Bulletin of the Connecticut Academy of Science and Engineering

1976

Volume 33,1 / Winter-Spring 2018

Center for Outcomes Research and Evaluation (CORE): Measuring Medical Success Based on Patient Outcomes

A recent article in *The New York Times* notes that "the United States spends almost twice as much on health care, as a percentage of its economy, as other advanced industrialized countries—totaling $3.3 trillion, or 17.9% of gross domestic product, in 2016." ["The New Health Care: Why the U.S. Spends So Much More Than Other Nations on Health Care." *New York Times*, 2018, Jan. 2]. For years, public and private organizations have sought reduced costs through process improvements and waste elimination. For the past 20 years, the Yale New Haven Hospital Center for Outcomes Research and Evaluation (CORE) in New Haven has been taking a different approach: applying data and science to shift the performance bar to consistent excellence, while not losing sight of patient expectations and outcomes.

"This organization was formed 20 years ago based on the realization that we needed a collaborative interface to serve the practical needs of the medical community while at the same time bringing the best science to bear on serving our patients," said CASE member Harlan Krumholz, founder and director of CORE.

"We bring together experts in health care and research, to apply data and science to issues facing health care, with the clear intent to translate that knowledge into practice and policy for people and patients to produce outstanding outcomes and exemplary medicine," Krumholz said.

The Center employs more than 130 people, including clinical investigators, statisticians, computer scientists, mathematicians, epidemiologists, management experts and administrative staff—and collaborates with an even broader range of national and international experts and organizations. It works closely with the federal government, including the Centers for Medicare & Medicaid Services and the Food and Drug Administration. Anchored in Yale New Haven Hospital, but also embedded within Yale University, the Center truly bridges scholarship and practice.

(See CORE, page 2)

UTRC's Michael Francis To Give Keynote Address at CASE Dinner

CASE Member Michael Francis will present the keynote at the CASE 43rd Annual Meeting and Dinner on May 24, 2018, on the topic of "Autonomy in Aviation: Past, Present and Future."

Francis recently retired as Senior Fellow and Chief of Advanced Programs for United Technologies Research Center (UTRC), capping an illustrious career as an aerospace executive and technologist with positions in government, industry and academia, including the Defense Advanced Research Projects Agency (DARPA), the Department of Defense, the US Air Force Academy, Lockheed Martin, and General Atomics. He was co-founder of Athena Technologies, subsequently acquired by Rockwell Collins. Alan Epstein, CASE Member and vice president of technology and environment for Pratt & Whitney, described Francis as "… a leader and innovator, someone who pushed new concepts and made things happen."

(See Keynote, page 8)

From the National Academies

The following is excerpted from press releases and other news reports from the National Academies of Sciences, Engineering and Medicine (www.national-academies.org).

◆ Making Medicines Affordable

Consumer access to effective and affordable medicines is an imperative for public health and social equity as well as economic development but this imperative is not being adequately served by the biopharmaceutical sector, according to a consensus report from the National Academies. Annual expenditures exceed a half trillion dollars and prescription costs are among the fastest growing segments of health care spending. Research and development of new drugs is extremely costly, yet "drugs that are not affordable are of little value, and drugs that do not exist are of no value." The report offers eight recommendations, including that the federal government should directly negotiate prices as well as improve methods for assessing value. It also recommends that direct-to-consumer advertising be "discouraged," patients receive more information regarding the cost/benefit of various drugs, insurance plans be adjusted to reduce the financial burden to patients, and the cost-sharing "donut hole" in Medicare be eliminated.

https://www.nap.edu/read/24946/

◆ New Report Urges Integration of Safety Systems to Develop In-Time Aviation Safety Management System

A comprehensive aviation safety system as envisioned by NASA would require integration of a wide range of systems and practices, including building an in-time aviation safety management system (IASMS) that could detect and mitigate high-priority safety issues as they emerge and before they become hazards, according to a new report by the National Academies of Sciences, Engineering, and Medicine. An IASMS

(See NAS, page 7)

CORE *(from page 1)*

One of CORE's first strategic relationships was with the organization now known as Qualidigm. "We shared a common belief that quality in medicine was not about finding bad apples, but that there was a need to shift the curve of performance to excellence," Krumholz said.

Since then, CORE has continued to build strategic partnerships and has become a leader in efforts to raise the quality of care and to influence national healthcare policy. "There are shortfalls and variations in levels of care and we target these as areas for intervention and improvement," Krumholz said.

Among the organization's contributions, Krumholz cites novel methods for assessing quality of care, improving the ethics of medical research and education, and promoting innovative practice strategies.

One of CORE's many successes was a study funded by the National Institutes of Health (NIH) to develop an approach to speed the care of patients with heart attacks. The study found that, in general, patients were waiting an average of 90 or more minutes for treatment.

"We realized that organizations were systematically not performing at the highest levels," Krumholz said. "We took a multidisciplinary approach that looked at medical, social and policy science aspects. We found vulnerabilities, and we were a catalyst for change. Even the best cardiologist can't be effective if the patient arrives too late. The team can be very good in the traditional sense, but if the entire team is not operating at the highest levels of efficiency, the end result will not yield the best performance."

The *BULLETIN* of the Connecticut Academy of Science and Engineering is published by the Connecticut Academy of Science and Engineering, Inc., 805 Brook Street, Building 4-CERC, Rocky Hill, CT 06067-3405. (860) 571-7143. acad@ctcase.org. www.ctcase.org. To subscribe, contact us by phone or email or subscribe on our web site. The Connecticut Academy of Science and Engineering is a private, nonprofit public-service organization established by Special Act No. 76-53 of the Connecticut General Assembly.

