Journal Scan

BMC Medicine

JHU CPHIT Team Details Costs, Predictors of Opioid Abuse

"Within a study cohort of 890,000 health plan members, we identify the increased healthcare costs and utilization -- emergency department use and hospitalization -- associated with high-risk markers in the same year and in the next."

The team at the Johns Hopkins University Center for Population Health Information Technology and colleagues at the JHU Center for Drug Safety and Effectiveness – both in the Bloomberg School of Public Health – have published research in *BMC Medicine* that "reports on the development and testing of three measures of 'high-risk prescription opioid use' that can be derived from pharmacy claims data," says Jonathan P. Weiner DrPH, a Professor of Health Policy & Management and of Health Informatics, CPHIT Director, ACG Co-Developer and Director of the ACG R&D Team at Hopkins – and a *Predictive Modeling News* Editorial Advisory Board member. The metrics, he adds, "can also be applied with EHR or prescription drug monitoring program data as well."

PDPM databases track controlled substance prescriptions in a state – both prescribing and patient behaviors – helping facilitate a nimble and targeted response to problems.

Says Weiner of the online journal report: "Patients who are 'chronic' opioid users in Year 1 have healthcare costs over $20,000 higher in Year 2 when compared to other health plan members. After adjusting for demographics and all morbidities the patient may have -- some of which are linked to the pain medication -- the 'extra' cost risk in Year 2 is over $6,000 per patient."

Duncan's PM/RA Text Now in 2nd Edition; Expert Details Changes

New PMN *Advisory Board Member book "provides a comprehensive guide for healthcare actuaries and other professionals interested in healthcare data analytics, risk adjustment and predictive modeling," according to statement from the publisher.*

Ian Duncan FSA FIA FCIA FCA CSPA MAAA, Adjunct Associate Professor of Actuarial Statistics in the Department of Statistics and Applied Probability at the University of California, Santa Barbara, and President at Santa Barbara Actuaries Inc. – and a *Predictive Modeling News* Editorial Advisory Board member – reports the just-published 2nd Edition of *Healthcare Risk Adjustment and Predictive Modeling*, which his publisher, Actex Learning, points out is "on the required reading list for the SOA Group and Health Specialty exam." The new edition "greatly expands on the 1st Edition," the publisher's statement adds, with new chapters covering Accountable Care Organizations and predicting hospital readmissions; it includes sample R code and access to four datasets for applied learning.

The book "begins with an overall discussion of health risk, clinical identification algorithms for diagnostic grouping and the use of grouper models," the statement explains, "before moving into data mining concepts and common approaches used by modelers. Duncan explores predictive modeling and risk adjustment case studies through examples from Medicaid, Medicare Advantage, ACA Exchanges, ACOs, disability and depression diagnosis." Data sets are provided "for those wishing to experiment with their own models," it adds, noting that "the use of predictive modeling and risk adjustment outside of the US is also discussed." Indeed, the publisher says, Duncan's book "sets the technological stage for the latest application of predictive modeling in the actuarial profession."

Duncan's PM/RA Text Now in 2nd Edition *…continued from page 1*

The statement even includes these blurbs:

- "All in all, this is the work of a superbly mathematical yet practical mind, a brilliant exposition of analytical techniques, coupled with a masterful explanation of how to apply health risk analysis," according to Regina E. Herzlinger, the Nancy R. McPherson Professor of Business Administration at Harvard Business School.
- And David B. Nash, founding Dean at the Jefferson College of Population Health, adds this: "I admonish our students to 'shut the faucet' rather than 'mop up the floor.' Duncan has given us elegant tools to figure out exactly which faucet we are to shut and which to avoid altogether! Kudos to Duncan for his contribution to the conversation surrounding the healthcare system."

Predictive Modeling News talked to Duncan about what's new in predictive analytics.

Predictive Modeling News: What's the biggest change in risk adjustment since you published the 1st Edition? ACOs? The focus on readmissions?

Ian Duncan FSA FIA FCIA FCA CSPA MAAA: I would name two changes in applications and one in the environment in which risk adjustment operates.

The Affordable Care Act created the opportunity for both ACOs and Exchanges, both of which required risk adjustment for their operation. I address both of these applications in individual chapters in the book. Applications within ACOs have not received as much attention as the Exchanges, where risk adjustment has come in for a lot of criticism. Issues are beginning to emerge that have to do with the application of risk adjusters in practical situations, rather than the theory (almost everyone agrees with the theory). Some of these issues are giving rise to new thinking and possibly new models.

In the risk adjustment environment, the 2016 Society of Actuaries comparative study of risk adjusters tested more models than ever, confirming the growing interest in and use of these models in the industry. Also in the environment, we see increasing interest in the accuracy of the raw material (claims and diagnoses) that feed risk models. The ACA also established the Hospital Readmission Reduction Program. Most hospitals that I am familiar with use the LACE model to risk stratify patients for readmission risk, but this is a fairly basic tool. Better models can be built, including one that I published recently in *Population Health Management*[1]. A description of the model and the modeling process is also included in the book.

PMN: How has communicating results changed over time? Is the message changing, the medium or both?

ID: There are so many more practitioners now than there were seven years ago when I published the 1st Edition. Interestingly, in my consulting practice, I am still constantly educating clients in the basics. Newsletters such as *Predictive Modeling News* help to spread the word, but a lot of what is written is technical and not accessible to the either the general audience or even the healthcare practitioner audience. This will be a challenge for us, as the models and applications proliferate.

PMN: Is PM/RA used differently elsewhere in the world? Is the technology different? The goals? How the results are used?

