

12-2011

# Program Committee Report December 2011

Regenstrief Center for Healthcare Engineering

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# Regenstrief Center for Healthcare Engineering

## *Report to the Regenstrief Foundation*

*December 2011*



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## A focus on impact

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Healthcare continues to take a prominent role in national conversations, often reflecting a need for improved healthcare delivery. In collaboration with its research and dissemination partners, the Regenstrief Center for Healthcare Engineering continues to pursue its goal of a transformed healthcare system that delivers on the six aims of the Institute of Medicine — a healthcare system that is safe, effective, patient-centered, timely, efficient, and equitable.

In the six months since RCHE presented its renewal application highlighting four years of research progress, it has continued its drive toward impact. The center has continued to engage partners in various stages of research projects, consistent with its research-to-impact model shown on page 7. The four supplement projects (see pages 7–11) continue to make progress in engaging partners, and conducting research based on salient needs. This report uses the readmissions project to illustrate the research-to-impact model that RCHE is following. It provides the program committee members with a specific example showing RCHE's approach to conducting research and implementing research findings. This project has moved through the single-pilot research stage and is entering the validation stage.

Extramural funding, publications, and awards provide validation of the quality of the center's research. Projects previously funded by the center are receiving recognition, and center researchers are receiving grants from institutions including the Agency for Healthcare Research and Quality and the National Institutes of Health.

## Projects

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### Current center projects

Infusion pump alerts and guidance. PI: Steve Landry, Industrial Engineering.

Infusion pump informatics. PI: Ann Christine Catlin, Rosen Center for Advanced Computing.

Patient-centered medical home utilization model. PI: Ping Huang, RCHE research scientist.

Proactive planning and scheduling intervention for diabetic care. PI: Mark Lawley, Biomedical Engineering; Laura Sands, Nursing.

Reducing hospital readmissions. PI: Hong Wan, Industrial Engineering; Lingsong Zhang, Statistics.

Retrospective Chart Review for Patients at Risk of Postoperative Cognitive Decline. PI: Susan DeCrane, Nursing.

Geospatial and Sociodemographic Analysis of Healthcare Seeking Behaviors within Safety Net Providers. PI: Haslyn Hunte, Health & Kinesiology.

Testing an Interactive Web-Based Nutrition Tool in Patients Enrolled in Cardiac Rehabilitation. PI: Ji Soo Yi, Industrial Engineering.

I-ADAPT Health Disparities Hub. PI: Mohan Dutta and Bart Collins, Communications.

SBI. PI: Cleveland Shields, Human Development and Family Studies.

Pathfinder Award to Promote Diversity in the Scientific Workforce. PI: Brad Duerstock, Center for Paralysis Research.

Transitions from hospital care: Post-discharge care for patients with type II diabetes. PI: Melissa Franks, Human Development and Family Studies.

### Past project updates

A publication stemming from the patient scheduling project funded under the first supplement and conducted by Mark Lawley, professor of biomedical engineering, was awarded the Best Applied Paper prize (see page 15).

Former communications faculty member Jake Jensen received an RCHE seed grant in 2009 to test the impact of a workplace campaign to increase colorectal cancer screenings. He has

continued to build on this research and in 2010 was invited to speak at the National Colorectal Cancer Roundtable in Washington, DC.

The Integrated Model of Healthcare Utilization, developed at RCHE by Drs. Witz and Musselman, has been included in the *Handbook of Healthcare Delivery Systems*.

Krannert professor Lee Schwarz received an RCHE seed grant to research group purchasing organizations in healthcare. His results have been published and he received media coverage in *Healthcare Finance News*, *Modern Healthcare*, and other news outlets.

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## RCHE operations

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### Featured project: A new look at hospital readmissions

Potentially preventable hospital readmissions have become an event of increasing interest as a means to improve healthcare quality and cost savings. A metric for preventable hospital readmissions is readmission rates within 30 days of discharge. This issue has taken on a new sense of urgency since the government announced that Medicare and Medicaid would begin reducing reimbursements to hospitals with high readmissions rates beginning in October 2012. Studies to date have shown that as many as one in five Medicare patients is readmitted within 30 days of discharge, often for reasons that could have been avoided. These include unidentified complications, poor transitions during and after discharge, and a lack of effective patient education about post-discharge self-care.

