Improving the Quality and Efficiency of Primary Care through Industrial and Systems Engineering – A White Paper.

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Executive Summary

Primary healthcare is in critical condition with too few students selecting careers, multiple competing demands stressing clinicians, and increasing numbers of elderly patients with multiple health problems. The potential for transdisciplinary research using Industrial and Systems Engineering (ISyE) approaches and methods to study and improve the quality and efficiency of primary care is increasingly recognized. To accelerate the development and application of this research, the National Collaborative to Improve Primary Care through Industrial and Systems Engineering (I-PrACTISE) sponsored an invitational conference in April, 2013 which brought together experts in primary care and ISyE. Seven workgroups were formed, organized around the principles of the Patient Centered Medical Home: Team-Based Care, Coordination and Integration, Health Information Technology (HIT) – Registries and Exchanges, HIT – Clinical Decision Support and Electronic Health Records, Patient Engagement, Access and Scheduling, and Addressing All Health Needs. These groups: (A) Explored critical issues from a primary care perspective and ISyE tools and methods that could address these issues; (B) Generated potential research questions; and (C) Described methods and resources, including other collaborations, needed to conduct this research.

A qualitative summary of the group discussions was completed, resulting in 118 unique ideas and over 60 research questions. The majority of ideas aligned along two dimensions - System Design Factors and Problems and Issues in Primary Care. Within these areas, the three general categories of System Design Issues were: Teams and Workload Distribution, Technology, and Policy (Governmental and Healthcare Organizations). The five general areas of Problems and Issues in Primary Care for research were: Cognitive Needs, Patient Engagement, Care of Community, Integration of Care, and Care Transitions. Examples of these, generated by the workgroups, are provided in the text.

		System Design Factors		
		Teams and Workload	Technology	Policy
Problems and Issues for Research	Cognitive Needs			
	Patient Engagement			
	Community			
	Integration			
	Transitions of Care			

Future work will include follow-up conferences to maintain momentum and monitoring of the results of ISyE and Primary Care Collaboration as well as establishing I-PrACTISE activities at other institutions.

Introduction

Topic Importance and Transforming Care

Primary care physicians are often overwhelmed by crammed schedules, inefficient work environments, information chaos, and unrewarding administrative tasks.[1,2] As a result, the quality of physician-patient interactions in primary care has been declining. In addition, primary care has become increasingly complex, which contributes to clinician burnout. Recent unpublished data from the Mayo Clinic system suggest that 47% of primary care clinicians are suffering from burnout. Support for clinicians and their practice staff is clearly needed.[2]

In an attempt to meet the many challenges of patient care including integrating technology and care coordination for more complex patients, the Patient-Centered Medical Home (PCMH) model has been proposed. This model has evolved into a national movement to transform primary care. PCMH principles include: 1) a personal physician; 2) care delivered by a physician-directed team; 3) a whole person orientation (team provides and/or coordinates all healthcare needs); 4) care that is coordinated/integrated across the healthcare system and patient community using health information technologies, registries, and health information exchanges; 5) a focus on quality and safety; 6) enhanced access to care; and 7) payment restructuring. Early analyses of PCMH demonstration projects show that this transformation is more complicated than initially thought, and evidence supporting best-practices to achieve this transformation remains elusive.[3]

New strategies, including efficient ways to implement the PCMH model and integrate HIT, are needed to support primary care practice, as current strategies may not be effective. As Black et al. noted, "There is a large gap between the postulated and empirically-demonstrated benefits of eHealth technologies... there has been a lack of robust research on the risks of implementing these technologies and their cost-effectiveness has yet to be demonstrated."[4] To alleviate this situation, we need a better understanding of what we term "the basic science of primary care". In addition, we need to develop and critically evaluate methods to support our primary care workforce so they can care for this nation. This is particularly urgent considering the increasing numbers of ageing and complex patients, and new patients under the Affordable Care Act.