ID: The 1st Edition surveyed use of PM and RA in the United Kingdom, the Netherlands, South Africa and Israel. This chapter has been updated for the latest developments in these countries and I have added a new section on Colombia. I have been doing some work in Colombia, like the people very much and admire the way that they are trying to implement risk adjustment into their health system. Interestingly, since the 1st Edition, most of the interesting expansion and new developments in payment models and risk adjustment have taken place in the United States.

PMN: Do private and public payers use PM/RA in different ways? Do Medicare/ Medicaid policies drive private sector practices, or does the private sector innovate?

ID: Public payers have the advantage of setting rules and controlling significant revenue in largely unfragmented markets. Whether they innovate at a comparable rate to commercial payers is a good question (for example, the time that it has taken to make changes to the ACA risk adjustment process). The model used in the Oncology Care Management Program is a very innovative one, and it would be good to see other similar innovation.

Duncan's PM/RA Text Now in 2nd Edition *...continued from page 2*

***PMN:** What's an especially interesting recent development in predictive models?*

ID: One of the interesting developments in managed care over the last eight to 10 years has been the transformation of disease management into a number of fragmented and targeted programs. Modeling used to be more homogeneous for big chronic disease programs, but recently we have been involved in modeling for a number of new conditions and programs. I believe that this is a good development because targeted programs have the opportunity to succeed through focusing on smaller groups of patients. The book covers a number of different models that are applicable to these new situations.

The other development in prediction since the 1st Edition is the explosion of Big Data and machine learning. Although we cover some of these techniques (lightly), the book is more focused on traditional statistical models, in the belief that there is still much more mileage to be wrung from traditional models -- and that we will continue to see innovations that will make these models more accurate and effective.

Actex is a leading publisher in the field of actuarial study materials. Contact Lauren Hettler at lauren@actexmadriver.com. Duncan has over 30 years' experience in healthcare and insurance product design, management, financing, pricing and delivery; he's founded multiple companies to perform predictive modeling and outcomes analysis for healthcare. Contact him at 805-893-6023 or at duncan@pstat.ucsb.edu.

[1] I. Duncan and N. Huynh: "A Predictive Model for re-admissions among Medicare Patients in a California Hospital." Published online: *Population Health Management*, January 2018.

Market Reports

❖ **Global Population Health Management Market to Reach $89B by 2025**

"Accountable Care Organizations -- consisting of hospitals, clinics, doctors and other caregivers -- collaborate with payers for the delivery of high-quality care to patients," begins a statement from Reportbuyer.com, and "private and public insurance providers have introduced various disease management programs to assist in the treatment of chronic illnesses. These multidisciplinary efforts are expected to result in efficient treatment outcomes and are likely to suggest the most suitable course of action that needs to be taken." In addition, the statement says, "successful large-scale trials in the US have enabled significant advancements in disease management programs."

All told, says a report by Grand View Research Inc. called *Population Health Management (PHM) Market Size, Share & Trends Analysis Report by Application (Software, Services), by End-Use (Payers, Providers, Employer Groups) and Segment Forecasts, 2018 - 2025* – which Reportbuyer.com is promoting -- "the global population health management market is expected to reach $88.9 billion by 2025." Additional findings include these:

- PMH "has changed focus from fee-for-service to value-based payments."
- Based on applications, the PHM market is grouped into software and services. Of them, "the software segment held the majority of market share in 2016, as it offers a higher level of customization based on business needs."
- PHM software "offers on-premise benefits and data analytics networks to manage multiple functionalities in a single platform."
- And it offers predictive data analytics, "which can be applied for interpreting population characteristics from unstructured clinical data."
- Healthcare providers "held the largest market share of the end-use segment in the market in 2016," and "with the help of PHM solutions, they can focus effectively on patient-centric care and reducing overall costs."
- North America was the largest PHM market in 2016, and is likely to retain its position over the forecast period, "as providers, payers, provider-payers and ACOs promote the use of PHM services."
- Asia-Pacific is expected to witness the fastest growth in the near term, "due to rising healthcare expenditure and the improving healthcare infrastructure in the region."

Allscripts, McKesson Corp. and Cerner Corp. are key market players, the statement adds, noting that "some of the strategic initiatives undertaken by these companies to strengthen their market presence include acquisitions and partnerships with other market players." Visit www.reportbuyer.com.

❖ **Global Predictive, Prescriptive Analytics Market to Reach $17B in 2023**

The global predictive and prescriptive analytics market was valued at $5.52 billion in 2017; rising to almost $17 billion by the end of 2023 will represent annual growth of more than 20%. That's according to *Global Predictive and Prescriptive Analytics Market – Segmented by End-User (BFSI, Healthcare, Retail) and Geography – Growth, Trends and Forecasts (2018 – 2023),* now available from ResearchandMarkets.com.

Market Reports...*continued*

"The growing demand for consumer goods indirectly boosts the adoption rate of predictive & prescriptive analytics tools," a statement says, "due to the fact that many retail organizations and online retail stores are using this software to analyze, predict and provide a solution for any demanding situation." The statement also emphasizes that "all major sectors, such as BFSI and healthcare, use predictive analytics for the development of effective methods for managing customer relationships, predicting end-user behavior and improving customer loyalty and retention policies." Key topics covered in the report include a healthcare analytics market overview, factors driving and restraining the market and data privacy and security concerns; in addition to healthcare and retail, the report examines the media & entertainment, telecommunications and industrial markets in North America, Europe and Asia-Pacific. Company profiles include Oracle Corp., SAP SE, IBM Corp., Microsoft Corp., SAS Institute Inc., Accenture PLC, Infor Inc., Teradata Corp., Angoss Software Corp. and Salesforce.com, and an investment analysis is included as well. Visit researchandmarkets.com.

