ENGINEERING OPTIMAL HEALTH CARE SCHEDULING

Hosted by the IOM Committee on Optimizing Scheduling in Health Care

November 21, 2014
National Academy of Sciences Building
2101 Constitution Ave. NW
Washington, DC 20418
ENGINEERING OPTIMAL HEALTH CARE SCHEDULING

NOVEMBER 21, 2014

TABLE OF CONTENTS

SECTION 1: DAY OF MATERIALS
- Agenda
- Speaker biographies
- Participant list

SECTION 2: BACKGROUND ON THE COMMITTEE
- Committee roster
- Member biographies
- Statement of task

SECTION 3: WORKSHOP FRAMING DOCUMENTS
- Systems Approaches for Health Innovation Collaborative
- Bringing a systems approach to health, Gary Kaplan et al.
- Engineering a learning healthcare system: a look to the future, IOM Learning Health System Series Workshop Summary

SECTION 4: CURRENT STATE: PRACTICES, STANDARDS, INNOVATION
- Appointment zen – shaping demand and matching capacity, Andrew Knight and Tony Lembke
- In search of joy in practice: a report of 23 high-functioning primary care practices, Christine A. Sinsky, et al.
- The Cincinnati Children’s experience, David Krier and Terra Thompson

SECTION 4: PATIENTS AND FAMILIES AS CHANGE AGENTS: EXPERIENCES AND EXPECTATIONS
- Human-Systems Integration, Sara Czaja
- Wait time – a patient view, David Andrews

SECTION 5: TECHNICAL APPROACHES TO WAIT TIME IMPROVEMENT
- Concurrent construction of patient panels and care provider times, Zelda Zabinsky et al.
- The promise of lean in health care, John S. Toussaint, MD, and Leonard L. Berry, PhD

SECTION 6: LOGISTICS
- Meeting logistics
Section 1: Day of Materials
ENGINEERING OPTIMAL HEALTH CARE SCHEDULING

An Institute of Medicine Public Workshop

NOVEMBER 21, 2014
THE NATIONAL ACADEMY OF SCIENCES BUILDING
2101 CONSTITUTION AVE NW
WASHINGTON, DC

Meeting goals

1. **Current profile.** Identify and better understand the current practices and standards in appointment scheduling, and reasons for variation.
2. **Engineering models.** Consider optimization strategies and experiences in health care and other industries.
3. **Patient expectations.** Discuss the role of patients and family as catalysts for achieving operational excellence in health care.
4. **Role of frontline providers and staff.** Explore the changing mental model for frontline personnel involved with scheduling improvements.
5. **Opportunities and strategies.** Identify a disciplined structure for change and a strategic and scalable approach to continuous improvement.

8:00 am Coffee and light breakfast available

8:30 am **Welcome, introductions, and overview**

**Welcome**
*Michael McGinnis, Institute of Medicine*

**Opening comments from the IOM**
*Victor Dzau, President, Institute of Medicine*

**Opening comments from Committee Chair**
*Gary Kaplan, Virginia Mason Health System*
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<th>Time</th>
<th>Session Title</th>
<th>Description</th>
<th>Moderator/Panelists</th>
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| 9:00 am | Current state: practices, standards, innovation | This session will include a moderated panel discussion to introduce the foundational concepts, practice patterns, performance standards, and new strategic approaches for scheduling and flow management in health care delivery, and the circumstances that lead to variation. | Moderator: Peter Pronovost, Johns Hopkins University  
Panel (30 minutes)  
Ambulatory approaches: Mark Hallett, ThedaCare  
Hospital-based approaches: David Krier & Terra Thompson, Cincinnati Children’s Hospital  
IT tools: Andrew Gettinger, Office of the National Coordinator for Health IT |
| 10:15 am | Break |  |  |
| 10:30 am | Patients and families as a change agent: experiences and expectations | This session will include a moderated panel discussion to identify the challenges and opportunities to incorporating patient and family expectations and preferences in best practices and standards for scheduling. | Moderator: Gary Kaplan, Virginia Mason Health System  
Panel (30 minutes)  
Human factors and system change: Pascale Carayon, University of Wisconsin and Sara Czaja, Miami Miller School of Medicine  
Perspectives from the patient: David Andrews, Georgia Regents  
Integrating patient perspectives and policy: Matthew Puglisi, Aptima, Inc. |
<p>| 11:45 pm | Lunch | The lunchtime facilitated discussion will introduce and address issues, opportunities, and priorities for applying systems engineering practices for continuous improvement in health care. | Moderator: William Pierskalla, The Anderson School at UCLA |</p>
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<th>1:00 pm</th>
<th><strong>Technical approaches to wait time improvement</strong></th>
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<td>This session will include a moderated panel discussion to explore best practices through technological innovations and lessons learned from other industries.</td>
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<td><strong>Moderator:</strong> Tom Nolan, Institute for Healthcare Improvement</td>
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<td><em>The scheduling interface:</em> Wes Walker, Cerner Corporation</td>
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<td><em>Operations management of flow:</em> Zelda Zabinsky, University of Washington</td>
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<td><em>Lessons using Lean:</em> Judy Worth, Lean Enterprise Institute</td>
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| 2:15 pm | **Break** |

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<td>This session will include a moderated panel discussion to identify strategic opportunities, priorities and commitments to inform the work of the Committee.</td>
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<td><strong>Moderator:</strong> Donald Berwick, IHI</td>
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<td><strong>Panel (30 minutes)</strong></td>
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<td>Maureen Bisognano, IHI</td>
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<td>Christine Sinsky, AMA</td>
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<td>Robert Dittus, Vanderbilt</td>
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<td><strong>Open Discussion (60 minutes)</strong></td>
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<th>4:00 pm</th>
<th><strong>Closing remarks from the Committee on Optimizing Scheduling in Health Care</strong></th>
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<td><em>Gary Kaplan,</em> Virginia Mason Health System</td>
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| 4:15 pm | **Adjourn** |

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Gary Kaplan, MD, FACP, FACMPE, (Committee Chair) has served as Chairman and CEO of the Virginia Mason Health System since 2000. He is also a practicing internal medicine physician at Virginia Mason. Dr. Kaplan received his medical degree from the University of Michigan and is board-certified in internal medicine. Since Dr. Kaplan became Chairman and CEO, Virginia Mason has received significant national and international recognition for its efforts to transform health care. The Leapfrog Group named Virginia Mason “Top Hospital of The Decade” for patient safety and quality, a distinction shared with only one other hospital. For the fifth consecutive year, The Leapfrog Group also named Virginia Mason as one of 65 U.S. hospitals to be designated as a “Top Hospital”. In addition, Virginia Mason has received HealthGrades’ “Distinguished Hospital Award for Clinical Excellence” for five consecutive years. Virginia Mason is considered to be the national leader in deploying the Toyota Production System to health-care management. In addition to his patient-care duties and position as CEO, Dr. Kaplan is a clinical professor at the University of Washington and has been recognized for his service and contribution to many regional and national boards, including the Institute for Healthcare Improvement, the Medical Group Management Association, the National Patient Safety Foundation, the Greater Seattle Chamber of Commerce and the Washington Healthcare Forum. Dr. Kaplan is a founding member of Health CEOs for Health Reform. In 2007, Dr. Kaplan was designated a fellow in the American College of Physician Executives. In 2011, he was named the 12th most influential U.S. physician leader in health care by Modern Healthcare magazine, and the same publication ranked Dr. Kaplan 33rd on its list of the “100 Most Influential People in Healthcare.” In 2012, he was named the 2nd most influential U.S. physician leader in health care by the same publication. In 2009, Dr. Kaplan received the John M. Eisenberg Award from the National Quality Forum and The Joint Commission for Individual Achievement at the national level for his outstanding work and commitment to patient safety and quality. Additionally, he was recognized by the Medical Group Management Association (MGMA) as the recipient of the Harry J. Harwick Lifetime Achievement Award. Each year, the MGMA and the American College of Medical Practice Executives honor one individual who has made outstanding nationally recognized contributions to health-care administration, delivery, and education in his career, advancing the field of medical practice management.

David Andrews was a college professor in New Hampshire for 32 years (cognitive neuroscience). On retiring he moved to Aiken, SC. Because he has a rare neurological disorder, he took all my medical care to the (then) Medical College of Georgia in Augusta, GA (now Georgia Regents University). After some less-than- satisfactory care he complained (or he likes to think, made some constructive criticisms) and was asked to be a patient advisor. That was a little over ten years ago. Since that time, he has been involved in an advisory role in nearly everything the hospital does from the very specific and concrete, like re-designing the bill and helping select new beds, to designing new facilities, regular membership on several advisory groups in specific service areas, to quality councils, to more general advisory councils, doing new employee orientations, doing presentations to medical students, and many others. In addition, he has done local, regional, national, and international presentations and training on patient- and family-centered care. He is currently working with the Georgia Hospital Association Hospital Engagement Network on strategies to disseminate patient- and family-centered practices to Georgia hospitals and to reduce all causes of hospital-based harm. More recently, he has been working on several national projects related to improving patient and family engagement. He also has been a reviewer for Patient-Centered Outcomes Research Institute (PCORI) research grant proposals, and is a PCORI Ambassador.
Donald M. Berwick, MD, MPP, FRCP is President Emeritus and Senior Fellow at the Institute for Healthcare Improvement (IHI), an organization that Dr. Berwick co-founded and led as President and CEO for 18 years. He is one of the nation's leading authorities on health care quality and improvement. In July, 2010, President Obama appointed Dr. Berwick to the position of Administrator of the Centers for Medicare and Medicaid Services (CMS), which he held until December, 2011. A pediatrician by background, Dr. Berwick has served as Clinical Professor of Pediatrics and Health Care Policy at the Harvard Medical School, Professor of Health Policy and Management at the Harvard School of Public Health, and as a member of the staffs of Boston's Children's Hospital Medical Center, Massachusetts General Hospital, and the Brigham and Women's Hospital. He has also served as vice chair of the U.S. Preventive Services Task Force, the first "Independent Member" of the Board of Trustees of the American Hospital Association, and chair of the National Advisory Council of the Agency for Healthcare Research and Quality. An elected member of the Institute of Medicine (IOM), Dr. Berwick served two terms on the IOM's governing Council and was a member of the IOM's Global Health Board. He served on President Clinton's Advisory Commission on Consumer Protection and Quality in the Healthcare Industry. He is a recipient of numerous awards, including the 1999 Joint Commission’s Ernest Amory Codman Award, the 2002 American Hospital Association’s Award of Honor, the 2006 John M. Eisenberg Patient Safety and Quality Award for Individual Achievement from the National Quality Forum and the Joint Commission on Accreditation of Healthcare Organizations, the 2007 William B. Graham Prize for Health Services Research, the 2007 Heinz Award for Public Policy from the Heinz Family Foundation, the 2012 Gustav O. Lienhard Award from the IOM, and the 2013 Nathan Davis Award from the American Medical Association. In 2005, he was appointed “Honorary Knight Commander of the British Empire” by the Queen of England, the highest honor awarded by the UK to non-British subjects, in recognition of his work with the British National Health Service. Dr. Berwick is the author or co-author of over 160 scientific articles and four books. He also serves now as Lecturer in the Department of Health Care Policy at Harvard Medical School.

Maureen Bisognano, BS, MS, is President and Chief Executive Officer of the Institute for Healthcare Improvement (IHI), an independent not-for-profit organization helping to lead the improvement of health care throughout the world. Previously, Maureen served as IHI’s Executive Vice President and Chief Operating Officer, leading IHI along with former President and CEO Dr. Donald Berwick for 15 years. She is a prominent authority on improving health care systems, whose expertise has been recognized by her elected membership to the Institute of Medicine of the National Academy of Sciences and by her service on the Commonwealth Fund’s Commission on a High Performance Health System, among other distinctions. Ms. Bisognano advises health care leaders around the world, is a frequent speaker at major health care conferences on quality improvement, and is a tireless advocate for change. She is also an Instructor of Medicine at Harvard Medical School, a Research Associate in the Division of Social Medicine and Health Inequalities at the Brigham and Women’s Hospital, and serves on the Boards of the Commonwealth Fund, Cincinnati Children’s Hospital Medical Center, the ThedaCare Center for Healthcare Value, and Mayo Clinic Health System-Eau Claire. Prior to joining IHI, Ms. Bisognano was Senior Vice President of the Juran Institute, where she consulted with senior management on the implementation of total quality management in health care settings. Before that, she served as Chief Executive Officer of the Massachusetts Respiratory Hospital in Braintree, MA, where she implemented a hospital-wide strategic plan that improved the quality of care while simultaneously reducing costs. Ms. Bisognano began her career in health care in 1973 as a nurse at Quincy Hospital in Quincy, MA. She held positions of increasing responsibility there, eventually serving as Chief Operating Officer from 1984-1987. She holds a Bachelor of Science degree from the University of the State of New York and a Master of Science degree from Boston University.

Pascale Carayon, PhD, is Procter & Gamble Bascom Professor in Total Quality in the Department of Industrial and Systems Engineering and the Director of the Center for Quality and Productivity
Improvement at the University of Wisconsin-Madison. She leads the Systems Engineering Initiative for Patient Safety (SEIPS) at the University of Wisconsin-Madison (http://cqpi.engr.wisc.edu/seips_home). SEIPS is an internationally known interdisciplinary research program that brings together researchers from human factors and ergonomics with researchers from medicine, surgery, nursing, pharmacy and health services research. Professor Carayon received her Engineer diploma from the Ecole Centrale de Paris, France, in 1984 and her Ph.D. in Industrial Engineering from the University of Wisconsin-Madison in 1988. Professor Carayon’s research belongs to the discipline of human factors engineering, in particular macroergonomics. Her scholarly contributions aimed at modeling, assessing and improving work systems (i.e. the system of tasks performed by individuals using various technologies in a physical and organizational environment) in order to improve system performance and worker well-being. She has developed human factors and systems engineering methods and the SEIPS model to improve patient safety and health information technologies in complex healthcare settings. More than 400 leaders in over 150 healthcare organizations in the US and elsewhere have been trained in the SEIPS model of work system and patient safety. Professor Carayon’s research has been funded by the Agency for Healthcare Research and Quality, the National Science Foundation, the National Institutes for Health, the National Institute for Occupational Safety and Health, the Department of Defense, various foundations and private industry. She is a Fellow of the Human Factors and Ergonomics Society and a Fellow of the International Ergonomics Association. She is the Recipient of the International Ergonomics Association Triennial Distinguished Service Award (2012), and is the first woman to receive this prestigious award. She has published more than 110 journal publications and over 220 conference papers and 30 technical reports, and is currently the Co-Editor-in-Chief of Applied Ergonomics. She is the editor of the Handbook of Human Factors and Ergonomics in Health Care and Patient Safety. She is a member of the National Research Council Board on Human-Systems Integration, and the IOM Committee on Diagnostic Error in Healthcare.

Sara J. Czaja, PhD, is a Leonard M. Miller Professor in the Departments of Psychiatry and Behavioral Sciences, and Industrial Engineering at the University of Miami. She is also the Scientific Director of the Center on Aging at the University of Miami and the Director of the Center on Research and Education for Aging and Technology Enhancement (CREATE). CREATE is funded by the National Institute on Aging involves collaboration with the Georgia Institute of Technology and Florida State University. The focus of CREATE is on the interface between older adults and technology systems in work, healthcare and living settings. Dr. Czaja has extensive experience in aging research and a long commitment to developing strategies to improve the quality of life for older adults. Her research interests include: aging and cognition, aging and healthcare access and service delivery, family caregiving, aging and technology, human-computer interaction, training, and functional assessment. She has received funding from the National Institutes of Health, Administration on Aging, National Science Foundation, the Markle and Langeloth Foundations, AT&T, and IBM to support her research. Dr. Czaja is very well published in the field of aging and has written numerous books, book chapters and scientific articles and serves on the editorial board of several top tier journals. She is a Fellow of the American Psychological Association, the Human Factors and Ergonomics Society and the Gerontological Society of America. She is also President of Division 20 (Adult Development and Aging) of the American Psychological Association. She is also a member of the National Research Council/National Academy of Sciences Board on Human Systems Integration and the Institute of Medicine Committee on the Public Health Dimensions of Cognitive Aging.

Robert Dittus, MD, MPH, is the Albert and Bernard Werthan Professor of Medicine, Associate Vice Chancellor for Public Health and Health Care, Senior Associate Dean for Population Health Sciences, and Director of the Institute for Medicine and Public Health at Vanderbilt University and Director of the Geriatric Research, Education and Clinical Center (GRECC), Senior Quality Scholar and Director of the Quality Scholars Program at the VA Tennessee Valley Healthcare System and has been a VA staff physician for over 28 years. He previously served 14 years as Chief of the Division of General Internal
Medicine and Public Health at Vanderbilt and 12 years as Director of Clinical Practice and Health Policy Analysis at the Regenstrief Institute at Indiana University. Dr. Dittus has combined training in industrial engineering, medicine and epidemiology to advance healthcare quality improvement, outcomes of care and overall individual and population health through his research on the effectiveness, efficiency, timeliness, safety and equity of health care. He has advanced the methodology of medical decision-making and conducted numerous studies delineating the comparative effectiveness of alternative strategies for clinical care. He has conducted numerous studies examining the microsystems of health care that have improved health care delivery and on the macrosystems of health care that have led to improvements in health policy. Over the past fifteen years, he has served as senior investigator to guide the discovery of critical illness associated delirium and long-term cognitive impairment and development of new treatment paradigms with global impact on reducing the mortality, morbidity and costs of critical care. He is currently principal investigator of a large CMS Innovation Project to improve health care delivery and population health through care coordination. He has led or been co-investigator of over $300 million in research and training funding and authored over 200 publications. Dr. Dittus has served as PI of fourteen federally funded fellowship training grants in clinical research, was the principal investigator of Vanderbilt’s NIH funded K30 award and is co-PI of the Vanderbilt CTSA. He has trained over 100 fellows and junior faculty, has served as the President of the Association for Clinical Research Training and received the 2013 Distinguished Educator Award from the Association for Clinical and Translational Science. He was named the Harvey Branscomb Distinguished Professor at Vanderbilt University, and has been given the Outstanding Industrial Engineer Award from Purdue University, the Distinguished Alumni Award from Indiana University, the Duncan Neuhauser Award for Curricular Innovation from the Academy for Healthcare Improvement, and the Innovation with Distinction Award in Research Training and Education from the AAMC. He served as the founding President of the Academy for Healthcare Improvement and is an elected member of the Association of American Physicians.

Victor J. Dzau is the 8th President of the Institute of Medicine (IOM). He is Chancellor Emeritus for Health Affairs and James B. Duke Professor of Medicine at Duke University and the past President and CEO of the Duke University Health System. Previously, Dr. Dzau was the Hersey Professor of Theory and Practice of Medicine and Chairman of Medicine at Harvard Medical School’s Brigham and Women’s Hospital, as well as Chairman of the Department of Medicine at Stanford University. Dr. Dzau has made a significant impact on medicine through his seminal research in cardiovascular medicine and genetics, pioneering the discipline of vascular medicine, and leadership in health care innovation. His important work on the renin angiotensin system (RAS) paved the way for the contemporary understanding of RAS in cardiovascular disease and the development of RAS inhibitors as therapeutics. Dr. Dzau also pioneered gene therapy for vascular disease, and his recent work on stem cell “paracrine mechanisms” and the use of microRNA in direct reprogramming provides novel insight into stem cell biology and regenerative medicine. In his role as a leader in health care, Dr. Dzau has led efforts in health care innovation. His vision is for academic health sciences centers to lead the transformation of medicine through innovation, translation, and globalization. Leading this vision at Duke, he and his colleagues developed the Duke Translational Medicine Institute, the Duke Global Health Institute, the Duke-National University of Singapore Graduate Medical School, and the Duke Institute for Health Innovation. These initiatives create a seamless continuum from discovery and translational sciences to clinical care, and they promote transformative innovation in health. As one of the world’s preeminent academic health leaders, Dr. Dzau advises governments, corporations, and universities worldwide. He has served as a member of the Council of the IOM and the Advisory Committee to the Director of the National Institutes of Health (NIH) and as Chair of the NIH Cardiovascular Disease Advisory Committee and the Association of Academic Health Centers. Currently he is a member of the Board of Directors of the Singapore Health System, Governing Board of Duke-National University of Singapore Graduate Medical School, and Senior Health Policy Advisor to Her Highness Sheikha Moza (Chair of...
the Qatar Foundation). He is also on the Board of Health Governors of the World Economic Forum and chaired its Global Agenda Council on Personalized and Precision Medicine. In 2011, he led a partnership between Duke University, the World Economic Forum and McKinsey. He founded the nonprofit International Partnership for Innovative Healthcare Delivery and chairs its Board of Directors. Among his honors and recognitions are the Gustav Nylin Medal from the Swedish Royal College of Medicine; the Max Delbruck Medal from Humboldt University, Charité, and the Max Planck Institute; the Commemorative Gold Medal from the Ludwig Maximilian University of Munich; the Inaugural Hatter Award from the Medical Research Council of South Africa; the Polzer Prize from the European Academy of Sciences and Arts; the Novartis Award for Hypertension Research; the Distinguished Scientist Award from the American Heart Association (AHA); and the AHA Research Achievement Award for his contributions to cardiovascular biology and medicine. He has received six honorary doctorates.

**Dr. Andrew Gettinger** is professor of anesthesiology, adjunct Professor of Computer Science at Dartmouth, and Senior Scholar at the Koop Institute, Geisel School of Medicine at Dartmouth and was formerly the Chief Medical Information Officer (CMIO) for Dartmouth-Hitchcock and Associate Dean for Clinical Informatics at Geisel. Gettinger has extensive experience in the field of health information technology. He led the development of an electronic health record (EHR) system at Dartmouth and subsequently was the senior physician leader during Dartmouth’s transition to a vendor-based EHR. Gettinger’s clinical practice and research has been focused both on anesthesiology and critical care medicine, and on information technology as it applies generally to health care. He founded the clinical informatics group at Dartmouth. He has been an active participant in the policy debates regarding patient privacy at both the state and federal level testifying before the Senate HELP Committee and participating as a member of the NH Legislative Taskforce on Privacy. He recently completed service in Senator Orrin G. Hatch’s office as a Robert Wood Johnson Health Policy Fellow. Currently, he is a Medical Officer and Director of the Safety team in the Office of the National Coordinator for Health Information Technology at the Department of Health and Human Services. Gettinger received his AB from Dartmouth College and his MD from Dartmouth Medical School. He trained at the Hartford Hospital, Boston Children’s Hospital, and Dartmouth-Hitchcock Medical Center in anesthesiology, pediatric anesthesiology, and critical care medicine. He is board certified in anesthesiology, critical care medicine and was one of the inaugural groups of physicians certified in clinical informatics by the American Board of Preventive Medicine in 2013.

**Mark Hallett, MD, MBOE,** serves as Chief Clinical Officer for ThedaCare and is primarily accountable for safety and quality results for ThedaCare. He combines over 20 years of practice experience with nine years of experience in medical group leadership including ThedaCare Orthopedics Plus, ThedaCare’s musculoskeletal specialty group, and later ThedaCare Physicians, ThedaCare’s employed primary care group. Under his leadership, ThedaCare Physicians received the highest ranking quality scores for chronic conditions and prevention among primary care physicians in the state, according to the Wisconsin Collaborative for Healthcare Quality. The CDC’s Million Hearts® campaign recently honored ThedaCare Physicians as a 2013 Hypertension Control Champion. Bellin-ThedaCare Healthcare Partners has been recognized as the highest quality, lowest cost accountable care organization nationally in the Pioneer ACO program. Mark is a board-certified family and sports medicine physician who has been with ThedaCare since 1993 and has been in full-time medical leadership since 2008. In 2012, he earned a Master of Business Operational Excellence for Healthcare from Ohio State University’s Fisher College of Business, as well as a Six Sigma Black Belt.

**Dave Krier, MHA,** is a Vice President of Cincinnati Children’s Hospital Medical Center overseeing the daily operations of Access Services, including a centralized scheduling center and registration functions, as well as Family Relations and Guest Services. Dave is currently Co-Leader of the Outpatient Clinical
System Improvement Team, which oversees the Advanced Access work for Cincinnati Children’s. He is also a leader of the Patient-Family Experience Initiative Team. In addition, he has overseen the development of organization wide initiatives, including a clinical concierge program for patients with complex scheduling needs and support programs for destination patients. Dave has received his undergraduate degree from the University of Notre Dame and his Master of Health Administration from The Ohio State University. Prior to joining Cincinnati Children’s, Dave had worked at The Cleveland Clinic, as well as the Ohio State University College of Medicine.

Michael McGinnis, MD, MPP, MA, is a physician, epidemiologist, and long-time contributor to national and international health programs and policy. An elected Member of the Institute of Medicine (IOM) of the National Academies, he has since 2005 also served as IOM Senior Scholar and Executive Director of the IOM Roundtable on Value & Science-Driven Health Care. Previously, he held appointments as Director, respectively, of the Health Group at the Robert Wood Johnson Foundation, the World Bank/European Commission’s Task Force for Health Reconstruction in Bosnia, disease prevention and health promotion policy through four U.S. Administrations (Presidents Carter, Reagan, Bush, Clinton), and the WHO smallpox eradication program in Uttar Pradesh, India. Notable contributions include the conception, founding, and stewarding of several initiatives of ongoing impact: U.S. Healthy People national goals and objectives (1980 and ongoing), U.S. Department of Health & Human Services’ Nutrition Policy Board (1979), U.S. Dietary Guidelines for Americans (1980 and ongoing), U.S. Preventive Services Task Force (1984 and ongoing), U.S. Ten Essential Services of Public Health (1993 and ongoing), Bosnia-Srpska Ministerial agreement on health sector reconstruction (1996), RWJF Health & Society Scholars program (2001 and ongoing), RWJF Young Epidemiology Scholars program (2001 to 2011), RWJF Active Living family of programs (2002 and ongoing), IOM Learning Health System Initiative (2006 and ongoing), IOM Innovation Collaboratives (2010 and ongoing), and IOM Perspectives publication series (2011 and ongoing). Widely published, he has made foundational contributions to understanding the basic determinants of health (e.g. “Actual Causes of Death”, JAMA 270:18 [1993] and “The Case for More Active Policy Attention to Health Promotion”, Health Affairs 21:2 [2002]). National leadership awards include the Arthur Flemming Award, the Distinguished Service Award for public health leadership, the Health Leader of the Year Award, and the Public Health Hero Award. He has held visiting or adjunct professorships at George Washington, UCLA, Princeton, and Duke Universities. He is a graduate of the University of California at Berkeley, the UCLA School of Medicine, and the John F. Kennedy School of Government at Harvard University, and was the graduating class commencement speaker at each.

Mr. Thomas W. Nolan is a statistician, author, and member of Associates in Process Improvement, a group that specializes in the improvement of quality and productivity. Over the past twenty five years, he has assisted organizations in many different industries in the United States, Canada, and Europe. He is a Senior Fellow of the Institute for Healthcare Improvement. At IHI he has guided the Research and Development function and led several of IHI’s strategic international initiatives such as the Triple Aim. His health care experience includes helping integrated systems, hospitals, and medical practices to accelerate the improvement of quality and the reduction of costs in clinical and administrative services. Mr. Nolan holds a doctorate in statistics from George Washington University and is the author of three books on improving quality and productivity. He has published articles on quality and safety in a variety of peer-reviewed journals including the Journal of the American Medical Association and the British Medical Journal. He was the year 2000 recipient of the Deming Medal awarded by the American Society for Quality. In 2010 the Statistics Division of the American Society for Quality awarded him the William Hunter Award for innovative applications of statistical methods.

