

2019 Scientific Year in Review





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First Quarter 2019

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Leadership Spotlight

Introducing Dr. Gretchen Purcell Jackson: Vice President, Chief Science Officer, and Director of the Watson Health Center for AI, Research, and Evaluation (CARE)



IBM has a long legacy of employing scientific methodologies to the understanding of major health and societal challenges. At IBM Watson Health, we continue this legacy, by focusing on applying services and next-generation data, analytics, and artificial intelligence (AI) technologies, so that people around the world can live better, healthier, and longer lives. As part of this mission, Dr. Gretchen Purcell Jackson, MD, PhD has joined our IBM Watson Health team, as Vice President and Chief Science Officer, to direct the Watson Health Center for AI, Research, and Evaluation (CARE). Dr. Jackson is an internationally recognized informatician and accomplished clinical surgeon with over 25 years of contributions to informatics research, innovations in health information technologies, and surgical science. She earned her Ph.D. in Medical Informatics at Stanford University in 1997 and held informatics faculty and leadership positions at three universities during her surgical residency and fellowship. She is board certified in general surgery, pediatric surgery, and clinical informatics, and has held numerous prestigious positions focused on the field of



clinical informatics and its impact on the care of patients. Prior to joining IBM Watson Health, Dr. Jackson was an Associate Professor of Surgery, Pediatrics, and Biomedical Informatics at the Vanderbilt University Medical Center and Director of Graduate Studies for the Biomedical Informatics Training Program at Vanderbilt University.

A Message from IBM Watson Health's New Chief Science Officer

Within IBM Watson Health we strive to lead with science, and we are proud to report several significant accomplishments in the first quarter of 2019. The business continues its long investment in scientific excellence and has recruited a talented group of biomedical informaticians, clinicians, program managers, research coordinators, data scientists, and writers to expand our Center for AI, Research, and Evaluation (CARE). Our center seeks to integrate research activities and generate high quality scientific evidence to support the performance and impact of Watson Health solutions.

Specifically, the goals of the center are:

- To design, conduct, and disseminate results of rigorous scientific research related to Watson Health offerings
- To support collaboration among design / development teams, IBM Research scientists, academic institutions, and client partners
- To lead in the science of health informatics, especially artificial intelligence and implementation science

At HIMSS 2019 we announced two long-term academic research collaborations with Vanderbilt University Medical Center and the Brigham and Women's Hospital, demonstrating IBM Watson Health's investment in the advancement of AI in health and healthcare. By partnering with these renowned academic institutions we will build a long-term relationship with leading biomedical informaticians and collaborate on studies about our products and thought leadership efforts in the fields of AI, health informatics, patient

safety, precision medicine, and health equity. Our center looks forward to supporting collaborations internally within IBM and externally with our academic and client partners to yield the highest quality science.

This work builds on IBM's longstanding commitment to leading with science and research. In 1945 IBM formally established IBM Research, which has enabled scientists to transform industries and society for the past seven decades. IBM employs over 3,000 scientists across 6 continents. Additionally, IBM has led the industry for 26 consecutive years in US patents, with over 9,100 accepted in 2018. We are proud of the people who continue to progress science across industries, including the six IBM associated employees who have received Nobel laureates over the years, the most recent, former IBM Research scientist and 2014 Nobel Prize winner Dr. W.E. Moerner who received his award commemorating his pioneering achievements in chemistry. Most recently, IBM has invested \$240M to advance artificial intelligence, software and algorithms in our partnership with MIT at the MIT-IBM Watson AI Lab.

In this first quarter of 2019 IBM scientists have produced over 85 contributions to the scientific literature in a wide variety of health and healthcare domains, as summarized below. We look forward to keeping you updated on our scientific journey!

Scientific Spotlight

Predicting the Early Risk of Chronic Kidney Disease in Patients With Diabetes Using Real-World Data

Citation: Ravizza S, Huschto T, Adamov A, Böhm L, Büsser A, Flöther F, Hinzmann R, König H, McAheren SM, Robertson DH, Schleyer T, Schneidinger B, Petrich W. 2019. Nature Medicine. 25:57-59. DOI: 10.1038/s41591-018-0239-8.

Read more
<https://go.nature.com/2VSmh5r>



Diabetes is the leading cause of chronic kidney disease (CKD). Early detection of risk may enable early intervention to slow progression or prevent onset of this severe complication. Use of real-world data (RWD) may offer advantages over clinical trial data to predict risk.

Authors carried out a direct comparison of algorithms derived from clinical trial data and RWD to focus on quantifying the risk of developing CKD as a long-term microvascular complication of diabetes.

Training

7 features from 417,912 records from IBM Explorys



Validation

Explorys validation set & Indiana Network for Patient Care Database

Roche/IBM algorithm

AUC = 0.7937

(95% CI, 0.790, 0.797)

The area under the receiver operating characteristic curve (AUC) measures the quality of the learning algorithm.

“

Here, a case-by-case comparison shows the predictive power of our real world data-based model for diabetes-related chronic kidney disease outperforms published algorithms, which were derived from clinical study data”
– Excerpt from manuscript



Publication Highlights

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To read the referenced content, scan the QR codes with your smartphone camera or type the URL

Research

Publications highlighting emerging technologies, pre-commercial research, and investments for the innovations of tomorrow

Cardiology

Machine learning derived segmentation of phase velocity encoded cardiovascular magnetic resonance for fully automated aortic flow quantification

—
Journal of Cardiovascular Magnetic Resonance

This novel machine learning methodology to automate analysis of phase contrast cardiovascular magnetic resonance to quantify automatic flow showed promise, with high correlation ($r=0.99$, $p<0.001$) and significant time savings (less than 0.01 min/case) compared to manual segmentation (3.96 + 0.36 min/case).delivery.



Read more
bit.ly/35OI2I6

Electronic Medical Records (EMR) Utility

Adverse drug events detection in clinical notes by jointly modeling entities and relations using neural networks

—
Drug Safety

Researchers combined joint modeling with the external resources method and achieved an F measure of 0.83 for relevant medical entity detection in extracting adverse drug events from clinical narratives.



Read more
bit.ly/2MrMKnb

Imaging

Predicting breast tumor proliferation from whole-slide images: the TUPAC16 challenge

—
Medical Image Analysis

Results from The Tumor Proliferation Assessment Challenge 2016 (TUPAC16) are reported. This is a comparison investigating tumor proliferation assessment from whole-slide images, which shows promise for automating and improving the efficiency of assessing tumor proliferation and prognosis in breast cancer patients.



Read more
bit.ly/2MR9ufl

Mobile Health

Just-in-time but not too much: determining treatment timing in mobile health

—
Proceedings of the ACM on Interactive, Mobile, Wearable and Ubiquitous Technologies

This paper discusses a method for spreading treatment uniformly across delivery times via mobile technologies.



Read more
bit.ly/2MT0tCt

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Neurology

A blood-based signature of cerebrospinal fluid A β 1–42 status

Nature Scientific Reports

A machine learning methodology for analyzing plasma protein levels, age and APOE ϵ 4 carrier status was developed to predict Alzheimer's disease (AD) risk indicator CSF A β 1–42 status. The model was tested on an independent validation cohort that predicted individuals with abnormal CSF A β 1–42 levels transitioned to an AD diagnoses over 10 years significantly faster than those predicted to have normal levels.



Read more
go.nature.com/33E5lSX

Neurology

Stratification of amyotrophic lateral sclerosis patients: a crowdsourcing approach

Nature Scientific Reports

This paper covers a novel crowd funding approach that challenged 30+ teams to develop new approaches for the machine learning analysis of diverse amyotrophic lateral sclerosis clinical trial data for the purpose of stratifying and predicting risk for subpopulations of amyotrophic lateral sclerosis patients.



Read more
bit.ly/2VUOnNf

Neurology

Data-driven subtyping of Parkinson's disease using longitudinal clinical records: a cohort study

Nature Scientific Reports

Using data from a longitudinal cohort study of patients with Parkinson's disease, a deep learning algorithm was used to identify and characterize three subtypes of disease progression.



Read more
bit.ly/33HXgwm

Oncology

Hydrogels with prolonged release of therapeutic antibody: Block junction chemistry modification of 'ABA' copolymers provides superior anticancer efficacy

Journal of Controlled Release

A new series of vitamin E-functionalized 'ABA' triblock copolymers with carbamate block junction, when loaded with Herceptin, suppressed tumor growth over a significantly longer period of time (90 days) as compared to Herceptin-loaded hydrogel with carbonate block junction (40 days).



Read more
bit.ly/35DOUrs

Publications featuring our unique data assets
and industry-leading scientists

Oncology

Innovations in large scale liquid biopsy analysis and the Broad/IBM cancer resistance project

Poster presented at the 2019 American Association for Cancer Research Meeting on 3/31/19.

In a collaboration between the Broad Institute and IBM, researchers report early experience in applying Broad's liquid biopsy sequencing platform to develop an improved assay workflow that may enable expanded cfDNA sequencing with lower tumor content for clinical and research applications.



Read more
bit.ly/2Ms39Iw

Behavioral Health

Best practices and barriers to engaging people with substance use disorders in treatment

U.S. Department of Health and Human Services Assistant Secretary for Planning and Evaluation

This study examines how factors such as the individual, provider, health plan, market and environment affect commercial and Medicaid health plan performance on Initiation and Engagement of Alcohol and Other Drug Dependence Treatment performance measures.



Read more
bit.ly/33IvfoI

Behavioral Health

Readmissions following inpatient treatment for opioid-related conditions

Substance Use & Misuse

A study of opioid related hospitalizations using Agency for Healthcare Research and Quality's Healthcare Cost and Utilization Project found that only 19.4% of patients with opioid-related conditions received treatment for drug use during the inpatient stay. Patients who received drug rehabilitation, had lower odds of an opioid-related readmission within 90 days of discharge.



