

CENTER FOR INNOVATION IN HEALTHCARE LOGISTICS



UNIVERSITY OF
ARKANSAS
COLLEGE OF
ENGINEERING



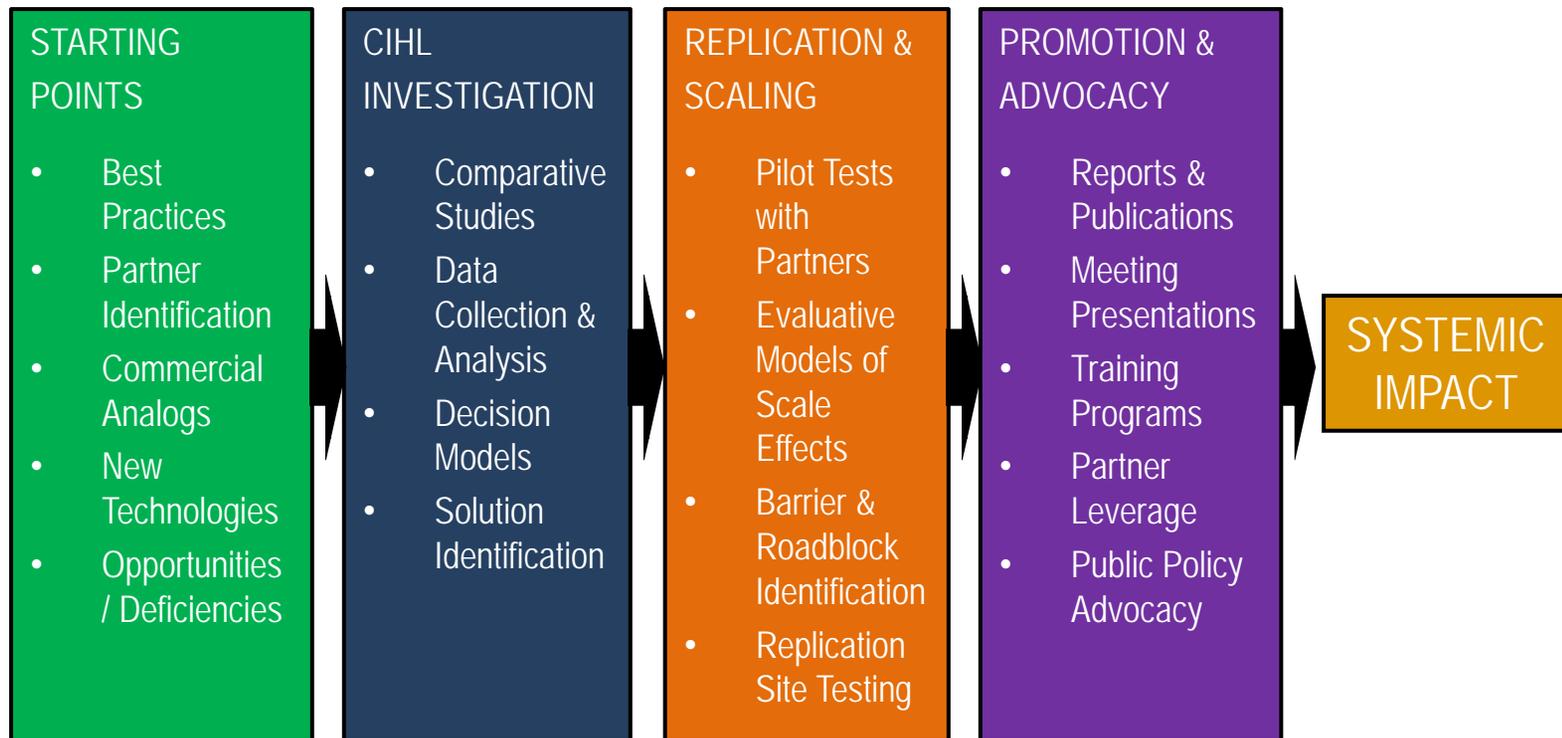
CIHL Vision

- The Center for Innovation in Healthcare Logistics (CIHL) is an industry-university partnership that leads a nationwide effort to identify and foster system-wide adoption of ground-breaking healthcare supply chain and logistic innovations
- CIHL provides a leading role in setting and pursuing healthcare supply chain innovation through a collaboration between healthcare professionals and their industrial organizations, joining with Center staff in intensive but objective engineering analysis of supply chain challenges with system-wide reach

CIHL Overview

- CIHL was launched in 2007 with founding support from Wal-Mart, Blue Cross Blue Shield, and the VHA Inc. hospitals
 - Additional support from AHRMM, Covidien, HIGPA, IBM, Johnson & Johnson, Logi-D, Owens & Minor, P&G, and Tecsys
- Leverages the University's broad background in engineering of logistics and supply chains
 - Provides access to industrial engineering faculty experts in applied operations research, economic analysis, systems engineering, data, operations, and quality management
- Maintains vigorous interactions with a variety of healthcare providers, and healthcare supply chain opinion leaders
 - Data gathering and pilot testing with multiple provider hospitals
 - Collaboration, network access, and dissemination through SMI, AHRMM, GS1, GHX

