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ANNUAL REPORT TO THE BOARD OF THE REGENSTRIEF FOUNDATION

JUNE 2012

Regenstrief Center
for Healthcare Engineering

PURDUE UNIVERSITY
Discovery Park

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MESSAGE FROM THE DIRECTOR



I am very pleased to highlight in this annual report the activities and accomplishments of the Regenstrief Center for Healthcare Engineering (RCHE) during the 2011–12 year. The faculty, staff, and students at RCHE are excited by the acceleration of our research activities addressing healthcare delivery issues of national importance. We view this as a critical time to contribute to evidence-based healthcare delivery and we are highly motivated by the unique opportunities provided by the Regenstrief Foundation Board.

While maintaining our research focus on care coordination and population health, we have seen faculty interest, funding awards, and partner needs stimulating new and complementary areas of investigation within our research focus. I am particularly pleased with this growth and view it as not only adding new knowledge in complex delivery issues, but establishing depth in our interdisciplinary foundation for improving healthcare.

RCHE emphasizes the research-to-impact model as a core element in operating the center to assure that our research will be able to be translated to practice. In this annual report, we highlight four research projects; two in each area of care coordination and population health. The report presents each project's progress in the research-to-impact model to illustrate RCHE's emphasis upon achieving impact.

Our research effectiveness has been bolstered with the addition of two new areas of faculty expertise, the expansion of our long-standing collaboration with St. Vincent Health, and the ability to launch two new research and dissemination partnerships. These additions bode strongly for the attainment of our future research goals.

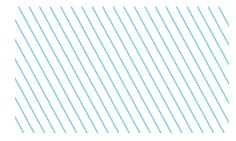
It has been very gratifying to see the innovative talents of our faculty applied in the development of a new RCHE research subcenter to better address the special needs of underserved populations, the Center on Poverty and Health Inequities (COPHI). COPHI's interface with RCHE lies in developing, implementing, and evaluating programmatic solutions and interventions that are directed at reducing documented healthcare disparities. This year's Pioneer Speakers contributed their nationally recognized expertise in health disparities to guide COPHI's development. Researchers who work under the auspice of COPHI bring strong new expertise to RCHE to enable our research to incorporate the goal of improving healthcare, particularly for the underserved populations who have been designated as priority populations in the Affordable Care Act.

Our optimism for continued research effectiveness emanates from our progress this year and the strong prospects for continued impact on improving healthcare delivery. These accomplishments directly result from the support received from the Regenstrief Foundation Board. We sincerely express our appreciation for your support in continuation of our core grant funding and enthusiastically look forward to the opportunity to continue to develop healthcare engineering as a central force in improving healthcare delivery.

A handwritten signature in black ink that reads "Steve Witz".

Steve Witz

St. Vincent Health Chair of Healthcare Engineering
Director, Regenstrief Center for Healthcare Engineering



CENTER OPERATIONS

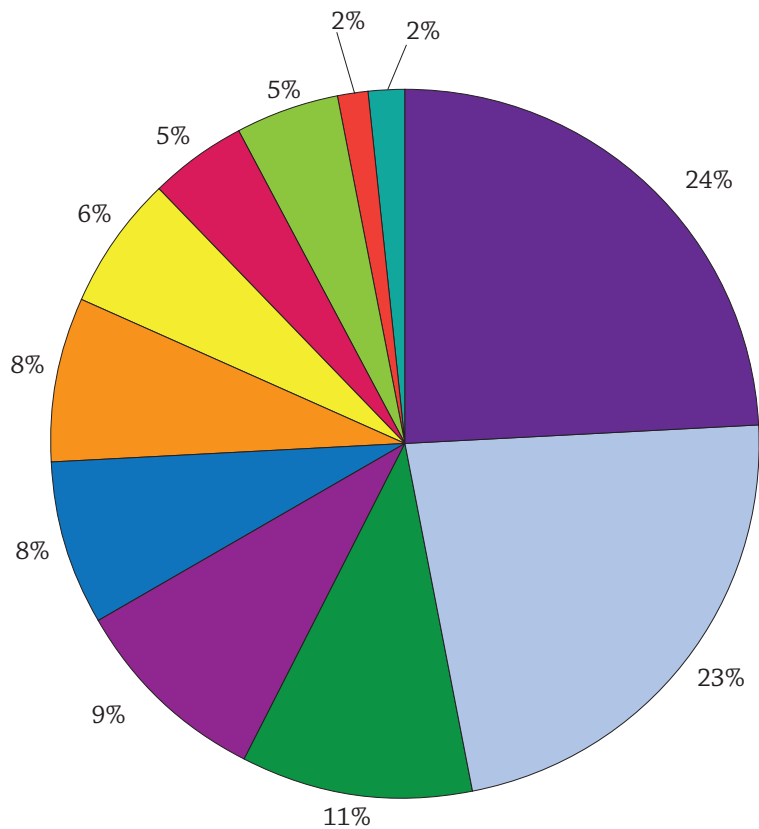
The Regenstrief Center for Healthcare Engineering and its partners collaborate to investigate research questions and develop solutions that will create positive change in the healthcare system.

Faculty Research Associates

RCHE faculty and staff research associates represent nearly all academic units at Purdue University. With specialties ranging from data mining to geriatrics, RCHE is where these faculty can pool their knowledge to collaborate on greater challenges.

Purdue College Representation at RCHE

- Health and Human Sciences
- Engineering
- Liberal Arts
- Library Sciences
- Science
- Technology
- Krannert (Management)
- Pharmacy
- Veterinary Medicine
- Education
- Medical Education



About RCHE Research

66
AFFILIATED FACULTY
RESEARCHERS

29 PURDUE DEPARTMENTS
AND SPECIALITIES
ENGAGED IN RESEARCH

2 GUIDING RESEARCH THEMES:
CARE COORDINATION AND
POPULATION HEALTH

RESEARCH PARTNERS,
FROM HOSPITAL SYSTEMS
TO NATIONAL ASSOCIATIONS **15**

Publications and Presentations

RCHE Faculty Research Associates publish in leading journals and present at conferences around the country. Below is a sample of publications and presentations for 2011–12. RCHE Faculty Research Associate names are in bold.

Selected Publications

Dutta, Mohan. *Communicating social change: Structure, culture, and agency.* Taylor & Francis, 2012.



DeCrane, Susan, Laura Sands, M. Ashland, E. Lim, T. Tsai, S. Paul, and J. Leung. “Factors associated with recovery from early postoperative delirium.” *Journal of PeriAnesthesia Nursing.* 26. no. 4 (2011): 231–241.

Huang, Ping, and Kwei Tang. “A constructive periodicity bound for the unbounded knapsack problem.” *Operations Research Letters.* (2012). <http://www.sciencedirect.com/science/article/pii/S0167637712000600?v=s5> (accessed May 22, 2012).