RCHE has partnered with researchers from the University of South Florida and Northeastern University, and clinical partners BayCare Health System and St. Vincent Health to approach the readmissions question from a new angle. Unlike previous projects, which have used primarily Medicare data available from the government, the RCHE project uses primary data from the participating hospitals and covers all patients, regardless of age, over a continuum of three years.

An analysis of patient data from BayCare Health System has revealed:

- The risk of readmission begins to increase at age 55, ten years earlier than trends that have been reported using Medicare data only. The primary discharge diagnoses most strongly associated with readmission are different based on the patient's age. Mental health concerns are the most common primary discharge diagnosis associated with readmission for patients under 65 years of age, but not one of the top three discharge diagnoses associated with readmission for patients over the age of 65.
- Patients' source of financial payment for their hospitalized care is associated with risk for readmissions. One observation is that patients with Medicaid have a higher risk of hospital readmission.
- Contrary to previous studies, BayCare's data indicates that hospitalists have fewer readmissions than primary care providers.
- Patients discharged to skilled nursing facilities and/or long term care facilities have some of the highest rates of readmissions.
- Ninety percent of patients readmitted to a hospital are observed as having three or fewer readmissions within the study period. This suggests that the readmissions challenge is systemic, with many patients being readmitted a handful of times.

- Patients with a short elapsed time from their immediate past hospital discharge have a higher probability of being readmitted. For example, hospitalized patients who are readmitted within 30 days of their previous hospital discharge have an 18 percent probability of being readmitted within 30 days of that discharge.

Two prediction models have been developed. The first creates a 30-day risk of readmission for a patient, given factors such as marital status, gender, and age, among others. The second illustrates on a graph the likelihood of the patient being readmitted across a more lengthy time period — up to three years. These models will be refined and validated.

RCHE's goal in this project is to research how prediction can contribute to better decision making. The center intends to continue to develop this research involving partner care providers, with the intent of testing the helpfulness of predictive models with providers for ultimate implementation and dissemination.

### A readmissions tale of two patients

On any given day, hospitals see many patients — patients like Li and Tyrone are typical.



Li is 41 years old. Six months ago, she was admitted to the hospital for a nervous system disorder. Yesterday, she was admitted again, and after some care, she is being discharged. It has been less than 24 hours, and her condition is not considered serious. Her husband will pick her up and bring her home. They have commercial insurance.



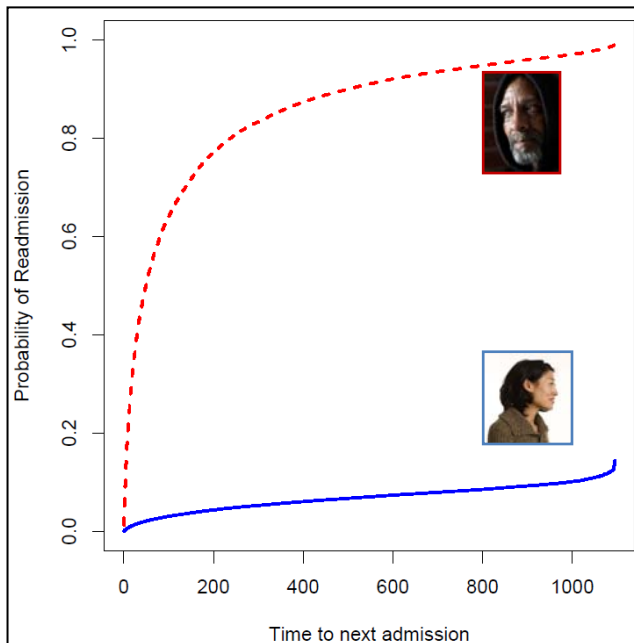
Tyrone is 70 years old. He and his wife have separated but he lives in his own home. He has a blood disorder and is in the hospital for treatment again after being admitted 15 days ago. His previous hospital stay was six days long, and his attending hospitalist hoped he would not have to return. He is concerned about the more serious level of disease he has.

Tyrone is covered by Medicaid.

According to the modeling developed in the readmissions study, the most significant characteristics in the descriptions that should be considered when calculating readmissions risk include: time from last discharge, length of stay, severity of illness, procedures associated with practice differences between hospitalists and primary care physicians, payer class, and marital status.