William P. Pierskalla, PhD, is a Distinguished Professor Emeritus of Decisions, Operations and Technology Management in the Anderson Graduate School of Management at UCLA. He is also the Ronald A. Rosenfeld Professor Emeritus, The Wharton School, University of Pennsylvania. He was
Dean of the John E. Anderson Graduate School of Management at UCLA. He holds the A.B. in Economics and M.B.A. degrees from Harvard University, an M.A. in mathematics from the University of Pittsburgh and a M.S. in statistics and a Ph.D. in operations research from Stanford University. His interests include operations research, operations management, issues of global competition and the management and delivery aspects of health care delivery. Dr. Pierskalla is a member of the National Academy of Engineering (USA). He was President of the International Federation of Operational Research Societies. He is on the Editorial Advisory Boards of Encyclopedia of Operations Research & Management Science, Health Systems Journal and Health Care Management Science Journal and has served on many other editorial boards. He was Vice President for Publications of the Institute for Operations Research and Management Sciences. He was President of the Operations Research Society of America, and is a past Editor-in-Chief of Operations Research. He is the 1989 recipient of the George E. Kimball Medal for distinguished service to the Operations Research Society of America and to the field of Operations Research and the 2005 INFORMS President’s Award given to work that advances the welfare of society. Previously he was the Deputy Dean for Academic Affairs, the Director of the Huntsman Center for Global Competition and Leadership, Executive Director of the Leonard Davis Institute of Health Economics and the Chairman of the Health Care Systems Department at the Wharton School of the University of Pennsylvania. Prior to his positions at Wharton, he was on the faculties of Northwestern University, Southern Methodist University and Case Institute of Technology and has worked at Westinghouse Electric Corporation. He is a current board member of the Phoenix Health Systems Corp. and the Institute for Healthcare Optimization. He was a board member of the Archibald Bush Foundation (chairman 2002-2007), the Griffin Funds, Northern Trust Bank of California, the iRise Corporation, Northern Wilderness Adventures Inc. and the Office Tenants Network Corporation. He has consulted to many business, educational and governmental organizations. He has given numerous lectures and seminars at Universities and organizations in the North and South Americas, Europe, Australia and Asia and has refereed articles in mathematical programming, transportation, inventory and production control, maintainability and health care delivery.

Peter Pronovost, MD, PhD, is a practicing anesthesiologist and critical care physician who is dedicated to finding ways to make hospitals and healthcare safer for patients. In June 2011, he was named director of the new Armstrong Institute for Patient Safety and Quality at Johns Hopkins, as well as Johns Hopkins Medicine’s senior vice president for patient safety and quality. Dr. Pronovost has developed a scientifically proven method for reducing the deadly infections associated with central line catheters. His simple but effective checklist protocol virtually eliminated these infections across the state of Michigan, saving 1,500 lives and $100 million annually. These results have been sustained for more than three years. Moreover, the checklist protocol is now being implemented across the United States, state by state, and in several other countries. The New Yorker magazine says that Dr. Pronovost’s “work has already saved more lives than that of any laboratory scientist in the past decade.” Pronovost has chronicled his work to improve patient safety in his book, Safe Patients, Smart Hospitals: How One Doctor’s Checklist Can Help Us Change Health Care from the Inside Out. In addition, he has written more than 400 articles and chapters related to patient safety and the measurement and evaluation of safety efforts. He serves in an advisory capacity to the World Health Organization’s World Alliance for Patient Safety. Dr. Pronovost has earned several national awards, including the 2004 John Eisenberg Patient Safety Research Award and a coveted MacArthur Fellowship in 2008, known popularly as the “genius grant.” He was named by Time magazine as one of the world’s 100 “most influential people” for his work in patient safety. He regularly addresses Congress on the importance of patient safety, prompting a report by the U.S. House of Representatives’ Committee on Oversight and Government Reform strongly endorsing his intensive care unit infection prevention program. Dr. Pronovost previously headed Johns Hopkins’ Quality and Safety Research Group and was medical director of Hopkins’ Center for Innovation in Quality Patient Care. Both groups, as well as other partners throughout the university and health system, have been folded into the Armstrong Institute.
**Matt Puglisi, MPP,** is the Executive Vice President of Business Strategy at Aptima. In this role, he is responsible for developing, refining and executing Aptima’s corporate strategy, and improving and executing Aptima’s business development process to accelerate growth. As a Senior Scientist, Mr. Puglisi also performs technical work related to training and performance assessment, in particular with the U.S. Marines. Prior to joining Aptima, Mr. Puglisi worked for the Government Accountability Office (GAO), where he analyzed and published reports and Congressional testimony describing private health insurance plans, and the change in prescription drug prices. He has also represented membership and trade associations before Congress and the Executive branch, and has served on expert panels convened by the National Academy of Science’s Institute of Medicine and the Department of Veterans Affairs. Mr. Puglisi served as an artillery forward observer for the First Battalion, Eighth Marines during Operation Desert Storm and commanded Battery G, Third Battalion, Fourteenth Marines. His personal decorations include the Navy Commendation Medal, Navy Achievement Medal, and the Combat Action Ribbon. Mr. Puglisi holds a Masters in Public Policy from Georgetown University, and a B.A. in Political Science from Siena College. He is a member of the Society for Simulation in Healthcare, the Marine Corps Association, and the Naval Institute.

**Dr. Christine Sinsky** is Vice President of Professional Satisfaction at the American Medical Association. Previously, she was a general internist at Medical Associates Clinic and Health Plans, in Dubuque, Iowa. She is board certified in internal medicine and Medical Associates Clinic and Health Plans has been recognized as a level 3 Patient Centered Medical Home since 2008. Dr. Sinsky serves on the executive committee of the Board of Directors of the American Board of Internal Medicine Board. She was a member of the Institute of Medicine’s Committee on Patient Safety and Health Information Technology. She also serves on the physician advisory panel for the National Committee for Quality Assurance (NCQA) physician recognition programs, is a member of the Society of General Internal Medicine’s Patient Centered Medical Home (PCMH) working group, and is a consultant for the John D. Stoeckle Center for Primary Care Innovation at the Massachusetts General Hospital. A frequent invited lecturer on practice innovation, redesign and the PCMH, Dr. Sinsky has presented to groups including the American College of Physicians, the Institute for Healthcare Improvement and the Patient Centered Primary Care Collaborative, as well as to private and academic medical centers. Dr. Sinsky received her bachelor’s and medical degrees from the University of Wisconsin and completed her post-graduate residency at Gundersen Medical Foundation/La Crosse Lutheran Hospital, in LaCrosse, Wisconsin, where she served as Chief Medical Resident.

**Terra Thompson, MS,** is the Business Director II for the Gastroenterology, Hepatology & Nutrition for Cincinnati Children’s Hospital Medical Center. She has a Bachelor’s degree in Business Finance from Thomas More College and a Master’s degree in Executive Leadership and Organizational Change from Northern Kentucky University. She began her healthcare career in 2003 as a Grant Specialist moving to management level in less than 2 years. Terra’s role in management and her desire to lead helped her move to the Director role in 2009. Terra’s goal is to lead her team to achieve funding, and to meet and expand clinical services by aligning divisional goals to Cincinnati Children’s Hospital Medical Center current strategic plan. By developing and leading an exemplary infrastructure, Scientists and Physicians can receive optimal support in achieving outstanding Research and Patient Care.

**Dr. Wes Walker** is currently the Chief Medical Officer - East Region for Cerner Corporation. He works in a strategic and operational capacity with the medical executive leadership of Cerner clients in the eastern United States. Prior to that, he served as a Physician Executive and Senior Manager in the Cerner Consulting organization, responsible for physician adoption on large-scale electronic health record projects in hospitals and health systems. He also worked as a physician lead for the Cardiovascular Division at Cerner, with a particular focus on clinical decision support, mobile device
integration, and automated reporting. Prior to working at Cerner, Dr. Walker served as a Medical Director of a hospitalist program for a national hospitalist company in Texas. He began his career as a practicing physician at a large, multi-specialty physician group in Texas where he was a partner and served on the board of directors. Dr. Walker completed his Internal Medicine residency at UCLA Medical Center and medical school at the University of Texas Health Science Center in San Antonio. He has collaborated on quality of care research at RAND Health in Santa Monica, California and recently served as a contributor to the IOM Discussion Paper Return on Information: A Standard Model for Assessing Institutional Return on Electronic Health Records.

Judy Worth got her first introduction to lean from one of her business partners, who left their company in Lexington, KY, to work at the startup of Toyota’s first North American plant in Georgetown, KY. She got additional exposure to the value-stream mapping tool when she served as instructional designer for LEI’s Mapping to See Kit for lean in office and services. For the past four years, Judy’s focus has been on implementing lean in healthcare. She has extensive experience facilitating value-stream mapping workshops in healthcare organizations, including hospitals and primary care, and has also provided training and coaching services for healthcare in-house lean facilitators. Judy is the co-author of a white paper on lean competencies, “Building Capability for Success with Lean: The Critical Competencies.” She currently aids companies implementing lean through Verble, Worth, and Verble, and the Lean Transformations Group.

Zelda B. Zabinsky, PhD, is a Professor in the Department of Industrial and Systems Engineering at the University of Washington, with adjunct appointments in the departments of Electrical Engineering, Mechanical Engineering, and Civil and Environmental Engineering. She is an IIE Fellow, and active in INFORMS, serving as General Chair for the INFORMS Annual Meeting held in Seattle in 2007. She has published numerous papers in the areas of global optimization and algorithm complexity, and her book, Stochastic Adaptive Search in Global Optimization, describes theory and algorithms useful for solving problems with multimodal objective functions in high dimension. The National Science Foundation (NSF), Department of Homeland Security, NASA-Langley, Federal Aviation Administration (FAA), Boeing Commercial Airplane Company, and most recently, Microsoft have funded her research. Professor Zabinsky teaches courses in Operations Research and has received the annual teaching award in Industrial Engineering at the University of Washington several times. Professor Zabinsky has applied optimization and OR models to the design of fuselage panels made of advanced composite materials; air traffic flow management; manufacturing; supply chain management; transportation; forestry; power systems; preparedness planning and real-time response for the allocation and distribution of medical supplies in the event of a natural disaster, and health care resource allocation. She currently leads an NSF grant, entitled "Models For Designing Evidence-Based Patient-Centered Health Care Systems."
ENGINEERING OPTIMAL HEALTH CARE SCHEDULING

November 21, 2014

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Section 2: Background on the Committee
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Medical Director, Healthcare Improvement
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Member Biographies

Gary Kaplan, MD, FACP, FACMPE, has served as Chairman and CEO of the Virginia Mason Health System since 2000. He is also a practicing internal medicine physician at Virginia Mason. Dr. Kaplan received his medical degree from the University of Michigan and is board-certified in internal medicine. Since Dr. Kaplan became Chairman and CEO, Virginia Mason has received significant national and international recognition for its efforts to transform health care. The Leapfrog Group named Virginia Mason “Top Hospital of The Decade” for patient safety and quality, a distinction shared with only one other hospital. For the fifth consecutive year, The Leapfrog Group also named Virginia Mason as one of 65 U.S. hospitals to be designated as a “Top Hospital”. In addition, Virginia Mason has received HealthGrades’ “Distinguished Hospital Award for Clinical Excellence” for five consecutive years. Virginia Mason is considered to be the national leader in deploying the Toyota Production System to health-care management. In addition to his patient-care duties and position as CEO, Dr. Kaplan is a clinical professor at the University of Washington and has been recognized for his service and contribution to many regional and national boards, including the Institute for Healthcare Improvement, the Medical Group Management Association, the National Patient Safety Foundation, the Greater Seattle Chamber of Commerce and the Washington Healthcare Forum. Dr. Kaplan is a founding member of Health CEOs for Health Reform. In 2007, Dr. Kaplan was designated a fellow in the American College of Physician Executives. In 2011, he was named the 12th most influential U.S. physician leader in health care by Modern Healthcare magazine, and the same publication ranked Dr. Kaplan 33rd on its list of the “100 Most Influential People in Healthcare.” In 2012, he was named the 2nd most influential U.S. physician leader in health care by the same publication. In 2009, Dr. Kaplan received the John M. Eisenberg Award from the National Quality Forum and The Joint Commission for Individual Achievement at the national level for his outstanding work and commitment to patient safety and quality. Additionally, he was recognized by the Medical Group Management Association (MGMA) as the recipient of the Harry J. Harwick Lifetime Achievement Award. Each year, the MGMA and the American College of Medical Practice Executives honor one individual who has made outstanding nationally recognized contributions to health-care administration, delivery, and education in his career, advancing the field of medical practice management.

Jana Bazzoli, MBA, MSA, CMPE, joined the Cincinnati Children’s Research Foundation and the Department of Pediatrics as vice president of Clinical Affairs. Bazzoli has nearly 20 years’ experience in hospital administration, having earned her MBA at Augusta State University in Georgia and her MSA at Central Michigan University. Her most recent position was associate administrator of outpatient operations at Nemours/Alfred I. DuPont Hospital for Children in Wilmington, Delaware. At Cincinnati Children’s, Bazzoli will work closely with departmental business directors and division directors to improve clinical care and systems. One of her primary responsibilities is to develop and implement new initiatives to achieve the departments’ clinical, operational, and academic goals while maintaining Cincinnati Children’s quality of care.

James C. Benneyan, PhD, is a leading authority on healthcare systems engineering, founding director of two federally-awarded healthcare engineering centers, and professor of Industrial Engineering and Operations Research at Northeastern University. Benneyan has served as director, co-director, principal investigator, or Co-PI in seven engineering research centers, and research laboratories totaling over $32 million in funding. His research focuses on mathematical modeling and optimization of healthcare systems broadly, with particular emphasis and area expertise in patient safety, access, logistics,
comparative effectiveness, quality, and treatment optimization. Benneyan currently serves as a director of the NSF Center for Organization Transformation, the New England VA Engineering Resource Center, and Northeastern's Quality and Productivity research laboratory. The work of these three enterprises collectively integrates academic research, real-world application, and workforce development. Methods research foci include statistical quality engineering, probabilistic optimization, computer simulation, risk-adjusted statistical methods, rare events, spatial surveillance, risk-benefit and comparative effectiveness models. Benneyan has published over 100 papers and served as senior or associate editor of four academic journals in the above areas, has received six teaching, service, and research awards, and has taught engineering to ages 6 through 60. Benneyan is a vice president of the Institute for Industrial Engineers (IIE), past president of the Society for Health Systems (SHS), senior fellow and faculty at the Institute for Healthcare Improvement, fellow of SHS and the Healthcare Information and Management Systems Society (HIMSS), and operations research faculty for Northeastern's NSF-NSEC Center for High-Rate Nanomanufacturing (CHN), and board member or advisor for several healthcare organizations. Prior to joining Northeastern, Jim was senior systems engineer for Harvard Community Health Plan, principal of Productivity Sciences Incorporated, and an industrial engineer at IBM and later Digital Equipment Corporation. Primary funding sources include the National Science Foundation, National Institutes for Health, Veteran's Health Administration, National Institute for Drug Abuse, Regenstrief Institute, United Network for Organ Sharing, U.S. Air Force Surgeon General's Office, and Agency for Healthcare Research and Quality.

Jim Conway is an adjunct lecturer at the Harvard School of Public Health in Boston and Senior Consultant, Safe and Reliable Healthcare, Evergreen, CO. From 2006-2009 he was Senior Vice President of the Institute for Healthcare Improvement (IHI) and from 2005-2011, Senior Fellow. During 1995-2005, Jim was Executive Vice President and Chief Operating Officer of Dana-Farber Cancer Institute, Boston. Prior to joining DFCI, he had a 27-year career at Children's Hospital, Boston in Radiology Administration, Finance, and as Assistant Hospital Director. His areas of expertise and interest include governance and executive leadership, patient safety, change management, crisis management, and patient-/family-centered care. He holds a Master of Science degree from Lesley College, Cambridge, MA. Jim is the winner of numerous awards including the 1999 ACHE Mass. Regents Award, the 2001 first Individual Leadership Award in Patient Safety by the Joint Commission on Accreditation of Healthcare Organizations and the National Committee for Quality Assurance. In 2008, he received the Picker Award for Excellence in the Advancement of Patient Centered Care, in 2009 the Mary Davis Barber Heart of Hospice Award from the Massachusetts Hospice and Palliative Care Federation, and in 2012 both the Institute for Patient and Family Centered Care Leadership Award and the first Honorary Fellowship of the National Association for Healthcare Quality. A Lifetime Fellow of the American College of Healthcare Executives, he has served as a Distinguished Advisor to the Lucian Leape Institute for the National Patient Safety Foundation. IOM Committees have included Identifying and Preventing Medication Errors and a Learning Healthcare System. Current Board service includes: board member, Winchester Hospital; board member American Cancer Society, New England Region; and member, Board of Visitors, University of Massachusetts, Boston. In government service, he served since 2006-2010, as a member of the Commonwealth of Massachusetts Quality and Cost Council.

Susan Dentzer is Senior Policy Adviser to the Robert Wood Johnson Foundation, the nation's largest philanthropy focused on health and health care in the United States. In this role, she works closely with foundation leaders to carry out the organizational mission of building a culture of health and improving the health and health care of all Americans. One of the nation's most respected health and health policy thought leaders and journalists, she is also an on-air analyst on health issues on the PBS NewsHour. From 2008 to April 2013, she was the editor-in-chief of Health Affairs, the nation's leading peer-reviewed journal of health policy, and led the transformation of that journal from a bimonthly academic publication into a highly topical monthly publication and web site with more than 120 million page views
annually. From 1998 to 2008, she led the PBS NewsHour’s health unit as on-air health correspondent, and was the recipient of numerous honors and awards. Dentzer is an elected member of the Institute of Medicine and the Council on Foreign Relations. Ms. Dentzer graduated from Dartmouth, is a trustee emerita of the college, and chaired the Dartmouth Board of Trustees from 2001 to 2004. She is a member of the Board of Overseers of Dartmouth Medical School and is a member of the board of directors of the International Rescue Committee, a leading humanitarian organization. She is also on the board of directors of Research!America, an alliance working to make research to improve health a higher priority; is a public member of the Board of Directors of the American Board of Medical Specialties; and is a member of the board of directors of the Health Data Consortium, which seeks to foster use of public and private data to improve the health and health care of Americans. A widely admired communicator, Dentzer is a frequent speaker before a wide variety of health care and other groups, and a frequent commentator on such National Public Radio shows as the Diane Rehm Show and This American Life. She and her husband have three children and live in the Washington, DC area.

**Eva Lee, PhD**, is a Professor in the H. Milton Stewart School of Industrial and Systems Engineering at Georgia Institute of Technology, and Director of the Center for Operations Research in Medicine and HealthCare, a center established through funds from the National Science Foundation (NSF) and the Whitaker Foundation. The center focuses on biomedicine, public health, and defense, advancing domains from basic science to translational medical research; intelligent, quality, and cost-effective delivery; and medical preparedness and protection of critical infrastructures. She is a Distinguished Scholar in Health Systems, Health System Institute at Georgia Tech and Emory University. She is also the Co-Director of the Center for Health Organization Transformation, an NSF Industry/University Cooperative Research Center. Lee partners with hospital leaders to develop novel transformational strategies in delivery, quality, safety, operations efficiency, information management, change management and organizational learning. Lee’s research focuses on mathematical programming, information technology, and computational algorithms for risk assessment, decision making, predictive analytics and knowledge discovery, and systems optimization. She has made major contributions in advances to medical care and procedures, emergency response and medical preparedness, healthcare operations, and business intelligence and operations transformation. Lee received the NSF CAREER Young Investigator Award for research on optimization and parallel algorithms and their applications to large-scale logistics and medical applications. She is the first and only IE/OR recipient for the prestigious Whitaker Foundation Biomedical Grant for Young Investigators. In 2005, she received the INFORMS Pierskalla Best Paper Award for research excellence in HealthCare Management Science for her work on emergency response and planning, large-scale prophylaxis dispensing, and resource allocation for bioterrorism and infectious disease outbreaks. Together with Dr. Marco Zaider from Memorial Sloan-Kettering Cancer Center, they were named winners of the 2007 Franz Edelman award for their work in operations research advances cancer therapeutics. Lee was selected by the National Academy of Engineering to serve on the organizing committee and to lead the "Engineering the Healthcare Delivery System" cluster for the 2009 National Academy of Engineering Frontiers of Engineering Symposium for outstanding young engineers. In 2011, her work with the Centers for Disease Control and Prevention on emergency response and mass dispensing was selected as an Edelman finalist. In the same year, her paper on vaccine response immunogenicity prediction in Nature Immunology was named “Paper of the Year” by the International Vaccine Society. Her work on optimizing and transforming emergency department workflow and patient care was recognized as 2nd prize winner in the 2013 Daniel H. Wagner Prize Excellence in Operations Research Application. She has received seven patents on innovative medical systems and devices.

**Eugene Litvak, PhD**, is President and CEO of the Institute for Healthcare Optimization (IHO). He is also an Adjunct Professor in Operations Management in the Department of Health Policy & Management at the Harvard School of Public Health, where he teaches the course “Operations
Management in Service Delivery Organizations”. Since 1995 he is leading the development and practical application of the innovative Variability Methodology for cost reduction and quality improvement in health care delivery systems. Application of this methodology has resulted in significant quality improvement and multimillion dollar margin improvements for every hospital that has applied it. Professor Litvak was a member of the Institute of Medicine Committees “The Future of Emergency Care in the United States Health System” and “The Learning Healthcare System in America” as well as a member of the "National Advisory Committee to the American Hospital Association for Improving Quality, Patient Safety and Performance". On behalf of IHO, he serves as Principal Investigator in many hospital operations improvement project in the US and internationally including CMS funded “Partnership for Patients” initiative with 14 hospitals in New Jersey and the nationwide “Whole System Patient Flow Improvement” initiative in Scotland.

Mark Murray, MD, is an international authority on the development of access and flow systems within healthcare. He has specific expertise in areas such as patient access to appointments in primary, specialty and ancillary care; patient access to information; and healthcare demand/supply matching and balance. Drawing from his direct experience in healthcare delivery and management, Murray has a unique perspective as a physician who practiced in multiple environments, as well as an understanding of how other businesses and industries use flow and demand/supply matching. He has also initiated and developed multi-operational quality improvement efforts and has consulted with healthcare organizations worldwide on a variety of quality improvement strategies including efficiencies in office practices, the development of healthcare teams, change management in healthcare settings, physician compensation and “big system” flow. Murray has worked with various types of organizations including the US government; fee for service and capitated environments; health practices, systems, plans and organizations; insurance companies; and various medical groups. In addition, he has worked extensively abroad. Murray completed his undergraduate training at St Mary’s College in California; attended Creighton University Medical School in Omaha, Nebraska; completed a residency in Family Medicine at the University of California, Davis; and obtained a Master’s degree in Health Services Administration from St Mary’s College. Following his medical training, he organized and developed a medical practice in an underserved rural area in Northern California. He also worked for Kaiser Permanente for 19 years holding various administrative positions including Assistant Chief of Medicine North Sacramento Valley where he had operational responsibility for the care of 270,000 patients; and Director of a regional call center which served 1.2 million patients. He left Kaiser in 1999 to pursue independent consulting on waits and delays in healthcare.

Thomas Nolan, PhD, is a Senior Fellow and member of the Institute for Healthcare Improvement (IHI) executive team, where his primary responsibility is the oversight of the research and development initiatives. Over the past 20 years, he has assisted organizations in the US, Canada, and Europe in many different industries, including health care, manufacturing, trucking, construction, and professional services such as law, architecture, and environmental consulting. His health care experience includes helping integrated systems, hospitals, and medical practices accelerate the improvement of quality and the reduction of costs in clinical and administrative services. Mr. Nolan has directed several IHI strategic initiatives, including the Triple Aim. He has authored books and peer-reviewed papers on quality and safety. In 2000, he received the Deming Medal from the American Society for Quality.

Peter Pronovost, MD, PhD, is a practicing anesthesiologist and critical care physician who is dedicated to finding ways to make hospitals and healthcare safer for patients. In June 2011, he was named director of the new Armstrong Institute for Patient Safety and Quality at Johns Hopkins, as well as Johns Hopkins Medicine’s senior vice president for patient safety and quality. Dr. Pronovost has developed a scientifically proven method for reducing the deadly infections associated with central line catheters. His simple but effective checklist protocol virtually eliminated these infections across the state of Michigan,
saving 1,500 lives and $100 million annually. These results have been sustained for more than three years. Moreover, the checklist protocol is now being implemented across the United States, state by state, and in several other countries. The New Yorker magazine says that Dr. Pronovost’s “work has already saved more lives than that of any laboratory scientist in the past decade.” Pronovost has chronicled his work to improve patient safety in his book, Safe Patients, Smart Hospitals: How One Doctor’s Checklist Can Help Us Change Health Care from the Inside Out. In addition, he has written more than 400 articles and chapters related to patient safety and the measurement and evaluation of safety efforts. He serves in an advisory capacity to the World Health Organization’s World Alliance for Patient Safety. Dr. Pronovost has earned several national awards, including the 2004 John Eisenberg Patient Safety Research Award and a coveted MacArthur Fellowship in 2008, known popularly as the “genius grant.” He was named by Time magazine as one of the world’s 100 “most influential people” for his work in patient safety. He regularly addresses Congress on the importance of patient safety, prompting a report by the U.S. House of Representatives’ Committee on Oversight and Government Reform strongly endorsing his intensive care unit infection prevention program. Dr. Pronovost previously headed Johns Hopkins’ Quality and Safety Research Group and was medical director of Hopkins’ Center for Innovation in Quality Patient Care. Both groups, as well as other partners throughout the university and health system, have been folded into the Armstrong Institute.