Shippee, Tetyana Pylypiv, **Kenneth Ferraro,** and Roland Thorpe Jr. “Racial Disparity in Access to Cardiac Intensive Care over 20 Years.” *Ethnicity and Health.* 16. (2011): 145–165.

Takahashi, P. Y., J. L. Pecina, **B. Upatiscing,** et al. “A Randomized Controlled Trial of Telemonitoring in Older Adults with Multiple Health Issues to Prevent Hospitalizations and Emergency Department Visits.” *Arch Intern Med.* 172. (2012): 773–779.

Xu, H., K. E. Covinsky, E. Stallard, **J. Thomas III,** and **L. P. Sands.** “Insufficient Help for ADL Disabilities and Risk for All-Cause Hospitalization.” *Journal of the American Geriatrics Society.* 60. (2012): 927–933.

Selected Presentations

DeCrane, Susan. “Confusion, Injuries, and Length-of-Stay in Postoperative Arthroplasty Patients.” *St. Vincent Health Research Symposium 2012.* Indianapolis, IN, June 2012.

DeCrane, Susan. “Electronic Medical Record Documentation of Delirium and Injuries in Postoperative Arthroplasty Patients.” *Sigma Theta Tau International 2012.* Brisbane, Australia, July 2012.

Musselman, Ken, Cody Mullen, and Zhiyi Tian. “Care Coordination and Hospital System Readmissions.” *Institute of Industrial Engineers Annual IE Conference and Expo.* Orlando, FL, May 2012.

Pope, Brandon. Hospital efficiency. *North American Productivity Workshop.* Houston, TX, June 2012.

Witz, Steven. “Healthcare Reform’s Impact on the Delivery Care System: Opportunities and Challenges.” *Aspen Institute Regional Summit.* Indianapolis, IN, October 2011.

Witz, Steven. “Healthcare Costs and the Mounting Federal Deficit.” *The Concord Coalition.* West Lafayette, IN, April 2012.

Building Interdisciplinary Research Teams

RCHE continues to develop interdisciplinary research teams to address the complexity of issues impinging on healthcare delivery and improving the ability to achieve research-to-impact. During the past year, two significant developments have added to the center's research capacity — the formalization of a research relationship with the Actuarial Science program and the establishment of the Center on Poverty and Health Inequities (COPHI).

Actuarial Science Program Partnership

Actuarial science is the discipline that has traditionally applied mathematical and statistical methods to assess risk in the insurance and financial industries. The discipline is actively pursuing expanded applications for its methodologies and has been recognized as offering an important contribution to understanding and mitigating risks associated with the implementation of the Affordable Care Act.

RCHE and Purdue's College of Science piloted a joint research program in the summer of 2011. Representatives from the Departments of Mathematics and Statistics presented the pilot results to the Actuarial Science Program Advisory Committee and received an overwhelming endorsement for continuing an applied research program with RCHE. In early 2012, this program was formalized with the establishment of a research scientist based in the Department of Statistics and conducting research on the implementation of accountable care organizations at RCHE. Dr. Xuanyao He will also be supervising actuarial students who have received College of Science Ruzika Scholarships to pursue individual research in the application of actuarial science to improve healthcare delivery.

The partnership has been led by Rebecca Doerge, professor and head of the Department of Statistics; Mark Ward, assistant professor, Department of Statistics; and Jeff Beckley, co-director, Actuarial Science Program, and professional actuary in residence, Department of Mathematics. RCHE expects the collaboration to continue with the 2012 recruitment of a tenured faculty in Actuarial Science to join these joint research efforts.

Center on Poverty and Health Inequities (COPHI)

RCHE's research addresses healthcare delivery issues that are associated with underserved patients. Healthcare delivery for these populations requires special accommodations. The establishment of the Center on Poverty and Health Inequities (COPHI) provides significant insight into these issues and the research methods required to have impact upon improving care. COPHI's interface with RCHE lies in developing, implementing, and evaluating programmatic solutions and interventions that are directed at reducing documented healthcare disparities.

COPHI was established in 2011 and emanates from RCHE's collaborations with the departments of Communications and Human Development and Family Studies. COPHI serves as an interdisciplinary research community with additional representation from Purdue's program in public health, the Department of Consumer Sciences and Retailing, College of Education, the Department of Agricultural Economics, and the program in Youth Development and Agricultural Education representing interests in rural populations.

Guiding Research Themes

RCHE's research direction is guided by feedback from strategic partners and advisors, and includes nationally identified priority populations and grand challenges. The center's research projects fall under two overarching research themes — care coordination and population health. These have been identified by groups such as the Institute of Medicine, the National Partnership for Priorities, and the Center for Medicare Innovation as areas in which improvement in healthcare delivery is an essential first step to overall healthcare system improvement.

Care Coordination

Care coordination among providers and patients is essential in creating better quality of care and more patient-centered care. Care coordination is the marshalling of personnel and other resources needed to support a continuous healing environment, enabled by integrated clinical services and characterized by the proactive delivery of evidence-based care and follow-up.

The National Partnership for Priorities estimates that patients with chronic conditions may have up to 16 different healthcare providers. Electronic health records will assist in improving care coordination but there are many other opportunities to coordinate care and engage patients in their healthcare. In particular, RCHE is interested in pursuing research projects that aim to improve care coordination in the primary care setting and for patients with chronic diseases. Two care coordination projects are covered in this report — potentially preventable readmissions, and the infusion pump informatics system.

Population Health

In population health, RCHE seeks to apply advancements found to be beneficial on the individual patient level to improve the care of larger population-level groups. Population health refers to the wellbeing of a population and the art and science of predicting and preventing disease, prolonging life, and promoting health through organized efforts and informed choices of society, organizations, public and private; communities and individuals.

Population health research aims to understand and improve the health of a population. It seeks to step beyond an individual-level focus to address equitable health outcomes on a population-level. It involves predicting and preventing disease, prolonging quality of life, and promoting health through organized efforts and informed choices of society, organizations, communities, and individuals. Two population health projects are covered in this report — the utilization model, and the safety net project, which focuses on underserved populations.

Partner Development

RCHE partners provide clinical feedback on research projects, access to primary data, and dissemination avenues for completed work. The center's continuous partner development ensures that its research can remain robust, relevant, and positioned to have greatest impact upon improving healthcare delivery.

Michiana Health Information Network (MHIN)

RCHE is in the early stages of developing a relationship with MHIN, a northern Indiana health information exchange. The relationship represents a pilot to assess the ability to upload data from MHIN into analytics developed by RCHE to impact care delivery such as the utilization model. MHIN's smaller size relative to other health information exchanges in Indiana enables this pilot. A successful outcome will be used to demonstrate this capability to the other health information exchanges in Indiana, thus expanding the impact these collaborations would have on care delivery. Indiana's leadership in the development of health information exchange provides an opportunity for national demonstration of the benefits of combining the advancements in health informatics and healthcare engineering.

