap"

Patient Portals (Untethered)

Analysis By: Mark Gilbert

Definition: Patient portals enable a secure digital patient-provider communications channel that provides access to clinical, financial and administrative functionality; educational information; and personal health maintenance tools. This profile tracks patient portal technologies that are untethered from an electronic health record (EHR). Untethered portals provide access to both EHR data and a wide range of tools and services beyond the EHR.

Position and Adoption Speed Justification: The U.S. Office of the National Coordinator for Health Information Technology (ONC) defines two kinds of personal health records (PHRs): PHRs tethered to an EHR, or stand-alone (untethered) PHRs. EHR-tethered portals typically display data retained within the EHR, such as patients' encounter summary, problem list, medication list, allergies, recent vital signs and lab results. Some EHR-tethered portals also provide patient services like allowing patients to schedule or request appointments, prescription refills, conduct an e-visit, and ask questions of providers or medical assistants. These features are all dependent upon the capabilities of the EHR they are tethered to, with capabilities varying widely.

Even several years following their introduction, EHR-tethered portals continue to experience lackluster adoption as evidenced in their struggle to achieve use by more than 5% of patients annually. They are frequently criticized for their limited number of services and accessibility challenges.

Untethered portals, in contrast, are not limited to providing patients access to services offered by an EHR. They provide both patients and consumers access to a wide breadth of health and healthcare applications and services.

The advantages of using an untethered portal include:

- Access to data and services can be made to consumers who don't have a pre-existing patient ID, or patients without forcing them to authenticate using passwords.
- A virtually unlimited number of health and healthcare services can be presented to consumers and patients. HDOs can pick among best-of-breed applications.
- Patients who see multiple providers will be able to see their data aggregated across multiple providers and their use of different vendors or instances of an EHR.
- Collection of a wide range of consumer-generated health data, including biometric monitoring, patient-reported outcomes and environmental monitoring.

Outside of the U.S., untethered patient portals are the leading portal choice for HDOs because of the need to integrate with multiple EHRs, patient administration systems, social services, wellness and prevention services, and chronic care management systems. Untethered portals are also used to engage citizens with their health both before and after they are patients.

Untethered patient portals outside of the U.S. provide all the features of tethered portals, plus:

- Prescription renewal and tracking
- Advanced scheduling tools capable of booking appointments with multiple providers of care
- Access to social services and health and prevention services
- Access to virtual care services
- PHRs
- A gateway to comprehensive digital health services
- Patient education
- Wayfinding
- Consumer-generated health data repositories

Examples of countries and regions that have pioneered untethered patient portals include Denmark, Estonia, Sweden, Andalusia (Spain), Lombardy (Italy), the U.K. and New Zealand. These stand-alone portals have experienced substantially higher adoption by citizens. The Denmark sundhed.dk portal has over 1.7 million unique users (31% of the population) using the portal each month.

The successes of international deployments of patient portals are now powering the advancement of untethered patient portal technology. We have seen through our inquiries a growing interest in the use of untethered patient portals. As such, we have positioned the technology just before the lowest point of the Trough of Disillusionment. This positioning reflects the balance between high levels of adoption and patient usage, and the struggles of health systems as they grapple with the complexity of their platforms' scope and scale, and with the growing issues of privacy and trust.

User Advice: CIOs of HDOs with multiple EHRs, whose EHRs lack adequate portal functionality, or those with a desire to improve their engagement with consumers/citizens, should consider using untethered patient portal technology. CIOs should consider two alternative vendor sets for their portal technology:

- High-productivity application platform as a service (hpaPaaS) technology vendors. These vendors offer the highest level of patient portal customization and integration with data and workflows. Example hpaPaaS vendors include: Temenos (Kony), Pega, OutSystems and TriFin Labs.
- Patient engagement platform as a service (PePaaS) vendors. These vendors offer both a development platform and a readymade suite of patient engagement tools. Examples include Appian, Bridge Patient Portal, CipherHealth, Get Real Health, Mendix and Progress (Kinvey).

Business Impact: Untethered patient portals improve engagement, patient activation, patient satisfaction, and improved healthcare system and physician loyalty. Untethered patient portals also provide patients more meaningful and lasting engagement with their health. The portals generate insights into individuals that can be the underpinning of effective wellness, prevention and chronic care management campaigns — making them the cornerstone of a personalized health strategy.

Benefit Rating: High

Market Penetration: 20% to 50% of target audience

Maturity: Early mainstream

Sample Vendors: Appian; Bridge Patient Portal; CipherHealth; Get Real Health; Mendix; OutSystems; Pega; Progress (Kinvey); Temenos (Kony); TriFin Labs

Recommended Reading: "Healthcare Provider CIOs: Bridge the Virtual Care Divide Between Provider- and Consumer-Directed Care"

"Connecting Consumer Engagement Moments Into a Longitudinal Healthcare Journey"

"The Evolution of Healthcare Consumer Engagement Hub Architecture"

"Magic Quadrant for Multiexperience Development Platforms"

"Magic Quadrant for Enterprise Low-Code Application Platforms"

3D Printed Presurgery Anatomical Models

Analysis By: Pooja Singh; Mike Jones

Definition: 3D printed presurgery anatomical models combine an individual patient's CT scans and/or MRIs with software and 3D printing (3DP) devices to produce highly accurate three-dimensional replicas of a patient's surgical site. The model can include dimensional details beyond those discernible by surgeons just from the images. Physicians can use models to visualize the anatomical landscape applicable to a wide variety of surgical and educational situations.

Position and Adoption Speed Justification: 3D printed models provide physicians a reference to efficiently and safely plan surgical procedures (including sizing and fitting), enhance patient consent processes, and improve interoperative visualization for both routine and highly complex cases, leading to improved clinical outcomes and patient experiences.

In the past few years, patient-specific anatomical models have achieved mainstream awareness and increased adoption. We measure adoption by determining the degree to which anatomical modeling is common across multiple surgical specialties and procedures, not just a unique circumstance or two. Common surgical specialties include orthopedic, cardiothoracic, vascular, oral and maxillofacial, oncology, plastics, reconstructive, urology and pediatrics.