CIHL Impact Model

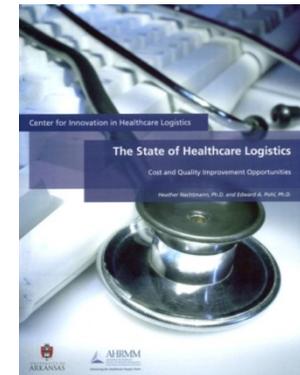


- Objective engineering analysis, free of commercial/institutional interests
- Avoiding “one-off” single-site investigations in favor of scalable projects with system-wide impact
- Commitment to broad dissemination of findings, practices & decision aids

Current CIHL Projects

- **Identifying Cost and Quality Opportunities in the Healthcare Supply Chain**

- In collaboration with AHRMM and HIGPA
- 2009 report: *The State of Healthcare Logistics*
- GS1 adoption surveys
- Developing activity-based logistics cost analysis tool with Mercy Northwest Arkansas



- **Electronic Health Records**

- Proof-of-concept study explores how healthcare supply chain inventory management and tracking systems can be integrated with best-practice tracking and recording in clinical and HER
- Related project extension with Logi-D

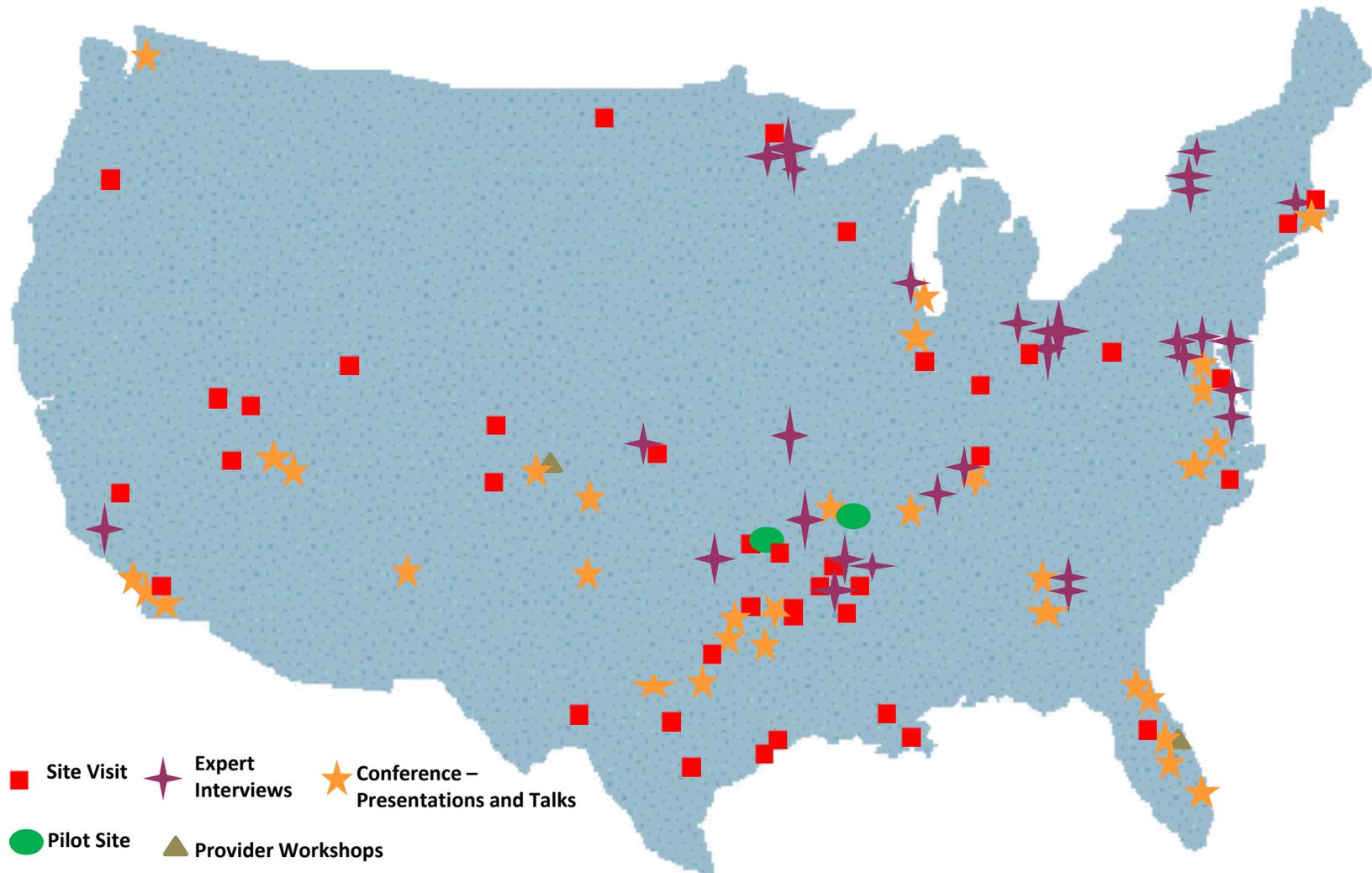
Current CIHL Projects (cont.)