❖ **Global Healthcare Predictive Analytics Sales Market Sees 'Cut-Throat Competition'**

A new report from Questale called *Future of the Global Healthcare Predictive Analytics Sales Market -- Growth, Latest Trend & Forecast 2022* says that market "is growing at a very rapid pace and has witnessed the entrance of many local and regional vendors offering specific application products for multiple end-users." But, a statement from the publisher adds, "new entrants are faced with cut-throat competition due to innovative technology, quality services and the diligence of international vendors." The report, the company adds, "delivers detailed analysis of the market and its future prospects," with "critical and significant data that makes it a very important tool for analysts and managers;" the research includes graphs and tables detailing "important market trends, drivers and challenges." In addition, the report features data from the past five years about key players in the industry, such as IBM, Verisk Analytics Inc. and McKesson Corp.; "the in-depth information enables managers to monitor future profitability and make vital decisions for sustainable growth," the statement says.

The study also provides product pictures and specifications, revenues, market share and contact details; sales in thousands of units and revenues are categorized by product type – including diet habits, physiological parameters and vital signs – with historical and projected market share information and compounded annual growth rates. Highlights, according to the statement, include: "an empirical assessment of the trajectory of the market," major changes in market dynamics, "emerging niche segments and regional markets" and "recommendations to companies to substantiate their foothold in the market." Visit questale.com.

❖ **Predictive Analytics the 'Fastest-Growing Segment' of Commercial Pharma Analytics Market**

Pharmaceuticals analytics – "the use of analytical software to analyze and manage biomedical and biological data from life science industries like hospitals, pharmaceutical companies and laboratories" – represented a global market of $1 billion in 2015, but should grow about 20% a year for the next decade. That's according to a new report from Wise Guy Reports called *Global Commercial Pharmaceutical Analytics Market Estimation Forecast to 2027*; the growth is "mainly attributed to growing adoption of new technologies and analytical tools in process streamlining, as well as the growing pharmaceutical industry, especially in developing nations."

On the other hand, a statement from Wise Guy cautions, "lack of skilled professionals and high software costs are major obstacles restraining market growth." The market, the report says, "is mainly segmented on the basis of type, deployment method, applications and regions." Market segmentation by type includes sub-segments detailing descriptive analytics, predictive analytics and prescriptive analytics. "The descriptive analytics sub-segment, valued at $817.9 million, held more than 75% market share in 2015," the statement notes.

Market categorization based on deployment methods includes on-premise and web-/cloud-based deployment. "The market has also been segmented based on applications, into research & development, marketing & sales, supply chain optimization, internal reporting and other applications," the statement adds. North America "held the largest market share of around 49% within the global commercial pharmaceutical analytics market in 2015," it says. "The European market, valued at $282.7-million, held the second-largest market share in 2015." Here are details of the key findings:

- With revenue of $630 million, on-premise deployment held the largest market share, around 60%, in 2015
- Marketing & sales is the fastest-growing application segment; it should grow at about 20% a year through 2027.
- The Asia-Pacific region "is estimated to achieve the fastest growth, 20.8% a year, during the forecast period on account of the high adoption rate in the coming decade," the report says.
- Leading players are Tata Consultancy Services Ltd. (India), ORACLE (US), Northwest Analytics Inc. (US), Wipro Ltd. (India), Microsoft (US), Allscripts (US), Cerner Corp. (US) and Fuzzy Logix Inc. (US).

In addition to the US, the report includes country-level and regional analysis of North America, Eastern Europe, Western Europe, Asia-Pacific and the Middle East & Africa. Wise Guy Reports is part of the Wise Guy Research Consultants Pvt. Ltd. Visit WiseGuyReports.com.

Movers and Shakers

EY Names SCIO's Namasivayam 'Entrepreneur of the Year' Finalist

SCIOInspire Corp., dba SCIO Health Analytics, reports that EY has named CEO Siva Namasivayam a finalist for its Entrepreneur of the Year 2018 Award for the New York Region. The awards program "recognizes entrepreneurs who are excelling in areas such as innovation, financial performance and personal commitment to their businesses and communities," a statement says. Namasivayam was selected as a finalist by a panel of independent judges; winners will be named later this month. Now in its 32nd year, the program "has expanded to recognize business leaders in over 145 cities and more than 60 countries throughout the world," the SCIO statement adds; regional award winners are eligible for the Entrepreneur of the Year National competition – it's held in November. Founded and produced by EY, the Entrepreneur of the Year Awards are nationally sponsored in the US by SAP America, Merrill Corp. and the Ewing Marion Kauffman Foundation. In New York, sponsors also include Marsh, Empire Valuation Consultants, Kirkland & Ellis LLP, Pine Hill Group, DLA Piper and SolomonEdwards Group. Visit www.sciohealthanalytics.com and ey.com.

Two PatientPoint Executives Named to *PM360* "ELITE 100"

PM360, an information resource for marketing decision makers in the pharmaceutical, biotech and medical device sectors, has named two PatientPoint executives to its annual ELITE 100 list of "the most influential people in the healthcare industry," a statement reports. Chief Growth Officer Traver Hutchins and Chief Analytics, Insights and Strategy Officer H. Scott Nesbitt are being honored with ELITE (for Exceptional. Leaders. Innovators. Transformers. Entrepreneurs.) Awards in the Strategists and Data Miners categories, respectively. Hutchins was the first to fill the position at PatientPoint; he's been "integral to developing the company's long-term growth plan and product roadmap while spearheading merger and acquisitions efforts," a statement says. Earlier this year, it adds, "he played a critical role in the company's partnership with MeU Care to launch the point-of-care mobile engagement and communications platform PatientPoint Connect."