3D printed presurgery anatomical models present the earliest and most common use case for medical 3DP. It doesn't have the business, regulatory or adoption complexities of the other medical use-cases we are tracking, such as 3D printed surgical plans/implants, 3D bioprinted human tissue or the ultimate aspirations for 3D bioprinted organs for human transplant.

Most of the barriers to model-only uses are around the practical translation of the technology to regular use. Barriers include awareness, joint planning and prioritization procurement and execution for multiple uses, and users across multiple hospital and physician locations. Vendor white papers that explain the best use cases are helping with this. However, the traction for models is also being fueled by the growing evidence of the value of surgical guides and custom-printed implants. These often include presurgery models as part of the total solution, such as Materialise's U.S. FDA clearance for 3D printed patient-specific radius and ulnar osteotomy guides for children. Other examples include:

- Johns Hopkins Carnegie Center for Surgical Innovation (Carnegie 3D Printing Facility)
- Materialise's 3D anatomical models
- Stratasys' 3D printed surgical procedure models
- Yale Medicine's surgeons discussing significant improvements when using 3D printing to plan surgeries

We have positioned the technology toward the end of Trough of Disillusionment, ready to enter the Slope of Enlightenment in coming years. At the current adoption rate, we estimate this technology's time to mainstream adoption to be five to 10 years.

User Advice: CIOs and CMIOs should play an orchestrating role in defining their health systems' strategies and roadmaps across physician stakeholders, use cases, technologies and vendors for medical 3DP capabilities. The setup of an innovation lab and the introduction of 3D printed presurgery anatomical models for multiple surgical specialties are solid places to start. While large hospitals and integrated delivery systems can create their own capability, smaller hospitals cannot really sustain this yet and will need a service bureau or partnership. Consult the legal department during planning and procurements to address risks and medical liabilities.

CIOs looking to enable 3D printed models in their healthcare facilities should partner with CMIO to:

- Focus on supporting surgical data models, workflows, medical imaging technology, design software and 3DP.

- Prioritize system development to bridge the different disciplines and domain expertise to develop more-realistic 3DP preoperative preparation tools and surgical guides.
- Establish a center of excellence (COE) for surgical planning tools and simulation, empowering a team approach that spans individual departments, where 3DP workflows can be optimized.

Business Impact: There is a growing anecdotal evidence about the many benefits of using 3DP in medicine and the surgery environment:

- Improved diagnostic ability and accuracy.
- Improved efficiency during procedure selection and surgery planning.
- Improved clinical productivity driven by the ability to practice presurgery. It also helps in potentially reducing time in surgery/operating room utilization, minimizing risk of complications/infections and save costs.
- Enhanced patient experience and consent process through better discussion and communication about situations, options and planned procedures.
- Educating and training new physicians, especially around complex/unusual pathological conditions.
- Improved communication among the multidisciplinary surgical team.

Benefit Rating: Moderate

Market Penetration: 1% to 5% of target audience

Maturity: Adolescent

Sample Vendors: axial3D; Embody; Formlabs; Materialise; Medical IP; Stratasys

Recommended Reading: "Healthcare Business Driver: Medical Innovations in Therapy, Diagnosis and Care Delivery"

"Manufacturing Industries Digitalization Primer for 2019"

"Predicts 2019: 3D Printing Accelerates, While 4D Printing Is Getting Started"

“Market Guide for 3D Printer Manufacturers”

“Hype Cycle for 3D Printing, 2018”

Climbing the Slope

Enterprise EHR Systems (Non-U.S.)

Analysis By: Mike Jones; Sharon Hakkennes

Definition: Enterprise electronic health records (EHRs) are clinical systems optimized for use by clinicians in acute care, ambulatory or outpatient clinics. They electronically capture and maintain patient-centric information about health status and care; support tasks and events directly related to patient care; facilitate clinical pathways and documentation; and enable evidence-based practice.

Position and Adoption Speed Justification: Enterprise EHRs provide capabilities such as clinical decision support, computerized physician order entry and clinical workflow. Today, they are essential technologies for health delivery organizations and medical practices. Mature EHRs have been available for well over a decade, and adoption in the U.S. has moved beyond the plateau. The positioning of this innovation profile reflects the overall non-U.S. market where interest and adoption continues to grow with steady progression through the Hype Cycle. Adoption programs are most active in Australia, Canada, U.K., Germany, Switzerland, Latin America, parts of the Middle East and Benelux and Nordic regions. EHR adoption has continued to expand globally as governments encourage their use and more hospital leaders recognize the value of fully integrated EHRs. Sales cycles remain very long and procurements complex. With COVID-19 being the main focus of attention for healthcare providers, a number of large regional EHR procurements and in-flight implementations have been stalled. For these reasons, we have advanced this profile marginally as adoption rates are now above 20% but generally below 50% in the majority of non-US regions.

Although there is ample proof that these systems can provide value when fully implemented (hence, the maturity rating), some notable implementation challenges have caused a fair amount of skepticism among healthcare delivery organization (HDO) executives, which is slowing adoption. Barriers include significant cost, difficulty in demonstrating an ROI, usability, lack of strong clinical leadership support and convincing clinicians that adoption of the most valuable modules such as clinical decision support and benchmarking performance analytics can result in better outcomes. EHR vendors can be divided into those that have clients in multiple countries across more than one continent, and those that are more geographically focused.

User Advice: Enterprise EHR systems are no longer “nice to have.” As the exponential growth of medical knowledge has exceeded the capabilities of human cognition, they have become essential. HDO CIOs must work with senior clinical leaders to help promote and implement these systems and to ensure that their organizations have the appropriate technical infrastructure and policies to support them. With regards to vendors, CIOs must also ensure clinical usability and a streamlined workflow are evaluated during procurement and continually targeted during and beyond implementation through strong vendor management practices and service-level agreements. A simplified, clean and configurable mobile end-user interface and workflow experience is an essential prerequisite for all new procurements, major EHR upgrades and contract renewals.

To take full advantage of EHR systems, HDO CIOs should approach them as part of an ongoing clinical transformation program effort (requiring process reengineering, ongoing clinical decision support and workflow evaluations, as well as clinical content life cycle management). If this is to succeed, there must be a strong clinical IT governance structure in place that includes a formal clinical content management committee.