St. Vincent Health's IMPACT Program

This winter, RCHE contributed to a St. Vincent Health proposal for a Center for Medicare and Medicaid Services Innovation Center grant. The program will advance St. Vincent's care of eligible patients in four key areas — reduction in ambulatory care sensitive conditions, reduction in 30-day hospital readmissions, reduction in unnecessary emergency department visits, and improved adherence to evidence-based guidelines. Although the results of the grant proposal will not be known for several months, St. Vincent has committed to starting the program and moving forward with the research goals immediately. RCHE will participate in this project by providing clinical analytics to assist in the development of new approaches to care delivery and by the evaluation of these efforts. RCHE's research on the utilization model and collaboration with St. Vincent on reducing preventable hospital readmissions will be used in these new delivery approaches.

Indiana Minority Health Coalition (IMHC)

The goal of the IMHC is to develop a broad-based, statewide network of community coalitions for the implementation of health promotion and disease prevention programming, for the impact on health policy as it relates to black and minority populations, and to empower all people to better care for themselves and their families.

Two research programs are being conducted by the Center on Poverty and Health Inequities (COPHI) that involve IMHC. In both programs, the IMHC has made important contributions to the development and execution of this research. As RCHE conducts research on the factors associated with the choice of primary care providers by those who are underserved in the Safety Net study, it anticipates a productive partnership with IMHC. Discussions were initiated in 2012 to form a collaboration which RCHE believes will substantially improve its ability to achieve impact on improving healthcare delivery in the 29 counties represented by IMHC.

Center Research and Dissemination Partners

Research Partners



Community Health Network — A leading non-profit health system with five hospitals and more than 70 sites of care in central Indiana.



Indiana State Department of Health — Promoting, protecting, and providing for the health of Hoosiers in their communities.



IU Medical Group — A practice of more than 135 physicians at 17 clinics.



IU School of Medicine — The provider of medical education in Indiana with more than 1,000 MD and PhD students.



Mayo Clinic — The first and largest integrated, non-profit group practice in the world.



Regenstrief Foundation — A private foundation that focuses its activities and financial support on the improvement of healthcare through medical research and process improvement.



Regenstrief Institute — A national leader in health services research, located at the Indiana University School of Medicine in Indianapolis.



St. Vincent Health — The state's largest healthcare employer with more than 3,000 physicians.



U.S. Department of Veterans Affairs — Including the Roudebush Veterans' Administration Medical Center, designed to enhance the VA's capacity to implement and sustain evidence-based practice.

Dissemination Partners



American College of Physicians — The largest medical-specialty organization and second-largest physician group in the United States.



American Hospital Association — The national organization that represents and serves all types of hospitals, health care networks, and their patients and communities.



Ascension Health — The nation's largest non-profit health system.



Indiana Hospital Association — The professional trade association for 167 Hoosier hospitals and health systems.

Pioneer Speakers

Pioneer Speakers

RCHE's Pioneer Speakers program supports up to three speakers of national prominence each year. While on campus, these experts present a public guest lecture, meet with students, and provide feedback and guidance on center initiatives. RCHE and its subcenters were pleased to host three external speakers this year. All speakers were open to the public and attendees represented a variety of departments from around campus.

Gary L. Kreps, PhD

Director, Center for Health and Risk Communication, Department of Communication,
George Mason University

"The Role of Strategic Health Communication Research & Interventions Across the Continuum of Care for At-Risk Populations"

William G. Coleman, PhD

Scientific Director, National Institute on Minority Health and Health Disparities,
National Institutes of Health

"Reducing Health Disparities: An Interdisciplinary Approach"

Robert Logan, PhD

Senior Communication Research Scientist, National Library of Medicine

"Native Voices: Native Peoples' Concepts of Health and Illness — A Tour with Editorial Comments"



Gary L. Kreps



William G. Coleman



Robert Logan

**" You don't blame your illness on being from
a poor area, but in order to get well, you
have to recognize the contributing factors."
— Rob Logan**

Speaker Series

Research Speaker Series

RCHE's Research Speaker Series highlights the work of RCHE faculty and staff research associates.

Mohan Dutta, PhD, Communication	"Center on Poverty and Health Inequities"
Margie Snyder, PharmD, Pharmacy	"Center for Medication Safety Advancement"
Chris Miller, PhD, Libraries	"Geospatial Imaging"
Ken Ferraro, PhD, Sociology	"Identifying Social Barriers and Facilitators to Assistive Device Use Among Older Adult Veterans"
Melissa Franks, PhD, Human Development & Family Studies	"Dyadic Communication"
Mark Lawley, PhD, Biomedical Engineering	"Optimal Scheduling with No-Shows for Diabetes Patients"
Ping Huang, PhD, RCHE	"Utilization Model"
Susan DeCrane, PhD, Nursing	"Post-Surgical Delirium Assessments"
Brandon Pope, PhD, RCHE/Industrial Engineering	"Efficiency Measurement in Hospital Production"
Steven Landry, PhD, Industrial Engineering	"Infusion Pump Threshold Alerts and Guidance"

Purdue Lectures in Ethics, Policy, and Science

RCHE co-sponsored the Purdue Lectures in Ethics, Policy and Science.

Arthur Caplan, PhD	"Personalized Medicine vs. Spitiomics — The Uncertain Future of Genetic Testing"
Gregory Kaebnick, PhD	"Synthetic Life: A New Industrial Revolution?"
Maria Merritt, PhD	"Global Public Health Research: Questions About Researchers' Responsibilities to Benefit Participants"
Frederick Grinnell, PhD	"Informed Consent and Risk: The Intersection Between Human Research and Genetics"

Student Research Projects

RCHE continued throughout this year to include undergraduate, graduate, and post-graduate students in research. Some of these students are sponsored by RCHE to conduct initial pilot studies to determine the feasibility of more comprehensive subsequent investigation. Each of the following students is involved in this type of research and exemplifies RCHE's strategy of introducing the methodologies of healthcare engineering to future healthcare professionals.

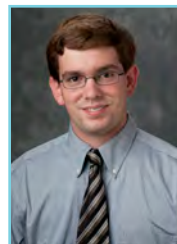
Stephen Lehnert, Post-Graduate Research Assistant. Lehnert joined the center for the summer. He will be initiating research on care mapping — a research methodology that identifies and analyzes services delivered to a defined group of patients who experience negative health outcomes. These methods are purported to provide new perspectives for opportunities to improve the timing and coordination of care and thus improve patients' health status. He will assist in the establishment of research piloting this methodology. Lehnert, a Purdue mechanical engineering graduate, will begin medical school at Indiana University fall semester 2012.