- **Retail vs. Healthcare Supply Chain Gaps**
 - Identify process and technology transfer opportunities between retail and healthcare supply chain
 - Understand unique healthcare issues that prevent adoption of others
 - Related project extension with Covidien
- **Characterizing the Home Healthcare Medical Equipment Supply Chain**
 - Investigating supply chain aspects of home health with a focus on more efficient utilization of resources (e.g. nurses, supplies, and transportation)
 - Pathway to broader look at other non-hospital alternate care

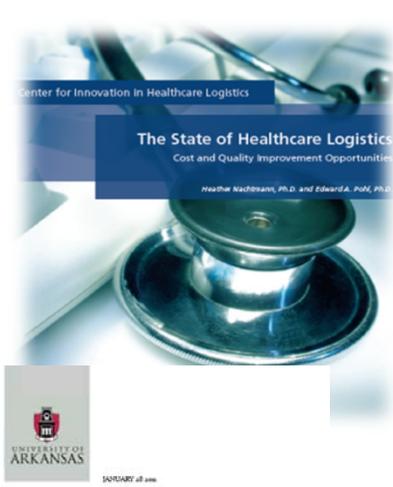
Completed CIHL Projects

- **Data Standards**
 - Adoption of GS1 data standards
 - Provider-focused in collaboration with GS1, SMI, and AHRMM
 - Pilots and data collection with multiple providers
 - Levels, Readiness, and Impacts Model (LRIM) tool
- **Unit and Dose Packaging Systems Analysis**
 - Re-packaging medications into unit-doses for administration to patients
 - Systems analysis to recommend best practices in the interest of safety and efficiency
- **Receiving-to-Patient Hospital Supply Chain Digitalization**
 - Digital technologies for tracking and inventory management of dock-to-patient material and portable clinical equipment
 - Predictive models for identifying best practices

CIHL's National Reach



CIHL Publications & Research Reports



Center for Innovation in Healthcare Logistics

The State of Healthcare Logistics

Cost and Quality Improvement Opportunities

Heather Nachmann, Ph.D. and Edward A. Ponn, Ph.D.

UNIVERSITY OF ARKANSAS

JANUARY 2011

Center for Innovation in Healthcare Logistics

GSI Data Standards Adoption Survey

Progress toward Global Trade Item Numbers (GTINs)
December 2011

Edward A. Ponn, Ph.D.
Heather Nachmann, Ph.D.




UNIVERSITY OF ARKANSAS

November 2011

Inventory Control Practices

CENTER FOR INNOVATION IN HEALTHCARE LOGISTICS

Bradley Samuel Bessert
Samer Agreel
Dorothy Hovak



UNIVERSITY OF ARKANSAS, Center for Innovation in Healthcare Logistics
and Bell Engineering Center, Fayetteville, AR, 72703
http://cihl.uark.edu/~lapj/pj04p

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Tutorial for a Tool to Support the Best Selection of Technology for Unit-Dose Packaging

Lisa M. Thomas
Ronald R. Rardin
Nabil L. Lehou, Ph.D.
Scott J. Mason
Sarah E. Rose



University of Arkansas

White Paper on Hospital Pharmacy Unit-Dose Acquisition and the Case for the Third-Party Repackaging Option

Ronald D. Miller, Jonathan A. Preece, Lisa M. Thomas, Scott J. Mason, Sarah E. Rose
Center for Innovation in Healthcare Logistics
University of Arkansas

William W. Chubb
Richard A. Warren, Hospital
Harvard University



Center for Innovation in Healthcare Logistics
Report Series 08-03
December 22, 2008

CIHL Survey of Hospital Pharmacy Directors — for Innovation in Healthcare Logistics

Final Results on the Current State of the Unit-Dose and Bedside Barcode-Enabled Dispensing Practice

Report Series 08-04
December 23, 2008

Scott J. Mason
Lisa M. Thomas
Ronald R. Rardin
Nabil L. Lehou
Jonathan A. Preece

University of Arkansas

Center for Innovation in Healthcare Logistics
and Bell Engineering Center, University of Arkansas
Fayetteville, AR, 72703
http://cihl.uark.edu/~lapj/pj04p



Center for Innovation in Healthcare Logistics
Report Series 08-01
December 18, 2008

An Organization Model for Supporting and Allowing Repackaging Technology for Unit-Dose Medications in Hospital Pharmacies

Jonathan A. Preece
Sarah E. Rose
Ronald R. Rardin
Scott J. Mason
Lisa M. Thomas

University of Arkansas



Center for Innovation in Healthcare Logistics

Pharmacy Data Standards Project Final Report

CENTER FOR INNOVATION IN HEALTHCARE LOGISTICS

Michelle Proulx
Nabil Lehou
Vijith Varghese
Eduardo A. Ponn
Prof. Ronald Rardin
Prof. Nabil Buyurgan
Raja Jayaraman



