

Precision Health Intelligence

The Key to Population Health Success



Executive Summary

Data and Analytics are increasingly at the heart of healthcare.

The disruption of fee-for-service healthcare – a supply-driven system that prizes volume over value and activity over outcomes – is causing a massive reshaping of the industry. Healthcare is rapidly evolving toward a value-based system, one centered on individuals, prevention, and the management of chronic disease.

This evolution is essential and will not be a one-time event. It hinges on several distinct but mutually reinforcing elements, particularly the new discipline of Population Health Management (PHM), where success will demand new competencies, skills, and infrastructures.

AI and analytics will be key among them. **The industry's traditional rules-based analytics and risk stratification methods are simply inadequate to the task.** They return little guidance on what actions to take and are incapable of systematically learning from data.

Healthcare's new business models will only succeed when organizations combine value-based payment mechanisms with activities that achieve outcomes with much more certainty and systematically use them to improve the health of individuals and populations.

This will require Precision Health Intelligence. Beyond all the hype around AI and Big Data, Precision Health Intelligence goes beyond any specific method or technique. It integrates several developments into a set of complementary technologies aimed at some of healthcare's biggest challenges. Organizations are maximizing their use of Precision Health Intelligence to:



Absorb new data to improve the contextual awareness of people's health, motivations, and behaviors, including data that characterizes treatments and health services



Create new measures that reflect people's responses, experiences, and outcomes



Accurately predict an individual's risk of specific outcomes under specific treatments and health services



Quickly simulate the range of potential outcomes attainable from different courses of action



Identify and match individuals with the options that best meet their needs



Explicitly account for healthcare and operating costs, calculate potential and realized savings, and compute individualized health economic impacts



Easily integrate with PHM workflows and activities



Support experimentation to test and compare innovations



Continuously monitor interventions to learn which are effective and under what circumstances



Regularly re-optimize the mix of interventions and their match with individuals in pursuit of individual and population health

Implementing a value-based healthcare agenda is not a one-shot effort; it is an open-ended commitment. It is a journey that begins with value as its destination, is guided by constant, measurable improvement, and sustained by strong leadership and a commitment to innovation and learning. Data and analytics will increasingly be at the heart of these accomplishments.

This paper describes Precision Health Intelligence and why it is critical to the transformation to value-based healthcare and successful population health management.

Table of Contents

Executive Summary2

The ACA @ 105

Alternate Payment Models Change Everything6

Population Health Management – The New Table Stakes.....8

PHM’s New Competencies9

 Re-imagining Primary Care9

Patient Engagement and Chronic Conditions.....11

Social Determinants of Health.....12

The 21st Century Learning Organization.....13

Getting Better Begins with Measurement14

Feedback Loops and Intelligence15

Big Data16

The AI Revolution.....17

Data Science Goes Mainstream18

The ACA @ 10

March 23, 2020 marked the 10th anniversary of the Affordable Care Act (ACA), whose passage ignited the most comprehensive set of changes in US healthcare. Ever. The industry had been changing for decades, but the ACA accelerated both the speed and the magnitude of change consuming the industry.

Despite the rocky start and prolonged resistance, the ACA has already left its mark. It created game-changing progress on coverage, rewrote the rules of the insurance market, has evidence of real impacts on health, and transformed the policy and legal landscape. Alternately hailed as a “big deal” and cursed that “the ACA simply doesn't work,” no recent legislation has provoked more controversy or been as resilient. The ACA has survived more than 70 efforts to “repeal and replace” and been to the Supreme Court five times concerning watershed disputes including matters involving Congress's power to regulate economic activity, Congress's obligations when using states and private implementers, the appropriate way to interpret Congress's wordings, and the extent to which ACA could press against religious freedoms.¹

The ACA has also shifted the baseline of public attitudes and with it, future policy making. One such attitude is that Americans should not lose health coverage because of pre-existing health conditions. The litmus test of policy alternatives is now a comparison of coverage numbers, with proposals judged on whether they cover roughly the same population. Given how recently ACA was passed, the significance of this cannot be overstated. Protections for pre-existing conditions are now table stakes. The debate has moved on.