The situation today is remarkably different as a result. "Patients now typically wait less than an hour and sometimes even as little as 15 minutes for treatment," Krumholz said.

Another NIH study sought to improve the outcomes of young women with heart attacks, leveraging observations that they fared worse than similarly aged men. Krumholz noted that the study included large groups of people and included data about young women versus men, as well as the impact of patient health status, income, and quality of care on medical outcomes. "The study required remarkable networks of professionals and patients," he said.

CORE also played a key role in focusing the nation's attention on readmission rates—the likelihood that a person recently hospitalized would need to be admitted again. The national readmission measure was conceived and developed by CORE, drawing on observations that CORE scientists had made over the prior decade. This assay of system performance underwent substantial scrutiny and peer review before becoming the basis of national policy.

In a story on National Public Radio (NPR) on July 18, 2017, titled "Pushing Hospitals to Reduce Readmissions Hasn't Increased Deaths" [https://www.npr.org/sections/health-shots/2017/07/18/537696772/pushing-shopitals-to-reduce-readmissions-hasn't-increased-deaths], Krumholz and Kumar Dhaarmarajan, a cardiologist and geriatrician who is chief scientific officer at Clover Health, a Medicare Advantage company, delved into the significant role that effective hospital-to-home transition can have in achieving successful long-term outcomes.

"Historically, US hospitals have had little incentive to keep patients healthy following discharge," the story said. "Hospital discharge indicated success, and we paid little mind to what happened on the other side. Meanwhile, one in five patients returned to the hospital within 30 days of discharge, and the health system largely felt it had no responsibility for that. Hospitals were paid each time a patient was readmitted."

The NPR story notes that the Affordable Care Act implemented changes designed to financially penalize hospitals that have higher than average readmission rates. The story continues, stating that with new financial incentives and Medicare investments in organizations with the highest readmission rates, hospitals began focusing on improving care for patients as they were discharged, ensuring medication lists were accurate, finding ways to integrate family members and caregivers in discharge planning, scheduling follow-up appointments and improving communications between inpatient and outpatient teams. The changes resulted in significant reductions in readmission rates.

"Hundreds of thousands of patients avoided being readmitted without evidence of any discernible unintended consequence," Krumholz said. "These better outcomes had nothing to do with medical drugs or procedures, but resulted from engagement with patients and families to promote effective transition to home. By promoting patient-centered, high-quality care—and employing the best science, we move the bar to consistent excellence."

CORE's activities are far-reaching and also emphasize the importance of data sharing. "We are on the cusp of a revolution in medicine," Krumholz said. "Sharing data allows us to be smarter about the way in which we are delivering care, how we are spending research time and dollars, and aligning what's being done with patient preferences and goals."

CORE is distinctive in pairing strong science and its application, and has developed strong collaborations nationally and internationally. "I

(See CORE page 8)

IN BRIEF

Science and Engineering Notes from Around Connecticut

Biomedical Research

STUDY SUGGESTS ROLE OF INTESTINAL MICROBES IN DIABETES. Yale researchers, including CASE Member and senior author **Richard Flavell**, published a study in the *Proceedings of the National Academy of Sciences* providing evidence that intestinal microbes may influence the incidence of type 1 diabetes. The team modified gut microbiota of mice by co-housing non-obese diabetic mice with animals that harbored altered microbes. Results showed an increase in regulatory T cells in the gut, which likely contribute to a beneficial outcome. When antibodies to treat diabetes were given in human clinical trials, regulatory T cells increased. These T cells migrated to inflamed organs and suppressed the other pathogenic T cells found to cause type 1 diabetes.

BIOASIS OPENS US SITE IN GUILFORD. In October, **Bioasis**, a biopharmaceutical company focused on the delivery of therapeutics across the blood-brain barrier and into the central nervous system for the treatment of neurological diseases and disorders, announced its new location in **Guilford**. The company will maintain its headquarters in Vancouver, Canada.

LAMBDAVISION AWARDED GRANT. UConn spinoff **LambdaVision** was awarded $500,000 in Series A Equity from **Connecticut Innovations** as part of the **Connecticut Bioscience Innovation Fund**. Led by co-founder and CEO **Nicole Wagner**, LambdaVision is developing a retinal implant to cure vision impairment and blindness. Using a protein grown in the laboratory and implanted behind the retina, the procedure treats patients with age-related macular degeneration and other retinal diseases. The protein is in pre-clinical trials to determine the stability and efficacy of the implant.

3-D PRINTING FOR BRAIN SURGERY. Doctors at **UConn Health** have developed 3-D printing technology to help with delicate brain surgery. Medical physicist **David Brotmann** developed the idea of creating an exact model of blood vessels, allowing doctors to learn the thrombectomy procedure of guiding a catheter through a patient's arteries and vessels into the brain to remove blood clots without practicing on live patients. Brotmann, now at **Yale School of Medicine**, brought his idea to **Clifford Yang**, a cardiac radiologist at UConn Health with an electrical engineering background. Yang showed it to **Charan Singh**, an interventional radiologist who teaches the thrombectomy procedure at UConn Health, which is making 3-D image files available to any hospital that wants to create their own models.