Read more
bit.ly/31pV4Ix

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Behavioral Health

Barriers faced by physicians in screening for substance use disorders among adolescents

—
Psychiatric Services

Primary care physicians were found to face many challenges in the screening, brief intervention and referral to treatment for substance use disorders. Challenges noted included parental involvement, a perceived lack of effectiveness of brief intervention services and lack of training.



Read more
bit.ly/2J1pMB8

Behavioral Health

Insurance-reimbursable mindfulness for safety-net primary care patients: A pilot randomized controlled trial.

—
Mindfulness

Mindfulness Training for Primary Care (MTPC) was successfully integrated into the workflow of a health system in a randomized, controlled, comparative effectiveness, pilot study and showed indications that it was more effective than the low-dose comparator for reducing anxiety and enhancing mindfulness and self-compassion.



Read more
bit.ly/2P8VOPV

Behavioral Health

Neighbors as distal support for individuals with serious mental illnesses***

—
American Journal of Orthopsychiatry

IBM Watson Health PULSE® Healthcare Survey data were used to study the impact of neighbor relationships on individuals with serious mental illness (SMI). The analysis found that individuals with SMI reported weaker relationships, higher levels of loneliness and lower levels of community connectedness than those without SMI.



Read more
bit.ly/32C5OfF

Cardiology

Healthcare utilization (HCRU) among non-valvular atrial fibrillation (NVAf) patients who switched from warfarin to a novel oral anti-coagulant (NOAC)

—
Stroke

An analysis of IBM® MarketScan data comparing non-valvular atrial fibrillation patients who switched from warfarin to dabigatran, rivaroxaban or apixaban found that healthcare utilization was similar between the dabigatran and apixaban patients. However, dabigatran patients had significantly lower inpatient visits and longer time to readmission than rivaroxaban patients.



Read more
bit.ly/2VYwcGD

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Culture of Health

The stock performance of American companies investing in a culture of health

—
American Journal
of Health Promotion

This study examined 17 publicly traded companies and the relationship between their Standard and Poor's 500 index performance and investment in internal and external cultures of health. Companies with a high investment in an internal culture of health had a stock price that appreciated by 115% compared to the S&P benchmark +69%) compared to the low culture of health which appreciated by 43%.



Read more
bit.ly/2BjG2JN

Electronic Medical Records (EMR) Utility

Predicting the early risk of chronic kidney disease in patients with diabetes using real-world data

—
Nature Medicine

A methodology for predicting the risk of patients with diabetes for developing chronic kidney disease was developed using real world IBM® Explorys data. Algorithms applied to real world data outperformed those applied to clinical study data, highlighting the value of real world data in risk prediction.



Read more
go.nature.com/2VSmh5r

Infectious Diseases

Early infectious diseases specialty intervention is associated with shorter hospital stays and lower readmission rates: a retrospective cohort study

—
Clinical Infectious Diseases

In an analysis of claims data, privately insured individuals with an infectious disease related acute-care stay were found to have a shorter length of stay, spending and mortality when managed by an infectious disease physician early in their stay as compared to those patients with late intervention.



Read more
bit.ly/2OY4sR5

Neurology

Relationship between treatment initiation and healthcare costs in Alzheimer's disease

—
Journal of Alzheimer's Disease

An analysis of IBM® MarketScan data found that early or concurrent treatment of Alzheimer's disease was associated with overall 9-19% lower healthcare costs in the year following diagnosis.



Read more
bit.ly/2J1zMKS

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Pulmonology

Differences in health care outcomes between post discharge COPD patients treated with inhaled corticosteroid/long-acting β_2 -agonist via dry-powder inhalers and pressurized metered-dose inhalers

—
International Journal of Chronic Obstructive Pulmonary Disease

An analysis of IBM MarketScan data found that patients using a pressurized metered-dose inhaler after a COPD-related hospitalization had significantly lower all-cause (10%) and COPD-related (19%) healthcare costs than those using a dry powder inhaler.



Read more
bit.ly/2Msp1U7

Oncology and Genomics

Translating cancer genomics into precision medicine with artificial intelligence: applications, challenges and future perspectives

—
Human Genetics

This paper explores “the current status and future directions of AI in its application to cancer genomics within the context of workflows to integrate genomic analysis for precision cancer care.”



Read more
bit.ly/2MPFeI6

Oncology and Genomics

“A tool, not a crutch”: patient perspectives about IBM Watson for Oncology trained by Memorial Sloan Kettering***

—
Journal of Oncology Practice

In a study of patient preferences and perceptions about Watson for Oncology, 46 patients in nine focus groups were generally found to have high levels of interest, perceived value, and acceptance of Watson for Oncology as a supplementary tool for their physicians’ decision making.



Read more
bit.ly/2MVjuV5

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Oncology and Genomics

Early experience with Watson for Oncology in Korean patients with colorectal cancer***

—
PLOS One

When the decisions of a multidisciplinary team that met with 51 colorectal cancer patients was compared with Watson for Oncology treatment options, concordance was 46.4% for “recommended” options and 88.4% when “for consideration” options were included. Stage of cancer was significantly associated with concordance.



Read more
bit.ly/2MSTERC

Oncology and Genomics

Concordance rate between clinicians and Watson for Oncology among patients with advanced gastric cancer: early, real-world experience in Korea***

—
Canadian Journal of
Gastroenterology & Hepatology

In a retrospective review of cases the of 65 patients with advanced gastric cancer who consulted Watson for Oncology and the Gachon Gil Medical Center multidisciplinary team, 41.5% were concordant at the “recommended” level and 87.7% were concordant when “for consideration” was included. The main reasons for discordance were lack of consideration of medical history, treatments that are considered outdated in Korea, patient preference for clinical trial participation and the impact of patient financial decisions.



Read more
bit.ly/2OWUIqc

Oncology and Genomics

Concordance assessment of Watson for Oncology in breast cancer chemotherapy: first China experience**

—
Translational Cancer Research

Concordance between Watson for Oncology and clinical practice was evaluated in 1301 breast cancer cases at the First Affiliated Hospital China. Concordance for chemotherapy regimen as defined by “recommended” or “for consideration” was 69.4% overall and 96.7% among cases for neoadjuvant chemotherapy.



Read more
bit.ly/31pSUIM

Oncology and Genomics

Concordance assessment of IBM Watson for Oncology with MDT in patients with breast cancer***

—
Cancer Research

This study found that overall concordance between Watson for Oncology and a multidisciplinary tumor board for adjuvant therapy for early stage breast cancer (n=73) and first-line therapy in metastatic breast cancer (n=28) was 76.51%. “Stage III disease or triple-negative breast cancer were most likely to be concordant.”



Read more
bit.ly/2pyplaC



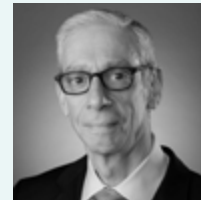
Second Quarter 2019

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Leadership Spotlight



Nathan Levitan, MD, MBA,
Chief Medical Officer for
Oncology and Genomics
at IBM Watson Health



Dr. Levitan is part of the leadership team at IBM Watson Health, overseeing the ongoing development and strategic direction of the Watson Oncology Suite, by imparting his real-world experience as a clinical oncologist practicing for over 30 years in the fields of oncology and hematology. Throughout his career, he has served in a series of progressively advancing roles at the University Hospitals Health System in Cleveland, ending his tenure there after a decade-long position as President of the Seidman Cancer Center, before joining IBM. He earned his Bachelor of Arts from Brandeis University, his Doctor of Medicine from Tufts University, and his Master of Business Administration from Case Western University.

Continues →

Unlocking the Power of AI in Health with Real-World Data

Data are the unsung heroes of the AI revolution. At IBM Watson Health, we recognize the critical role that data play as the central building blocks of health information technologies and have invested heavily in not only the databases, tools and analytics for sourcing data, but also the scientific research needed to apply it to some of the biggest challenges in population health and healthcare today.

We’re only half way through the year and have already seen exciting scientific advancements throughout the medical community using real-world data – such as new studies presented at the American Society of Clinical Oncology (ASCO) Annual Meeting that reveal unprecedented improvement in 5-year overall survival in certain types of advanced non-small-cell lung cancer (Garon EB¹ et al. ASCO 2019), novel targeted therapy options for rare cancer types (ASCO Press Release² 1/31/19), and “big data” analytics studies to derive insights into cancer care disparities in the United States (Adamson BJS³ et al. ASCO 2019).

These results generate tremendous excitement and seemingly change the oncology conversation overnight. As a scientist and clinician, the most gratifying aspect of these breakthroughs is the knowledge that they are based on rigorous scientific methods, helping ensure these advancements provide reliable insights for researchers, oncologists and their cancer patients.

These are foundational observations that are only possible with real-world data, powerful analytics, and rigorous scientific research – all of which are areas that IBM has pioneered for the last 110 years and continues to drive as we head into the AI-enabled future.

Individually, many of these studies may look like incremental steps forward in the continued march of science. Taken together, within the larger context of IBM’s ambitious mission in healthcare, they become critical building blocks to our better understanding the full spectrum of healthcare and offer a starting point for how to improve it. Our clinical leadership team is excited to share more updates next quarter about this important, growing body of science.

Footnote links

Scan the QR code with your smartphone camera or type the URL to get access to the referenced content

- 1 Garon EB
bit.ly/2MRZum9



- 2 ASCO Press Release
bit.ly/2HGDiv3



- 3 Adamson BJS
bit.ly/31td7xg



Scientific Spotlight #1

A Prospective Blinded Study of 1000 Cases Analyzing Role of Artificial Intelligence. Watson for Oncology in Change of Decision Making of a Multidisciplinary Tumor Board (MDT) From a Tertiary Care Cancer Centre

Somashekhar SP, Sepulveda MJ, Shortliffe
EH, C RH, Rauthan A, Patil P, Yethadka R. J
Clin Oncol. 2019; 37(suppl): abstract 6533.

