The annual report is presented by the office of the president of Aurora Research Institute, which oversees the patient-centered research conducted throughout Aurora Health Care.

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Aurora Health Care
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ON THE COVER:
Aurora Research Institute’s Biorepository and Specimen Resource Center features robotic technology, otherwise known as ORBIT, which combines biospecimens and informatics (p.12).

The information presented in this annual report is intended for general information and educational purposes. It is not intended to replace the advice of your own physician. Contact your physician if you believe you have a health problem.
PURPOSE
We help people live well through innovative research.

VISION
Offer more treatment choices and improve patient outcomes through research and innovation.

VALUES
• Every patient and community deserves the best care.
• Resources should be managed responsibly.
• A healthy workplace is built through accountability, teamwork and respect.
Board of directors

Aurora Research Institute is governed by an advisory board of directors consisting of Aurora Health Care leaders who help shape the institute’s future.

Presidential Office

Randall Lambrecht, PhD
Senior Vice President

Chair

Patrick Falvey, PhD
Executive Vice President and Chief Transformation Officer

Treasurer

Gail Hanson
Chief Financial Officer

Secretary

Mike Lappin
Chief Administrative Officer, Corporate Secretary

Assistant Secretary

Rachelle (Shelly) Hart
Senior Vice President and General Counsel

Gerard Colman, PhD
Chief Operating Officer

Dennis Potts
Executive Vice President, South Region

Preston Simons
Chief Information Officer

“...the clinical research being conducted at Aurora Health Care underscores our system as a best-in-class destination health care provider. We connect patients to clinical trials and translate those results to better patient care and experiences. These ongoing innovations place Aurora at the forefront of the development of leading-edge therapies and medical technologies.”

Nick Turkal, MD
President and CEO, Aurora Health Care

Leadership team

AURORA RESEARCH INSTITUTE PRESIDENT’S OFFICE

Randall Lambrecht, PhD
President, Aurora Research Institute

Vicki Soerens
Executive Assistant

Kurt Waldhuetter
Vice President, Research Business Services

Kelly Piacsek, PhD
Vice President, Patient-Centered Research

MANAGERS

Karen Cheek, RN
Oncology Clinical Trials

Don Conrad
Research Business Innovation

Wendy Dunaj, RN
Cardiovascular Clinical Trials

Katie Klein
Research Publications

David Krum
Translational Research

Andy Marek
Research Analytics

Karen Michel
Translational Research

Annette Paul
Aurora BayCare Medical Center Research

Natalie Polinske
Biomarkers Program

Katie Richter
Clinical Trial Business Services

Carol Tutino, BSN
Neuroscience and Emerging Research Clinical Trials

Mindy Waite, PhD
Research Grants and Projects

PRESIDENT

Randall Lambrecht, PhD
Senior Vice President

CHAIR

Patrick Falvey, PhD
Executive Vice President and Chief Transformation Officer

TREASURER

Gail Hanson
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SECRETARY

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Chief Administrative Officer, Corporate Secretary

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Rachelle (Shelly) Hart
Senior Vice President and General Counsel

Gerard Colman, PhD
Chief Operating Officer

Dennis Potts
Executive Vice President, South Region

Preston Simons
Chief Information Officer

PATIENT-CENTERED RESEARCH DIRECTORS

Amy Beres, PhD
Oncology

Nina Garlie, PhD
Neuroscience and Emerging Areas

Natalie Polinske
Biomarkers Program

Katie Richter
Clinical Trial Business Services

Carol Tutino, BSN
Neuroscience and Emerging Research Clinical Trials

Mindy Waite, PhD
Research Grants and Projects

MEDICAL RESEARCH DIRECTORS

Dennis Baumgardner, MD
Aurora UW Medical Group/Editor-in-Chief, JFCRR

Michael Thompson, MD, PhD
Oncology (Early Phase Clinical Trial Program)

Judy Tjoe, MD
Stroke Center (TOSQUE)
Aurora Research Institute continues to be guided by its mission to help people live well through innovative research, and I am proud of how we embrace our mission to unlock unprecedented opportunities that drive discovery, technology and economic impact to enhance health care delivery.

Skilled scientists and research support staff working closely with talented physicians and gifted clinicians enable the creativity necessary to discover the secrets of health and disease with a sense of urgency, integrity and passion.

With numerous internal and external strategic partners, the institute supports hundreds of clinical trials and translational research studies throughout Aurora Health Care. I am delighted to share what we delivered in 2017 through our seventh annual report of patient-centered research.

I hope you’ll take some time to read about ways we’ve improved health and patient outcomes, empowered collaboration and supported new initiatives. Our sense of purpose lies in our patients’ stories; learn about four remarkable people and their battles.

On behalf of the entire institute, its board of directors, Aurora’s physicians and our heroic research participants, I am pleased to provide this highlight of our 2017 outcomes.

Helping people live well through innovative research,

Randall Lambrecht, PhD
Senior Vice President, Aurora Health Care/President, Aurora Research Institute
2017 data summary

**EXTERNAL FUNDING**

*2017 data summary*

$9 million expenditures

**BY SOURCE**

- Philanthropic Support ($2,273,530) 31%
- Extramural Grants & Awards ($2,144,942) 24%
- Industry Contracts ($1,910,502) 24%
- Other ($194,683) 2%

**BY CLINICAL FOCUS AREA**

- Emerging Research ($1,127,259) 43%
- Oncology ($924,771) 35%
- Neuroscience ($158,998) 29%
- Cardiovascular ($283,854) 52%
- Other ($25,000) 1%

**COMMUNITY BENEFITS**

>$1 million community benefit

A community benefit refers to any program, service or activity that represents Aurora Health Care in some way, supports the community and costs more than what we receive for providing the activity. Examples include clinical and community health research and studies on health care delivery that are generalizable, shared with the public, and funded by the government or a tax-exempt entity (including Aurora). Other activities include education initiatives.

**SCHOLARSHIP**

*2017 data summary*

$2.6 million external grants awarded

**BY SOURCE**

- Federal (4,172,452) 67%
- Foundation (4,399,692) 17%
- Industry (4,311,317) 12%
- State ($100,000) 4%
- Other ($25,000) 1%

**BY CLINICAL FOCUS AREA**

- Oncology ($1,356,563) 14%
- Emerging Research ($1,127,259) 43%
- Neuroscience ($158,998) 29%
- Cardiovascular ($283,854) 52%
- Other ($25,000) 1%

**$548,013 internal grants expenses**

**BY SOURCE**

- Industry Contracts ($3,910,562) 44%
- Extramural Grants & Awards ($2,114,942) 24%
- Philanthropic Support ($2,273,530) 31%
- Other ($194,683) 2%

**$105,308 internal grants awarded**

*supported by donations provided by Vince Lombardi Cancer Foundation and Styberg Foundation; all other awards supported by donations made to Aurora Health Care Foundation*
351 Aurora-authored publications*

*Includes peer-reviewed journal articles, book chapters and abstracts

3-year trend

RESEARCH BUSINESS SERVICES

285 research agreements

BY CLINICAL FOCUS AREA

Cardiovascular
(145) 41%

Oncology
(30) 9%

Emerging Research
(129) 37%

Neuroscience
(194) 53%

RESEARCH INNOVATION

20 unique entrepreneurial projects, intellectual property disclosures or both

5 startup companies supported by Aurora Research Institute
2017 data summary

**TOTAL PROJECTS**

498 total research projects* as of Dec. 31, 2017

*includes clinical trials and translational and biorepository studies

**TRANSLATIONAL STUDIES**

181 translational studies* as of Dec. 31, 2017

*includes basic science, preclinical, biospecimen, bioinformatic and medical practice research

3-year trend
OVERVIEW

CLINICAL TRIALS

317
open* clinical trials** as of Dec. 31, 2017

1,586
newly enrolled clinical trials subjects

*open to accrual or follow-up
**includes sponsored clinical trials, investigator-initiated trials, humanitarian use devices, compassionate and emergent uses, and registries

3-year trend

<table>
<thead>
<tr>
<th>Year</th>
<th>Cardiovascular</th>
<th>Oncology</th>
<th>Neuroscience</th>
<th>Emerging Research</th>
</tr>
</thead>
<tbody>
<tr>
<td>2015</td>
<td>289</td>
<td>79</td>
<td>172</td>
<td>22</td>
</tr>
<tr>
<td>2016</td>
<td>329</td>
<td>88</td>
<td>181</td>
<td>22</td>
</tr>
<tr>
<td>2017</td>
<td>317</td>
<td>88</td>
<td>181</td>
<td>22</td>
</tr>
</tbody>
</table>

3-year trend

<table>
<thead>
<tr>
<th>Year</th>
<th>Cardiovascular</th>
<th>Oncology</th>
<th>Neuroscience</th>
<th>Emerging Research</th>
</tr>
</thead>
<tbody>
<tr>
<td>2015</td>
<td>1,202</td>
<td>589</td>
<td>348</td>
<td>164</td>
</tr>
<tr>
<td>2016</td>
<td>1,409</td>
<td>585</td>
<td>388</td>
<td>101</td>
</tr>
<tr>
<td>2017</td>
<td>1,586</td>
<td>620</td>
<td>388</td>
<td>101</td>
</tr>
</tbody>
</table>
Research oversight and quality

Throughout Aurora Health Care, a network of diverse caregivers is working toward the common goal of achieving the highest level of professional and ethical standards in research.

Aurora Research Institute caregivers collaborate with various groups within the health system to ensure the conduct of efficient, transparent and safe research.

COUNCIL FOR QUALITY ASSURANCE AND IMPROVEMENT IN RESEARCH

The Council for Quality Assurance and Improvement in Research oversees the institute’s Quality Management Plan, which ensures high-quality compliant research is conducted throughout Aurora.

Chaired by Nina Garlie, PhD, the council includes a broad representation of the institute, as well as members from Research Subject Protection Program and Research Compliance.

The council develops a strategic annual quality monitoring plan, assesses key performance indicators and makes recommendations to improve the quality of research. Melanie Guenther, senior research quality specialist, and Marsha Rehklau, research quality specialist, administer the quality assurance activities and report findings to the council on a monthly basis.

Pictured, left to right: Melanie Guenther and Marsha Rehklau

RESEARCH SUBJECT PROTECTION PROGRAM/INSTITUTIONAL REVIEW BOARD

Led by Michelle Maternowski, Aurora’s Research Subject Protection Program (RSPP) is charged with the oversight of human and animal subject research conducted at Aurora, safeguarding the rights, welfare, and dignity of the human and animal subjects who participate in the research process.

RSPP’s responsibilities include managing Aurora’s institutional review board, which ensures research proposals meet the highest ethical standards.

Pictured, left to right: Sheldon Garrison, Brooke Mecheke and Linda Stahovic
JPCRR
Journal of Patient-Centered Research and Reviews

Published quarterly by Aurora Health Care through Aurora Research Institute. Journal of Patient-Centered Research and Reviews (JPCRR) is a peer-reviewed medical journal dedicated to improving patient outcomes and care experiences by sharing scholarly works from numerous disciplines.

RECORD READERSHIP

JPCRR extended its international reach in 2017, with more than half of online readers hailing from foreign countries.

The journal also added readers from 22 new countries in 2017, increasing the overall tally to 174. Irrespective of geography, JPCRR set a record high in annual readership, with nearly 30,000 article downloads, and closed the year with its most active quarter to date (more than 8,500 article downloads).

EDITORIAL BOARD EXPANSION

In addition to reaching more readers than ever before, the journal diversified the scope and doubled the size of its multispecialty editorial board in 2017, adding six physicians and scientists from institutions such as University of California Los Angeles, Mayo Clinic, and Barts and The London School of Medicine.

“These additions bring to the board fresh perspective and wisdom on matters including breast cancer surgery, gastroenterology, pediatrics and cardiovascular medicine,” Editor-in-Chief Dennis Baumgardner, MD, said.

Other 2017 highlights

Surpassed 65,000 total article downloads over four years of publication

Special issue on health disparities and inequities in the United States

Article of the Year awarded to “First-Case Operating Room Delays,” authored by Cox Bauer et al.

Published proceedings of Health Care Systems Research Network and Aurora Scientific Day research symposiums

To read the latest article or submit a scholarly work, visit: aurora.org/jpcrr
Aurora Research Institute’s Biorepository and Specimen Resource Center (BSRC) collects, processes, stores and distributes biospecimens from consenting research participants throughout Aurora Health Care. This allows Aurora researchers, academic institutions, companies and other investigators to advance innovative research to improve outcomes more quickly and easily.

“BSRC efficiently collects biospecimens from generous Aurora patients and provides them to the researchers who need them most,” said Natalie Polinske, manager of the biorepository program. “We play a key role in helping to advance health care innovations.”