YALE TO LAUNCH CENTER FOR GENOMICALLY ENCODED MATERIALS. Last fall, **Yale University** researchers received a three-year, $1.8 million grant from the National Science Foundation to establish the **Center for Genomically Encoded Materials** (C-GEM), where they plan to develop a method to generate synthetic polymers using re-engineered cells. The work involves synthesizing sequence-defined chemical polymers by repurposing Escherichia coli translational machinery. C-GEM is being established as an NSF Center for Chemical Innovation (CCI), and is being overseen by CASE members **Alanna Schepartz** and **Dieter Söll**, as well as **Farren Isaacs** and **Jeffrey Townsend**, all of Yale, with University of California Berkeley collaborator Jamie Cate.

UCONN STARTUP RECEIVES NIH AWARD FOR HERPES RESEARCH. The National Institute of Allergy and Infectious Diseases, part of the National Institutes of Health, awarded **Quercus Molecular Design** (QMD), a **UConn Health**-related startup, a Small Business Technology Transfer (STTR) grant of $256,000 to develop inhibitors that block Herpes Simplex Virus (HSV) proteins used in reproduction of the virus. QMD's approach is intended to develop production of antiviral therapeutics that are more potent and less susceptible to mutation-based drug resistance. QMD's team includes CASE member and chief chemistry officer and UConn professor of medicinal chemistry, **Dennis Wright**; co-founder, chief biology officer, and UConn professor of medicinal chemistry, and past president, **Sandra Weller**, chair of the department of molecular biology and biophysics at UConn Health; and her brother, **Bradford Weller**, QMD's CEO. QMD is located at the **UConn Technology Incubation Program**.

Business & Industry

UTC STUDIES BREAKUP OPTIONS. United Technologies Corp. (UTC) is studying a plan to split a portfolio that includes jet engines, elevators and air conditioners into three businesses, according to remarks CEO **Greg Hayes** made to an investor conference. Hayes sees an aerospace business with about $45–$50 billion in sales; an Otis elevator operation with about $12–$13 billion; and a climate-control division, which makes Carrier air conditioners, with $17–$18 billion. UTC announced last September plans to acquire Iowa-based avionics maker Rockwell Collins for $30 billion in what will be one of the largest acquisitions in aerospace history; the deal is expected to close by mid-2018.

P&W OPENS NEW ENGINEERING HQ. Last fall, **Pratt & Whitney** opened a new engineering and technology center in **East Hartford**. With more than 1,700 employees, the center will serve as the company's engineering headquarters. "This new facility … becomes the nerve center of Pratt & Whitney's continued excellence and global leadership in the design of the finest commercial and military engines in the world," Pratt & Whitney **President Robert Leduc** said at the dedication.

YALE, UCONN GET WATER TREATMENT GRANTS. UConn and **Yale University** will receive about $150,000 each from the Bureau of Reclamation, a federal agency responsible for research projects involving desalination and water purification. The awards are part of $3.62 million in federal funding that is being matched by $3.52 million in non-federal funds. According to Alan Mikkelsen, acting commissioner, the bureau is the largest wholesaler of water in the country.

BIOARRAY RECEIVES STATE R&D FINANCING. Last fall, **Bioarray Genetics**, a personalized medicine startup, announced receipt of $4 million in Series B Equity Financing from **Quark Venture**, a personalized medicine startup housed at **UConn's Technology Incubation Program** and GF Securities through their Global Health Science Fund and **Connecticut Innovations**, the state's quasi venture capital arm. Bioarray will use this funding to bring their first product, BA100, to clinicians and conduct research and development on other tests, including those focused on treatments for metastatic breast and colon cancers.

Items that appear in the In Brief section are compiled from previously published sources including newspaper accounts and press releases. For more information about any In Brief item, please call the Academy at (860) 571-7143, or contact us at acad@ctcase.org.

IN BRIEF

Science and Engineering Notes from Around Connecticut

ARKANSAS FIRM TO OPEN WINDSOR FACILITY. Late last year, SCA Pharmaceuticals, an Arkansas-based company, announced it would open a facility in Windsor, creating approximately 360 new jobs. The company, which received an $8.5 million loan from the **Connecticut Department of Economic and Community Development**, manufactures injectable pharmaceuticals in ready-to-administer dosages for use at hospitals and healthcare facilities.

STANLEY AND TECHSTARS PARTNER IN ACCELERATOR PROGRAM. Stanley Black & Decker and **Techstars**, a startup accelerator, recently announced the formation of a three-year partnership and the launch of the **STANLEY+Techstars Additive Manufacturing Accelerator** in Hartford. The program will select 10 startups in the additive manufacturing space to participate in its first year. Applications opened in January 2018, and the program will be available in the third quarter of 2018. Similar programs will run in 2019 and 2020, with 30 potential startups.

Communication

CT JOINS NET NEUTRALITY SUIT. Connecticut recently joined 21 states and the District of Columbia to sue the Federal Communications Commission's (FCC) repeal of net-neutrality rules. The rules barred companies like AT&T, Comcast and Verizon from interfering with internet traffic and favoring their own sites and apps. The states asked the federal appeals court to overturn the FCC decision, calling it "arbitrary, capricious and an abuse of discretion."

TELEMEDICINE NETWORK TO EXPAND. Harvard Pilgrim Health Care has awarded $32,000 in grants to two Connecticut health systems to expand the Community eConsult Network (CeCN) program, a telemedicine program launched in 2015 by Middletown-based **Community Health Center** and now used in about a dozen states. CeCN was awarded $20,000 to launch a year-long pilot through the Value Care Alliance (VCA) to collect data to determine the efficiency and suitability of the CeCN program for VCA outpatient clinics. Another $12,000 grant will enable CeCN to work with the leadership and clinical staff of **Community Medical Group** to implement an eConsult referral process available to all 400 primary care physicians in the group's Independent Practice Association.