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JANUARY 2011

CIHL-WRMC MEDSURG REPORT

CENTER FOR INNOVATION IN HEALTHCARE LOGISTICS

Prof. Ronald Rardin
Prof. Nabil Buyurgan
Nabil Lehou
Vijith Varghese
Raja Jayaraman
Angela Barbano
Ashraf Hajjivej
Ramy Elwan
Nabil Lehou



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JANUARY 2011

Levels Readiness and Impact Model (LRIM) User's Guide

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Recall and Outdate Management Processes Report

7/2012

in Healthcare Logistics
of Arkansas



Center for Innovation in Healthcare Logistics (CIHL)
University of Arkansas

Angela Barbano, PhD [PI]
University of Arkansas
angela@uark.edu

Scott J. Mason, PhD [Co-PI]
Clemson University
smason@clemson.edu

Behrooz Kamali, James Hilborn (Graduate Research Assistants)
Eric Pham (Undergraduate Research Assistant)

Proceedings of the 2011 Industrial Engineering Research Conference
T. Doolen and E. Van Aken, eds.

Data Standards in Healthcare Supply Chain Operations

Raja Jayaraman¹, Ronald Rardin, Nabil Buyurgan, Vijith Varghese, Angela Barbano, Jennifer Pazzour, Nabil Lehou, Ashraf Hajjivej and Danny Dixon
Center for Innovation in Healthcare Logistics
University of Arkansas
Department of Industrial Engineering
4207 Bell Engineering Center, Fayetteville, Arkansas 72701 USA

Proceedings of the 2011 Industrial Engineering Research Conference
T. Doolen and E. Van Aken, eds.

A Levels, Readiness, and Impact Evaluation Model for GSI Adoption in Healthcare

Nabil Lehou, Ronald Rardin, Nabil Buyurgan, Raja Jayaraman, Vijith Varghese, Angela Barbano, Ashraf Hajjivej, Eghbal Rashidi, Pamina Farrokhar
Center for Innovation in Healthcare Logistics, University of Arkansas
Department of Industrial Engineering,
4207 Bell Engineering Center, Fayetteville, AR 72701, USA.

Abstract

Involvement with CIHL

- CIHL is recognized across the broader healthcare industry as a source of advanced supply chain innovations
 - Industry leaders have affirmed CIHL's impact
- CIHL provides access to academic researchers with expertise in healthcare logistics
 - Access to future workforce
- CIHL research partnerships exist as strategic partners, focused project partnerships, affiliate members, and supporting collaborators
- CIHL can provide access to state-of-the art education in healthcare logistics and operations management

IE Faculty Doing Healthcare Research

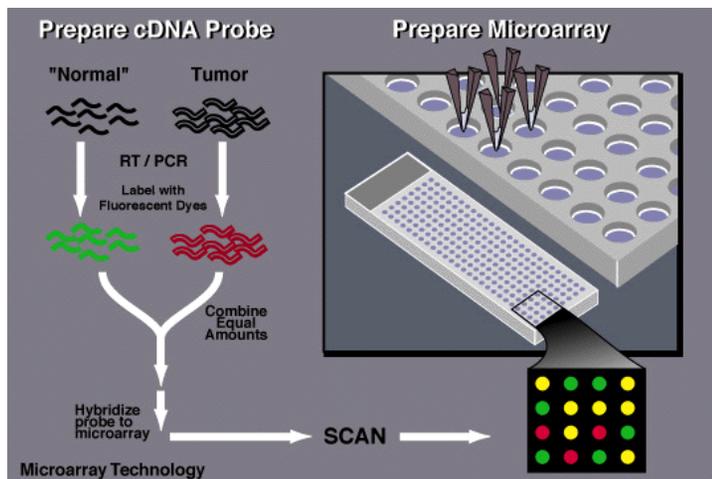
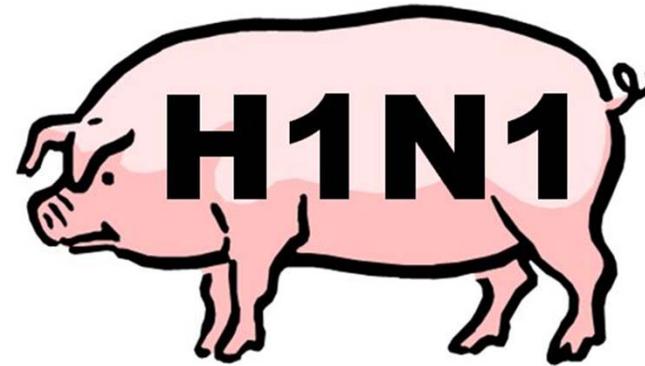
- Dr. Justin Chimka
- Dr. Russell Meller
- Dr. Ashlea Bennett Milburn
- Dr. Heather Nachtmann
- Dr. Kim LaScola Needy
- Dr. Greg Parnell
- Dr. Ed Pohl
- Dr. Chase Rainwater
- Dr. Manuel Rossetti
- Dr. Shengfan Zhang
- Data analytics
- Activity based costing
- Healthcare cost and quality
- Simulation modeling of patient flow
- Lean Processes
- Policy analysis with systems dynamics
- Coordination mechanisms for transition to post-acute care settings
- Inventory management strategies
- Predictive length of stay modeling and analysis
- Decision support tools for reducing pharmaceutical waste
- Scheduling and appointment models (nurses, OR, ER, outpatient radiation)