The Institute of Medicine (IOM), the National Academy of Engineering, The National Research Council, the National Science Foundation, and the Agency for Health Care Quality and Research (AHRQ) have funded workshops intended to address these concerns.[5,6,7] These groups have all recommended collaborations between Industrial and Systems Engineering (ISyE) and healthcare

professionals as one way to develop the science base to inform the effective development of teams; technology; and policies to improve care, practice efficiency, and the primary care workforce. ISyE science is the science of systems integration, human and technological, and not the study of components in isolation; the ultimate goal is to designing systems to optimize the outputs of all these components simultaneously. The healthcare component of ISyE studies is how humans and technology can best be utilized to improve healthcare, care quality and efficiency. This component often focuses on understanding the cognitive and workflow attributes of primary care – "the basic science of primary care". Improvements in effectiveness, efficiency, timeliness, quality, and safety should result from this research.

The National Collaborative for Improving Primary Care through Industrial and Systems Engineering (I-PrACTISE)

The I-PrACTISE collaborative (http://cqpi.engr.wisc.edu/I-PrACTISE_Home), also known as the "Karsh Initiative", is an educational and research collaborative between the University of Wisconsin (UW) Department of ISyE, and the Departments of Family Medicine, Medicine, and Pediatrics of the UW School of Medicine and Public Health. I-PrACTISE was established in 2012. It is an initiative housed administratively under the UW's Center for Quality and Productivity Improvement (CQPI), an interdisciplinary research and education center at the UW-Madison's College of Engineering. In addition to I-PrACTISE, other research and educational activities at CQPI are listed in Appendix A.

The formation of I-PrACTISE provided a formal structure and administrative home for activities which aim to improve patient care and primary care practice by becoming more efficient though new knowledge and techniques created by the collaboration between ISyE and the primary care specialties. We realized that to accelerate the collaborations repeatedly called for by the IOM required close collaboration not just between ISyE researchers and healthcare professionals/researchers generally, but rather between ISyE researchers who study healthcare and specific healthcare domain specialists such as primary care specialists.

The I-PrACTISE mission is: To create an interdisciplinary collaboration for scholars and clinicians with interest and expertise in ISyE and/or primary care. This collaboration will facilitate the conduct of both internally- and externally-funded projects directed at improving the quality and safety of primary care for patients, clinicians, and staff. The collaborative is open to faculty from UW as well as interested scholars from other professions and institutions.

The initial conference, described in this white paper, launched this transdisciplinary research by convening nationally-recognized experts from both areas to develop a research agenda to promote primary care practice transformation to meet current and future US healthcare challenges. The conference sought to build a research agenda for primary care broadly and not in one particular area (e.g., electronic health record [EHR] design). Our ultimate goals are to: 1) Make the transition of primary care to the PCMH faster *and* easier; 2) Develop better HIT

solutions such as EHRs and their implementations that are better tailored to the unique information management and coordination demands on primary care professionals; 3) Improve the performance of primary care teams; 4) Improve scheduling of primary care patients based on each patient's unique demands; 5) Optimize information flow within primary care teams, during transitions of care, and between care settings; and 6) Streamline clinic operations.

Collaborators

Collaborators included the UW Departments of ISyE, Family Medicine, Medicine, Pediatrics, Nursing, and Pharmacy. Brief descriptions of these departments can be found in Appendix B.

Linkages for Research Collaboration and Dissemination

Important linkages, both for research collaboration and dissemination include the Wisconsin Research and Education Network (http://www.fammed.wisc.edu/research/wren); Medicare's Quality Improvement Organization, MetaStar (http://www.metastar.com/web/); and UW's Institute for Clinical and Translational Research (ICTR). These organizations and their links to I-PrACTISE are also described in Appendix B.