Read more
bit.ly/2IYBmx2



MDT evaluated 1,000 breast,
lung, and colorectal cancer cases



MDT was presented with Watson for
Oncology's information on options

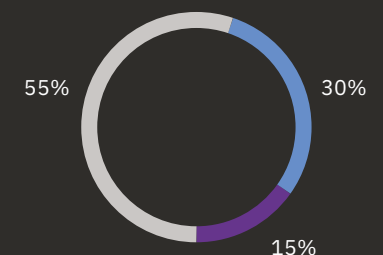


MDT reviewed and finalized
their decision

The MDT reviewed and
ultimately chose treatments
not previously considered
based on information from
WFO in 13.6% of cases.

Reason for Decision Change:

- Evidence for newer
treatment(s)
- More personalized treatment
alternatives
- New genotypic, phenotypic
and clinical insights



“

The study suggest[s] that cognitive computing decision support system[s] holds substantial promise to reduce cognitive burden on oncologist[s] by providing expert, updated, recent evidence-based [evidence-informed] insights for treatment-related decisions making.”

– Excerpt from abstract

Scientific Spotlight #2

What is the Business Case
for Employers' Investment
in Health Communities:
Improved Employee Health,
Lower Health Care Costs,
and Higher Stock
Performance?

Henke RM, Goetzel RZ, Kent KM, Head MA,
Roemer EC, Fabius R, McCleary K, Berko J.
Academy Health Conference, 2019.

Read more
bit.ly/31kNE9q



“

Investments in internally focused COH programs and practices
generally reduced employees' health risks and health care utilization.”
– Henke RM, et al.

Authors developed a survey to quantify
employers' investments in building a
culture of health (COH) internally (INT)
and externally (EXT) and measured
associated changes in employees'
health risks, healthcare costs and
utilization analyzing claims and health
risk assessment (HRA) data.

21 organizations, with IBM
MarketScan® claims and HRA
data representing 641,901
employees and COH surveys
were studied

Study Results

(2013-2015)

Utilization [per employee]

**5 point increase in COH-INT
associated with:**

\$33
reduction in
healthcare
expenditures

0.37
fewer prescription
drug refills

**5 point increase in COH-EXT
associated with:**

\$10
reduction in
healthcare
expenditures

0.02
fewer inpatient
admissions

Risk

Increases in COH-INT score were
associated with significant decreased
probability of employee being at risk
($p < 0.05$) for:

- BMI
- Blood pressure
- Poor nutrition
- Tobacco use



Publication Highlights

- 40 Research
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- 48 Real World Evidence and Artificial Intelligence Combined
- 49 Artificial Intelligence

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Research

Publications highlighting emerging technologies, pre-commercial research, and investments for the innovations of tomorrow

Behavioral Health

Natural language processing: Opportunities and challenges for patients, providers, and hospital systems

—
Psychiatric Annals

In this article, authors review the history of natural language processing, provide examples of its application in psychiatry, and address future direction and potential applications in health and healthcare delivery.



Read more
bit.ly/2VBzGx1

Oncology

A single-cell atlas of the tumor and immune ecosystem of human breast cancer

—
Cell

Tumor ecosystems are comprised of cancer cells plus other cells and structural components the cancer interacts with such as immune cells. The authors used single-cell mass cytometry of 144 human breast cancer samples compared to 50 non-tumor tissue samples to study the cellular make up and physical expression of the genetic makeup of these tumor ecosystems. Tumors displayed individuality in ecosystem cell composition. Relationship analyses between tumor and immune cells revealed characteristics of ecosystems related to immunosuppression and poor prognosis



Read more
bit.ly/2VSPA7N

Real World Evidence

Publications featuring our unique data assets and industry-leading scientists

Behavioral Health

County-level characteristics and opioid-related hospitalization rates

—
Academy Health Annual Research Meeting

As we continue to seek solutions to the opioid crisis domestically and abroad, a new study was able to identify characteristics associated with counties with high vs. low rates of opioid-related hospitalization rates (classified as hot spots). This study measures shared several characteristics in the evaluation of hospital discharge data for 45 states and the District of Columbia, indicating the potential need to target opioid-related interventions to local community characteristics.



Read more
bit.ly/2MrdBjr

Behavioral Health

Economic impact of adherence to pain treatment guidelines in chronic pain patients

—
Pain Medicine

Patients who were adherent to pain management guidelines experienced significantly lower health care resource use and costs, such as fewer emergency department visits, compared to nonadherent patients in a retrospective cohort study of IBM® MarketScan® claims data (n=682,802).



Read more
bit.ly/2qrP9WD

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Behavioral Health

Employees with opioid use disorder, receipt of pharmacotherapy and healthcare costs

Academy Health Annual Research Meeting

Employees with opioid use disorder (OUD) not receiving pharmacotherapy had approximately \$19,182 more healthcare costs than other employees in a study evaluating claims data for a sample of Fortune 500 companies from the IBM® MarketScan® Research Databases. In comparison, employees with OUD that received pharmacotherapy had approximately \$5,460 more in healthcare costs than other employees, supporting a case for expanding access to pharmacotherapy treatment in OUD.



Read more
bit.ly/2MSabVP

Oncology

Mental and substance use disorder treatment spending increased at a greater rate than general health care spending from 2006-2015

Academy Health Annual Research Meeting

Spending for mental and substance use disorder (SUD) treatment rose 62% between 2006 and 2015 (\$131 to \$212 billion) in an analysis of data from the Centers for Medicare & Medicaid Services and IBM® MarketScan® Research Database. This increase outpaced growth in overall healthcare spending. A more pronounced increase seen in SUD spending coincided with the growth in the opioid epidemic and accelerated following passage of federal mental health parity legislation and Medicaid expansion in some states.



Read more
bit.ly/2Bp3Hse

Behavioral Health

Naloxone prescriptions among commercially insured individuals at high risk of opioid overdose***

JAMA Network Open

As opioid-related mortality continues to increase, the opioid overdose reversal drug naloxone remains a critical intervention in preventing overdose death. New data indicate prescribing in emergency, inpatient, and outpatient settings represents an opportunity to improve access to naloxone therapy. Overall, 98.5% (n = 135,973) of high-risk patients did not receive naloxone, despite many interactions with the health care system in an evaluation of claims data from IBM® MarketScan® Research Databases.



Read more
bit.ly/33Eu7Cr

Behavioral Health

The distribution and correlates of neonatal abstinence syndrome across counties in the United States, 2016

Academy Health Annual Research Meeting

More mental health inpatient stays, partial shortages of mental health professionals, higher unemployment and poverty rates, and a higher percentage White population were associated with higher county-level rates of neonatal abstinence syndrome (NAS) in an evaluation of data from 2439 counties in 47 states, representing 96.2% of the US population. Counties with the highest rates of NAS were concentrated throughout Appalachia, Maine, and Vermont, and in areas of the Great Lakes, Colorado, Montana, New Mexico, and Utah.



Read more
bit.ly/32pFXAc

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Healthcare Reform

Changes in hospital service demand, cost, and patient illness severity following health reform

—
Health Services Research

Rates of uninsured inpatient discharges and emergency department visits fell in many demographic groups across Medicaid expansion states, while rates remained stable or increased slightly in nonexpansion states, in an evaluation of data from the Healthcare Cost and Utilization Project.



Read more
bit.ly/2qs2Ogt

Immunologic Diseases

Impact of plan-level access restrictions on effectiveness of biologics among patients with rheumatoid or psoriatic arthritis

—
Pharmacoeconomic Open

Patients with rheumatoid or psoriatic arthritis covered by insurance plans with step therapy requirements had lower odds of treatment effectiveness compared with patients in plans without access restrictions or with prior authorization only in an evaluation of IBM® MarketScan® claims data (n=5706). This difference was primarily due to lower odds of adherence over the 12 months following initiation of subcutaneous biologic disease-modifying antirheumatic drugs.



Read more
bit.ly/2JhgpxJ

Immunologic Diseases

New methods for analyzing clinical and cost outcomes in RA with interactive visual analytics

—
Drug Information Association 2019 Global Annual Meeting

Application of disease-model definitions and a visual analytics engine applied to IBM® MarketScan® Research Databases identified differences in outcomes and cost associated with rheumatoid arthritis patients without the need for data science, clinical or programming knowledge.Databases.



Read more
bit.ly/2oWSIn4

Metabolic Diseases

Trends in total out-of-pocket payment on a yearly insulin supply among private health insured U.S. adults with diabetes from 2003 to 2016***

—
Diabetes

The total annual payment for insulin increased from \$1982 in 2003 to \$6250 in 2016, with a 3-fold annual rate increase seen between 2013 and 2016 in an evaluation of IBM® MarketScan® claims data for adult patients with diabetes (n=1,703,343). While out-of-pocket payments increased as well, analyses indicate that payers bore most of the increase.



Read more
bit.ly/2OYwVWX

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Oncology

Potentially avoidable acute care use among patients receiving oxaliplatin***

Journal of Clinical Oncology

The new CMS oncology outcomes measure (OP-35) defines 30-day post chemotherapy inpatient and emergency room utilization as “potentially avoidable” if the events involved nausea, vomiting, or one of eight other toxicities. Analysis of clinical data from the IBM Watson Explorys database of oxaliplatin treatment for colorectal cancer (n=4,231 courses of oxaliplatin) found that approximately one third were associated with “potentially avoidable” nausea and/or vomiting, indicating a need for more aggressive preventative therapy.