Stephen Lehnert



Wei Liu



Cody Mullen



Lauren Parker

Wei Liu, Graduate Research Assistant. Liu is an industrial engineering graduate student completing a PhD degree. She is working with Dr. Ping Huang on the operational research methods inherent in the utilization model to identify and prioritize opportunities to improve medical management of primary care patients. Her work will be transferred for application in the hub-based utilization explorer to allow healthcare providers greater access to this research and for impact on improving healthcare delivery. Liu anticipates a career in healthcare consulting.

Cody Mullen, Post-Graduate Research Assistant. As a Purdue undergraduate interdisciplinary science student, Mullen has worked at RCHE on research to prevent unnecessary hospital admissions. His efforts have focused on whether critical access hospitals (small rural hospitals with less than 25 beds) have similar re-hospitalization experience as larger hospitals. His findings will inform the need to develop unique interventions to prevent unnecessary hospitalizations at critical access hospitals. His work has allowed him to be recognized as a recipient of the Sally Mason Undergraduate Travel Scholarship to attend and present at the May 2012 IIE conference in Florida. He has also been accepted to the Institute for Health Improvement Student Quality Leadership Academy in Boston, sponsored by the Robert Wood Johnson Foundation. Mullen has received a University Fellowship from IUPUI, where he will begin the PhD program in public health in the fall of 2012. He looks forward to a career in academics.

Lauren Parker, Graduate Research Assistant. Parker holds an MPH from Purdue and is completing her PhD degree with a concentration in health services research, health policy, and geriatrics. At RCHE, she is collaborating with the Indiana Office of Medicaid Planning and Policy to model and evaluate opportunities to improve healthcare services for the "dual eligible" population (beneficiaries of Medicare and Medicaid). These patients utilize a disproportionately large amount of healthcare resources and have been designated as a priority population in the Affordable Care Act. Parker's career interests focus on policy development and healthcare implementation for geriatric patients.

Transforming Healthcare Delivery Online

CatalyzeCare represents a major research and development initiative by RCHE to utilize web-based technologies to advance healthcare engineering and the dissemination of research to healthcare providers. CatalyzeCare enables researchers and healthcare providers to interact on a real-time basis to communicate, share data, and apply research. RCHE has made substantial progress in the development and use of CatalyzeCare during 2012 to support research and dissemination findings.

CatalyzeCare has been a central component of RCHE's development of Infusion Pump Informatics. Development of the Healthcare Utilization Explorer, the second major application on the hub, is underway and envisioned to be the primary means by which providers will access and use research conducted in the Utilization Model project. RCHE will continue to develop and evaluate CatalyzeCare as exemplified in following examples.



Ken Musselman narrates the CatalyzeCare introductory video, which highlights the many ways researchers, educators, and providers can use the hub.

Development — Improving Data Support

One of the most valuable features of the hub is its ability to make sharing, accessing, and analyzing data easier for project collaborations. RCHE is building upon this feature and developing tools to improve its usability. The first upgrade is a separate database server to accommodate larger datasets and sensitive data. RCHE is also spearheading a project to create the infrastructure necessary to allow users to create databases for analysis using hub tools. On the hub, database tools, such as the IPI project, allow geographically disparate research teams to examine the same data in a browser without the challenges of software availability, downloading, or uploading and overwriting data. RCHE's database tool will allow hub users to upload an Excel database into the hub, and then manipulate data within it. The tool is under development and functionality is expected to be added throughout next year.

Evaluation — Understanding and Improving How Providers Use CatalyzeCare

With a sufficiently large community of providers using Infusion Pump Informatics (IPI) to improve medication safety, RCHE has begun research to understand how information present in IPI is being used. Research will examine most frequently used information, preferred formats, order of information viewed, and provider comparisons. RCHE anticipates that evaluation of Catalyze Care will enhance its functionality and prove to be a significant and successful strategy for achieving impact from research.

Center Finances

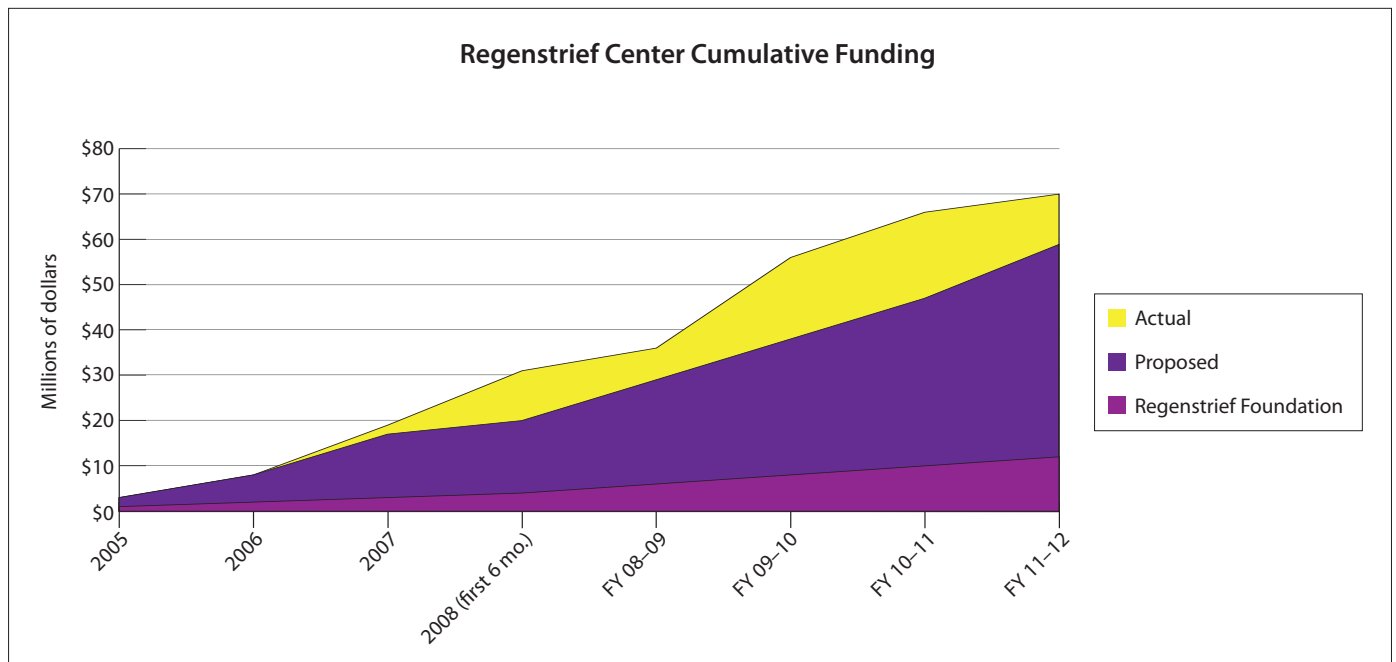
Funding Sources

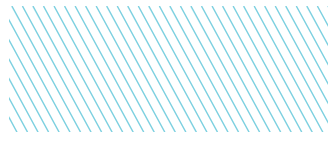
Key funding sources during this fiscal year include:

- Indiana Minority Health Coalition
- National Institutes of Health
- National Institutes of Health — Community Health Engagement Program
- Pfizer Inc.

