Artificial Intelligence in Healthcare – Technological Advancements
(Part Three of a Four-Part Series)

In an ever-evolving healthcare industry, the utilization of innovative technologies is essential to ensure the provision of quality patient care while simultaneously sustaining the financial health of the organization. This third installment of a four part series on *artificial intelligence* (AI) reviews recent technological trends in AI innovation in the healthcare industry, including the benefits of AI to providers and patients, as well as the potential future implications of AI.

Many recent AI technological advancements have been accelerated by the connection of AI to the *Internet of Things* (IoT), which connects various devices to the Internet, and allows them to communicate in some manner.[1] This communication typically involves the continuous collection of automated data uploads by the sensors of the device utilizing IoT to recognize patterns.[2] This innovation serves to automate similar procedures, and allow the AI to flag any data anomalies for human review, or report potential steps to resolve the recognized inconsistencies.[3]

AI already has the ability to supplement the work of healthcare providers by acting as an "*advisor"* to reduce human error in prescribing and diagnosing. For example, the startup company MedAware focuses on prescription drug use for normal and off-label use of pharmaceuticals. MedAware uses AI machine learning to identify potentially incorrect prescriptions by flagging those that vary from the norm.[4] Additionally, AI machines have been developed to aid providers in analyzing data, by asking the right questions in a timely manner.[5] Pre-AI, big data analysis was nearly impossible, but this process has become relatively easy (and even automated) due to AI such as IBM's Watson that can use IoT data to recognize patterns that humans may not. Watson is arguably the most well-known supercomputer, achieving international fame when it convincingly beat two "*Jeopardy!*" champions at the trivia game.[6] Shortly after Watson's "*Jeopardy!*" performance, IBM joined with clinicians at Memorial Sloan Kettering Cancer Center (MSKCC) to develop Watson's ability to suggest diagnoses and the most effective, cost efficient treatments for certain types of cancers.[7] MSKCC clinicians contributed over 14,000 hours toward fine-tuning Watson's accuracy,[8] and during that period, Watson scanned over 500,000 pieces of medical evidence, two million pages of text, and 25,000 training

cases.[9] Additionally, while Watson Health was not designed to be a physician, or to replace physicians, it has been implemented to interface as an "*expert counselor*" to physicians who are not experts in that particular area of medicine.[10] Watson has proven itself in the medical field by reportedly being able to successfully diagnose lung cancer 90 percent of the time, in contrast to human doctors, who are only able to diagnose it 50 percent of the time.[11] In addition to the clinician collaboration at MSKCC, clinicians at Cleveland Clinic have been central to IBM's efforts to build Watson Health's cognitive capabilities.[12] In January 2017, Cleveland Clinic teamed up with IBM's Watson Health to provide clinicians with help in treating patients and securing data.[13] Utilizing these integrations may allow the rest of the healthcare delivery system to provide better patient care in a more patient friendly way.

In addition to the services that AI may perform to aid healthcare providers, AI also has the capacity to improve patient care, by reducing the burden of maintaining chronic conditions.[14] As previously mentioned, AI may help providers improve diagnoses, in helping to make those diagnoses sooner, potentially resulting in a speedier and fuller recovery of the patient.[15] Further, when patients are diagnosed with a chronic condition, they are often burdened with manually tracking their condition and assuming responsibility for management of the condition. For example, diabetic patients with insulin pumps still have to manually input data, such as food consumptions, to accurately control their glucose levels.[16] Watson and Medtronic, a medical device company, are working to automate these processes so that patients will not have their daily lives interrupted by diabetic care.[17] Through this Medtronic partnership, Watson will be able to predict near-term hypoglycemic events up to three hours in advance.[18] Through this and similar integrations, patients may experience better health outcomes, and clinicians may have a better chance of achieving quality metric thresholds, resulting in higher reimbursement under value-based reimbursement (VBR) models.