Read more
bit.ly/31npgUt

Oncology

Pharmacy Cost in Cancer***

Journal of Clinical Oncology

Mean total cost of care and total drug cost per patient for cancer patients over a 21-month period were \$141,415 and \$13,579, respectively, in an evaluation of IBM® MarketScan® claims data. Total pharmacy expenditures across all study patients (n=195,290) were approximately \$2.5 billion, with antineoplastic drugs making up the largest portion. The potential for unsustainable growth in the cost of cancer care support the need for investigating drug price regulation.



Read more
bit.ly/2nW00Hi

Renal

Prediction and risk stratification of kidney outcomes in IgA nephropathy

American Journal of Kidney Diseases: the Official Journal of the National Kidney Foundation

A model applying machine learning to real world data accurately classified risk of end-stage kidney disease or 50% reduction in kidney function for patients within 5 years of a diagnosis of immunoglobulin A nephropathy [n=2047; C statistic of 0.84 (95% CI, 0.80-0.88)].



Read more
bit.ly/2VVsn4R

Real World Evidence and Artificial Intelligence Combined

Studies applying artificial intelligence technologies, such as machine learning, to deliver more robust insights from real world data

Oncology

Predicting breast cancer by applying deep learning to linked health records and mammograms

Radiology

A deep learning algorithm was trained on 9611 mammogram images linked to electronic health record data to make breast cancer predictions on biopsy malignancy and differentiation between normal and abnormal screening. For malignancy prediction, the area under the receiver operating characteristic (ROC) curve was 0.91 (95% CI: 0.89, 0.93) with specificity of 77.3% (95% CI: 69.2%, 85.4%) at a sensitivity of 87%. Area under the curve of ROC is a measure of how well a model distinguishes between two groups, indicating potential utility for this model to assist radiologists in breast cancer diagnosis



Read more
bit.ly/31CSbFu

Artificial Intelligence

Publications featuring our AI-enabled solutions

*** publications that are produced solely by non-IBM authors using IBM data or technology

Metabolic Diseases

Machine learning to predict hypoglycemic events from continuous glucose monitoring data

Diabetes

A machine learning model achieved 90% accuracy in predicting hypoglycemic events within a two-hour window and 85% accuracy in predicting hypoglycemic events within a four-hour window, with anonymized data from approximately 10,000 patients using Medtronic Guardian™ Connect CGM and Medtronic MiniMed™ 530G.



Read more
bit.ly/33GgzpT

Oncology

A prospective blinded study of 1000 cases analyzing the role of artificial intelligence: Watson for oncology and change in decision making of a Multidisciplinary Tumor Board (MDT) from a tertiary care cancer center***

Journal of Clinical Oncology

A multidisciplinary tumor board (MDT) reviewed and ultimately chose treatments they had not previously considered, based on information from Watson for Oncology, for 13.6% of cases after reviewing information on options for 1000 cases of breast, lung and colorectal cancer in this blinded study.



Read more
bit.ly/2IYBmx2

*** publications that are produced solely by non-IBM authors using IBM data or technology

Oncology

An evaluation of artificial intelligence-based clinical decision supports use in Brazil

—
Journal of Clinical Oncology

Over 85% of Brazilian oncologists surveyed (n=7; 903 cases) agreed that Watson for Oncology (WFO) provided relevant and actionable information at the right time in their workflow. Additionally, over 50% shared that WFO exceeded their expectations as a clinical decision support tool for managing patients.



Read more
bit.ly/2J2pD0u

Oncology

Artificial intelligence-based clinical decision-support system improves cancer treatment and patient satisfaction***

—
Journal of Clinical Oncology

Patients receiving consultation with a 7-step approach supported by Watson for Oncology indicated higher satisfaction toward treatment options, higher confidence level in their health care workers, and greater willingness to follow the treatment option when compared to patients in a traditional non-CDS system group.



Read more
bit.ly/2qsusd9

Oncology

Clinical insights for hematological malignancies from an artificial intelligence decision-support tool

—
Journal of Clinical Oncology

In interpreting 54 South Korean patients with blood-based cancers, Watson for Genomics' annotations of sequencing results correlated well with manually curated expert opinion (90% in randomized subset) and identified clinically actionable insights missed by manual interpretation (33%).



Read more
bit.ly/2OVdK0d

Oncology

Implementation of artificial intelligence (AI) for lung cancer clinical trial matching in a tertiary cancer center

—
Annals of Oncology

Watson for Clinical Trial Matching enabled high-volume patient screening in less than half the time compared to manual efforts in the Mayo Clinic Lung Oncology practice.



Read more
bit.ly/2BqABZz

*** publications that are produced solely by non-IBM authors using IBM data or technology

Oncology

Shared-decision making in prostate cancer with clinical decision-support

Journal of Clinical Oncology

A study comparing treatment options from Watson for Oncology (WfO) to shared treatment decisions made in 48 Brazilian patients with prostate cancer found complete concordance in 54% of cases and partial concordance in 15% of cases. While great variation exists in the treatment of prostate cancer, WfO was at least partially concordant with shared decision making in the majority of patients.



Read more
bit.ly/2VTQd0Y

Oncology

Use of machine learning to identify relevant research publications in clinical oncology

Journal of Clinical Oncology

A machine learning model was 93% accurate in classifying high-quality, clinically relevant papers from a set of 988 PubMed abstracts related to cancer treatment when applied to evaluate the quality of publications.



Read more
bit.ly/2J23LIX

Oncology

Watson for oncology applied to teaching and remote consulting model***

Journal of Clinical Oncology

More than 80% of primary hospitals surveyed (n=56) were willing to learn about standardized treatments and recent treatment progress of tumors via remote consulting augmented with Watson for Oncology, indicating an interest in applying the technology to better understand standard treatment and progress on the treatment of cancer.



Read more
bit.ly/2nZu3Ov



Third Quarter 2019

To read the referenced content, scan the QR codes with your smartphone camera or type the URL

Leadership Spotlight



Dr. Mark Davies, BSc, FRCP,
FRCGP. Chief Medical Officer
Europe, IBM Corporation and
IBM Watson Health



Dr. Davies has over 20 years' experience as a General Practitioner in West Yorkshire, England. His long-standing interest in health policy and system redesign led him, for the 10 years before coming to IBM, to work in a number of clinical leadership roles at the Department of Health Cabinet Office. Most recently he served as the executive medical director of the Health and Social Care Information Centre in the UK. While at the Cabinet Office, he led work on health data transparency when at which led to some of the most significant open health initiatives in the world.

Clinically he has had an interest in service redesign especially in end of life care and emergency services. He founded and was medical director of one of the largest social enterprise providers in the UK – Local Care Direct. Which developed a model of integrated urgent care using multi-professional groups to cover a population of 3 million people. Mark has an interest in population health, clinical quality measurement and the use of technology to optimize care for individuals. He is a faculty member on the primary care home programme at the National Association of Primary Care, a fellow

of the Royal college of Physicians and General Practitioners. He is also a non- executive director for the British Medical Journal.

The Discipline of Evidence-Based Practice

Healthcare is a knowledge industry. Its successful delivery is predicated on the effective application of clinical knowledge in the context of an individual patient or service. The problem is that not all knowledge is equal. Learnt experience and professional consensus is an important part of the story, but scientific knowledge is the boss. In the context of medicine, we apply science through the discipline of evidence-based practice (EBP). A similar approach can be used to decide on what health technology to use, clinicians need to find those health technologies which are supported by evidence that their use produces increased performance, impact, and value. This is why in IBM Watson Health 'Leading with Science' is so important.

EBP has become mainstream during my clinical career, established as received

wisdom and is now the foundation of clinical practice. But it wasn't always like that. I can remember discussions early in my career when EBP was resisted as something that might undermine professional autonomy and devalue individual judgment. The argument was eventually overcome by demonstrating the consequences of unexplained variation in care and examples of established clinical practices that were of little value or, in fact, actually harmful. In short, following the evidence leads to better outcomes. As a result, EBP became hard to resist. We have now reached a more mature state where the clinical value of EBP is fully recognised. Evidence is seen as the foundation of a consultation, but is also paired alongside the human aspects of professional judgment, instinct and critically, the patient's own perspective. It therefore found its place in clinical practice in a balanced way.

As a young clinician early in my career, I was a champion of EBP and its application at the point of care. However, over the years, two major challenges have emerged ...

The first was simply my inability to remember all the relevant evidence. Clinicians need to stop pretending that we can always remember everything for every patient. A gap has emerged between the requirement in modern clinical practice to process the available knowledge and the finite capacity of the human brain to manage such large volumes of information. Medical knowledge has been expanding exponentially. Whereas the doubling time was an estimated 50 years back in 1950, it accelerated to 7 years in 1980, 3.5 years in 2010, and a projected 73 days by 2020¹. Unfortunately, there has not been doubling of clinician brain power to the same degree. The mismatch is clear. There has never been a better time to augment clinicians with contextually relevant decision support.

The second challenge was that the patient in front of me usually bore no resemblance to the neat cohorts in the randomised controlled trials. My patients reflected real life and tended to have multiple conditions, be older and have the usual complex interplay between social, medical and psychological factors rather than fit the

neat cohorts of a randomised controlled trial which had screened out the more complicated patients. A luxury that is largely unavailable in clinical practice.

Since its beginning, IBM has been working in the health field, Watson Health was formed because we recognized the opportunity to help address challenges like these and make improvements in the industry with technology. For example, the ability to process and contextualize large volumes of unstructured data and present it in the context of an individual patient. The papers we have presented at ASCO and ESMO are building on the body of evidence for this. Watson Health can also help us rethink and invigorate how evidence is generated. By using tools like Watson for Clinical Trial Matching we can help close the gap between research and direct patient care – helping to make trial recruitment an everyday part of direct care. We know the majority of patients want to take part in research and we also know that less than 5% of patients actually do.^{2,3} This is a big opportunity for us to accelerate the generation of knowledge in healthcare. Additionally, with

the emergence of modern data management and advanced analytics using sophisticated linkage and normalization techniques we can start identifying evidence from actual populations rather than research cohorts – so-called real-world evidence. Not only will this mean that complex patients would be included in research it also means that clinicians better understand what works in the real situations of complex healthcare delivery.