NORWALK TECH FIRM WINS INNOVATION AWARD. Norwalk-based **Triax Technologies, Inc.**, a provider of jobsite technology for connectivity, visibility and worker safety, was the recipient of the 2017 Innovation Awards from *Business Insurance Magazine* for its spot-r, a wearable device providing real-time monitoring of construction site worker activities. The award recognizes innovative products and services for risk managers and commercial insurers.

Education & Cognition

NEW HEALTH SCIENCE CENTER OPENS AT NCCC. On September 12, the new **Joyner Health Science Center** opened at **Northwestern Connecticut Community College** in Winsted. The center includes space for the **Veterinary Technology Program**. The second floor will house the **Allied Health Program** including three Allied Health classrooms, a computer lab and faculty offices.

YSM RECEIVES $12M TO STUDY EARLY AUTISM INDICATORS. The **Yale School of Medicine** has received a $12.4 million grant jointly funded by the National Institute of Mental Health and the National Institute of Neurological Disorders and Stroke to pinpoint early indicators of autism spectrum disorder in fetuses and newborns. Led by **Child Study Center** professor **Katarzyna Chawarska**, the project will explore the development of functional brain connections, focusing specifically on families affected by autism. The interdisciplinary effort includes faculty from radiology, neuroscience and statistics, including CASE members **Laura Ment** and **Fred Volkmar**. The study includes five interrelated projects involving imaging fetuses, newborns and school-aged children, as well as studying induced pluripotent stem cells and behavioral interventions.

UCONN LAUNCHES CHAPTER OF INNOVATION ACADEMY. UConn recently launched a local chapter the National Academy of Inventors (NAI) to boost innovation. The chapter's president is CASE member **Cato Laurencin**, who became UConn's first NAI Fellow in 2013. The chapter represents a collaboration between the **Connecticut Institute of Clinical and Translational Science** and the office of **UConn's Vice President of Research**.

UCONN, URI PARTNER WITH US NAVY FOR NEW INSTITUTE. In November, **UConn** announced a partnership with the University of Rhode Island and the US Navy to form the **National Institute for Undersea Vehicle Technology**, established at UConn's coastal Avery Point campus. The purpose is to develop personnel to accelerate research in submarine and other undersea technologies. **Arun Shukla**, URI Simon Ostrach Professor of Mechanical, Industrial and Systems Engineering, and CASE member **Richard Christenson**, UConn professor of civil and environmental engineering, are the co-directors. A three-year, $1.3 million Office of Naval Research STEM grant was awarded to URI and UConn to encourage undergraduates to join the shipbuilding industry.

CT TO PARTNER WITH SANS ON CYBERSECURITY. Connecticut will partner with the SANS Institute to increase cybersecurity training for high school women, according to state officials. The initiative, known as GirlsGoCyberStart, was initiated by SANS after launching their CyberStart program, allowing 3,500 students in seven states to discover their aptitude for cybersecurity. The Connecticut **Department of Emergency Services and Public Protection** and **State Department of Education** will collaborate with the **Girl Scouts of Connecticut** to encourage girls in grades 9–12 to participate.

COLLEGES TO GET SOLAR ENERGY SYSTEMS. Manchester and **Middlesex Community Colleges**, along with **Southern Connecticut State University** will receive solar energy installations on their campuses to reduce energy consumption and decrease expenses, according to officials. The project, a partnership between the Connecticut State Colleges and Universities and three private companies, is funded through the **Connecticut Green Bank**. CSCU president **Mark Ojakian** says the cost savings to the state could be more than $10 million within the next 20 years.

Energy

CT RANKED HIGH ON ENERGY EFFICIENCY. An October report from the financial site WalletHub, an agency that measures efficiency of auto and home-energy consumption in 48 US states, ranks **Connecticut** 10th for combined auto and home energy efficiency, but 7th out of 48 in auto energy efficiency alone. The average American family spends at least $2,000 per year on utilities and another $1,900 on gasoline and motor oil, according to WalletHub.

IN BRIEF

Science and Engineering Notes from Around Connecticut

SUB BASE TO GET FUEL CELL POWER PLANTS. FuelCell Energy announced in October an agreement with the **Connecticut Municipal Electric Energy Cooperative** (CMEEC) for the long-term supply of power to the **US Navy Submarine Base** in Groton. CMEEC will work with **Groton Utilities** to implement the new power supply while FuelCell Energy will install and operate the installation. Two SureSource 4000TM power plants will be located on the submarine base, supplying an existing electrical substation. The fuel cell plant is part of a multifaceted plan by CMEEC to provide new power resources and support the Department of Defense in its effort to add resiliency and grid independence to key military installations.

SUSTAINABLE CT LAUNCHED TO SUPPORT TOWN EFFORTS. In early December, **Middletown** and **Durham** became the first two communities to join **Sustainable CT**, a new program supporting sustainability actions by Connecticut towns. Additionally, Middletown earned a silver designation from the national SolSmart program for making it faster, easier and more affordable for homes and businesses to go solar. The initiative was developed by **The Institute for Sustainable Energy** at **Eastern Connecticut State University** in partnership with the **Connecticut Conference of Municipalities**. Sustainable CT is a state initiative that includes sustainability best practices, tools and resources, peer learning and recognition.