Alternate Payment Models Change Everything

ACA's more visible effects can be seen in the delivery system where it is accelerating the arrival of value-based healthcare that is aligned with – and paid based on – health outcomes. The ACA contained several such initiatives, including the [Hospital Readmissions Reduction Program](#), [Bundled Payments for Care Improvement](#), [Medicare Shared Savings Program](#) (MSSP), and [Accountable Care Organizations](#) (ACOs), which have seen remarkable growth. As of June 2019²:



Nearly 1,000 ACOs now cover almost 44 million



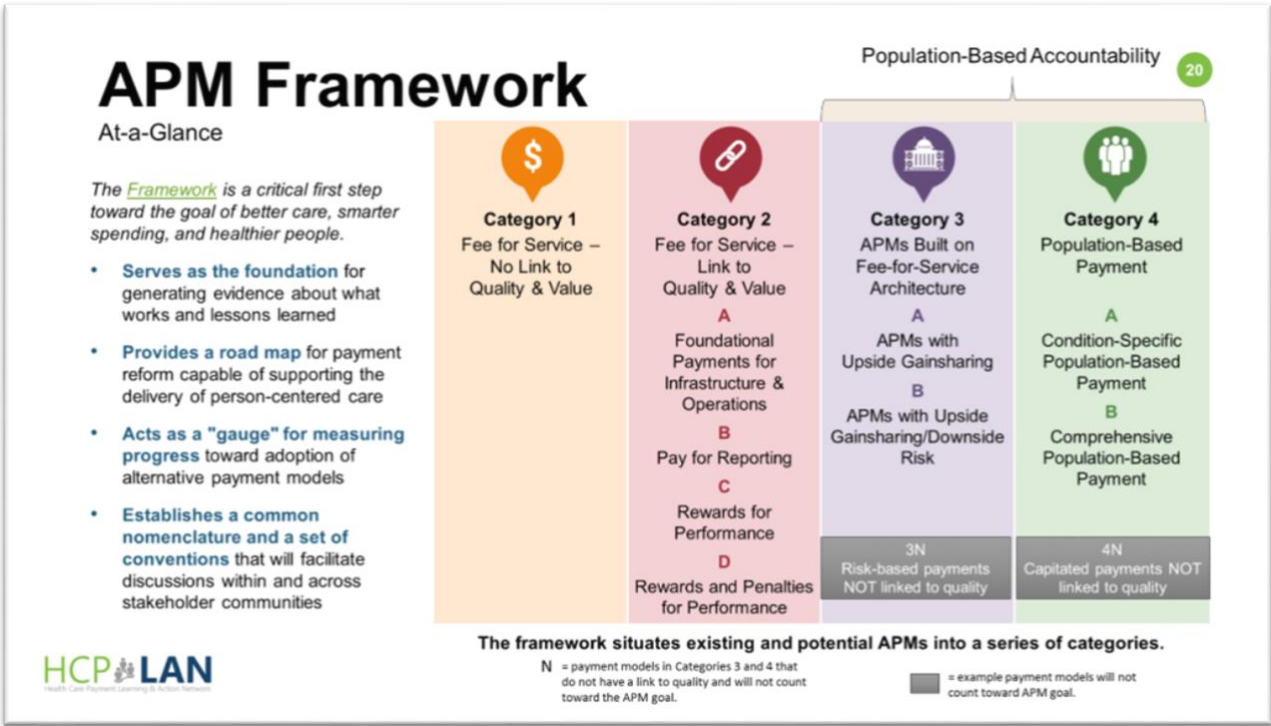
ACOs are now physician-led (43%) more than hospital- or jointly- led, a reversal from early on



More ACOs are starting to take downside risk, with physician-led ACOs taking downside risk more often than hospital-led ACOs

This growth is not a surprise, since part of ACA's reforms included funding the Center for Medicare & Medicaid Services Innovation Center (CMMI), a \$10 billion investment in developing and testing multiple payment and delivery model innovations and alternate payment models (APMs). In the past decade, CMMI has devised 90 alternate care delivery and payment models, ranging from P4P, bundles, and global payments.³

To help drive APM adoption, CMS established the [Health Care Payment Learning & Action Network](#) (LAN) in 2015. The LAN's mission has been to accelerate the transition to APMs by combining the innovation, power, and reach of the public and private sectors. The LAN's landmark achievement has been the APM Framework (*see graphic, below*). The APM Framework establishes core APM design principles, classifies APMs into distinct categories, and establishes a common vocabulary and pathway for measuring successful models.⁴



The Framework also forms the basis of the annual [APM Measurement Effort](#) which measures progress in the adoption of APMs. In 2018, APM Measurement reported 36% of healthcare payments flowing through Categories 3 & 4.⁵ Despite significant uptake, nearly 2/3rds of payments remain rooted in fee-for-service (FFS). Experts agree this will fail to drive fundamental change and that the next stage must focus on APMs that support population health management and community engagement, and other value-adding activities.

CMS recently announced goals to accelerate the percentage of payments into two-sided risk APMs even further. They are targeting 100% of Medicare and 50% of Commercial and Medicaid by 2025.⁶ To drive adoption, CMS made one of the largest changes to the Medicare ACO program since its inception. Called Pathways to Success, it includes a major overhaul of MSSP.