My generation has built the case for evidence-based practice but thanks to technologies offered by Watson Health, the next generation of clinicians will be able to apply it at scale. I believe we will see a shift in clinical practice to one that is much better connected to the use of evidence for clinicians, managers, and patients.

Footnote links

Scan the QR code with your smartphone camera or type the URL to get access to the content

-
- 1 Densen P. Challenges and opportunities facing medical education. *Trans Am Climatol Assoc.* 2011; 122:48-58.



bit.ly/34vrkvZ

-
- 2 Moorcraft SY, Marriott C, Peckitt C, Cunningham D, Chau I, Starling N, Watkins D, Rao S. Patients' willingness to participate in clinical trials and their views on aspects of cancer research: results of a prospective patient survey. *Trials.* 2016; 17:17.



bit.ly/2L5aYCS

-
- 3 Unger JM, Cook E, Tai E, Bleyer A. The role of clinical trial participation in cancer research: barriers, evidence and strategies. *Am Soc Clin Oncol Educ Book.* 2016; 35:185-98.



bit.ly/33vCa3Q

Scientific Spotlight #1

The effect of organization-
directed workplace
interventions on physician
burn out: a systematic review

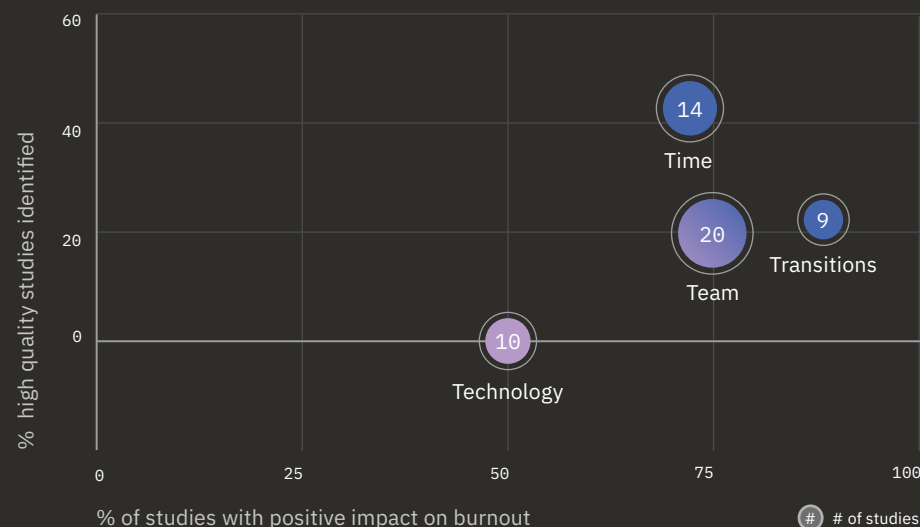
DeChant P, Acs A, Rhee KB, Boulanger TS,
Snowdon JL, Tutty MA, Sinsky CA, Craig KJ.
Accepted July 2019. In press.

Read full abstract
bit.ly/37LAiY7



633 records screened, 50 included studies

Synthesized 50 studies on organization-directed workplace interventions to determine the impact on physician burnout and developed the **4Ts framework: Time, Team, Transitions, and Technology**



“

The largest benefits resulted from interventions that improved processes, promoted team-based care, and incorporated the use of scribes/medical assistants to complete EHR documentation and tasks.”

– Excerpt from abstract

4Ts Framework: What works to improve burnout?

Time

- Improve work-life balance
- Autonomy for meaningful use of time
- Duty-hour limits did not work for interns and/or residents

Transitions

- Process redesign
- Six Sigma quality improvement plans
- Simplify processes that integrate into workflows

Team

- Use of scribes/medical assistants
- Expand team responsibilities
- Provide shared space for learning and connectedness with colleagues

Technology

- Less is more in EHRs (electronic health records), e.g. reduce keystrokes; improve templates
- EHRs with insights



Scientific Spotlight #2

A Blinded Comparison of Patient Treatments to Therapeutic Options Presented by an Artificial Intelligence-based Clinical Decision-support System

Suwanvecho S, Suwanrusme H, Issarachai S, Jirakulaporn T, Taechakraichana N, Lungchukiet P, Thanakarn N, Decha W, Boonpakdee W, Wongrattananon P, Preininger A, Dankwa-Mullan I, Solomon M, Wang S, Esquivel J, Patel V, Shortliffe E, Jackson GP, Kiatikajornthada N. ESMO 2019.

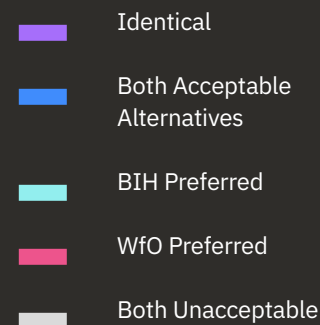
Read full abstract
bit.ly/35Sa9W3



A blinded expert panel compared **228 treatments** given to patients with lung, colon, breast and rectal cancers to therapeutic options suggested by Watson for Oncology (WfO)

This blinded evaluation compared treatment options suggested by Watson for Oncology (WfO) to treatment decisions made by oncologists at Bumrungrad International Hospital (BIH).

Evaluation of WfO options and BIH-physician-chosen treatment



“

“This blinded study suggests WFO®’s therapeutic options are at least as good as (or are an acceptable alternative to) treatments in practice.”

– Excerpt from abstract



Publication Highlights

- 70 Research
- 72 Real World Evidence
- 78 Real World Evidence and Artificial Intelligence Combined
- 79 Artificial Intelligence

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Research

Publications highlighting emerging technologies, pre-commercial research, and investments for the innovations of tomorrow

*** publications that are produced solely by non-IBM authors using IBM data or technology

Adverse Events

Automated detection of wrong-drug prescribing errors***

—
BMJ Quality and Safety

Authors linked free-text indications from the IBM® Micromedex® database to ICD-9 codes to help develop an algorithm that provided triggers to detect look-alike/sound-alike medication prescribing errors with a positive predictive value of 12.1% (95% CI 10.7% to 13.5%).



Read full article
bit.ly/35V4oXv

Neurologic

Handwriting features of multiple drawing tests for early detection of Alzheimer's disease: a preliminary result

—
Studies in Health Technology and Informatics

Using digital tablets, authors constructed a three-class classification model, developed from multiple handwriting tasks carried out on a tablet, to assist with differentiating between Alzheimer's disease and mild cognitive impairment, improving diagnostic accuracy by 11.3% for a final accuracy of 74.6%.



Read full article
bit.ly/2Le0GAu

Neurologic

Using tablet-based assessment to characterize speech for individuals with dementia and mild cognitive impairment: preliminary results

—
Proceedings – AMIA Joint Summits on Translational Science

A digital tablet-based application for neuropsychological assessments and speech data, developed from 44 Japanese native speakers who were either healthy controls (HC) or had mild cognitive impairment (MCI) or dementia, differentiated MCI and dementia from HC with up to 82.4 and 92.6% accuracy, respectively.



Read full article
bit.ly/2DybXax

Technology

Blockchain: an enabler for healthcare and life sciences transformation

—
IBM Journal of Research and Development

Case studies and proposed architectures involving the use of blockchain, a distributed transaction system of record, are described for examples of patient consent and health data exchange, outcome-based contracts, next-generation clinical trials, supply chain traceability, and payments and claims transactions.



Read full article
bit.ly/2r784GJ

Real World Evidence

Publications featuring our unique data assets
and industry-leading scientists

*** publications that are produced solely by non-IBM authors using IBM data or technology

Endocrine and Metabolic Diseases

Progressions from metabolic syndrome to non-alcoholic fatty liver disease: analyses in EMR-Claims database

—
Presented at ISPOR 2019

Patients with metabolic syndrome who were at high risk for non-alcoholic fatty liver disease (NAFLD) were likely to be older (54.9 v. 50.7) and more likely to be male (43.4% versus 37.8%) compared to low risk patients, $P < 0.001$, as analyzed in a study of disease progression using the IBM® MarketScan® Explorys® Claims-EMR Dataset.



Read full article
bit.ly/34I5Ax9

Infectious Diseases

Impact of healthcare utilization on meningococcal adolescent vaccination in the United States (US)

—
Presented at ISPOR 2019

Older adolescents were less likely than young adolescents to receive the meningococcal conjugate vaccine series (adjusted odds ratio [OR] [95% confidence interval (95%CI)]: 0.68 [0.67, 0.69]) and more likely to have a missed opportunity (OR [95%CI]: 1.27 [1.25, 1.28]) in an analysis of IBM® MarketScan® Commercial data.



Read full article
bit.ly/2Rjjq5l

Immunologic

An analysis of treatment patterns in knee osteoarthritis in a U.S. administrative claims database

—
Presented at ISPOR 2019

Among new knee osteoarthritis patients, those diagnosed by orthopedic surgeons received more knee-osteoarthritis related procedures and earlier prescriptions than those diagnosed by general practitioners as identified using the IBM® MarketScan® claims database.



Read full article
bit.ly/2OFf9Ht

Mental Health and Substance Abuse

Depression treatment, healthcare expenditures, and depression severity in patients with depression using patient health questionnaire-9 scores to assess depression severity

—
Presented at ISPOR 2019

Seven percent of patients who had severe or moderate depression as identified by scores on the Patient Health Questionnaire-9 depression assessment tool received no antidepressant therapy as identified in IBM® MarketScan® claims data. Mean all-cause expenditures for patient groups with mild, moderate or severe depression were significantly higher than expenditures in patients with minimal depression ($p < 0.001$).