Ronald M. Wyatt, MD, is the medical director in the Division of Healthcare Improvement at The Joint Commission. In this role, Dr. Wyatt promotes quality improvement and patient safety to internal and external audiences, works to influence public policy and legislation for patient safety improvements, and serves as the lead patient safety information and education resource within The Joint Commission. Dr. Wyatt collaborates in the development of National Patient Safety Goals, and oversees data management and analyses related to the Sentinel Event database. Prior to coming to The Joint Commission, Dr. Wyatt served as the director of the Patient Safety Analysis Center at the Department of Defense (DoD) where he directed and maintained the DoD Patient Safety Registries. These registries house de-identified clinical, root cause analyses, and failure mode and effects analyses data on the DoD’s adverse patient safety events. Previously, Dr. Wyatt was the medical director at several health care organizations where his responsibilities included directing patient safety and quality improvement activities. He also served as a captain in the U.S. Army Reserves and was on active duty in the Internal Medicine Clinic at Reynolds Army Hospital in Ft. Sill, Oklahoma. He has received numerous awards, including a U.S. Army Commendation Medal for his service in Desert Storm. Dr. Wyatt served on the Federal Drug Administration (FDA) Drug Safety Oversight Board, the Agency for Healthcare Research and Quality (AHRQ) Science of Public Reporting Special Emphasis Panel, and the Comprehensive Unit-Based Safety Program to Eliminate Health Care-Associated Infections (CUSP) Technical Expert Panel. He is a mentor to the Center for Medicare & Medicaid Innovation (CMI) Advisors program at the Centers for Medicare & Medicaid Services (CMS), and a member of the American College of Physicians. Dr. Wyatt is on the faculty at the Institute for Health Care Improvement. He was named one of the “Top 50 Patient Safety Experts” in the USA by Becker’s Magazine in 2013 and 2014. Areas of special interests include social determinants of health, health disparity, patient activation, and professionalism (disruptive behavior). Dr. Wyatt co-authored the DoD Patient activation tool-kit. He contributed to the National Patient Safety Goal on Medical Alarm Management, the revised Sentinel Event Policy, and the development and writing of the Patient Safety Systems chapter for The Joint Commission hospital accreditation manual. Dr. Wyatt is an Internist with over 20 years of practice experience and is currently licensed in the state of Alabama. He earned his medical degree at the University of Alabama Birmingham and completed residency at the St. Louis University hospital, where he served as the first African-American Chief Resident in the department of Internal Medicine. Dr. Wyatt earned the Executive Master of Science in Health Administration (MSHA) from The University of Alabama at Birmingham. In 2000, the Morehouse School of Medicine conferred Dr. Wyatt with an honorary Doctor of Medical Sciences degree. As a George W. Merck Fellow with the Institute for Healthcare Improvement in 2009-2010,
Wyatt was trained in performance improvement, measurement, epidemiological, and statistical principles. He also completed a Harvard School of Public Health program in Clinical Effectiveness – a joint program of Brigham and Women's Hospital, Massachusetts General Hospital, Harvard Medical School, and Harvard School of Public Health. Dr. Wyatt actively presents on a variety of patient safety topics throughout the US and Canada. He has written and published numerous articles on patient safety topics.
STATEMENT OF TASK

An ad hoc committee will conduct a study and prepare a report directed at exploring appropriate access standards for the triage and scheduling of health care services for ambulatory and rehabilitative care settings to best match the acuity and nature of patient conditions. The Committee will:

1. Review the literature assessing the issues, patterns, standards, challenges, and strategies for scheduling timely health care appointments;

2. Characterize the variability in need profiles and the implications for the timing in scheduling protocols;

3. Identify organizations with particular experience and expertise in demonstrating best practices for optimizing the timeliness of scheduling matched to patient need and avoiding unnecessary delays in delivery of needed health care;

4. Organize a public workshop of experts from relevant sectors to inform the committee on the evidence of best practices, their experience with acuity-specific standards, and the issues to be considered in applying the standards under various circumstances; and

5. Issue findings, conclusions, and recommendations for development, testing, and implementation of standards, and the continuous improvement of their application.

In the course of their work, the committee will consider mandates and guidance from relevant legislative processes, review VA wait time proposals from the Leading Access and Scheduling Initiative, and evaluate all evidence indicated above, along with input and comment from others in the field.
Section 3: Workshop Framing Documents
Systems Approaches for Health Innovation Collaborative

Bringing together medicine and engineering for systems-based solutions

**Issue.** Application of basic systems engineering principles can improve the quality, safety, and value achieved by health care, as well as assist clinicians in managing the increasing complexity of modern care, while laying the foundation for a continuously learning health system. Central elements of daily life, such as assuring clean water, promoting aviation safety, automobile manufacturing, and developing new imaging technologies, have benefited from broader application of engineering principles. Similarly, engineering offers a powerful, yet underutilized, method of accelerating improvement in the health system. Various organizations have successfully implemented its tools and techniques to prevent health care acquired infections and promote safety, deliver best practices reliably, and optimize their general operations. Greater application of these principles can link people, processes, structures, and technology in an integrated and interdependent whole, creating reliable high-performing “systems” approaches that can be implemented at scale and achieve sustainably high levels of patient safety and outcomes, and improve value.

**Collaborative.** A joint Institute of Medicine (IOM) and National Academy of Engineering (NAE) ad hoc convening activity, under the auspices of the Roundtable, the Systems Approaches for Health Innovation Collaborative (SAHIC) seeks to build on the foundation of prior work engaged by the IOM and NAE by convening organizations and individuals actively working to design, develop, test, and evaluate innovative systems-based strategies for improving outcomes and lowering costs in health care.

**Participants.** Participants include experts from public and private organizations with prominent activities and leadership responsibilities related to development and application of system-based tools and processes for improving health and health care. The aim is for an inclusive Collaborative—without walls—and participation in individual projects is structured according to interest, need, and practicality.
Activities. Projects under way or under consideration by SAHIC include:

- **Making the case for systems approaches in health.** Draft a discussion paper that describes the benefits, and identifies the barriers, of applying a systems approach to improving health and health care.

- **Systems approaches in health professional education.** Increase the visibility and knowledge of systems approaches among health professionals by developing short modules for medical, nursing, other health professional, and public health education courses.

- **Learning labs.** Develop 4 to 5 learning labs that bring together engineering and health care professionals to address important problems that affect health care quality, population health, and health care costs.

**REPRESENTATIVE PARTICIPANTS**

**ORGANIZATIONS**
- Institute of Medicine
- National Academy of Engineering
- Agency for Healthcare Research and Quality
- Applied Physics Laboratory
- Arizona State University
- Consumer Reports
- Consumers Union
- Dartmouth College
- Department of Defense
- Department of Health and Human Services
- Department of Veterans Affairs
- Epic Systems
- Geisinger Health System
- Gordon and Betty Moore Foundation
- Harvard University
- Institute for Healthcare Improvement
- Institute for Healthcare Optimization
- Johns Hopkins School of Medicine
- Kaiser Permanente
- Masimo
- Massachusetts Institute of Technology
- Mayo Clinic
- MedStar Health
- National Patient Safety Foundation
- Northeastern University
- Northwest Physicians Network
- Partners HealthCare System
- Premier, Inc.
- President’s Council of Advisors on Science and Technology
- Purdue University
- Regenstrief Center for Healthcare Engineering
- Stevens Institute of Technology
- ThedaCare Center for Healthcare Value
- University of Arkansas
- University of Michigan
- University of Pittsburgh
- University of Washington
- University of Wisconsin
- Value Capture
- Vanderbilt University
- Virginia Mason Medical Center
Bringing a Systems Approach to Health

Gary Kaplan, Virginia Mason; George Bo-Linn, Gordon and Betty Moore Foundation; Pascale Carayon, University of Wisconsin; Peter Pronovost, Johns Hopkins University; William Rouse, Stevens Institute of Technology; Proctor Reid, National Academy of Engineering; and Robert Saunders, Institute of Medicine

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*Participants in the IOM/NAE Systems Approaches for Health Innovation Collaborative and IOM Roundtable on Value & Science-Driven Health Care

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Bringing a Systems Approach to Health

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Although the U.S. health system excels in several areas, its overall performance remains uneven in terms of safety, quality, value, and the health outcomes achieved. One important lever to address these performance gaps is the use of structured, evidence-based systems-engineering approaches, which have been used successfully by many other industries. When these approaches have been applied to health and health care, they have often brought about significant improvements in care quality, value, patient safety, patient experience, and overall health outcomes. Yet, such approaches remain generally underutilized in the health system, and their potential for improvement remains largely untapped.

A systems approach improves health by considering the multiple elements involved in caring for patients and the multiple factors influencing health. By understanding how these elements operate independently, as well as how they depend on one another, a systems approach can help with the design and integration of people, processes, policies, and organizations to promote better health at lower cost. These approaches can be useful for all levels of the health system—patient-clinician interaction, health care unit, organization, community, and nation—with different tools available for the needs at different levels and across levels. These tools include production system methods and other management systems to help organizations continuously improve their operations and identify problems; queuing theory and operations management to ensure that resources are available when patients need them; and human-factors engineering to spot safety, quality, and reliability challenges by understanding how humans interact with technologies and processes. Spreading these systems principles more broadly will require specific technological supports, such as more advanced data systems and interoperable devices; supportive culture and leadership; engagement of patients, families, clinicians, and the broader public in these methods; and new incentive structures.

URGENT CHANGE IS NEEDED TO IMPROVE HEALTH OUTCOMES AT LOWER COST

Although the American health system has islands of excellence, it currently performs below its potential in several dimensions, with uneven patient safety, escalating costs and stagnant productivity, and inconsistent use of scientific evidence (IOM, 2001, 2012; Kocher and Sahni, 2011a). Even though overall health care expenditures have continued to grow, several studies suggest that up to 30 percent of health care expenditures is unnecessary or wasted (Farrell et al., 2008; IOM, 2010, 2012; Martin et al., 2012; Wennberg et al., 2002). Furthermore,

¹ Participants in the IOM/NAE Systems Approaches for Health Innovation Collaborative and the IOM Roundtable on Value & Science-Driven Health Care.

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Evidence is inconsistently applied to clinical care, with patients receiving evidence-based care recommended by guidelines only half of the time (McGlynn et al., 2003).

One particular concern is the incidence of patient harm, which remains far too common. Research in the past decade estimates that up to 20–30 percent of hospitalized patients experience harm during their stay (Classen et al., 2011; Landrigan et al., 2010; Levinson, 2010, 2012). Patients can experience multiple harms in each health care interaction, especially in critical or complex environments and across care settings. Beyond traditional measures of harm, patients are often at risk for another type of harm: the loss of dignity and respect. In one survey, almost half of all patients report concerns about the patient-centeredness of their health care encounters, such as being listened to, having information explained clearly, being shown respect, and receiving sufficient time for their health concerns (Schoen et al., 2006).

These quality and safety shortfalls occur even as clinicians expend considerable time and effort caring for their patients. The problem is not with the individuals working in the health care enterprise, but with the design and operation of the multiple systems in health care. As currently designed, these systems depend on the heroism of clinicians to ensure patient safety and promote care quality. At the same time, they add unnecessary burdens to clinical workflows, silo care activities, and divert focus from patient needs and goals.

Efforts to address these concerns are hampered by several implementation challenges, including a limited capacity for measurement. For example, improving safety has been impeded by the lack of agreement on a definition of patient harm. Multiple definitions are currently in use, which has led to divergent estimates on the proportion of care delivered safely (Classen et al., 2011; Pham et al., 2013). The lack of standardized definitions and standard metrics has also challenged institutions seeking to improve their care processes and compare their performance to others.

Implementation efforts are further challenged by the complexity of modern clinical care, which strains individual human capacity (IOM, 2012). To exemplify the extent of complexity, an average intensive care unit (ICU) patient requires 200 clinical interventions every day, which is beyond the capabilities of any individual care provider to manage (Donchin et al., 1995). Furthermore, this same provider may have to monitor and react to up to 240 vital sign inputs for these critical care patients (Donchin and Seagull, 2002). Complexity is not limited to hospital environments. A 2008 study of a large multispecialty practice in Massachusetts found that the average primary care physician managed 370 unique primary diagnoses, each associated with a set of evidence-based practices; 600 unique medications; and approximately 150 unique laboratory tests (Semel et al., 2010). The complexity of health care extends beyond these specific examples to permeate all aspects of clinical care, and highlights the need for systems approaches to delivering care.

New technologies, such as electronic health records, introduce great potential for better managing complexity. But in order to make gains in quality, safety, or cost, technological interventions require thoughtful execution, implementation, and coordination. Applied without forethought, new technologies may even exacerbate existing inefficient care processes or create new problems. A new technology could add unnecessary steps to clinical workflows, thereby lowering efficiency, or be poorly designed, thus becoming a source of errors and potential safety challenges. For example, even though health care has increased its investment in health information technology (IT) in recent years, the expected gains in productivity and patient outcomes have not been seen (Kellermann and Jones, 2013; Kocher and Sahni, 2011b). The potential gains are great—health care’s cost challenge could be substantially reduced if health
care achieved just half the productivity gains from IT as the telecommunications industry (Hillestad et al., 2005; Kellermann and Jones, 2013). There are multiple reasons that these gains have not occurred, such as the lack of interoperability, yet a major reason is that care processes have not been redesigned to take advantage of the efficiencies offered by health IT.

As illustrated above, the solution to the quality, safety, and value challenges in the health care system is to understand and address the underlying broken processes, and to take a systems approach in doing so (Hoffman and Emanuel, 2013). Moreover, given the complexity of modern clinical care, initiatives that simply add to a clinician’s current workload are unlikely to succeed. Rather, significant and sustainable improvement requires reconfiguring the environment, systems, and processes in which health care professionals practice (Carayon et al., 2006; IOM, 2012). As a result of doing so, a systems approach can reduce the burden of work that clinicians face while providing improved safety, quality, and value.

This paper examines systems solutions to health care delivery with case studies of successful systems-based interventions in health care and other sectors of the economy. The paper limits itself to care delivery because of the multiple opportunities to improve care, the greater traction for solutions from a limited scope, and the availability of results demonstrating the impact of systems approaches. Although this paper specifically examines health care, systems approaches are equally applicable throughout the broader health system to produce better health at lower cost.

A SYSTEMS APPROACH HAS IMPROVED QUALITY AND VALUE IN OTHER INDUSTRIES

Many other sectors of the economy have utilized systematic, evidence-based engineering approaches to achieve striking results in quality, efficiency, safety, and other aspects of operations. These methods are diverse, including strategies drawn from systems engineering, industrial engineering, human factors engineering, and operations research. They leverage multiple types of tools, including statistical process controls, supply chain management, usability evaluation, and modeling and simulation. By using systems approaches, industries have been able to coordinate operations across multiple sites, coordinate the delivery and management of supplies, design usable and useful technologies, and provide consistent and reliable processes (Agwunobi and London, 2009; IOM and NAE, 2011; IOM and NAE, 2005).

Perhaps the most visible and transformative application of systems engineering for improved performance is found in aviation. Aviation has made substantial strides in improving safety with a systems approach. Its first strides in safety resulted from improving the mechanical components of the planes and ensuring that all technologies were supported by redundancies. However, even with these mechanical improvements, aviation accidents still occurred. To eliminate these residual safety problems, the industry had to address human factors. This meant building systems that corrected or mitigated the inevitable human error. The tools for accomplishing this included checklists to promote reliability and provide shared mental models, crew resource management to encourage communications and support a team approach, and general human factors engineering tools to improve the ease of use for cockpit controls and information displays (Nance, 2011; Wiegmann and Shappell, 2001). Under this approach, airline safety statistics have improved dramatically. The number of fatalities that have occurred for domestic commercial airlines has fallen from 2.1 per 100,000 aircraft departures in 1980 to none in the period from 2007 to 2010 (Bureau of Transportation Statistics, 2011).
Aviation is of course not alone in applying systems methods. Another notable example, taken by multiple industries, is to apply management systems to their operations. These management methods, such as Six Sigma, lean, production system methods, Total Quality Management, and others, provide a systematic approach to addressing problems and continuously improving operations. By using such methods, industries have been able to improve both the quality and value of their operations (Chassin and Loeb, 2011; Hammer, 2004; Kaplan and Patterson, 2008; Kenney, 2008).

Another example can be found in automobile manufacturing, such as with the Toyota production system. The Toyota production system breaks complex processes down into discrete steps with clearly defined order and responsibilities (Bohmer, 2010; Kenney, 2011). Routine communication is also standardized, such that expectations and timelines are consistent and unambiguous. Moreover, the system defines processes that link all the tasks and communications together for a given product or service to further reduce ambiguities. When conflicts or ambiguities do arise, designated teachers assist workers in learning to identify and correct inefficiencies, encouraging a culture of continuous learning within a highly structured and transparent process (IOM, 2012; Spear and Bowen, 1999).

Naval nuclear aircraft carriers provide another example of system approaches to produce high reliability, as safety on the carrier flight deck is challenged by a hazardous, fast-paced, and extremely complex environment (Rochlin et al., 1987). In order to produce safe operations, multiple types of workers—air traffic controllers, dispatchers, ground crews, and others—must seamlessly work together, make decisions in real time based on information provided by other teams, and continually monitor each other’s work for potential safety problems (Baker et al., 2006; Roberts and Rousseau, 1989). This must all be accomplished in short time frames, with planes launching or landing every 30–60 seconds (Roberts and Rousseau, 1989; U.S. Navy, 2013), and any failure having catastrophic consequences. In order to manage under such conditions and achieve low rates of failure, aircraft carriers and other high-reliability industries have had to adopt certain practices. Their operations exhibit collective mindfulness, in which everyone understands the importance of safety and continually searches for any changes that could challenge safety; they use robust process improvement tools to eliminate any potential deficiencies; and their leadership and culture encourages trust, communication, and the need for continuous improvement (Chassin and Loeb, 2011).

A SYSTEMS APPROACH COULD BE SIMILARLY TRANSFORMATIVE FOR HEALTH CARE

Although other industries often have achieved striking successes from systems approaches, health care overall has been slow to adopt such approaches and techniques. System approaches have applicability for a variety of issues facing the health and health care system, including improving patient safety; preventing disease with a community-based approach; enhancing coordination and communication between care team members; managing the growing complexity of biomedical evidence and diagnostic and treatment options; and continually improving the quality, value, and outcomes of care.

Drawing from experiences with systems approaches in other industries, a systems approach to health is one that applies scientific insights to understand the elements that influence health outcomes; models the relationships between those elements; and alters design, processes, or policies based on the resultant knowledge in order to produce better health at lower cost.
In effect, four general stages are represented in the approach:

1. **Identification**: Identify the multiple elements involved in caring for patients and promoting the health of individuals and populations.
2. **Description**: Describe how those elements operate independently and interdependently.
3. **Alteration**: Change the design of organizations, processes, or policies to enhance the results of the interplay and engage in a continuous improvement process that promotes learning at all levels.
4. **Implementation**: Operationalize the integration of the new dynamics to facilitate the ways people, processes, facilities, equipment, and organizations all work together to achieve better care at lower cost.

**Systems Approach to Health: A Working Definition**

A systems approach to health is one that applies scientific insights to understand the elements that influence health outcomes; models the relationships between those elements; and alters design, processes, or policies based on the resultant knowledge in order to produce better health at lower cost.

Two issues are particularly salient in this respect: 1) because health care alone does not necessarily translate to improvement in health, there is a need to integrate all the systems and subsystems that influence health; and 2) separately optimizing each component does not optimize the overall system results. For example, optimizing health IT systems for one group of tasks is not as effective as optimizing the technology to support high-quality, high-value care processes across the board (Walker and Carayon, 2009).

Another important consideration is the decentralized nature of American health care with many independent, yet interconnected, stakeholders. This means that the overall system cannot be understood by only examining individual stakeholders, as new properties emerge from the stakeholders adapting and interacting with each other. There are various conceptual frameworks that describe this unique behavior, including complex adaptive systems, systems of systems, and ultra-large-scale systems, that can help describe how the system behaves (IOM, 2001, 2011; Sage and Cuppan, 2001). These theoretical frameworks are useful in highlighting potential unintended consequences to new policies or describing the resilience or capabilities of the entire system.

During the past several years, the Institute of Medicine (IOM) and the National Academy of Engineering (NAE) have sponsored a number of activities aimed at better understanding and mapping the ways systems engineering principles might accelerate progress toward a more efficient and effective health system. Three prominent examples include

- **Building a Better Delivery System: A New Engineering/Health Care Partnership**. This study focused on engineering tools and technologies that could help the health system improve along the six domains of quality outlined by *Crossing the Quality Chasm: A New Health System for the 21st Century*. It found that the health system had not taken advantage of potentially transformative engineering strategies and technologies, even though those tools had revolutionized quality, productivity, and overall performance in other sectors (IOM and NAE, 2005)
- **Systems Engineering to Improve Traumatic Brain Injury Care in the Military Health System**. This workshop identified opportunities to apply engineering tools for improving
care for patients with traumatic brain injury. These engineering tools can be applied to model, analyze, design, and structure care in all settings, including the battlefield, military health facilities, Veterans Health Administration facilities, and private providers (IOM and NAE, 2009).

- **Engineering a Learning Healthcare System: A Look at the Future.** This workshop explored engineering principles that are foundational to building a learning health system that continuously learns and improves in terms of its effectiveness, efficiency, safety, and value. It considered how lessons from engineering could help to redesign all aspects of the system, from generating new knowledge to continuously reducing waste to providing safeguards that ensure consistently safe care (IOM and NAE, 2011).

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<th>Engineering a Learning Healthcare System</th>
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<tr>
<td>Common Understandings</td>
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<td>• Foster a leadership culture, language, and style that reinforce teamwork and results.</td>
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**SOURCE:** IOM and NAE, 2011.

In the latter publication, from a co-sponsored IOM/NAE workshop, a number of common understandings emerged from the assessment by participants of various examples available at the time to illustrate variations on the approach to application of systems principles to health. An abbreviated synopsis follows (IOM and NAE, 2011).

- **The system’s processes must be centered on the right target—the patient.** Health care is by nature highly complex, involving multiple participants and parallel activities that sometimes take on a character of their own, independent of patient needs or desires. Here, patient needs and perspectives must be at the center of all process design, technology application, and clinician engagement.

- **System excellence is created by the reliable delivery of established best practices.** Identifying and embedding practices that work best, and developing the system processes to ensure their delivery every time, help to define excellence in system performance and to focus the system on delivering the best possible care for patients.

- **Complexity compels reasoned allowance for tailored adjustments.** Established routines may need circumstance-specific adjustments for differences in the appropriateness for various individuals, variations in caregiver skill, and the evolving nature of the science
base—or all three. Mass customization and other engineering practices can help ensure a consistency that can in fact accelerate the recognition of the need for tailoring.

- **Learning is a nonlinear process.** The focus on an established hierarchy of scientific evidence as a basis for decision making cannot fully accommodate the fact that much of the sound learning in complex systems occurs in local and individual settings. There is a need to bridge the gap between dependence on formal trials, such as randomized clinical trials, and the experience of local improvement in order to speed learning and avoid impractical costs.

- **Emphasize interdependence and tend to the process interfaces.** A system is most vulnerable at the interfaces between and among critical processes. In health care, attention to the nature of relationships and handoffs between elements of the patient care and connected processes, such as administrative processes, are vital.

- **Teamwork and cross-checks trump command and control.** In systems designed to guarantee safety, system performance that is effective and efficient requires careful coordination and teamwork as well as a culture that encourages parity among all those with established responsibilities.

- **Performance, transparency, and feedback serve as the engine for improvement.** Continuous learning and improvement in patient care requires transparency in processes and outcomes as well as the ability to capture feedback and make adjustments.

- **Expect errors in the performance of individuals, but perfection in the performance of systems.** Human error is inevitable in any system and should be expected. On the other hand, resilient work systems, safeguards, and designed redundancies can deliver perfection in system performance, by mapping processes and embedding prompts, cross-checks, and information loops.

- **Align rewards on the key elements of continuous improvement.** Incentives, standards, and measurement requirements serve as powerful change agents, and it is vital that incentives be carefully considered and directed to the targets most important to improving the efficiency, effectiveness, systemic shortfalls, and challenges in health care today, reflecting changes needed and how systems engineering may help foster the health and safety of the system—and ultimately improve patient outcomes.

- **Education and research can facilitate understanding and partnerships between engineering and the health professions.** Common vocabularies, concepts, and ongoing joint education and research activities that help generate stronger questions and solutions will encourage greater collaborative work between them.

- **Foster a leadership culture, language, and style that reinforce teamwork and results.** A positive leadership culture fosters and celebrates consensus goals, teamwork, multidisciplinary efforts, transparency, and continuous monitoring and improvement—all of which require supportive and integrated leadership.
SYSTEMS APPROACHES TO HEALTH: EXAMPLES

The experiences of several organizations with impressive outcomes from application of systems approaches can be illustrative on the potential applications of systems tools to
- design health care operations to assure consistently high performance, such as using safeguards and redundancies, standard and resilient work processes, and elements that account for human factors;
- develop frameworks for understanding health care structures, processes, and outcomes, along with their relationships (Carayon et al., 2006);
- adopt measurement, feedback, and control tools for continuous improvement, adaptation and tailoring, and managing complex processes;
- apply modeling and simulation tools that highlight interconnections, potential failure points, and possible implications from different policy options; and
- discover new knowledge using data mining, predictive modeling, and other methods.

This section highlights six examples in which systems principles have been applied to significantly advance performance, including safety, quality, and value.

### Examples of Systems Approaches to Health

Multiple systems approaches have the potential to improve health and health care, including:
- Human factors engineering
- Industrial and systems engineering
- Production system methods
- Modeling and simulation
- Predictive analytics
- Supply chain management
- Operations management and queuing theory

### Case Study: Johns Hopkins University

The Armstrong Institute of Johns Hopkins University, in conjunction with the Gordon and Betty Moore Foundation, has launched a 2-year initiative seeking to improve care in the ICU. This initiative builds on prior work from this team, which has found that systems approaches can improve safety and patient outcomes in critical care environments. For example, one initiative spearheaded by the group found that checklists could reduce the incidence of catheter-related bloodstream infections, a potentially harmful complication occurring in many hospitals. These studies found that the checklist, when implemented across ICUs throughout an entire state, eliminated catheter-related bloodstream infections in the ICUs of most hospitals and resulted in an 80 percent decrease in infections per catheter-day (Pronovost et al., 2006a; Pronovost et al., 2009). If routinely used nationally, this type of tool could help to eliminate these infections, which claim almost 30,000 lives per year and cause approximately $2 billion in health care costs (Pronovost et al., 2006a).
The current initiative, called the Patient Care Program Acute Care Initiative, aims to enhance care quality and reduce patient harms in the intensive care unit. In critical care environments, multiple problems are common, such as deep venous thrombosis, ventilator-associated injuries, and central line–associated bloodstream infections. To prevent these common harms one at a time, a clinician would have to perform multiple preventive interventions for each potential harm, most of which need to be performed several times a day. Adding the number of preventive interventions together, it is estimated that a clinician would need to provide nearly 200 interventions every day under this type of ad hoc approach.

In contrast to the typical approach of tackling each harm one at time, the project seeks to take a systems perspective to eliminate all types of patient harm, including the harm of a loss of dignity and respect, and integrate preventive interventions directly into the clinical work flow. It intends to do so by reengineering the ICU using an interdisciplinary, patient-centered approach that integrates clinical information systems and clinical equipment, reengineers the care team workflows, and incorporates patient and family goals into routine care. A schematic of the systems engineering approach being used to design and continuously improve the clinical environment is illustrated in Figure 1.

![Figure 1](image)

**FIGURE 1** The development approach to designing and continuously improving care processes in the Patient Care Program Acute Care Initiative.

One critical part of the project is developing technology platforms that coordinate and integrate various technologies and clinical processes. To improve reliability and consistency, one platform will include a dashboard that displays the status of necessary interventions to prevent harms—interventions that are due and intervention that have already been accomplished—and make that status visible to clinicians, patients, and families. To improve safety and productivity, another platform will integrate various medical technologies and electronic health data. The first phase of this platform will convey the orders in an electronic health record to the dose in an infusion pump for patients in critical care units. The initial platform will save considerable nursing time and effort, as the current process for adjusting an infusion dose requires a nurse to manually enter in the new dose level into the infusion pump based on the order in the electronic health record, and a second nurse to manually verify the accuracy of the order. Moreover, the platform will provide greater reliability and accuracy by eliminating the potential for human error. This application will be implemented in the surgical ICU at Johns Hopkins in the summer of 2013 and at the University of California, San Francisco, in the summer of 2014.