BSRC has amassed a diverse inventory of more than 70,000 discarded blood products (whole blood, plasma and serum) and collects surgically removed tumor and tissue samples for current and future research studies.

Through trusted collaborations with external partners, BSRC shares samples with investigators throughout the country.

Supported by the institute’s Research Analytics team, the open-access robotic biorepository and informatics technology (ORBIT) searches for eligible biospecimens. All biospecimens are linked to the electronic health record so that relevant clinical data are associated with every sample. BSRC provides de-identified data through an honest broker system.

BSRC maintains approval by Aurora’s institutional review board (IRB) to manage protocols for the collection of biospecimens that are donated by generous research participants. Established IRB protocols help ensure that BSRC provides researchers the exact type of biospecimen their studies require in a highly efficient manner.

- 199,394 patients consented to donate blood samples since 2008
- >70,000 inventory of whole blood, plasma and serum samples
- 15 biospecimen requests fulfilled in 2017

15 tissue collection research projects as of Dec. 31, 2017

Cardiovascular (3) 25%
Neuroscience (5) 25%
Oncology (6) 50%

274 tissue collections in 2017

Cardiovascular (144) 53%
Neuroscience (39) 14%
Oncology (91) 33%
Recognitions

“I have the distinct privilege of working with some of the most talented people in the world.”
Randall Lambrecht, PhD, Aurora Research Institute president

RESEARCH RECOGNITION EVENT (Milwaukee, Wisconsin)
- Alenia Brooks, Research Hero Award
- Vinay Thohan, MD, Cardiovascular Research Award
- Antony Ruggeri, MD, Oncology Research Award
- Srikanth Chakravarthi, MD, Neuroscience Research Award
- Santhi Konduri, PhD, Principal Investigator Award
- Lynda Yanny, BSN, Clinical Trials Research Award
- Stacie Edwards, Research Appreciation Award
- Melanie Guenther, Research Appreciation Award
- Callie Cox Bauer, DO, Danielle Greer, PhD, Kiley Vander Wyst, Scott Kamele, MD, Journal of Patient-Centered Research and Reviews Article of the Year Award
- Katie Klein, Aurora Research Institute President’s Award

FALL RESEARCH AND MEDICAL EDUCATION RECEPTION (Green Bay, Wisconsin)
- Dhimant Patel, MD, Aurora Research Institute President’s Award
- Stephen Brada, MD, Medical Educator of the Year
- Pediatrics, Medical Education Department of the Year
- Byron Crouse, MD, Special Medical Education Award
- M. Ziad Darkhabani, MD, Principal Investigator of the Year
- John Bosco, MD, Innovation Award
- Gerald Eckardt, MD, Principal Investigator in Clinical Research Award
- Daniel McKenna, MD, Principal Investigator in Clinical Research Award
- Melisa Engebose, RN, Research Support Award
- Jennifer Meredith, Research Support Award
- Peggy Process, RN, Research Support Award
- Amanda Thompson, NP, Research Support Award
- Julie Zeeman, RN, Research Support Award

Fall Research and Medical Education Reception award recipients
AURORA SCIENTIFIC DAY

Rieselbach Distinguished Papers
• Susan Olet, PhD – Incremental Value of Estimated Glomerular Filtration Rate in Improving Stroke Risk Stratification in Patients With and Without Atrial Fibrillation Deemed Low Risk by CHA₂DS₂VASc Score
• Sara Stanenas, DO – Hormonal Contraception and Therapy Use in Breast Cancer Survivors: Do Recurrence and Mortality Risks Increase?

Oral Presentations
• 1ST PLACE – Judy Tjoe, MD
• 2ND PLACE – Jessica Behrens, DO
• 3RD PLACE – Ibrahim Habib, MD
  Pediatric GI Endoscopic Procedures Can Be Safely Done in Ambulatory Surgery Centers

Judged Posters
• 1ST PLACE – Bilal Omery, MD
  Assessment of Chronic Disease to Determine Appropriateness of Implantable Cardioverter-Defibrillator Therapy
• 2ND PLACE – Scott Chandler, DO
  Impact of Primary Care Provider Education on Appropriate Level of Opioid Prescription for Chronic Noncancer Pain
• 3RD PLACE TIE – David Kress, MD
  Characterizing Recurrence Following Hybrid Ablation in Patients With Persistent Atrial Fibrillation
• 3RD PLACE TIE – Christina Sauld, MSN
  Remote Hemodynamic Monitoring Program: A Single-Center Experience in Reducing Heart Failure Admissions
DISTINCTIONS

Academic relations

Aurora Research Institute is dedicated to providing educational opportunities for future researchers with a variety of internships and shadow opportunities.

LEARNING TO LOVE RESEARCH

Medical research was never part of Janae Lampkins’ career plan. And she had a detailed plan.

The junior at Cardinal Stritch University has long aspired to become a pediatric anesthesiologist. She remembers how impressed she was as a 16-year-old by the anesthesiologist who helped a family member through a medical procedure.

“I began to ask her questions about her career,” Lampkins said. “I knew then that I wanted to be responsible for seeing a person through such an uncomfortable and worrisome process.”

She also knew that before enrolling in college, she’d uphold a family tradition of serving in the military by enlisting in the U.S. Army. Lampkins has a great-grandfather, three uncles, two cousins and an aunt who currently serve or have served in the Army. Lampkins enlisted after high school.

Lampkins, 23, had never considered going into research until the day her biology professor at Cardinal Stritch recommended her to Nina Garlie, PhD, director of patient-centered research for neuroscience and emerging areas, for an internship at Aurora Research Institute. Lampkins earned one of 23 summer internship positions out of more than 80 applicants, and she continued her research through the 2017-2018 school year, with funding by Cardinal Stritch through the Great Lakes Higher Education Corporation & Affiliates’ Career Ready Internship Grant.

Working both at Aurora St. Luke’s Medical Center’s Regenerative Medicine Center and Aurora Sinai Medical Center’s Discovery Laboratory, both in Milwaukee, Lampkins contributed to various cancer research projects, including whether exosomes, or microscopic cell products, which are normally used by cells to communicate with other cell types, can instead be used to send orders to cancer cells to stop reproducing or even to die.

“Janae is incredibly talented and motivated,” said Amy Beres, PhD, director of patient-centered oncology research. “She has truly been the driving force behind this project.”

Lampkins’ drive and discipline — honed in her two years of active military service — even caught the attention of Milwaukee’s FOX6 News, which profiled her and her research for Veterans Day.

Lampkins still has her eye on anesthesiology, but, over the course of her internship, she began to see how she can incorporate research into her career goals.

“Research is critical to the care that is provided for patients,” she said. “And it takes patience and dedication to work in the lab.”

Amy Beres (left) mentors Janae Lampkins as she looks under a microscope at Aurora Research Institute. (Photo courtesy of Cardinal Stritch University.)

Over the course of her internship, Lampkins began to see how she can incorporate research into her career goals.
AURORA RESEARCH INSTITUTE SUMMER STUDENT INTERNSHIP PROGRAM
Led by Randall Lambrecht, PhD, and David Krum

Arian Albert, junior at University of Minnesota-Twin Cities
Mentors: Danielle Greer, PhD, Dennis Baumgardner, MD

Matthew Bemis, first-year at University of Wisconsin-Madison School of Pharmacy
Mentors: Anthony DeFranco, MD, Eric Weiss, MD, Tracy Hammonds, PhD

Austin Epping, senior at Viterbo University
Mentors: Sarika Walia, MD, Srikanth Chakravarthi, MD

Emily Grubich, junior at Loyola University Chicago
Mentor: Ariba Khan, MD

Kelley Grubich, junior at Northwestern University
Mentor: John Richards, PhD

Kayla Heslin, second-year graduate student at University of Iowa-City
Mentors: Danielle Greer, PhD, Judy Tjo, MD

Brian Hoeynck, second-year medical student at Creighton University School of Medicine
Mentors: Jessica Kram, Dennis Baumgardner, MD

Manoj Khanal, graduate student at University of Wisconsin-Milwaukee
Mentor: Rosy Joshi-Mukherjee, PhD

Janae Lampkins, junior at Cardinal Stritch University
Mentor: Amy Beres, PhD

Ismail Ahmad, junior at Benedictine University
Mentor: Farhan Rizvi, PhD

Minhal Gardezi, sophomore at Wellesley College
Mentor: Hershel Raff, PhD

Momin Mohis, junior at Johns Hopkins University
Mentor: Gracious Ross, PhD

Manisha Pirzani, senior at Emory University
Mentor: Santhi Konduri, PhD

Saagar Shah, sophomore at Illinois Institute of Technology
Mentor: Larisa Emelyanova, PhD

AURORA METRO MEDICAL STAFF SUMMER RESEARCH FELLOWSHIP PROGRAM
Led by Neil Guenther, MD, and Hershel Raff, PhD; supported by physicians who donated to Aurora Health Care Foundation’s Medical Staff Endowment Fund

Noah Wlodarski, sophomore at Loyola University Chicago
Mentor: Amber Lacrosse, PhD

AURORA BAYCARE MEDICAL CENTER RESEARCH INTERNSHIP PROGRAM
Led by Annette Paul

Alex Baek, graduate of University of California-San Diego
Mentors: Alex Albers, Taylor Romdenne, Danielle Greer, PhD

Matt Kroll, first-year medical student at St. George’s University
Mentors: Alex Albers, Taylor Romdenne, Danielle Greer, PhD

AURORA RESEARCH INSTITUTE SUMMER STUDENT INTERNSHIP PROGRAM
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SHADOW OPPORTUNITIES
In addition to providing opportunities for students through internships, Aurora Research Institute has provided other educational experiences like shadow opportunities for Discovery World campers (pictured: Sarika Walia, MD, left) and engineering students in Marquette University’s E-Lead program, and Aurora Health Care’s diversity and inclusion initiative Make It in Milwaukee.
Together, we raised more than $1 million to support research efforts and other initiatives led by Aurora Health Care.

Thank you to our generous sponsors:

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Mortenson

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Jere McGaffey and Foley & Lardner LLP

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Aurora Research Institute

Joanne Disch and Jane Barnsteiner
Sheldon and Marianne Lubar Charitable Fund
Donald J. and Gale A. Nestor
Dr. Nick and Kathy Turkal

give.aurora.org/gala
Aurora Gala

A record-breaking crowd of more than 900 guests came to celebrate research and innovation led by Aurora Health Care physicians, scientists and visionary leaders at Aurora Health Care Foundation’s 2017 Aurora Gala presented by Synaptive Medical.

Aurora Research Institute will use its portion of the proceeds to help transform innovative research into extraordinary care by providing critical seed funding to Aurora researchers for ongoing and future studies, and education for future researchers through clinical and laboratory-based opportunities.

“On behalf of the institute, I would like to express my profound appreciation to the donors and supporters of research at Aurora,” said Randall Lambrecht, PhD, senior vice president of Aurora Health Care and president of Aurora Research Institute. “This generous gift will be used to fund original patient-centered research and the education of future researchers through internship and fellowship opportunities.”

The black-tie event featured innovation stations by Synaptive, Medtronic, APN Health and Aurora Research Institute, which showcased its growing transformative research program funded by the Howe Fund for Innovation.

During the night, guests witnessed stories of survival from Aurora patients, including Lee Pinkus, who is highlighted on Pages 47-48.

“The stories of these courageous people who have fought, and continue to fight, disease affirm the decision of so many at Aurora who are dedicated to research and finding more options that result in better outcomes for patients,” Dr. Lambrecht said.
Philanthropy

Aurora Research Institute caregivers found even more ways to give back to their communities this year. In addition to donating and fundraising for Aurora Health Care Foundation’s 2017 Aurora Partnership Campaign, institute caregivers shopped, played, read, walked, educated and more. Some highlights include collecting holiday gifts for local students, boxes of cereal for local food pantries, and supplies for the women and children at Meta House; volunteering at schools and Boys and Girls Clubs in Green Bay and Milwaukee through Aurora Health Care’s Weeks of Caring campaign; and staffing a booth at the American Heart Association 2017 Greater Milwaukee Heart and Stroke Walk/5K Run.

BAILED OUT

Notorious criminals Snake Oil Kate (a.k.a. Katie Klein, manager of research publications) and Doc (a.k.a. Mindy Waite, PhD, manager of research grants and projects) raised $267 for the Aurora Foundation Patient-Centered Research Fund as part of a Jail-and-Bail event.

ADOPT-A-STUDENT

Forty institute and Center for Urban Population Health caregivers fulfilled wishes of warm clothes, action figures, dolls and more for 27 economically disadvantaged students in Milwaukee through the Aurora Sinai Medical Center Adopt-A-Student program.