Successful organizations have established clinical informatics roles, including a chief medical informatics officer (CMIO) partnered with a chief nurse and midwifery officer (CNMIO) whose function is to ensure that deployment, adoption and content life cycle management work are accomplished. Anticipate that the entire effort might double the HDO’s IT budget as a percentage of operating expenses because of access, security, infrastructure, data center availability and business continuity investments related to the EHR system. HDOs with a generation 3 system already in place should focus on clinical optimization activities such as creating evidence-based order sets and care plans, defining clinical workflows and improving clinical decision support.

They should also focus on creating an effective knowledge management mechanism to track advances in evidence-based medicine. Those without EHRs need to plan for implementation or look to alternative strategies such as using an openEHR Foundation-enabled platform with a more federated and open ecosystem of application vendors using truly open APIs. The total cost of ownership (TCO), ROI and degree of orchestration for these different approaches will vary significantly. The latter approach is gaining interest as health service funding pressures bite, and there is a desire among some regions to have more control of the underlying data for research, federated health information exchange and genuine semantic interoperability.

Business Impact: An enterprise EHR system can provide support for a wide variety of clinical activities and workflows that affect all caregivers and patients. It can reduce the rate of medical errors, eliminate unwarranted practice variations, improve operational efficiency and compensate for the shortage of skilled healthcare workers by streamlining previously manually intensive workflows. Although the potential benefits are considerable, it takes substantial planning, time, money and vendor collaboration to obtain the full value of an EHR system.

There is evidence from CIO interactions that predictable TCO and interoperability requirements are not being met by all vendors. In these circumstances, CIOs should undertake EHR scenario planning to examine EHR pain points, risks and opportunities when refreshing their digital roadmap.

Benefit Rating: High

Market Penetration: 20% to 50% of target audience

Maturity: Early mainstream

Sample Vendors: Allscripts; Cambio Healthcare Systems; Cerner; ChipSoft; Epic; InterSystems; MEDITECH; Philips; System C; TietoEVRY

Recommended Reading: "Toolkit: Best Practices for EHR Success — Life Cycle Stage 3, Select"

"Toolkit: Best Practices for EHR Success — Life Cycle Stage 4, Deploy"

"Toolkit: Enterprise EHR Generation Evaluation"

"A Healthcare Provider CIOs Playbook on Lessons Learned From Global Electronic Health Record Projects"

"A Healthcare Provider CIO's Guide to Accurate EHR Total Cost of Ownership"

"The Benefits and Realities of the Healthcare Provider CIO's Quest for EHR Value Delivery"

"The Digital Care Delivery Framework for Healthcare Provider CIOs"

Personal Health Management Tools

Analysis By: Jeff Cribbs; Mike Jones

Definition: Personal health management tools (PHMTs) are technologies that aid consumers in managing their health and wellness, providing interactive functionality beyond simple educational content. PHMTs can include capabilities for tracking symptoms, diet, exercise and routine care; monitoring chronic illnesses; or connecting to a wearable or sensor device. PHMTs may be recommended by a clinician, but generally are not reimbursed by healthcare payers, do not have robust evidence of efficacy and support minimal clinical data integration.

Position and Adoption Speed Justification: Healthcare providers, governments and healthcare payers continue to show significant interest in consumer and patient engagement as a way to improve outcomes, lower medical costs and differentiate themselves from their competitors (see "Healthcare Business Driver: Power Shifting to the Consumer"). PHMTs are a means to achieving these ends.

For healthcare organizations, there are three main challenges. The first is to find the best way to promote effective use of PHMTs when consumers most often choose their PHMTs themselves. The second challenge is that that most downloaded PHMTs rapidly fall into consumer disuse. The third challenge is that even when consumers use devices with persistence (like when device use is mandated for participation in a study), there is sparse evidence that PHMTs achieve the health outcomes they purport to drive (as just one example, see the 2018 meta-analysis of controlled trials of PHMTs in Nature).

We nudge PHMT past the Trough of Disillusionment in 2020 in acknowledgment of two key developments. The first is the maturity of the consumer mobile market across diverse geographies. The second key development is the growing belief in the value of PHMT by clinicians, especially for management of highly targeted chronic populations (see the AMA's follow-up study "AMA Digital Health Care 2016 and 2019 Study Findings"). Medical communities are actively developing best practices for incorporating PHMTs into clinical service delivery and disease management pathways (see Nature's "Beyond Validation: Getting Health Apps Into Clinical Practice").The path forward will require policy and regulatory organizations to adopt consistent standards for evaluation and efficacy of PHMTs, such as Xcertia or NICE's "Evidence Standards Framework for Digital Health Technologies."

User Advice: Healthcare CIOs should work with their clinician counterparts to identify well-designed PHMTs that have shown positive impacts that are relevant for the range of clinical services they provide. Unfortunately, many healthcare CIOs report that their medical counterparts are just as likely to be charmed by a new app as their patients and members are. Ensure proper vetting of the quality of these tools, especially for subsets of patients with chronic or complex medical conditions, or in sociodemographic groups with different technology utilization patterns and digital access and literacy. CIOs should work with senior leaders to develop enterprise understanding and expectations of likely impact policy on the vetting, provision and support of PHMT. CIOs are best-positioned to alert other leaders to the potential of instantiating data, care process and consumer experience silos that work against other efforts to streamline and coordinate consumer journeys in healthcare.

Business Impact: In some situations, PHMTs:

- Help improve the quality of care delivered to patients
- Provide education and advice in an engaging mobile format
- Provide a scalable way for payer and provider organizations to influence consumers' lifestyle decisions that are key to long-term outcomes

Remaining barriers include scant evidence of the effectiveness of the various tools and the difficult task of achieving patient acceptance, overcoming health and IT literacy issues in patients, and supporting persistent use. Until there is such evidence, the impact of these tools will remain low. It is also the case that this first generation of PHMTs is fundamentally limited by the lack of specific clinical and administrative data about the individual consumer. The next generation of PHMT will have improved access to personal health records (PHRs), which are less mature in the Hype Cycle. This will create the opportunity for much greater personalization and impact as they actively use and contribute to a clinical health record data.