For his part, Nesbitt "has led the way in developing the company's proprietary predictive measurement methodology to measure POC channel effectiveness," the statement adds, noting that he's also "shaping auditing standards for the entire industry as a leader in the Point-of-Care Communication Council." In a statement, PatientPoint founder and CEO Mike Collette lauds Hutchins' "uncanny ability to predict trends, seize opportunity and bring concepts to life" and Nesbitt's "visionary work to develop auditing and validation standards for PatientPoint and the rest of our industry." The *PM360* ELITE Awards received more than 500 submissions, the statement adds; criteria included accomplishments; testimonials from supervisors, clients and colleagues; and supporting evidence that reflects the impact of their efforts. The winners were profiled in *PM360*'s May 2018 issue; it's "the premier, must-read magazine for marketing decision makers in the pharmaceutical, biotech and medical device industries." Visit www.patientpoint.com.

SOTERIA Retains McNeil as Bioinformatics, Machine Learning Advisor

SOTERIA Precision Medicine Advisory Inc. reports that John McNeil, President at John McNeil & Company Inc., "will architect data capture, machine learning, workflow and reporting solutions to support the effective handling and interpretation of large-scale precision medicine information." SOTERIA, an international concierge precision advisory service, lauds his "track record of positioning new biotechnology companies for success" and his 25 years of experience in bioinformatics, validated data management systems and IT. SOTERIA "provides information to navigate the rapidly changing landscape of precision medicine and molecular testing, coordinating health history, current health state and immediate health needs." The company "identifies optimal testing and treatment options, provides context and meaning to reports and data, optimizes the collection and use of biological specimens and facilitates communication between hospitals, research institutions and biotechnologies." Visit soteriaone.com.

Health Solutions Names McCusker Broker Relationship Manager

Health Solutions LLC reports that Stacy McCusker has joined the firm as Broker Relationship Manager, leading the company's national broker relations, reporting to EVP of Business Development Sam Houston. She's "a world-class sales leader with expertise forging relationships and expanding value for brokers," he says. McCusker joins Health Solutions from Transamerica, where she helped lead the broker relations business, managing seven distributions that were consistently in the Top Ten for premium annually. A key focus now: drive adoption and support for the Wellnelytics initiative, "the flagship predictive analytics and clinical coaching solution." She'll "provide consultative support to brokers, empowering them to incorporate best practices, technology and support from the team at Health Solutions so they can grow their practices and protect key accounts." HSI "provides clinically based wellness coaching that integrates biometric data and reporting to provide financially sound wellness initiatives to decision makers." Visit https://www.healthywithhsi.com.

Journal Scan...*continued from page 1*

Weiner adds: "In addition to potential implications for opioid abuse mitigation interventions, this study has many implications for care management programs. The metrics we developed in this study are being embedded in the next release – v12.0 -- of our Johns Hopkins ACG System risk adjustment/predictive modeling software." And he notes that both CPHIT and CDSE "are working with many partners on other research projects focusing on ways to identify persons at risk of adverse opioid-related outcomes" – noting specifically that "we are also exploring the application of many additional data sources." Here are excerpts from the *BMC Medicine* article, "Healthcare costs and utilization associated with high-risk prescription opioid use: a retrospective cohort study."

- Earlier studies "focused on patients diagnosed with an opioid disorder," but the JHU team's work "evaluates the impact of various high-risk prescription opioid use groups on healthcare costs and utilization."
- Three costs were derived from 2013 outcomes data: total, medical and pharmacy.
- As were four binary utilization indicators: top 5% total cost users, top 5% pharmacy cost users, any hospitalization and any ED visit.
- 1.45% of people with opioid prescriptions were chronic users.
- 4.81% were concomitant users.
- And 0.94% were diagnosed as having an opioid use disorder.
- Chronic users "had statistically significant higher prospective total (40%), medical (3%) and pharmacy (172%) costs."
- The increases associated with concomitant users were 13%, 7% and 41%, and 28%, 21% and 63%, respectively, for users with a diagnosed opioid use disorder.
- Total costs and pharmacy costs increased -- statistically significantly -- with the length of time a patient was characterized as high-risk.
- Only concomitant users were associated with a higher odds of hospitalization or ED use.

Predictive Modeling News talked to Hsien-Yen Chang PhD, Hadi Kharrazi MD PhD and Weiner, three of the co-authors of the paper, all faculty members at CPHIT and all members of its Johns Hopkins ACG System R&D team, about opioid abuse's impact on pharmacy and medical costs.

Predictive Modeling News: Were you surprised by anything in the findings? Did you expect costs to be that much higher? Did you expect odds of hospitalization or ED use to be higher than they were?

Hsien-Yen Chang PhD, Hadi Kharrazi MD PhD and Jonathan P. Weiner DrPH: Based on our literature review, we hypothesized that people with higher risk of prescription opioid use would incur higher healthcare costs and utilization than non-prescription opioid users. However, we did not expect a considerable difference in the percentage increase between medical and pharmacy costs; for example, among concomitant users (i.e., both opioids and benzodiazepine), the percentage increase in pharmacy costs was 41%, while this increase was only 7% in medical costs. In addition, we did not observe a higher odds ratio of any hospitalization or ED visits other than concomitant users, which is expected, as the proportional increase in total costs is mainly derived from pharmacy costs.

PMN: What's the main implication for care management programs? What action should your results prompt first?

H-YC, HK and JPW: Our results show a major increase in pharmacy costs, compared to the lower increase of medical costs, for high-risk prescription opioid users. Thus, when dealing with high-risk opioid users, care management programs should probably focus more on the pharmacy utilization, as there will be more room to contain cost. In addition, case managers can develop targeted interventions and guide high-risk prescription opioid users toward such programs to achieve the intended cost-saving outcomes -- as well as helping such users decrease their opioid dependencies.

PMN: Does the ACG System software deal with EHR or PDMP data? Have you tested the new metrics on that kind of data yet?