As technology by itself does not lead to sustainable change, this effort is coupled with culture change and teamwork interventions (Pronovost et al., 2005; Timmel et al., 2010). Therefore, the project will combine interventions to culture, technology, and workflow in order
for new capabilities to emerge. The importance of combining these elements is represented in the conceptual framework for the project, as illustrated in Figure 2.

![Conceptual view of the critical components of the Patient Care Program Acute Care Initiative.](image)

**FIGURE 2** Conceptual view of the critical components of the Patient Care Program Acute Care Initiative.

**Case Study: Virginia Mason Health System**

Research has found that management practices adopted from manufacturing sectors can improve the operations of health care organizations, resulting in better patient health outcomes. One recent study found that management practices were associated with improved care process measures and lower mortality for heart attack patients (McConnell et al., 2013). However, this same study pointed out that there was substantial diversity in the types of management practices used, and only one-fifth of institutions were fully implementing them according to best practices. This underscores both the potential for management practices and the challenges preventing these techniques from being consistently used in routine practice.

One institution that has implemented a management system across its entire operations is the Virginia Mason Health System. Virginia Mason uses the Virginia Mason Production System, which is inspired by the Toyota Production System. Although Virginia Mason has used production system methods in all departments, the case of its spine center is instructive for its results and for the challenges it faced. The spine center was encouraged to restructure its processes due to concerns about long wait times and high costs. The center began by mapping out the clinical pathways for its patients and discovered that care was inconsistent—some patients received advanced imaging, like magnetic resonance imaging (MRI) tests, and specialist care, while other similar patients directly received physical therapy. To improve, the clinic reviewed the literature on back pain treatments and developed a standard evidence-based process. Under this new process, patients with non-complicated back pain were directed immediately to physical therapy, and MRI scans and intensive evaluation were reserved for more complex cases. This new process aligns with clinical evidence showing that imaging for lower back pain is often overused, especially in clinical situations where it is unlikely to improve outcomes (Good Stewardship Working Group, 2011). Moreover, Virginia Mason found that this new way of delivering care reduced wait times, improved outcomes, and reduced costs (Blackmore et al., 2011; Fuhrmans, 2007).

Virginia Mason’s experience also reveals the challenges in adopting systems approaches. Implementing the evidence-based system across the organization has required substantial
leadership support, backing from the governing board, and transforming the organization’s culture to sustain this work. Furthermore, the current payment system for health care can be an impediment. In the spine center example, the institution began to lose money after adopting the new clinical approach. This was because the institution was paid for high-cost imaging studies, which it was conducting less frequently, but was not paid for inexpensive follow-up care such as telephone consultations, which it was conducting more often. To sustain the improvement initiative, it had to negotiate with local insurers and employers to establish a new payment system for back pain (Blackmore et al., 2011; Fuhrmans, 2007). This experience highlights the multiple factors that can limit spreading systems approaches broadly.

**Case Study: Vanderbilt University**

Ventilator-associated pneumonia is a serious complication for patients in critical care environments, leading to death in 20 to 50 percent of patients affected (Pham et al., 2013). Preventing ventilator-associated pneumonia requires not just implementing specific preventive measures, but also consistently performing an entire bundle of interventions. When Vanderbilt University Medical Center examined how often it performed each of these preventive measures in its critical care units, it discovered that each individual intervention was conducted frequently, but performance was poor when implementing the entire bundle for every patient.

To improve the consistent delivery of the prevention bundle and reduce the rates of ventilator-associated pneumonia, Vanderbilt adopted systems engineering tools and implemented a feedback and control system. Specifically, the organization developed visual dashboards that showed every care team member the status of ventilator preventive measures for each patient— which measures had been done, which needed to be done, and which were overdue. The display was coupled with management reports, provided online and in real-time, that identified improvement opportunities across all patients by time and location (McConnell et al., 2013). As a result of these initiatives, average compliance with the ventilator bundle increased from 40 to 90 percent in 1 year, and rates of ventilator-acquired pneumonia dropped by over one-third during the same time period (IOM, 2012). The example highlights the potential of systems approaches to increase reliability and consistency in care, thereby improving safety and reducing errors.

**Case Study: Veterans Health Administration (VHA)**

In the early 1990s, health care provided by the Veterans Administration (VA) was widely criticized for uneven quality, fragmentation and limited access, poor customer service, and high cost. Based on these concerns, the VA implemented a system-wide reengineering effort to transform the way it delivered care. The reengineering occurred across multiple dimensions, including the system’s leadership, management processes, care coordination, quality improvement, incentives, resource allocation, and information technology and electronic health record capacity. The guiding principle throughout all of these improvement initiatives was to reliably provide high-quality, high-value, patient-centered care to all veterans served by the system (Kizer, 2011; Kizer and Dudley, 2009).

One of the key tools for the improvement efforts was the implementation of a system-wide electronic health record system called VistA (Veterans Health Information Systems and Technology Architecture). The transition built on prior IT infrastructure investments in order to
provide digital patient records for all patients, with information flowing among all providers and facilities. The expanded digital infrastructure provided new clinical capabilities to ensure reliability, such as clinical alerts; new methods for sharing best practices and implementing new knowledge, such as clinical decision support; and new data sources for generating knowledge, such as clinical and administrative data repositories (Brown et al., 2003).

As a result of these efforts, the VHA improved its performance on multiple care quality measures, increased the use of evidence-recommended care, and increased the efficiency of its operations. Studies have found that the VA performs as well as, and often exceeds, the performance of other systems on measures ranging from prevention to management of chronic diseases to treating acute conditions (Asch et al., 2004; Jha et al., 2003; Perlin et al., 2004; Singh et al., 2010; Trivedi et al., 2011).

**Case Study: Managing Patient Flow**

Another set of initiatives used a technique from the operations research field to ensure that resources are available when patients need them in a hospital setting. It accomplishes this by examining how patients enter and move throughout the hospital, from their initial admission, through the different units of the hospital, until their discharge. Importantly, this must include scheduled cases (such as elective surgeries) and unscheduled cases (such as emergency admissions), as both contribute to variability in the hospital census. The patient data are analyzed using mathematical models, and the results of that analysis are used to adjust hospital processes, such as the daily operating room schedule, to lower variability in the flow of patients to different hospital units (Litvak and Bisognano, 2011).

By adopting these techniques, one hospital, Cincinnati Children’s Hospital, was able to improve care quality while simultaneously increasing surgical volume by 7 percent annually for 2 years, all without adding staff or increasing the number of hospital beds (Litvak and Bisognano, 2011). Similar results have been seen at another institution, Mayo Clinic in Florida, which implemented this methodology and was able to increase surgical volumes by 4 percent while decreasing variability by 20 percent, reducing staff turnover by 40 percent, and reducing overtime staffing by 30 percent (Smith et al., 2013).

**Case Study: Human Factors Engineering with Electronic Health Records**

Human factors engineering can help to identify potential safety, quality, and reliability challenges for technologies or processes by focusing on how humans will interact with them. In one example of this approach, a human factors analysis was performed on the medication ordering, dispensing, and administration processes, including a computer physician order entry (CPOE) system. The researchers for the study, at Centre Hospitalier Universitaire in Lille, France, analyzed the user interface to the CPOE system and identified multiple issues that limited the usability of the software. This was followed by a simulation of the typical nursing work environment, in which the participating nurses identified 28 usability issues during that test (Beuscart-Zephir et al., 2010; Carayon et al., 2013; Pelayo et al.). By identifying and correcting potential usability issues, the user interface can better support care processes and promote the efficiency and reliability of care.

As a second example, current medical devices produce a significant quantity of information for clinicians to review, and produce false alarms at a high frequency. These two
factors have created a complex work environment in which clinicians have too much information to review and are unable to judge which alarms are truly critical. The situation has led the Joint Commission and professional societies to encourage health care leaders to examine alarm fatigue and to reconfigure device design, where appropriate, to limit alarms to situations in which they are clinically necessary.

**Despite Examples of Success, Systems Approaches Remain Limited**

Although current initiatives have had real effects on patient’s lives, most of these are point-based or disease-focused, and, on the grand scale of the health system, they are isolated micro-victories. These examples of success have also depended on an extraordinary combination of circumstances, leadership, culture, and resources. Multiple opportunities are now available for a systems approach, ranging from accountable care organizations to the new information ecosystem. An outstanding question is how these systems approaches can be spread more broadly, involving multiple health care organizations and integrating the health and health care systems.

**TECHNOLOGICAL, CULTURAL, AND STRUCTURAL BARRIERS PREVENT WIDESPREAD USE OF SYSTEMS APPROACHES**

Although cases of successful systems approaches to health and health care exist, little progress has been made in spreading systems approaches, with multiple barriers preventing widespread implementation of successful tools. One major challenge is the current incentive structure for health care, the fee-for-service payment model. This payment model pays for each specific health care service but does not pay for simple tasks like communicating with patients or coordinating care. As such, it discourages any improvement initiative that reduces the number of health care services performed, because it would also reduce revenue for the organization. Even more perversely, a hospital may see its margins decrease as a result of initiatives that reduce preventable harms (Hsu et al., 2013). This means that initiatives that improve patient outcomes at a lower cost can be unsustainable, and eventually threaten an organization’s long-term survival. Yet, changing the reimbursement system is only a first step, as sustainable improvement will require coupling reimbursement changes with a systems approach to redesigning care processes.

Another major challenge is the current culture of health care, which focuses on individual clinicians rather than systems and in which blame is the standard reaction to any error. As a result, this culture relies on the heroism of clinicians to prevent harm. The difficulty with this type of culture is that humans, no matter how experienced, skilled, or vigilant, will always make mistakes. This is magnified in chaotic health care environments that place substantial physical and mental stresses on clinicians, who are attempting to simultaneously manage the care needs of multiple patients. Moving away from blame allows an organization to learn from mistakes and conduct systematic improvement efforts based on that knowledge. Moreover, this cultural shift will allow systems to be built that recognize and account for inevitable human error, and provide redundancies and cross-checks that maintain safety regardless.

Furthermore, organizational culture is a necessary prerequisite for the successful implementation and sustainability of improvement initiatives (Garvin et al., 2008; Klein and Sorra, 1996). Some organizational cultures, particularly those that are overly hierarchical or have punitive responses toward any failure, may not support transparency, standardization, or other
factors that a systems approach demands. As with any change to the provision of care, a strong culture of collaboration and communication in which teamwork, creativity, and innovation are valued is foundational to success. For example, one study found that a culture in which staff felt empowered to report safety concerns was critical to reducing catheter-related bloodstream infections in critical care environments (Pronovost et al., 2006a; Pronovost et al., 2006b; Vigorito et al., 2011). In a similar vein, one study found that organizations that promoted staff buy-in to systems tools by training their clinical and nonclinical staff in process improvement had the strongest improvements, as this technique gave everyone in the organization the ability to apply systems-based problem solving and promoted more extensive use of these tools (Edwards et al., 2011; Lukas et al., 2007).

Several studies have demonstrated the significant impact that an organization’s culture can have on its performance. For example, after implementing an initiative focused on teamwork, coaching, and communication skills in selected facilities, a large, multi-facility health system found that its mortality rates decreased by 18 percent and its adverse events continued to decrease, while non-participating facilities only saw a 7 percent mortality reduction (IOM, 2012; Neily et al., 2011; Neily et al., 2010). Another study found that the top hospitals for heart attack outcomes were characterized by a commitment to learning and improvement, had senior management involvement in its initiatives, and had non-punitive approaches to problem solving (Curry et al., 2011).

In a complementary fashion, supportive leadership is required for successful implementation and sustainable solutions. By defining and emphasizing that a systems approach is an organizational goal, leadership at all levels can encourage all parts of the organization to implement this approach as a routine part of care. Leaders have multiple tools at their disposal to promote systems concepts, including the ability to raise their visibility, prioritize their use, align expectations and provide a shared vision, and ensure that the necessary resources—in terms of time, staff, and finances—are provided. Studies have demonstrated the impact that executive leadership can have—one study found that hospitals whose leader was strongly involved in improvement initiatives often provided higher-quality care (Vaughn et al., 2006).

An additional challenge to the routine use of systems approaches is the cultural difference between the engineering and health disciplines. Many clinicians and public health officials may not be aware of the potential benefits of system-based improvements, especially in clinical areas, and the cultural divide between the disciplines may not be one that clinicians consciously recognize. Furthermore, the two fields use different terminologies and view problems with different conceptual frameworks, making communications between the fields difficult. Finally, the incentive structures for the fields differ. Engineering faculty do not have academic incentives to pursue health care challenges, as their academic incentives are focused on solving new, thorny problems—as opposed to applying existing solutions to health care problems.

Further collaborations among clinicians, industry, and engineers are important to ensure that engineering lessons are applied to medical technologies, including human factors engineering principles that can improve the usability of a device. One example initiative that advances this goal was announced earlier this year by nine different device makers, who pledged to develop devices that were interoperable and able to share patient health information to reduce harm (Patient Safety, 2013).

Greater expertise in systems methods also influences its technical success. System tools can rarely be applied in a cookbook fashion, but generally need to be understood in order to be customized to local conditions and needs. Ensuring that the necessary expertise is available for
such customization can be done in several ways, from increasing the number of engineers involved in routine care redesign to embedding systems techniques in health professional education. Further improvements to clinical education and continuing education can improve the application of systems tools, such as teaching methods for applying evidence to clinical decision making, how to deliver care in an interdisciplinary team environment, and how to continue learning new methods for providing care (AAMC, 2011; Lucian Leape Institute Roundtable On Reforming Medical Education, 2010).

One additional foundational element is an expanded digital infrastructure that can routinely capture health and health care data, share such data with those who need it, and provide feedback based on current research. By leveraging the capabilities of a digital infrastructure, systems of care can be redesigned to improve their operational processes and patient health needs; initiatives can be evaluated for their effectiveness and efficiency at improving health; and new research and evidence can be quickly communicated to clinicians and public health officials. Furthermore, the new digital infrastructure provides new sources of information about the effectiveness of new clinical treatments, interventions, and process improvements, and can supplement the knowledge gained from the existing clinical research enterprise.

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<tr>
<th>What Are the Critical Factors for Successfully Applying a Systems Perspective to Health?</th>
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<tr>
<td>There are multiple prerequisites for implementing a systems approach, including</td>
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<td>- Reimbursement systems that reward value and outcomes</td>
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<td>- Supportive culture and organizational leadership</td>
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<td>- Expanded digital infrastructure that captures essential data elements</td>
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<td>- Collaborations among clinicians, public health officials, engineers, and industry</td>
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<td>- Embedding engineering expertise in care delivery and clinical education</td>
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**SUCCESS DEPENDS ON CENTERING INITIATIVES ON PATIENTS AND THE PUBLIC**

For the success of systems-based initiatives, the importance of one factor deserves special emphasis: centering the initiatives around patients and the public. This is important as the goal of any improvement initiatives should be centered on the individual served—whether it is a person in the community, a patient, or a consumer—and improving his or her health and care experience. Moreover, individuals play critical roles in managing their health outside of clinical encounters, from managing complex treatment regimens to everyday decisions on nutrition and exercise. Finally, individual patients and the public can be vital partners in implementing systems tools and techniques by highlighting how these tools work on the ground and providing feedback on whether these tools improve their care experience or aid their health maintenance.

The imperative for systems approaches to center their efforts on patients follows a similar obligation for the broader health system. This obligation has been known for many years; the criticality of patient-centered care was highlighted more than a decade ago in the IOM report *Crossing the Quality Chasm* (IOM, 2001). Yet, this type of care is still not routinely delivered, and the typical culture of care does not support or encourage patients to engage in their health
and health care (Berwick, 2009). Patients find that clear communication is often lacking, with less than half of patients receiving understandable information on the benefits and tradeoffs of their treatment options (Fagerlin et al., 2010; Sepucha et al., 2010). Furthermore, patients are often not engaged in their medical care to the extent they prefer, with almost half of patients reporting that they are not satisfied with their current level of participation in medical decisions (Blue Shield of California Foundation, 2012; Degner et al., 1997; Singh et al., 2010). Improving patient engagement depends on addressing the multiple system factors that move the focus of care away from patients, such as the current incentive structure, health care culture, and clinical environment.

The recent IOM report *Best Care at Lower Cost* noted that a “learning health care system is anchored on patient needs and perspectives and promotes the inclusion of patients, families, and other caregivers as vital members of the continuously learning care team” (IOM, 2012). It further found that improved patient engagement was linked to better patient experiences, health outcomes, quality of life, and reduced costs, yet patient and family involvement in care was limited. Patient engagement is a relatively broad concept, and presents a significant challenge for the culture of care. As articulated in *Best Care at Lower Cost*, patient engagement requires a true partnership between clinicians and patients, with clinicians providing scientific expertise on treatment options while patients provide their knowledge on the suitability of care options based on their needs, goals, and circumstances (IOM, 2012).

Beyond the obligation to focus initiatives on patients, patients and the public are important actors in any improvement process. Several institutions have successfully included patients in safety initiatives, and these cases have reported reduced medical errors or increased hand hygiene with patient involvement (Davis et al., 2007; Longtin et al., 2010; Weingart et al., 2005; Weingart et al., 2011). Another institution reported positive results from including patients in systematic improvement activities, such as value-stream mapping and production-system methods, in order to ensure that value was measured from the patient perspective (Toussaint, 2009). Yet another institution involved families in the analysis and redesign of family-centered rounds in a pediatric hospital (Carayon et al., 2011; Kelly et al., 2013; Xie et al., 2012). The Dana-Farber Cancer Institute has seen positive results from involving patients and families throughout its organizational governance structures, from involving patients in continuous improvement teams to asking for input into institutional policies through patient and family advisory councils (Ponte et al., 2003). These cases highlight the potential for greater partnering with patients and the broader public in implementing systems approaches across the health system.

**SPREADING SYSTEMS APPROACHES DEPENDS ON TECHNOLOGY, LEADERSHIP, CULTURE, AND GREATER LEARNING**

The various examples in which systems tools have been applied successfully to health and health care underscores the potential of this approach. Yet, multiple barriers now prevent their routine use. To address the barriers, multiple strategies are needed, and we include several strategies below to spark discussion among policymakers in health and health care arenas.

- *Increase the generation and dissemination of systems knowledge.* Sharing best practices across organizations and learning from successful cases can increase the potential success of systems approaches.
Develop materials that summarize how other fields have successfully applied systems concepts and what they have learned.

Establish multidisciplinary learning labs with close collaboration between health care and engineering to promote communication between the disciplines.

Develop a research agenda to stimulate innovation in systems approaches and understand the factors limiting the use of these approaches.

- **Provide the necessary technological supports for systems approaches.** Although technologies alone cannot reform broken processes, systems tools cannot work without an interoperable, integrated technological infrastructure.
  - Promote the growth of digital records that capture the necessary data for process redesign, routine care and health maintenance, and evaluating success.
  - Improve the interoperability, usability, usefulness, and integration of different technologies by adopting standards for interoperability of medical devices and human factors methods.

- **Support system-based initiatives with appropriately structured financial incentives.** Financial incentives currently discourage improvement efforts and can make those initiatives unsustainable.
  - Promote payment methods that reward improvement and better health outcomes.

- **Expand expertise in systems methods throughout the health system.** Increasing technical knowledge about systems approaches can allow for greater application of these methods, improve communications between health and engineering professionals, and promote greater customization of these tools to local conditions.
  - Integrate systems concepts into the education of health professionals, including the standard curriculum for medicine, nursing, and other clinical providers, with a focus on how they may be applied to improve care (IOM and NAE, 2005; Spear, 2006).
  - Expand educational opportunities for engineering professionals to apply their field to health and health care delivery in order to enhance their ability to integrate into health care organizations (Carayon, 2010; Xiao and Fairbanks, 2011)

- **Prioritize the key opportunities for progress.** Although there are numerous areas where systems methods could be used to improve health and health care, progress will be accelerated by developing priorities for greater attention.
  - Identify the health conditions and health care processes that would be most amenable to prevention and management using a systems approach. Given the potential for systems approaches across the health care landscape, the areas for its application are wide-ranging, including primary care; chronic care management, such as type 2 diabetes care; emergency medicine; obstetrics; and mental health.
  - Outline how a systems approach could address problems in the patient and family care experience, such as the loss of dignity and respect.
Each of these strategies can individually increase the use of systems tools, but greater progress will depend on a comprehensive approach that addresses the many underlying challenges preventing their use.

CONCLUSION

It is clear that urgent change is needed to improve the health system, given its safety, quality, cost, and complexity challenges. One method for addressing these challenges is through a systems approach to improvement. A systems approach has improved quality and value in other industries, and it could be similarly transformative for health and health care. Indeed, a limited number of health care organizations have seen substantial improvements from their application. In order to be applied to health, a systems approach would need to incorporate all of the elements influencing health, including the interfaces among these different elements. Because of its comprehensive nature, there are multiple challenges preventing the widespread use of systems approaches, such as technological, cultural, and structural barriers. Furthermore, progress in spreading systems tools depends on centering these initiatives on patients and the public, as well as engaging patients as vital partners in their use. Addressing the barriers preventing the routine use of systems approaches will require a comprehensive set of strategies, including the interoperability of technologies, expanding expertise, and greater dissemination of best practices. By addressing these barriers, systems approaches can become routine for improving the health of all Americans and promoting better health at lower cost.

REFERENCES


Center the system’s processes on the right target—the patient: Patient-centered care was defined in the 2001 IOM report * Crossing the Quality Chasm* as providing care that is respectful of and responsive to individual patient preferences, needs, and values and ensuring that patient values guide all clinical decisions. Throughout several sessions, workshop participants emphasized the need to ensure that processes support patients—and patients are not forced into processes. Patient needs and perspectives must be at the center of all process design, technology application, and clinician engagement.

System excellence is created by the reliable delivery of established best practice: In health care, establishing practices from the best available evidence and building them as routines into practice patterns, as well as developing systems to document results and update best practices as the evidence evolves, will integrate some of the best elements from the engineering disciplines into healthcare issues. Participants often cited the need for better integration of best practices development, and communication in healthcare systems, as well as process systems to track care details and outcomes, and feedback to inform practice refinement and lead to better patient outcomes.

Complexity compels reasoned allowance for tailored adjustments: Established routines may need circumstance-specific adjustments, either because of differences among individuals in the appropriateness for them of the established healthcare regimens, variations in caregiver skill, the evolving nature of the science base—or all three. Mass customization and other engineering practices can help assure the consistency that can accelerate the recognition of the need for tailoring and delivering the most appropriate care, with the best prospects for improved outcomes, for the patient.

Learning is a non-linear process: The focus on an established hierarchy of scientific evidence as a basis for evaluation and decision making cannot accommodate the fact that much of the sound learning in complex systems occurs in local and individual settings. Participants cited the need to bridge the gap between dependence on formal trials, such as randomized clinical trials, and the experience of local improvement, in order to speed learning and avoid impractical costs.

Emphasize interdependence and tend to the process interfaces: A system is most vulnerable at links between critical processes. In health care, attention to the nature of relationships and hand-offs between elements of the patient care and administrative processes is therefore vital and a crucial component of focusing the process on the patient experience and improving outcomes.

Teamwork and cross-checks trump command and control: Especially in systems designed to guarantee safety, system performance that is effective and efficient requires careful coordination and teamwork, as well as a culture that encourages parity among all with established responsibilities. During the workshop several examples were cited of other industries that have used systems design and social engineering to better integrate and strengthen their systems processes with great improvements in efficiency and safety.

Performance, transparency, and feedback serve as the engine for improvement: Continuous learning and improvement in patient care requires transparency in processes and outcomes, as well as capacity to capture feedback and make adjustments.

Expect errors in the performance of individuals, perfection in the performance of systems: Human error is inevitable in any system and should be assumed. On the other hand, safeguards and designed redundancies can deliver perfection in system performance. Mapping processes, embedding prompts, cross-checks, and information loops can assure best outcomes, and allow human capacity to focus on what can not be programmed—compassion and individual patient needs. Several workshop presentations shared success stories and lessons learned from other industries, such as automotive and the airline industry, that have effectively incorporated this strategy.
Align rewards on the key elements of continuous improvement: Incentives, standards, and measurement requirements can serve as powerful change agents. Participants noted that it is vital that incentives be carefully considered and directed to the targets most important to improving the efficiency, effectiveness and safety of the system and ultimately patient outcomes, as well as taking into consideration the patient and provider experiences.

Development of education and research to facilitate understanding and partnerships between engineering and the health professions: The relevance of systems engineering principles to health care and the impressive transformation brought to other industries speaks to the merits of developing common vocabularies, concepts, and ongoing joint education and research activities that help generate stronger questions and solutions. Workshop participants pointed to the dearth of training opportunities bridging these two professions and spoke of the need to encourage greater collaborative work between them.

Foster a leadership culture, language, and style that reinforce teamwork and results: Positive leadership cultures foster and celebrate consensus goals, teamwork, multidisciplinary efforts, transparency, and continuous monitoring and improvement. In citing examples of successful learning systems, participants highlighted the need for a supportive and integrated leadership.

**Issues for Further Attention**

Clarify terms. The ability of healthcare professionals to draw upon relevant and helpful engineering principles for system improvement could be facilitated by a better mutual understanding of the terminology. A collaborative effort by the Institute of Medicine and the National Academy of Engineering could create a targeted glossary and develop potentially bridging terminology for use as appropriate.

Identify best practices. Three areas of systems orientation are particularly important to improving the efficiency and effectiveness of health care: 1) focusing the system elements more directly on the key outcome—the patient experience; 2) ensuring transparency in the performance of the system and its players and components; and 3) establishing a culture that emphasizes teamwork, consistency, and excellence. Progress could be accelerated by identifying and disseminating examples of best practices from health care and from engineering on each of these dimensions.

Explore health professions education change. In the face of a rapidly changing environment in health care—expanding diagnostic and treatment options, much greater knowledge available, movement beyond the point at which any one individual can personally hold all the information necessary, and information technology that opens new capabilities—changes to the education of health professionals can advance caregiver skills in knowledge navigation, teamwork, patient/provider partnership, and process awareness.

Advance the science of payment for value. With cost increases in health care consistently outstripping gains in performance by most measures, progress towards counteracting this trend could be achieved with a stronger focus on ways to enhance both health and economic returns from healthcare investments. This could include work in the areas of understanding, measuring, and providing incentives for value in health care.

Explore fostering the development of a science of waste assessment and engagement. Similarly, and directly related, an exploration of the elements of inefficiency in health care, how to define and measure waste, and how to mobilize responses to eliminating waste could contribute to increasing value within healthcare systems.

Support the development of a robust health information technology system. The development of a health IT system, designed with systems-related continuous improvement principles in mind, must lie at the core of an efficient, effective learning system. Beginning with challenges to EHR adoption, much work remains in order to achieve such a system that allows for continuous learning; permits data sharing, including the construction of databases; employs consistent standards; and addresses privacy and security concerns.
Section 4: Current State: Practices, Standards, Innovation
Appointment Zen – shaping demand and matching capacity

Background
Ten years of experience with hundreds of general practices in the Australian Primary Care Collaboratives program has provided many lessons for improving practice appointment systems.