Benefit Rating: Low

Market Penetration: More than 50% of target audience

Maturity: Early mainstream

Sample Vendors: Garmin; healow; Keep; MyFitnessPal; Ovia Health; Patient Journey App; Qin Baobao

Recommended Reading: "Create Connected Care Pathways That Bridge Consumer and Healthcare Provider Activities"

"Healthcare Provider CIOs: Bridge the Virtual Care Divide Between Provider- and Consumer-Directed Care"

"Healthcare CIOs Will Enable Three Generations of Consumer Engagement"

"Healthcare Business Driver: Power Shifting to the Consumer"

"The Digital Care Delivery Framework for Healthcare Provider CIOs"

OpenNotes

Analysis By: Sharon Hakkennes; Mike Jones

Definition: OpenNotes is a healthcare delivery organization (HDO) initiative to give patients convenient access to their clinical notes stored within electronic health records (EHRs). This is most often accomplished through a portal tethered to the EHR.

Position and Adoption Speed Justification: OpenNotes is a growing international movement, rather than a product. Founded in 2010, the effort is based at Beth Israel Deaconess Medical Center in Boston, Massachusetts, with collaborators around the U.S. and overseas. Shared notes document interactions patients have with doctors, nurses and other clinicians, and make up "the story" of a person's healthcare. The notes are separate and distinct from after visit summaries made available to patients following visits. Leading EHR vendors have made implementation of OpenNotes a matter of standard configuration, rather than coding. HDOs decide which type of notes they will open to patients, which roles are included and the scope of which departments participate. Clinicians can elect to share viewing of the notes during a visit and make the notes available through a patient portal tethered to the EHR.

Patients and their families report that reading their notes results in a better understanding of their health conditions and gives a feeling of being more in control of their care. It improves recall of the content of visits; provides the ability to spot and rectify mistakes before they lead to harm; and increases adherence to medications and care plans. Yet, only approximately 10% of patients with access to their EHR use it. The OpenNotes group reports implementation in more than 200 organizations, with more than 40 million people across the U.S. and Canada registered for portals that share notes with patients (up from the 20 million we reported in the 2018).

The movement has attracted a lot of interest in Europe, Australia and New Zealand, but adoption is often directly related to EHR usage in those countries. For example, Estonia's nationwide EHR displays visit notes and notes in Sweden are viewable on a countrywide portal. In the U.K., general practitioners (GPs) committed to providing patients with online access to their full record, including the ability to contribute their own information from April 2020.

With increased deployment of mature EHRs, growth of next-generation patient portals and government initiatives internationally encouraging transparency by granting individuals' access to their records, we expect continued empowerment for patient notes access. The finalization of the U.S. Office of the National Coordinator for Health IT (ONC) Interoperability and Information Blocking Rule on 9 March 2020 requires standardized APIs to enable patients' free access and control of their electronic health data via smartphone apps of their choice. Enforcement of the new rule will accelerate adoption in the U.S over the next two years and resolve some of the issues around patient use of the information when they have access to it. It is increasingly likely that OpenNotes, at least in the U.S., will reach mainstream adoption in the next two to five years.

User Advice: Healthcare provider CIOs, chief medical and chief nursing informatics officers, and public health agencies and ministries of health should endorse and advocate for the philosophy of patient-provider collaboration and transparency in data sharing.

CIOs planning to progress OpenNotes initiatives should:

- Engage clinical leadership, technical teams and your EHR vendor to develop a plan for achieving compliance with the requirements outlined in the ONC Interoperability and Information Blocking Rule (CIOs based in the U.S.).
- Engage the technical teams supporting the EHR and/or patient portal to determine which policies and reporting requirements can be accommodated and with what level of effort (CIOs based outside of the U.S.).
- Develop policies and processes to exempt patients from online access to their records or parts of their records in circumstances where access would be detrimental to the individual. Additionally, develop policies and processes for granular patient consent, enabling patients to specify their preferences for information sharing.
- Establish processes to support patients in their access to and use of their electronic health information.

- Explore options with your EHR, patient portal and open API vendors to evaluate functionality for notes co-produced by patients and clinicians together.
- Explore regional approaches to gain momentum for broad access and adoption.

Business Impact: OpenNotes has shown significant value to patients and providers; assessment of impacts on clinical, utilization and financial outcomes is ongoing. Some have demonstrated that the availability of clinical notes has driven significant increases in patient portal adoption, thereby indicating potential secondary value in meeting federal reporting requirements. Those HDOs that adopt an OpenNotes policy will be able to use it in messaging to underscore their commitment to enabling transparency through technology, providing patient access to records and fostering patient engagement with their caregivers.

Benefit Rating: Moderate

Market Penetration: 5% to 20% of target audience

Maturity: Adolescent

Sample Vendors: Allscripts; Apple; Cerner; eClinicalWorks; Epic; MEDITECH

Recommended Reading: "Healthcare Industry Hot Topic: Debating the U.S. ONC Interoperability and Information-Blocking Rule"

"Healthcare CIOs: Prepare for Granular Patient Consent"

"ONC NPRM Envisions Open and Equitable Health Information Exchange"

"Healthcare Innovation Trends: Bridging Consumers' Engagement Gap With Their Health"

"The Evolution of Healthcare Consumer Engagement Hub Architecture"

"Best-Practice Exemplar: Andalucía Health System Builds a Citizen-Centered Digital Care Ecosystem"

Healthcare Interoperability

Analysis By: Barry Runyon

Definition: Interoperability among health information systems and devices refers to the ability to share, exchange, and effectively use electronic health information in a timely and meaningful manner. For this profile, interoperability refers to the adoption of and advances in notable healthcare interoperability rules, standards, and industry initiatives.

Position and Adoption Speed Justification: Rather than plotting the adoption and progress of the myriad of individual healthcare industry interoperability rules, standards, protocols, frameworks, initiatives, technologies, and platforms, we have chosen to express their collective and overall impact and maturity.

Interoperability includes the concepts of interfacing, application integration, and health information exchange. It is a healthcare industry challenge and mandate that impacts providers, payers, and other industry stakeholders and constituents (e.g., consumers, patients, members) and the near singular focus of the most recent Office of the National Coordinator for Health Information Technology (ONC) and Centers for Medicare & Medicaid Services, CMS rulemaking process.