AI has the potential to significantly improve the healthcare delivery system from both the provider's perspective and the patient's perspective. However, as AI becomes more advanced, the potential risks associated with AI may become greater as well. While AI systems

have the ability to gather data meaningful to achievable metrics and goals,[19] those systems (depending on the user), also have the ability to wreak havoc on other systems, e.g., through cyberattacks or gaining unauthorized access to a provider's network.[20] Ironically, the best defense against an AI cyberattack is by using AI to monitor network security.[21] Machines can identify attacks and respond more quickly than humans.[22] Because data breaches can cost millions of dollars to resolve, and 90 percent of hospitals have reported a breach in the past two years,[23] providers would be well-

served to closely monitor their network and data security, and take the necessary steps to ensure, and even improve, the level of that security.

As the healthcare industry and healthcare technology evolve, both providers and patients may anticipate ameliorated health outcomes and patient care through the provision of *evidence-based medicine*. AI can also protect providers and patients in the current age of big data analytics, by utilizing AI to thwart security risks and the threat of patient data breaches.[24]

1 "A Simple Explanation of the 'Internet of Things'" By Jacob Morgan, Forbes, 5/13/14, https://www.forbes.com/sites/jacobmorgan/2014/05/13/simple-explanation-internet-things-that-anyone-can-understand/#2827ffd41d09 (Accessed 6/12/17).

2 "The Internet of Things is Far Bigger than Anyone Realizes" By Daniel Burrus, Wired, https://www.wired.com/insights/2014/11/the-internet-of-things-bigger/ (Accessed 6/13/17).

3 *Ibid*; "Using Big Data to Prevent Drug errors" By Sabriya Rice, Modern Healthcare, 7/11/15, http://www.modernhealthcare.com/article/20150711/MAGAZINE/307119976/usingbigdatatopreventdrugerrors (Accessed 4/4/17).

4 "Eliminating Prescription Errors" MedAware, http://www.medaware.com/ (Accessed 6/12/17).

5 Daniel Burrus, Wired, Accessed 6/13/17; "The Dark Side of Big Data" By Tom Goodwin, Forbes, 7/14/16, https://www.forbes.com/sites/tomfgoodwin/2016/07/14/the-dark-side-of-big-data/#126288515bd5 (Accessed 6/13/17).

6 "Computer Finishes off Human Opponents on 'Jeopardy!'" by Jason Hanna, Cable News Network, 2/17/11, http://www.cnn.com/2011/TECH/innovation/02/16/jeopardy.watson/index.html (Accessed 6/9/17).

7 "IBM Watson Hits Daily Double Fighting Cancer With Memorial Sloan Kettering" By Bruce Upbin, Forbes, 3/22/12, https://www.forbes.com/sites/bruceupbin/2012/03/22/ibm-watson-hits-daily-double-fighting-cancer-with-memorial-sloan-kettering/#41aa97a22d7c (Accessed 6/9/17).

8 *Ibid*.

9 *Ibid*.

10 *Ibid*.

11 *Ibid*.

12 "Cleveland Clinic Inks Five-year Agreement with IBM" By Lydia Coutre, Modern Healthcare, 2017, http://www.modernhealthcare.com/article/20170103/NEWS/170109990 (Accessed 6/6/17).

13 *Ibid*.

14 "Medtronic and IBM Watson Health Partner to Develop New Ways to Tackle Diabetes" Medtronic, May 2016, http://www.medtronic.com/usen/about/news/ibmdiabetes.html (Accessed 6/9/17).

15 "Early Detection is the Key" National Institutes of Health Medline Plus, Winter 2013, Vol. 7, No. 4 (2013), p. 5.

16 Medtronic, May 2016

17 *Ibid*.

18 "Cognitive Diabetes App Concept at CES" Endocrine news, 2016, http://endocrinenews.endocrine.org/medtronic-and-ibm-watson-unveil-cognitive-diabetes-app-concept-at-ces/ (Accessed 6/12/17).