Cumulative Funding

RCHE began this funding period in January 2008 with a goal of achieving \$68,470,655 in cumulative external funding by the end of the period, June 30, 2013. RCHE has now achieved this goal. The center will continue to pursue external funding with a goal of having raised \$108,470,065 by the end of the next funding period, June 30, 2018. Center cumulative funding through the current fiscal year is displayed below.





CENTER RESEARCH

The Regenstrief Center for Healthcare Engineering pursues healthcare delivery research with the potential to directly and positively impact the healthcare system.

The Core Four: Projects That Target Research and Impact

RCHE's interdisciplinary faculty team is particularly suited to addressing healthcare challenges that are multi-faceted in nature and that require input from fields as diverse and different as communication and industrial engineering. Within the guiding research themes of care coordination and population health, RCHE faculty and staff expertise is currently focused on four large projects:

- Potentially preventable readmissions,
- Utilization model,
- Healthcare disparities, and
- Infusion pump informatics.

These projects selected have three qualities: the potential to impact the healthcare system, input from partners indicating it as an area of need, and faculty from a variety of disciplines able to contribute their expertise to the research.

In each large project, additional smaller research projects have developed as new research questions emanate from the initial research findings. By pursuing these projects, RCHE encourages both breadth and depth within a research area, and reaffirms its commitment to conducting thorough research by addressing all key questions arising during the process. A table is provided for each large project detailed in this report to list the additional projects generated from the first line of research.



Bill Malloy (above), pharmacist, Roudebush VAMC, and Jim Young, quality assurance process improvement pharmacist, Wishard Health Services, led a research project investigating durations data within the Infusion Pump Informatics system (see page 22). Medication administration duration can be affected by many attributes, including drug and patient weight, and can impact the alerts generated; however, the data field was not well understood. Malloy and Young have conducted research into this and will present to the IPI community in June.

From Research to Impact

In 2010, RCHE proposed the testing of a new research-to-impact model, using supplement funding from the Foundation. The model was created to illustrate a research management concept in which partners and stakeholders played a key role throughout the entire process. The model also highlights the cyclical nature of research, emphasizing that once the results have been disseminated to providers, feedback is used to either continue to refine the product or to develop a new line of research building upon the initial results.

Essential to this research-to-impact process is collaboration with healthcare providers to establish research direction, conduct applied research in a pilot site, validate at multiple sites, and disseminate on a broad scale.

The center expects that continually engaging partners throughout the research process will yield two key benefits. First, the final project will be more tailored to the needs of the healthcare system. This will lead to a greater uptake of the results by providers. Second, partner involvement throughout the process will result in a greater understanding of the end product and greater application of the research. The Research-to-Impact model is intended to improve the impact RCHE's research has on improving healthcare delivery.

RCHE identified four projects whose goal and progress was appropriate for inclusion in this new test model — Potentially preventable readmissions, the Infusion Pump Informatics project on CatalyzeCare, the Utilization Model, and the Safety Net project. With half of the project timeline completed, this report provides a mid-course update on each project.

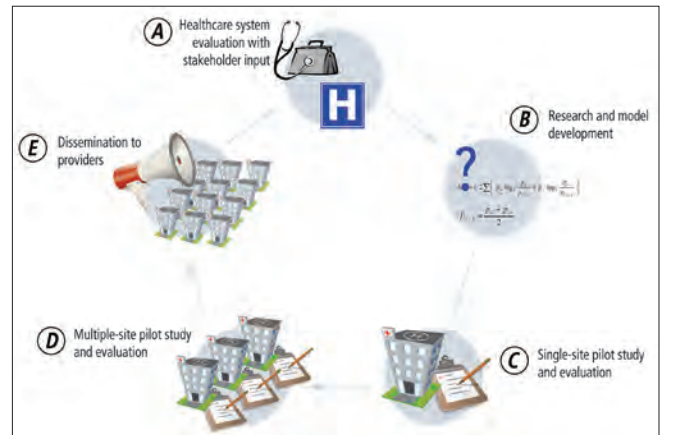


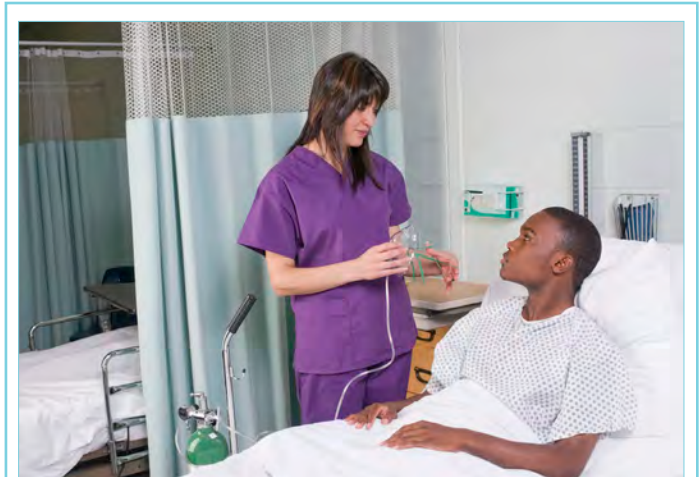
Figure 1. RCHE's Research-to-Impact model (above) illustrates the cyclical nature of impactful research and partner involvement. In the projects described on the following pages, areas of this diagram will be marked to show the progress of the project over time.

About the Model. RCHE's research is practice-based and is directed in part by the evaluation of healthcare delivery with stakeholder input (A). A research project is developed (B) and a single-site pilot study is conducted (C), both with stakeholder input continuously helping to refine the project. A multi-site evaluation validates pilot study results and helps avoid a premature treatment of the pilot site innovation as a "best practice" (step D). The implementation of innovation from practice-informed research returns essential feedback from the field of practice to drive a rapid cycle, closed-loop applied research process (steps E and A).

Targeting Potentially Preventable Readmissions

RCHE’s research in potentially preventable readmissions was developed through discussions with strategic partners to identify research that would be the most beneficial to the industry. A team of faculty from three universities was assembled to study this issue. Because the causes of readmissions are not well understood, the team has taken a broad approach, considering a variety of factors. The center’s readmissions work differs from many others in that the data is primary and covers all patients and all diagnoses.