Interfacing is message brokering — copying, transforming, enriching, and routing health data from one endpoint to another. Interfacing has almost exclusively been a healthcare provider activity until recently. Integration is about making a vendor's suite of products work together as a system and in concert with other systems and platforms within their IT ecosystem. Interoperability is about achieving similar results between various, often competing, vendor products and platforms and healthcare industry players — regardless of the product architecture, technologies, and tools they employ. Interoperability involves technologies such as message brokering, web services, electronic data interchange (EDI), APIs, cloud computing, file transfer, email, and fax and database connectors. It consists of a plethora of wire protocols, data exchange standards, application platforms, common data elements, and vocabularies (semantic interoperability).

Interoperability involves standards development organizations and interoperability networks and industry alliances such as CommonWell Health Alliance, Carequality, Surescripts, and IHE offerings by technology service providers and clinical vendors. It also includes semantic interoperability or the exchange of clinical information with enough meaning and granularity to support clinical decision support, care management, clinical research, quality assessment, and business intelligence.

In February of 2019, the U.S. Department of Health & Human Services (HHS) issued a "Notice of Proposed Rule Making to Improve Interoperability of Health Information." More specifically, the NPRM was issued by the ONC, and it supports the overall mission and goals of the 21st Century Cures Act — i.e., the seamless and secure access, exchange, and use of electronic health information (EHI), including more convenient access for caregivers and patients. The rule promotes and incentivizes the adoption of open application programming interfaces (APIs) and trust frameworks and an expanded set of core clinical data elements for more effective health information exchange. The ONC NPRM most notably addressed the practice of "information blocking."

Around the same time, CMS issued a complementary rule that required government health plans as well as health plans offered through Affordable Care Act (covered plans) to provide patients with free control of, and increased access to, their HIPAA EHI. The CMS rule aims to improve access to and the quality of information that citizens need to make informed healthcare decisions, including data about healthcare prices and outcomes while minimizing reporting burdens on affected plans, healthcare providers, or payers.

After an extended public comment period, both rules were finalized in March of 2020 to reflect public and industry feedback and current administration priorities. This event has served to advance interoperability in general within the industry in 2020 and has justified the advancement of this profile on this Hype Cycle.

User Advice: We recommend the following:

- Evaluate your enterprise interface/integration platform plans to support more robust interoperability requirements and industry timelines.
- Participate in a regional health information exchange network that takes advantage of existing interoperability standards, trust frameworks, and industry alliances.
- Promote the use of HL7 Fast Healthcare Interoperability Resources (FHIR) and SMART on FHIR capabilities of your electronic health record (EHR) vendor (API technology supplier) necessary to support consumer and third-party EHI access.
- Report incidents of suspected information blocking by referring to the guidelines set forth within the ONC rule. Seven legitimate information-blocking exceptions should be taken into consideration.

- Strengthen patient engagement by preparing for consumer-mediated health information exchange (HIE). Investigate notable industry alliances and advocacy groups such as the CARIN alliance and government initiatives such as MyHealthEData.

Business Impact: Healthcare IT systems, whether self-developed or purchased, must be able to work together to deliver on healthcare IT's value proposition. Interoperability makes it possible for disparate, heterogeneous systems to exchange health information to support care delivery, care coordination, and business requirements across system and organizational boundaries. Interoperability makes it possible for access and exchange of longitudinal patient records. Safe and effective interoperability is essential for the industry to evolve and transform. There have been more interoperability advances in the last five years than in the previous twenty.

Benefit Rating: Transformational

Market Penetration: 20% to 50% of target audience

Maturity: Early mainstream

Sample Vendors: Carequality; CARIN alliance; CommonWell Health Alliance; Da Vinci Project; Health Level Seven International; IHE; Surescripts

Recommended Reading: "7 Critical Domains of a Successful Healthcare Provider Interoperability Strategy"

"Best Practices for Healthcare Provider CIOs to Select the Right Patient Data Interoperability Platform"

"Healthcare Payer CIOs, Leverage Vendor Partners to Succeed at Clinical Data Integration"

"Healthcare Provider CIOs: Prepare for the Consumer-Mediated Health Information Exchange"

"Market Guide for Clinical Communication and Collaboration"

"ONC NPRM Envisions Open and Equitable Health Information Exchange"

Remote Patient Monitoring

Analysis By: Sharon Hakkennes; Mark Gilbert

Definition: Remote patient monitoring (RPM) is the use of medical-grade mobile devices, information and communications technologies to actively monitor patients' conditions. Patients use mobile and wearable sensors and monitoring devices that capture biometrics and physiological data, such as vital signs, blood glucose levels, ECGs and weight. The devices then transmit or stage this data to a remote clinician for analysis, review and appropriate intervention.

Position and Adoption Speed Justification: RPM emphasizes the monitoring of a patient under the care of a clinician. We are changing the name from remote medical monitoring to remote patient monitoring this year to better reflect the expansion of scope in monitoring to also include health and wellness. Advances in monitoring hubs, smartphone platforms, sensor technologies, cellular networks, cloud computing, and mobile and wearable medical devices have removed many of the technical barriers to RPM.

The COVID-19 pandemic has accelerated adoption and scaling of RPM globally. Prior to the pandemic, many HDOs had been successful in their deployment of RPM for the top 1% of patients with complex care management needs. However, the case for expanding these services to the top 5% of high-cost healthcare users was proving more difficult. The overwhelming demand on clinical services driven by COVID-19 has pushed HDOs to prioritize execution of their RPM strategy — fueling rapid scaling and deployment of RPM solutions to enable:

- Monitoring COVID-19 positive and those suspected of being positive with mild to moderate symptoms in their own home, avoiding the need for hospital admission.
- Monitoring patients at home postacute admission to facilitate an earlier discharge from acute care.
- Monitoring patients with chronic conditions who are unable to visit care facilities for regular follow-ups.

Changes in funding models, including easing of restrictions such as the conditions eligible for RPM, have facilitated the deployment of these services. For example, in the U.S. prior to COVID-19, Medicare RPM coverage was restricted to patients with one or more chronic conditions. Funding reforms introduced for the duration of the public health emergency now provide coverage for acute and chronic conditions as well as new and established patients.

As a result of the surge in interest and deployment of RPM solutions related to COVID-19, we are advancing this profile positioning further past the Trough of Disillusionment to the trough-plateau midpoint. We believe that as HDOs move from their initial tactical response to COVID-19 to building out mid to long-term strategic plans for virtual care, RPM will be a consistent feature. Assuming funding models continue to support RPM as a core component of clinical care into the medium term, adoption will continue to accelerate over the coming 12 months.