Objective
In this article, we describe how general practitioners can, by actively managing our appointment systems, reduce waiting times and delays, improve patient care, improve our quality of life and improve practice financial viability.

Discussion
Demand is finite and predictable. We can shape our demand by influencing when, why and for whom people make appointments. We can change our daily appointment numbers and our team capacity to match our reshaped demand. Contingency plans for expected and unexpected drops in capacity can prevent appointment backlogs. Embedding and monitoring our demand and capacity management can help ensure smooth flow of patients through the practice with good care and improved staff and patient satisfaction.

Keywords
appointments and schedules; general practice; health services accessibility

Demand for our general practice services can seem uncontrollable and overwhelming. It seems no matter how hard we work or how late we stay back, someone wants more. Finding time to complete paper work or do new activities doesn’t seem possible. In fact, demand for our services is finite. It can be measured and analysed. Once we understand our demand we can influence it, shape it and, in turn, change the capacity of our practice to match the reshaped demand. Waiting times can be reduced and patient care improved, as can practitioner quality of life and practice financial viability.

In a previous article we described how to measure demand in a practice and monitor appointment system functioning.1 We have also described five basic appointment system types that we encountered in our work with the Australian Primary Care Collaboratives Program (APCC).2 In this article we share practical ideas to help improve practices, based on experience over a decade of work with hundreds of Australian practices in the APCC3 and on overseas experience.4–6 Collaborative practices learn to make changes using the Model for Improvement, which is a tool designed to support safe and effective change.7

Shaping demand
Once we understand the size and nature of patient demand we can shape it, influencing when people come, why people come and how they are handled.

Influencing when people come

Keep Mondays free
There is always more demand on Mondays. It makes sense in most practices not to book elective appointments such as excisions or care plan appointments on a Monday. This thinking will lead to booking elective appointments out of influenza season or holiday season. By measuring demand1 you can know with confidence when your busy times are and plan rationally.

Influence when people book appointments
Although some people need an appointment on a specific day or time, many patients are flexible concerning routine appointments. Steer flexible people to less sought after times, (eg. ‘how about Wednesday afternoon at 3pm?’). When we see a patient on a Monday, asking them to return in a month will often mean a follow-up on a Monday. Instead, nudge them to another day. Airlines use price signals to influence booking of flights they know will be difficult to fill. Although few practices actually offer a price differential, receptionists can aim to ‘sell’ the cheaper seats.
Anticipate associated needs of patients and meet them

Try to meet every need that you can in today’s consultation. Provide repeat prescriptions to prevent a return visit just for that. Ask the patient if there is anything else to discuss. Check weight, blood pressure and order routine blood tests. Suggest to patients that they come with a written list so that things are not forgotten. If possible, ask the practice nurse to do urinalysis and weight or blood pressure measurements before the patient enters your room for the consultation. Spending an extra 5 minutes today or utilising other practice staff might gain you a whole appointment next week.

Rationalise follow up

We influence future demand by our follow-up habits. How often do I see my patients with well-controlled diabetes? Do I ask everyone to come for normal results?

Each of us needs to think about our use of follow-up visits. If possible, agree as a practice on a consistent protocol, preferably following evidence-based guidelines. In this way it may be possible to free up significant numbers of appointments and decrease variation in patient care.

Influencing why people come

Increase patients’ self-management

By improving patients’ self-management skills you can improve physiological measures of disease, quality of life, health status and functional status. Improved self-management skills can improve satisfaction with your service, risk behaviours, knowledge, service use and adherence to treatment. Effective interventions are educational sessions, motivational counselling and use of educational materials.8

Each member of the team should reinforce messages about self-management. A care plan is a useful tool to assist with this. Provision of self-management support by a range of providers such as nurses, pharmacists, dietitians and community health workers can increase self-management and improve outcomes.9

Target frequent flyers

Some people attend often but can their needs be met without a consultation with the doctor? Perhaps with a regular scheduled appointment once a month they can self-manage for longer and be confident that they can discuss issues during their scheduled appointment. See Case 1 for an example of an APCC practice that used this strategy to good effect.

Maximise continuity

Improved continuity of primary care improves patient satisfaction and health outcomes and decreases the use of health systems resources.10 Some authors suggest an association between increased personal continuity and decreased demand for visits.11 Utilising the practice team in a way that increases continuity of care will improve outcomes and satisfaction.

Quick clinics

A popular strategy with APCC practices was to set aside time for short appointments. A patient requiring a repeat prescription or a referral renewal could book with their doctor for the quick clinic on the understanding that only that issue would be dealt with. Feedback suggests this is efficient for patients and preserves capacity for more complex issues.

Change how people are handled

Use staff to their peak skill set

Are some staff members under-employed while others work flat out? Can GPs’ time be better leveraged by enlisting the help of other staff? Some APCC practices have:

• use a chronic disease coordinator to run a chronic disease management clinic
• use a practice nurse to do pap smears or give normal pathology results (Table 1); do routine blood pressure measurements, BMIs, urinalysis, take blood, do wound management and vaccinations; and coordinate care plans and reviews
• use non-clinical staff to sterilise equipment; ‘room’ patients, preparing them for the GP by opening the computer record, entering presenting complaints, recording observations, chasing up equipment or results that will be needed.

Even up doctor panels

Are some doctors booked out for weeks while others have capacity on the day? Although some patients seem ‘welded’ to a particular doctor, when we analysed demand we were surprised to find many patients were happy to see another doctor for a particular issue. Receptionists can help by steering new patients or those with an acute condition or without a strong preference to doctors in less demand. Some practices use a traffic light system with busy doctors ‘red’ (no new patients), others ‘yellow’ (new patients under some circumstances; eg. relatives of existing patients) and others ‘green’ (accepting all comers). Some practices ‘buddy up’ more senior and junior doctors to form a care team. (eg. ‘I’ll get Fiona to review you in 2 weeks time, and I’ll see you in a month. She’ll let me know what’s happening’).

Develop alternative ways for patients to access the practice’s services

The practice website

Websites can provide education and links to other resources (eg. community health programs, exercise programs, patient self-management resources). Some practices have started online booking,12,13 interfacing the appointment system with the website. Results, reminders and script repeats can also be organised online. (See Case 2)

Email

A marked change associated with the implementation of the Patient Centred Medical Home in the US has been increased email contact between doctors and patients.14 As funding models change in Australia this may become more common. The Royal Australian College of General Practitioners standards require practices to have policies around the use of email for clinical communication.15

eConsultations

Telephone consulting has long been used overseas,16,17 although funding models make it more challenging in Australia. Telephone triage can reduce the need for face-to-face consultations by up to 39%.18 Skype consultations are offered by some practices. There are services currently available13 that can facilitate the provision of results and other

Table 1

Chronic Disease Management

<table>
<thead>
<tr>
<th>Issue</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient 1</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>Patient 2</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
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</table>

Case 1

The APCC practice that used this strategy to good effect...
services without a consultation. This is likely to be a growing strategy for shaping demand.

**Match capacity**

Having shaped demand so that patients come at the best time, for the right reasons and are being handled in the optimal way, the next step is to change the capacity, to meet this shaped demand. This is a continuing process.

**Match the appointments**

**Match the overall number of appointments**

Many APCC practices are surprised when they measure demand and capacity to find they are in balance. Their apparent excess demand is actually delay (backlog). However, some find that even when demand is shaped to be as effective as possible and the skills of the practice team are utilised at their peak, they simply do not have enough appointment slots in the week. Finding extra doctors may be necessary and can be challenging. Training registrars in the practice can be one solution. As well as the extra pair of hands during the training term, many practices have found that their high-quality training environment has encouraged registrars to stay on permanently when training is complete.

**Match each day**

The most obvious step is to ensure that the maximum number of appointments is available on the days when demand is highest. The work done on measuring demand may indicate that the practice requires more doctors on Mondays and Thursdays. It may be necessary to reschedule rosters and/or extend the skill mix of the team to ensure there are enough team members working on high demand days.

**Match the type of appointments**

Analysis of demand may indicate task mismatch with, for instance, doctors doing a lot of activities better done by nurses. Nursing appointments could be increased to reduce the pressure on doctor appointments. Some appointments, such as care plans and health assessments, could be booked at quieter times. One practice in the APCC discovered they were using many appointments to give normal results (Table 1). Some use other strategies, including a web-based service, to handle some of these results.

**Match the skills**

An inventory of the team’s skills should be taken and the team used to the maximum level of skill. For example, the receptionist might also be an ECG technician (ours was!). Consider whether the practice nurse could be doing a much wider range of clinical work (such as chronic disease management) than currently.

**Develop new skills in your existing team**

Training staff to do venepuncture, ECGs, pap smears, weight and height measurements, and other tests may increase job satisfaction and free up doctors.

Managing populations requires new administrative skills such as database management.

**Add new team members**

The best solution may be to take on new staff. Skills in coordinating chronic disease care have been identified by many APCC practices as their main need.

**Case 1. Shaping demand and matching capacity**

**Dr Kingsley Pearson**

At the time I participated in the APCC I was running a solo practice. We measured demand at 180–200 requests for appointments a week and I had a capacity of 150–160, so we were consistently 30–40 appointments short each week. The result was our third available appointment measure went out to 10–14 days and the practice felt like a pressure cooker.

I decided to look at the nature of our demand by analysing our diabetes and heart disease register over the preceding 12 months. Our 62 patients with diabetes presented 8.2 times a year, on average, for a total of 505 consultations. Our patients with coronary heart disease came 9.1 times in the year, on average, for a total of 584 consultations.

I decided to take the plunge and employ a practice nurse to do more than immunisations, dressings and wound management. I intended the role to evolve into being a chronic disease practitioner. I knew a nurse living locally with 25 years’ experience in rehabilitation, community nursing and care planning.

She started for two sessions a week and rapidly moved to 2 full days. My role was in the care plan and she took care of the team care arrangements. She became an ongoing motivator for change (eg. smoking cessation). She made follow-up appointments and had patients who booked to see her.

It was a remarkable change. The appointment book was freed up and the third available appointment came back to 1–2 days. Patients were able to book appointments to see me and the pressure cooker feeling left us.
Table 2. Situations requiring a contingency plan

<table>
<thead>
<tr>
<th>Issue</th>
<th>Expected</th>
<th>Unexpected</th>
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<tbody>
<tr>
<td>Increased demand</td>
<td>eg. flu vaccination time, winter:</td>
<td>eg. health scares, natural disasters, epidemics:</td>
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<tr>
<td></td>
<td>• Notify patients when their usual doctor will be on holiday so they can</td>
<td>• Reschedule booked appointments/flexible appointments eg. health</td>
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<tr>
<td></td>
<td>plan around it</td>
<td>assessments</td>
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<tr>
<td></td>
<td>• Leave capacity unbooked before and after holidays to cope</td>
<td>• Receptionists explain delays as patients arrive and offer</td>
</tr>
<tr>
<td></td>
<td>with extra demand</td>
<td>appointment on another day or with a nurse</td>
</tr>
<tr>
<td></td>
<td>• Don’t book elective activities for remaining doctors during leave</td>
<td>• Sign-in reception explaining delays or offering appointments on another</td>
</tr>
<tr>
<td>Decreased</td>
<td>eg. holidays, study leave:</td>
<td>day</td>
</tr>
<tr>
<td>capacity</td>
<td>• Book a locum if possible</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Have enough doctors so that someone is always away and the practice is</td>
<td></td>
</tr>
<tr>
<td></td>
<td>‘self-covering’</td>
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</tr>
<tr>
<td></td>
<td>• Clinics for ‘flu vaccination</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Coordinate holidays so only one person is off at a time</td>
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Embed and monitor the system

Continually analysing and shaping demand and matching the team will improve the care provided and the financial viability of the practice. To ensure continued improvement, the changes need to become a part of the routine operations at the practice. There are some key ways to do this:

- Job descriptions and new staff induction can include key aspects of the staff member’s role in ensuring good access to the practice. As staff move on corporate knowledge is retained.
- Have ‘access’ as a standing item at the practice meeting.
- Regularly inform staff about access measures. Put in place a plan to regularly monitor the system so that any fluctuations are identified and addressed early. Determine the key indicators of access performance and make their collection and reporting routine. Routinely review these measures and manage the system. Listen to staff and patient feedback.

Maintaining an effective appointment system requires agility. Managing variability requires active management. ‘Appointment golf’ and other strategies outlined in our previous articles may be helpful.¹ ²

Contingency plans

In addition to matching demand to capacity to improve a practice’s efficiency, consideration should also be given to potential disruptions, such as staff members going on holidays, sick leave or to conferences. Expected or unexpected, these disruptions can prevent a practice from meeting demand smoothly. Build-up of a backlog can block up a practice’s appointment system for weeks. Planning for contingencies will enable the practice to maintain the benefits achieved (Table 2). A contingency plan should be agreed and documented. People whom the plan affects need to agree to it. The plan will state the circumstances that will trigger action and will identify and empower the person who will activate it.

Conclusion

The match between well-shaped demand and well-maintained capacity can help improve outcomes, incomes and quality of life in general practice. Thinking this way helps establish that patient care is the job of the whole team. It can only be achieved if the team is supportive of each other, committed to each other and committed to patient care.

Case 2. eConsults, eMessages, eAppointments

Dr Andrew Gowers

Holdsworth House Medical Practice
www.holdsworthhouse.com.au

‘We do skype and telephone consultations and also use SMS and email. Patients can email appointment requests through our website, which we confirm by email or text. It’s not ‘alternative’ for us now. Doctors spend maybe half an hour a day on e-messaging. It’s efficient and frees up more time for consulting.

Skype consults are great for people who are overseas or out of town. Results are regularly given by email with text tailored by the doctor to the clinical circumstance. This is quick, reduces administrative costs and personalises doctor/patient communication.

Our philosophy is to support our patients in living as normal lives as possible. We have many patients with serious chronic illness whose healthcare consumes their time. Why insist on a 3-hour exercise of attending the practice for face-to-face results? Sometimes this is essential and each doctor decides how to handle each clinical situation.

Our patients love it. Young people (and many older people) prefer to communicate this way and it can be more efficient. It frees our clinicians to do the higher value activities that patients appreciate and are willing to pay for.

We try to be open to new approaches. Suggestions come from our staff, from what we see on our travels and other industries. We try to nurture new ideas and not to punish ‘failure’. If they work that’s great and if they don’t we learn!’
Appointment Zen – shaping demand: matching capacity

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References
In Search of Joy in Practice: A Report of 23 High-Functioning Primary Care Practices

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ABSTRACT

We highlight primary care innovations gathered from high-functioning primary care practices, innovations we believe can facilitate joy in practice and mitigate physician burnout. To do so, we made site visits to 23 high-performing primary care practices and focused on how these practices distribute functions among the team, use technology to their advantage, improve outcomes with data, and make the job of primary care feasible and enjoyable as a life’s vocation. Innovations identified include (1) proactive planned care, with previsit planning and previsit laboratory tests; (2) sharing clinical care among a team, with expanded rooming protocols, standing orders, and panel management; (3) sharing clerical tasks with collaborative documentation (scribing), nonphysician order entry, and streamlined prescription management; (4) improving communication by verbal messaging and in-box management; and (5) improving team functioning through co-location, team meetings, and work flow mapping. Our observations suggest that a shift from a physician-centric model of work distribution and responsibility to a shared-care model, with a higher level of clinical support staff per physician and frequent forums for communication, can result in high-functioning teams, improved professional satisfaction, and greater joy in practice.


Working at Starbucks would be better.
Benjamin Crocker, MD, October 3, 2007

I look forward to going to work each day. I’m loving it!
Benjamin Crocker, MD, July 13, 2011

INTRODUCTION

By all reports, primary care physicians are at high risk of burnout. Fewer physicians are choosing primary care, many are leaving it. Although waning interest in adult primary care careers is multifactorial, driven by such forces as the primary care–subspecialty income gap, medical schools’ devaluing of primary care, and the unsustainable primary care work life, we focus on the work life issue. One study suggests that the difficult work life may be the most influential factor discouraging medical students from primary care careers.

Those who practice adult primary care are often deeply dissatisfied, spending much of their days performing functions that do not require their professional training. More than one-half of general internists and family physicians have symptoms of burnout. Time pressure, chaotic work environments, increasing administrative and regulatory demands, an expanding knowledge base, fragmentation of care delivery, and greater expectations placed on primary care contribute to the strain. Workdays are getting longer and rewards are diminishing. Joy is in short supply.

We propose joy in practice as a deliberately provocative concept to describe what we believe is missing in the physician experience of primary care. The concept of physician satisfaction suggests innovations that are limited to tweaking compensation or panel size. If, however, as the litera-
ture suggests, physicians seek out the arduous field of medicine, and primary care in particular, as a calling because of their desire to create healing relationships with patients, then interventions must go far deeper. Joy in practice implies a fundamental redesign of the medical encounter to restore the healing relationship of patients with their physicians and health care systems.

Joy in practice includes a high level of physician work life satisfaction, a low level of burnout, and a feeling that medical practice is fulfilling. Physicians who dread going to work each day are not experiencing joy in practice.\(^\text{11-17}\) Physician fulfillment in daily work is tightly related to the organization of the practice environment, including relief from paperwork and administrative hassles,\(^\text{18,19}\) the opportunity to form meaningful relationships with patients,\(^\text{20,21}\) and the ability to provide high-quality care to patients.\(^\text{22}\)

Why should joy in practice matter? Physician burnout is associated with diminished patient satisfaction and reduced adherence to treatment plans,\(^\text{12,12}\) it also contributes to students’ avoidance of primary care careers.\(^\text{13}\)

In the face of the dismal current primary care climate, we explored whether there are places where physicians and other staff are thriving and whether some practices have found innovative solutions to the challenges of office organization. This report focuses on practice innovations that we believe can address barriers to the healing relationship between physician and patient, take advantage of the resources of the health care team, and improve care for patients, thereby enhancing physician joy in practice.

We approached 23 high-performing practices we believed were likely to support both quality of care and physician work life satisfaction. The practices represented different geographic regions and include small private practices, large integrated delivery systems, academic medical centers, the Veterans Affairs, and Federally Qualified Health Care Centers.

Most of the practices had achieved patient-centered medical home recognition. Participation in meaningful use electronic health records and the Physician Quality and Reporting System were also tracked as surrogate markers of quality (Supplemental Appendix 1, http://annfammed.org/content/11/3/272/suppl/DC1).

Our study was certified as exempt by the University of California San Francisco Human Research Protection Program Committee on Human Research.

**Site Visits**

At least 1 of the authors visited each of 21 sites (Table 1), shadowing physicians and their teams for a day and meeting with administrative and clinical leaders. We made virtual visits to 2 additional practices with a telephone interview and follow-up e-mail communication with leaders or practitioners. A semistructured site visit questionnaire (Supplemental Appendix 2, available online-only at http://annfammed.org/content/11/3/272/suppl/DC1) guided observations and interviews.

Although a description of how these practices made their changes, as well as quantitative data as to whether these changes directly and independently improved patient care, is beyond the scope of this report, a narrative summary describing in greater depth the care model and in some cases the change process, along with the investigators’ personal reflections on the mod-

<table>
<thead>
<tr>
<th>Table 1. Specialty, Setting, and Clinicians at Study Sites</th>
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<td><strong>Site</strong></td>
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<td>In-person visits</td>
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<td>Ambulatory Practice of the Future</td>
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<td>Brigham and Woman’s Hospital</td>
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<td>Cleveland Clinic Strongsville</td>
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<td>Clinica Family Health Services</td>
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<td>West Los Angeles VA</td>
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<td>Virtual visits</td>
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<td>Allina-Cambridge</td>
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<td>North Shore Physicians Group</td>
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\(^a\) Includes physicians, physician assistants, nurse practitioners.

\(^{FM} = \text{family medicine}; \ GIM = \text{general internal medicine}; \ IM = \text{internal medicine}; \ VA = \text{Veterans Affairs.}\)
SOLUTIONS TO COMMON PROBLEMS

During our site visits, we observed a number of solutions to problems commonly faced in primary care; these solutions include (1) proactive planned care, with previsit planning and previsit laboratory tests; (2) sharing clinical care among a team, with expanded rooming protocols, standing orders and panel management; (3) sharing clerical tasks with collaborative documentation (scribing), nonphysician order entry, and streamlined prescription management, (4) improving communication by verbal messaging and in-box management, and (5) improving team functioning through co-location, team meetings, and work flow mapping (Table 2). Below we organize our findings as solutions to common problems in primary care.

Reducing Work Through Previsit Planning and Preappointment Laboratory Tests
Primary care visits are often disorganized and rushed.

Solution
Many high-functioning sites have learned that previsit planning and previsit laboratory tests can reduce the total volume of work to be done, save time, and improve care.

Example At Mayo Red Cedar Medical Center patients have their laboratory tests done a few days before their appointments and are able to discuss results and engage in shared decision making at the time of the visit. This system eliminates an hour or more per day of post-appointment results reporting. David Eitrheim, MD, reported (e-mail, July 9, 2012):

Patients like to discuss the results of their lab work at the time of their office visit. I can’t imagine going back to the day when I used to send out letters to patients with results of HbA1c and lipid profiles and not use those results as an opportunity for motivational interviewing, goal setting and developing an action plan.

Adding Capacity by Sharing the Care Among the Team
In many practices, patients cannot reliably see their own primary care physician the same day a need arises. In addition, most patients are not receiving all recommended prevention and chronic illness care.23

Solution
Improving access and increasing adherence to clinical guidelines requires building additional capacity into the practice. Many sites accomplished capacity building by transforming the roles of medical assistants, licensed practical nurses, registered nurses, and health coaches so that they assume partial responsibility for elements of care.24,25 In addition, some practices have an extended care team of social workers, behavioralists, nutritionists, and pharmacists, usually working with several clinician–medical assistant teamlets.24,26

Example 1 At North Shore Physicians Group (NSPG) in the Boston area, the medical assistant’s role has been transformed. When a patient is taken to an examination room (rooming), the process has been expanded from 3 minutes to 8 minutes and now includes medication review, agenda setting, form completion, and closing care gaps. For example, the medical assistant reviews health-monitoring reminders, gives immunizations, and proactively books appointments for mammograms and DXA (dual-energy x-ray absorptiometry) scans for osteoporosis. A medical assistant training curriculum is available at http://www.safetynetmedicalhome.org. The role transformation for medical assistants is part of a larger team-care initiative at NSPG, which has resulted in a 14% increase in primary care physician satisfaction scores. “We knew our physicians were dissatisfied with the quality of the...
interaction with the patient because of all the things they had to do in the exam room that were nonphysician work,” said Sharon Lucie, Vice President for Operations, during an interview (December 11, 2011). “Now providers are begging us to get them started in the new model.”

Example 2 Clinica Family Health Services near Denver, Colorado, has created standing orders empowering registered nurses to diagnose and treat simple problems without a physician’s involvement. These problems include streptococcal throat infections, conjunctivitis, ear infections, head lice, sexually transmitted diseases, uncomplicated urinary tract infections, and warfarin management.

Example 3 At Clinica Family Health Services, nonprofessional health coaches provide patient education and counseling to help patients with chronic conditions set goals and formulate action plans. Medical assistants sensing depression symptoms administer the 9-item Patient Health Questionnaire depression screen and then contact the team’s behaviorist.

Example 4 Group Health Cooperative (GHC) couples centralized population management with team-based panel management. Centrally, GHC sends birthday letters to patients reminding them of overdue preventive services. Medical assistants on clinical teams are responsible for outreach to patients who do not respond and address remaining care gaps during the rooming process.

We observed that team development must often overcome an anti–team culture. Institutional policies (only the doctor can perform order entry), regulatory constraints (only the physician can sign paperwork for hearing aid batteries, meals delivery, or durable medical equipment), technology limitations (electronic health record workflow is designed around physician data entry), and payment policies that only reimburse physician activity constrain teams in their efforts to share the care. An extended care team of a social worker, nutritionist, and pharmacist may be affordable only in practices with external funding or global budgeting.

Eliminating Time-Consuming Documentation Through In-Visit Scribing and Assistant Order Entry
Physicians across our study sites reported spending about 2 hours per day on visit note documentation, and some physicians reported spending up to an additional hour per day on computerized order entry.

Solution
Six sites have extended the concept of sharing the care by empowering nurses and/or medical assistants to become an integral part of the visit: scribing the note, entering orders, preparing the after-visit summary, and reinforcing the plan with the patient.

Example At the Cleveland Clinic Strongsville, primary care physicians work with 2 medical assistants or 1 medical assistant and 1 registered nurse. The nurse or medical assistant first completes an expanded rooming protocol, then returns with the physician to record notes while the physician talks with and examines the patient. After 1 year in the new model, average daily visits increased from 21 to 28, thereby improving access and continuity. Revenue was up 20% to 30%, which has exceeded the cost of the additional medical assistant or nurse. Quality metrics, as well as patient, staff, and physician satisfaction scores, improved.

Kevin Hopkins, MD, the family physician leading the innovation noted (in conversation, December 6, 2011):

The MAs and nurses are more fully engaged in patient care than they have ever been and they enjoy their work…. They have increased knowledge about medical care in general and about their individual patients in particular. I am far more satisfied. I leave work an hour earlier every day and have a very fulfilling relationship with my team…. We’re having fun.

Saving Time by Reengineering Prescription Renewal Work Out of the Practice
Managing calls, e-mails, and faxes regarding prescription renewals consumes many health care resources.

Solution
By separating prescription renewal from chronic illness appointment adherence, and by providing 12- to 15-month prescriptions for stable medications, practices can avoid repeating the same work multiple times throughout the year.

Example At Allina-Cambridge in the Minneapolis area, medications are renewed for a full year at the annual comprehensive care visit, thus avoiding unnecessary interval handling of stable prescriptions. For example, a 3-month supply with 4 refills covers the patient until the next annual visit. Prescriptions initiated at interval appointments will have refills remaining. These prescriptions are resynchronized with all other chronic prescriptions once a year. Amy Haupert, MD, explained (personal communication, July 10, 2012): “Two to 5 minutes spent refilling all medications for the upcoming year saves us time dealing with phone calls and refill requests later throughout the year.”

Reducing Unnecessary Physician Work Through In-box Management
Tasks previously entrusted to receptionists, pharmacists, nurses, and transcriptionists have been transferred to the physician with many electronic health record implementations.
Solution
In several practices the nurse or medical assistant filters all the electronic and paper information, passing on to the physician only that information which specifically requires a physician’s level of expertise. In addition, replacing asynchronous electronic messaging with verbal messaging reduces the volume of in-box messages.

Example Fairview Clinic in Minneapolis has decreased the in-box work from 90 minutes to only a few minutes per day for many physicians. All messages are first directed to the medical assistant or nurse, who filters out normal laboratory results, prescription renewals, or requests that can be managed by protocol, passing through to the physician only messages that require physician-level attention.

Whenever possible, electronic messaging is replaced by more time-efficient verbal messaging between nurse and physician. Dr Haupert of Allina (personal communication, November 15, 2011) commented that “communication throughout the day is crucial to efficiency. We can answer questions on the fly rather than waiting to get back to the computer and pinging messages back and forth.”