“It’s heartwarming to see not only the amount of participation we get each year for the Adopt-A-Student gift drive, but the excitement by our caregivers,” said Julie Basquin, financial planning manager.
Cardiovascular research

163 cardiovascular research projects as of Dec. 31, 2017

620 new subjects enrolled in cardiovascular trials in 2017

145 cardiovascular publications in 2017
By almost any measure, Jeff Shirley, 56, of Baroda, Michigan, has an alarming family history of heart problems.

Shirley, like his father did, loves sports, particularly basketball. But he always has, in the back of his mind, the knowledge that his father died on a basketball court from “a massive coronary” at age 46.

When Shirley’s mother was in her early 60s, she had several heart bypass surgeries before dying due to heart complications within a few years. Shirley’s maternal grandmother, was born with a problematic heart defect. Her husband, Shirley’s maternal grandfather, died at age 51 of a heart attack as well. Shirley’s paternal grandmother died of congestive heart failure.

“And those are just the main players,” he said.

After his own initial battle with heart disease, Shirley was ultimately diagnosed with an inability to break down lipids or fats in the body.

However, cardiac researchers are conducting a clinical trial for a drug designed to improve Shirley’s heart condition and were looking for trial participants. Trying to avoid the fate of so many in his family tree, Shirley has enrolled as a research participant at Aurora St. Luke’s Medical Center in Milwaukee.

The “cold pressure” in his chest was not from a chest cold or stress.

HEART TROUBLES OF HIS OWN

In May 2015, Shirley began to feel what he called “cold pressure” in his chest. He thought maybe he was getting a chest cold, but other cold symptoms never came. Then he thought the chest pressure might be stress. Shirley, who served on a nuclear submarine in the United States Navy, is now a maintenance supervisor at a nuclear power plant.

“Working at a nuclear power plant is pretty stressful,” he said.

Finally, Shirley decided it didn’t matter if the cause of the pressure was from a cold, stress or something else, he needed to see a local doctor.

“I went in, had an angiogram, had three major blockages and got two stents,” he said.

The chest pressure subsided, Shirley began exercising again and life moved on — briefly.
By October 2015, Shirley was back in the hospital, this time for triple bypass heart surgery due to all new blockages in his arteries that weren’t there at the time of his previous visit.

Shirley was referred to a local cardiologist, and, over the next several months, he continued to feel pressure in his chest, continued to receive angiograms and continued to fill prescriptions for medications to alleviate the pressure. By summer of 2017, Shirley’s cardiologist in Michigan recommended he make an appointment at Cleveland Clinic, if he was willing to make the five-hour drive.

SEARCHING FOR SOLUTIONS

Doctors at Cleveland Clinic provided some clarity, diagnosing Shirley with premature coronary artery disease and an abnormal lipid profile.

The Cleveland Clinic doctors told Shirley that there was no treatment, but there was a clinical trial studying a drug designed to treat an abnormal lipid profile in participants with cardiovascular disease.

Very interested but concerned about the long drive to Cleveland, Shirley asked if there were any other study sites that might be closer. After hearing that there was a trial site in Milwaukee, Shirley did a little research.

“Then I found out it was this place,” Shirley said about Aurora St. Luke’s Medical Center.

Aurora St. Luke’s is still a three-hour drive from Baroda, but, satisfied that Aurora would take good care of him, Shirley had the Cleveland Clinic doctor contact Jennifer Cooper, BSN, the Aurora St. Luke’s research coordinator for the trial. Cooper obtained Shirley’s initial consent for the trial and introduced him to Anthony DeFranco, MD, cardiovascular disease specialist and Aurora principal investigator for the trial.

“This is an area of specialty for Dr. DeFranco,” Cooper said.

PARTICIPATING IN CLINICAL RESEARCH

The clinical trial is placebo controlled, meaning there is an equal chance of getting the study drug or a placebo.

“This is what we call a double-blind study, so none of us know if he’s getting the drug or not,” said Dr. DeFranco, who enrolled Shirley in the trial. “Not even the pharmacy knows.”

But that didn’t matter to Shirley, who was eager to help advance the research and will take any chance he can get to become the exception to his family’s history of heart problems. Shirley will complete the trial in November.

“It wouldn’t have mattered if I only had a 10 percent chance of receiving the drug,” he said. “Doing a drug trial benefits the science, and maybe at some point I will see some benefit out of it.”
Clinical research

LEADING THE WAY IN PULMONARY ARTERIAL HYPERTENSION

Pulmonary arterial hypertension (PAH) is a rare but serious condition that causes critically high pressure in the pulmonary arteries, which connect the heart to the lungs. Women with the condition are counseled to avoid pregnancy as it could be fatal.

Sixteen years ago, cardiovascular disease specialist Dianne Zwicke, MD, developed a protocol for treating PAH in pregnant women, which, to date, has been successful in keeping alive 100 percent of the mothers and children her team has treated.

“The death rate of the mothers with PAH is 35 to 57 percent in the best of situations in the U.S. and abroad,” she said. “Except here at Aurora St. Luke’s Medical Center, where it is zero. Since 2002, we have had 100 percent survival.”

After years of trying to educate her colleagues around the world, Dr. Zwicke’s work is beginning to find a foothold. She recently traveled to Bologna, Italy, for the “Cardiac Problems in Pregnancy” conference, where she received an award for Clinical Researcher of the Year. What’s more, for the first time, the latest edition of the Cardiac Problems in Pregnancy textbook will include a chapter on PAH in pregnant women, with Dr. Zwicke as the author.

Dr. Zwicke’s research into PAH goes beyond treating pregnant women. She opened six new clinical trials with Aurora Research Institute in 2017, bringing her total number of enrolling trials to 12, as of publication. The trials study various oral and inhaled drugs for a range of conditions associated with PAH.

“Dr. Zwicke feels every study has potential significance to benefit future patients,” said Linda Boehm, RN, research coordinator on seven of Dr. Zwicke’s open trials. “Every study, each unique pathway and any opportunity to provide help for the PAH population is worth exploring, since there is so little available to them.”

“Since 2002, we have had 100 percent survival”

- Dianne Zwicke, MD
FROM TAVR TO TMVR

Starting with participation in clinical trials seven years ago, Aurora Health Care continues to advance heart valve treatments using noninvasive heart valve replacement systems, which provide less invasive alternatives to open-heart surgery.

After celebrating its 1,000th transcatheter aortic valve replacement (TAVR) procedure — the first health system in the country to perform that many — in 2016, Aurora is building on that success. In 2017, Aurora St. Luke’s Medical Center in Milwaukee enrolled the first patient in the United States in the landmark APOLLO trial for Medtronic’s Intrepid™ transcatheter mitral valve replacement (TMVR) system (clinicaltrials.gov identifier: NCT03242642).

Interventional cardiologist Tanvir Bajwa, MD, and cardiothoracic surgeon Daniel O’Hair, MD, who also serves as co-vice president of the Aurora cardiovascular and thoracic service line, led the implantation team and serve as Aurora Research Institute’s lead investigators for the international clinical trial.

The trial is designed to evaluate the safety and efficacy of the TMVR system in up to 1,200 patients with severe, symptomatic mitral valve regurgitation, which, left untreated, can lead to heart failure or death.

Aurora’s success with TAVR procedures has continued as well. The institute’s research efforts were key in Medtronic’s CoreValve™ device gaining Food and Drug Administration (FDA) approvals for various uses in 2014 through 2016. In 2017, Aurora has contributed to the FDA’s decision to expand the population eligible for the TAVR procedure to those with intermediate risk for open-heart surgery based on the outcomes of the SURTAVI clinical trial (clinicaltrials.gov identifier: NCT01586910). Aurora is no longer enrolling patients in the SURTAVI trial; enrolled participants will be followed for 10 years after receiving the device.

Aurora is the only site in Wisconsin to participate in the trials contributing to the various approvals for CoreValve™ and was the first in the state to offer it to patients after each FDA approval.

TFVR ACCOMPLISHMENTS

Aurora’s TAVR team was recognized by Boston Scientific Corp. as the third highest enroller in the REPRISE III clinical trial, which studies the use of the Lotus™ Valve System and Lotus Edge™ Valve System in TAVR procedures (clinicaltrials.gov identifier: NCT02202434).

Dr. Bajwa was also an author on the REPRISE III study’s endpoint article published in Journal of the American Medical Association (2018;319:27–37).

CLINICAL TRIAL STATISTICS - CARDIOVASCULAR

88 open clinical trials* as of Dec. 31, 2017

620 new subjects enrolled in 2017

*open to accrual or follow-up, includes 18 registries
Translational research

DEVELOPING TOOLS TO GUIDE CARE

Aurora Health Care cardiovascular specialists combine experience with leading technologies and therapies to deliver personalized care. Aurora Research Institute scientists and biostatisticians, collaborating with analysts from the institute’s Research Analytics department, are developing and implementing clinical decision support tools that assist these doctors in making the most informed and precise care decisions possible.

Recent clinical decision support breakthroughs at Aurora include a tool that determines surgical risk for a specific heart procedure, a way to simulate clinical trials using real patient data, and electronic health record modifications that signal when genetic testing should be ordered to determine the best medication prescription for heart attack and stroke prevention.

PERSONALIZING PRESCRIPTIONS

Someday soon, a patient will be able to walk into a pharmacy, bring up her gene sequence on her smartphone and ask for a prescription based on her individual genome, joked Michael Michalkiewicz, PhD, senior research scientist, at a presentation of his current research project, a collaborative precision medicine study for which he is the principal investigator for Aurora.

That future may not be too far off. Through his research, funded by National Institutes of Health via an award from Vanderbilt University, Dr. Michalkiewicz has developed a clinical decision support tool that interfaces with Aurora’s electronic health record system to assist physicians in prescribing the most effective heart attack and stroke prevention medications based on the patient’s genotype.

Much of Dr. Michalkiewicz’s research is focused on clopidogrel, the most commonly prescribed antiplatelet drug.

“Because of a mutation in their CYP2C19 gene, some patients do not respond well to treatment with clopidogrel,” Dr. Michalkiewicz said.

To combat this, Dr. Michalkiewicz developed a system that streamlines

“Taking into account a patient’s genetic characteristics, in some instances we can be more precise in selection of a more effective and less harmful drug.”

– Michael Michalkiewicz, PhD
orders for genetic testing and automates results. Those genetic test results are processed through an algorithm within the electronic health record, which then provides physicians with a prescription tailored to the patient, thus enhancing treatment efficiency and safety.

“One type of drug does not cure all patients to the same extent, or it could even be harmful for some,” Dr. Michalkiewicz said. “Taking into account a patient’s genetic characteristics, in some instances we can be more precise in selection of a more effective and less harmful drug.”

Looking ahead, Dr. Michalkiewicz said the clinical decision support tool could be expanded to find genetic pairings for a number of other drugs, including pain killers, antidepressants and many anticancer drugs.

A graphical depiction of personalized prescriptions

Four-year grant total: more than $775,000

Cardiovascular Services and ACL Laboratories and with help from Aurora’s information technology department. The tool will first be implemented at Aurora St. Luke’s Medical Center in Milwaukee. His next step will be to assess whether genetic testing yields better outcomes for patients in need of heart attack and stroke prevention therapy. As part of the study, Dr. Michalkiewicz will also evaluate prescribing patterns and improvements in outcomes for patients who had their particular gene sequence examined. The study, which began in 2015, will wrap up in this year. He hopes to publish the results of the study in 2019.

DETERMINING RISK TO SAVE LIVES

When cardiologist Daniel Ortiz, MD, was a resident at Aurora St. Luke’s, he witnessed firsthand the potential dangers when a high-risk patient undergoes a major medical procedure. In Dr. Ortiz’s case, the procedure performed was peripheral vascular intervention (PVI) and the risk was potentially fatal internal bleeding.

This led Dr. Ortiz — recipient of the 2014 Sullivan Cardiac Research Award for Residents and Fellows, made possible by a $1 million donation from Vivian and Tim Sullivan of Milwaukee to Aurora Health Care Foundation — to create a clinical decision support tool with the help of a cross-functional research team, which included Maharaj Singh, PhD, Aurora Research Institute senior biostatistician.

Together they developed a set of criteria that a nurse will review before a patient undergoes the procedure. The criteria can help identify patients who are at high risk for complications.

“Out of all of the research projects on which I’ve worked, Dr. Ortiz’s PVI research had the best patient-centered outcome and one of the best publications,” Dr. Singh said.

Doctors at Aurora St. Luke’s are using the tool now.

“This is groundbreaking, because this tool didn’t exist before; no one thought it was possible, because there are so many ways this surgery can be done, and every patient is different,” Dr. Ortiz said. “But our method works, and it’s already saving lives.”
Translational research

SIMULATING CLINICAL TRIALS TO TARGET RESEARCH

Clinical trials are the standard pathway of testing new therapies before they are approved for general use. Clinical trials are time consuming, often requiring years of study and patient follow-up.