Using the prediction model developed by the RCHE readmissions team, Li has a four percent likelihood of being readmitted in the next 30 days. Tyrone has a 29 percent likelihood of being readmitted in the same timeframe.





Extending the prediction to 600, 800, and 1,000 days (almost three years), the graph at left shows each patient's likelihood of being readmitted over time. It is unlikely that Li will be readmitted, even over the course of three years. However, it is a near certainty that Tyrone will be readmitted by the end of the same period. Knowing this, the hospital can elect to focus on discharge planning and post-care interventions for Tyrone and patients like him with a similar risk of readmission.

Patients with the greatest risk for readmission appear to be the

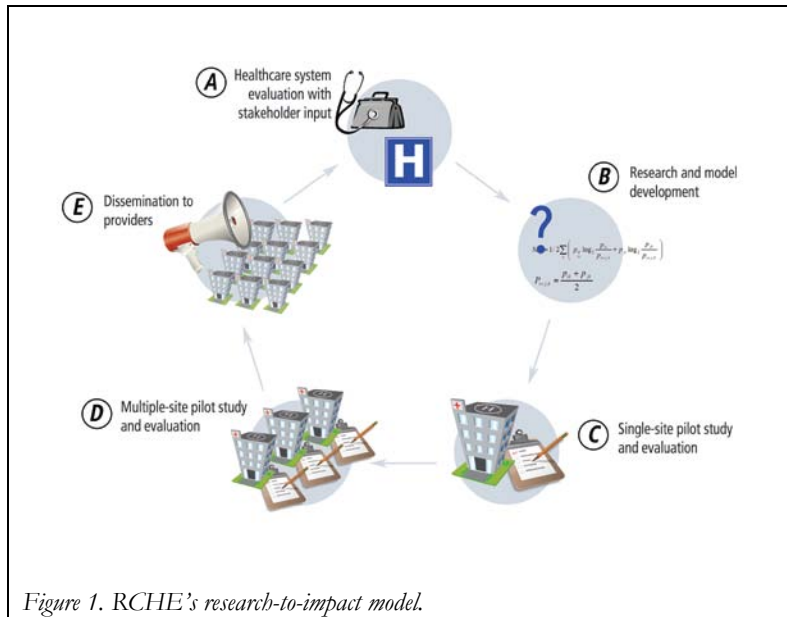
optimal focus for these types of discharge and post-card interventions. This research can help hospitals stratify patients based on risk for re-hospitalization and focus their efforts where they are likely to have the greatest impact. Interventions may not be uniformly applicable to all high risk patients, but do appear to share common delivery system attributes, such as structuring discharge planning to:

- Effectively educate patients and their families in critical self-care activities,
- Provide immediate contact with post-discharge care providers, and
- Initiate patient monitoring through the post-discharge period in which readmissions are most likely to occur.

Evaluating interventions based upon these attributes is RCHE's next focus for research and a critical step towards achieving impact from this research. The research team looks forward to sharing these findings with the Health Research and Educational Trust (the American Hospital Association's research foundation), one of RCHE's dissemination partners on this research project.

## Supplement funding project update

In its 2010 proposal for supplemental funding, RCHE put forward a new approach to completing the research-to-impact cycle (below). The model involves external partners more significantly and at earlier stages of research than had previously been the case. Partner input at the earliest stages of the project ensures research that better reflects the needs of providers and builds engagement for improved dissemination at a later stage.



The supplement funds increased project management and partner relations for four selected projects to move through this model. Updates on the first year of the supplement are included here.

## Safety Net community support

<b>Research team</b>	Haslyn Hunte, Health & Kinesiology; Lingsong Zhang, Statistics; Chris Miller, Library Sciences
<b>Partners</b>	Regenstrief Institute, Eskanazi Health
<b>Current model stage</b>	B — Research and model development

### Project overview

The number of individuals in the U.S. who do not have sufficient financial resources to purchase basic healthcare is growing — the uninsured, beneficiaries of several publicly funded programs, and the under-insured. Their health status is negatively affected by limited access to healthcare and presents a moral as well as public health issue for all Americans.

Core safety net providers offer the best opportunity to provide access to critically needed healthcare, deliver patient-centered care, and provide coordinated healthcare services; however, they are operating in an increasingly financially challenged environment with growing demand for service.