H-YC, HK and JPW: Although the paper we published in *BMC Medicine* was intended to add to the scientific knowledge base, we have incorporated the three "opioid markers" described in this study into our next ACG System release, due out later this year. The software can be run with any version of ICD and NDC input data, though most users will apply it with claims.

As you have previously reported, we have recently published a study showing that electronic health record data can be used effectively for risk adjustment. Some of our users having primarily EHR data, including several major EHR vendors, will likely incorporate our new ACG opioid markers into their population health management platforms.

We are currently working on a project funded by the Department of Justice that utilizes a wide range of risk stratification techniques, including some ACG measures, to identify patients at risk for overdoses of all types of opioids, both legally and illegally acquired. This project relies heavily on the PDMP in Maryland, although the ACG System has yet to be integrated into the PDMP platform.

PMN: Can you name any of the data sources you're examining for ways to identify possible opioid problems? Can you detail any of the other research projects you're focused on?

H-YC, HK and JPW: The opioid problem is multifactorial. Similarly, there are multiple data sources that can provide different pieces of this large puzzle, and boost the prediction of utilization rates in this complex denominator of patients.

Journal Scan...*continued*

As noted above, PDMP data within a state -- which covers both insured and self-pay prescriptions -- is a major data source for identifying the underlying populations of risk, but other data sources are often needed to fully train and test the customized predictive models.

- For example, in collaboration with the State of Maryland Health Department and CRISP, the State's Health Information Exchange, we are integrating data from the PDMP, hospital discharge records, coroner reports, drug treatment clinic (e.g., methadone) data, legal system and juvenile services data -- which captures illegal opioid use.

We are using these data to develop more advanced predictive models that can be used by public health agencies to help identify a wider range of populations and individuals in need of interventions that may potentially save their lives. We will share the results of the expanded opioid risk models with your readers in the future. Given the breadth and depth of the impact of this crisis, we hope the tools we are developing at Johns Hopkins can be part of the solution.

Contact Chang at hchang24@jhmi.edu, Kharrazi at kharrazi@jhu.edu and Weiner at jweiner1@jhu.edu. Access the article at https://bmcmedicine.biomedcentral.com/articles/10.1186/s12916-018-1058-y.
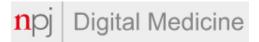
== "Healthcare costs and utilization associated with high-risk prescription opioid use: a retrospective cohort study." Chang et al. *BMC Medicine* (2018) 16:69 https://doi.org/10.1186/s12916-018-1058-y.

'Predicting Adherence to Chronic Disease Medications in Patients with Long-Term Initial Medication Fills Using Indicators of Clinical Events and Health Behaviors'

The researchers note that "efforts at predicting long-term adherence to medications have been focused on patients filling typical month-long supplies" – but it's harder to make that prediction for longer first fills, a practice the paper calls "increasingly common as a method to enhance medication adherence." So they set out to "extend methods involving short-term filling behaviors" and to "develop novel variables to predict adherence" in a group of first-fillers, using claims from "a large national insurer;" specific areas of focus included meds for diabetes, hypertension and hyperlipidemia. In total, the paper reports, 125 demographic, clinical and medication characteristics" – at baseline and after set measurement periods – "were used to predict adherence." They found that "predictions using only baseline variables was relatively poor; including indicators of acute clinical conditions, health resources utilization and short-term medication filling in the first 120 days more accurately predicted future adherence." The model that performed best included all 125 – "suggesting the utility of measuring these novel post-baseline variables in this population."

== *J Manag Care Spec Pharm*. 2018;24(5):469-77

'Scalable and Accurate Deep Learning with Electronic Health Records'

Using EHR data for predictive modeling "is anticipated to drive personalized medicine and improve healthcare quality," says the report. "Constructing predictive statistical models typically requires extraction of curated predictor variables from normalized EHR data, a labor-intensive process that discards the vast majority of information in each patient's record." Instead, the researchers "proposed a representation of patients' entire raw EHR records based on the Fast Healthcare Interoperability Resources format" – and their work demonstrated that "deep learning methods using it can accurately predict multiple medical events from multiple centers without site-specific data harmonization." The research team validated the approach "using de-identified EHR data from two US academic medical centers," the journal paper adds; "in the sequential format we proposed, this volume of EHR data unrolled into 47 billion data points, including clinical notes." Deep learning models, it says, "achieved high accuracy for tasks such as predicting: in-hospital mortality across sites, 30-day unplanned readmission, prolonged length of stay and all of a patient's final discharge diagnoses." The models outperformed predictive models now in use in all cases; the researchers say their approach "can be used to create accurate and scalable predictions for a variety of clinical scenarios." Indeed, in a case study of a particular prediction, they "demonstrated that neural networks can be used to identify relevant information from the patient's chart." Access the article at https://www.nature.com/articles/s41746-018-0029-1.

== npj *Digital Medicine*; volume 1, Article number: 18 (2018); doi:10.1038/s41746-018-0029-1

'The Effect of Clinical Pharmacist-Led Comprehensive Medication Management on Chronic Disease State Goal Attainment in a Patient-Centered Medical Home'

Clinical pharmacy services were offered at seven of 11 clinics in a network; they targeted patient with diabetes, primarily, for in-person and telephone visits in addition to regular meetings, often involving assessment of hA1c, cholesterol and blood pressure. Researchers set out to "assess whether the addition of the clinical pharmacy service had a positive effect on patient therapeutic goal attainment rates in those areas." They looked at the effects of both the bundle of assessments and of each, as well as at the average number of medications each group – clinical pharmacy service or no clinical pharmacy service -- used.