Kourosh Ravvaz, MD, PhD, Aurora Research Institute senior research scientist, is looking for innovative ways to evaluate new treatments on a shorter timeline. With collaborators at Harvard Medical School, Brigham and Women’s Hospital, and the University of Minnesota, Dr. Ravvaz published a study in Circulation: Genomic and Precision Medicine utilizing a new method for simulating clinical trials by using clinical avatars, or simulated subjects (2017; epub ahead of print).

The study, supported by a National Institutes of Health grant, demonstrates how patient data can be used to guide precision medicine research.

“This study set out to create a virtual sandbox, where we could test multiple protocols at once across diverse patient populations,” Dr. Ravvaz said.

Real patient data was combined with genetic data from similar populations to create the clinical avatars. The new data from the avatars was then analyzed as if the avatars had been subjects in a clinical trial.

The researchers applied the new simulation method to address the difficulties of warfarin therapy, a common blood-thinning drug used to prevent stroke and the single greatest cause of drug-induced emergency room visits for older Americans.

The simulated trial found that for about one-third of the clinical avatars, who have rare genes and are younger than average, standard warfarin therapy can lead to dangerous complications. The simulated trial suggested these patients receive a more complex treatment protocol or an altogether different drug.

Although simulation will not replace real-world clinical trials in the foreseeable future, Dr. Ravvaz said it could lead to more targeted research, and potentially more precise patient management.

Four-year grant total: more than $315,000
American Physiological Society highlighted an abstract led by Farhan Rizvi, PhD, Aurora Research Institute research scientist, that was presented at the organization’s Cardiovascular Aging: New Frontiers and Old Friends conference in Westminster, Colorado.

Dr. Rizvi and his team identified a molecule that can be measured with a noninvasive blood test to help predict the patients most at risk of experiencing atrial fibrillation (AFib), or irregular heartbeat, following cardiac surgery.

The risk of this postoperative complication increases with age, but it is difficult to identify patients who are at highest risk, especially if there is no history of AFib or severe heart ventricle problems prior to surgery. Routine tests used to identify patients at risk of postoperative atrial fibrillation, such as electrocardiogram and biochemical and imaging biomarkers, are available but lack accuracy. Therefore, Dr. Rizvi’s team hypothesized that testing of microRNAs — small molecules that help control actions of genes, protein synthesis and biological processes — could offer a better predictive approach.

The analysis revealed age and higher levels of one particular type of microRNA (miR-423) circulating in the blood were independent predictors of postoperative atrial fibrillation.

“This study provides new information that will be used to design a larger clinical study to aid preoperative identification of postoperative atrial fibrillation risk,” Dr. Rizvi said.

Dr. Rizvi’s research was funded by Aurora Cardiovascular Surgery Research Awards and the David V. Uihlein Foundation.
Aurora Research Institute   |  2017 Annual Report

Grant awards

EXTERNAL FUNDING

$356,563 received in 2017 from federal and industry sources

2017 external awards

- The MyHEART study: a young adult hypertension self-management randomized controlled trial
  Investigator: Lisa Sullivan Vedder, MD
  $185,887
  National Institutes of Health subaward from University of Wisconsin-Madison

- Chitogen SoftSeal™-STF hemostatic pad compared to Vasc Band™ hemostat for hemostasis following transradial access during diagnostic and interventional procedures
  Investigator: M. Fuad Jan, MD
  $136,334
  Chitogen

- Using systems science methods to study cardiac risk in the Somali community
  Investigator: Ahmed Dalmar, MD
  $24,118 (continuing support)
  National Institutes of Health subaward from HealthPartners Institute for Education and Research

- A pragmatic multicenter randomized trial antihypertensive therapy for mild chronic hypertension during pregnancy (CHAP)
  Investigator: Ryan Stone, MD
  $10,224
  National Institutes of Health subaward from University of Wisconsin-Madison

Award highlight

Lisa Sullivan Vedder, MD, of Aurora Family Care Center received a National Institutes of Health/National Heart, Lung, and Blood Institute subaward totaling $956,228 over a five-year period from University of Wisconsin-Madison to help support the MyHEART study, “Young adult hypertension self-management clinical trial” (clinicaltrials.gov identifier: NCT03158051).

The two health care systems will evaluate MyHEART’s impact on blood pressure among 310 geographically and racially/ethnically diverse young adults age 18 to 39 with hypertension. Through MyHeart, young adults are coached by phone on ways to manage uncontrolled hypertension through lifestyle modifications such as exercise, nutrition, weight loss, smoking cessation and stress management.

The study includes four components:
- telephone-based health coaching with adult education specialists to teach self-management skills
- electronic health record documentation of coach-subject telephone contacts
- individualized hypertension education materials
- home blood pressure monitoring

The goal is to determine whether the MyHEART interventions significantly decrease blood pressures and increase hypertension self-management compared to usual clinical care. The trial differs from previous studies by targeting barriers specific to young adults, such as time to meet with a doctor, resources and access to health care, knowledge of hypertension, and motivation to make lifestyle changes. The results of this study will address an unmet need by providing evidence-based interventions that improve hypertension control in young adults.

Mary Briggs-Sedlachek, RN, and Lori McElrone are the clinical trial coordinators. Abigail Tran and Erin Barwick are the health coaches.
There are numerous treatment options for patients with atrial fibrillation, or abnormal heart rhythm. In an effort to determine which treatments will ultimately result in the best outcomes, cardiac electrophysiologist Vinay Mehta, MD, will compare them as part of his study, “Does catheter ablation in patients with cardiomyopathy and atrial fibrillation/flutter lead to decreased mortality and hospital readmission?”

Dr. Mehta, winner of the 2017 Cardiac Research Award, received $22,100 from Aurora Research Institute to conduct the study.

The study, conducted with the help of Alex Albers, research coordinator, will use national provider inpatient data from Centers for Medicare and Medicaid Services to compare treatment outcomes for patients who were hospitalized for heart failure and treated for atrial fibrillation or atrial flutter.

The goals of the study are to determine the frequency with which different treatment options — cardioversion, cardiac ablation or neither — were used in patients admitted with heart failure and to compare the outcomes of those treatment options. The results obtained from this study will be used to develop future studies to validate best practices in the treatment of patients presenting with systolic heart failure and atrial dysrhythmia.
CARDIOVASCULAR RESEARCH

Cardiovascular research appendix

Co-VPesidents, Aurora Cardiovascular Services
Daniel O’Hair, MD   Jasbir Sra, MD

COMMITTEES

Cardiovascular Clinical Trials Committee
Co-chair: Indrajit Choudhuri, MD
Co-chair: Nasir Sulemanjee, MD

Cardiovascular Investigator-Initiated Research Committee
Co-chair: Renuka Jain, MD
Co-chair: Imran Niazi, MD

Cardiovascular Fellowship Research Committee
Co-chair: Suhail Allaqaband, MD
Co-chair: M. Fuad Jan, MD

VOLUMES (SYSTEMWIDE)
Source: Clarity 2

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<th>CARDIOVASCULAR SURGERY</th>
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<td>942</td>
<td>1,004</td>
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<td>CABG on pump</td>
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<td>718</td>
<td>774</td>
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<td>Mitral valve replacement</td>
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<td>Aortic valve repair</td>
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<tr>
<td>Other valve repair</td>
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<td>Catheterization w/ pressures</td>
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<td>Angiogram w/o pressures</td>
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<td>With stent</td>
<td>2,254</td>
<td>2,206</td>
<td>1,840</td>
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<td>Drug-eluting stent only</td>
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<td>Non-drug-eluting stent only</td>
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<tr>
<td>Both</td>
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<td>75</td>
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<tr>
<td>Percutaneous CI without stent</td>
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<td>Open</td>
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<td>111</td>
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<td>Closed</td>
<td>58</td>
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<td>272</td>
<td>334</td>
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<th>Transcatheter mitral valve replacement (TMVR)</th>
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<td>With stent</td>
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<td>Without stent</td>
<td>847</td>
<td>1,331</td>
<td>886</td>
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<td>147</td>
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<tr>
<td>Open</td>
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<tr>
<td>Open</td>
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<td>Cardiac mapping</td>
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<td>Cardioversion</td>
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<th>Ablation – percutaneous</th>
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19 abstracts accepted for presentation by American College of Cardiology

For a second year in a row, American College of Cardiology accepted 19 abstracts by Aurora Health Care researchers for presentation at its 2017 annual meeting. Of those 19 studies, seven were co-authored by Aurora Research Institute caregivers.

Pateric TE, Patel N, Ammar KA, Chandrasekaran K. Improving health outcomes through patient education and partnerships with patients. Prog (Baylor Univ Med Cent) 2017;30:112-3.


Ravazz K, Weissert JA, Ruff CT, Chi CL, Tonellato NZ. Does left ventricular assist device implantation affect driving patterns in patients with end-stage heart failure? VAD J 2017;5:Article S.


204 oncology research projects as of Dec. 31, 2017
388 new subjects enrolled in oncology trials in 2017
47 oncology publications in 2017
Jim Kleinschmit, 66, is a creature of habit.

He has lived most of his life in Oshkosh, Wisconsin. He taught fifth grade at the same elementary school in Waupaca, Wisconsin, for 37 years. After retiring in 2011, he got up every morning to go check on his elderly father, who lives alone, then went for a walk for some exercise and often spent the afternoons reading, usually historical fiction.

“There were always things I could find to do,” Kleinschmit said.

Kleinschmit and his fellow retired teachers would go on at least one trip a year — Nashville, Washington, D.C., Las Vegas — and he and his long-time girlfriend, Tammi Dillman, would often hike all over Wisconsin and travel out to Colorado to visit his son, Adam, and his 2-year-old grandson, Ryland.

‘GET YOUR YEARLY EXAMS’

On April 10, 2017, Kleinschmit saw his primary care doctor for what he thought would be a routine checkup, as he was feeling healthy. This time, however, a blood test found abnormal proteins, which eventually led to a diagnosis of multiple myeloma, throwing his entire routine off balance.

Multiple myeloma is cancer of plasma cells, white blood cells that are found in the bone marrow and play an important role in the body’s immune system. It is a relatively rare form of cancer, affecting about 30,000 Americans each year.

Kleinschmit was stunned.

“At the time, I was feeling fine,” he said. “I was totally surprised. I guess it’s a good reason to get your yearly exams. It probably saved me years of my life by catching it early.”

FINDING A CLINICAL TRIAL

After the initial diagnosis, Kleinschmit’s primary care doctor referred him to Shamsuddin Virani, MD, an oncology and hematology specialist at Vince Lombardi Cancer Clinic at Aurora Medical Center in Oshkosh.

Dr. Virani informed Kleinschmit of the possibility of a multiple myeloma clinical trial.

Immediately interested, Kleinschmit was introduced to Michelle Martin, BSN, a research coordinator, who initially obtained consent for a “smoldering” multiple myeloma trial, which meant the cancer had not progressed very far.
“There are certain criteria that put you in either the smoldering multiple myeloma or the active multiple myeloma category,” Dr. Virani said. “And, unfortunately, a scan showed that Jim’s cancer was a little more progressed than initially thought.”

Dr. Virani enrolled Kleinschmit in a phase III clinical trial called ENDURANCE (EA1A11), which is studying the use of the drug combination carfilzomib, lenalidomide and dexamethasone compared to the current standard of care [clinicaltrial.gov identifier: NCT01863550]. The drug combination being studied had already been approved by the Food and Drug Administration to treat recurrent multiple myeloma, but this clinical trial uses the same drug combination to treat newly diagnosed multiple myeloma. Dhimant Patel, MD, serves as Aurora Research Institute’s local principal investigator. The ECOG-ACRIN Cancer Research Group developed and leads this trial.

ANOTHER CHANGE OF PLANS

After a matter of days, Kleinschmit found out he was randomized into the study’s investigational arm and began receiving the new drug combination. Because Aurora Health Care is designated as one of 34 National Cancer Institute Community Oncology Research Program sites in the nation, Kleinschmit was able to receive treatment at his local clinic.

Kleinschmit had received four cycles of the study treatment and was responding quite well, so the option of stem cell transplant was discussed. If Kleinschmit’s condition were to deteriorate in the future, he might not be able to undergo a stem cell transplant, so, after careful consideration and deliberation with transplant specialists, Jim underwent a stem cell transplant Nov. 6.

After the transplant, he stopped receiving the clinical trial drug combination, ending his active participation in the study.

“I think having research involved in his treatment helped him through this journey,” said Martin, who added that Kleinschmit will continue to be followed as a participant in the trial.