Research Areas

- Applied Multivariate Statistical Analysis
- Statistical Quality Control

Example Applications

- Microarray Quality Control Standards
- Medication Error Severity Data
- Influenza Activity



Research Focus

Applying operations research tools and techniques to problems encountered in healthcare systems and other public sectors; primarily *home health care* and *disaster management*

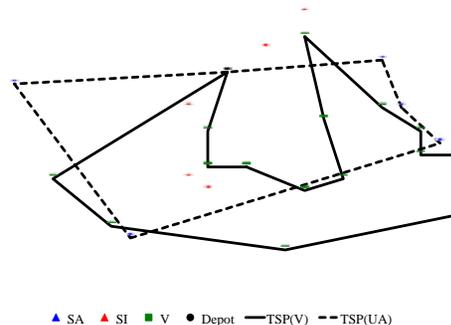
Application Areas

- Incorporating information taken from social media and other Web 2.0 technologies in disaster relief planning:
 - vehicle routing decisions
 - facility location decisions

Application Areas (cont.)

- Developing decision support models to enable better use of home health resources:
 - nurse routing and scheduling
 - assignment of nurses to service regions
 - allocation of remote monitoring systems
- Developing quantitative methods to identify and explain variations in access, quality, and efficiency in home health services and providers
- Characterizing the home health care supply chain and quantifying time home health nurses spend on supply chain duties

Haiti earthquake, day 8: food/water request locations from social media



Planned relief routes

“Food water needed for group of 30 people (15 children). The address is #7 Marin 878 with the Blue Gate...” - Ushahidi, Haiti dataset, 02/01/2010

Home health nurses, supply chain duties

Observation	Time/nurse/yr (hrs)			
	Driving	Picking	Ordering	Total
1	48.0	242.7	5.0	295.6
2	24.0	69.3	2.2	95.6
3	0.0	0.0	2.5	2.5
4	83.1	52.0	0.0	135.1
5	6.0	4.8	1.7	12.5
6	107.3	52.0	0.3	159.6
7	199.0	47.7	3.8	250.5
8	62.4	28.6	3.1	94.0
9	0.0	0.0	4.8	4.8
10	187.8	424.7	3.3	615.8

Research Focus

- Transportation systems engineering
- Logistics modeling
- Economic decision analysis
- Engineering pedagogy

Application Areas

- Maritime transportation
- Rural transportation networks
- Transportation security and resilience
- Healthcare logistics
- Inventory control and management

Mack-Blackwell Rural Transportation Center



Photo Courtesy of MBTC 3024



Photo Courtesy of AHTD



Photo Courtesy of MBTC 1102

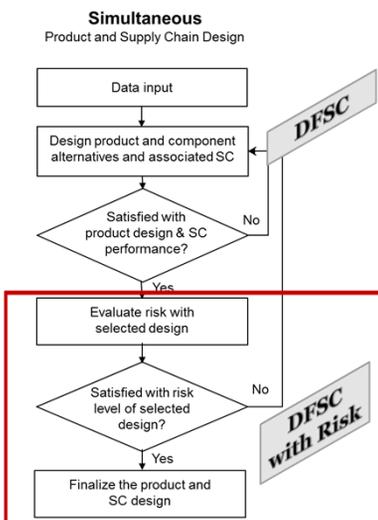
Research Focus

- Sustainable Engineering
- Engineering Management
- Engineering Economic Analysis
- Integrated Resource Management



Application Areas

- Impact of **green** building construction and its improvements in worker productivity, health & safety, maintenance costs and energy savings with a focus on healthcare facilities, public and commercial buildings.
- Quality management in the capital facilities delivery industry
- Assessing and mitigating risk in the design for supply chain (DFSC) problem



Additional Information

	Base Case	Ratio change 25/75	Ratio change 75/25	Productivity change (270N,185O)	Production capacity change (70% N)
NPV	\$4,257,718	\$2,945,186	\$5,570,249	\$7,858,776	\$5,410,315
Break Even Period (Years)	12.5	25.9	8.5	5.5	8.8
B/C (Additional Investment)	1.7	1.2	2.2	3.1	2.2
B/C (Annual TAS and TAC)	2.2	1.2	21.9	N/A	2.8

Economic Analysis with Sensitivity



Castcon Stone Production Facility, Saxonburg, PA.