Improving Team Communication Through Co-location, Huddles, and Team Meetings
If nurses and medical assistants cannot quickly run a problem by the physician, the problem loops around the office via time-consuming asynchronous e-messaging, creating more work and delays for patients. In addition, the lack of meeting time precludes development of improved work flows.

Solution
Co-location can make minute-to-minute communication more efficient. Team meetings provide protected time to improve processes and strengthen trust and reliance among the team.

Example 1 In the team care model at NSPG the medical assistant and physician sit side-by-side in “flow stations.” One of the early adopters was an established physician with a large panel of patients (2,500) with highly complex conditions. Previously this physician took 2 to 3 hours of work home each night, with co-location that facilitates efficient verbal communication and the expanded role for medical assistants, he routinely leaves the office with all of his work completed.

Example 2 At the Cleveland Clinic, the physician and clinical staff meet weekly to review data and refine their work flows. Dr Hopkins explained (in conversation, December 6, 2011):

We set aside 1 hour every Friday morning to go over the week. what worked well, what didn’t, what changes do we need to make. We do some education as to why do we do microalbumins on diabetic,s etc. Learning why we do certain things gains buy-in.

Improving Team Functioning Through Systems Planning and Work Flow Mapping
Medical care involves a large number of recurrent tasks: registration, rooming, ordering studies, making referrals, refilling prescriptions, informing patients of laboratory results, forms completion, etc. These work flows can be efficient, rapid, and promote patient safety, or they can be complex and fraught with hazards. Without careful planning, new work flows developed in response to changing regulations or technology can push much of the work onto the physician.

Solution
Adopting a systems approach to practice redesign can improve efficiency and reduce waste.

Example ThedaCare-Oshkosh in central Wisconsin saw its performance on clinical and operational metrics move from last to first place in its 22-clinic organization. The group attributes this to systematic work flow planning using Lean techniques, which include identification and elimination of waste through value stream mapping and process standardization.29

Clinic site director, Kathy Markofski, reported (in conversation, September 26, 2011), “The team maps out the work flow of a patient visit. We identify wait times, do a root cause analysis, develop countermeasures and then quickly reassess with data.”

DISCUSSION
The current practice model in primary care is unsustainable. We question why young people would devote 11 years preparing for a career during which they will spend a substantial portion of their work days, as well as much of their personal time at nights, on form-filling, box-ticking, and other clerical tasks that do not utilize their training. Likewise, we question whether patients benefit when their physicians spend most of their work effort on such tasks.30 Primary care physician burnout threatens the quality of patient care, access, and cost containment within the US health care system.

We set out in search of joy in practice. What we found were pockets of professional satisfaction. Even at the best of practices, physicians are still often caught in what Chesluk has coined the “frantic bubble,” trying to manage an overwhelming burden of clerical work, conform to constraining regulations, and deal with cumbersome technology workarounds, all in a time-pressured environment. Our observations suggest that these 23 innovative sites are pointing the way to
a better model. No single practice has solved every issue; each practice still struggles to overcome its own unique set of constraints.

There were unifying themes among our sites. Practices that build stable, well-trained teams which work together every day and meet regularly to improve their work can create efficient work flows and rewarding practice environments. Standardized work flows with higher levels of clinical support personnel can make practices less chaotic, save time, and meet patients’ needs more quickly. Teamwork is facilitated by proximity of workstations and frequent forums for interaction. Thoughtful physical layout with co-location of staff and line of sight enhances communication. Face-to-face verbal communication is often more effective, efficient, and enjoyable than circulating asynchronous electronic messaging.

Despite these unifying themes, we found contrasting approaches to several common issues in primary care among our study sites, including the details of delegating responsibility, scheduling, and documentation.

Sharing Responsibility Among Team Members
Physicians can share the care with a team in 2 distinct ways. In the first model physicians are involved with every patient visit but entrust responsibility for many visit-based tasks (medication reconciliation, order entry, after-visit summary, visit note documentation, self-management support) to other team members. These practices prioritize access, continuity, and relationship with the same physician, maximally leveraging the skills of the physician. In the second model physicians perform most visit-based tasks, but they are involved with only a subset of patient visits, while directing the patient to other team members for discrete episodes of care: a pharmacist for hypertension or a nurse for anticoagulation. These practices prioritize continuity with the larger care team.

Scheduling
We observed 2 distinct approaches to scheduling in attempt to de-stress the physician’s workday. One approach, exemplified by GHC, decreases the number of visits per day and reduces physician panel size.32 Another approach, developed by Newport News, Allina, Cleveland Clinic, and Mayo Red Cedar Medical Center, increases capacity and access by directing clerical tasks away from the physician.

Scribing and Team Order Entry as an Antidote to Waste
The volume of work associated with record keeping and order entry has increased during the past decade with the introduction of electronic health records, quality-monitoring initiatives, and increasingly complex billing regulations. Tasks that took a few seconds in the pre—electronic health record world can take several minutes in the electronic world. Visit notes have become lengthy documents, formatted on a billing template, complicating rather than facilitating the cognitive work of finding key information. Scribing is a powerful tool to reduce the burden of record keeping and order entry and to free the physician to focus more fully on direct patient care and relationship building.

FUTURE RESEARCH
The observations described here could lead to a series of hypotheses for future research (Supplemental Appendix 3, at http://annfammed.org/content/11/3/272/suppl/DC1). For example, do physician burnout scores diminish when a practice initiates standing orders that empower team members to assume new responsibilities? Does patient and non-physician staff satisfaction change when such standing orders are instituted? To add context to such quantitative studies, physicians, nonphysician staff, and patients can be interviewed individually or in focus groups to gain greater understanding of the impact of team-empowering standing orders. Similar research questions can be asked about scribing and about each of the innovations listed in Table 2. Furthermore, although staff satisfaction and the patient experience fell outside the scope of the project, some managers and staff reported that professional satisfaction was increased for medical assistants and nurses with each of these innovations—another area for future study.

The core work of primary care remains meaningful and rewarding, but this work has been crowded out by increasingly complex regulatory, technological, and administrative requirements. Primary care physicians across the country now spend much of their time on large volumes of clerical work, including visit note documentation, order entry, prescription processing, and clearing the in-box. As a result, primary care physicians experience low levels of professional satisfaction3 and underutilize the training that society has invested in them. We believe a shift from a physician-centric model of work distribution and responsibility to a shared-care model, with a higher level of clinical support staff per physician and frequent forums for communication, can result in high-functioning teams, improved professional satisfaction, and greater joy in practice.

To read or post commentaries in response to this article, see it online at http://www.annfammed.org/content/11/3/272.

Key words: personal satisfaction, physician; health care delivery; health services research; patient-centered care; primary health care; patient care team; burnout, professional; organizational innovation; primary health care
3. Okie S. Innovation in primary care—staying one step ahead of...

Author contributions: All authors participated in the site visits. C. Sinsky, Willard, T. Sinsky, and Bodenheimer prepared the initial and revised manuscripts. Schutzbank and Margolius offered critical input and revisions. All authors read and approved the final manuscript.

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References

Engineering Optimal Health Care Scheduling

November 21, 2014

Dave Krier, Vice President
Access Services and Family Relations

Terra Thompson, Business Director
Gastroenterology, Hepatology and Nutrition

Drivers to make a change

- Robert Wood Johnson “Pursuing Perfection” Grant
- Feedback from referring physician surveys
- Feedback from families
- Feedback from staff physicians
- Known problem areas: many subspecialties scheduling over one month out, high patient cancellation rates

What Do We Monitor?

<table>
<thead>
<tr>
<th>What</th>
<th>How</th>
</tr>
</thead>
<tbody>
<tr>
<td>How soon can a patient be seen by a provider?</td>
<td>3rd next available appointment</td>
</tr>
<tr>
<td>Do providers know their clinical expectations?</td>
<td>Supply Management</td>
</tr>
<tr>
<td>Are these clinical expectations met?</td>
<td>Supply Management</td>
</tr>
<tr>
<td>Are individual clinics operating efficiently?</td>
<td>Fill Rate, No-show rate</td>
</tr>
<tr>
<td>Are patients and families satisfied?</td>
<td>Wait Time during the Visit, Family Satisfaction Survey</td>
</tr>
</tbody>
</table>
### Why Did We Pick 10 Days for our 3rd next goal?

<table>
<thead>
<tr>
<th>Time to 3rd Next Available Appointment</th>
<th>Patient Satisfaction with Access for a New Visit</th>
<th>Cumulative Increase in Satisfaction</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;= 80 Days</td>
<td>% Satisfied</td>
<td>% Unsatisfied</td>
</tr>
<tr>
<td>&lt;= 30 Days</td>
<td>73.3%</td>
<td>26.7%</td>
</tr>
<tr>
<td>&lt;= 15 Days</td>
<td>81.0%</td>
<td>19.0%</td>
</tr>
<tr>
<td>&lt;= 14 Days</td>
<td>82.7%</td>
<td>17.3%</td>
</tr>
<tr>
<td>&lt;= 13 Days</td>
<td>84.5%</td>
<td>15.5%</td>
</tr>
<tr>
<td>&lt;= 12 Days</td>
<td>84.8%</td>
<td>15.2%</td>
</tr>
<tr>
<td>&lt;= 10 Days</td>
<td>85.3%</td>
<td>14.7%</td>
</tr>
<tr>
<td>&lt;= 7 Days</td>
<td>87.5%</td>
<td>12.5%</td>
</tr>
<tr>
<td>&lt;= 3 Days</td>
<td>87.8%</td>
<td>12.2%</td>
</tr>
<tr>
<td>&lt;= 1 Day</td>
<td>80.8%</td>
<td>11.2%</td>
</tr>
</tbody>
</table>

FY 2005 and FY 2006 Quarters 1 & 2
Population: Base Hospital Patients with New Visits

### What Did We Want to Accomplish?

- Reduce time to 3rd Next Appointment to within 10 days for all subspecialties
- Improve family satisfaction with time to getting an appointment and total appointment time
- Improve referring physician satisfaction
- Decrease no show/same day cancellation
- Improve efficiencies of ambulatory practice

### Advanced Access Key Concept Learnings

- Managing supply is critical to achieving access goals
- Consistent supply maintains a stable 3rd Next Available Appointment
- Being able to anticipate when supply dips allows for contingency planning to minimize big spikes in 3rd Next Available Appointment
- Division & Provider understanding of how much outpatient clinical supply you actually have allows for the ability to identify future resource needs & plan for future growth
- How much Supply you NEED is dependent on your Patient Demand for Appointments
What Are The Key Drivers?

Primary Outcome

Supply

Increase patient satisfaction with access
Increase referring physician satisfaction with access

Design Changes/PDQ’s

- Favorable staff vs. virtual hours
- Eliminate wait for appointment
- Minimize FU
- Increase scheduling blocks

- Add capacity
- Standardize clinic practices
- Add alternative providers
- Reduce number of appointment types
- Added temporary appointments to reduce backlog
- Add capacity
- Remove scheduling blocks
- Eliminate rules for appointment types (NV vs. FU)

- Identify patient and provider champions
- Graduate patients to Adult Care
- On-Site Repair
- Reduce back-up variation
- Reduce scheduling
- Utilization of space
- Other capacity needed for staff

Supply

- Analyze the Templates of Current Clinics
- Appointment Durations
- Limits to the number of appts; especially those that do not match demand
- “Slotting”
- Blocks of unavailabilities
- Appropriate distribution of patient arrivals (“Truth in Scheduling”)
- Develop Outpatient Work Guidelines (expectations)
- Physician Effort
- Clinic Definition
- Clinic Cancellation
- Clinic Coverage
- Identify Providers Needed to Meet Demand
- Use Alternate Providers

Template Analysis: Division X Before Advanced Access

<table>
<thead>
<tr>
<th>Provider</th>
<th>Duration</th>
<th>Duration</th>
<th>Ratio per Clinic</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>NV = 30</td>
<td>PU = 15</td>
<td>4 NV's, 6 FU's</td>
</tr>
<tr>
<td>2</td>
<td>NV = 30</td>
<td>PU = 15</td>
<td>4 NV's, 6 FU's</td>
</tr>
<tr>
<td>3</td>
<td>NV = 30</td>
<td>PU = 15</td>
<td>4 NV's, 4 FU's</td>
</tr>
<tr>
<td>4</td>
<td>NV = 30</td>
<td>PU = 15</td>
<td>6 NV's, 6 FU's</td>
</tr>
<tr>
<td>5</td>
<td>NV = 30</td>
<td>PU = 15</td>
<td>5 NV's, 6 FU's</td>
</tr>
<tr>
<td>6</td>
<td>NV = 30</td>
<td>PU = 15</td>
<td>6 NV's, 4 FU's</td>
</tr>
<tr>
<td>7</td>
<td>NV = 30</td>
<td>PU = 15</td>
<td>5 NV's, 7 FU's</td>
</tr>
<tr>
<td>8</td>
<td>NV = 30</td>
<td>PU = 15</td>
<td>5 NV's, 6 FU's</td>
</tr>
<tr>
<td>9</td>
<td>NV = 30</td>
<td>PU = 15</td>
<td>5 NV's, 6 FU's</td>
</tr>
<tr>
<td>10</td>
<td>NV = 30</td>
<td>PU = 30</td>
<td>0 NV's, 6 FU's</td>
</tr>
<tr>
<td>11</td>
<td>NV = 30</td>
<td>PU = 30</td>
<td>5 NV's, 2 FU's</td>
</tr>
<tr>
<td>12</td>
<td>NV = 30</td>
<td>PU = 15</td>
<td>5 NV's, 6 FU's</td>
</tr>
<tr>
<td>13</td>
<td>NV = 30</td>
<td>PU = 15</td>
<td>4 NV's, 6 FU's</td>
</tr>
</tbody>
</table>

Net gain of 44 h / month
Outpatient Clinic Work Guidelines

We are committed to balancing supply and demand, reducing scheduling rules, setting guidelines for referrals, and improving clinic flow.

1. Standardized Outpatient Clinical FTE Calculation
   - 100% O/P FTE = 8 half day clinics a week
   - half day clinic equals four hours of patient care time
2. Physicians must do 45 weeks of clinic a year (86.5% time)
3. If a physician cancels more than the equivalent of 7 weeks of clinic a year a mandatory make-up policy is implemented.
4. Coverage Policy for seminars and extensive vacations
   - If clinic supply is less than 50% of available - all physicians out of clinic will double the number of new appointments the week before and the week after the time off.
   - This does not eliminate the need to make-up clinics

We are committed to balancing supply and demand, reducing scheduling rules, setting guidelines for referrals, and improving clinic flow.

<table>
<thead>
<tr>
<th>Year/Season</th>
<th>Total Last Available</th>
<th>Expected Hours</th>
<th>Absent Hours</th>
<th>Absent %</th>
<th>Clinical FTE’s (Agreed upon)</th>
<th>Clinical FTE’s needed to match supply</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allergy</td>
<td>4</td>
<td>2,724</td>
<td>2,355</td>
<td>86.4%</td>
<td>1.0</td>
<td>1.7</td>
</tr>
<tr>
<td>Cardiology</td>
<td>19</td>
<td>5,191</td>
<td>4,485</td>
<td>86.4%</td>
<td>3.1</td>
<td>3.6</td>
</tr>
<tr>
<td>Endocrinology</td>
<td>47</td>
<td>3,924</td>
<td>3,198</td>
<td>80.0%</td>
<td>2.1</td>
<td>2.8</td>
</tr>
<tr>
<td>Gastroenterology</td>
<td>15</td>
<td>5,216</td>
<td>4,975</td>
<td>94.4%</td>
<td>3.1</td>
<td>3.4</td>
</tr>
<tr>
<td>Neurology</td>
<td>55</td>
<td>8,844</td>
<td>7,246</td>
<td>85.7%</td>
<td>5.1</td>
<td>6.9</td>
</tr>
<tr>
<td>Ophthalmology</td>
<td>38</td>
<td>3,541</td>
<td>3,343</td>
<td>94.4%</td>
<td>2.1</td>
<td>4.3</td>
</tr>
<tr>
<td>Rheumatology</td>
<td>51</td>
<td>2,779</td>
<td>2,836</td>
<td>94.9%</td>
<td>1.7</td>
<td>2.1</td>
</tr>
<tr>
<td>Urology</td>
<td>21</td>
<td>2,069</td>
<td>2,096</td>
<td>101.3%</td>
<td>1.2</td>
<td>1.6</td>
</tr>
</tbody>
</table>

*Annualized through March

Alternate Providers

- Over 200 APNs added to 27 subspecialties
- Serve both inpatient and outpatient settings
- See primarily follow-up patients, as well as new visits for specific patients, increasing physician capacity for new visits
Managing Demand

• Collaborate with community primary care to manage conditions
• Predict no-show rates and book accordingly
• Graduate patients to primary care or adult care

Supply & Demand Together

• Supply & Demand are charted together to see the relationship between the # of requests for an appointment and the number of clinic hours available to satisfy those requests.
• **Measures:** Percent of Demand Met = Total Supply/Total Demand. The goal is to maintain approximately 120% of your demand in order to satisfy access goals. Most divisions who maintain this ratio have consistent 3rd Next Available Appointment that is 10 days or less.
• Percent of Demand Met should be monitored with 3rd Next Available Appointment to see how sensitive your division is to shifts in this number and what your number should be after you’ve sustained good access over a period of time.

Division Outpatient Supply Management Tool

Am I on track?

Current Functionality

• Clinic Cancellation Tracking
• Supply/Demand Projections for the future

Use of the Tool helps to Answer:

• Are my providers on track to only cancel 13.5% of clinics (86.5% physician utilization)?
• Is there significant provider variation in regards to cancellations that needs to be addressed?
• Do we need to start planning for some potential “bad” access months?
• Do I have enough supply for optimal Access? Do I have too much supply? Is my overall demand increasing or decreasing? Do I need to start planning for recruiting or marketing?

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• Do we need to start planning for some potential “bad” access months?
• Do I have enough supply for optimal Access? Do I have too much supply? Is my overall demand increasing or decreasing? Do I need to start planning for recruiting or marketing?
Tool: Special Cause Alerts

<table>
<thead>
<tr>
<th>Division</th>
<th>Alert</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Division 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Division 2</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

A spike above the upper limit has been observed over the past 9 weeks in Cardiology's third next available appointment, with recent weeks also exceeding the upper control limit. Is there any special cause explanation? Have you implemented any code-red rule interventions?

Response:

There are three primary factors contributing to the spike:
1. Faculty PTO during July and August created a backlog.
2. Clinic schedules reduced by 50% in anticipation of the EPIC go live on 9-28-10.
3. One physician left on 9-17-10, with other faculty covering his scheduled clinics until 11-1-10, when all remaining clinics will be canceled and patients rescheduled.

Dr. XX's plan is to add clinic days by requesting volunteers to take on additional patient loads and add-on clinics where feasible.

If you have any questions, please page me.

XX, MD

Gastro
Beginning the week of 8/31, Gastro's third next available has dropped significantly and has been below the current lower control limit for three weeks. Is there any special cause explanation?

Response:

We've added new providers:

- XX has a 16-hour per week schedule that started in mid-September.
- XX has a 12-hour per week schedule also started in mid-September.
- XX has a 6-hour per week schedule that started in August. An additional 4 hours will be added soon.
- A nurse practitioner on maternity leave returned in September and now works 3 days per week.

We have one more new provider awaiting his license; he will do 4 hours per week until July 2011, then expand to 12-16 hours per week. Based on this, we should get back on track.

Learning collaborative: Improvement and spread methods

- Five divisions per session
- PDAS with shared learning facilitated by Quality Improvement Consultants
- Data Analyst Support
- "Graduation" upon achievement to 3rd next available goal

Learning Collaborative:
Improve and spread methods

- Five divisions per session
- PDAS with shared learning facilitated by Quality Improvement Consultants
- Data Analyst Support
- "Graduation" upon achievement to 3rd next available goal

Optimizing Scheduling in Healthcare: A Case Study

Objective: Access to Nephrology scheduled new visit appointment is 28 days.

Goal is to be 10 days or less.

SMART AIM
To increase Patient appointment access to 10 days or less by April 2010

GLOBAL AIM
To increase appointment availability for patients

Division of Nephrology

<table>
<thead>
<tr>
<th>Project Leader: Terra Thompson</th>
</tr>
</thead>
</table>

KEY DRIVERS
- Maximum number of clinics per provider clinical FTE
- Provider availability
- Clinical resource utilization
- No show initiative for chronic no shows (added no show slots at end of clinic)
11/18/2014

Key Interventions/Results

- Appropriate alignment of providers’ clinics to their clinical FTE
- Outpatient Supply & Demand tracking system to ensure clinic cancellation by provider and report tracking to leadership
- No Show Initiative/Add N/S slots: Addressed chronic no shows by placing them in designated appointment slots and opened other slots to fill.
  - Sustainably reduced No Show Rate from 20% to 12%

What Lessons Have We Learned?

- Requires constant oversight
- Data integrity and ownership are critical
- 3rd next available metric is fragile: prone to fluctuations
- Importance of engaged clinical leadership
- Engage specialties in a collaborative environment
- QI/PDSA understanding and discipline were helpful
- Regular reporting to create accountability

Creating “Buy In” for Guidelines

Prepared a financial analysis of physician clinics, revenue and expenses (salary and resources) to match clinical FTE/effort requirement by CCHMC
Section 5: Patients and Families as Change Agents: Experiences and Expectations
Board on Human-Systems Integration

Established as the Committee on Human Factors (COHF) in 1980 at the request of the Army, Navy, and Air Force
Housed within the Division of Behavioral and Social Sciences and Education
In 2008, Committee on Human Factors became Committee on Human-Systems Integration (COHSI)

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- Barbara Silverstein, Ph.D., Washington State Department of Labor and Industries
- David H. Wegman, M.D., M.Sc., Univ. of Massachusetts, Lowell

ENGINEERING OPTIMAL HEALTH CARE SCHEDULING

Sara J. Czaja
Department of Psychiatry and Behavioral Sciences
Center on Aging
University of Miami Miller School of Medicine

Prepared for the Institute of Medicine Public Workshop, November 21, 2014
Background

• Dramatic increase in healthcare expenditures within the United States and most other countries.
• Trend from in-patient to out-patient care and increased reliance on family members to provide needed care and support.
• Consumers are expected to take more active role in health self-management.
• Increased use of technology within the healthcare arena has expanded the realm of health-related tasks performed by consumers.
• Healthcare environment is increasingly complex and difficult for many consumers to navigate.
• Optimization of this new healthcare reality requires a human/systems integration approach.

Components of the Model: People

The healthcare consumer: people receiving care:
- Age
- Education
- Ethnicity/culture
- Literacy and language skills
- Sensory, physical, cognitive and emotional abilities
- Health self-efficacy and healthcare beliefs
- Social and economic resources
- Nature of care demands

The healthcare providers
- Formal care providers
- Informal care providers
  - Age
  - Culture/Ethnicity
  - Sensory, physical, cognitive and emotional abilities
  - Skill level/training, experience
  - Attitudes

Who Are Adult Patients?

- Current and future populations of adults are and will be characterized by increased diversity:
  - Age (2021): 65+ will increase to 93 million by 2060
    - 65-74: 24 million people
    - 75-84: 13.3 million people
    - 85+: 5.9 million people
    - 100+: 61,985 people (93% since 1980)
  - Ethnicity/Culture (2012-2060)
    - Hispanics: 53.3 million – 128.8 million
    - African Americans: 41.2 million – 61.8 million
    - Asian: 15.9 million – 34.4 million
  - Education
    - Less than high school education: 13%
    - High School Education: 28%
    - Some college: 21%
    - College Degree or Higher: 38%
  - Income
    - Less than $25,000: 24%
    - Less than $50,000: 25%
Who Are Adult Patients?

- **Literacy**
  - Below Basic Prose Literacy: 13%
  - Below Basic or Basic Health Literacy: 30%
  - Intermediate Health Literacy: 38%

- **Cognitive Impairments**
  - Report memory loss: ~ 13%
  - MCI: ~10-20%
  - Alzheimer's Disease: 5 million and 16 million by 2050

Components of the Model: Tasks

- **The tasks that are performed**
  - Health maintenance
  - Episodic care
  - Chronic care
  - End-of-life care

- **Scheduling**
  - With whom and how do I choose
    - Multiple providers or tests
  - Where
  - When and how frequent
  - Coordination
  - How (phone, patient portal)

Components of the Model

- **The equipment/technology being used**
  - Assistive devices
  - Monitoring devices
  - Meters
  - Respiratory equipment
  - Computers /Internet/Software

- **The complexity of the technology**
  - Complexity
  - Size/portability
  - Level of automation
  - Hardware and software interface
  - Instructional support and maintenance requirements
Recent Findings: Consumer/Patient Attitudes
(Taha, Czaja, Sharit and Morrow, in press; Zarcadoolas, Vaughon, Czaja et al., 2013; Czaja, Zarcadoolas, Vaughon et al., in press)

- Patients/Consumers:
  - are willing to use PHRs
  - perceive PHRs as valuable
  - PHRs will facilitate the performance of health management tasks
  - PHRs will improve their ability to manage health conditions

Recent Findings: Consumer/Patient Performance

- Have difficulty or are unable to access these systems
- Have difficulty performance basic health management tasks using PHRS:
  - Finding and understanding health information
  - Interpreting lab/test results
  - Understanding medication schedules
  - Scheduling appointments
- Individual characteristics important to performance:
  - Age
  - Cognitive Abilities
  - Technology/Internet Experience
  - Health literacy and numeracy

Conclusions

- There are enormous opportunities and challenges for Human Factors Engineers in the design and implementation of these systems.
- Unless an HF/HSI approach is used in the design of healthcare systems healthcare disparities will increase and there will be a wider gap between the “haves” and “have nots”!
- Fundamental elements of this approach are:
  - Knowing thy user!
  - Early and continual involvement of the user in design of healthcare systems
Wait Time – A Patient View

David Andrews
Patient Advisor
Georgia Regents Medical Center

Disclaimers

• My personal experience is less with delays in getting an appointment than delays in seeing the Dr. at an appointment – but the same problems and solutions are central to both
• Issues of understaffing and “triage” (including the right people to triage, care options, appropriate software systems, etc.) are best left to the others – but I’ll say some things about these later, particularly “triage”

How I became a Patient Advisor

I had several appointments in different areas with an average wait in the waiting room of over an hour with no information

When I pointed out that there was a very long wait I was told, without exception, “we’re busy” – it was about them and not about me!

So I sent an email to the CEO – and was asked to be a patient advisor

Possible Wait Time Causes

• Understaffing
• Ineffective “Triage”
• Counterproductive Incentives
  • Overbooking to counter no-shows
  • Documentation time
• Priorities – good and bad
  • Emergencies
  • Drs. taking extra time to work with patients they feel need it
Problem: Wait or Communication?

Can the problem be reduced by good communication about the wait, causes and efforts to address the issue?