RESEARCH PARTICIPATION

Despite the change of treatment plans, Kleinschmit remained glad he had participated in clinical research.

Indeed, at one point in his treatment, Kleinschmit was experiencing pain in his shoulder. He called Martin, who immediately told him to go to the emergency room. It turned out to be a blood clot in his lung. Kleinschmit said if he didn’t have Martin just a phone call away, he probably would’ve waited three or four more days, hoping the pain would subside, before going to the hospital.

“It helps so much to have somebody like Michelle,” Kleinschmit said. “I don’t know how many times I called her. Probably 50 times.”

Several months after his stem cell transplant, Kleinschmit was feeling great and had begun receiving a series of vaccinations to rebuild his immune system. He also made plans to return to his retirement routine — perhaps with a bit more travel.

“Tammi and I have already talked about going to Florida in the early summer,” Kleinschmit said. “And then with my teacher buddies, we’ve talked about going to Hawaii, maybe this fall.”

This clinical trial is ongoing. Kleinschmit’s experience should not be used to predict outcomes of the clinical trial.
Clinical research

With Aurora Health Care’s designation as one of just 34 National Cancer Institute Community Oncology Research Program (NCORP) sites nationwide, Aurora Research Institute’s concerted effort to offer more early phase (Phase I, I/II and II) clinical trials and the 2017 launch of the Oncology Precision Medicine program, more Aurora cancer patients have access to clinical trials that could potentially be tomorrow’s best cancer treatment options.

EXPANDING AURORA NCORP

For the fourth year in a row, National Cancer Institute (NCI) has increased the grant allotment to Aurora NCORP, bringing the four-year grant total to $3,413,327. Aurora, which started its fourth year of participation in NCORP in 2017, is projected to receive more than $4 million by the time its five-year NCORP grant cycle ends in 2019. Thomas Saphner, MD, and Michael Thompson, MD, PhD, serve as institute principal investigators for Aurora NCORP.

NCORP brings clinical cancer trials to people in their own communities instead of only at major research institutions. Conducting clinical trials in a range of communities small and large means that a more diverse patient population can participate in clinical trials in “real world” health care settings. This expanded access to clinical trials, in turn, generates more broadly applicable evidence that contributes to improved patient outcomes and a reduction in cancer disparities.

Currently, Aurora NCORP has more than 50 NCI clinical trials open to recruitment for multiple cancer types, including brain, breast, lung and prostate cancers, as well as leukemia, lymphoma and melanoma. Nineteen of these trials are considered early phase trials. These studies are available at nearly all 19 Aurora cancer clinics.
STUDYING CANCER’S FINANCIAL IMPACT

Not all research is about treating disease. Cancer care delivery research is a unique multidisciplinary science, supported by NCORP, that studies the availability, quality, cost and outcomes of cancer care. This type of research improves clinical practices and allows better understanding of the optimal delivery mode of cancer treatments. Dr. Saphner leads Aurora’s Cancer Care Delivery Research program.

Led by institute principal investigator Federico Sanchez, MD, Aurora NCORP is participating in a clinical trial that studies the use of a financial impact assessment tool by participants diagnosed with metastatic colorectal cancer (clinicaltrials.gov identifier: NCT02728804). To gather a complete picture of the financial impact of cancer, researchers collect credit reports and administer questionnaires to analyze participants’ income, assets, debt, employment status, health insurance coverage and quality of life.

The goal of the study, sponsored by SWOG, one of five clinical trial groups in the NCI’s National Clinical Trials Network, is to gauge how often over a 12-month period participants experience financial hardship because of their cancer treatment. By analyzing this data, researchers may be able to help doctors better understand the financial impact of cancer and help patients avoid financial problems during treatment. This is the first such federally sponsored trial of its kind.

RECOGNIZING HIGH ENROLLERS

Aurora NCORP continues to build on its research participant enrollment success. At the 2017 NCORP Annual Meeting, 13 Aurora physicians received a certificate for being high enrollers of research participants.

• Shamsuddin Virani, MD: Platinum Award – 54 accruals since Aurora Research Institute received its initial NCORP grant in August 2014
• Michael Mullane, MD: Gold Award – 40 accruals
• The following physicians received Appreciation Awards – between 11 and 19 accruals over the past three years:
  − George Bobustuc, MD
  − Osama Halaweh, MD
  − John Maul, MD
  − Ubaid Nawaz, MD
  − Dhimant Patel, MD
  − Rubina Qamar, MD
  − Gilberto Rodrigues, MD
  − Cheruppolil Santhosh-Kumar, MD
  − Thomas Saphner, MD
  − Corey Shamah, MD
  − Judy Tjoe, MD
Clinical research

ADVANCING PRECISION MEDICINE

Physicians have always tried to personalize treatment. In cancer care, however, physicians typically used the same therapies to treat patients with the same type and stage of cancer. The challenge created by that approach is that patients often respond differently despite seemingly similar circumstances.

With the creation of the Oncology Precision Medicine program, Aurora Health Care is using new precision medicine techniques to target genetic alterations in cancer cells to try to kill the cancer while minimizing adverse effects on the patient.

“The precision medicine hasn’t explained all variation in treatment response, but, in some cases, targeting molecular alterations in cancer can produce impressive anticancer responses,” said Michael Thompson, MD, PhD, who serves as Aurora’s Oncology Precision Medicine program’s medical co-director along with Jennifer Godden, PharmD.

The program relies on molecular profiling of a patient’s tumor to tailor medical treatment to individual characteristics of each patient. Launched in 2017, the program set a goal to evaluate 50 patients in its first year. That goal was surpassed in the program’s first four months.

“Awareness of precision medicine has increased substantially,” Dr. Godden said. “This field continues to evolve very quickly, and, with such rapid growth, it became necessary to bring together a centralized group of people to help with the adaptation and integration of these practices into routine patient care.”

Since its creation, the program has focused on increasing the number of available clinical trials, as every patient in the program is considered for a trial. Aurora Research Institute currently has 15 open clinical trials in the Oncology Precision Medicine program.

Toward that end, Aurora also created a Molecular Tumor Board, in which members from around the state meet weekly using video teleconference technology to discuss treatment options for de-identified patients based on molecular profiling results. Doctors and research coordinators use the videoconference meetings to identify relevant clinical trials for patients.

Because the field is advancing so quickly, many of the therapies that were research protocols not long ago have since become Food and Drug Administration-approved treatments, meaning Aurora Oncology Precision Medicine is helping patients who were not even referred to the program.

Aurora’s new Oncology Precision Medicine program is targeting genetic alterations in cancer cells.
STUDYING NEW LEUKEMIA TREATMENTS

Aurora Health Care is studying the drugs ubiliximab and umbralisib for chronic lymphocytic leukemia as part of an international clinical trial (clinicaltrials.gov identifier: NCT02612311).

Researchers are comparing the new drugs, developed by TG Therapeutics Inc., with approved immunotherapy drug obinutuzumab and chlorambucil chemotherapy. The new combination also is being compared against each of the new drugs individually.

Michael Thompson, MD, PhD, medical co-director of Oncology Precision Medicine for Aurora Cancer Care, is the principal investigator of this industry-sponsored trial for Aurora Research Institute. The institute is conducting the study at 18 Aurora Cancer Care sites.

“The cancer treatments of today are based on clinical trials in the past. The future therapy options are based on the trials of today. This trial helps us understand and improve chronic lymphocytic leukemia therapy,” Dr. Thompson said. “Partnering with pharmaceutical sponsors brings access to new drugs to patients across the state.”

The study reached its goal of enrolling 700 international participants and is following research subjects for up to four years.

Leukemia is a type of cancer that starts in the bone marrow and can spread through the bloodstream and affect organ function. More than 60,000 new cases will be diagnosed in the U.S. in 2018. About a quarter of new leukemia cases are chronic lymphocytic, affecting cells associated with the immune system response.

“The future therapy options are based on the trials of today.”

– Michael Thompson, MD, PhD

CLINICAL TRIAL STATISTICS – ONCOLOGY

181 open clinical trials* as of Dec. 31, 2017

- Breast (27% [48])
- Other (20% [36])
- Hematology (14% [25])
- Gynecology (13% [24])
- Lung (10% [18])
- Prostate (7% [13])
- Colorectal (6% [11])
- Renal Cell (3% [6])

388 new subjects enrolled in 2017

- Breast (45% [175])
- Hematology (22% [84])
- Other (10% [40])
- Gynecology (10% [38])
- Lung (7% [26])
- Prostate (4% [16])
- Colorectal (2% [7])
- Renal Cell (1% [2])

*open to accrual or follow-up, includes 6 registries
Translational Oncology Research: Quest for Understanding & Exploration

Aurora Research Institute’s breast cancer research program, Translational Oncology Research: Quest for Understanding & Exploration, or TORQUE, is led by medical research director and breast cancer surgeon Judy A. Tjoe, MD. TORQUE consists of three components: clinical and laboratory-based research, as well as Team Phoenix, a cancer survivorship program that seeks to better understand how exercise improves survival after cancer.

CLINICAL RESEARCH

Standard of care for treatment of breast cancer patients can include chemotherapy to shrink a tumor before surgery. Traditionally, breast cancer surgeons then surgically remove the tumor bed to verify that upfront chemotherapy completely destroyed the originally diagnosed malignant cells.

Through a Phase II interventional clinical trial sponsored by NRG Oncology, TORQUE researchers will track trial participants with breast cancer as they undergo neoadjuvant chemotherapy (upfront chemotherapy before surgery) and then trimodality imaging (mammogram, ultrasound and magnetic resonance imaging, or MRI) to ensure there is no radiographic evidence of residual tumor (clinicaltrials.gov identifier: NCT03188393). If that is the case, then a core biopsy of the breast tumor bed will be taken to see if it matches the results predicted by imaging. Participants will then undergo breast-conserving surgery as per the standard of care. TORQUE researchers will then compare the tumor removed during surgery, the tumor tissue collected from the core biopsy and the imaging results to check if they are the same.

If this study demonstrates a positive correlation between the predictive ability of trimodality imaging and the results of the core biopsy, then potential future clinical trials can study whether breast cancer patients can avoid surgery after neoadjuvant chemotherapy if trimodality imaging shows no evidence of residual tumor.

A study that may one day change the standard of care

Aurora Health Care, with TORQUE medical research director and breast cancer surgeon Dr. Tjoe as local principal investigator, is able to offer this trial locally as one of 34 sites nationwide that belong to the National Cancer Institute Community Oncology Research Program (NCORP).
LABORATORY RESEARCH

Advancements in precision medicine have allowed for new treatments for cancer patients, specifically those who demonstrate a resistance to traditionally successful first-line drugs. But one of the key barriers to precision medicine therapies for cancer patients is the identification of biomarkers that can indicate drug resistance before prescription of a particular drug. This is where Research Scientist Jun Yin, PhD, has focused her efforts since joining Aurora Research Institute in 2017.

“I am currently focused on determining gene signatures that will serve as biomarkers to assist clinicians in accurately predicting drug resistance of human epidermal growth factor receptor 2 (HER2)-positive breast cancers to anti-HER2 treatment,” she said.

The HER2 gene produces a protein important to cancer cell growth and prevalent on the surface of cancer cells in patients with HER2-positive breast cancer. First-line treatment typically uses anti-HER2 monoclonal antibodies, such as trastuzumab or pertuzumab, which are formulated proteins that bind to the HER2 protein and slow or stop cancer cell growth. These treatments have been shown to improve survival of HER2-positive breast cancer patients.

Yet as many as 23 percent of patients with early-stage HER2-positive breast cancer treated with trastuzumab still experience recurrence within 10 years.

“This highlights the importance of identifying prior to treatment initiation which HER2-positive patients will respond to this treatment,” Dr. Yin said.

Educated as a pharmaceutical and chemical engineer and statistician, and possessing a background in cancer biology from her time at MD Anderson Cancer Center in Houston, Dr. Yin uses a systems biology approach, integrating computational and experimental techniques in the institute’s Discovery Laboratory, to conduct her research into breast cancer biomarkers. She is also examining the mechanisms that give these biomarkers their predictive power with the goal of revealing new therapies for trastuzumab-resistant HER2-positive breast cancer patients.

Working with Dr. Tjoe, who is offering important clinical context to Dr. Yin’s bench research, and taking advantage of her unique access to in-house patient samples via the institute’s Biorepository and Specimen Resource Center, Dr. Yin hopes a gene-signature-guided biomarker discovery could be a powerful tool to predict drug response of other drug-resistant populations and quickly be introduced into clinical practice to assist physicians’ diagnosis and selection of treatments for HER2-positive breast cancer patients.