Thought Leaders' Corner

Each month, *Predictive Modeling News* asks a panel of industry experts to discuss a topic suggested by a subscriber. To suggest a topic, send it to us at info@predictivemodeling.com. Here's this month's question:

Q "Which predictive modeling activities are most effective for smaller healthcare organizations, those with limited budgets and few, if any, dedicated analytics staff?"

"This fits in exactly with what we do at Roundtable Analytics! Limited scope and low-barrier-to-entry analytics solutions exist that can have an extremely high ROI, which is a great place to start. That's exactly what we've focused on at Roundtable Analytics: high-impact, affordable, best-of-breed analytics solutions for emergency department performance that, among other benefits, can have an immediate positive impact on revenue that far exceeds the cost to implement."

Thomas F. Bohrmann PhD
Co-Founder of and Director of Statistical Practice
Roundtable Analytics
Research Triangle Park NC

"Since predictive modeling can be applied to many different areas, the answer to this question depends on the business model and market position of the healthcare organization. For example, a smaller healthcare organization that has a dominant position in its area would not benefit as much from predictive modeling for customer relationship management or marketing purposes, and it might benefit greatly from revenue cycle analytics that enable more effective allocation of billing and collection resources. In general, predictive modeling initiatives should contribute as directly as possible to the business model of the organization and provide actionable insight rather than simply data. In that way, they will be more likely to demonstrate a return on investment, adding to the margin necessary to further the mission of the organization."

Ken Perez
Vice President of Healthcare Policy
Omnicell Inc.
Mountain View CA

"Smaller healthcare organizations also need to accurately size the markets that will be impacted by their solutions or services. Specifically, they will need predictive models which answer stratification, revenue forecasting and operational optimization questions for their ultimate customers and key stakeholders. At the same time, smaller organizations often lack the data, resources or expertise to develop their own predictive models. Because of these barriers, it is crucial for these organizations to form a partnership with an analytic organization experienced in developing clinically relevant predictive models -- and one that understands the practical challenges of using analytics to improve healthcare."

Swati Abbott
Chief Executive Officer
Blue Health Intelligence
Chicago

Thought Leaders' Corner

"For smaller healthcare organizations, leveraging predictive analytics for risk assessment (e.g. population assessment) and risk adjustment could be a good start (the 'Crawl' state). Using commercially available predictive modeling solutions for care management identification, stratification and triaging could be a good next step in the predictive modeling journey (the 'Walk' state). Developing custom predictive models to address specific needs (e.g. predicting hospital-acquired conditions) could represent the 'Run' state. Leveraging advanced predictive modeling techniques such as artificial intelligence, machine learning, deep learning, etc., to solve complex business problems (e.g. emergency room department demand and flow) could qualify as the 'Fly' state."

Soyal Momin MS MBA
Vice President, Center of Excellence for Data and Analytics
Presbyterian Health Services
Albuquerque

Industry News

KAISER PERMANENTE.
Kaiser Permanente Washington
Health Research Institute

Kaiser Permanente Researchers Develop New Models for Predicting Suicide Risk

Combining data from electronic health records with results from standardized depression questionnaires "better predicts suicide risk in the 90 days following either mental health specialty or primary care outpatient visits," according to a statement from Kaiser Permanente; the plan's research scientists led a team from the Mental Health Research Network. The study, *Predicting Suicide Attempts and Suicide Death Following Outpatient Visits Using Electronic Health Records*, was conducted in five Kaiser regions, Colorado, Hawaii, Oregon, Southern California and Washington; at the Henry Ford Health System in Detroit; and the HealthPartners Institute in Minneapolis; it was published in the *American Journal of Psychiatry*.

The new models the researchers developed "combine a variety of information from the past five years of people's electronic health records and answers to questionnaires; they "predicted suicide risk more accurately than before," the paper says, adding that "the strongest predictors include prior suicide attempts, mental health and substance use diagnoses, medical diagnoses, psychiatric medications dispensed, inpatient or emergency room care and scores on a standardized depression questionnaire." In the 90 days following an office visit, the statement adds:

- Suicide attempts and deaths among patients whose visits were in the highest 1% of predicted risk were 200 times more common than among those in the bottom half of predicted risk.
- Patients with mental health specialty visits who had risk scores in the top 5% accounted for 43% of suicide attempts and 48% of suicide deaths.
- Patients with primary care visits who had scores in the top 5% accounted for 48% of suicide attempts and 43% of suicide deaths.

Kaiser Permanente Researchers *…continued*

The study "builds on previous models in other health systems that used fewer potential predictors from patients' records," the statement adds. "Using those models, people in the top 5% of risk accounted for only a quarter to a third of subsequent suicide attempts and deaths. More traditional suicide risk assessment, which relies on questionnaires or clinical interviews only, is even less accurate." The new study involved seven large health systems serving a combined population of 8 million people in nine states; the researchers examined 20 million visits by 3 million people, including 10.3 million mental health specialty visits and 9.7 million primary care visits with mental health diagnoses.

"Other health systems can replicate the approach to risk stratification," the statement adds. "Better prediction of suicide risk can inform decisions by healthcare providers and health systems, including how often to follow up with patients, refer them for intensive treatment and reach out to them after missed or canceled appointments, and whether to help them create a personal safety plan and counsel them about reducing access to means of self-harm." Visit kpwashingtonresearch.org and kp.org.

/ZILLION®
Behavior. Architected.

Zillion Launches Precision Health Tool for Metabolic Syndrome

Zillion, a behavior architecture company, reports launching "enhanced tools that apply analytics and behavioral science to bring a new level of precision health intervention focus for coaches." The tools "foster the highest likelihood of success for participants in the Restore Metabolic Syndrome program," a statement explains, "by identifying the outcomes and expected return on investment for each intervention before ongoing financial or time investments are made."