Environment

SHELTON RECEIVES BROWNFIELDS GRANT. In August, the city of **Shelton** received a US Environmental Protection Agency grant of $200,000 to assess contaminated brownfields in the **Shelton Canal** and **Shelton Industrial District**. The funds will be used to update three Phase I environmental site assessments, conduct three Phase II environmental site assessments, and prepare three cleanup plans. Grant funds will also support community outreach activities, including updates to the city's brownfields website. Shelton won an EPA brownfield grant for the second year in a row in an intense nationwide competition.

DEEP STANDARDIZES RECYCLING RULES. In November, the Connecticut **Department of Energy and Environmental Protection** (DEEP) announced standardized recycling rules. The new "What's In, What's Out?" campaign is driven by the **RecycleCT Foundation.** On its website, residents can see what is accepted curbside. Some of the "out" items include loose bottle caps, prescription bottles, plastic bags, aerosol containers, coffee pods, expanded polystyrene foam, ice cream containers, shredded paper, take-out containers, paper cups, foil yogurt tops, and paint cans. The RecycleCT site includes information on other ways to recycle unaccepted items.

3-YEAR BIRD SURVEY TO BEGIN. On December 4, the **Connecticut Audubon Society** announced the largest and most important effort in state history to survey bird populations, nesting sites, breeding activities and migration patterns. The survey will provide data that will help decide where scarce conservation funding should best be spent. The work requires 600 volunteers and is partially funded by $750,000 in federal funds, as well as contributions from a variety of Connecticut birding and environmental organizations. **UConn** scientists will help collect and collate the information over the next three years.

REPORT ASSESSES RISK OF CHEMICALS. A December report by the Center for Effective Government, "Living in the Shadow of Danger: Poverty, Race and Unequal Chemical Facility Hazards," stated that approximately 5% of **Connecticut** residents live within one mile of the 27 Connecticut facilities that use large enough quantities of hazardous chemicals to require disaster response plans to be submitted to the US Environmental Protection Agency. The center reported that children of color under age 12 are 2.2 times more likely than white children to live within a mile of a facility. Close-by residents are often unaware of the dangers of leaks and explosions or the adverse health effects of exposure.

Food & Agriculture

AG STATION RECEIVES FIRE BLIGHT RESEARCH GRANT. The **Connecticut Agricultural Experiment Station** has received a three-year, $459,978 grant from the USDA's National Institute of Food and Agriculture to study fire blight, a disease that kills apple trees or reduces yield. **Quan Zeng**, assistant plant pathologist and bacteriologist with the Station's Department of Plant Pathology and Ecology, worked with colleagues to develop technology to control the disease. Their research, published in *Frontiers in Microbiology*, focuses on Antisense Peptide Nucleic Acid- Cell Penetrating Peptide, and uses a strand of Peptide Nucleic Acid (PNA) to break into the cells of the damaging bacteria, where it identifies the bacteria's DNA and binds to the genes that help keep the bacteria alive, destroying them.

CT AG CHIEF TO HEAD NATIONAL ASSOCIATION. Connecticut Commissioner of Agriculture **Steven K. Reviczky** was elected president of the National Association of State Departments of Agriculture (NASDA) for 2017-18. This is the first time a Connecticut commissioner has held the position.

QUANTUM BIOPOWER BEGINS GENERATING POWER. **Quantum Biopower**, a food recycling plant founded by **Brian Paganini**, a graduate of **UConn's School of Business,** "flipped the switch" and is now supplying energy to the local grid. The $14 million facility—the state's first waste food-to-energy plant—began operations in December 2016, accepting up to 140 tons of food waste a day including expired meat, bread or bakery items, cafeteria waste or spoiled food from a commercial freezer. Food is ground and moved to a tank where, at high temperatures, it begins anaerobic digestion with microscopic organisms aiding the breakdown. Methane is captured, cleaned and used to fuel engines and create power. The plant began generating power with a 1.2-megawatt combined heat and power (CHP) unit in December 2017.

CT AG SECTOR DRIVEN BY 'GREEN INDUSTRIES.' According to a 2017 study published by **UConn's Zwick Center for Food and Resource Policy**, Connecticut's $4 billion agriculture sector is dominated not by field crops, but by "green industries" like nurseries and greenhouses, floriculture, sod production, egg and poultry production and dairy farming, with products from greenhouses and nurseries accounting for half of the state's agricultural sales. The study defined the agricultural industry "as encompassing crop and livestock production, forest products, and the processing of the state's agricultural production." The study found that agriculture adds more than 21,000 jobs and $800 million in wages to the state's economy.

STUDY LINKS ASIAN TIGER MOSQUITOES TO VIRUSES. A study released at the 66th Annual Meeting of the American Society of Tropical Medicine and Hygiene last fall by researchers at the **Connecticut Agricultural Experiment Station** and the **Yale School of Public Health** determined that the invasive Asian tiger mosquito, *Aedes albopictus* that is proliferating across the United States and

IN BRIEF

Science and Engineering Notes from Around Connecticut

Europe can spread Zika virus more quickly and effectively than previously recognized. While Asian tiger mosquitos are not as efficient as *Aedes aegypti* at spreading Zika virus. **Doug Brackney**, a virologist at the Station and the lead author of the study stated, "they appear to be much more efficient vectors than we previously thought for this exotic virus."