User Advice: Regardless of whether the HDO has an RPM program currently in place, all CIOs should now be engaging clinical and operational leaders to review or develop their organization's RPM strategy. This should include identification of both medium-term opportunities to support the HDO's ongoing response to COVID-19 and longer-term opportunities for care transformation in line with the overarching strategic priorities of the organization.

To sustain RPM services that have been deployed or scaled in response to COVID-19 over the long term, HDOs will require evidence that they support the delivery of high-quality clinical care, are financially viable and are accepted by clinicians and patients. Where these measures have not yet been implemented, CIOs must work with the CMIO, CNIO and clinical leaders to do so now.

The eventual goal should be cost and clinically effective monitoring of all patients enrolled in remote monitoring programs. To achieve this, CIOs should consider:

- Using a mix of medical-grade monitoring and consumer-grade medical devices.
- Automating workflows using artificial intelligence
- Making continuous improvements within the integration with existing clinical workflows and HDO-based clinical technology platforms.

Business Impact: RPM enables closer monitoring and faster intervention in the care of certain groups of patients. It can detect deterioration of patients with chronic conditions and after an acute care episode, improve patient engagement, enhance the patient experience and increase adherence to care plans. Evidence continues to build that HDOs can achieve clinical, cost and quality-of-life improvements using remote patient monitoring. RPM can also enable an HDO to negotiate shared-value-realization contracts for large numbers of patients.

Benefit Rating: High

Market Penetration: 5% to 20% of target audience

Maturity: Early mainstream

Sample Vendors: Aerotel Medical Systems; Ambio Health; Health Recovery Solutions; Medtronic; Philips; Raziel Health; Roche; Tunstall; Vivify Health

Recommended Reading: "Healthcare Provider CIOs: Bridge the Virtual Care Divide Between Provider- and Consumer-Directed Care"

"Create Connected Care Pathways That Bridge Consumer and Healthcare Provider Activities"

"Scaling Virtual Care Requires a New Look at Its Enabling Architecture"

"How Healthcare Provider CIOs Can Successfully Achieve Digital Care Transformation"

On-Demand Virtual Visits

Analysis By: Pooja Singh; Mike Jones

Definition: On-demand virtual visit systems broker a remote healthcare connection (initiated by the consumer) with a network of clinicians that are often available 24/7 for nonemergency care, by means of communication channels such as phone, video and secure messaging. Servicing clinicians may not have a formal and pre-established relationship with the consumer prior to becoming a patient.

Position and Adoption Speed Justification: On-demand virtual visits have emerged as an option for healthcare providers that want to offer more convenient access to care and overcome the uneven availability of clinicians. Solutions are either marketed direct to a consumer or delivered through by existing provider or payer networks. These systems enable individuals to triage symptoms, initiate an immediate visit, schedule a future visit or wait for an available clinician, and often include decision support to choose the right medical specialty clinician. Individuals can also search for gender, language spoken and specialty, or browse a list of clinicians and their satisfaction ratings.

These on-demand virtual visits tend to be low acuity with a focus on the convenience of rapid access to the vendors' own networks of providers. Some integrated delivery systems (IDSs) are leveraging the underlying technology of virtual care vendor platforms but are using their own network of clinicians and providing care for more conditions. As smaller practices merge or become acquired by hospitals or integrated delivery systems, it has made easier for IDSs to consider using their own clinicians for these services. Recently, some questions about the cost-effectiveness of these services have arisen, in part, due to the ease by which convenience can lead to increased treatment for conditions that might not warrant clinical intervention (for example, a simple cold).

The COVID-19 pandemic has acted as a catalyst driving the adoption of on-demand virtual visits across health systems, globally. The technology has helped healthcare providers scale up their care delivery capacities, manage in-patient flow in order to minimize infection risk, and ensure safety. Additionally, the recent move by the U.S. government on temporarily expanding telehealth benefits for Medicare beneficiaries has slightly helped address the long-lasting questions surrounding the payment related challenges associated with use of technology. Organizations are gaining experience and equipping themselves with right set of tools when it comes to payment and reimbursement of the services (see "U.S. Provider CIOs' COVID-19 Action Plan to Improve Revenue").

This year, we are moving the profile to pre-plateau 40% stage, with time to plateau in less than 2 years. Gartner's clients have experienced increases in number of on-demand virtual consultations by 20 fold or more. (Virtual urgent care appointments increased by 600% at NYU Langone Health.)

The technology has moved from a good-to-have to a must-have stage for provider organizations. As healthcare providers continue to manage costs and maintain their health system scalability during the crisis, we expect this technology to maintain the current growth trend. The leading vendors in the space have grown and expanded their capabilities to meet the increasing demand. Few vendors have reported increase in virtual visits by as high as 1,000%.We have also seen an increase in number of new entrants offering on-demand virtual care solutions.

User Advice: Healthcare provider CIOs should:

- Collaborate with business leaders to determine the circumstances under which on demand virtual visits can in fact reduce costs, and improve care access and quality.

- Prioritize investing in the on-demand virtual visit technology — at this time many vendors are currently waiving initial licensing fees for organizations to support health systems navigate through COVID-19.
- Ensure that on-demand virtual visits are offered supports and align with the existing clinical care pathways. They should be integrated into a continuum of care that includes prevention and follow-up, especially for patients with chronic conditions. It will be critical to carefully manage the handoff and information-sharing between remote clinicians and face-to-face clinicians.
- Be aware that real-time virtual visit services will compete with the IDS for patients. It is, therefore, essential to monitor competitive activity and to consider offering these kinds of services as well.
- To enable care through on-demand virtual visits, CIOs must execute on the requirements such as the right technology platform (cloud-based), ability to integrate with your current IT landscape and capabilities such as e-prescribing. Also, how patient records can be imported to EMR, can the virtual visits be billed through the platform or require an interface with patient accounting.