Targeted Payments in Categories 3 & 4

	Medicaid	Commercial	Medicare Advantage	Traditional Medicare
2020	15%	15%	30%	30%
2022	25%	25%	50%	50%
2025	50%	50%	100%	100%

CMS also recently launched several new value-based models. One is the [Primary Cares Initiative](#), a new set of APMs that it hopes will “transform” primary care to support high-value care.⁷ The new models create voluntary options for primary care

physicians and their practices to be paid for keeping patients healthy and out of the hospital. The agency considers these new models to be potential game-changers and, when introducing the new models, said the goal was to “dismantle” fee-for-service payments. CMS has aggressive goals for this program and is targeting to cover 11 million Medicare beneficiaries.^{8,9}

“Value-based payment ... is the future. So, make no mistake: If your business model is focused merely on increasing volume rather than improving health outcomes, coordinating care and cutting waste, you will not succeed under the new paradigm.”⁹

- Seema Verma

Most recently, CMS launched the [Community Health Access and Rural Transformation](#) (CHART) Model whose goal is to accelerate opportunities for rural communities.¹⁰ This effort makes investments that enable rural communities to pursue innovative financial arrangements and gain the operational and regulatory flexibility they need to pursue value-based arrangements.

The transformation to value-based care will eventually disrupt nearly every aspect of how care is organized, delivered, measured, and reimbursed. The process is creating opportunities for new entrants and start-ups with more compelling business models and is reshaping the industry and its key segments, including where profit pools lie and who gets them. Healthcare organizations, including its leaders, are having to aggressively adapt or risk long-term viability.¹¹

Population Health Management – The New Table Stakes

While there is no longer any doubt about the need for value-based care, the challenge should not be underestimated. Decades of entrenched practices and interests call for an essential departure from the past and despite progress, the real work of creating value remains ahead of us.¹²

The new APMs are crucial but by themselves are not enough.¹³ Organizations that have succeeded in this ‘shared risk’ world have learned they must integrate APMs with people, processes, and technologies able to achieve better outcomes with much greater certainty. Industry leaders define these combined capabilities as Population Health Management (PHM) and view them as essential for catalyzing and sustaining value-based business models.¹⁴

PHM is more than simply focusing on high cost patients or certain conditions. PHM is also different from the industry's earlier efforts in things like disease management, which suffered from poor design, lackluster engagement, little measurement, and anemic results.

“We need to stop thinking about population health as the next cool innovation project...it will be the way we're going to practice healthcare within the next two to five years.”¹⁴

- Ramon Castano

First and foremost, PHM demands a different way of thinking. It redefines care as systematically addressing the preventive and chronic care needs of everyone, including addressing the social and environmental determinants that affect health or exacerbate illness over time. Effective PHM requires a remarkable paradigm shift that is opposed to a fee-for-service mindset. Success demands that practices acquire the ability to systematically:



Prioritize patient-centered outcomes



Proactively identify and engage individuals to promote health and reduce costs



Actively partner as part of a broader health system



Exchange and share information while continuing to compete

To accomplish this, successful programs have learned how to generate and integrate diverse sources of individual and population-level data, use robust HIT and predictive analytic technologies, deliver team-based coordinated care and engagement, and form strong community partnerships. For many organizations, building robust PHM capabilities required mastering new competencies that, as new competitors gained traction and value-based care has taken hold, have quickly become the new table stakes.

PHM's New Competencies

Re-imagining Primary Care

Purchasers are banking on primary care to save money and the government is pumping billions of dollars into primary care improvement and innovation.¹⁵ After decades of being undervalued and the de facto gatekeeper to specialists, primary care will be the nexus that drives value and better outcomes. That means challenging old assumptions and reimagining its role.

“If the ACA is a balance between expanding insurance coverage and encouraging non-traditional ways to pay for and deliver medical services, then primary care is its fulcrum.”

A prime example of this shift is [Iora Health](#), a practice model that takes a dramatically different approach to primary care, which they accomplish by building new practices from scratch. This is paramount because, according to CEO Dr. Fernandopulle, success demands a completely different vision of primary care. He describes their model as radically consumer-centric, team-based, digitally enabled, and centered on relationships as opposed to transactions. The key – getting people to change behaviors and improve their health – is patient engagement, which has driven a 40% reduction in hospitalizations.¹⁶

Iora Health is not the only organization pursuing such models. [ChenMed](#) and [Oak Street Health](#) are on similar missions that see primary care as a cornerstone to better outcomes. ChenMed starts by having physicians spend more time with patients – [10 times more](#), on average.¹⁷ They believe that the more doctors see their patients, the easier it is to keep small issues from becoming big ones. It works: patients have [33% fewer hospitalizations and ER visits](#) and doctors have a renewed sense of passion and purpose.¹⁸ And then there's newly public Oak Street Health (OSH on the New York Stock Exchange) with its 60 primary care centers. They recently announced a [partnership](#) to bring their clinics into Walmart, which has been investing more heavily in retail care clinics.¹⁹