19 "AI is the Future of Cybersecurity, For Better and For Worse" By Dr. Roman V. Yampolskiy, Harvard Business Review, 5/8/17, https://hbr.org/2017/05/ai-is-the-future-of-cybersecurity-for-better-and-for-worse (Accessed 6/13/17).

20 *Ibid*.

21 *Ibid*.

22 "Artificial intelligence in Security: How Smart is Smart?" By Rick Robinson, Security intelligence, March 15, 2017, https://securityintelligence.com/author/rickmrobinson/ (Accessed 6/13/17).

23 "Cost of a Breach: A Business Case for Proactive Privacy Analytics" Protenus, http://marketing.protenus.com/hubfs/Content/20160923_Cost_of_a_Breach.pdf?hsCtaTracking=8a783f15-aacc-4442-b521-a699fb7a3803|215dd5c7-a1f4-44f0-9444-8d099d0fe204&utm_campaign=Cost+of+a+Breach&utm_medium=email&_hsenc=p2ANqtz-_Z8QeQKU-b-dn8HZvtLtL7lN2MPMr4 Accessed 6/15/17).

24 Bruce Upbin, 2/8/13; "IBM's Watson is Better at Diagnosing Cancer than Human Doctors" by Ian Steadman, Wired, 2/11/13, http://www.wired.co.uk/article/ibmwatsonmedicaldoctor (Accessed 4/6/17); Roman V. Yampolskiy PhD, 5/8/17

Robert James Cimasi, MHA, ASA, FRICS, MCBA, CVA, CM&AA, serves as Chief Executive Officer of **HEALTH CAPITAL CONSULTANTS** (HCC), a nationally recognized healthcare financial and economic consulting firm headquartered in St. Louis, MO, serving clients in 49 states since 1993. Mr. Cimasi has over thirty years of experience in serving clients, with a professional focus on the financial and economic aspects of healthcare service sector entities including: valuation consulting and capital formation services; healthcare industry transactions including joint ventures, mergers, acquisitions, and divestitures; litigation support & expert testimony; and, certificate-of-need and other regulatory and policy planning consulting.

Mr. Cimasi holds a Master in Health Administration from the University of Maryland, as well as several professional designations: Accredited Senior Appraiser (ASA – American Society of Appraisers); Fellow Royal Institution of Chartered Surveyors (FRICS – Royal Institution of Chartered Surveyors); Master Certified Business Appraiser (MCBA – Institute of Business Appraisers); Certified Valuation Analyst (CVA – National Association of Certified Valuators and Analysts); and, Certified Merger & Acquisition Advisor (CM&AA – Alliance of Merger & Acquisition Advisors). He has served as an expert witness on cases in numerous courts, and has provided testimony before federal and state legislative committees. He is a nationally known speaker on healthcare industry topics, and is the author of several books, the latest of which include: "*The Adviser's Guide to Healthcare – 2nd Edition*" [2015 – AICPA]; "*Healthcare Valuation: The Financial Appraisal of Enterprises, Assets, and Services*" [2014 – John Wiley & Sons]; "*Accountable Care Organizations: Value Metrics and Capital Formation*" [2013 - Taylor & Francis, a division of CRC Press]; and, "*The U.S. Healthcare Certificate of Need Sourcebook*" [2005 - Beard Books].

Mr. Cimasi is the author of numerous additional chapters in anthologies; books, and legal treatises; published articles in peer reviewed and industry trade journals; research papers and case studies; and, is often quoted by healthcare industry press. In 2006, Mr. Cimasi was honored with the prestigious "*Shannon Pratt Award in Business Valuation*" conferred by the Institute of Business Appraisers. Mr. Cimasi serves on the Editorial Board of the Business Appraisals Practice of the Institute of Business Appraisers, of which he is a member of the College of Fellows. In 2011, he was named a Fellow of the Royal Institution of Chartered Surveyors (RICS). In 2016, Mr. Cimasi was named a "*Pioneer of the Profession*" as part of the recognition of the *National Association of Certified Valuators and Analysts* (NACVA) "*Industry Titans*" awards, which distinguishes those whom have had the greatest impact on the valuation profession.