Business Impact: On-demand virtual visits offer potential benefits to multiple stakeholders:

- Healthcare consumers will gain immediate and convenient access to healthcare from home for minor medical conditions and, potentially, when they have an exacerbation of a chronic disease. This will be appealing to time-pressured individuals, patients with mobility challenges, chronic disease sufferers and patients who live in areas with shortages of clinicians. It can also appeal to patients with highly sensitive conditions, such as behavioral health.
- HDOs will be able to reduce the number of uncompensated emergency room visits by offering patients real-time virtual visits. Additionally, on-demand virtual visits will help combat clinician shortage on hospital floor and improve operational efficiency.

Benefit Rating: High

Market Penetration: 20% to 50% of target audience

Maturity: Early mainstream

Sample Vendors: 98point6; Amwell; Doctor On Demand; Intellivisit; MDLIVE; Teladoc Health; Zipnosis

Recommended Reading: "Healthcare Provider CIOs: Bridge the Virtual Care Divide Between Provider- and Consumer-Directed Care"

"Healthcare Providers: Combat COVID-19 With Virtual Care"

"Scaling Virtual Care Requires a New Look at Its Enabling Architecture"

"Adopt This Decision Framework for Virtual Healthcare Delivery"

"Master These Proof Points to Create a Sustainable Virtual Care Roadmap"

Entering the Plateau

Medical Device Connectivity

Analysis By: Gregg Pessin

Definition: Medical device connectivity (MDC) systems connect medical devices and patient monitors to the electronic health record (EHR) system. They translate and transfer data between proprietary instrument formats to the input requirements of specific EHR systems. They provide data buffering during EHR downtime, can flag abnormal data, and provide a user interface (UI) for clinicians to review the data from the medical device or instrument.

Position and Adoption Speed Justification: MDC is a well-established technology that supports both low- and high-acuity devices such as infusion pumps and bedside monitors, as well as vital signs and oxygen saturation devices. MDC vendors provide, with their systems, extensive certification of specific instrument software releases. UIs are available for many classes of devices, including patient monitoring, infusion, respiratory care, anesthesia administration, and critical care monitoring. Device libraries continue to grow year over year.

Some vendors have already achieved substantial penetration of the global market through direct channels and remarketing by EHR vendors. Most major EHR vendors now have experience working with these products in various workflows. Device manufacturers are increasingly supportive because they realize that EHR integration affects the time to market for new instruments. In the U.S., many MDCs are regulated by the U.S. Food and Drug Administration (FDA) as medical device data systems (MDDSs). If the data that the MDDS transfers are used for continuous monitoring of a patient or immediate clinical decision making, then it is more strictly regulated. Under this regulation, manufacturers do not require premarket approval. Still, they must meet requirements for good manufacturing practices (GMP), including formally tracking problems and resolutions, collecting adverse events, and providing the FDA with an annual report of adverse events. These regulations apply to healthcare organizations that have built their own MDC software. Regulation requirements outside the U.S. vary by country. MDC vendors have also started to provide data from devices for analytics purposes.

We have positioned this technology at the end of the Hype Cycle (reflecting the U.S. position) because the usage of these products has been stable, as evidenced by continued low level of inquiries in 2019. However, non-U.S. HDOs are currently implementing integrated EHRs, so they are early in the implementation and use of this technology. Therefore, the adoption rate has been adjusted to 20% to 50% of target audience, and so it remains on the Hype Cycle.

As the IoT platform market matures, it is clear that the real value these systems provide is not derived from the raw data itself but from what systems do with the data. As competition grows for this capability set, the various functional components of MDC will define their own market space and align under IoT, IoT Platforms, clinical service buses, and event listeners/responders. Clinical devices and data collection systems will publish data associated with events occurring in the care venue to the service bus. Various response systems will subscribe to the service bus for specific event types and, subsequently, process them according to their purpose — such as delivering clinical alert notifications to the appropriate caregiver.

User Advice: HDO CIOs should:

- Obtain business sponsorship from nursing, critical care medicine, and biomedical engineering for an MDC project.
- Develop a pilot program and work with clinicians to determine business value and success by measuring the time until device data is available in the EHR system and the amount of nursing time required.
- Take note of nurse call integration requirements and alarm management issues.
- Review other integration capabilities between the MDC and existing (or planned) systems and medical devices.

Business Impact: Medical device connectivity:

- Allows clinicians to spend more time on direct patient care, providing demonstrable savings in nursing full-time-equivalent requirements.
- Improves the accuracy of charted vital signs and other respiratory and blood parameters.
- Enables near-real-time access to medical device data.

- Enables EHR-improved decision making and automated alerts.
- Provides a faster time to market for new instruments and more consistent instrument interactions with EHR systems.
- Introduces medical device integration into nursing workflows, which improves nursing efficiency, chart accuracy, and more timely use of decision support capabilities.

Benefit Rating: High

Market Penetration: 20% to 50% of target audience

Maturity: Mature mainstream

Sample Vendors: Bridge-Tech Medical; Capsule; CareTrends; Cerner; GE Healthcare; Masimo

Recommended Reading: "Strategic Roadmap to the Real-Time Health System"