The pilot sites were three hospitals in the BayCare Health System in Tampa, Florida. Billing data covering three years of patient admissions was provided for these locations. Drawing on this data, a prediction algorithm is being developed and tested against an additional six months of data. A successful prediction algorithm would allow the hospital to target system and patient interventions to those areas with the greatest potential for improvement.



RCHE’s initial readmissions profile showed that BayCare Health System had better than average readmissions but that initiatives to reduce those even further had not yet made an impact, leaving room for improvement.

Because readmissions is one of several high-profile events being targeted nationally for improvements in quality and safety, the center is researching the relationship between readmissions and these other events, including hospital acquired infections. “Frequent fliers” and comorbidities are also being explored for their significance in predicting readmissions.

The pilot data set contains billing data from three hospitals; another eight hospitals were provided for the multi-site pilot study and evaluation. Further review of these hospitals with a representative from BayCare indicates that they serve a wide range of economies, social structures, and ethnicities. The research team is reviewing inter-system and intra-system flows with respect to readmissions. Initial analyses indicate findings such as patients discharged to another facility, are less likely to be readmitted. Interventions to improve care coordination for patients transferred to post-hospital care facilities are now being assessed.

Additional Readmissions Research Projects

Research	Lead researcher or faculty	Department
St. Vincent Health IMPACT Program	Steve Witz	RCHE
Care transitions for diabetic patients	Melissa Franks	Human Development & Family Studies
Critical access hospital readmissions	Steve Witz, Cody Mullen	RCHE
Readmissions recommendation engine	Luo Si	Computer Science

Research-to-Impact: Readmissions

Project partners: BayCare Health (Florida), St. Vincent Health (Indianapolis)

RCHE's Research-to-Impact work in readmissions expands upon current projects by engaging the partners throughout the research process to develop impactful solutions. This partner involvement has led to the addition of eight hospitals within the BayCare system, as the project now enters the multi-site pilot phase of the Research-to-Impact process.

Over the last 18 months, the research has advanced in the following ways:

- BayCare Health has provided additional data following nearly 350,000 patients with approximately 560,000 visits.
- A second hospital system, St. Vincent Health, in Indianapolis, has joined the project. St. Vincent Health will provide data on readmissions for several hospitals in its Indianapolis system. This partner will serve as the validation partner and add to the multi-site trial. As with the pilot partner, the data includes patients of all ages at a variety of acute care and specialty hospitals.
- Validation of the predictive model developed with the first set of data from BayCare Health is now in progress.

Project progress: Readmissions



Making an Impact: Multi-Site Validation Research

A key stage of the research-to-impact model is the multi-site pilot, which allows researchers to test findings from the pilot and validate models for more generalizable applicability. While many studies may skip this stage, RCHE considers it essential to developing programs that will be adopted and have an impact in the healthcare delivery system.



Building on the pilot conducted in 2011, RCHE is now conducting a multi-site pilot. Data from eight hospitals in Florida and three hospitals in Indiana have been submitted for analysis in this phase of the readmissions project. Researchers will expand and validate the prediction model developed during the single-site pilot, and analyze the data against other healthcare challenges including comorbidities, ambulatory-care sensitive conditions, and healthcare-acquired infections.

Utilization Model: Better Data for Better Decision-Making

Healthcare Utilization Explorer

Work to develop the basis of the utilization model has continued this year through RCHE core research funds as a complement to the model work being conducted within the supplement. A key development is the Healthcare Utilization Explorer tool. This tool, available in CatalyzeCare, visually displays the utilization of healthcare services by a specified population of patients. The purpose of the system is to provide a graphical decision support tool for quickly exploring patient utilization of healthcare services. The system provides information that is not routinely available to healthcare providers in a user-friendly decision support system. This information is then able to be exported to Excel for additional analyses.

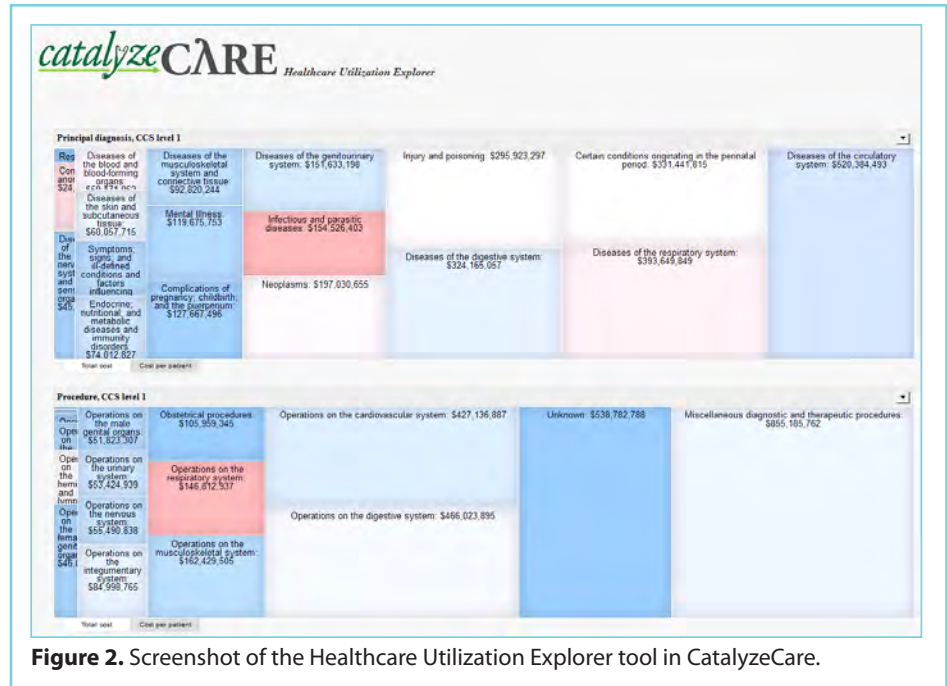


Figure 2. Screenshot of the Healthcare Utilization Explorer tool in CatalyzeCare.

As the project continues, healthcare providers will drive the development of additional information presentation and decision support.