Other retail players are moving to enhance their clinical footprints. Consider CVS - in addition to the existing 1,100 MinuteClinics are 200 new [HealthHUBs](#), which devote 20% of floor space to healthcare products and services.²⁰ CVS plans to have 1,500 by the end of 2021. And Walgreens recently [invested \\$1 billion](#) to open full-service doctor's offices in its stores managed by VillageMD, a medical services provider and plan to have 700 clinics in the next five years.²¹

Innovations also reach beyond brick and mortar. Virtual care companies like [Teladoc](#) are transforming how people access healthcare while others like [Livongo](#) use remote monitoring to prompt new behaviors or spot early warning signs. The use of such services saw steady growth and then exploded with COVID-19. In general, [experts expect](#) this higher usage to outlast the pandemic. In fact, Teladoc and Livongo saw enough of an opportunity that they did a [mid-pandemic merger](#).

Consumers are reacting positively and are starting to select primary care that fits their lifestyles. With new entrants offering innovative options that bring convenience and value (e.g. convenient care, house calls, at-your-service care, digital health, and nurse-led care), [80% of consumers are open](#) to non-traditional ways of receiving basic medical attention.²²

Amid this change, traditional practices are having to adapt to stay relevant: about one-third of physicians²³ have changed their business model to adapt. Some now offer entirely new services so they can compete with new entrants, including virtual care and one-stop-shopping conveniences like co-locating care team offices with lab, imaging, physical therapy, and other complementary services.

As these care model innovations mature, successful organizations will offer a combination of services through an ecosystem that embraces all of a person's health needs instead of isolating one acute problem for attention.

Patient Engagement and Chronic Conditions

An early and high-priority focus for PHM is the management of chronic conditions. They account for over 75% of total healthcare costs and are deeply connected to our behaviors: 31% of costs are directly linked to behaviorally affected conditions and nearly 70% are strongly influenced by behaviors.²⁴ Poor medication adherence alone costs nearly \$300B annually.²⁵

Engaging patients in managing their chronic conditions begins with acknowledging their role. It is inescapable that people living with chronic conditions are their own principal caregivers. The question is not whether people manage their conditions; it is how well they manage them.²⁶

"Patients with the lowest engagement levels cost from 8 percent to 21 percent more than the patients who were actively engaged in their health."²⁶

Engaging patients also means appreciating how chronic disease differs from acute illness and that taking an active and primary role often means acquiring new skills and behaviors.²⁷ For the PHM practitioner, it means becoming a teacher who helps patients acquire them and also recognizing that teaching is also likely to be a new competency.

Engagement is so important to improving chronic disease outcomes, it has been called the "blockbuster drug of the 21st century."²⁸ It also demands a different kind of science, where the social sciences become as important to outcomes as the biomedical ones. Learning to promote engagement is often a new competency but mastering it can be accelerated by exploiting analytics that allow practitioners to measure and learn what works.

There is already some evidence that certain interventions improve engagement, particularly efforts focused on skill development, problem solving, peer support, changing the social environment, and tailoring support to each person's level of engagement. Crucially, however, there is no 'gold standard' for what kinds of programs are the most effective, and no robust evidence of which ones work best for specific populations.²⁹

Today's leaders are not waiting for the research world to create it. Instead, they are busy learning what works for themselves. They have taken Atul Gawande's comments to heart when he said, "achieving quality outcomes reliably, at scale, requires that we supplement carefully controlled, after-the-fact evaluations with continuous real-time learning to improve the quality and effectiveness of both systems and programs."³⁰

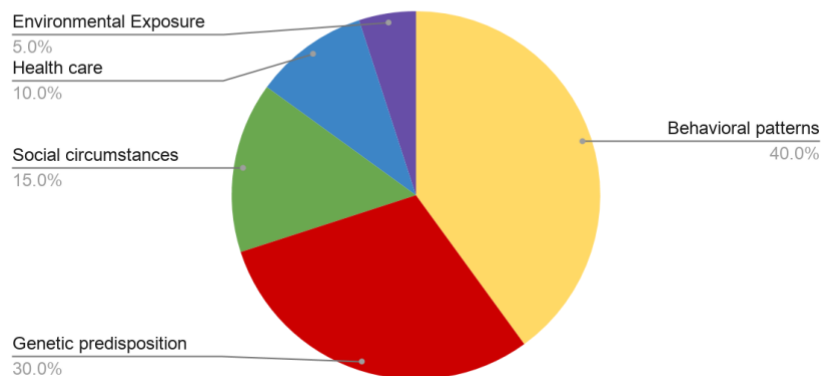
Social Determinants of Health

The Social Determinants of Health (SDoH) are defined as "the conditions in which people are born, grow, live, work and age." More than two decades of research has established that these determinants not only strongly shape health, their effects on health are even larger than those of medical care.³¹