TEAM PHOENIX

Team Phoenix, led by Dr. Tjoe and cancer rehabilitation specialist Leslie J. Waltke, DPT, is a 14-week graduated exercise program that trains female cancer survivors for a sprint distance triathlon under the direction of professional coaching staff and volunteer medical staff. The program is designed to help patients improve endurance and strength while addressing cancer treatment-related side effects. Seventy-five percent of Team Phoenix members adhere to the American Cancer Society’s recommendation of 150 minutes of moderate exercise per week, compared to the reported 35 percent national average.

As part of the program, TORQUE researchers, in collaboration with Marquette University’s Department of Exercise Science and College of Nursing, are studying the effects of exercise on aerobic capacity, strength and psychological well-being after cancer treatment.

For information, call 414-219-TEAM.
Grant awards and gifts

Aurora Health Care researchers received nearly $1 million in grant awards and gifts to conduct oncology research.

Through its Aurora Cancer Care Research Award (now Oncology Research Award), Aurora Research Institute’s Sponsored Programs Office provides funding for Aurora research projects aimed at eradicating cancer and improving health outcomes through detection, treatment, education and prevention.

In 2017, the Sponsored Programs Office awarded two Aurora Cancer Care Research Award grants totaling $50,000.

Danielle Greer, PhD, senior biostatistician, received $25,000 for her study “Feasibility of accurate tumor diameter and myometrial invasion measurement via preoperative magnetic resonance imaging in endometrioid endometrial cancer.”

During surgery to remove a primary endometrial cancer tumor, which is situated within the lining of the uterus, a surgeon may remove lymph nodes to assess whether cancer has spread outside of the uterus. However, removal of lymph nodes is associated with severe complications, including lymphedema, which is fluid retention causing swelling in the arms and legs.

Dr. Greer and her collaborators will assess the challenges of having a radiologist use magnetic resonance imaging (MRI) prior to surgery to obtain measurements of the endometrial tumor that are known to predict whether the cancer has spread. If it is feasible to use MRI for measuring tumor size and myometrial invasion, which is the percentage of myometrial wall of the uterus invaded by the tumor, many patients may be saved from undergoing unnecessary lymph node removal during surgery.

The study is supported by Vince Lombardi Cancer Foundation and Styberg Foundation.

Learn about how Aurora is continuing to provide cancer clinical trials to people in their own communities through National Cancer Institute Community Oncology Research Program (NCORP) on Page 37 and conducting cancer care delivery research on Page 38.
Oncology research appendix

Vice President, Aurora Cancer Care
James Weese, MD

COMMITTEES

Oncology Research Steering Committee
Chair: Rubina Qamar, MD

Precision Medicine Research Steering Committee
Chair: Michael Thompson, MD, PhD

Cancer Leadership Council Research Subcommittee
Co-chair: Amy Beres, PhD
Co-chair: Michael Thompson, MD, PhD

VOLUMES (SYSTEMWIDE NEW CASES)

Source: Cancer Registry

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*estimated; complete data not available at time of publication

Meeting highlight
American Society of Clinical Oncology

Physician researchers shared findings and contributed to important discussions on oncology care at the American Society of Clinical Oncology 2017 annual meeting:

• Amin Kassam, MD
• Michael Mullane, MD
• Antony Ruggeri, MD
• Federico Sanchez, MD
• Michael Thompson, MD, PhD
Oncology research appendix

PEER-REVIEWED PUBLICATIONS (SYSTEMWIDE)

<table>
<thead>
<tr>
<th>Year</th>
<th>Journal Articles/Book Chapters</th>
<th>Abstracts</th>
</tr>
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<tbody>
<tr>
<td>2015</td>
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<td>2016</td>
<td>33</td>
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<tr>
<td>2017</td>
<td>47</td>
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</tbody>
</table>

Article citations


Neuroscience research projects as of Dec. 31, 2017

30 neuroscience publications in 2017

254 new subjects enrolled in neuroscience trials in 2017
How did a 70-year-old drug for treating chronic alcoholism become the new hope in the fight against metastatic brain cancer? It started with a pioneering team, including a neurosurgeon, neuro-oncologist and senior research scientist, and a patient with nothing to lose.

TIMING IS EVERYTHING

In 2011, Lee Pinkus, then 43, from Monticello, Arkansas, was diagnosed with nodular melanoma, the most aggressive form of melanoma.

George Bobustuc, MD, who has been a neuro-oncologist for more than 16 years, joined Aurora Health Care in 2012. Santhi Konduri, PhD, Aurora Research Institute senior research scientist soon joined him in 2013. Drs. Bobustuc and Konduri have been collaborating since they first met 18 years ago in the neuro-oncology research lab at The University of Texas MD Anderson Cancer Center in Houston.

World-renowned neurosurgeon Amin Kassam, MD, also joined Aurora in 2013, launching Aurora Neuroscience Innovation Institute (ANII) with a three-pronged mission of innovation, clinical care and education.

In 2014, after a years-long battle, Pinkus, with dozens of tumors spread throughout his body, was referred to Aurora St. Luke’s Medical Center in Milwaukee.

Transforming research into the future of medicine

“IT was everywhere. The doctors at one point gave me eight to 10 days.”
– Lee Pinkus

LIFESAVING REFERRAL

By the time Pinkus had arrived at Aurora St. Luke’s, he had been through the gamut of cancer care back home in Arkansas, undergoing procedures to have melanomas removed five different times — the fifth procedure included removal of his lymph nodes, treatment for a brain tumor, and a battle against dozens of tumors in his small intestine, brain and lung that included a clinical trial.

“It was everywhere,” Pinkus said. “The doctors at one point gave me eight to 10 days.”

Pinkus had tried many doctors throughout the country. Some turned him away and others made unsuccessful attempts to keep the cancer at bay. Pinkus’ fiancée, Lacey Eppinette, searched out a treatment center in Illinois. Doctors there referred Pinkus to Aurora St. Luke’s.
"I was in a real bad state when I got here," Pinkus said. "I couldn’t see. I couldn’t hear. I couldn’t walk. I didn’t talk much. I was tired all the time. I was going to die."

Dr. Kassam removed a tumor from Pinkus’ brain after a complex, six-hour surgery that involved reworking Pinkus’ eye socket.

UNKNOWN TERRITORY
Though Pinkus regained control of his bodily functions, there were still other tumors in his brain, intestines and lungs following the surgery. Pinkus was ineligible for any clinical trial, so Dr. Bobustuc escalated Pinkus’ treatment by adding an unlikely off-label medication, disulfiram.

Approved by the Food and Drug Administration 70 years ago to treat alcoholism, disulfiram has been sporadically reported to help patients with cancer. In Pinkus’ case, the drug combination ultimately shrank the tumors until nearly all of them disappeared. And he did not experience significant side effects, allowing the chemotherapy dosages to be reduced.

Dr. Bobustuc believes the drug combination will have wide-ranging effects in the fight against cancer.

The drug combination ultimately shrank the tumors until nearly all of them disappeared.

"The drug combination is intended to both completely block, at multiple levels, one of the most important signaling pathways in cancer and also insulate it from any possible downstream stimulatory crosstalk, while it makes tumor cells significantly more sensitive to standard treatments," Dr. Bobustuc said.

Pinkus returns to Aurora St. Luke’s every few months for check-ups. At his most recent visit in March 2018, Pinkus’ brain magnetic resonance imaging (MRI) revealed continued improvement in two small remaining areas of note, which are mostly made up of scar tissue from his surgery, radiation and ongoing chemotherapy.

"You plant something and it grows and matures and it gives you life," Pinkus said. "The doctors here, they’re the same. They’ve assembled the best team of doctors that I’ve ever seen, and, because of that, I’m still here."

LABORATORY RESULTS
Dr. Bobustuc was confident in prescribing disulfiram based on the collaborative laboratory research with Dr. Konduri, who was studying multiple existing drugs with the intent to repurpose them for cancer treatment.

Pleased that his patient was seeing results, Dr. Bobustuc wanted to know if this could be replicated in other patients with other brain tumors. He asked Dr. Konduri to study the drug. Based at Discovery Laboratory on the Aurora Sinai Medical Center campus in Milwaukee, Dr. Konduri was able to generate enough data to receive approval for testing in research participants with brain cancer.

There are four clinical trials in the United States studying the anticancer properties of disulfiram for glioblastoma, the most aggressive form of brain cancer. Aurora St. Luke’s is the only site in the nation studying a disulfiram-copper-temozolomide (a chemotherapy drug) combination in research participants with newly diagnosed glioblastoma who have a genetic marker showing them to be less responsive to chemotherapy alone (clinicaltrials.gov identifier: NCT03363659).

Sponsored by Aurora Health Care, the clinical trial is ongoing. Pinkus’ experience should not be used to predict outcomes of the clinical trial.
Innovative research, world-renowned expertise and first-in-the-world neurosurgery technologies come together under Aurora Neuroscience Innovation Institute (ANII) to improve care for people with brain tumors and neurological disorders.

Led by neurosurgeon Amin Kassam, MD, ANII includes a multidisciplinary clinic, education suite, a dedicated neuroanatomical laboratory and four neurosurgical operating suites.

ANII’s efforts are already helping Aurora Health Care patients. Aurora was the first program in the world to use surgical tools with 3-D imaging and GPS positioning, allowing ANII neurosurgeons to safely access and remove previously inoperable tumors. With Aurora Research Institute, ANII is also connecting people with brain cancer and neurological disorders, like multiple sclerosis, to clinical trials, including international drug studies.

Through the institute’s Biorepository and Specimen Resource Center, ANII researchers are studying tumor tissue obtained during surgeries to make the next discoveries to bring to patients.

NEW SURGICAL TECHNIQUES

The use of robotics in surgery has been a topic of interest among ANII researchers.

Although most of the discussion surrounding surgical robotics in the medical community has involved implementing robotic devices to enhance dexterity and maneuverability, ANII researchers have also participated in research to improve optical visualization during surgery through the use of robotics, called “detectors.” In fact, Dr. Kassam, ANII neurosurgeon Richard Rovin, MD, and other Aurora neuroscience researchers contributed to a study published in Neurosurgical Focus (2017 May;42:E9) that is considered the first step toward a meaningful integration of detector robotics into neurosurgery.

In the study, the researchers’ objectives were to describe the feasibility and safety of a new detector device called the robotically operated video optical telescopic-microscope (ROVOT-m; BrightMatter Servo System, Synaptive Medical) in a wide range of cranial microsurgical applications. The researchers concluded that new adopters of the robotic detector should anticipate a learning curve in both setup and execution, with further studies deemed necessary to evaluate the efficacy of ROVOT-m.
Clinical research

TREATING BRAIN ANEURYSMS

An intracranial aneurysm is an abnormal dilation or ballooning of the wall of an artery in the brain due to a weakening of the blood vessel wall. If the artery wall becomes too thin, it can rupture, resulting in a hemorrhage in the space around the brain, which can lead to a stroke, coma or death.

One treatment option is the use of coil technology to fill the ballooning wall and eliminate blood flow into the aneurysm. This treatment option does not require opening of the skull — the coil is deployed via a microcatheter inserted through the femoral artery of the leg and advanced up into the brain.

Coil technology fills the ballooning artery wall and eliminates blood flow into the aneurysm.

Aurora St. Luke’s Medical Center in Milwaukee is participating in a clinical trial studying the treatment of people with intracranial aneurysms or other malformations. This prospective, multicenter study, led at Aurora by neurologist Thomas Wolfe, MD, will gather postmarket data on the Penumbra SMART Coil® System [clinicaltrials.gov identifier: NCT02729740]. The Food and Drug Administration has cleared this device for commercial use.

The study is expected to enroll about 1,000 participants with intracranial aneurysms or other malformations at up to 100 sites. Aurora St. Luke’s is one of only two sites in Wisconsin. Lynda Yanny, BSN, is coordinating the trial at Aurora St. Luke’s.

CLINICAL TRIAL STATISTICS – NEUROSCIENCE

26 open clinical trials* as of Dec. 31, 2017

254 new subjects enrolled in 2017

- Interventional radiology: 38% (10)
- Neuro-oncology: 23% (6)
- Stroke: 15% (4)
- Multiple sclerosis: 12% (3)
- Surgical: 8% (2)
- Epilepsy: 4% (1)

78% (198) Surgical
7% (18) Stroke
7% (18) Interventional radiology
4% (11) Multiple sclerosis
4% (9) Neuro-oncology

*open to accrual or follow-up, includes 2 registries
Could a virus infect brain cancer cells, causing them to die, while preserving healthy cells? Like an infection, the idea has grown and spread, gaining popularity in oncology research. Parvez Akhtar, PhD, a research scientist hired in 2017 by Aurora Research Institute to study the possibility, hopes this research could eventually reduce cancer recurrence.