How This Paper is Organized

The remainder of this white paper presents the conference aims and procedures, including data summarization (Methods); individual summaries of the seven working groups created from notes and summaries provided by the workgroup leaders and compiled by one of the editors, M.S. (Results: Specific Findings by PCMH Attribute Workgroup), and a summary of the results, developed by the conference research associate, E.O. (Results: Summative). These sections are followed by a conclusion and call to action created by Dr. John Beasley. These are followed by a listing of the seven group participants, Tables and Figures, references, and appendices.

 Methods

The aims of the 2013 conference were to: 1) Develop a research agenda for advancing primary care practice using ISyE science; 2) Produce conference deliverables, including a white paper, conference presentations, and formal presentations about the research agenda; and 3) Widely disseminate conference products to funding agencies and researchers directly through publications and presentations, and at the I-PrACTISE and partnering websites.

The conference was attended by 75 invitees, 46 from Wisconsin and the remainder from elsewhere in the US and Canada. Twenty-nine participants were experts in primary care, 27 were experts in industrial engineering, and the remainder were from other related disciplines including psychology, nursing, pharmacy, administration and medical informatics. Following plenary sessions by Drs. Carolyn Clancy (Director of AHRQ), Pascale Carayon (ISyE) and Christine Sinsky (Primary Care), participants were divided into seven workgroups, each organized along

one of the PCMH attributes: 1) Team-Based Care, 2) Coordination and Integration, 3) Health Information Technology (HIT) – Registries and Exchanges, 4) HIT – Clinical Decision Support (CDS) and Electronic Health Records (EHRs), 5) Patient Engagement, 6) Access and Scheduling (including efficiency and job satisfaction), and 7) Addressing All Health Needs. The purposes of the 7 groups are listed in Table 1. We did not ask any one of the groups to address funding issues as this was deemed to be outside the scope of the research agenda (although one did), and we divided HIT into two subgroups which addressed two different aspects of HIT use.

Each of the seven workgroups had two co-chairs, one selected for their expertise in primary care and the other selected for their expertise in ISyE. The group writing process was facilitated by a "writing coordinator", most often a graduate student or post-doc in ISyE, so that the group co-chairs could focus on running the groups.

Each workgroup met three times for 90 minutes each and, with a few exceptions, the composition of each group remained stable throughout. The three sequential sessions examined:
1. Relevant issues from a primary care perspective and ISyE tools and methods that could address these issues;
2. Specific research questions and projects that could be developed; and
3. Methods and resources, including other collaborations, needed to conduct this research.

The group leaders, with the assistance of the writing coordinators, submitted notes and workgroup reports shortly after the meeting. Write-ups were then reviewed by conference leaders and summarized by a research associate (E.O.) skilled in qualitative analysis. The initial analysis was carried out in the following manner:
1. All 118 unique workgroup ideas generated were organized into a list. An idea was included if it was mentioned more than once or represented a main idea discussed by one of the groups. There was no attempt to organize ideas apriori into themes.
2. If a workgroup idea was also generated or discussed by another workgroup, the workgroup idea was added to the list again. This resulted in a list of 140 ideas, some of which were duplicates. This way central ideas generated by more than one group could be identified by a simple count.
3. The 140 workgroup ideas were then classified within larger themes in an ad hoc fashion by the research associate. If a workgroup idea represented a specific facet of a larger theme, it was placed in a subgroup within that theme.
4. Once workgroup ideas were classified into themes, these were rank listed and diagramed based on counts to indicate the most important concepts or issues generated by the groups.
5. Group notes and summaries were provided to a medical editor who summarized key ideas, research questions and discussion points within each group, creating text summaries and tables for this white paper.

Results: Specific Findings by PCMH Attribute Workgroup

Team-Based Care

Discussion began with definitions of healthcare teams (Table 1). Key characteristics were also discussed for developing and maintaining successful care teams centered around defined populations and team membership (Table 1). Model development was also discussed with a need to consider boundaries listed in Table 1.