Health

OPIOID OVERDOSE DEATHS RISE. Connecticut Chief Medical Examiner **James Gill** reported 1,038 accidental drug intoxication deaths in **Connecticut** in 2017. This includes 677 for fentanyl in any deaths. In 2012, 357 accidental drug intoxication deaths were reported, with 917 in 2016. State representatives urge increasing treatment capacity, enforcing parity, expanding access to naloxone, mandating prescriber education, and providing federal funding and tech support to enhance interstate data sharing among state-based prescription drug monitoring programs..

GENETIC PROFILING LINKED TO VACCINE RESPONSE. Yale researchers have published findings in *Science Immunology* indicating that genetic profiling can predict individual responses to the flu vaccine. The study included six different cohorts receiving the flu vaccine from across the country; research centers included Yale, the Baylor Research Institute, Emory University, the Mayo Clinic, and the National Institutes of Health. The large cohort allowed researchers to not only identify genes and gene clusters associated with vaccine response, but to confirm findings in an independent cohort of participants. The findings may help investigators predict responses and develop strategies to improve vaccines, or treatments to boost the immune system's response to vaccination.

DRUGS SHOW PROMISE FOR MIGRAINES. A study published in the *New England Journal of Medicine* in January found that two medications—fremanezumab and erenumab—could provide relief for chronic migraine sufferers. "These are engineered, what I would call smart, molecules," explains **Peter McAllister** with **New England Institute of Neurology and Headache** in Stamford and a principal investigator for the study. Both drugs are injectable and although they impact different pathways in the brain which trigger migraines, their results are similar, with a 75% reduction of headaches in one group and 100% in another. The drugs have few side effects.

ORGAN MATCHING SOFTWARE OFFERS NEW TOOL. New Jersey-based BiologicTx's kidney paired donation software, BiologicTx MatchGrid™, was used for a successful 9-way kidney exchange at **Yale New Haven Hospital** that began May 9 and concluded June 21, 2017. This kidney exchange, the largest in Connecticut's history, included 9 donor and recipient pairs and was initiated by a non-directed donor. BiologicTx Paired Donation's MatchGrid is a software application providing doctors and clinicians tools to accurately match living organ donors with patients who have willing, healthy, but incompatible donors. Using advanced matching and optimization algorithms, MatchGrid evaluates all potential matches within a center in minutes.

High Technology

PARTNERSHIP FACILITATES OPIOID INFO ACCESS. Yale New Haven Health and **Yale School of Medicine** will work with Appriss Health and the **State of Connecticut** to fight opioid abuse using Yale's Epic EHR system and the **Connecticut Prescription Monitoring and Reporting System** (CPMRS) to provide access to information on opioid prescriptions, ensuring compliance with state regulations and safe patient treatment. Yale will also use Appriss Health's NarxCare to gather analytics and opioid treatment information. In the past, physicians logged into a separate website to access the CPMRS cross-referencing that information with what was in the EHR. The partnership allows clinicians to stay within the EHR to access NarxCare, providing a patient's opioid history with one click.

DIGITAL TECHNOLOGY PROTECTS BABIES. Stamford Hospital recently announced technology to improve the safety and security of babies born at the hospital by using digital documentation of babies' footprints and their mothers' fingerprints. **Richard Miller** of Fairfield-based **Certascan Technologies** explains, "The actual core detail on the footprint will not change, so we can use that for precise identification any time we need to make a precise ID." The digital footprints will be stored for 21 years, but parents can download them.

WEARABLE TECH FIRM WINS SBIR GRANT. Farmington-based **Mobile Sense Technologies, Inc.**, has been awarded a $225,000 Small Business Innovation Research (SBIR) Phase I contract from the National Heart, Lung & Blood Institute of the National Institutes of Health to expand and develop its patented wearable technology to detect arrhythmias in the broader population. Mobile Sense Technologies, cofounded by CASE member and **UConn** professor of biomedical engineering **Ki Chon**, enables people to screen their vital signs using smart watch technology, with the possibility for long-term use of the monitor on the upper arm as prescribed by a cardiologist. Mobile Sense is housed at the **UConn Technology Incubation Program** (TIP) at **UConn Health** in Farmington.

ALPAY TO HEAD INNOVATION HUB. CASE member **S. Pamir Alpay** has been named executive director of **UConn's Innovation Partnership Building** (IPB) at the **UConn Tech Park**, replacing CASE member **Radenka Maric** now serving as vice president of research at **UConn** and **UConn Health**. Alpay is a professor of materials science and engineering and leads the **UTAS Center for Advanced Materials**, which will be housed in the IPB. He is working closely with several companies associated with the Tech Park as well as staff and UConn faculty to establish new industry partnerships.

NEW SOFTWARE PLATFORM AIDS CELL BIOLOGISTS. In a paper published in the Biophysical Journal in October, researchers led by **UConn Health** biophysicist and CASE member **Leslie Loew** described the development of a software platform, The Virtual Cell, or VCell, which provides a comprehensive set of modeling and simulation capabilities for cell biology, making it easier for cell biologists to build complex biological models. Using VCell, a biologist can predict the outcome when a particular drug encounters a filtration cell in the kidney or how a hemoglobin molecule in a red blood cell reacts to a spike in carbon dioxide.

TIP STARTUPS DRAW RECORD FUNDING, INVESTMENTS. UConn in January announced that startups in its **Technology Incubation Program** (TIP) attracted $60 million in equity, debt, grant, and revenue funding to accelerate the growth of their operations in 2017. This is over $15 million more than the previous record set in 2016. The majority of this investment came from out-of-state funds and sources. TIP supports UConn startups as well as innovative external technology ventures. TIP startups can conduct R&D activities at UConn and benefit from access to the university's research infrastructure, specialized equipment, customized business support services, and graduates.