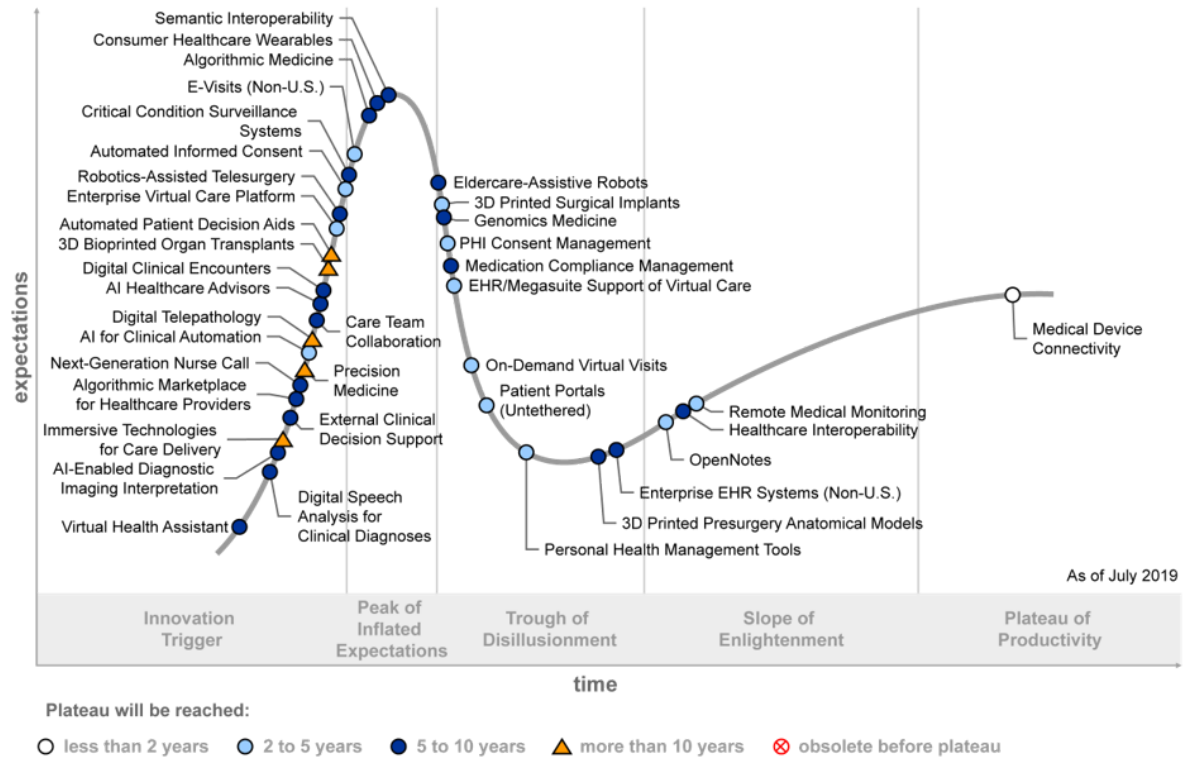
"HDO CIOs, Get Ready to Transform Your Alarms and Notification Systems Into IoT Platforms"

"Evolving IoT Security Risks Demand New Approaches From Healthcare Delivery Organizations"

"Healthcare Provider's Unique IoT Challenges Demand a Platform Strategy"

Appendixes

Figure 3. Hype Cycle for Digital Care Delivery Including Telemedicine and Virtual Care, 2019



Source: Gartner
ID: 369516

Hype Cycle Phases, Benefit Ratings and Maturity Levels

Table 1: Hype Cycle Phases

(Enlarged table in Appendix)

Phase ↓	Definition ↓
Innovation Trigger	A breakthrough, public demonstration, product launch or other event generates significant press and industry interest.
Peak of Inflated Expectations	During this phase of overenthusiasm and unrealistic projections, a flurry of well-publicized activity by technology leaders results in some successes, but more failures, as the technology is pushed to its limits. The only enterprises making money are conference organizers and magazine publishers.
Trough of Disillusionment	Because the technology does not live up to its overinflated expectations, it rapidly becomes unfashionable. Media interest wanes, except for a few cautionary tales.
Slope of Enlightenment	Focused experimentation and solid hard work by an increasingly diverse range of organizations lead to a true understanding of the technology's applicability, risks and benefits. Commercial off-the-shelf methodologies and tools ease the development process.
Plateau of Productivity	The real-world benefits of the technology are demonstrated and accepted. Tools and methodologies are increasingly stable as they enter their second and third generations. Growing numbers of organizations feel comfortable with the reduced level of risk; the rapid growth phase of adoption begins. Approximately 20% of the technology's target audience has adopted or is adopting the technology as it enters this phase.
Years to Mainstream Adoption	The time required for the technology to reach the Plateau of Productivity.

Source: Gartner (August 2020)

Table 2: Benefit Ratings

Benefit Rating ↓	Definition ↓
Transformational	Enables new ways of doing business across industries that will result in major shifts in industry dynamics
High	Enables new ways of performing horizontal or vertical processes that will result in significantly increased revenue or cost savings for an enterprise
Moderate	Provides incremental improvements to established processes that will result in increased revenue or cost savings for an enterprise
Low	Slightly improves processes (for example, improved user experience) that will be difficult to translate into increased revenue or cost savings

Source: Gartner (August 2020)

Table 3: Maturity Levels

(Enlarged table in Appendix)

Maturity Level ↓	Status ↓	Products/Vendors ↓
Embryonic	▪ In labs	▪ None
Emerging	▪ Commercialization by vendors ▪ Pilots and deployments by industry leaders	▪ First generation ▪ High price ▪ Much customization
Adolescent	▪ Maturing technology capabilities and process understanding ▪ Uptake beyond early adopters	▪ Second generation ▪ Less customization
Early mainstream	▪ Proven technology ▪ Vendors, technology and adoption rapidly evolving	▪ Third generation ▪ More out-of-the-box methodologies
Mature mainstream	▪ Robust technology ▪ Not much evolution in vendors or technology	▪ Several dominant vendors
Legacy	▪ Not appropriate for new developments ▪ Cost of migration constrains replacement	▪ Maintenance revenue focus
Obsolete	▪ Rarely used	▪ Used/resale market only

Source: Gartner (August 2020)

Evidence

Journal articles and conversations with clients — both end users and vendors — were conducted over the past 12 months in order to frame the trends and adoption of the myriad forms of digital care delivery.

Document Revision History

Hype Cycle for Digital Care Delivery, Including Telemedicine and Virtual Care, 2019 - 15 July 2019

Hype Cycle for Digital Care Delivery Including Telemedicine and Virtual Care, 2018 - 18 July 2018

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Hype Cycle for Telemedicine and Virtual Care, 2016 - 6 July 2016

Hype Cycle for Telemedicine and Virtual Care, 2015 - 30 July 2015

Hype Cycle for Telemedicine, 2014 - 14 July 2014

Hype Cycle for Telemedicine, 2013 - 18 July 2013

Hype Cycle for Telemedicine, 2012 - 23 July 2012

Hype Cycle for Telemedicine, 2011 - 28 July 2011

Hype Cycle for Telemedicine, 2010 - 23 July 2010

Hype Cycle for Telemedicine, 2009 - 16 July 2009

Hype Cycle for Telemedicine, 2008 - 25 June 2008

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Business Drivers of Technology Decisions for Healthcare Providers, 2020

Leverage CIO, CNIO and CMIO Collaboration to Advance Digital Care Delivery

Healthcare Provider CIOs: Build Clinical Informatics Leadership to Succeed in Digital Clinical Transformation

Healthcare Provider CIO's Action Plan for COVID-19

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