Additional Utilization Model Research Projects

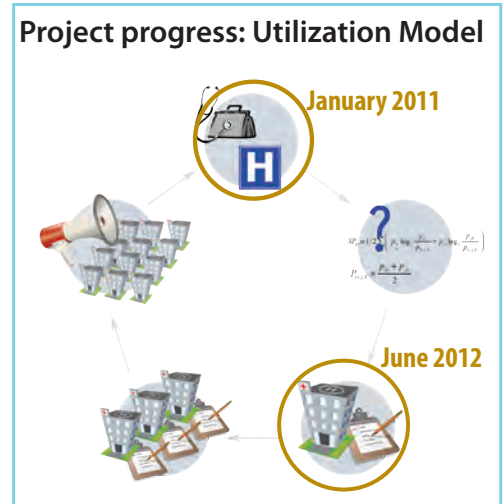
Research	Lead researcher or faculty	Department
Explorer graphical user interface	Mike Zentner	ITaP (Information Technology)
Three perspectives on users	Ken Musselman	RCHE
Health Information Exchange	Steve Witz	RCHE
Application of model to assist in ACO pilot strategies	Ping Huang, Wei Liu	RCHE
Care mapping	Stephen Lehnert, Steve Witz	RCHE

Research-to-Impact: Utilization Model

Project partners: MHIN, Purdue Human Resources, American College of Physicians, St. Vincent Health

The Utilization Model project was developed to address a key shortcoming identified in national medical home pilots. Providers in these pilots reported that they did not have the expertise to manipulate their patient data into a format that was meaningful for creating better patient care. This project seeks to create a tool that addresses this need. Partnerships are key to this project. Data may be in the form of insurance claims from payors or bills from providers. Further, as the project seeks to address a need, partnerships with providers in the pilot and evaluation stages will be essential.

RCHE is developing this project for dissemination through CatalyzeCare (see page 11) to ensure widespread availability of this tool to providers. Purdue claims data is being used for the pilot project. The St. Vincent IMPACT Program is planned to serve as a validation site.



Making an Impact:

Dollars and Cents of Prevention

Biannual HbA1c blood tests measure blood glucose control over the previous three months and help diabetes patients and their providers determine if their overall management plan is working. Testing also helps providers identify and mitigate any issues before they become serious.

Analysis from RCHE's pilot study of the utilization model shows that while regular testing can improve patient health, it can also contribute to significantly lower overall healthcare utilization and expenditures. Patients without this important test had more than \$10,000 more in healthcare expenses that year than patients who had the test.

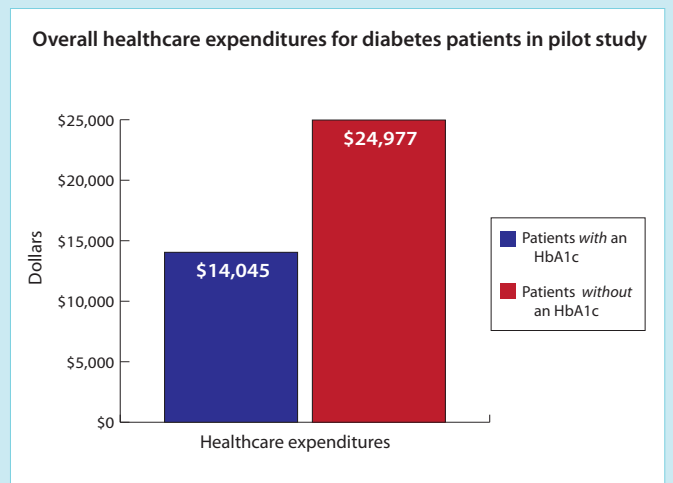


Figure 3. Patients with an HbA1c test had \$10,000 less in annual healthcare expenditures than those that did not have the test.

Investigating Healthcare Disparities

RCHE’s research portfolio on healthcare disparities and underserved populations began with a project investigating the healthcare-seeking behaviors of the Indianapolis Safety Net population and has now grown to support disparities research with several other populations. Researchers are included in the RCHE sub-center, Center on Poverty and Healthcare Inequities (COPHI).

The Duals Project

Dual-eligibles — patients who are eligible for both Medicare and Medicaid support — account for nearly 15 percent of Medicaid enrollees nationally, but they account for 39 percent of Medicaid spending. They are among the sickest and poorest of patients covered, and they must navigate both Medicare and Medicaid for services and coverage. Their high rate of utilization has made this group one of interest for both policymakers and researchers, and the first identified step toward improvement has been to identify opportunities for better coordination within and between programs.

RCHE is working with the Indiana Office of Medicaid Policy and Planning to evaluate a state-level initiatives to improve care coordination for the Indiana dual-eligible population. The prevalence of multiple chronic conditions in this group necessitates improving care coordination and developing innovative new programs. RCHE anticipates incorporating the research of Dr. Laura Sands, who has identified new approaches to providing support for older adults in their homes to delay the need for placement in skilled nursing facilities.

The center is providing research assistance to determine which initiatives have been successful in other states and might translate well to the Indiana dual-eligible population. Other states launching initiatives have been successful with telemedicine programs, a regional care system with dedicated care managers for dual-eligible patients, and targeting the management of the most common conditions. RCHE will assist the team from the state in determining if these initiatives match the needs of the Indiana dual-eligible population.



Many dual-eligible patients have multiple chronic conditions, making care coordination an essential component of improving care.

Additional Health Disparity Research Projects

Research	Lead researcher or faculty	Department
CUAHD — African-Americans targeting heart disease	Mohan Dutta	Communication
Social and behavioral influences on clinical communication and pain management	Cleveland Shields	Human Development & Family Studies
Participatory communication and health literacy in Hispanic minority patients	Lala Acharya	Consumer Sciences and Retailing

Research-to-Impact: Safety Net

Project partners: IMHC, Wishard Hospital, Regenstrief Institute

To prepare for the dissemination of this research, preliminary steps have been taken to facilitate the use of findings from this research to have impact.

Project planning with senior leadership at Wishard Hospital has aligned the research team's interests with those of Wishard and provided an opportunity for discussions of the use of the anticipated research results. Wishard has suggested that, with research results, they would consider re-convening a group of Marion county safety net providers. They felt the research may provide information that this group could use to evaluate services being provided to the safety net recipients.

Planning for this research involved a review of the Fairbanks Foundation sponsored inventory of Marion and doughnut counties' safety net providers. RCHE has been interested in having the results of its safety net study contribute regional information used in planning and evaluating the safety net system's effectiveness. Research results will be disseminated to participants in this previous study.

The research team has met with leaders of the Indiana Minority Health Coalition. IMHC has been briefed on the goals of this research and offered their full support. RCHE's current plans are to continue to work with the IMHC on plans for research implementation and will include them in validation of research findings. The coalition has pledged support to assist in the recruitment of safety net recipients to participate in interviews to be conducted in the second phase of this research. IMHC has asked to receive the research results.

RCHE hosted three national leaders in health disparities to participate in research planning and to provide advice on disseminating results. Dr. Gary Kreps, Director, Center for Health and Risk Communication at George Mason University, Dr. William Coleman, Director of the National Institute for Minority Health at NIH, and Dr. Robert Logan from the National Library of Medicine (see page 8) visited Purdue and will continue to advise dissemination of this research.