(See In Briefs, page 8)

From the National Academies *(from page 1)*

could continuously monitor the national airspace system, assess the data that it has collected, and then either recommend or initiate safety assurance actions as necessary. Real-time system-wide safety assurance (RSSA) is one of six focus areas for the National Aeronautics and Space Administration (NASA) aeronautics program. This report identifies challenges to establishing an RSSA system and the high-priority research that should be implemented by NASA and other interested parties in government, industry, and academia to expedite development of such a system.

https://www.nap.edu/catalog/24962

◆ Decrypting the Encryption Debate

Encryption protects information stored on smartphones, laptops, and other devices—in some cases by default. Encrypted communications are provided by widely used computing devices and services such as smartphones, laptops, and messaging applications, that are used by hundreds of millions of users. Individuals, organizations, and governments rely on encryption to counter threats from a wide range of actors including unsophisticated and sophisticated criminals, foreign intelligence agencies, and repressive governments. Encryption on its own does not solve the challenge of providing effective security for data and systems, but it is an important tool.

https://www.nap.edu/catalog/25010

◆ New Reports Find that Public Safety During Severe Weather and Other Disasters Could Be Improved With Better Alert Systems and Improved Understanding of Social and Behavioral Factors

A more cohesive alert and warning system that integrates public and private communications mechanisms and adopts new technologies quickly is needed to deliver critical information during emergency situations. At the same time, better understanding of social and behavioral factors would improve the ways we communicate about hazards, inform response decisions such as evacuations, develop more resilient urban infrastructure, and take other steps to improve weather readiness. Two reports by the National Academies of Sciences, Engineering, and Medicine propose steps to improve public safety and resilience in the face of extreme weather and other disasters. *Emergency Alert and Warning Systems: Current Knowledge and Future Research Directions* examines how government systems such as Wireless Emergency Alerts (WEA) and Integrated Public Alert and Warning System (IPAWS) will need to evolve as technology advances. *Integrating Social and Behavioral Sciences Within the Weather Enterprise* emphasizes the need for government agencies, industry, and academic institutions involved in the weather enterprise to work together to more actively engage social and behavioral scientists, in order to make greater progress in protecting life and enhancing prosperity. While efforts to improve physical weather prediction should continue, the report says, realizing the greatest return on investment from such efforts requires understanding how people's contexts, experiences, knowledge, perceptions, and attitudes shape their responses to weather risks.

https://www.nap.edu/catalog/24935

◆ Organ Donor Intervention Research: Saving Lives by Improving the Quality and Quantity of Organs for Transplantation

While the annual number of organ transplants has doubled to just over 30,000 since 1988, the waiting list of potential recipients has increased at a much more rapid pace, from ~ 18,000 to 120,000. This consensus report from the National Academies examines the challenges to maximizing the utilization of potential organs from already available deceased organ donors. It recommends formation of a unified national donor registry accessible to organ procurement organizations, clarification of policy for organ donation for research that is followed by transplantation, appropriate revisions to the Uniform Anatomical Gifts Act and development of a centralized research system with a dedicated review board (IRB).

https://www.nap.edu/read/24884/

◆ Applying Risk Analysis, Value Engineering, and Other Innovative Solutions for Project Delivery

This report from the Transportation Research Board examines the state of the art in managing project development and delivery through application of Value Engineering (VE). VE is a systematic process that combines creative and analytical techniques to achieve a common understanding of project requirements. At the project level, the goal of VE is to achieve balance between project needs and resources.

http://www.trb.org/main/blurbs/176394.aspx

◆ Information Technology and the US Workforce: Where Are We and Where Do We Go from Here?

Recent years have yielded significant advances in computing and communication technologies, with profound impacts on society. Technology is transforming the way we work, play, and interact with others. From these technological capabilities, new industries, organizational forms, and business models are emerging. The Committee on Information Technology, Automation, and the US Workforce was convened by the National Academies of Sciences, Engineering, and Medicine to examine current and possible future impacts of emerging information and communication technologies on the workforce. The charge to the committee was framed broadly: assess many dimensions of the evolving relationship between technology and work and set forth a research agenda. The resulting report is an exploration of the current state, trends, and possible futures of technology and work. It considers the issue from economic, organizational, individual worker, and societal levels, along with the capabilities of certain technologies that are likely to drive significant change. The report identifies key issues and questions for policy makers and suggest new research pathways and new data-collection efforts.

https://www.nap.edu/read/24649/

◆ Public Health Consequences of E-Cigarettes

E-cigarettes are diverse products containing a heating element which produces an aerosol from a liquid that can be inhaled via a mouthpiece. They are used by millions in the United States, with use greatest among young adults, particularly young males. This Congressionally mandated report concludes that, compared with conventional tobacco cigarettes, e-cigarettes deliver nicotine similarly but have less toxicants, have significantly less biological activity in most—though not all—in vitro, animal and human systems, and may be useful as a cessation aid for conventional smokers. However, the report cautions that users are more likely to transition to combustible cigarette use and continued research is needed to clarify if e-cigarettes reduce—or induce —harm at the individual and population level.

https://www.nap.edu/catalog/24952/

In Briefs *(from page 6)*

Transportation

NEW WALLINGFORD STATION DEBUTS. The first train station to serve the new **CT*rail* Hartford Line** opened in **Wallingford** on November 6. Currently providing service to existing Amtrak trains, it is expected to begin serving trains on the CT*rail* Hartford Line by May. The $21 million project features several amenities aimed at improving the passenger experience, including high-level platforms on both sides of the tracks, elevators, stairways, canopies covering approximately half of each platform, ticket vending machines, a passenger information display system, and an overhead pedestrian bridge. To improve passenger safety, the new station features automatic platform snow melting systems, security cameras, and blue-light emergency call boxes. The new line will connect **New Haven** to Springfield, Massachusetts, with connecting or direct service to places like Boston and Vermont. It will pass through **Meriden** and **Berlin** on the way to Hartford, connecting Connecticut towns with New York City. The state is spending $564 million on the entire line, with the federal government contributing nearly $205 million.