Read full article
bit.ly/2Rc98E6

Mental Health and Substance Abuse

The effect of organization-directed workplace interventions on physician burn out: a systematic review

Mayo Clinic Proceedings:
Innovations, Quality & Outcomes

An analysis of the 50 articles on organization-directed workplace interventions for physician burnout identified four unique categories of interventions – teamwork, time, transitions and technology. Of these studies, 70% reported interventions which resulted in improved measures of physician burnout, job satisfaction, and/or stress.



Read full article
bit.ly/35T3jzh

Mental Health and Substance Abuse

Factors associated with potentially problematic opioid prescriptions among individuals with private insurance and Medicaid

Addictive Behaviors

Patients with commercial insurance who had potentially problematic opioid prescriptions were eight times more likely to develop an opioid use disorder than patients without potentially problematic opioid prescriptions, while those with Medicaid were three times more likely.



Read full article
bit.ly/33IihGS

Mental Health and Substance Abuse

Health care burden associated with outpatient opioid use following inpatient or outpatient surgery

Journal of Managed Care
& Specialty Pharmacy

Analyzing IBM® MarketScan data, a study of surgical patients found that adjusted predicted 1-year post-period total health care costs were significantly higher for post-surgical opioid users than nonopioid users for patients with commercial insurance (inpatient: \$22,209 vs. \$14,439; outpatient: \$13,897 vs. \$8,825), Medicare (inpatient: \$31,721 vs. \$26,761; outpatient: \$24,529 vs. \$15,225), and Medicaid (inpatient: \$13,512 vs. \$9,204; outpatient: \$11,975 vs. \$8,212), respectively ($P < 0.001$).



Read full article
bit.ly/37XdwWq

Mental Health and Substance Abuse

Mental health parity and addiction equity act and the use of outpatient behavioral health services in the United States, 2005-2016

American Journal of Public Health

An evaluation of IBM® MarketScan Commercial data found that the implementation of the 2008 Paul Wellstone and Pete Domenici Mental Health Parity and Addiction Equity Act had significant positive associations with utilization of mental health and substance use disorder outpatient services; trends which continued over the 5-year post-parity act period.



Read full article
bit.ly/2LeGrIW

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Oncology

Cost of leukopenia and neutropenia in metastatic breast cancer within last 12, 36, and 60 months using a curated disease model

Presented at ISPOR 2019

IBM® Access and Value Connect solution with IBM® MarketScan® Commercial and Medicare Supplemental Database was used to determine the mean total per-patient-per-month (PPPM) costs for different cohorts of metastatic breast cancer (mBC) patients. PPPM costs ranged from \$6,562 for the 75+ age group at 60 months to \$14,201 for the 45-54 age group at 12 months.



Read full article
bit.ly/2rKK7Fn

Women's Health

Breast, cervical, and colorectal cancer screening: patterns among women with Medicaid and commercial insurance

American Journal of Preventive Medicine

In an analysis of IBM® MarketScan® Commercial and Medicaid data, 43.4% of commercially insured women and 68.9% of Medicaid-insured women, aged 40-59 years had a greater than 2.5-year gap between mammograms and 59.3% of commercially insured women and 57.1% of Medicaid insured women, aged 30-59 years, had a greater than 3.5 year-gap between Pap tests



Read full article
bit.ly/2Y7K4PT

Women's Health

Economic and clinical outcomes among women with abnormal uterine bleeding treated with inpatient or outpatient hysterectomy versus endometrial ablation

Presented at ISPOR 2019

Global endometrial ablation procedures were approximately one-half the cost of hysterectomies in the treatment of abnormal uterine bleeding, as analyzed over a 12-month follow-up period in the IBM® MarketScan® Commercial database.



Read full article
bit.ly/2OFBgxB

Women's Health

Maternal immunization in the U.S.: a nationwide retrospective cohort study

American Journal of Preventive Medicine

Although suboptimal, maternal tetanus toxoid, reduced diphtheria toxoid, and acellular pertussis (Tdap) and influenza vaccinations increased from 2010 to 2017 in an analysis of IBM® MarketScan® Commercial and Medicaid data. Tdap immunizations increased from 1% to 56.3% for the commercially insured population and from 0.5% to 31.4% for the Medicaid population; while influenza vaccinations increased from 14.7% to 31.3% and from 9.7% to 17.5%, respectively.



Read full article
bit.ly/2P3HpTh

Real World Evidence and Artificial Intelligence Combined

Studies applying artificial intelligence technologies, such as machine learning, to deliver more robust insights from real world data

Endocrine and Metabolic

Artificial intelligence predicts the progression of diabetic kidney disease using big data machine learning

Scientific Reports

The electronic medical records from 64,059 patients with diabetes were used to construct a predictive model for diabetic kidney disease aggravation with 71% accuracy using AI, natural language processing, and machine learning techniques.



Read full article
bit.ly/2rHKPDk

Artificial Intelligence

Publications featuring our AI-enabled solutions

Oncology

A blinded comparison of patient treatments to therapeutic options presented by an artificial intelligence-based clinical decision-support system

Presented at ESMO Congress 2019

In a blinded evaluation of 228 treatments, an expert panel determined that 88.6% of therapeutic options suggested by Watson for Oncology were either identical to or equally acceptable as treatments chosen by oncologists at Bumrungrad International Hospital.



Read full article
bit.ly/2ODn3kO

Oncology

Artificial intelligence in health in 2018: new opportunities, challenges and practical implications

Yearb Med Inform

The top artificial intelligence (AI) health papers were selected out of a field of 1,480 publications by the editorial board of the 2018 International Medical Informatics Association Yearbook. Papers selected used AI techniques incorporating domain knowledge or explored approaches to support distributed or federated learning.



Read full article
bit.ly/2RanYuL

Oncology

Comparison of the accuracy of human readers versus machine-learning algorithms for pigmented skin lesion classification: an open, web-based, international diagnostic study

Lance Oncol

In this open, web-based, international skin lesion diagnostic study, 139 algorithms created by 77 machine-learning labs achieved a mean of 2.01 more (95% CI 1.97 to 2.04, $p < 0.0001$) correct diagnoses compared to human readers (17.91 [SD 3.42] vs 19.92 [4.27]).



Read full article
bit.ly/2OGaANe

Oncology

Learning health system for breast cancer: pilot project experience

JCO Clin Cancer Inform

De-identified electronic health record data for 50 patients with stage III breast cancer was analyzed by natural language processing (NLP) annotators designed to extract medical concepts from unstructured clinical text to describe the patient's clinical journey. Following adjustment, final disagreement between NLP and the chart was found in 6 out of 171 data elements.



Read full article
bit.ly/33CDYYP

Oncology

Predicting breast cancer by applying deep learning to linked health records and mammograms.

Radiology

Applying a training set of 9611 mammograms and health records, an algorithm predicting biopsy malignancy achieved an area under the receiver operating characteristic curve of 0.91 (95% CI: 0.89, 0.93), with specificity of 77.3% (95% CI: 69.2%, 85.4%) at a sensitivity of 87%.



Read full article
bit.ly/2Y8T4V0

Oncology

Prescribing practices based on recommendations of the Veterans Health Administration's national precision oncology program

Presentation at the Association of VA Hematology/Oncology
September 20-22, 2019

IBM® Watson for Genomics was used to categorize/annotate, next-generation sequencing (NGS) information gathered from the tumor samples of 5,987 patients participating in the Veteran Health Administration's National Precision Oncology Program. At least one genetic variant with Level 1 or 2A actionability was noted in 10.3% of the samples.



Read full article
bit.ly/2RdpFaz

Oncology

Identification of targetable BRAF Δ N486_P490 variant by whole genome sequencing leading to dabrafenib-induced remission of a BRAF-mutant pancreatic adenocarcinoma

Molecular Case Studies

In a single-patient case report, pancreatic cancer tumor genome sequencing revealed a BRAF variant, Δ N486_P490, previously demonstrated to be a kinase-activating alteration in the BRAF kinase domain. Genomic sequencing and analysis led to targeted treatment that resulted in a significant size decrease of both primary and metastatic lesions.



Read full article
bit.ly/2Y5471x

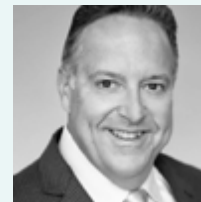


Fourth Quarter 2019

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Leadership Spotlight

Dr. Rob DiCicco: IBM Watson Health Deputy Chief Health Officer Life Sciences



Dr. Rob DiCicco joined IBM Watson Health as Deputy Chief Health Officer Life Sciences in November of 2019 after a nearly 30-year career in pharmaceutical research and development. Dr. DiCicco spent 25 years with GlaxoSmithKline where he served in a variety of leadership positions including Vice President of Clinical Pharmacology Sciences and Study Operations. Rob received his Doctor of Pharmacy Degree from the University of the Sciences in Philadelphia.

[Continues →](#)



As we continue to move from a fee-for-service model of reimbursement to one that is value based, the importance of outcomes-based clinical and cost endpoints continues to increase. The ability to leverage real-world evidence (RWE) and artificial intelligence (AI) to deliver actionable insights at the point of care is one of the most important opportunities and challenges as we attempt to harness the power of “Big Data” and analytics.