In generating research questions (Table 2), a number of important concepts were introduced. First, that populations were not likely to be fixed/static, thus the team and its membership must be fluid in order to accommodate changing needs. Second, all stakeholders should be considered in developing and implementing team models (Table 2, question 3) along with an understanding of how to communicate this change in care delivery and how to facilitate it. Facilitation may in fact include engaging patients as team members. Third, as teams are likely able to provide more care and care coordination while striving to provide the highest quality care, models must include ways to activate the team outside of the traditional office visit to optimize preventive care and health maintenance. Once teams form, methods for sustaining high performing teams must be investigated (Table 2, question 6). Reward was seen broadly in this context, going beyond financial remuneration. In addition, in order to create and maintain a successful team, team training and education should be provided to all members.

Finally, information sharing must flow between team members to support distributed cognition and team performance. However, information sharing and the method by which it is shared is constrained by numerous factors including governmental regulations, institutional policies, and access and functionality of EHRs. In fact, as EHRs are increasingly implemented, more research needs to be done to learn about EHR's role in team-based care.

Coordination and Integration

Discussion focused on generating issues that require ISyE research from a primary care perspective on care coordination (Table 1) and forging an ISyE/primary care partnership at the practice level. Ideas included synchronous vs. asynchronous communication and relationship building between team members and team members and patients (including involvement in practice improvement and care coordination efforts). Other considerations were barriers to care coordination at the macro and micro levels. The macro level included policy constraints, provider allocation, and reimbursement. The micro level included practice management buy-in, cultural differences, care transitions, and unnecessary steps during the patient visit.

Facilitators are also needed to improve care coordination such as technology and systems approaches across the "care journey", care continuity (informal, management, relational), change implementation (simple, rapid cycle improvements), and community-based management of patient populations. These could be further distilled into areas of clarification and optimization of roles within and between clinical and nonclinical care team members and levels and systems of

care. Enhancing communication, collaboration and care coordination with attention to health literacy and patient engagement are essential components as is effective design and use of technologies (health IT, telemedicine, data capture) to improve care coordination.

In discussing care across multiple healthcare settings (e.g., long term care, home care) and through multiple perspectives (patient/family, provider, system), the model created by McDonald was forwarded (Appendix C).[8] Key research considerations are listed in Table 1 and the central research question are displayed in Table 2.

Health IT – Registries and Exchanges

Definitions of registries can be narrow (e.g., clinical treatment data) or broad (a functional, dynamic set of attributes derived from any available clinical data to serve a variety of purposes); the latter was favored by physicians in the group. Such functional registries should provide point-of-care information as well as population-level data for management of patient panels. EHRs designed as copies of medical records do not support physician workflow and are proprietary, which creates a barrier to information sharing in a universal registry. To accomplish data sharing across EHRs and other data sources, Extraction, Translation and Loading (ETL) processes must be applied to normalize data. In addition, the rigid division of labor in many areas of healthcare fostered by cultural, organizational, and policy-related factors such as regulation and licensing, impede widespread use of system tools.

Discussion began with underscoring the importance of employing theories of organizational change (e.g., Diffusion of Innovations Theory) in crafting a health IT implementation plan. Implementation plans must be adapted to different problems/situations and actively involve clinical staff to ensure that the technology meets clinical needs and aligns with workflows. With respect to staff involvement, note was taken of the importance of protocol development, policies for sharing data, data governance, and a physician champion to promote registry use.

Financing and choosing among multiple registries across multiple vendors can be obstacles; ideally EHR's should facilitate point-of-care CDS and allow staff to create their own registries. In addition, implementing registry software must overcome the challenges of EHR access and privacy concerns such as need for data deidentification and IRB approval for some uses of data (quality improvement vs. research purposes). At the population level, registries should enable appropriate allocation of human resources. In practices with learners, medical education should be addressed.