AVANGRID AWARDS $2M FOR ZERO-EMISSION REBATES. Orange-based **AVANGRID, Inc.**, recently announced a $2 million grant for the **Connecticut Hydrogen and Electric Automobile Purchase Rebate** (CHEAPR) program, allowing Connecticut to continue offering up to $5,000 in rebates for Connecticut residents purchasing zero-emissions vehicles. Commissioner **Rob Klee** of the **Connecticut Department of Energy and Environmental Protection** said the grant will "help Connecticut meet its goals as part of an eight-state effort to put 3.3 million zero emission vehicles on the road by 2025."

CTDOT GETS $1.45M FOR BATTERY ELECTRIC BUSES. Last fall, the US Department of Transportation's Federal Transit Administration announced a new $55 million grant program funding various regional transit organizations for the purchase of low- and no-emissions buses and associated infrastructure. Under the "Low or No Emission (Low-No) Vehicle" program, the **Connecticut Department of Transportation** (CTDOT) will receive $1,450,000 in funding to purchase 40-foot Proterra E2 Max battery electric buses through a joint effort with **CT*transit's* Hartford Division** and **Greater Bridgeport Transit**.

STATE RELEASES $15M FOR TRANSIT-RELATED PROJECTS. The **Responsible Growth and Transit-Oriented Development Grant Program,** administered by the state **Office of Policy and Management**, will release $15 million to fund projects considered to be transit-oriented. **Berlin** will receive $536,884 to purchase property near a train station for redevelopment and **New Britain** will receive nearly $2 million to continue redeveloping the business district adjacent to the downtown **CT*fastrak*** station.

—Compiled and edited by Wendy Swift

The following Connecticut scientists were elected to the National Academies in 2017:

NATIONAL ACADEMY OF ENGINEERING

Arindam Bose, PhD
Consultant/Sole Organizer
AbiologicsB, LLC

NATIONAL ACADEMY OF MEDICINE

Amy F. T. Arnsten, PhD
Professor of Neuroscience and of Psychology
Yale School of Medicine

NATIONAL ACADEMY OF SCIENCES

Robert H. Crabtree, PhD
Conkey P. Whitehead Professor of Chemistry
Yale University

Nicholas Read, PhD
Henry Ford II Professor of Physics and
Professor of Applied Physics and Mathematics
Yale University

Karen C. Seto, PhD
Senior Associate Dean of Research,
Frederick C. Hixon Professor of Geography and
Urbanization Science, and Director of Doctoral Studies
Yale School of Forestry and Environmental Studies

Daniel A. Spielman, PhD
Henry Ford II Professor of Computer Science and
Statistics and Data Science
Yale University

Keynote *(from page 1)*

Best known for his work in unmanned air systems development while at the DARPA, Francis is recognized for significant contributions to the science and technologies of aeronautics through his leadership in the flight research of high performance manned and unmanned aircraft. He holds BS, MS, and PhD degrees in Aerospace Engineering Sciences from the University of Colorado, as well as an honorary Doctor of Science from that Institution.

He is a Fellow of the American Institute of Aeronautics and Astronautics (AIAA). Major awards include the AIAA Wright Brothers Lectureship; Smithsonian Air & Space Museum Trophy; the German Aerospace Society (DGLR) "Ehrennadel der Deutschen Luftfahrt" Medal; the AIAA Distinguished Service Award; the AIAA Hap Arnold Award for Aeronautical Program Management; the Israel Society of Aeronautics and Astronautics' Von Karman Memorial Lecture; and the Aviation Week & Space Technology Aerospace Laurels Award.

CORE *(from page 2)*

attribute part of our success to the fact that the things we are interested in are transformative change and truly collaborative partnerships. We want to create learning health care systems that one day will routinely use data generated every day in the course of health care delivery to enable the health care systems to produce the best care. Our team is dedicated to making that happen."

Krumholz noted that the health care industry is "catching up" with other industries to leverage data capabilities in new ways, including the use of machine learning, artificial intelligence and digital technologies.

"We seek to be on the cutting edge of what's next," he said. "We are trying to keep in touch with the bedside, appreciate the perspective of patients, apply new technologies and ask smart questions. We have an exciting opportunity to have even more impact by using good science and seeing it translated into action."

"One of the best things about our organization is that many on our team are medical practitioners, and many more have experience as patients or caregivers—and we link with patient groups, too," he said. "We understand firsthand the demands on the system, medical professionals and patients. Our job is to invent the future of medicine—one that is more responsive to the needs of patients, more affordable to people and society, more effective in informing choices, and more successful in helping patients achieve their goals."—***Karen Cohen, freelance writer and owner, The Write Stuff, LLC.***