Glioblastoma is a deadly form of brain cancer. Standard treatment involves surgery, followed by chemotherapy and radiation. Yet, within six months, most tumors recur, fueled by a small population of glioblastoma stem cells that resist and survive treatment. There are no drugs that specifically target glioblastoma stem cells.

Dr. Akhtar’s team is studying a virus to determine if it will specifically target and destroy glioblastoma stem cells. Using cell lines generated from brain tumor tissues donated by Aurora Health Care patients to the institute’s Biorepository and Specimen Resource Center, Dr. Akhtar first hopes to determine if the virus can enter glioblastoma stem cells and whether that infection leads to cell death. The next step calls for modifying the virus to ensure it doesn’t attack healthy cells.

Based in Discovery Laboratory on the Aurora Sinai Medical Center campus in Milwaukee, Dr. Akhtar studies the virus in the biosafety level two virology laboratory. Dr. Akhtar said all safety protocols are followed by laboratory staff.

This work may take several years before it could be used in humans. However, if it works, the modified virus could supplement existing cancer therapy, reducing recurrence and improving survival rates.

Dr. Akhtar is hopeful. Before coming to Aurora, he investigated human DNA tumor viruses (human papillomavirus, Epstein-Barr virus and Kaposi’s sarcoma-associated herpesvirus) at the University of Pittsburgh Cancer Institute in Pennsylvania.

“Like the viruses we hope to use in the fight against cancer, the idea is spreading, but unlike a virus, it is providing hope,” Dr. Akhtar said.
Grant awards and gifts

Aurora Health Care researchers received $233,831 in grant awards and gifts to conduct neuroscience research.

KARL STORZ Endoscopy-America Inc. donated $174,983 worth of equipment that will be used by fellows, clinicians and researchers in the neuroanatomy laboratory at Aurora St. Luke’s Medical Center to study and refine minimally invasive surgical techniques in the brain.

A joint effort between Aurora Neuroscience Innovation Institute (ANII) and Aurora Research Institute, the neuroanatomy laboratory is filled with more than $4 million in surgical and imaging equipment that replicates a neurosurgery operating suite to enable simulation of surgical procedures on cadaver specimens for training and research purposes.

“The outcomes of this simulation research help make existing surgical procedures more accurate, less invasive and safer for patients,” said Srikant Chakravarthi, MD, postdoctoral research fellow, who studies in the neuroanatomy laboratory.

In 2017, 1,500 training and research hours resulted in numerous publications and presentations, including at the Congress of Neurological Surgeons 2017 Annual Meeting. Amin Kassam, MD, vice president of neuroscience, presented a seminar on supratentorial anatomy using surgical cases and high-definition, 3-D video illustrations.

A pivotal outcome from the lab was publication in Operative Neurosurgery (2017; epub ahead of print) of a 3-D atlas of the structural and functional scaffolding of human white matter (i.e., a surgical white matter chassis) for use as an organizational tool in designing precise and individualized trajectory-based neurosurgical corridors.

Of the $233,831 in grant awards and gifts, $6,963 was awarded by Aurora Research Institute thanks to the generosity of donors to Aurora Health Care Foundation.

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Of the $233,831 in grant awards and gifts, $6,963 was awarded by Aurora Research Institute thanks to the generosity of donors to Aurora Health Care Foundation.

$226,868
received in 2017 from industry and federal sources

$6,963
awarded to Aurora Health Care researchers in 2017 by Aurora Research Institute

2017 external awards and gifts

- **Equipment donation**
  Investigator: Amin Kassam, MD
  $174,983
  KARL STORZ Endoscopy-America Inc.

- **The Epilepsy Connectome Project**
  Investigator: Umang Shah, MD
  $51,885
  National Institutes of Health subaward from Medical College of Wisconsin

2017 internal awards

- **Aurora Research Institute Research Seed Grant Program**
  Intraoperative cognitive monitoring
  Investigator: Joseph Cunningham, PhD
  $5,980

- **Aurora Research Institute Research Seed Grant Program**
  Feasibility of aromatherapy in an awake craniotomy environment
  Investigator: Richard Rovin, MD
  $983

*supported by Aurora Health Care Foundation
Neuroscience research appendix

VOLUMES (SYSTEMWIDE)

Source: Aurora Smart Chart & Medipac

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<th></th>
<th>2015</th>
<th>2016</th>
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<td>Stroke</td>
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<td>Ischemic</td>
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<td>Transient ischemic attack</td>
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<td>284</td>
<td>204</td>
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<tr>
<td>Hemorrhagic</td>
<td>247</td>
<td>251</td>
<td>244</td>
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<tr>
<td>Interventional radiology (# of patients)</td>
<td>446</td>
<td>357</td>
<td>445</td>
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(For cancers of the brain and the central nervous system, see table on Page 44.)

PEER-REVIEWED PUBLICATIONS (SYSTEMWIDE)

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<th>2015</th>
<th>2016</th>
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<tr>
<td>Abstracts</td>
<td>20</td>
<td>10</td>
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</table>

Neuroscience publications

Article citations


Jennings JE, Kassam AB, Fukui MB. The surgical white matter chassis: a practical 3-dimensional atlas for planning subcortical surgical trajectories. Oper Neurosurg (Hagerstown) 2017 Aug 5 [Epub ahead of print].


...
Emerging areas research

- 79 research projects in emerging areas as of Dec. 31, 2017
- 324 new subjects enrolled in trials in emerging research areas in 2017
- 129 publications in emerging research areas in 2017
Women’s health research

IMPROVING THE LIVES OF WOMEN THROUGH RESEARCH

Just days after undergoing a procedure as part of a clinical trial to have a device implanted in her bladder, Alenia Brooks, 53, of Menomonee Falls, Wisconsin, slept through the night for the first time in more than three years.

“People don’t understand that I am sick,” she said. “I don’t look sick.”

Brooks suffers from interstitial cystitis (IC), also called painful bladder syndrome, and Hunner’s lesions, or Hunner’s ulcers. Interstitial cystitis is a relatively common chronic condition in women that causes pressure and pain in a patient’s bladder. Hunner’s lesions are distinctive areas of inflammation on the bladder wall and are quite rare, affecting only about 5 to 10 percent of IC patients. Doctors aren’t sure what causes IC or Hunner’s lesions.

“When I met Alenia, she was suffering from frequent and painful urination, bladder spasms, and exhaustion, as she was getting up eight to 10 times a night because of the pain and needing to go to the bathroom,” said Lori McElrone, Aurora Research Institute senior research coordinator at Aurora West Allis Medical Center.

Brooks had long been a patient of urogynecologist Alexis Chesrow, MD, who, when presented with the opportunity to enroll participants in a clinical trial studying IC with Hunner’s lesions, knew Brooks was the perfect fit.

“This is a disease that no one talks about,” Dr. Chesrow said. “It affects self-esteem, family relations, lifestyle, professional life and health perception.”

Dr. Chesrow and the Center for Continence and Pelvic Floor Disorders continually look for studies that allow them to expand care options at Aurora.

The clinical trial was a randomized, double-blinded, placebo-controlled study of the safety and efficacy of LiRIS®, a device-drug combination implanted on a participant’s bladder and left for two weeks, gradually releasing the pain medication lidocaine or a placebo, until it is removed [clinicaltrials.gov identifier: NCT02395042]. The Phase II trial involved up to three insertions of the device. Participants had a 50 percent chance of receiving the active drug for the first insertion, a 75 percent chance for the second insertion, and all participants who requested, and were eligible, to receive a third insertion received the active drug.

“People don’t understand that I am sick. I don’t look sick.”

– Alenia Brooks
“Many people with IC have limited mobility, suffer from depression, cannot work and have limited social lives,” Brooks said. “However, I am fortunate. I am an Aurora patient.”

So despite not knowing whether the study would benefit her, Brooks took a chance, if not for her then for all the millions of women across the world suffering from IC.

“There were no guarantees,” Brooks said. “And there are never guarantees with clinical research. But without clinical trials, we would not have the opportunity to improve the lives of millions of patients.”

After participating in the trial, Brooks’ pain was severely reduced, and diagnostic imaging had shown that her Hunner’s lesion had drastically shrunk in size.

For her participation in the clinical trial, the institute awarded Brooks the 2017 Research Hero Award at its eighth annual Research Recognition Event.

Sponsored by Allergan, the clinical trial is closed. Brooks’ experience should not be used to predict outcomes of the clinical trial.

**WOMEN’S HEALTH VOLUMES (SYSTEMWIDE)**

Source: AIM/Epic Hospital and Professional Billing Data

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<td>Diagnostic</td>
<td>30,401</td>
<td>43,101</td>
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<tr>
<td>Digital (%)</td>
<td>100%</td>
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<td>16,826</td>
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<td>18,050</td>
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<td>C-section (%)</td>
<td>27.4%</td>
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<td>13,221</td>
<td>12,823</td>
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<td>Hospital newborn level III</td>
<td>1,114</td>
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<td>NICU admissions</td>
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<td>Ave. stay length (days)</td>
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<td>IVF cycles</td>
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<td>Aurora West Allis</td>
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<td>Aurora Green Bay</td>
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<td>Hysterectomy</td>
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<td>Outpatient (%)</td>
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<td>Laparoscopic (%)</td>
<td>59.1%</td>
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<tr>
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<td>10.3%</td>
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<td>Robotic assist (%)</td>
<td>26.3%</td>
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<tr>
<td>Open (%)</td>
<td>16.1%</td>
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<td>Routine gynecologic exam</td>
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<td>Excessive bleeding and pelvic pain</td>
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<tr>
<td>Pelvic inflammatory disease and other gyn. conditions</td>
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<td>46,836</td>
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<tr>
<td>Urogynecology (specialty provider) office visits</td>
<td>7,191</td>
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<tr>
<td>Urogynecology surgical hospital cases</td>
<td>590</td>
<td>621</td>
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Translational research

AN ALTERNATIVE TO OPEN ORTHOPEDIC SURGERY

Even as the number of minimally invasive procedures continues to grow, traditional open surgery remains the gold standard for many conditions. In orthopedics, the use of suture tape to augment open ankle stabilization surgeries is a growing trend.

Foot and ankle surgeon Jason DeVries, DPM, suggested that a minimally invasive arthroscopic procedure for lateral ankle ligament injuries is as effective as open surgery augmented with the suture tape. Both procedures are used to stabilize the ankle for injuries when the ankle is “rolled,” which commonly occurs in basketball and soccer.

With collaborator Brandon Scharer, DPM, Dr. DeVries reviewed the charts of 55 patients who had undergone either procedure at Aurora BayCare Medical Center. They compared the times from surgery to bearing weight in a boot and then in a brace, and finally returning to sports or activity. The procedures were comparable, with a statistical significance for the arthroscopic option allowing a return to sports or activity more quickly than with open surgery.

“Either option is effective, suggesting support for the arthroscopic procedure despite the increasing popularity of suture tape augmentation,” Dr. DeVries said.

Taylor Romdenne coordinated the study on behalf of Aurora Research Institute.

ORTHOPEDIC VOLUMES (SYSTEMWIDE)

<table>
<thead>
<tr>
<th>Source: Aurora Smart Chart</th>
<th>2015</th>
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<tr>
<td><strong>ADMITS/VISITS</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hand/Wrist/Forearm</td>
<td>13,478</td>
<td>22,582</td>
<td>22,046</td>
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<tr>
<td>Knee</td>
<td>14,737</td>
<td>20,857</td>
<td>22,586</td>
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<td>Lower Leg/foot/Ankle</td>
<td>24,845</td>
<td>42,443</td>
<td>45,367</td>
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<td>Pelvis/hip/femur</td>
<td>11,601</td>
<td>20,369</td>
<td>22,531</td>
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<tr>
<td>Shoulder/elbow/upper arm</td>
<td>20,683</td>
<td>38,590</td>
<td>42,473</td>
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<tr>
<td>Spine/back/neck</td>
<td>69,265</td>
<td>96,996</td>
<td>96,594</td>
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<tr>
<td>Other</td>
<td>21,085</td>
<td>19,388</td>
<td>16,951</td>
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<tr>
<td><strong>Totals</strong></td>
<td>175,694</td>
<td>261,225</td>
<td>268,548</td>
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AWARD-WINNING ARTICLE

American Physiological Society presented several Aurora Research Institute caregivers with the APS select award for their article titled “Insulin sensitivity, leptin, adiponectin, resistin, and testosterone in adult male and female rats after maternal-neonatal separation and environmental stress.”

Published in American Journal of Physiology—Regulatory, Integrative and Comparative Physiology, the article was led by endocrinology researcher Hershel Raff, PhD, and co-authored by senior research technologists Ashley Gehrand and Jonathan Phillips. Aurora Metro Medical Staff interns Mack Jablonski and Cole Leonovicz also contributed to the study.