Industry News

Zillion Launches Precision Health Tool *...continued*

Using streaming and predictive analytics, it adds, Zillion's technology "analyzes multiple data points for each individual member, including sleep patterns, stress responses, biometric interactions, nutrition and activity," then translates the data into "meaningful and actionable steps that can project the likelihood of success and the most impactful areas of focus to achieve optimal risk migration."

The latest release supplements existing Zillion features that include Zillion TV and the Zillion Cube, "allowing true engagement with members in meaningful ways," the statement notes, and represents "Zillion's ongoing commitment to utilizing data insights to arm clinical care teams with the information they need to personalize individual member experiences." As employers "continue to support total well-being," the company adds, "it's important for programs to leverage analytical tools to provide nudges that support small, sustainable changes in order to promote individual risk migration and overall population health improvements." Visit www.restorehealth.com.

Restore Health Reports Risk Factor Reduction Program Results

Restore Health, a personalized digital coaching program, reports the results of "a successful one-year case study designed to reverse risk factors -- increased blood pressure, high glucose or hbA1c levels, high BMI, high triglyceride levels and low levels of HDL cholesterol -- that can lead to diabetes, heart disease and other chronic conditions."

One in three people live with metabolic syndrome, the precursor to heart disease and type 2 diabetes; more than 1,300 participants were enrolled in the program in 2017.

Designed to identify and support people living with metabolic syndrome, Restore Health "focuses on promoting insulin sensitivity and helping people make small, achievable lifestyle adjustments through choice architecture that leads to long-term behavior modification and better outcomes," a statement says. "With a smart technology infrastructure and a scientific approach, it customizes the program for each member, making it easy to positively impact the four major contributing factors to reversing metabolic syndrome: diet, activity, stress and sleep."

Here are results from the case study:

- Participants completing a high-intensity intervention period completed a second biometric screening to determine the impact of the program on clinical outcomes.

Restore Health Reports *...continued*

- The program saw 95% completion, an average of 3.8 "meaningful participant interactions" per day during the high-intensity intervention and an 80% monthly active user base through 12 months.

- One clinically significant outcome was this: 73% of participants with metabolic syndrome risk factors reversed at least one.

- At-risk participants saw a 9.7% decrease in systolic blood pressure, a 9.2% decrease in diastolic blood pressure, a 17.3% decrease in A1C, a 29% decrease in triglycerides and 6.2% average weight loss – plus a 12% increase in HDL.

The financial results were significant, too. "Assessment from the pilot period suggests a $1,466 per-member-per-year savings driven by a decline in medical visit claims and scripts," the statement adds. Visit www.restorehealth.com.

Anthem to Acquire Aspire Health

Anthem Inc. (NYSE:ANTM) reports it will acquire Aspire Health, one of the nation's largest non-hospice community-based palliative care providers. "Anthem is focused on enhancing our ability to offer innovative, integrated clinical care models," comments Gail K. Boudreaux, CEO and President. "Aspire shares our perspective on the increasingly important role of integrated care and has built a unique model that provides palliative care and support services for patients and their families."

With the addition of Aspire to CareMore Health and AIM, Anthem says, it can offer "a broader array of programs and services that drive future growth opportunities for our company."

Aspire provides services under contract to more than 20 health plans in 25 states; it uses "proprietary predictive clinical and claims-based patient algorithms" to identify patients who could benefit from "an extra layer of support," a statement explains.

Once patients are identified, Aspire "assigns a comprehensive care team that includes physicians, nurse practitioners, nurses, social workers and chaplains," it adds. "The team works in an integrated approach to address symptom management, patient-family communication and advance care planning and to coordinate care with primary care, specialty care and in-home care providers."

Financial terms have not been disclosed; the acquisition should close in the third quarter. The transaction is expected to be neutral to earnings in 2018 and accretive to earnings in 2019. Visit antheminc.com.

Industry News

TripleTree Advises SCIO Health Analytics on Acquisition by EXL

Health TripleTree LLC, a strategic advisor and merchant bank "serving innovative companies in healthcare," reports that client SCIO Health Analytics, a leading provider of advanced healthcare analytics and performance optimization solutions, has agreed to be acquired by EXL, an operations management and analytics company.

The purchase consideration: $240 million, excluding adjustments for cash, debt and working capital. SCIO "is dedicated to helping its clients identify and resolve underlying issues that lead to excessive spending and suboptimal health outcomes," a statement says. "Together, SCIO and EXL provide a broader range of solutions in payment integrity, care management and customer engagement."

SCIO's ability to "identify and analyze high-value data across disparate parts of the healthcare system creates tremendous value to a broad range of industry constituents," the pair add; their combined capabilities "will deliver value to clients and provide end-to-end cost recovery and care management services."

SCIO "delivers more than $540 million in client value annually through the elimination of healthcare waste and improved performance associated with its reimbursement and care optimization solutions," the statement says. Visit triple-tree.com and www.sciohealthanalytics.com.

EarlySense Attains Global Rights to New Version of eCART Tool

EarlySense, a market leader in contact-free continuous monitoring solutions across the healthcare continuum, reports securing "exclusive global rights to a new version of the eCART predictive analytics score tool developed by Dana Edelson MD, Executive Medical Director of Rescue Care at the University of Chicago."

The new Lite tool will be integrated into EarlySense's products, according to a statement, "and is the first-ever scientifically validated early warning score to use only heart rate, respiratory rate and patient age, making it ideal for use in conjunction with continuous monitoring sensors."