This study will provide leaders and policymakers for the core safety net providers in Marion and surrounding counties with information pertaining to where uninsured and under-insured patients go to seek care. Analyses will be coordinated to identify factors influencing care seeking behavior and model changes in care seeking behavior as these factors change. This information will support the core safety net providers planning and system operation. Three research objectives are being pursued:

1. Identify and map the location of where individuals live and where they receive care within the core safety net provider system. Determine the distance traveled and travel time to receive care from providers included in the data sample.
2. Determine whether bypass behavior is exhibited by patients for each episode of care they seek.
3. Determine the association among sociodemographic variables and care seeking behavior.

### **Project update**

RCHE has established two research partners for this project, Wishard Health Services and the Regenstrief Institute. Wishard leadership has been instrumental in the development of research questions to address issues of importance for safety net service provision. The Regenstrief Institute has been involved in defining available data and processes for data transfer to RCHE. A data agreement and Purdue IRB approval have been obtained. We anticipate the first phase of data exchange by the end of 2011.

Consistent with the research-to-impact model and desire to validate research to improve the application of findings, RCHE has invited a second core safety net provider hospital to participate in this study. If this invitation is accepted, this second hospital provides an initial opportunity to validate research findings from Wishard. RCHE views the opportunity to engage other hospital members of the National Association of Public Hospitals and Health Systems as a priority for expanding hospital participation.

RCHE's research capacity and breath of research expertise for this study has been expanded through the development of the RCHE sub-center, the Center on Poverty and Health Inequities (COPHI). COPHI is currently engaged in healthcare delivery to safety net recipients in Marion and Lake counties. Much of the research interest in COPHI is focused on community-based engagement. COPHI has well-established relationships with the Indiana Black Health Coalition and the Indiana Black Caucus, and these community groups offer additional venues for dissemination of this research to leverage impact.

### Patient-centered medical home (PCMH)

<b>Research team</b>	Ping Huang, RCHE
<b>Partners</b>	American Health Network, American College of Physicians
<b>Current model stage</b>	B — Research and model development