Project progress: Safety Net



Making an Impact:

Community Engagement is Key

Research indicates that affecting behavior change in minority communities is most effective when the information comes through community leaders and the community can become engaged in the information process. RCHE faculty have developed key partnerships with community leaders in Indiana through which future projects and positive behavior change can be channeled. These partners include:

- Health Communities of Clinton County Coalition
- Indiana Minority Health Coalition (IMHC)
- Indiana Office of Medicaid Policy and Planning

Infusion Pump Informatics: Improving Patient Safety

After three years of Infusion Pump Informatics (IPI) community development, significant improvements are occurring in the safety of IV medication administration. The Infusion Pump Informatics project has now grown large enough to support more research projects that promise additional impact in improving patient safety.

Alerts Thresholds and Guidance

Setting and tight alert thresholds on infusion pumps can prevent many medication safety issues but may also generate a lot of alerts, leading to alert fatigue, habituation, and the potential for errors in patient care. Dr. Steven Landry, assistant professor of industrial engineering, is conducting research into alert fatigue and threshold identification on the pumps. Existing research in alerting cannot be easily applied to infusion pumps because of the frequency of alerts, multiplicity of alerts due to many alerting systems, and an unknown distribution of prediction error. Landry will be developing this new research area using data from the IPI project. Landry’s team will examine the data, including thresholds and assumptions, to determine if a model may be constructed to inform infusion pump alerting operations. The research goal is to improve compliance, avoid adverse drug events, and set the stage for addressing other alerting system problems in future research.

Disruptive Formalization

Infusion pumps standardize how drugs are administered, reduce end-user reliance on memory, and increase access to decision support information; however, in spite of these virtues, there can be negative consequences, including inflexibility, flaws in software, constant alarms, and added bureaucracy. Dr. Benjamin Dunford, associate professor of management, has developed a construct called “disruptive formalization,” which describes nurse perceptions of unintended negative aspects of the formalization of medication administration procedures. By contrast, enabling formalization refers to the extent to which nurses perceive that the pumps and related procedures improve patient safety.

This project use anonymous surveys of randomly sampled nurses at three Midwestern hospitals to learn more about the positive and negative perceptions and workflows surrounding the pumps. The results of the survey will contribute to discussions on nurse attitudes regarding the pumps and procedures, and potential insights into how to improve patient safety. The data will also be available for future studies on this topic.

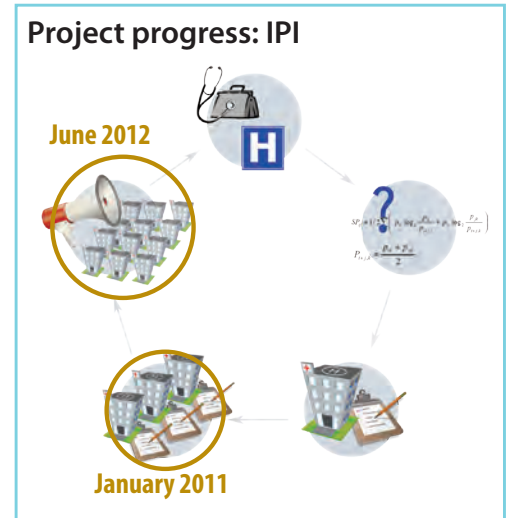
Additional Infusion Pump Informatics Research Projects

Research	Lead researcher or faculty	Department
Alert threshold guidance	Steve Landry	Industrial Engineering
Organizational dynamics	Ben Dunford	Management
Durations	Jim Young and Bill Malloy	Partners — Wishard and Roudebush VAMC

Research-to-Impact: IPI

Project partners: Indianapolis Patient Safety Coalition, Community Health Network, Franciscan St. Francis Health, IU Health, St. Vincent Health, University of Nebraska Medical Center, University of Iowa Hospitals and Clinics, Witham Health, University of Wisconsin Hospitals and Clinics

The Infusion Pump Informatics System was developed to contribute to improved patient safety in hospitals by providing pharmacists and nurses with a more robust and user friendly analysis tool for alert data from IV infusion pumps. Since the project's inception in 2008, participation has grown to include hospitals around the Midwest who are using the IPI to improve IV medication safety.



This year, the following advancements have been made:

- Feedback from community participants has led to the development of additional analysis capabilities including pivot tables, advanced compare charts, and clickable bar charts. New features such as hospital events timelines, compliance data, and usage analytics contribute to a stronger understanding of the data by adding context to the data. Hospitals are now able to indicate when a guardrail change occurred, which likely changes the alert data. “Good catch” and “Missed catch” reports have been developed and are being refined.
- Four hospital systems have been added — University of Iowa Hospitals and Clinics, University of Nebraska, IU Health, and the Roudebush VAMC. This doubled the size of the community during 2011–12.
- A second pump provider, Hospira, has been added to the system.
- A steering committee has been created to allow the growing group to participate in more self-direction with respect to system development and community engagement. Steering committee members are: Cindy Gaston (U. of Wisconsin), Todd Walroth (Wishard Health), and Bev Vermace (U. of Iowa).
- Two Purdue research projects based on the system have been launched. Steve Landry, associate professor of industrial engineering, is working with a team to study alert fatigue. Ben Dunston, associate professor of management, is researching change management.

Making an Impact:

Making the “Good Catch”



This year, RCHE’s Infusion Pump Informatics (IPI) system hit a milestone, impacting more than 200,000 hospitalizations across the nine participating hospital systems in four states. But how can nurses know that this latest alert-generating machine is helping patients? How can pharmacists know if they’re improving patient safety?

A new feature introduced this year is aptly called, “Good Catch.” “Good Catch” mines the data and displays alert events in which the alert amount was dramatically higher than the guardrail, and a medication safety

event was likely avoided. For each event, pharmacists can see the programmed dose, guardrail hit, action taken, and reprogrammed dose.

“The ‘Good Catch’ feature is a powerful way to see how the technology is benefitting us,” says LeeAnn McGinley-Wright, RPh, BCPS, clinical staff pharmacist at Franciscan St. Francis Health and IPI leader in developing the “Good Catch” feature.

“We’re all humans and we make human errors, and although many times those errors won’t cause patient harm, it can be one or two times it does cause severe patient harm,” says Cindy Gaston, PharmD, senior clinical pharmacist from the University of Wisconsin Hospitals and Clinics. Many of the Good Catch alerts are reprogrammed to the correct value and appear to be a typing error — 2,000 when the intended amount was 20.

“Anytime you have something greater than a ten-fold difference, it has the potential to be significant enough to cause harm,” says McGinley-Wright. “When you see that the alert was reprogrammed to the intended dose, you know that the pump really saved a medication event.”

The catches are not just a reason for celebration but an opportunity for education. Smart infusion pumps, with drug and fluid libraries, guardrails, and alerts, have only been on the market for 10 years. They are just one of up to half a dozen machines in a patient room that may beep for attention.

“We can show examples of these good catches in hospital committees, and in education and communication materials to help remind people why we have this technology,” says McGinley-Wright.