Children's Hospital of Pittsburgh

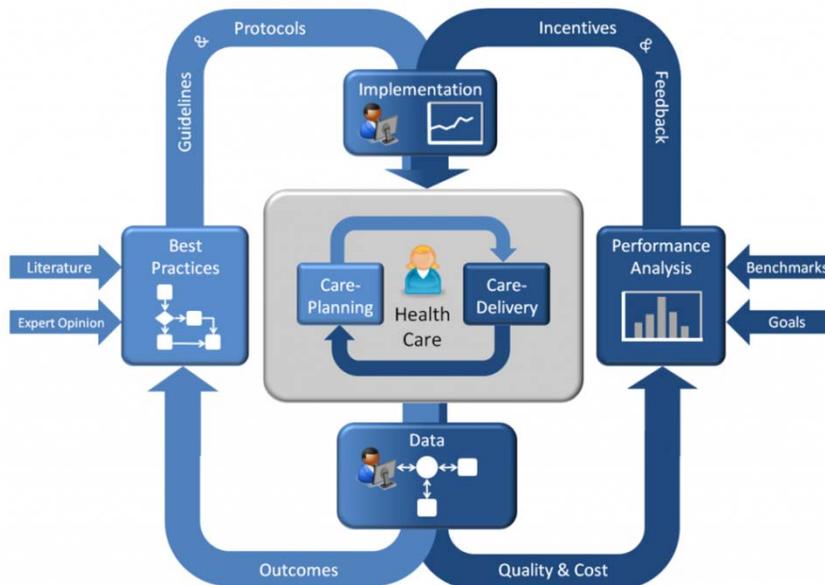
Research Focus

- Strategic Planning
- Performance Measurement & Analysis
- Resource Allocation Decision Making
- Systems Engineering
- Decision Analysis
- Risk Analysis

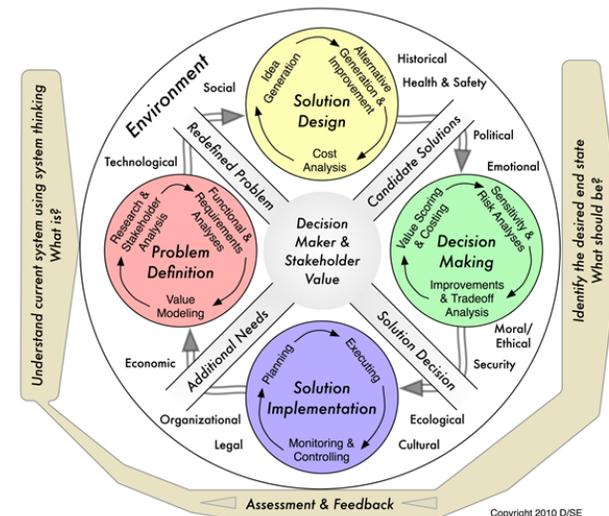
Application Areas

- Defense
- Homeland Security
- Intelligence
- Environmental
- Healthcare

Health Care System



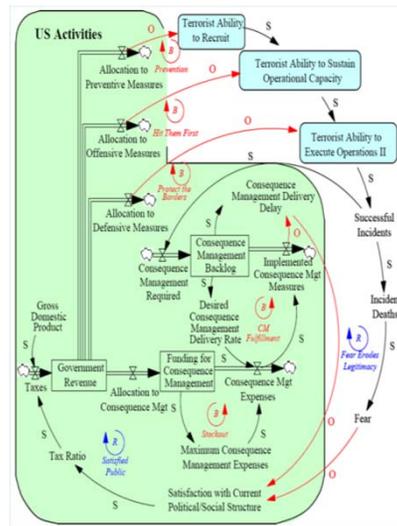
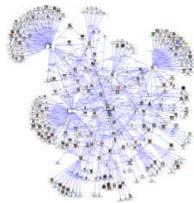
Systems Decision Process



Parnell, G. S., Driscoll, P. J., and Henderson D. L., Editors, **Decision Making for Systems Engineering and Management**, 2nd Edition, Wiley Series in Systems Engineering, Wiley & Sons Inc., 2011

Research Focus

- Reliability and Quality
- Decision and Risk Analysis
- Engineering Optimization
- Stochastic Modeling
- Systems Engineering

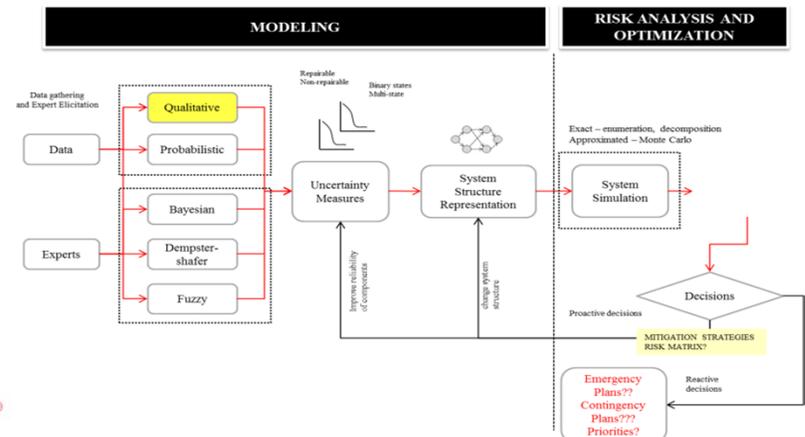
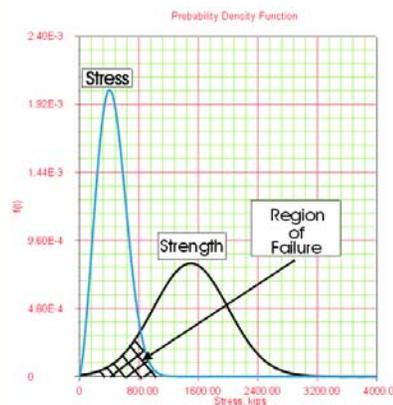
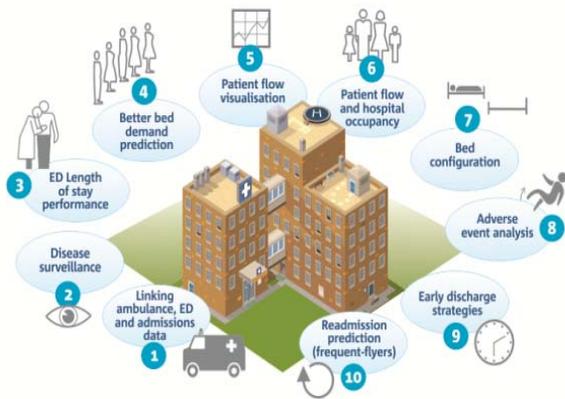