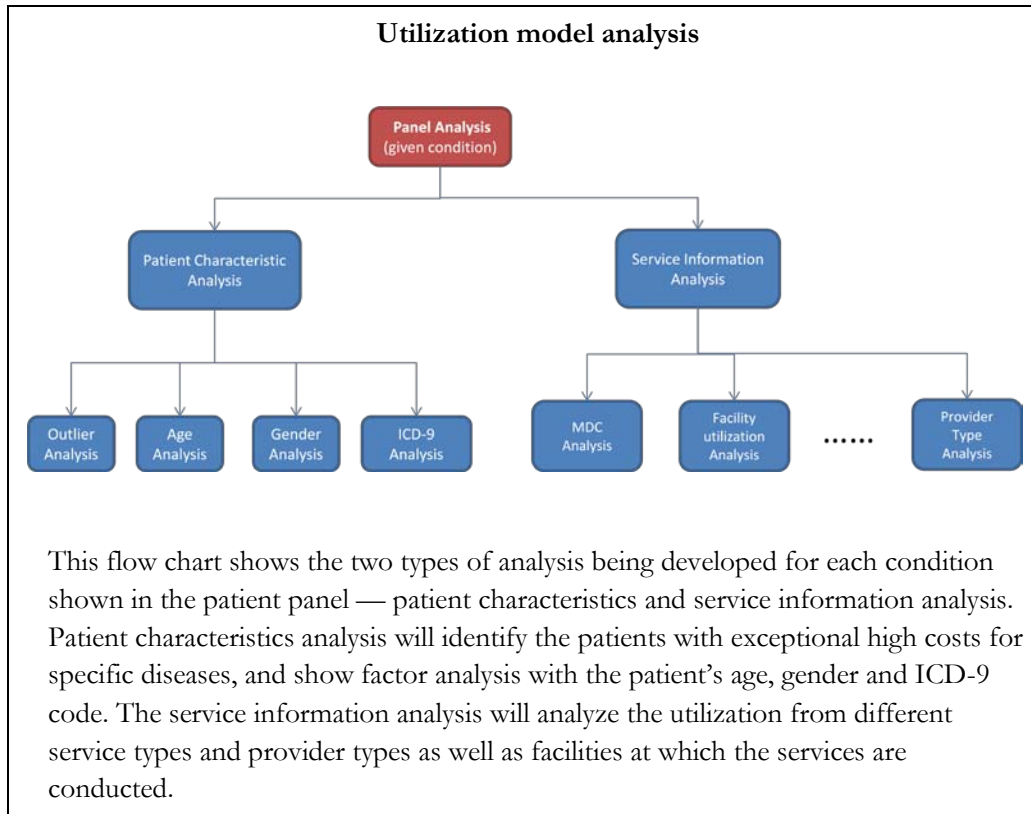
#### **Project summary**

The American College of Physicians (ACP), a center dissemination partner, has been interested in research pertaining to the viability and successful implementation of the medical home model. RCHE's PCMH project builds on their interest and feedback, and seeks to develop a utilization model that would allow providers to view their patients' healthcare utilization to select target areas for medical management strategies. The model also has the potential to inform accountable care organizations (ACOs) about areas in which improved medical management may be helpful. This model is intended to provide healthcare providers with interactive decision support assisting successful accountable care delivery.

#### **Project update**

RCHE has met with the Purdue benefits team and secured access to Purdue's claims data. Purdue is self-insured. The data provides three years of healthcare claims for approximately 25,000 Purdue employees and family members, and will allow the team to develop an initial proof-of-concept. RCHE is enrolling regional providers to participate in the project.

The research team continues to develop algorithms and classification documentation, which will be used in future analyses. With the input of the ACP, the center will continue to refine the initial proof-of-concept model before analyzing data from new, larger partners, with the goal of examining care delivery from three perspectives: PCMH, ACO, and purchaser.



## Hospital readmissions

- Research team** Steve Witz, RCHE; Ken Musselman, RCHE; Lingsong Zhang, Statistics; Hong Wan, Industrial Engineering
- Partners** BayCare Health System, St. Vincent Health
- Current model stage** C — Single-site pilot study and evaluation

### Project summary

As discussed on previous pages, the center is conducting preventable readmissions research through partnerships with other universities and medical centers. BayCare Health System in Tampa, Florida, and St. Vincent Health in Indianapolis, Indiana, are providing both data and clinical feedback. RCHE, University of South Florida, and Northeastern University are partnering to provide the healthcare engineering expertise. In a departure from other readmissions projects, RCHE’s project will consider all readmissions, regardless of age or payer.

**Project update**

The BayCare data set includes more than 130,000 admissions across nearly 100,000 patients. The research team is analyzing more than 34,000 readmissions among almost 20,000 patients, equating to a readmissions rate of 26 percent, and involving nearly 20 percent of the patients. The team conducted the following analyses: demographics (including age, gender, ethnicity, etc.); system flow (discharge disposition, provider, and class of provider); readmissions rate and time, using different definitions of each; and developing predictive models. Two predictive models have been developed for presentation to BayCare and validation.

In the coming months, St. Vincent Health will also provide patient data for the readmissions study. Similar analyses will be conducted and will serve as a comparison to begin to explore regional and institutional variations.

**IV medication safety administration**

**Research team**      Bart Collins, Communications; Ann Christine Catlin, Rosen Center for Advanced Computing; Steve Landry, Industrial Engineering; Ben Dunford, Management

**Partners**              St. Francis Health, Community Health Network  
Eskanazi Health, University of Wisconsin, University of Iowa Health Care, University of Nebraska, Indiana University Health, Witham Hospital, Indianapolis Coalition for Patient Safety

**Current model stage**    D — Multi-site validation

**Project summary**

The Infusion Pump Informatics System was developed by RCHE to make it easy for healthcare providers to work together to analyze and share IV medication administration data and best practices. The system allows for infusion pump data to be readily accessible, meaningful, and actionable. RCHE developed the system with two hospitals as pilot sites. Two additional hospitals joined later to further test and develop the system. Through the supplement funds, the center is seeking to extend the system’s analysis capabilities, more than double the size of the community, and support a multi-provider medication administration safety study.