These determinants and their effects are also unevenly distributed, creating disparities that are persistent, pervasive, and expensive. Between 2003 and 2006, nearly one third of the care for minorities in the U.S. were the result of health disparities, with costs exceeding \$1.2 trillion (at the time, more than 15 percent of national debt).³² A report from the Agency for Healthcare Research and Quality (AHRQ) shows that disparities, despite improved access from ACA and an improved understanding about how to reduce them, have barely changed in the last 10 years.³³

Addressing SDoH and health inequities is gaining attention in part because APMs create incentives that lead organizations to explore the root causes of poor health, some of which lead to underlying social needs. In an effort to improve outcomes, ACOs are beginning to attend to patients' non-medical needs (e.g. transportation, housing, and food), State Innovation Models (SIMs) are exploring ways to connect care and social services, and payment models are adding SDoH measures to risk adjustment.³⁴

Proportional Contribution to Premature Death



In addition, Community Based Organizations (CBOs) are emerging that systematically link healthcare and social services for people at risk of poor outcomes. More organizations are forming to specifically address SDoH, and partnerships between clinicians, social service agencies, and CBOs are on the rise. One such collaboration is the [Pathways Community HUB model](#) (HUB).³⁵ The HUB acts as a ‘registry’ for at-risk individuals, pairs them with a coordinator with access to services, enables and monitors service delivery via Pathways, and ties payments to milestones and improved outcomes. In another example, the [Idaho Health Data Exchange](#) (IHDE) is implementing a search and referral platform for its users to better understand SDoH and enhance the exchange of data.³⁶ It also partnered with [Aunt Bertha](#), a social care network, to help IHDE users connect their patients with relevant social services and community resources.

A major barrier to this growing interest is a substantial evidence gap in what SDoH interventions are most effective.³⁷ Evidence is needed regarding interventions (e.g. impacts in different populations and/or settings, components and operating models that work best under different circumstances, and assessments of economic impacts), as well as the determinants themselves (e.g. their underlying mechanisms, how they differ across populations and/or settings, the pathways by which they operate, and ways to disrupt them).

“Our challenge is to rapidly improve our understanding of which new ideas work, and under what circumstances, and use that information to scale up and spread successful approaches broadly.”²⁴

If there is a silver lining, it is that this evidence is starting to come from the PHM practitioners themselves. Organizations are moving away from a reliance on academicians and RCTs and adopting Learning Evaluation implementation frameworks to more rapidly learn, facilitate improvement, and generate transportable lessons.³⁸

The 21st Century Learning Organization

Across several industries, the learning organization is experiencing a renaissance. This is because defeating one’s competition by refining the current business models is no longer enough. To survive and grow, companies view continuous innovation as their only way to create a true, sustained advantage. New approaches emphasize experimentation, feedback, and iterative design and have explicit goals to measure and learn what works.

Harvard professor and expert David Garvin defines a learning organization as one that is skilled in “creating, acquiring, interpreting, transferring, and retaining knowledge, and at purposefully modifying its behavior to reflect new information and

insights.”³⁹ He calls this a surprisingly stringent test because companies can be skilled at acquiring knowledge, but notably less effective at applying it to their own activities or translating it into new ways of behaving. The key, he says, is mastery of the details including collecting intelligence from outside sources, accumulating data through targeted actions and experimentation, and a “command of the levers that shape behavior.”

For healthcare organizations, this is akin to the ‘performance revolution’ James Surowiecki discusses in *Better All the Time*.⁴⁰ Surowiecki describes how professional sports went through a performance revolution that now produces the best athletes in the world. Today, technology provides a flood of data about what is happening on the field and teams use Moneyball-style analytics to improve tactics and strategy. Efforts that once seemed sophisticated and obsessive are now what it takes to stay in the game. For healthcare, what may seem overly sophisticated today will soon be essential in value-based healthcare. Surowiecki’s message for organizations just starting out: their first goal should be to get better at getting better.