Multiple questions were generated about components (which may change) and functions of registries; creating 360 data incorporating claims, hospital, clinic, and patient data; increasing registry use (e.g., staff education, point-of-care access); optimizing implementation (note was made of creating a vendor-agnostic registry, embedding registries within EHRs, and need for consistent data entry); defining the appropriate terms and the need for a data warehouse; and

identifying ways that registries might improve outcomes, including patient satisfaction. Also discussed was the need to understand stakeholder perspectives, create access for both groups, and the importance of information exchange that goes beyond shared registry data. Consideration of a minimal dataset (core data) as a starting point was mentioned and how to prioritize data for capture. Finally, what can be gained from ISyE with respect to registries and information exchanges such as understanding workflow through use of mathematical modeling or simulation?

A distinction was made between health information exchange and registries, the former enabling information about specific patients vs. populations. The group recognized a need for commonly accepted definitions and conceptual models for both. To summarize the many stakeholders and issues that must be considered in studying registries, a table shell designed by the group is provided in Appendix C. Specific research questions generated by the group are listed in Table 2.

Health IT – Clinical Decision Support (CDS) and Electronic Health Records (EHR)

Important issues raised during initial conversations included distraction effects (signal noise), workload distribution, and total workload generated from use of these tools, which can increase or decrease physician and administrative workload unless designed well. There is also a need to address different needs for standard vs. undifferentiated work, extend CDS across the health care team, and find ways to prioritize and limit numbers of messages, especially for patients with multiple co-morbidities. Systems need to be built with an understanding of the cognitive work of primary care, be user-centered with context-specific customization, and be improved upon through crowdsourcing (obtaining needed services, ideas, or content by soliciting contributions from a large group of people, and especially from an online community) by users who work directly with the systems or monitor them. EHRs and CDSs can't exist in isolation but need to connect with other healthcare systems and the patient.

ISyE perspectives should be sought around sociotechnical system design; cognitive process analyses; user experience evaluation; and analytical tools and methods such as mathematical modeling, process modeling, and value-stream mapping. Vendors and healthcare organizations should be encouraged to take advantage of ISyE as a resource. The possibility of creating a national repository for best practices was also mentioned.

Researchable ideas are listed in Table 2. In discussing research questions, this group offered suggestions for how such research might be conducted. Ideas included using mixed methods approaches, best practice study, conducting basic science on how to function in teams and lead teams, and advancing cognitive science as it applies to undifferentiated-patient encounters and time/resource-intensive patient encounters. Researchers should also study information-seeking behavior, user pathways, and workarounds devised by team members, and use those results to redesign systems and displays. Greater understanding of these systems may also be gained through measuring work involved in EHRs and CDSs (which components add value), the

mismatch between work and worker level when using these tools; lean perspectives (preserving value with less work); and how displays are shared between the patient and clinician. How patients prioritize health problems and make use of e-visits and other outside-of-office care will also inform these tools.

Finally, key contributors to these efforts include ISyE; behavioral, cognitive, information, and organizational scientists; front-line workers; patients; user experience experts; facilitators/coaches; payers; economists; and health policy makers. Potential funders for this work include federal grants, payers (especially large block single payers, Centers for Medicare & Medicaid Services, and Veterans Administration), purchasers, vendors, foundations, industry, and Accountable Care Organizations, and other large healthcare organizations.

Patient Engagement

Discussion began with attempts to define patient engagement. One definition offered was activity and actions in which the patient partakes, outside of office visits, to promote their own health-related goals. The role of the provider was seen as important for providing information rather than persuasion and to give permission to the patient to engage with them in this endeavor. Patient satisfaction was also mentioned as a driver for looking at patient engagement. Also noted was the importance of broadening this concept beyond a particular problem or issue such as cost or a particular disease, while remaining patient-centered.

People are more educated and informed and health is no longer embarrassing to talk about. Many individuals are interested in medical decision-making and in guiding their healthcare, often taking the initiative to engage (especially in the early motherhood realm). In addition to receiving input before seeing a provider, it may take time for some to be willing to even seek care from the health system. Patient engagement may be a developmental process moving through engagement and activation to empowerment or motivation to change. This brought to mind the five levels of involvement incorporated into the Health Canada Policy Toolkit for Public Involvement in Decision Making (http://www.hc-sc.gc.ca/ahc-asc/pubs/_public-consult/2000decision/index-eng.php#a11) which moves from communication, listening and consulting to engaging and partnering.