Application Areas

- Healthcare Logistics
- Supply Chain Risk
- Complex Systems Analysis
- Operations Management
- Healthcare Policy Analysis
- Homeland Security -Disaster Relief
- Project and Engineering Management



Additional Information



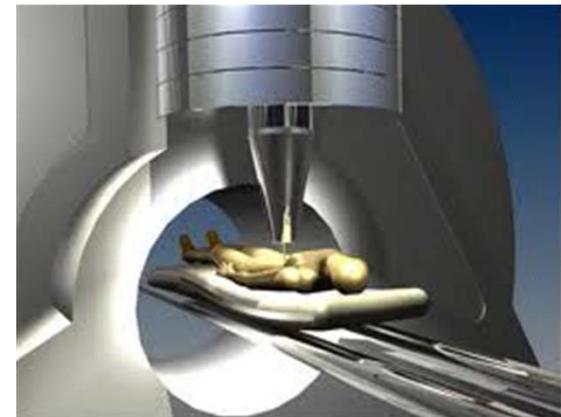
Research Focus

- Decomposition-based algorithm approaches to exploit advancements in parallel computing
- Integration of optimization and constraint programming
- Dynamic network optimization
- Large-scale heuristic design

Application Areas

- Medical supply chain
- Patient scheduling at proton therapy cancer treatment facilities
- Transportation of medical equipment and supplies
- Medical inventory systems analysis

Additional Information



Research Focus

- Multi-echelon inventory optimization
- Forecasting methods for intermittent demand
- Simulation modeling and analysis
- Computing methods for large scale simulations
- Supply chain modeling and optimization

Application Areas

- Emergency Room Staffing and Scheduling
- Healthcare automation for clinical laboratories
- Inventory and supply management and best practices
- Benchmarking analysis
- Forecasting material usage, patient load
- Healthcare simulation

SKU Proliferation Control for Physician Preference Items



Robotic Delivery Systems for Hospitals



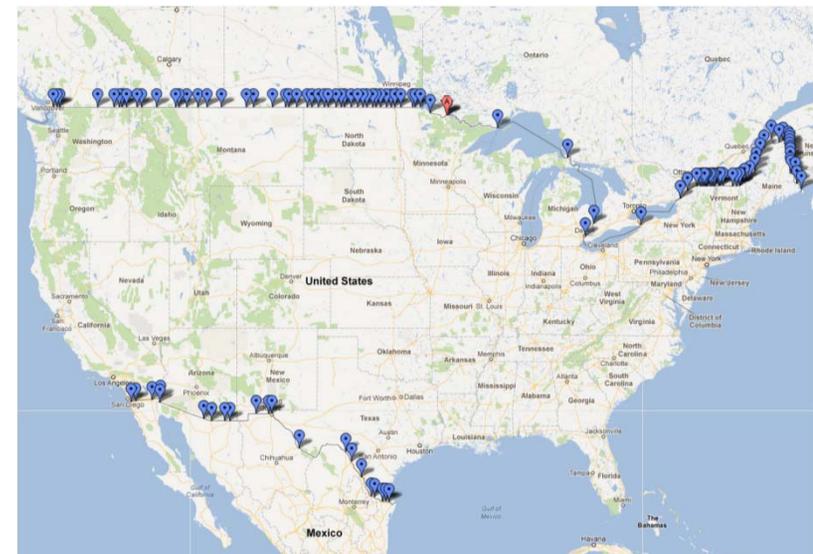
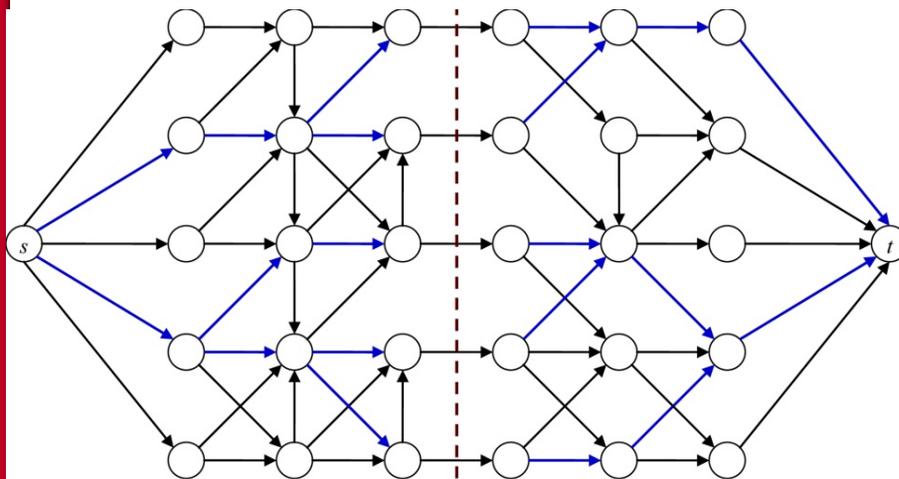
Research Focus