Adds Avner Halperin, cofounder of and CEO at EarlySense: "Risk scoring is a critically important tool, but is limited to complex multi-parameter tests and lab systems found in EMR systems. Combining Edelson's approach with real-time data enhances true deterioration detection."

eCART was designed to "identify risk of health deteriorations and cardiac arrests based on over 30 clinical data points per patient," the statement explains; it was developed using a data set of nearly 300,000 cases and "assists clinicians in early detection through the real-time collection of vital signs while patients lie or sit," leveraging artificial intelligence and Big Data analytics "to provide actionable health insights and improve clinical outcomes -- while enhancing the patient experience through its passive collection approach." Visit www.earlysense.com.

Journal Scan…*continued*

Their findings? "Patients in the intervention group had significantly higher rates of therapeutic goal attainment for the three endpoints, 40% v 12%," the paper reports; noting as well that group also had "statistically significantly higher improvements in the individual areas of hA1c, blood pressure and statin goal attainment." As well, the researchers say, "there were no significant differences in the number of medications for diabetes or anti-hypertensive medications used between the groups." That, they add, "suggests that the integration of clinical pharmacists into primary care clinics could have positive effects on the clinical outcomes of diabetic patients."

         == *J Manag Care Spec Pharm*. 2018;24(5):423-29

'Development of a Pharmacoeconomic Model to Demonstrate the Effect of Clinical Pharmacist Involvement in Diabetes Management'

Separately, "a data collection tool was deployed to clinical pharmacists at Department of Veterans Affairs facilities to document interventions and associated clinical outcomes," the paper points out. Intervention and outcome data were then used to "populate a validated clinical outcomes modeling program to predict long-term clinical and economic effects" in patients with type 2 diabetes; researchers looked specifically at baseline patient demographics and biomarkers, as well as number and duration of visits with the clinical pharmacist, for three groups of patients, based on their hA1c levels.

They found that "analysis of costs and events on two-, three-, five- and 10-year time horizons demonstrated significant reductions in major adverse cardiovascular events, myocardial infarctions, episodes of acute heart failure, foot ulcers and foot amputations" compared to the group that received "usual guideline-directed medical care." In the group with the highest hA1c, absolute risk reduction was 1.82%, 1.73%, 2.43%, 5.38% and 2.03%, respectively, for the five markers. And, they report, "the incremental cost-effectiveness ratios for cost per quality-adjusted life-year during the two-, three-, five- and 10-year time horizons were cost-effective" for patients in the two highest hA1c level categories.

         == *J Manag Care Spec Pharm*. 2018;(5):449-57

PredictablyQuotable

Recent interesting and provocative quotes regarding predictive modeling and analytics

"The need for population health services that combine multiple functionalities is increasing, due to the complex nature of care delivery and of payment models. PHM solutions can process clinical, financial and operational data for the improvement of efficiency and patient care. The convenience offered by value-based payment models is responsible for the increased adoption of population health solutions by Accountable Care Organizations."

Reportbuyer.com, in a statement announcing the availability of a new report from Grand View Research Inc. called *Population Health Management (PHM) Market Size, Share & Trends Analysis Report by Application (Software, Services), by End-Use (Payers, Providers, Employer Groups) and Segment Forecasts, 2018 – 2025*.

"Several studies have repeatedly demonstrated how advanced illness programs can provide high patient and family satisfaction, reduce hospitalization and decrease costs. As part of Anthem, we believe we will be able to further scale our model and positively impact the lives of even more consumers and families, making home-based advanced illness care available to patients who need it."

Brad Smith, Chief Executive Officer at Aspire Health, in a statement about the company's acquisition by Anthem Inc.; visit antheminc.com.

"We demonstrated that we can use electronic health record data in combination with other tools to accurately identify people at high risk for suicide attempt or suicide death."

Gregory E. Simon MD MPH, a Kaiser Permanente psychiatrist in Washington and a senior investigator, in a statement about new research -- *Predicting Suicide Attempts and Suicide Death Following Outpatient Visits Using Electronic Health Records --* showing that combining data from EHRs with results from depression questionnaires better predicts suicide risk; visit kpwashingtonresearch.org and kp.org.

"It would be fair to say that the health systems in the Mental Health Research Network, which integrate care and coverage, are the best in the country for implementing suicide prevention programs. But we know we could do better. So several of our health systems, including Kaiser Permanente, are working to integrate prediction models into our existing processes for identifying and addressing suicide risk."

Simon, in the same comments

"The increasing demand for consumer goods creates a need for major vendors in the retail space to focus on customer retention and attracting new customers with effective and substantiated marketing techniques, backed by relevant data. Prescriptive and predictive analytics provide the ultimate platform to understand consumer behavior and sentiments, capable of influencing their purchasing patterns, which plays a critical role in redefining consumer preferences and marketing techniques of leading international conglomerates."

Researchandmarkets.com, in a statement announcing the availability of a new report called *Global Predictive and Prescriptive Analytics Market – Segmented by End-User (BFSI, Healthcare, Retail) and Geography – Growth, Trends and Forecasts (2018 – 2023*.

"By working with EarlySense to adapt this hospital-proven predictive clinical score to be used with a streamlined set of data points, including continuously collected heart and respiratory parameters collected from the EarlySense bed sensors, we maybe able to extend the predictive clinical score beyond the confines of the hospital and into post-acute and home environments. This in turn enables earlier intervention and prevention of patient deterioration and adverse events."

Dana Edelson MD, Executive Medical Director of Rescue Care at the University of Chicago, in a statement announcing the exclusive licensing of the new version of her eCART predictive analytics score tool; visit www.earlysense.com.

"Our expertise in behavior architecture supports long-term behavior change through a series of choice decision prompting. Using the most advanced analytics, informatics and predictive models provides us the opportunity to prioritize behavior focus for clinical teams, empowering them to get the best results with the most precise interactions in secure environments."

Cheryl Morrison-Deutsch, Chief Experience Officer at Zillion, in the same statement; visit www.restorehealth.com