Patient Promoted Improvements

- Identify that wait time is a problem and make it a priority to improve the situation
- Identify where and/or who and/or what is the cause of the delays
- Have a good system for collecting and sharing data – and getting the data to those who can do something about it.
- “Triage”

Communication

- Have a good system to keep track of the queue and make sure the people who communicate with the patients know that information
- Have communication training for those who are the buffer between the patient and the care
- Provide alternatives to sitting and waiting

Our Results

Appointments
- Before: My average wait was over several weeks
- After: Depends on need – can be several weeks or same day or between

Waiting Room
- Before: average, over an hour
- After: average, approximately zero
**Prescription: Patient Engagement**

Having a mechanism (Patient and Family Advisory Councils) for patients to be partners in identification of issues, and development and implementation of solutions can solve problems before they become crises, and can engage critics in ongoing repair and maintenance of workable systems.
Which Outpatient Wait-Time Measures Are Related to Patient Satisfaction?

Julia C. Prentice, PhD,1 Michael L. Davies, MD,2 and Steven D. Pizer, PhD1

Abstract

Long waits for appointments decrease patient satisfaction. Administrative wait-time measures are used by managers, but relationships between these measures and satisfaction have not been studied. Data from the Veterans Health Administration are used to examine the relationship between wait times and satisfaction. Outcome measures include patient-reported satisfaction and timely appointment access. Capacity and retrospective and prospective time stamp measures are calculated separately for new and returning patients. The time stamp measures consist of the date when the appointment was created in the scheduling system (create date [CD]) or the date the appointment was desired as the start date for wait-time computation. Logistic regression models predict patient satisfaction using these measures. The new-patient capacity, new-patient time stamp measures using CD, and the returning-patient desired-date prospective measure were significantly associated with patient satisfaction. Standard practices can be improved by targeting wait-time measures to patient subpopulations.

Keywords

wait-time measures, patient satisfaction, VA, VHA, access to care

More than a decade ago, the Institute of Medicine identified timely access to health care as an essential way to improve health care quality in the United States. Appointment wait times continue to be an essential measure of access as the health care system continues to struggle with long wait times.1,2,3 For example, a national survey in 2009 found an average wait time of 20.3 days for an appointment in family practice.4 Wait times for outpatient care are expected to further increase with the implementation of the Patient Protection and Affordable Care Act that expands health insurance coverage.5-7 Negative consequences of delayed access to care include poor health outcomes, especially among older and more vulnerable patient populations,7-11 and lower patient satisfaction.12-14

Reliable wait-time measures are underdeveloped in the United States. One way to measure wait times uses physician surveys that ask how long it would take to get an appointment for patients with a nonemergency condition.4,15 Unfortunately, survey data are expensive to obtain and do not continuously monitor changes in wait times. As an alternative, proponents of scheduling interventions that are focused on decreasing wait times (eg, Advanced Clinic Access [ACA]) have suggested capacity measures, such as how many days until the third next available appointment for a physical exam.16,17 Capacity measures are easily calculated from most scheduling systems but they do not measure how long an individual patient actually waits. Variation in provider practice schedules and clinic limitations related to appointment types also may make these measures less reliable.16,17

As the Veterans Health Administration (VHA) shifted services from inpatient to outpatient care,18 stakeholders developed a strong interest in knowing the timeliness of appointments for individual veterans. Consequently, the VHA also consistently measures patient satisfaction through patient surveys. This article compares the ability of alternative measures of wait times to reliably predict patient satisfaction. To place the forthcoming analyses in context, the following section describes each of the wait-time measures along with their advantages and disadvantages.

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**Wait-Time Measures in the VHA**

**Capacity Measures**

In response to complaints about long waits for VHA care, Congress requested information on outpatient waiting times starting in 1999. Early performance metrics focused on capacity measures such as the first available appointment (FNA; M. Davies, e-mail communication, September 2010). This is a prospective wait-time measure that uses the day an appointment is being created as the starting point and measures the time between that day and the day the first available open appointment slot occurs (Table 1). This measure counts only the days the clinics are open, ignoring weekends, holidays, or unavailable days for part-time providers. FNA is considered a marker of the amount of backlogged appointments in the system, in that it measures how far into the future a scheduler has to look before finding an open appointment.

The strengths of FNA include the ability to benchmark performance with other organizations that use similar capacity measures, but there are a number of limitations. Like all capacity measures, FNA does not reflect how long patients actually wait but rather the capacity of the clinic to have open appointments. Individual patients may not actually want the FNA appointment because the appointment length or type does not meet their needs or because they want a follow-up appointment in the future. The latter case is more problematic for returning patients who wish to schedule an appointment when, in reality, this time slot is committed.

**Time Stamp Create Date (CD) and Desired Date (DD)**

The limitations of FNA led VHA managers to consider time stamp wait-time measures (M. Davies, e-mail communication, September 2010). Time stamps require choices in what to use as starting and ending points. The first starting point used was based on the CD. CD is the date that an appointment is created (ie, made) or the date the patient is entered into an electronic waiting list (Table 1). The main strength of this measure is that CD time stamp captures the creation of an appointment, the results of measuring CD are believed to reflect the pattern of booking appointments. For example, suppose a patient comes in for a checkup and agrees to schedule a follow-up appointment in 6 months. If the clinic creates the follow-up appointment on the day of the initial appointment (“on today”), the resulting measured wait time will be 6 months. Alternatively, the clinic might contact the veteran 5 months from “today” and create the intended 6-month follow-up appointment, resulting in a measured wait time of 1 month. Another limitation of this measure is that it does not take patient preferences into account. For example, a new patient may want the certainty of making an appointment “on today” but “for” a future time after a holiday or family gathering.

Recent VHA policy has attempted to overcome these limitations by focusing on DD as the initial “start date.” (M. Davies, e-mail communication, September 2010; Table 1). This time stamp designates the ideal time “a patient or provider wants the patient to be seen.” If the patient has an established relationship with the provider and agrees to return for a future appointment (ie, internal demand in ACA literature), the date the patient and provider agree on as the desired return date is the DD. If this returning patient requests an unanticipated appointment or if a new patient requests their first appointment, the scheduling clerk is instructed to ask the patient when they would like to be seen (regardless of when they are able to see an open slot). The answer to this question establishes the DD for this “external demand” situation. The strength of the DD time stamp measure is that it reflects the patient’s or provider’s wishes. Additionally, it is not influenced by differences in local scheduling practices. For example, in the case of the patient who was scheduled to come back in 6 months, the DD for the follow-up appointment would be the date 6 months into the future regardless of when the appointment ultimately was scheduled.

The principal limitation of this measure is its reliance on schedulers to accurately determine DDs. Initial audits of VHA’s scheduler performance in 2005 found that DD was correctly entered 40% to 60% of the time. Follow-up audits after educational efforts found that DD was entered...
correctly more than 90% of the time (M. Davies, oral communication, April 2012).

Combinations of the time stamp measures described above are thought to reflect the patient experience. It was hypothesized that patients who receive appointments closest to when they are desired have higher satisfaction levels. A patient may have their CD, DD, scheduled appointment (SA), and completed appointment (CA) all on (or close to) the same day. An example of this is when patients walk in to request an appointment, and the clinic gives them an appointment on the same day. A backlogged clinic unable to accommodate this “today” patient may have lower patient satisfaction. Alternatively, an appointment may be created at an earlier point in time than desired, while still being scheduled and completed on the DD, causing high patient satisfaction. An example of this situation is a returning patient who schedules a future appointment. In contrast, a backlogged clinic that cannot accommodate the follow-up appointment when desired for this returning patient may have lower patient satisfaction.

**Completed Versus Scheduled Appointments**

To calculate a wait time, in addition to the “start date,” an ending point time stamp also must be established (Table 1). One ending point is the CA date collected automatically by the computer. The CD and DD to CA measures are retrospective measures that include only successfully completed appointments. If a patient does not show up

Table 1. Summary of Wait-Time Measures.

<table>
<thead>
<tr>
<th>Measure</th>
<th>Algorithm</th>
<th>Example Calculation</th>
<th>Strengths</th>
</tr>
</thead>
<tbody>
<tr>
<td>First next available appt (FNA-capacity)</td>
<td>FNA − Appt request</td>
<td>Patient X requests first available appt on 1/1/2010 and this is 1/15/2010 1/15/2010 − 1/1/2010 = 15 days</td>
<td>Comparable to private sector measure Captured by scheduling system in contrast to scheduler entry of dates</td>
</tr>
<tr>
<td>Retrospective, create date (CD)</td>
<td>Completed appt date − Appt CD</td>
<td>Patient X requests an appt on 1/1/2010, cannot take the appt offered 1/15/2010, so the scheduler schedules and patient completes an appt on 1/21/2010 1/21/2010 − 1/1/2010 = 21 days Patient Y requests an appt on 1/1/2010 and accepts a 1/10/2010 appt date. Patient Y does not show up for the 1/10/2010 appt. This appt is never included in retrospective wait-time calculations</td>
<td>Captured by scheduling system in contrast to scheduler entry of dates</td>
</tr>
<tr>
<td>Prospective, CD*</td>
<td>Scheduled appt date − Appt CD</td>
<td>Patient X has a scheduled appt for 1/21/2010 that was created on 1/1/2010 1/21/2010 − 1/1/2010 = 21 days Patient Y has a scheduled appt for 1/10/2010 that was created on 1/1/2010 1/10/2010 − 1/1/2010 = 10 days</td>
<td>Captured by scheduling system in contrast to scheduler entry of dates Includes all scheduled appts compared to only completed appts</td>
</tr>
<tr>
<td>Retrospective, DD</td>
<td>Completed appt date − DD</td>
<td>Patient X wanted an appt on 1/15/2010 and was scheduled for and completed an appt on 1/21/2010 1/21/2010 − 1/15/2010 = 6 days Patient Y wanted an appt on 1/20/2010 and was offered and agreed to an appt on 1/27/2010. Patient Y canceled the 1/27/2010 appt and never rescheduled. This appt is never included in retrospective wait-time calculations</td>
<td>Captures when patient desires appt in contrast to clinical capacity or clinic booking patterns</td>
</tr>
<tr>
<td>Prospective, DD*</td>
<td>Scheduled appt date − DD</td>
<td>Patient X has a scheduled appt for 1/21/2010 and this patient desired this appt on 1/15/2010 1/21/2010 − 1/15/2010 = 6 days Patient Y wanted an appt on 1/20/2010 and was offered and agreed to an appt on 1/27/2010 1/27/2010 − 1/20/2010 = 7 days</td>
<td>Captures when patient desires appt in contrast to clinical capacity or clinic booking patterns Includes all scheduled appts compared with only completed appts</td>
</tr>
</tbody>
</table>

Abbreviation: Appt(s), appointment(s).

*A A snapshot of all pending appts in the system is taken on the 1st and 15th of each month to calculate prospective wait-time measures.*
for the appointment or the appointment is canceled and never rescheduled, the appointment is excluded from these retrospective wait-time measures (S. Campbell, e-mail communication, May 2012).

Wait times may also be measured prospectively by examining appointments that have not occurred yet (M. Davies, e-mail communication, September 2010). The VHA pending appointment list keeps track of all SAs, and a snapshot measure of this list is taken bimonthly. Waits are calculated by subtracting the original CD or DD from the SA date. Prospective measures do not reflect future actions such as cancellations or no-shows, so all appointments are included (Table 1). Consequently, prospective measure results may be very different from retrospective measures. For example, if there are 2 appointments scheduled when a report is pulled and the waits are calculated to be 10 days and 28 days, the average SA wait time is 19 days (38/2). If the 28-day wait-time appointment turns out to be a no-show, the average CA wait time would be only 10 days.

A weakness of any wait-time measure used to reward performance, as done in the VHA, is that the measures can be thwarted.23-25 Individuals could inappropriately hold open an FNA appointment, manage the times appointments are created, enter incorrect DD data, or cancel appointments inappropriately. Educational efforts, mandatory quality reviews and feedback, and inspections can be thwarted.23-25 Individuals could inappropriately hold open an FNA appointment, manage the times appointments are created, enter incorrect DD data, or cancel appointments inappropriately. Educational efforts, mandatory quality reviews and feedback, and inspections are used to ensure the integrity of the system.

**Methods**

**Facility-Level New- and Returning-Patient Wait-Time Measures**

Wait-time measures were obtained from 2010. These include the FNA, retrospective CA measures using CD and DD, and prospective SA measures using CD and DD (Table 1). Facility-level wait times were needed for analysis, not individual wait times, because individual satisfaction with waits is likely to be simultaneously determined with individual health status. Individuals in poor health tend to report lower satisfaction and also tend to have shorter wait times because clinics triage cases and arrange to see more urgent cases more quickly. It is a mistake to conclude that shorter waits for these patients caused lower satisfaction. To avoid this problem facility-level averages were computed for each measure.7-10,26

Each measure is calculated separately for new and returning patients. The scheduling system examines whether an individual has been seen in a specific clinic (eg, cardiology) in the previous 24 months (going back to 2008 data); if not, the patient is defined as new.22 Wait times of all new patients and returning patients within clinic stops and VHA facilities are averaged together, and this facility-level wait time is used in the analysis.

This study focuses on wait times for 50 appointment types used for performance measurement by VHA operation managers and in previous research linking wait times to health outcomes (the list of appointment types is available from the authors on request). These appointment types have high volume, include 93% of patient-provider interactions (vs other services such as labs or telephone consultations), and cover all major medical subspecialties (eg, mental health, orthopedics).9,10 Appointment types are weighted by national utilization and averaged together at each VHA medical center. Missing wait times are imputed with 0 when appropriate.7,10,26

**Patient Satisfaction**

The dependent variables measuring satisfaction come from the 2010 Survey of Healthcare Experiences of Patients (SHEP) that is modeled after the Consumer Assessment of Healthcare Providers and Systems family of survey instruments. Human subjects institutional review board approval was obtained from the VA Boston Healthcare System. Managed by the VHA Office of Quality and Performance, SHEP is an ongoing nationwide survey that seeks to obtain patient feedback on recent episodes of VHA inpatient or outpatient care to improve health care quality.27 For outpatient care, a simple random sample of patients with completed appointments at VHA facilities is selected each month. The overall response rate was 53%, and there were 221 540 respondents included in this study who had valid satisfaction data. Respondents came from all VHA medical centers (n = 129). The median number of patients from each facility was 1805 (interquartile range = 1314-2725). (A list of the facilities included in the study along with the number of patients from each facility is available from the authors on request.)

**Dependent Variables**

Five different patient satisfaction measures are taken from SHEP. Satisfaction with timeliness of care is measured by asking respondents how often they were able to get VHA appointments as soon as they thought they needed care, excluding times they needed urgent care. Access to VHA tests or treatments and appointments with VHA specialists is measured by asking how easy it was to get this care in the past 12 months. Response options for these 3 measures include always, usually, sometimes, and never. General satisfaction is measured by asking respondents to rate VHA health care in the past 12 months on a scale of 0 to 10 and their satisfaction with their most recent VHA visit using a Likert

<table>
<thead>
<tr>
<th>Table 1: Facility-level New- and Returning-Patient Wait-Time Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Type</strong></td>
</tr>
<tr>
<td>----------------</td>
</tr>
<tr>
<td>FNA</td>
</tr>
<tr>
<td>CA (Prospective)</td>
</tr>
<tr>
<td>CA (Retrospective)</td>
</tr>
<tr>
<td>SA</td>
</tr>
</tbody>
</table>

**Note:** The CA wait time would be only 10 days. If the 28-day wait-time appointment turns out to be a no-show, the average CA wait time would be only 10 days.
scale ranging from 1 to 7, with higher numbers indicating greater satisfaction.

**Risk Adjustment**

Risk adjustors include age, sex, race/ethnicity, education level, number of visits to a doctor’s office in the past 12 months, and self-reported health status, all obtained from the 2010 SHEP.

**Analyses**

STATA 10.0 (StataCorp LP, College Station, TX) was used to run logistic regression models that predicted patient satisfaction. For the timeliness of care, access to treatment, and specialist measures, outcomes are coded as always or usually versus sometimes or never. Models predict ratings of 9 or 10 versus less than 9 for the measure “rating of the VHA in the past 12 months,” and 6 or 7 versus less than 6 for the measure “satisfaction with the most recent visit.”

The completed appointment date that the VHA uses to target individuals for the SHEP sample was matched to each of the wait-time measures. For prospective measures (FNA and SA using CD and DD), the wait time in the month before the targeted appointment date is assigned to reflect waits when the appointments are requested or desired. This specification results in having 11 instead of 12 months of data in these models (because the first month has no previous month in these data). For the retrospective wait-measures, the wait time in the current month of the targeted appointment is assigned (so all 12 months could be used in analysis). Wait-time measures are categorized into quartiles, with the lowest quartile used as the reference group.

**Results**

The SHEP respondents in this study generally reflected the larger VHA patient population. Respondents were predominantly male, in poor health, and frequent health care users. Satisfaction levels with VHA care were high. More than 80% of respondents rated VHA care in the past 12 months in the top 2 categories, and more than 80% did the same for satisfaction with the most recent VHA visit (Table 2).

There was significant variation in measured wait times using the different methods of measurement for new and established patients (Table 3). Wait-time measures that rely on the CD for appointments were the longest for both new and returning-patient measures compared with the FNA appointment and DD measures. The wait-time measures that rely on DD were the shortest for new-patient measures, with the mean wait time for the FNA appointment capacity measure being similar to the CD new-patient measures. The retrospective DD returning-patient measure had the shortest waits followed by the FNA appointment capacity measure and the prospective DD measure for returning-patient measure.

Patients visiting VHA facilities with shorter new-patient FNA or CD waits (retrospective or prospective) were more satisfied because the odds ratio for wait times in the second, third, and fourth quartile were significantly lower compared with the odds ratio in the first quartile for all 5 satisfaction measures (Table 4). For example, patients visiting VHA facilities with the longest retrospective new-patient CD waits (Q4) were 17% to 34% less satisfied compared with patients visiting facilities with the shortest retrospective waits. In contrast, there was no consistent relationship between the new-patient retrospective DD measure and patient satisfaction. Longer waits using the new-patient prospective DD measure were significantly associated with lower patient satisfaction for 2 of the 5 measures (VHA rating and treatment access).

There was a consistent and significant relationship between individuals visiting VHA facilities with longer waits, using the returning-patient prospective DD measure, and decreased satisfaction (Table 5). Patients visiting facilities in the highest quartile of waits using the returning-patient FNA measure were between 7% and 10% less satisfied than patients visiting facilities in the lowest quartile, depending on the satisfaction outcome. The other 4 returning-patient wait-time measures did not reliably predict patient satisfaction.

**Discussion**

This study associates operational measures of administrative wait times with commonly used measures of patient satisfaction. Findings suggest that health care systems should utilize a wider variety of wait-time measures than are popular in current practice because different new and returning wait-time measures were associated with patient satisfaction.

Longer waits using a new-patient capacity measure (FNA) and the retrospective and prospective new-patient CD wait-time measures were significantly associated with patient satisfaction for timely VHA appointments, ease of access obtaining treatments or specialist appointments, rating of VHA care, and satisfaction with the VHA at the last visit (Table 4). The capacity measure finding is consistent with past research that finds a significant causal relationship between longer FNA waits and poorer health outcomes, especially among older and more vulnerable
veterans.\textsuperscript{7-10} New patients typically want to be seen as soon as possible, often because of a change in health status that is causing concern.\textsuperscript{21} Consequently, it is not surprising that capacity or time stamp measures that use the date that an appointment request was made as the start date (Table 1) were successful predictors of patient satisfaction. These wait-time measures can be calculated easily from most scheduling systems to help health care providers continually track access for new patients.\textsuperscript{16,17}

Returning patients are more complicated because they may not be interested in obtaining the next available appointment for follow-up care. Surveys of patients have found that scheduling future appointments at convenient times or maintaining continuity of provider may outweigh concerns about long waits for appointments for follow-up care.\textsuperscript{21,28,29} Recognizing these complexities, VHA policy makers recently shifted to using a DD approach to measure wait times (ie, schedulers ask

### Table 2. Descriptive Statistics of Individuals in the SHEP Sample.

<table>
<thead>
<tr>
<th>Demographics (n = 221,540)</th>
<th>Mean or Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>66.96</td>
</tr>
<tr>
<td>Male</td>
<td>95%</td>
</tr>
<tr>
<td>Had some college</td>
<td>53%</td>
</tr>
<tr>
<td>White</td>
<td>79%</td>
</tr>
<tr>
<td>Black</td>
<td>10%</td>
</tr>
<tr>
<td>Hispanic</td>
<td>5%</td>
</tr>
<tr>
<td>Other</td>
<td>6%</td>
</tr>
<tr>
<td>≥5 Visits to a doctor’s office in the past 12 months</td>
<td>31%</td>
</tr>
<tr>
<td>Excellent/Very good self-reported health status in the past 12 months</td>
<td>25%</td>
</tr>
</tbody>
</table>

### Table 3. Descriptive Statistics of Facility-Level Wait-Time Measures.

<table>
<thead>
<tr>
<th>New-Patient Measures</th>
<th>Mean \textsuperscript{a}</th>
<th>25% \textsuperscript{a}</th>
<th>50% \textsuperscript{a}</th>
<th>75% \textsuperscript{a}</th>
</tr>
</thead>
<tbody>
<tr>
<td>First next available\textsuperscript{b}</td>
<td>20.06</td>
<td>17.24</td>
<td>19.53</td>
<td>22.14</td>
</tr>
<tr>
<td>Retrospective create date\textsuperscript{b}</td>
<td>17.97</td>
<td>15.61</td>
<td>17.50</td>
<td>19.96</td>
</tr>
<tr>
<td>Prospective create date\textsuperscript{b}</td>
<td>31.13</td>
<td>26.65</td>
<td>30.19</td>
<td>34.77</td>
</tr>
<tr>
<td>Retrospective desired date\textsuperscript{b}</td>
<td>4.72</td>
<td>2.77</td>
<td>4.69</td>
<td>6.14</td>
</tr>
<tr>
<td>Prospective desired date\textsuperscript{b}</td>
<td>15.65</td>
<td>12.11</td>
<td>15.42</td>
<td>18.61</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Returning-patient measures</th>
<th>Mean \textsuperscript{a}</th>
<th>25% \textsuperscript{a}</th>
<th>50% \textsuperscript{a}</th>
<th>75% \textsuperscript{a}</th>
</tr>
</thead>
<tbody>
<tr>
<td>First next available\textsuperscript{b}</td>
<td>7.88</td>
<td>5.41</td>
<td>8.01</td>
<td>10.17</td>
</tr>
<tr>
<td>Retrospective create date\textsuperscript{b}</td>
<td>30.90</td>
<td>23.60</td>
<td>29.05</td>
<td>34.95</td>
</tr>
<tr>
<td>Prospective create date\textsuperscript{b}</td>
<td>72.26</td>
<td>50.54</td>
<td>66.71</td>
<td>86.90</td>
</tr>
<tr>
<td>Retrospective desired date\textsuperscript{b}</td>
<td>2.72</td>
<td>1.91</td>
<td>2.60</td>
<td>3.36</td>
</tr>
<tr>
<td>Prospective desired date\textsuperscript{b}</td>
<td>17.19</td>
<td>13.75</td>
<td>16.79</td>
<td>19.91</td>
</tr>
</tbody>
</table>

\textsuperscript{a}Means and quartiles are calculated using facility-months weighted by the number of observations at each facility.
\textsuperscript{b}n = 201,819 For capacity and prospective wait-time measures, and n = 221,540 for retrospective wait-time measures. Sample sizes differ between types of wait-time measures because December 2009 wait-time data (for January 2010) are missing on the capacity and prospective measures.
Results from this study provide some support for the validity of these policy changes. Patients visiting facilities with longer returning-patient prospective DD waits were significantly less satisfied on all 5 patient satisfaction measures (Table 5). In contrast, the returning-patient retrospective DD measure did not consistently predict patient satisfaction. For this measure, if the patient never comes for an appointment (no show rates are ~12.5%) or if a patient or clinic cancels an appointment and never reschedules it, the appointment is excluded, whereas the prospective DD measure includes all appointments on the day a report is pulled. The longer waits in the returning-patient prospective DD wait-time measure compared to the retrospective DD measure (Table 3) combined with the significant relationships between the returning-patient prospective DD and satisfaction (Table 5) suggest that prospective DD is a more accurate reflection of access to the system for returning patients. Future research should confirm the reliability of DD by examining whether the association holds when predicting other health outcomes.

This study has several limitations. The main limitation is that one cannot be certain that the identified relationships between longer wait times and patient satisfaction are causal because omitted variables may be responsible for the observed relationship. For example, a flu epidemic may increase waits for care and also decrease satisfaction levels because patients do not feel well. In this case, lower satisfaction cannot be blamed entirely on access. Because of the cross-sectional nature of this study, facility quality could not be controlled for through facility fixed effects, and the findings of the present study should be confirmed in future longitudinal studies. Despite this reservation, past research has found that longer wait times using capacity measures cause poorer health outcomes, especially among older and more vulnerable populations,7-11 so it is plausible that administrative wait times are causally linked to lower patient satisfaction. The sample consists predominantly of adult males, so results may not be generalizable to women and children. Finally, the data are combined from a nationwide sample of facilities, so patient experiences at specific facilities may not be comparable to each other.

The recent popularity of interventions such as ACA has encouraged clinics to better utilize information available in the scheduling system because performance metrics based on the scheduling system are much

### Table 4. Logistic Regressions Predicting Patient Satisfaction Using New-Patient Wait-Time Measures.

<table>
<thead>
<tr>
<th></th>
<th>Timely Visit</th>
<th>VHA Rating</th>
<th>Treatment Access</th>
<th>Specialist Access</th>
<th>VHA Satisfaction</th>
</tr>
</thead>
<tbody>
<tr>
<td>FNA (reference = Q1)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Q2</td>
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<td>0.96i</td>
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<td>0.74d</td>
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<td></td>
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</tr>
<tr>
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</tr>
<tr>
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<tr>
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<td>0.86d</td>
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</tr>
</tbody>
</table>

Abbreviations: Q, quartile; VHA, Veterans Health Administration; FNA, first next available; CD, create date; DD, desired date; SHEP, Survey of Healthcare Experiences of Patients.

aFor the range in days of each quartile for the wait-time measures, refer to Table 3.
bSample sizes differ between models because of the retrospective versus prospective wait-time measures and because not all SHEP respondents answered every satisfaction question.
cReported numbers are odds ratios.
d$P < .05$. 

patients what day they desire their appointment). Results from this study provide some support for the validity of these policy changes.

Patients visiting facilities with longer returning-patient prospective DD waits were significantly less satisfied on all 5 patient satisfaction measures (Table 5). In contrast, the returning-patient retrospective DD measure did not consistently predict patient satisfaction. For this measure, if the patient never comes for an appointment (no show rates are ~12.5%) or if a patient or clinic cancels an appointment and never reschedules it, the appointment is excluded, whereas the prospective DD measure includes all appointments on the day a report is pulled. The longer waits in the returning-patient prospective DD wait-time measure compared to the retrospective DD measure (Table 3) combined with the significant relationships between the returning-patient prospective DD and satisfaction (Table 5) suggest that prospective DD is a more accurate reflection of access to the system for returning patients. Future research should confirm the reliability of DD by examining whether the association holds when predicting other health outcomes.

The recent popularity of interventions such as ACA has encouraged clinics to better utilize information available in the scheduling system because performance metrics based on the scheduling system are much
cheaper and easier to obtain than provider surveys taken at sporadic intervals.16,17,21 The VHA has a long history of using a wide variety of wait-time measures and now http://www.merritthawkins.com/compensation-surveys.aspx; is investing in research to link these measures to patient outcomes. The results of this work suggest that fairly simple modifications to current scheduling systems can support improved wait-time measures that will better predict patient satisfaction across all patient populations.