Getting Better Begins with Measurement

Measurement in healthcare exploded in response to reform. The National Quality Measures Clearinghouse now lists more than 2,500 performance measures used across quality reporting, accountability, and payment programs sponsored by payers, agencies, and quality assessment organizations.⁴¹ Despite this excess, healthcare remains poorly measured or unmeasured, with most capturing processes, guidelines compliance, or clinical indicators, which all fall short of actual outcomes.⁴²

“Rigorous measurement of value (outcomes and costs) is perhaps the single most important step in improving healthcare. Wherever we see systematic measurement of results, we see those results improve.”⁴³

The Institute of Medicine’s 2015 report, *Vital Signs: Core Metrics for Health and Health Care Progress*, finds that the proliferation of measures is creating serious problems.⁴³ Not only do measures focus on narrow or technical aspects of processes, the cacophony leads to confusing results, still lacks data to calculate important metrics, and creates significant burdens in capturing and reporting.

To begin addressing this, CMS recently announced the [Meaningful Measures initiative](#).⁴⁴ Launched in 2017, the goals are to improve outcomes, reduce reporting burden, focus on areas that matter most to patients and clinicians, promote alignment, and inspire innovation in new types of measures. And while this last goal may seem ill-timed, creating new types of measures could make achieving breakthroughs much more common. According to Bill Gates,⁴⁵ this is the lesson from a bygone era:

“Harnessing steam power required many innovations, [but among] the most important were new ways to measure energy output. Such measuring tools allowed inventors to see if their incremental design changes led to [improvements]. There's a larger lesson here: Without feedback from precise measurement, invention is doomed to be rare and erratic. With it, invention becomes commonplace.”

Achieving population health will involve constructing new measures able to fully characterize a person's health over time, the outcomes actually being sought (and not just being avoided), their functional capacity and perceived health, and their behaviors, experiences, and motivations. As with the steam engine, PHM innovator will need measuring tools so they can learn whether and where their interventions lead to improvement.⁴⁶ To foster this learning, tools must be able to build and exploit feedback loops.

Feedback Loops and Intelligence

Feedback loops are a profoundly effective tool for changing behavior,⁴⁷ whether talking about individuals changing their behaviors or corporations taking a lean approach to innovation. This is because feedback loops are how we learn.

Feedback is more than information. It is the control of a system by reinserting into it the results of its performance. In other words, information about a performance gap can only be considered ‘feedback’ when it is used to close the gap. If it is merely shared or is too vague to lead to action (e.g. a summary grade given by a teacher), it cannot be properly considered as feedback.⁴⁸

The potential of feedback loops to affect behavior was explored most notably by Albert Bandura, a pioneer in the study of behavior change and motivation. He found that giving individuals a clear goal and a means to evaluate their progress toward that goal greatly increased the likelihood they would achieve it. He later expanded this into the concept of self-efficacy, which holds that the more we believe we can meet a goal, the more likely we are to do so.⁴⁹ People who are persuaded they need to change will still not move toward change unless there is hope for success.

Feedback loops help companies, too. Enterprise platforms harness Big Data and analytic approaches to fuel feedback loops that enable dynamic learning and experimentation. Writ large, such capabilities are what Jerry Chen calls a System of Intelligence™ which he claims are the new ‘moats’ of sustained competitive advantage.⁵⁰ Traditional moats have included economies of scale, network effects, and intellectual property. Now, and because companies attack hard problems with deep technology and open source, such moats are shallower and harder to protect long term.

The battleground is shifting - from the platforms themselves (e.g. systems of record or engagement platforms) to what you do with the data that comes from them. Such strategies harvest a platform's data by-products, transform them (e.g. by

integrating other data and using AI), and fold them back into the business to create new products and services. Such strategies, especially when executed recursively and repeatedly, create a composite intelligence that is difficult to replicate and can be an effective barrier against competitors.

As a result, feedback loops are entering a kind of renaissance, particularly as emerging technologies make data more available and feedback more rapid. By creating quicker cycles of learning and improvement, they have become a powerful technique for fostering change in individuals and organizations.

One example is Livongo, whose health technology captures and wirelessly syncs test results (e.g. blood sugar, blood pressure). Over the years, they added sophisticated machine learning to analyze their massive store of data and feed it back to the customer in useful ways. For instance, it might advise a patient showing a spike in blood sugar to drink two glasses of water and take a short walk, and test again in 15 minutes. Or it might encourage them to phone their physician.⁵¹ Glen Tullman, Livongo's CEO, called their capability a flywheel, saying that the more data they have, the better their answers get.

Importantly, feedback loops should not be confused with their technologies. While certain technological advances may be fueling a renaissance, at the heart of a feedback loop lies something much simpler. It is an idea that is opened by realizing that every step of a process generates data (or can be made to do so) and is closed once the data is used to measure and improve performance.

Big Data

Big Data is not simply lots of data. Companies across retail, telecommunications, finance, and other data-centric industries have had 'lots of data' for a long time. But such traditional datasets were a static, well-behaved input, regardless of their size. They were never Big Data.