This opportunity is recognized by many, including the United States government. Signed into law in 2016, the 21st Century Cures Act covers a variety of healthcare policy issues including the opioid crisis, National Institutes of Health (NIH) funding, precision medicine, antimicrobial stewardship and RWE among others. The stated purpose of this legislation is “An Act: To accelerate the discovery, development, and delivery of 21st century cures, and for other purposes.” This legislation requires the Food and Drug Administration (FDA) to establish a program to evaluate RWE as a means of evaluating new indications for approved medicines and fulfilling post-licensing commitments. The

FDA is just beginning to realize the potential of this approach. RWE could potentially help make this process more efficient. For example, in 2019, the FDA approved Pfizer’s Ibrance® (palbociclib) in combination with endocrine therapy for hormone receptor (HR)-positive, human epidermal growth factor receptor 2 (HER2)-negative advanced or metastatic breast cancer in men. The FDA used real-world tumor response and safety data from electronic health records to support a labelling claim without conducting a randomized controlled trial in that setting. This is just one example of how RWE has the potential to revolutionize how medications come to market more quickly and efficiently.

IBM® MarketScan® claims and IBM® Explorys® clinical data sets have been used to study disease progression, treatment patterns, health outcomes, as well as their associated costs. Results from these studies have been published in over 2,300 peer-reviewed publications and utilized to influence policy decisions and educate healthcare providers and payers. In this update, we share studies

published in the fourth quarter of 2019. For example:

- MarketScan Commercial and Medicare Supplemental Claims Database helped Alford, Ng and Meade describe new methods to utilize visual analytics to assess outcomes in asthma patients.
- The value of collecting data from patients in the real world is further demonstrated by the presentation of a model to predict nocturnal hypoglycemia, as described in a paper by Vu, Kefayati, Idé, et. al.

IBM Watson Health brings together researchers, data scientists, clinicians, and other leaders in healthcare to help solve the industry’s biggest challenges. For example, in life sciences, we help our clients uncover new insights designed to improve clinical development and commercialization. In November 2019, IBM Watson Health released IBM Study Advance, a cloud-based software solution that designed to help optimize clinical trial study design using real-world patient data, which can significantly improve study execution. In its first

release, IBM Study Advance uses MarketScan data to help inform cohort development, as well as inclusion and exclusion criteria. Failure to adequately describe the appropriate study population routinely can result in failure to recruit to plan, significant delays in study completion and costly amendments. As we work with individual clinical trial sponsors, we plan to explore using additional clinical sources to meet their needs.

There is a lot of potential to help improve healthcare with more effective use of RWE. As you review the data and evidence in this update, you’ll see that 14 out of the 25 featured studies employed RWE to gain insights. We hope you are as excited as we are about how the field is evolving.

Footnote links

Scan the QR code with your smartphone camera or type the URL to get access to the referenced content

-
- 1 **21st Century Cures Act. H.R. 34, 114th Congress. 2016**
ibm.biz/wh2020q4_1



-
- 2 **FDA website revised 4/2019**
ibm.biz/wh2020q4_2



-
- 3 **Alford SH, Ng TH, Meade D. New Methods for analyzing clinical and cost outcomes in asthma with interactive analytics. Value in Health 2019, 22: Supplement 3, S585.**
ibm.biz/wh2020q4_3



-
- 4 **Vu L, Kefayati S, Idé T, et. al. Predicting nocturnal hypoglycemia from continuous glucose monitoring data with extended prediction horizon. Presented at the AMIA Symposia 2019**



Scientific Spotlight #1

Weather Conditions as Predictors of Severe Migraines: A Case-crossover Study Using Linked Weather and Claims Data

Thiel E, Irwin D. Paper presented at: ISPOR
Europe 2019; 2019 November; Copenhagen,
Denmark.

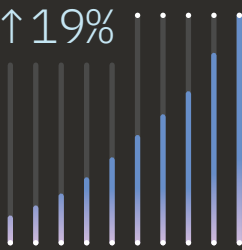
Read more
ibm.biz/wh2019q4_10



Migraines can be debilitating and may be more likely following environmental stimuli. Weather has been perceived as a trigger; however scientific data showing an association are inconsistent



Linked claims and weather data for
34,776 patients with severe migraine
from each major US region



Odds of migraine increased by **19%**
for each **1 inHG** unit increase in the
day's maximum barometric pressure

Studying a novel set of linked
weather and administrative
medical claims data may
offer insight into the impact
of weather on health

Scientific Spotlight #2

Enabling Care Continuity Using a Digital Health Wallet (DHW)

Osebe S, Wachira CM, Matu F, Bore N, Kaguma D, Mutahi J, Ogallo W, Cintas C, Remy SL, Walcott A, Weldemariam K. Paper presented at: IEEE International Conference on Healthcare Informatics (ICHI); June13, 2019; Xi'an, China.

Read more
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Health Information Exchange (HIE) presents a number of challenges for payers, providers and patients, including poor care coordination, duplication of tests and prescriptions, and inefficient use of healthcare resources. These challenges are amplified in low-resource settings where patient data are in fragmented systems.

Core capabilities of the constructed DHW platform



Patient management and control
of health data

Integrates health data across
separate health facilities

Blockchain orchestration of workflows
and data transferred between
providers and systems

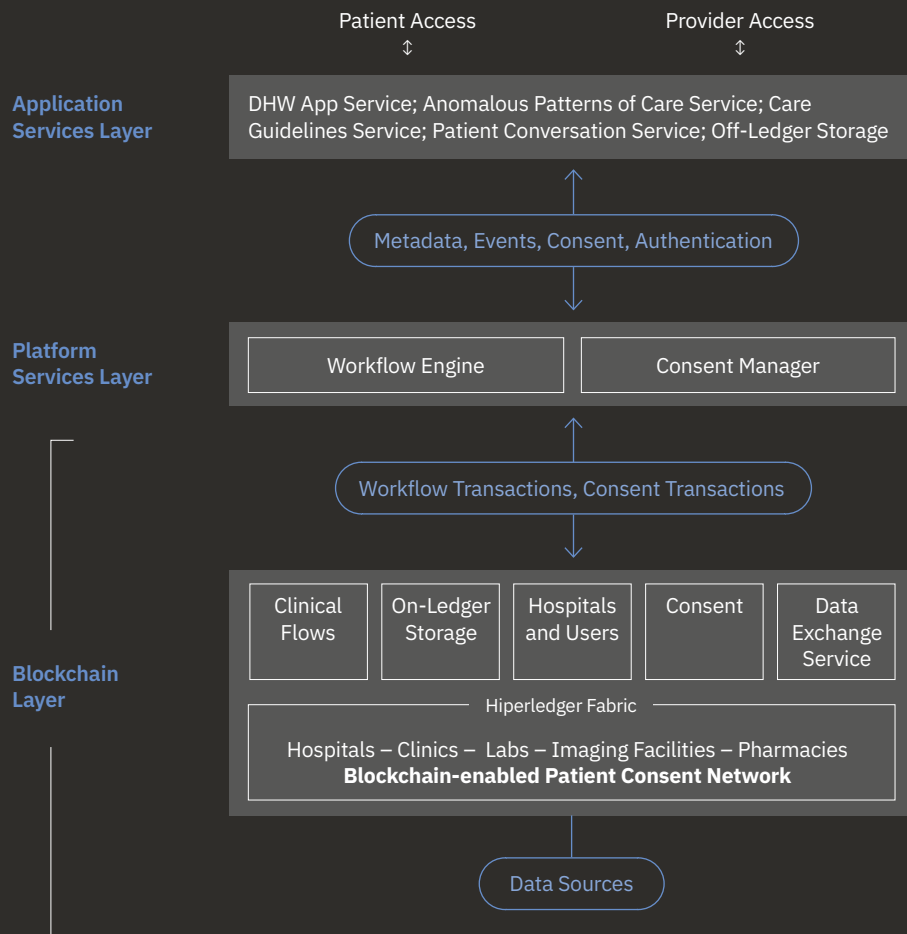
Adheres to FHIR3 data sharing
standards

Hybrid cloud solution with consent
and Hyperledger fabric

Scientific Spotlight #2

Continued

**Constructed blockchain enabled platform for the DHW
to enable complex clinical care workflows:**





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Research

Publications highlighting emerging technologies, pre-commercial research, and investments for the innovations of tomorrow

Oncology

Cancer patients' emotional health discovering: influences of health literacy, fatalism and social support

—
AMIA 2019

Health literacy level was found to be negatively associated with cancer fatalism, which was negatively associated with the emotional health of patients with cancer in a study that analyzed data from the National Cancer Institute's Health Information National Trends Survey (n = 479). Alternatively, social support had a positive effect on patients' emotional health.



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Real World Evidence

Publications featuring our unique data assets and industry-leading scientists

Endocrinology and Metabolism

Association between switching to a high-deductible health plan and discontinuation of Type 2 diabetes treatment

—
JAMA Network Open

No significant overall difference in discontinuation of antihyperglycemic medications was found between patients with type 2 diabetes enrolled in high-deductible health plans (HDHP) and non-HDHP (n=2980) in an analysis of MarketScan commercial claims data. However, patients who switched to an HDHP were more likely to not refill brand name medications than those in a non-HDHP [81 of 396 (20.5%) vs 61 of 437 (14%), respectively; P=0.009].



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Endocrinology and Metabolism

Alterations in patient weight and clinical factors following gastric bypass surgery

—
ISPOR Europe 2019

Six months after a gastric bypass procedure was performed in 1,556 adults, as identified in the IBM MarketScan® Explorys® Claims-EMR Dataset, the percentage of patients with a BMI greater than or equal to 40 mg/kg² (classified as morbidly obese) fell from 72.7% to 12.9%. Improvements in key clinical measures and decreased healthcare costs were also noted 6 and 12 months following surgery.



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Hematology

Economic burden of end organ damage among patients with sickle cell disease in the US

—
Presented at ASH Annual Meeting 2019

In an analysis of IBM MarketScan® Medicaid database claims for 10,784 patients with sickle cell disease the costs incurred by patients with end organ damage in the first year after stroke were 4.68 times as high as those of patients without any organ damage.