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The views expressed in this article are those of the authors and do not necessarily represent the position or policy of the Department of Veterans Affairs or Boston University.

References


Table 5. Logistic Regressions Predicting Patient Satisfaction Using Returning-Patient Wait-Time Measures.

<table>
<thead>
<tr>
<th></th>
<th>Timely Visit</th>
<th>VHA Rating</th>
<th>Treatment Access</th>
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<th>VHA Satisfaction</th>
</tr>
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<td>FNA (reference = Q1)</td>
<td>(n = 144 538)</td>
<td>(n = 200 207)</td>
<td>(n = 165 053)</td>
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<tr>
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Abbreviations: Q, quartile; VHA, Veterans Health Administration; FNA, first next available; CD, create date; DD, desired date; SHEP, Survey of Healthcare Experiences of Patients.

aFor the range in days of each quartile for the wait-time measures, refer to Table 3.

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Reported numbers are odds ratios.

P < .05.


Section 6: Technical Approaches to Wait Time Improvement
The Promise of Lean in Health Care

John S. Toussaint, MD, and Leonard L. Berry, PhD

Abstract

An urgent need in American health care is improving quality and efficiency while controlling costs. One promising management approach implemented by some leading health care institutions is Lean, a quality improvement philosophy and set of principles originated by the Toyota Motor Company. Health care cases reveal that Lean is as applicable in complex knowledge work as it is in assembly-line manufacturing. When well executed, Lean transforms how an organization works and creates an insatiable quest for improvement. In this article, we define Lean and present 6 principles that constitute the essential dynamic of Lean management: attitude of continuous improvement, value creation, unity of purpose, respect for front-line workers, visual tracking, and flexible regimentation. Health care case studies illustrate each principle. The goal of this article is to provide a template for health care leaders to use in considering the implementation of the Lean management system or in assessing the current state of implementation in their organizations.

Pediatric surgeons at Seattle Children’s vie to perform surgery at their new Bellevue Clinic and Surgery Center because of the efficient flow for patients, families, and the care team. Nonoperative time, defined as the time when dressings are placed on patient A to incision time for patient B, is 50% less than for similar operations performed at the main campus surgery center. Operations start when scheduled 99% of the time. More than 90% of patients and families give the Bellevue Surgery Center a 9 or 10 rating for overall care. ThedaCare, a Wisconsin-based integrated health system, reduced inpatient total cost of care by 25% while improving patient satisfaction to nearly 100% of patients rating their care 5 of 5. For 5 years running, no medication reconciliation errors occurred for patients in hospital units served by care teams that include a pharmacist. The staff of the otolaryngology department of the Christie Clinic in Champaign, Illinois, begins each day with a huddle to identify problems and discuss potential solutions. The daily rhythm of the huddles, which include physicians, has improved internal communications and teamwork. In less than 1 year after starting the huddles, waiting time for appointments decreased by 28%, departmental capacity improved by 10% with no increase in head count, and patient satisfaction increased from 4.3 to 4.7 on a 5-point scale. Leadership of the huddles rotates weekly among the department’s staff.

What links these 3 institutions is their journeys of implementing a quality improvement philosophy and set of principles originated by the Toyota Motor Company commonly referred to as Lean. The 3 health systems named and numerous others have clearly demonstrated that the Lean approach is just as applicable and useful in complex knowledge work as in assembly-line manufacturing. Early health system experiences with Lean also reveal the arduous nature of the journey.

Lean is not a program; it is not a set of quality improvement tools; it is not a quick fix; it is not a responsibility that can be delegated. Rather, Lean is a cultural transformation that changes how an organization works; no one stays on the sidelines in the quest to discover how to improve the daily work. It requires new habits, new skills, and often a new attitude throughout the organization from senior management to front-line service providers. Lean is a journey, not a destination. Unlike specific programs, Lean has no finish line. Creating a culture of Lean is to create an insatiable appetite for improvement; there is no turning back. As Lean consultant Joan Wellman states, “With Lean, you will keep changing your definition of what ‘good’ is.”

The emergence of Lean success stories in health care, a rapidly changing reimbursement
environment that necessitates improved quality and efficiency, and the trend to public reporting of health care performance data\textsuperscript{4,5} are converging to encourage health care leaders to consider Lean for their institutions. No health care organizations or practicing clinicians are immune from the simultaneous pressures to improve quality and lower costs. As former Centers for Medicare & Medicaid Services administrator and Institute for Healthcare Improvement founder Donald Berwick, MD, states, “The only way we can rescue American healthcare is to improve it…. We know what to do—better care, better health, lower cost.”\textsuperscript{6}

The growing health care interest in Lean creates fertile ground for rushing something that cannot be rushed, misunderstanding something that is not easily understood, and under-investing in something that requires ongoing, multifaceted investment. Attempts to even define Lean have been elusive.\textsuperscript{7} Health care personnel have encountered various versions of Lean. We’ve been told it is a 5-day workshop on the one hand and a whole system cultural change on the other hand. In this article, we apply our collective experiences in leading a Lean transformation at ThedaCare and in visiting more than 100 health care systems applying Lean (J.S.T.) and in career-long service quality research inside and outside health care (L.L.B.) to define Lean and present its essential principles. The principles are illustrated by case studies from health care based on information provided by the institutions featured, personal visits, and follow-up communications. Our goal is to provide a template for health care leaders to use in considering the opportunity Lean offers their institutions or in assessing the state of its implementation in their organizations.

DEFINITION AND PRINCIPLES OF LEAN

Influenced by the work of Womack and Jones,\textsuperscript{8} we define Lean in health care as “an organization’s cultural commitment to applying the scientific method to designing, performing, and continuously improving the work delivered by teams of people, leading to measurably better value for patients and other stakeholders.” Lean is an operating system composed of 6 principles that constitute the essential dynamic of Lean management. To miss on any one of these principles is to miss on Lean’s full potential to benefit the organization’s stakeholders.

**Principle 1: Lean Is an Attitude of Continuous Improvement**

Continuous improvement has its basis in a principle introduced by Shewhart\textsuperscript{9} and refined by quality improvement pioneer Edwards Deming. The Deming Cycle is the foundation of Plan-Do-Study-Act (PDSA), a central tenet of Lean.\textsuperscript{10} The PDSA approach is a scientific method applied to daily work: defining an explicit and measurable hypothesis about how a process can be improved, objectively testing the hypothesis, and, if improvement occurs, making the improved process “standard work” until such time as further improvement can be demonstrated.\textsuperscript{11} Health care personnel are familiar with the scientific method in the form of controlled double-blind studies to test new treatments. Lean uses the same basic approach of measuring whether new process B is superior to existing process A.

For Lean to take hold in an organization and transform its culture to one of continuous improvement, senior management must relinquish the role of master problem solver to those who are closer to the problems to be solved—to benefit from their knowledge of the focal process, to give them hands-on experience in using Lean methods and to see first-hand the performance improvement and teamwork this can create, and to promote an attitude that what exists can likely be improved.

Clinical and nonclinical staff members who are given the encouragement, training, and time to make meaningful improvements in how the work is done are unlikely to want to retreat to an earlier period when formalized effort to improve existing processes was outside their domain of responsibility. As staff members gain confidence in their problem-solving skills and as they witness positive changes, momentum for even more improvement work is likely to build. This is Lean at its best; employees keep raising the bar, the organization becomes increasingly innovative, more staff want to be directly involved, and an attitude of continuous improvement becomes the driving force behind all work.

At St. Jude Medical Center in Fullerton, California, a team recognized a significant issue with scheduling radiology appointments.
The mean wait time on the telephone was 20 minutes, with a 17% to 20% dropped call rate. A process based on PDSA known as a rapid improvement event led to changes that include a staff huddle every morning to monitor and discuss the metrics of wait time, call volume, and dropped call rate, among other topics. The staff problem-solves issues from the previous day and anticipates issues for the upcoming day. At any time during the day, any team member can call for a huddle if performance issues arise. Such a huddle enables the staff to quickly identify and resolve problems. Total call volume has increased while wait time has decreased to under 1 minute and the dropped call rate to less than 3% with no increase in staffing.

**Principle 2: Lean Is Value-Creating**

Health care is for patients; health care resources, directly or indirectly, should be used to benefit patients. The underlying goal of Lean in health care is to improve value for patients. Doing so should also benefit other health care stakeholders. Fewer medication errors, fewer nosocomial infections, less nursing time away from the bedside, faster operating room turnover time, improved care team communication about patients, and faster response time for emergent cases not only benefit patients but also physicians, nurses, health care organizations, payers, and the community.

Value in health care has been conceptualized as health outcomes per dollar spent over time. Patients, however, typically view value more broadly as benefits received for burdens endured. Burdens include both monetary costs and nonmonetary costs. The benefits vs burdens conceptualization of value includes medical outcomes and financial costs but extends beyond these constructs to also include patients’ perceptions of the overall health care experience. A clinician’s sensitivity in answering patients’ questions, an operation that starts on time, and a quiet, calming medical facility may be ancillary to the medical outcome, but they can still be important to patients’ assessment of value. Conversely, a clinician’s insensitivity, a delayed operation, and a stress-increasing medical facility can be meaningful nonmonetary burdens to patients in their assessment of value. Measuring improvement in processes due to Lean interventions ideally should encompass a benefits vs burdens effect on all affected stakeholders. Who is affected by the changed processes and in what ways? Do benefits increase? Do burdens decrease? These are the questions that robust Lean measurement should answer.

Value stream maps are a principal Lean tool used to distinguish between discrete steps in a process that do or do not contribute value (Figure 1). A team close to the work creates a visual map of each step in an existing process to better understand it (ie, the current state). Clearly understanding the current state is essential to improving it, and creating a

**FIGURE 1.** Example of a value stream map.
detailed depiction of the process facilitates understanding. A value stream map differs from other mapping by combining information flow and material and people flow; this enables the team to more clearly see a complex system’s current state and offers a roadmap for improvement. By studying a value stream map, the team can ask questions such as, “Why do we do this step?” “Would a patient be willing to pay for this part of the process if he/she had a choice?” “Is there a more efficient or effective alternative?” “Which steps in the process are most vulnerable to errors?”

Value stream mapping requires attention to detail; each discrete step in a process should be captured on the map. Lean is primarily about “majoring in minors,” that is, performing many small tasks better and creating value through the cumulative effect of small improvements. ThedaCare has a conference room that contains a large, finely detailed map of the patient’s experience during a hospital stay. The admission process involves 124 steps, the discharge process 140 steps. This map has been through 7 stages of refinement at this writing. Various interfunctional teams work with different parts of the map in search of measurable improvement. One team, for example, has been working on reducing hospital readmission rates by improving the discharge process. The hospital value stream map room is where dozens of ThedaCare personnel working on various improvement teams seek to deeply understand the hospital care system’s current state with the goal of improving the value it delivers—increasing the benefits and reducing the burdens for all stakeholders.17

In perioperative services at 8 member hospitals of the New York City Health and Hospitals Corporation, management recognized the need for a different infrastructure to support improvement. To engage interdiscipli- nary teams of front-line staff in the application of Lean tools, an external sensei (teacher) trained internal Lean facilitators at each site to design and lead improvement events. These teams sought to reduce handoffs and steps in presurgical testing, to increase on-time first case starts, to reduce turnaround time between cases, and to reduce the waste in searching for materials and the potential for errors caused by poorly managed inventory. Before the improvement events, the facilitator and area managers collected data to study process steps, cycle and flow times, and handoffs, and they crafted problem statements. During 4.5-day rapid improvement events, teams reviewed the problem; mapped the current and target state; described the ideal state (perfection) and analyzed the gap between the current and target state; developed, tested, and implemented successful solutions; and crafted the metrics necessary to confirm achievement of the target state. Results as of spring 2012 generated from improvement events occurring between 2009 and 2011 at these 8 hospitals include the following:

• Percentage of on-time starts increased from a baseline of 50% of total to a mean of 70%.
• Number of operating room cases per month increased from a baseline of 329 to a mean of 351.
• Operating room turnaround time decreased from a mean of 60 minutes to less than 40 minutes.
• Percentage of cases rescheduled due to late starts decreased from a mean of 21% to a mean of 4.4% of total cases.
• Same-day surgery cancellations decreased from 7% to less than 3% of total cases.

**Principle 3: Lean Is Unity of Purpose**

Because health care organizations are complex systems, it is difficult for the staff to know what tasks are most important. Properly executed, Lean clarifies priorities and guides staff in improvement work accordingly. Lean work is focused work; priorities govern investment of improvement resources.

A key senior management role in Lean is to prioritize and clearly communicate a small number of strategic goal categories that are relevant throughout the organization and that have the most promise to strengthen the organization and create stakeholder value. Ideally, all Lean improvement projects fit within this strategic framework. Specific improvement projects (the “how”) move the organization forward in its prioritized goal categories (the “what”). Management uses a process called “catchball.” From chief executive officer to front-line supervisor, a series of conversations is constantly occurring. These conversations are documented on a single
sheet of paper and changed each time different team members’ ideas are gathered. On the single sheet (called an A3 simply to denote paper size), background and current conditions are documented for the strategy being studied. A strategy statement is developed and goals are established. The opportunities in the marketplace the strategy is attempting to address are identified and countermeasures are suggested. Finally, a plan is established. Through the catchball process, it is not unusual to have 15 drafts of the A3, indicating that many people have been involved in defining the new strategy. This communication back and forth in the organization builds consensus, understanding, and engagement around the priorities.

Lean organizations often use the symbolic term true north and visual expression to communicate and reinforce strategic priorities. ThedaCare’s true north framework (Figure 2) puts the patient in the middle of a triangle and the strategic goal categories at the tips of the triangle. Two metrics are used to measure progress for each goal category and one for the patient, which is a customer loyalty score. This specific framework appears on improvement work boards in virtually every department and unit throughout ThedaCare’s system of hospitals, clinics, and administrative offices. The several teams that conduct 4-day rapid improvement events every week at ThedaCare show how their work supports the true north framework on day 5, when they present their findings at an employee gathering called “Report Out.”

St. Jude Medical Center has defined its true north as “Perfect Care, Healthiest Communities, and Sacred Encounters.” Perfect Care is translated into specific initiatives and metrics for inpatient, outpatient, and support areas. The Perfect Care focus on the critical care floor is the elimination of ventilator-acquired pneumonia. Before conducting a rapid improvement event, critical care staff believed they were doing everything possible to prevent ventilator-acquired pneumonia. The event showed otherwise, and staff implemented a visual management board outside each room of a patient receiving ventilatory assistance. On this board, red and green magnets are flipped every 2 hours as preventable measures are executed. This technique enables staff to quickly determine whether any preventable measure was missed. The care team meets regularly to review clinical evidence and discuss any misses in the preventable measures. The critical care unit has had zero preventable cases of ventilator-acquired pneumonia for more than 3 years at this writing, the result of unity of purpose around a true north metric.

**Principle 4: Lean Is Respect for the People Who Do the Work**

A Lean leadership and management system differs from a hierarchical system in which

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**FIGURE 2.** ThedaCare true north framework. DART indicates days away, restricted, and transferred and is an Occupational Safety and Health Administration formula to track employee injuries and illnesses.
higher-level managers and supervisors tell lower-level personnel what to do and how to do it.20 This is perhaps the biggest challenge Lean implementation poses in many organizations: the people in charge may have to change the most for a Lean culture to develop. Lean, in a sense, turns leadership upside down, with front-line workers doing much of the innovating and managers trusting them to do it and supporting them. Respect for the potential of front-line workers to have the brainpower and commitment to improve the work must pervade the organization. Respect flows downward, not just upward.

In Lean organizations, higher-level managers support the “improvers” by regularly visiting the worksites (or “Gemba” in Lean parlance) to learn firsthand about problems and barriers to improvement, by becoming teachers and role models of quality improvement, and by investing in the education, skills training, and tools necessary for front-line staff to be effective in improvement work. Management must make special efforts to create a safe environment for innovation, such as attacking processes rather than people so that staff members do not fear reporting problems.3 Lean health care organizations often commit to retaining and, if necessary, retraining employees whose positions are eliminated by productivity gains or structural innovations. Such a policy alleviates staff concerns about working themselves out of a job.

Leading a Lean transformation from the top of the organization demands perseverance (because setbacks are inevitable as are pockets of resistance) and humility (because Lean exposes many problems, some of which are caused by the senior leaders themselves). Lean has the potential to turn an organization into a community of innovators. However, this can happen only in a culture of respect.

Martin Health System, based in Stuart, Florida, had an incident in which an emergency department (ED) nurse at its satellite hospital could not quickly locate an intravenous (IV) pump for a patient in the ED. Critical time was wasted before a pump could be located. This incident led to a comprehensive evaluation of nursing care processes. One finding was that nurses were each spending a mean of 38 minutes per shift looking for needed equipment. If the equipment was not available in the unit, additional time was then spent waiting for it to be provided. The effect on patients was less bedside nursing time and delayed treatments.

Nursing staff thought that there were never enough pumps and the solution was to order more. Lean concepts were applied to determine whether a shortage existed and, if so, how many more pumps were needed. The hospital had an inventory of 508 IV pumps to serve 344 beds. On the basis of a national IV pump-to-bed ratio of 1.2 pumps per bed, there was actually a surplus of 96 pumps. The issue was not a shortage but the lack of a procedure for nurses to access pumps quickly and easily. The lack of a procedure led to nurses hoarding unused pumps, which exacerbated the problem.

To improve, Martin installed “equipment supermarkets” in nursing units. The supermarkets contained all necessary equipment for specific units, for example, IV pumps, patient-controlled analgesia pumps, feeding pumps, sequential compression devices, and bed alerts. Standard work was developed to facilitate the availability of needed equipment. The equipment supermarket shelving was color coded and numbered with the quantity of items for each color: green indicates that supply is adequate; yellow, supply needs replenishing; and red, the need to call for immediate restocking of the item. This process improvement has reduced mean nursing time spent gathering equipment to less than 1 minute, contributing to hard-dollar savings and productivity gains. For example, when use of a medication is discontinued, the IV pump is cleaned and returned to the equipment supermarket. By improving the use or “turns” of IV pumps, the hospital was able to replace the existing pump inventory with 100 fewer units, which yielded a direct savings of $300,000. Total nursing time spent gathering supplies was reduced by 34 hours per day.

Multiple departments collaborated on developing, testing, and refining the nursing equipment flow process, including nursing, material management, housekeeping, and decontamination. These staff members became a community of innovators to find a better way to ensure that essential hospital equipment was available where and when it was needed while minimizing nonuse of the
Principle 5: Lean Is Visual

Visual tracking centers exist in numerous locations within a Lean hospital or clinic. These tracking centers are information displays mounted on the walls in staff-only areas. Their purpose is multifold: to present daily and trend performance data on key metrics (eg, patient satisfaction, cost, and quality metrics); to provide a dedicated place for any staff member to communicate an issue that needs attention or to post an improvement idea; to organize all relevant improvement information in one place (including projects not yet started, work in progress, and projects completed); to provide a gathering spot for both scheduled and impromptu staff meetings; and to symbolize a culture of transparency. A common sight in a Lean health care facility is staff meeting in front of a tracking center with the meeting leader continually referring to the posted information. This practice is referred to as “working the wall.”

Visual tracking center information is ever-changing, and thus it is common practice to use erasable marking pens, pencils, or sticky notes to present it. Whereas conventional bulletin boards at worksites often become stale because information either is not relevant or rarely changes, the converse is more likely with Lean tracking centers; the information is dynamic and directly relates to what staff are thinking about in terms of how best to provide what patients need and want.

When Seattle Children’s built its new Bellevue Clinic and Surgery Center, it used Integrated Facility Design, a process based on Toyota’s Production Planning Process approach. The Integrated Facility Design process brings a diverse set of stakeholders together for planning before a shovel ever enters the ground. The early involvement of stakeholders typically results in fewer changed work orders and more efficient construction. During planning, Seattle Children’s brought together nurses, physicians, support staff, patients, architects, designers, and others to help determine the needs, goals, and metrics for the facility and to think through the most efficient flow and use of space. Value stream maps depicting the workflow were developed and agreed on by all vested parties, including patients and families. Families played an important role in fostering understanding of their needs and wants. For example, parents stressed their desire to stay with their child in the preoperative area and the space was designed to accommodate the presence of parents.

The value stream maps helped prioritize design requirements that contributed to the facility being built for $30 million less than initial estimates. The mapping allowed the team to see the waste in their existing care process, much of which they removed in designing a new ideal-state care process. The new ideal state was used to design the building space required, which cost less, rather than the space proposed in the original architectural design. The maps are still displayed in the back hall of the building and are regularly reviewed and updated. Metrics for both the clinic and surgery center are displayed in visual tracking centers throughout the facility.

Principle 6: Lean Is Flexible Regimentation

Processes are perfectly designed to produce the results that occur. But what if the results are not optimum? What if the results of specific processes indicate needless waiting, lost productivity, unexplained error rates, staff dissatisfaction, or patient harm? The key to improvement is determining the root cause (or causes) of performance shortfalls and ridding the process of the cause(s) through redesign. This is the essence of Lean: take nonstandard work processes and transform them into standard processes that improve performance and then continue to improve the standard work design through PDSA.

Standard work is best described as flexible regimentation, a phrase coined by Robert Wilson, MD, a ThedaCare cardiologist. Regimentation refers to developing a common or standard process for performing a specific service based on the best available evidence; flexible refers to ongoing efforts to improve the standard process. A paradox of standard work is that the standards established release creativity. With standard clinical approaches, patients who deviate from the standard are more easily appreciated, freeing up the clinicians to expend their mental energy on issues and patients. An example at Seattle Children’s is the asthma care unit, in which standardization of albuterol therapy has allowed physicians to better identify patients who are not following the typical
course. The fact that the standard approach to treatment does not work calls into question the diagnosis of asthma and forces the physician to search for other causes. The specific design of a standard process offers the opportunity for focused study and testing. Knowledge work is easier to study once it has been defined as a set of expected activities.

Process outcomes are sometimes so variable that they first must be stabilized before they can be standardized. Stabilizing a process involves finding a short-term method to contain unacceptable results until a standardized solution can be developed. For example, a patient falling off the fracture table in an operating room would be considered a “never event.” Should it happen, a hospital might decide to place a nurse on both sides of the table. Stabilizing this process with 2 nurses ensures the safety of the next patient in the same situation, but it may not be the final solution to fixing the problem. The root cause of the fall must be identified before new standard work can be designed to permanently eliminate the defect.

Inova, an integrated health system in Virginia, has 9 EDs that treat approximately 400,000 patients annually. At the beginning of 2008, Inova’s EDs were achieving average performance on quality, patient satisfaction, cost, and throughput measures. During 2008, Inova initiated process improvement in its EDs in conjunction with the implementation of a new electronic medical record system. Each ED completed staff-developed value stream maps that indicated significant flow issues in intake and triage. Patients were routinely ping-ponged back and forth among registration, triage, and the lobby, sometimes even when physicians were available in the back to see them. The prevailing culture in most of the EDs was that a nurse would always see a patient in the examination room before the physician. The value stream mapping work changed this so that physicians could enter the room at any time and their evaluation of the patient would take precedence.

Other new standards included quick registration (3 minutes) followed by quick triage (3 minutes) followed by the patient going directly to a treatment location. Several of the EDs elected to do all triage at the bedside. Use of the new electronic medical record system to measure and trend all stages of the process and to make performance visible was instrumental in improvements realized across all EDs by 2011: length of stay for discharge patients decreased from 215 to 135 minutes, time to seeing a physician decreased from 55 to 22 minutes, diversion decreased from 1300 hours annually to approximately 50 hours, and patient satisfaction increased from the 60th percentile to the 80th percentile in the national database of a commercial research vendor. The EDs have provided approximately $10 million in incremental income each year since 2009 based on a 2008 baseline. Volume has increased 6% to 7% each year with only a few ED beds added. By the end of 2012, the EDs will have provided more than $6 million in labor productivity gains.

CONCLUSION

Lean is an innovative management approach that has proven successful in health care organizations. It offers promise for improving quality and efficiency while controlling costs in the provision of optimum patient care. To implement the Lean philosophy and principles, however, is to undertake an arduous, never-ending improvement journey. Because Lean transforms organizational culture from the inside out, it offers both challenges and opportunities. It requires a major shift in roles: managers and leaders must become facilitators, mentors, and teachers and allow front-line workers to make improvements. It engages the entire staff in identifying and solving problems based on a continuous improvement attitude, the driving force behind Lean work.

The underlying goal of Lean is to improve value for the patient. Innovation through Lean’s proven methods provides hope for better health care at less cost rather than worse health care at less cost. To us, this choice is clear.

Abbreviations and Acronyms: ED = emergency department; IV = intravenous; PDSA = Plan-Do-Study-Act

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REFERENCES

3. Wellman J. Paper presented at: Nemours Foundation Board of Directors Meeting; November 7, 2011; Orlando, FL.
Section 7: Logistics
The Consensus Committee on Optimizing Scheduling in Health Care is looking forward to your participation on November 21st in the Public Workshop on Engineering Optimal Health Care Scheduling. If you have any questions regarding workshop logistics, please contact Kate Burns at kburns@nas.edu or 202-334-2497.

MEETING LOCATION
The workshop will begin at 8:30am and will end at 4:15pm on November 21st in the Lecture Room of the National Academy of Sciences building at 2101 Constitution Avenue NW in Washington, DC. Breakfast will be served on site beginning at 8:00am on November 21st, with the agenda commencing at 8:30am. While the agenda for this meeting has not been finalized, these times provide an accurate estimation for travel planning purposes.

LODGING
Suggested nearby hotels include:
- State Plaza Hotel / 2117 E Street, NW / 202-861-8200 (7 min walk)
- Hotel Lombardy / 2019 Pennsylvania Avenue, NW / 202-828-2600 (12 min walk)
- One Washington Circle Hotel / 1 Washington Circle, NW / 800-424-9671 (16 min walk)
- The Willard Intercontinental / 1455 Pennsylvania Avenue NW / 202-628-9100 (4 min drive)
- The Fairfax at Embassy Row / 2100 Massachusetts Ave NW / 202-293-2100 (5 min drive)

DIRECTIONS AND GROUND TRANSPORTATION
Airports: The meeting site is approximately 5 miles from Washington National Airport (a 20-minute cab ride depending on the time of day) and approximately 25 miles from Dulles International Airport (a 45-minute cab ride).

Metro: The Foggy Bottom metro stop (Orange/Blue Line) is located at 23rd and I Streets NW. Walking from the metro to the NAS building takes approximately 12 minutes. The C Street Entrance to the NAS building is the closest entrance to Metro.

Parking: The parking lot for the National Academy of Sciences is located on 21st Street NW, between Constitution Avenue and C Street. However, space is very limited, so you may want to use an alternate mode of transportation. If the lot is full, there is a Colonial Parking garage near G and 18th Streets, NW (cash only). It is about 15 minutes walking distance from the NAS building.

Detailed driving and Metro directions to the National Academy of Sciences may be found at: http://www.nationalacademies.org/about/contact/nas.html