The study examined the hypothesis that physiological stress in premature infants combined with separation from their mothers may have lasting effects into adulthood.

Dr. Raff also was named the Association of Chairs of Departments of Physiology 2017 Distinguished Service Awardee for his outstanding service to the discipline of physiology.
Clinical research

STUDYING INFLAMMATORY BOWEL DISEASE TREATMENTS

Crohn’s & Colitis Foundation selected Aurora Health Care as one of 19 expected sites for its Study of a Prospective Adult Research Cohort with Inflammatory Bowel Disease (SPARC IBD).

Lilani Perera, MD, director of Aurora’s inflammatory bowel disease program and Aurora Research Institute principal investigator, will enroll adult IBD patients at Aurora Medical Center in Grafton, Wisconsin, Aurora East Mequon Surgery Center in Mequon, Wisconsin, and Aurora St. Luke’s Medical Center in Milwaukee and follow them throughout the course of their disease.

IBD is a complex disease that causes chronic inflammation in the gastrointestinal tract due to an abnormal immune response in the body resulting from interaction among genes, microorganisms in the gut and the environment. Although understanding of IBD has improved significantly during the past decade, there is still no cure, only treatments to address the underlying inflammation.

The goal of the study is to develop strategies for precision medicine therapies for IBD and to identify tools to predict which patients will respond to which therapies. SPARC IBD investigators nationwide plan to enroll 7,000 patients in the study over the next three years.

“Aurora recognizes that offering the best care to IBD patients requires dedicated IBD specialists and multidisciplinary care, as well as the devotion of time and effort to IBD research to advance the field and improve disease management and patient outcomes,” Dr. Perera said. “Precision medicine offers that promise, and, with our high population of IBD patients and dedicated researchers, I felt that we could make a real impact.”

There is no cure for IBD, only treatments to address the underlying inflammation.

CLINICAL TRIAL STATISTICS – EMERGING AREAS RESEARCH

22 open clinical trials* as of Dec. 31, 2017

324 new subjects enrolled in 2017

*open to accrual or follow-up

- Orthopedics 36% (8)
- Primary care 32% (7)
- Gastroenterology 14% (3)
- Women’s health 9% (2)
- Critical care 9% (2)
AUWMG  
Aurora UW Medical Group

More than 250 Aurora Health Care physicians accredited by University of Wisconsin School of Medicine and Public Health serve as voluntary clinical adjunct professors through Aurora UW Medical Group (AUWMG) to teach students, residents and fellows.

The AUWMG Research Core is responsible for supporting, growing and coordinating research and scholarly activity among AUWMG faculty members and their students in areas such as health care quality, medical education, geriatrics, women’s health, and maternal and child health. Dennis Baumgardner, MD, oversees these activities.

IMPROVING REFUGEE HEALTH CARE

People from around the world seek refuge in the United States, and physicians are grappling with how to provide care to this racially, culturally and linguistically diverse population.

Family medicine specialist Fabiana Kotovicz, MD, sought to identify major challenges and barriers faced by refugees when obtaining health care in the U.S. and ways to improve their medical visits in the primary care setting.

In Journal of Patient-Centered Research and Reviews (2018;5:28-35), Dr. Kotovicz shared the findings of her study, which used focus groups made up of refugee settlement case managers, interpreters and pharmacists to identify major challenges both during and outside of a clinic visit.

“In caring for refugees involves complex challenges, but is also highly rewarding,” said Dr. Kotovicz, University of Wisconsin School of Medicine and Public Health clinical adjunct assistant professor. “A more comprehensive understanding of their difficulties can make us better clinicians and advocates for this vulnerable population.”

Language, lower levels of education and lack of trust were barriers to care. The study determined that visit times for refugees should be increased and more resources allocated in a standardized way for the care of refugees.

The study was supported by a grant award in 2017 from University of Wisconsin School of Medicine and Public Health Foundation’s Aurora UW Medical Group Pilot Funds. The award supported two additional projects led by Michael Farrell, MD, and Ariba Khan, MD.

Dr. Khan developed a model to predict delirium in older patients admitted with heart failure using cardiac and noncardiac variables in the electronic health record.

Dr. Farrell studied health care provider-patient communication and whether patient experiences improved after health care providers reviewed the feedback.
Founded in 2001 by Aurora Health Care, University of Wisconsin School of Medicine and Public Health, and University of Wisconsin-Milwaukee (UWM), Center for Urban Population Health (CUPH) offered a unique opportunity to join health care with the multidisciplinary expertise that existed within participating institutions. Sixteen years later, much has changed within the public and population health landscape. But those founding institutions have recommitted to each other, CUPH and the community because of the same unique opportunity to better understand and address the health and well-being of urban populations that remains today.

Metabolic syndrome (MetS) is a constellation of metabolic conditions, including abdominal obesity, high blood pressure and high fasting blood glucose levels. Adults with MetS face increased risk of chronic health conditions, such as coronary artery disease, sleep apnea and depression. Despite these well-known associations, criteria used for diagnosing MetS have been inconsistently defined, and adequate scientific evidence supporting the use of one combination of diagnostic criteria over another is lacking.

Led by Danielle Greer, PhD, biostatistician and epidemiologist for CUPH and Aurora Research Institute, center researchers quantified the prevalence of MetS and documented MetS diagnoses within a community health care system patient population. Recognizing three sets of criteria as possible gold standards for diagnosing MetS, the team also computed the accuracy achieved in documenting MetS within the health care system. They found MetS to be rarely and variably diagnosed in medical practice, despite clear evidence of satisfied criteria. Using the diagnostic criteria of the World Health Organization, for example, 24 percent of nearly 1.4 million patients had MetS, but less than 2 percent of these MetS-positive patients were diagnosed. The team also identified an opportunity to create policy around selecting criteria and improving practice in diagnostic care and treatment of MetS.

Collaborators: Jennifer Fink, PhD, assistant professor in the UWM College of Health Sciences, Renee Walker, DrPH, associate professor in the UWM Zilber School of Public Health, and Tiffany Mullen, DO, integrative medicine physician at Aurora.

Life expectancy at birth is used as a barometer of the health and well-being of a population. Life expectancy varies greatly among counties across Wisconsin. Erica LeCounte, epidemiologist for the City of Milwaukee Health Department, and Geoffrey Swain, MD, CUPH scientist and professor at University of Wisconsin School of Medicine and Public Health, found that there was an even greater difference (12 years) between the lowest and highest life expectancy across zip codes within Milwaukee County.

The researchers also found a strong positive correlation between life expectancy in Milwaukee County zip codes and median household income, educational attainment of a bachelor’s degree or higher, and a broader measure of socioeconomic status. The authors suggested health practitioners may help reduce these disparities by seeking ways to improve social and economic conditions, allowing their patients to live healthier, longer lives.

FUNDING SOURCES

State and local contracts 57%
State and local foundations 20%
Federal 43%

31 projects and $2.1 million in extramural funding
Grant awards

EXTERNAL FUNDING

$1,127,259
received in 2017 from federal, state, foundation and other sources

Award highlight

A multidisciplinary team of researchers, led by Sarah Reimer, MD, an Aurora Health Care radiologist and nuclear medicine specialist, conducted a randomized controlled trial to study a clinical decision support tool embedded in the electronic health record that issues best practice alerts for imaging orders.

Providers maintain their authority over imaging and treatment plans, with the alerts providing information about the clinical appropriateness of a given order and alternative suggestions specific to each patient stemming from national guidelines.

“We will determine the value of the tool to assist providers in choosing the best imaging option for each patient,” Dr. Reimer said.

This data-driven outcomes research study is a collaboration with Massachusetts Institute of Technology, the North American headquarters of the Abdul Latif Jameel Poverty Action Lab that supports the use of randomized controlled trials in health care delivery. Aurora researchers and health economics researchers from MIT will generate the most rigorous evidence to date on whether this tool affects the number, type and appropriateness of specific high-cost radiology imaging orders: magnetic resonance imaging (MRI), computed tomography (CT) and nuclear medicine studies, including positron emission tomography (PET).

The study is supported by a $542,000 grant award over three years, with more than $223,000 in the first year, through funding from Laura and John Arnold Foundation. The foundation funds randomized, controlled trials in health care, justice and education, and shares the results with key decision-makers in government so that legislation impacting these crucial areas has the strongest available evidence base.

“Aurora caregivers and physicians and external scholars are leading the way in discovering hidden treasures through randomized, controlled trials that leverage Aurora’s electronic health record to inform best practices and deliver better value to our patients,” said Kurt Waldhuetter, vice president of Research Business Services for Aurora Research Institute. “This study is an example of how the institute’s multidisciplinary team works with departments throughout Aurora to adopt new decision and delivery support solutions that demonstrate better outcomes and lower costs.

The institute’s Sponsored Programs Office is administering the grant.
Aurora Research Institute in 2017 launched a Research Seed Grant Program to provide investigators with the means to gather enough preliminary data to create competitive research proposals, particularly for publication and future extramural support.

One of the first awardees is specialty pharmacy coordinator Tom Dilworth, PharmD. With his $3,000 award, he will gather preliminary data on the efficacy of the broad-spectrum antibiotics of last resort, daptomycin and linezolid, against enterococci bacteria that have developed resistance to the antibiotic vancomycin (vancomycin-resistant enterococci or VRE) among participants being screened as potential carriers of VRE, including those eligible for or who have received a new liver.

“VRE represent a growing threat to human health, and antibiotic treatment options are limited for this problematic bacteria,” Dr. Dilworth said. “Additionally, VRE that is resistant to daptomycin or linezolid is a growing concern.”

The project will be done in collaboration with infectious diseases physicians, intensive care unit physicians, abdominal transplant physicians and other pharmacists. Patient-, medication- and environmental-related characteristics associated with VRE that is resistant to daptomycin or linezolid will be collected.

Vancomycin-resistant enterococci (VRE) (Photo courtesy of Centers for Disease Control and Prevention)
Emerging areas research appendix

PEER-REVIEWED PUBLICATIONS (SYSTEMWIDE)

Kreuziger LB, Saeian K, Stein D. Increased rate of venous thromboembolism in hospitalized inflammatory bowel disease patients with Crohnoidstricum difficile infection. Inflamm Bowel Dis 2017;23:1847-52.
Aurora St. Luke’s Medical Center was ranked the No. 1 hospital in the Milwaukee metro area by U.S. News & World Report in its 2017-18 Best Hospitals rankings. Aurora St. Luke’s was also ranked the No. 2 hospital in Wisconsin, with five specialties earning spots in the national Top 50. Aurora Medical Center in Grafton also received recognition.

“This achievement demonstrates Aurora is leading the way in delivering top clinical quality and medical excellence,” said Patrick Falvey, chief transformation officer for Aurora Health Care. “Our patients can expect high-quality, cost-effective care that is driven by the passion and dedication of our caregivers, who show every day they are committed to truly helping people live well.”

Aurora St. Luke’s received national Top 50 honors for these high-performing specialties:
• cardiology and heart surgery
• gastroenterology and gastrointestinal surgery
• geriatrics

The hospital’s additional high-performing specialties were cancer, diabetes and endocrinology, nephrology, neurology and neurosurgery, orthopedics, and urology.

“Aurora’s researchers have increased the health system’s reputation through presentation at major international conferences and publication in renowned scientific journals of their work studying ways to provide more options to patients that improve outcomes,” said Randall Lambrecht, PhD, senior vice president of Aurora Health Care and president of Aurora Research Institute.

Aurora Medical Center in Grafton was ranked No. 3 in Southeastern Wisconsin and tied for No. 6 in Wisconsin, with two high-performing specialties, orthopedics and urology. Both Aurora St. Luke’s Medical Center and Aurora Medical Center in Grafton also achieved “recognized in Southeastern Wisconsin” status.

The annual Best Hospitals rankings, now in their 28th year, are part of U.S. News’ patient portal, designed to help patients make informed decisions about where to receive care for life-threatening conditions or for common elective procedures.

For the 2017-’18 rankings, U.S. News evaluated more than 4,500 medical centers nationwide in 25 specialties, procedures and conditions. In the 16 specialty areas, 152 hospitals were ranked in at least one specialty. In rankings by state and metro area, U.S. News recognized hospitals as high performing across multiple areas of care.

The U.S. News methodologies include risk-adjusted survival and readmission rates, volume, patient experience, and other care-related indicators.
The patient-centered research encapsulated in this book is made possible by dedicated researchers, physicians and caregivers; generous sponsors, friends and donors; and the commitment of Aurora Health Care, the Aurora Research Institute Board of Directors and leadership at sites throughout the system. Most importantly, this work wouldn’t be possible without the research participants, or research heroes, who volunteer for the unknown with possibly no benefit to themselves. We thank you.