Read more
ibm.biz/wh2019q4_7

Infectious Diseases

Factors associated with measles transmission in the United States during the postelimination era

—
JAMA Pediatrics

An analysis of 2,218 confirmed cases of the measles and transmissions of the disease in the United States, found that measles transmission was least likely to occur from individuals who received two doses or more of the measles vaccine and that unvaccinated patients with measles were approximately three to four times more infectious than those who received one or two vaccinations.



Read more
ibm.biz/wh2019q4_8

Neurology

Predictors of preventive therapy non-persistence among patients with migraine

—
Academy of Managed Care Pharmacy Nexus 2019

Persistence of preventive migraine medication was low, 20-28% across different measures of persistence, 12 months after initiation for 94,646 adult patients with migraine identified in the IBM® MarketScan® databases. Male sex, select pre-initiation conditions such as chronic pain and constipation, and pre-initiation use of NSAIDs and strong opioids were also risk factors for non-persistence.



Read more
ibm.biz/wh2019q4_9

Neurology

Weather conditions as predictors of severe migraines – a case-crossover study using linked weather and claims data

—
ISPOR Europe 2019

The odds of a severe migraine event increase by 19% (OR: 1.189; p=0.001) for each 1 inHg unit increase in the day's maximum barometric pressure in a study of the linked weather and administrative claims database, IBM® MarketScan® Weather Database.



Read more
ibm.biz/wh2019q4_10

Psychiatric

Annual cost of major depressive disorder and impact of key clinical events

—
Academy of Managed Care
Pharmacy Nexus 2019

Mean per patient per year (PPYY) healthcare costs were \$10,074 (outpatient 59%, inpatient 21%, outpatient pharmacy 20%) for 455,082 newly diagnosed adults with major depressive disorder and a new anti-depressant prescription identified in the IBM® MarketScan® Commercial database. Clinical events of interest with the highest mean PPYY cost were brain stimulation therapy (\$49,121), severe mental health disorder (\$23,096), and MDD-related hospitalization (\$15,941).



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Psychiatric

Comparison of healthcare resource utilization (HCRU) and expenditures among US commercially-insured patients with opioid use disorder (OUD) by type of medication-assisted treatment (MAT) received

—
ISPOR Europe 2019

Naltrexone initiators had a higher number of all-cause outpatient encounters (mean=88.05; 64.45; 68.89) and outpatient costs (mean=\$15,318.19; \$7,454.79; \$6,037.04) than buprenorphine and methadone, respectively, six months after initiation of medication-assisted treatment for opioid use disorder as studied in 37,705 patients in the IBM® MarketScan® Commercial claims and encounters database.



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Psychiatric

The characterization of trends in mental illness in the United States

—
Academy of Managed Care
Pharmacy Nexus 2019 – Silver
Medal Awardee

In a study evaluating the real-world prevalence of mental illness, the overall prevalence in patients captured in the IBM® MarketScan® database in 2017 was 16%, with anxiety (10.2%) and depression (6%) being the most common diagnoses. Increased age was associated with a higher prevalence of mental illness in females, while prevalence in males peaked in adolescence and older adulthood.



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Psychiatric

Opioid prescribing rates from the emergency department: down but not out

—
Drug and Alcohol Dependence

In an analysis of 19.1 million emergency department (ED) visits captured in the IBM® MarketScan® Research Database, ED opioid prescribing rates declined from 2010 to 2016; however, approximately 15% of ED patients still received opioid prescriptions in 2016.



Read more
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Real World Evidence and Artificial Intelligence Combined

Studies applying artificial intelligence technologies, such as machine learning, to deliver more robust insights from real world data

Respiratory

New methods for analyzing clinical and cost outcomes in asthma with interactive visual analytics

—
ISPOR Europe

IBM® Access and Value Connect was used to quickly visualize a disease model comparing costs and outcomes for 222,312 adult and pediatric asthma patients with claims in IBM® MarketScan® Commercial and Medicare Supplemental databases.



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Respiratory

Pollen exposure and asthma-related healthcare resource utilization in children with asthma: an analysis of patient-level claims and linked weather data

—
ISPOR Europe

In an analysis of data from 225,776 children with asthma in the IBM® MarketScan® Commercial database linked with IBM MarketScan Weather database, incidence rates per 100,000 patient days for both asthma-related inpatient admissions and emergency department visits were highest when pollen counts were high/very high (grass: IP 2.41, ED: 37.88; tree: IP 1.83, ED 28.42).



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Endocrinology

Predicting nocturnal hypoglycemia under free-living conditions from continuous monitoring data with extended prediction horizon

—
AMIA Annual Symposium 2019

A model to predict nocturnal hypoglycemia with a 6-hour horizon demonstrated an overall prediction performance of 0.84, with 0.90 for early night and 0.75 for late night as measured by the area under the curve of the receiver operating characteristics curve.



Read more
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Women's Health

Use of comprehensive health records to improve breast cancer risk prediction

—
Radiological Society of North America 2019 Scientific Assembly and Annual Meeting

A machine learning model based on 17,651 clinical factors outperformed the state-of-the-art Gail model for predicting 1-year breast cancer risk in women as measured by the area under the curve (AUC) of the receiver operating characteristics curve (ROC). Following training and testing using clinical data of 68,342 women who had undergone mammography screening, the machine learning model achieved an ROC AUC of 0.74 (95% CI, 0.72-0.77) versus the Gail model ROC AUC of 0.55 (95% CI, 0.51-0.58).



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Artificial Intelligence

Publications featuring our AI-enabled solutions and technologies

Cardiovascular

Automatic detection of aortic dissection using contrast X-ray computed tomography (CT)

—
Radiological Society of North America 2019 Scientific Assembly and Annual Meeting

A new automated algorithm to detect aortic dissection in contrast computed tomography (CT) studies achieved a performance of 0.982 as measured by area under the curve of the receiver operating characteristics curve (ROC AUC) of 0.982 (95% CI: 0.955-0.998). Future application of such algorithms may have the potential to improve time to diagnosis.



Read more
ibm.biz/2019q4_16

Imaging

Automatic patient data summarization for radiologist

—
Radiological Society of North America 2019 Scientific Assembly and Annual Meeting

In an evaluation of an electronic health record (EHR) summarization template that expanded 1,385 radiologist-chosen seed concepts into 29,798 clinically and semantically relevant concepts, 97.32% of clinical concepts were found to be useful and relevant following clinician review. This approach keeps the clinician input at the center while applying a rich ontology to produce a holistic view of a patient's EHR.



Read more
ibm.biz/wh2019q4_17

Oncology

A pilot study to implement an artificial intelligence system (AI) for gastrointestinal cancer clinical trial matching

—
Annals of Oncology

In a pilot study of 35 patients with newly diagnosed gastrointestinal cancer, clinical research coordinators using Watson for Clinical Trial Matching screened patients against criteria for 50 clinical trials and identified more studies in less time than manual screening methods.



Read more
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Oncology

Association of mutational profile and human papillomavirus status in patients with head and neck squamous cell carcinoma

—
Association for Molecular Pathology Conference

The tumor profiles of human papillomavirus (HPV)-positive and -negative head and neck squamous cell carcinomas (HNSCC) were found to be different, with mutations within TP53 and the p16/CDK/Rb pathways more common in p16-negative tumors (non-HPV) and RAS pathway mutations occurring exclusively in p16-positive HPV tumors. In this study, IBM® Watson for Genomics was used to identify and annotate clinically relevant variants in HPV positive and HPV negative head and neck squamous cell cancer (HNSCC) cases.



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Oncology

Experience and lessons learned from global implementation of clinical decision support for oncology

—
International Congress on Cancer and Clinical Oncology

This paper describes how Watson for Oncology was successfully implemented and used in diverse cancer care settings in the United States, India, Korea, Thailand, Taiwan, and Brazil.



Read more
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Population Health

Enabling care continuity using a digital health wallet

—
IEEE Xplore. Best Paper
Honourable Mention at the 2019
IEEE International Conference on
Healthcare Informatics (ICHI)

This paper describes the development of the Digital Health Wallet, constructed as a secure blockchain-enabled system to manage the secure access to healthcare encounter data and referral information between participating providers, as controlled by the permissions (consent) determined by the patient.



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Population Health

Making study populations visible through knowledge graphs

—
18th International Semantic Web
Conference

Researchers constructed a Study Cohort Ontology (SCO) to assist clinicians with understanding how well their patient population matches the study cohorts used to develop clinical practice guidelines.



Read more
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Population Health

Sonoma county empowering caseworkers to better serve the most valuable

—
AMIA Annual Symposium 2019

IBM and Sonoma County California partnered to create a three-pronged approach to help the most vulnerable and complex citizens of the county by creating a system that could identify vulnerable citizens, match them with needed resources, coordinate their housing needs using a multidisciplinary team, and create a master data index from multiple relevant sources of information about these citizens.



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Psychiatric

Artificial intelligence for mental health and mental illnesses: an overview

—
Current Psychiatry Reports

A review of 28 studies focused on applying artificial intelligence technology to predict, classify, and subgroup mental health illnesses found high accuracies in the mostly proof-of-concept work, pointing towards the potential of using machine learning algorithms to provide insights into mental health with further research.



Read more
ibm.biz/wh2019q4_24

Psychiatric

Novel online behavioral health platform for delivery of evidence-based psychological resilience skills training program

—
APHA 2019

In a pilot study, remote employees of a single company tested a cloud-based, evidence-based psychological resilience skills training platform and experienced a 41% reduction in perceived stress ($p < 0.00001$), a 41% reduction in anxiety ($p < 0.005$) and a 34% reduction in depression ($p < 0.005$).



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For additional information, or to receive the full list of studies published in the fourth quarter of 2019, please contact **Jill Pritts** at jpritts@us.ibm.com.



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