To help clarify things, the consultancy Gartner coined the "three Vs" to characterize what makes data big: volume, velocity, and variety. In sufficient volumes, it challenges conventional IT structures, with demands for scalable storage and distributed processing. Managing its velocity means handling the increased rate at which it flows into (and through) an organization, its integration with other data that also comes at different speeds, and its burstiness instead of predictable, steady tempos.

But data's most interesting and challenging aspect is its variety. Data sources now include social network chatter, web server logs, traffic flow sensors, satellite imagery, broadcast audio streams, banking transactions, music, web page content, scans of documents, GPS trails, telemetry from automobiles, financial market data and medical records. These various sources, with their differing structures and flow rates, far outstrip traditional processing capabilities, and have thrust data curation and governance into critical roles.

Just how much "data" is there? A rough estimate of the generation of measurements and other sorts of recorded facts gives

about five exabytes from the birth of civilization to 2003.⁵² By 2013 we were creating that much data per day. And the pace is rising exponentially. In 2020, there are approximately 40 trillion gigabytes of data (40 zettabytes), 90% of which was created in the last two years.⁵³ This is partly because the Internet of Things (IoT), which adds sensors to virtually everything. By 2025, the number of IoT devices could rise to 41.6 billion. These connected devices produce 5 quintillion bytes of data daily, which could amount to 79.4 zettabytes of data by 2025. Experts see the biggest growth coming from automobiles, home management systems and health monitoring devices.

Included in these trends is healthcare, which is now a Big Data industry. Healthcare data includes electronic health records (EHRs), medical and pharmacy claims, SDoH and environmental data, and genomic markers, and is increasingly adding data from care management programs, remote health monitoring devices, and personal health trackers.

Lest the terminology lag reality, there is even a discussion underway on what to call Big Data's soon-to-be-largest quantities. Today, the yottabyte (1,000 zetabytes or 1 million exabytes) is the largest measure, and currently the end of the scale. What comes next? Ninabyte and brontobyte have been proposed, but another leading candidate is hellabyte!⁵⁴

The AI Revolution

But data has only ever been as good as the intelligence gleaned from it. As Steve Lohr said in 2011, "if 'big data' is to be more than a marketing term, it has to be the raw material for making smarter decisions, faster."⁵⁵ And the reality of Big Data is that unless its analytics change, it will be more burden-than-bonanza. It brings obstacles that cannot be overcome with traditional approaches or by employing statistics more carefully, precisely, or guardedly. It requires moving away from conventional analytic paradigms, which begin by assuming only certain variables are key and end by correlating only those. It requires computational methodologies able to exploit its diversity.

In a data-driven world, the limits of rules-based approaches (where programs must pre-specify each if-then-else sequence) are fatal. These approaches, which are usually simple and unable to learn, cannot perform better than the rules underlying them and only improve when experts come armed with better rules.

In a Big Data world, classic statistics is also reaching its limits. Such analyses begin with a specific hypothesis (i.e. an explicit statement of how certain variables combine to explain an observation or outcome) which is then statistically tested to confirm whether the data supports it. Methods such as linear regression or ANOVA are adequate when the number of variables is small, because there is a manageable limit to the number of ways variables can be combined to explain the data. But when the number of variables gets big, the number of such possible combinations explodes astronomically. It becomes literally impossible to formulate and examine each one by hand.

To overcome such barriers, companies have turned to artificial intelligence (AI) and machine learning. For half a century, researchers predicted AI was right around the corner. Yet, and until a few years ago, it seemed as stuck in the future as ever. AI is fundamentally different from its analytic predecessors and harnesses three powerful trends in its combination of:



Cheap parallel (cloud) computing – Thinking is an inherently parallel process and building learning algorithms requires many different processes to take place simultaneously. Until recently, the typical processor could only ping one thing at a time.



Big Data – Part of the AI breakthrough lies in being able to find useful patterns in the avalanche of data collected, where the entire digital universe has become the teacher making AI smart.



Better algorithms – Machine learning was invented in the 1950s, but a resurgence in the last decade has helped computer scientists tame the astronomically high number of relationships involved.

Rather than being swamped by big data, AI exploits its volume and diversity, learning directly and at-scale from it. Problems that seemed unconquerable a few years ago are now being solved, with companies reporting startling gains, particularly with a branch of AI called ‘deep learning’. There are Star Trek-like instant language translation capabilities, companies building self-driving cars, robot dogs that walk like their living counterparts, and promising molecules for new drugs being quickly identified. According to Yann LeCun, a computer scientist at New York University, there have been “a number of stunning new results with deep-learning methods. The kind of jump we are seeing in the accuracy of these systems is very rare indeed.”⁵⁶

Data Science Goes Mainstream

Riding the coattails of these sweeping advances in AI is another revolution, one that has been dubbed “the last mile of analytics.” Bridging this last mile involves creating data-driven software (DDS) that delivers sophisticated machine learning without having to be a data scientist.