Todd A. Zigrang, MBA, MHA, ASA, FACHE, is the President of **HEALTH CAPITAL CONSULTANTS** (HCC), where he focuses on the areas of valuation and financial analysis for hospitals, physician practices, and other healthcare enterprises. Mr. Zigrang has over 20 years of experience providing valuation, financial, transaction and strategic advisory services nationwide in over 1,000 transactions and joint ventures. Mr. Zigrang is also considered an expert in the field of healthcare compensation for physicians, executives and other professionals.

Mr. Zigrang is the co-author of "*The Adviser's Guide to Healthcare – 2nd Edition*" [2015 – AICPA], numerous chapters in legal treatises and anthologies, and peer-reviewed and industry articles such as: *The Accountant's Business Manual* (AICPA); *Valuing Professional Practices and Licenses* (Aspen Publishers); *Valuation Strategies; Business Appraisal Practice*; and, *NACVA QuickRead*. In addition to his contributions as an author, Mr. Zigrang has served as faculty before professional and trade associations such as the American Society of Appraisers (ASA); the National Association of Certified Valuators and Analysts (NACVA); Physician Hospitals of America (PHA); the Institute of Business Appraisers (IBA); the Healthcare Financial Management Association (HFMA); and, the CPA Leadership Institute.

Mr. Zigrang holds a Master of Science in Health Administration (MHA) and a Master of Business Administration (MBA) from the University of Missouri at Columbia. He is a Fellow of the American College of Healthcare Executives (FACHE) and holds the Accredited Senior Appraiser (ASA) designation from the American Society of Appraisers, where he has served as President of the St. Louis Chapter, and is current Chair of the ASA Healthcare Special Interest Group (HSIG).

John R. Chwarzinski, MSF, MAE, is Senior Vice President of **HEALTH CAPITAL CONSULTANTS** (HCC). Mr. Chwarzinski's areas of expertise include advanced statistical analysis, econometric modeling, as well as, economic and financial analysis. Mr. Chwarzinski is the co-author of peer-reviewed and industry articles published in *Business Valuation Review* and *NACVA QuickRead*, and he has spoken before the Virginia Medical Group Management Association (VMGMA) and the Midwest Accountable Care Organization Expo.

Mr. Chwarzinski holds a Master's Degree in Economics from the University of Missouri – St. Louis, as well as, a Master's Degree in Finance from the John M. Olin School of Business at Washington University in St. Louis. He is a member of the St. Louis Chapter of the American Society of Appraisers, as well as a candidate for the Accredited Senior Appraiser designation from the American Society of Appraisers.

Jessica L. Bailey-Wheaton, Esq., is Vice President and General Counsel of **HEALTH CAPITAL CONSULTANTS** (HCC), where she conducts project management and consulting services related to the impact of both federal and state regulations on healthcare exempt organization transactions and provides research services necessary to support certified opinions of value related to the Fair Market Value and Commercial Reasonableness of transactions related to healthcare enterprises, assets, and services. Ms. Bailey-Wheaton is a member of the Missouri and Illinois Bars and holds a J.D., with a concentration in Health Law, from Saint Louis University School of Law, where she served as Fall Managing Editor for the *Journal of Health Law & Policy*.

Daniel J. Chen, MSF, is a Senior Financial Analyst at **HEALTH CAPITAL CONSULTANTS** (HCC), where he develops fair market value and commercial reasonableness opinions related to healthcare enterprises, assets, and services. In addition he prepares, reviews and analyzes forecasted and pro forma financial statements to determine the most probable future net economic benefit related to healthcare enterprises, assets, and services and applies utilization demand and reimbursement trends to project professional medical revenue streams and ancillary services and technical component (ASTC) revenue streams. Mr. Chen has a M.S. in Finance from Washington University St. Louis.