- System fortification and hardening infrastructure against disruption
- Optimization under uncertainty
- Integer programming
- Network optimization

Application Areas

- Locating electronic health records across virtual hubs in order to minimize delays experienced by network users
- Allocation of scarce resources in the design of reliable systems
- Cyber security
- Prevention of nuclear smuggling

Network Optimization in Prevention of Nuclear Smuggling



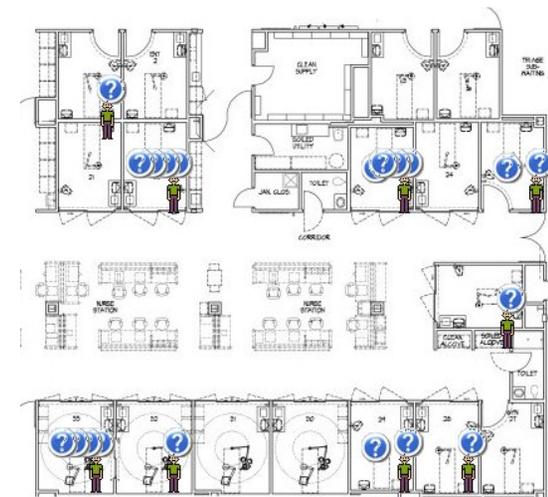
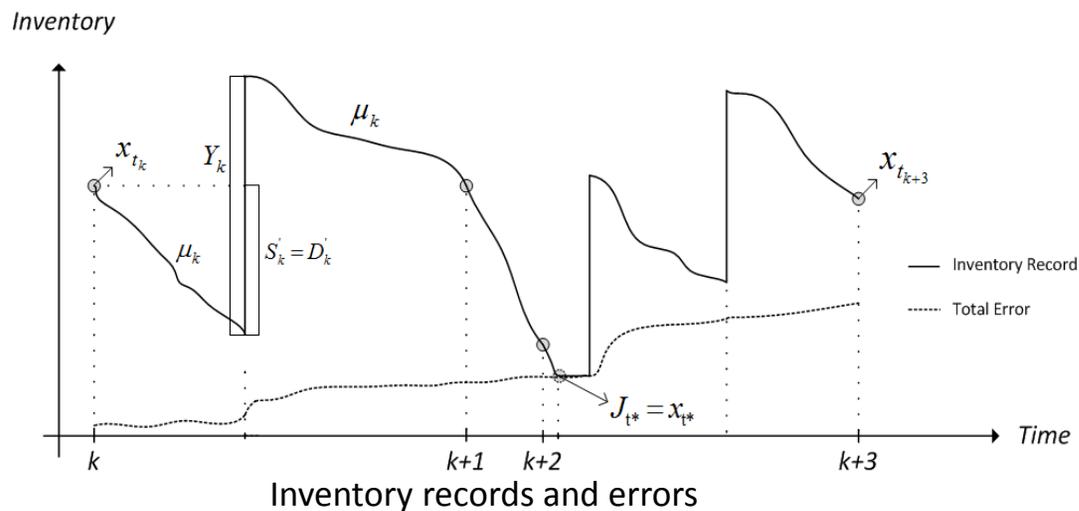
Research Focus

- Mathematical and statistical modeling of stochastic systems
- Decision and risk analysis
- Data mining and data analytics for complex systems
- Health informatics
- Quality engineering and management

Application Areas

- Medical decision making related to the detection, treatment and prevention of chronic diseases
- Healthcare delivery and process improvement
- Inventory record inaccuracy analysis
- Scheduling and planning
- Facility location planning

Additional Information



Source: NovaSim Outpatient clinic flow

CIHL Contacts

Edward A. Pohl, Ph.D.

CIHL Director, Professor, Department Head

Department of Industrial Engineering

University of Arkansas

479-575-6042 (phone)

epohl@uark.edu (email)

Karin Alvarado

CIHL Program Coordinator

Department of Industrial Engineering

University of Arkansas

479-575-2124 (phone)

karina@uark.edu (email)