“Ten years ago, data science was sitting in the math department; it was part of academia. Today, you see data science applications [across] multiple industry verticals. In the next 5 to 10 years, data science will disrupt every industry, resulting in better efficiency, huge new revenue streams,

new products and services, and new business models. We're seeing a very rapid evolution." ⁵⁷

-T.M. Ravi,

This evolution should not be a surprise; the path from infrastructure to applications is a familiar one. The pattern occurs with practically every new and disruptive technology. In the early days of the internet, most of the innovation focused on infrastructure. While there were small groups of sophisticated people doing very cool things, most people were unable to really take advantage of the technology. Fast forward and the technology matured to the point where every company uses it as a business tool. The internet started as a science project, and now we have Amazon and OpenTable.

This will be a boon to business everywhere, since one of the often-cited barriers to exploiting AI has been the shortage of data scientists. In an ironic twist, by making AI available to the masses, data science may end up automating itself out of "the sexiest job of the 21st century."

Precision Health Intelligence

Precision Health Intelligence is beyond any specific method, algorithm, or technique. It is a synthesis of complementary technologies designed to address the specific challenges organizations face as healthcare is transformed into a value-based system.

Platforms with these capabilities integrate the tools PHM practitioners need, actively foster learning the most effective ways to promote health, and help generate the knowledge individuals and organizations need.

Writ large, healthcare's 'systems of intelligence' will transform the ability to realize and sustain the health of individuals and across populations. Such platforms are already becoming integral to healthcare and embedded in delivery and decision-making because of their ability to:



Absorb new data to improve the contextual awareness of people's health, motivations, and behaviors, including data that characterizes treatments and health services



Create new measures that reflect people's responses, experiences, and outcomes



Accurately predict an individual's risk of specific outcomes under specific treatments and health services



Quickly simulate the range of potential outcomes attainable from different courses of action



Identify and match individuals with the options that best meet their needs



Explicitly account for healthcare and operating costs, calculate potential and realized savings, and compute individualized health economic impacts



Easily integrate with PHM workflows and activities



Support experimentation to test and compare innovations



Continuously monitor interventions to learn which are effective and under what circumstances



Regularly re-optimize the mix of interventions and their match with individuals in pursuit of individual and population health

Forward-thinking ACOs and health plans are already well-positioned to leverage Precision Health Intelligence systems. These

organizations already possess essential assets and capabilities, and can begin by taking several practical steps:



Acquire and combine new data sources to create and expand available measures



Create value-based segmentation and targeting capabilities to improve outcomes



Broaden interventions to expand competencies in engagement and increase knowledge of how clinical therapies and social determinants affect people's health



Actively experiment, by introducing and continually refining interventions using data-driven feedback to learn where they are effective and why



Form partnerships that introduce value-based pricing mechanisms and share savings

Healthcare's leaders know that the journey to achieving a value-based system is a long-term commitment, one that begins with value as its destination and is guided by constant, measurable improvement. Their success will be determined by their sustained leadership and commitment to Precision Health Intelligence.

Let the journey begin.

End Notes

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Carol McCall is a health actuary and population health executive whose specialty is finding ways to combine innovations in health services, predictive modeling, and business models. Her aim is to rethink the traditional notions of care, accelerate the ability to learn what works, and catalyze sustainable value-based ecosystems and a culture of health.

Carol's experience spans actuarial work, health plan and PBM operations, innovations in health services, start-ups, predictive analytics and AI, health economics and outcomes research, the psychology of behavior change, personalized medicine diagnostics, national health information policy, and public health.

Prior to joining ClosedLoop, Carol earned her MPH from George Washington University and served as a strategic advisor and consultant to health analytic, HIT companies and women-led health start-ups with Springboard Enterprises.

Carol also served as Chief Strategy and Product Officer for GNS Healthcare and as Chief Innovation Officer for Vanguard Health Systems. At Humana, Carol led R&D innovation where she pioneered Humana's use of sophisticated analytics to build a portfolio of predictive, knowledge discovery, and simulation models. She also launched Humana's personalized medicine innovations and led their Health Services Research Center (HSRC). In other roles at Humana, Carol served as Chief Information Officer and as VP of Pharmacy Management.

In policy and advisory roles, Carol served a four-year term on the National Committee on Vital and Health Statistics and as co-chair of its Quality Workgroup; as a member of the HSRC's governing board; and as an advisor to the High-Risk Plaque Scientific Program Board.

Carol is a Fellow of the Society of Actuaries, a member of the American Academy of Actuaries, and a member of the Golden Key International Honors Society.