**Project update**

Since the supplement funds were awarded, five hospital systems have joined the community, contributing both their data and expertise. Discussions are in progress with other hospital systems who are interested in joining. Tri-annual meetings with the community and system developers have provided the center with essential insight into the types of information being

sought, how the system is being used and changing practices, and needed updates. Based on community feedback, pivot tables have been added, and a training session for staff pharmacists is scheduled. RCHE is now exploring how to engage various healthcare organizations (e.g., UHC) into this community of users.

A significant differentiator in the system is the data sharing; participating hospitals must agree to share their data results with the community. Pharmacists have indicated that having access to their colleagues' data is tremendously helpful.

Steve Landry, an associate professor of industrial engineering, has begun a project that explores guardrail thresholds and alert fatigue, drawing on alarm research from the airline industry. Ben Dunford, an associate professor in the school of management, is embarking on a patient safety study using the infusion pump data with several of the partnering hospitals.

### Affiliated faculty and staff

As of November 2011, RCHE has 66 affiliated faculty members.

<b>Unit</b>	<b>Faculty affiliates</b>
Education	1
Engineering	15
Health & Human Sciences	16
Krannert (Management)	4
Liberal Arts	7
Library Sciences	6
Medical Education	1
Pharmacy	3
Science	5
Technology	5
Vet Med	3
<b>TOTAL</b>	<b>66</b>

RCHE also attracts staff members throughout Purdue who wish to be affiliated with the center.

<b>Unit</b>	<b>Staff affiliates</b>
Discovery Park	8
Information Technology	3
Human Resource Services	2
Technical Assistance Program (leadership)	2
<b>TOTAL</b>	<b>17</b>



## Communications

### Center website

The RCHE website is a primary vehicle for disseminating news about center projects and researchers. From October 2010 through October 2011, the site had the following visitor statistics:

- 11,376 visits
- 9,893 unique visitors
  
- Visitors from 65 countries, of which the top five were the U.S., India, Canada, Japan, and China.
- Visitors from all 50 states, of which the top five were Indiana, Illinois, Pennsylvania, Texas, and New York.

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## Research effectiveness

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### Research partners

RCHE continues to build both living laboratory and national dissemination partnerships. Currently, we have active partnership agreements with:

- American College of Physicians
- Ascension Health
- Community Health Network
- Eskanazi Health
- Indiana Hospital Association
- Indiana State Department of Health
- Indiana University Health
- IU Medical Group
- IU School of Medicine
- Mayo Clinic
- Regenstrief Institute
- St. Vincent Health
- U.S. Department of Veterans Affairs

### Research validation

RCHE seeks external sources of information to validate the focus and quality of its research. In addition to the input of our partners, RCHE derives useful information from agencies providing competitive funding, publication in peer-reviewed journals, professional conference presentations, and advice from our advisory council.

During the 2010–11 academic year, RCHE affiliated faculty reported 10 papers published in peer-reviewed journals.

- Ahmed AH, Sands LP. Effect of Pre- and Postdischarge Interventions on Breastfeeding Outcomes and Weight Gain Among Premature Infants. *Journal of Obstetric Gynecologic and Neonatal Nursing*, 39(1):53-63,2010
- Blaum C, Cigolle CT, Boyd C, Wolff JL, Tian Z, Langa KM, Weir DR. Clinical complexity in middle-aged and older adults with diabetes: the Health and Retirement Study. *Med Care*. 2010 Apr;48(4):327-34.
- Chakraborty, S., Muthuraman, K., Lawley, M., “Sequential Clinical Scheduling with General Service Times and No-show Patients” *IIE Transactions*, 2010.

- Cigolle CT, Lee PG, Langa KM, Lee YY, Tian Z, Blaum CS. Geriatric conditions develop in middle-aged adults with diabetes. *J Gen Intern Med.* 2011 Mar;26(3):272-9. Epub 2010 Sep 29.
- Hu, Qiaohai (Joice). “Do GPOs Promote or Stifle Competition in Healthcare-Product Supply Chains”, *Production and Operations Management*, 20:1, pp. 1-15.
- Schaffer, S.P. (2010). Evaluation of knowledge development in a healthcare setting. *Lecture Notes of the Institute for Computer Sciences, Social-Informatics and Telecommunications Engineering*, 27, 5, 112-115.
- Schaffer, S.P., Reyes Paulino, L., & Collins, W. (2010). Using Activity Theory to Understand Learning Design Requirements of Patient Self-Management Environments. *Educational Media International*, 1469-5790, 47, 4, 2010, 329 – 342.
- Wang L. and N. Kong, "Security Constrained Economic Dispatch: A Markov Decision Process Approach with Embedded Stochastic Programming," 2010. *International Journal of Operations Research and Information Systems*. Vol. 1, No. 2, pp. 1 – 16.
- Xu H, Weiner M, Paul S, Thomas III J, Craig BA, Rosenman M, Carney Doebbeling C, Sands LP. Volume of home- and community-based Medicaid Waiver services and risk of hospital admissions, *Journal of the American Geriatrics Society*, 58(1):109-115, 2010.
- Yih, Y. (editor) *Handbook of Healthcare Delivery Systems*, CRC Press, 2010.

Faculty and staff were asked to present their work at more than 25 conferences or professional meetings. Jake Jensen was invited to the National Colorectal Cancer Roundtable in Washington, DC, in November 2010. Jensen received an RCHE seed grant in 2009 for his project, “Using Narrative Persuasion to Increase Colon Cancer Detection in High-Risk Individuals: A Worksite Intervention.”

A center project on clinic scheduling with no-show patients has continued to produce results and contribute to the field. “Sequential Clinical Scheduling with Patient No-Shows and General Service Time Distributions,” an article on scheduling algorithms for no-show patients by professors Mark Lawley, Santanu Chakraborty, and Kumar Muthuraman was awarded the Best Applied Paper Prize, Operations Engineering and Analysis, for *IIE Transactions* in 2010. RCHE has provided support for this scheduling project since 2008. Lawley is currently working with Laura Sands, professor of nursing, to develop support for and complete a single-site pilot of the algorithm in a clinical setting.

## Research collaboration

RCHE collaborates with other universities and centers at Purdue to further the field of healthcare engineering and develop research projects and proposals whose impact can reach beyond Purdue.

## Other universities

RCHE works with researchers at other universities as a means of strengthening collaborations, growing the field, and learning from others. Collaborations with other universities in 2010–11 include:

- Northeastern University — readmissions, scheduling
- University of South Florida — readmissions
- University of Wisconsin — infusion pump informatics
- University of Iowa — infusion pump informatics
- University of Nebraska — infusion pump informatics
- Indiana University — no-show behavior, trauma care
- University of Texas — sequential scheduling
- University of Rochester — SBI

## Regenstrief Institute

Several projects and researchers collaborated with the Regenstrief Institute this year, including:

- Haslyn Hunte on the Safety Net project. The Institute has been instrumental in helping to create and define the scope of the research.
- Laura Sands continues to work with Institute researchers on various projects.
- RCHE has worked on the St. Vincent Health subcontract under the BEACON grant. BEACON is an IHIE grant.

## Learning and innovation

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### Speaker series

Mohan Dutta, director, Center of Poverty and Health Inequities. September 7.

Margie Snyder, co-director, Center for Medication Safety Advancement. September 28.

Chris Miller, assistant professor of library science. October 5.

Ken Ferraro, director, Center on Aging and the Life Course. October 19.

Cody Mullen and Haylei Lorca, RCHE undergraduate research fellows. November 9.

### RCHE speaker

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*. August 30.

### Pioneer speaker

William Coleman, PhD. Scientific Director, Intramural Research Program, National Institute on Minority Health and Health Disparities. *Reducing Health Disparities: An Interdisciplinary Approach*. October 20.

## Financial management

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### Awards

The center is pleased to report the following key awards:

#### 2010–11:

- SBI study. Cleveland Shields, Human Development and Family Studies. Funded by the National Institutes of Health. \$2,700,000.
- Pathfinder Award to Promote Diversity in the Scientific Workforce. Brad Duerstock, Center for Paralysis Research. Funded by the National Institutes of Health. \$2,000,000.
- I-ADAPT. Mohan Dutta and Bart Collins, Communications. Funded by the Agency for Healthcare Research and Quality. \$1,500,000.

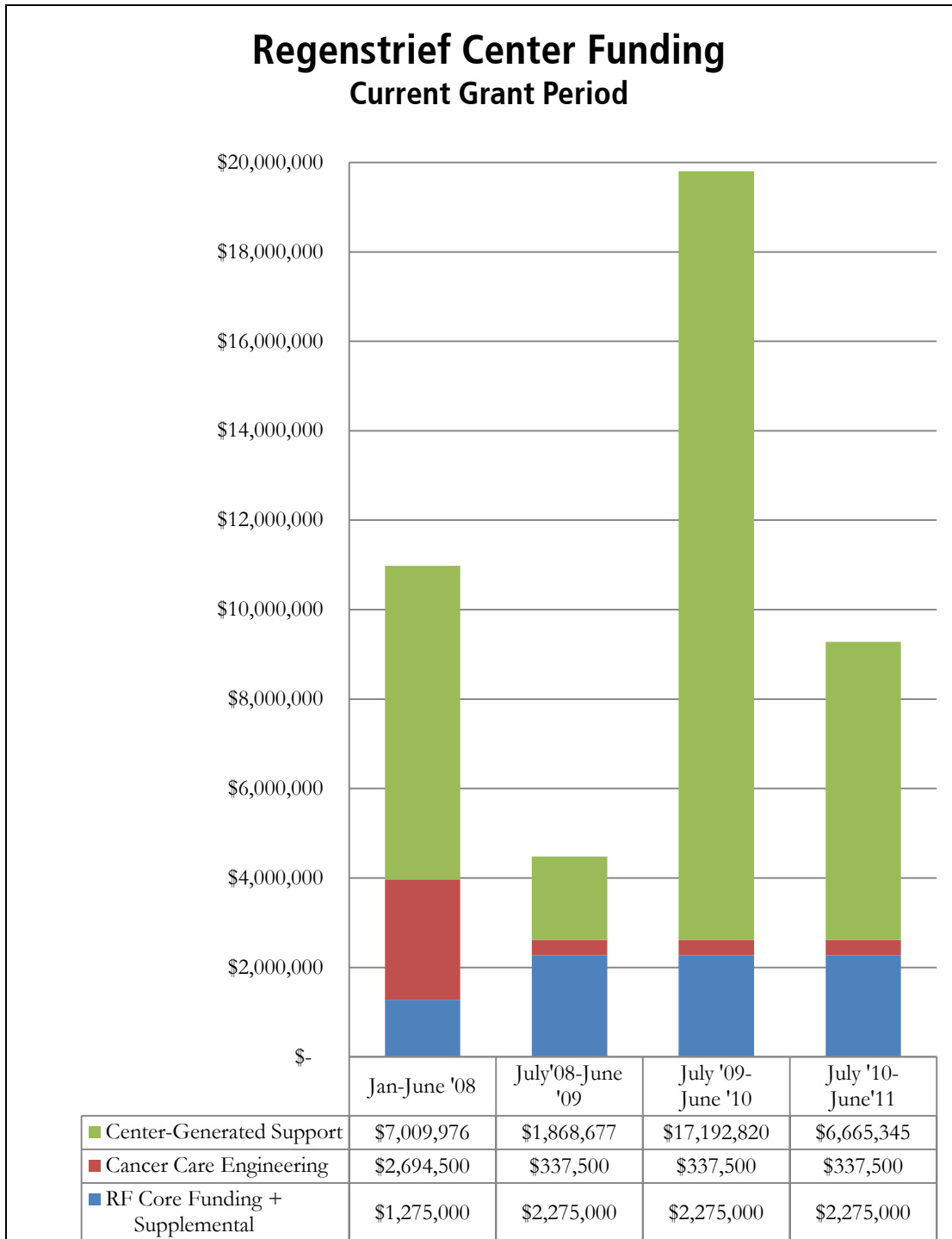
### Funding sources

RCHE and its researchers continue to draw funding from organizations around the country.

In 2010–11, these included:

- National Institutes of Health
- Agency for Healthcare Research and Quality
- National Institute on Aging
- Pfizer Inc.

**Financials**



*Note: Center-generated support does not include the \$25,000,000 CTSI grant, of which RCHE was a part, nor the VERC awards for regions other than Indiana. I-HITEC award is counted in Center-Generated Support, although the project benefits from a significant contribution by HealthcareTAP. VERC is listed under Center-Generated Support.*

### Cumulative center funding

To date, RCHE has generated \$65 million in cumulative funding against a proposed target of \$47 million since its inception, heading to an overall target of \$68 million by 2013.