Messages provided to patients are therefore important, as healthcare was seen by the group members as being more commercialized/market driven, which can be to the detriment of patients. Patient engagement is also influenced by factors such as geography, health literacy, and prior experience and the system needs to calibrate to provide optimal messages to fit patient needs. As tools, like patient portals, are being developed, it is important to bridge gaps in informational needs and the process of care. Through understanding patients' needs, they can be directed to the right person and right place.

It is as yet unclear whether a best approach to patient engagement is need driven, goal driven, or should be developed in some other way through empirical data. Starting with needs may run the risk of improving old ways instead of coming up with new ones. Later in the conversation, one participant spoke about using technology as a rapid way of getting assessment information; learning in rapid cycles could replace the current clinical trials system for studying innovations and engagement.

Discussion moved to what ISyE can bring to patient engagement and what can be adapted to the healthcare environment. Note was made of ISyE's multiple roles in manufacturing and ergonomics. One member voiced concern that a cost perspective should not be the most motivating factor in healthcare. Tools that might be useful would be those built around shared decision-making, risk-algorithms including numeric estimates based on best evidence, communicating, and goal alignment with a focus on health. As one participate stated, "the process needs to be improved; integrating clinical evidence with business goals to come up with something everyone can live with."

As a final note, the group considered the use of the word "patient" and the social constructs surrounding the term, as engaging in health maintenance activity such as jogging does not bring the word "patient" to mind. Health providers also need to engage the healthy segment of the population around healthy behaviors outside of traditional settings. A big question might be whether the construct is patient engagement with health or engagement with healthcare systems.

Access and Scheduling

The group discussed the work of primary care that has implications for understanding access and scheduling. These included diagnosis and disease management (e.g., number of visits for a laceration and long standing thyroid disease will differ), stakeholder satisfaction and levels of frustration, and physician reimbursement and facility fees. Ultimately the question came down to "how do we make time for all the clinical encounters needed (access) and appropriately match patients with clinicians to maximize their interaction (scheduling)?" This was deemed especially important in light of the enhanced role primary care is expected to play within the Affordable Care Act 2010.

Research questions began with those leading to an understanding of the current system (Table 2). Identified research methods from ISyE for studying access and scheduling included data mining to elucidate useful patterns and trends within the primary care setting with respect to population characteristics, scheduling patterns, and shifts in panel composition; modeling and simulation around patient flow and to test changes in processes as they related to access and work flow; Value Stream Mapping to document, analyze and improve the flow of information and materials to optimize performance and identify redundancies and obstacles; and studying the work system through human factors and ergonomics and industrial psychology. The latter included usability

assessments of tools and cognitive artefacts, assessment of the work climate and relational coordination, and failure mode and risk assessment techniques for assessing processes.

Potential obstacles to performing this type of research were also discussed. Although there are few sources of research funding dedicated solely to primary care, organizations with platforms/mission statements that appear amenable to this primary care research include AHRQ (www.ahrq.gov), the American Academy of Family Physicians Foundation (www.aafpfoundation.org/), Office of Behavioral and Social Science Research at the National Institutes of Health (obssr.od.nih.gov/), National Science Foundation (www.nsf.gov), Robert Wood Johnson Foundation (www.rwjf.org), the Commonwealth Fund (www.commonwealthfund.org), Clinical and Translational Science Awards Consortium (www.ncats.nih.gov), and the Institute for Clinical and Translational Research at University of Wisconsin/Madison (https://ictr.wisc.edu/). Identifying and preparing practice sites for study may also be problematic due to the Health Insurance Portability and Accountability Act (HIPAA) laws, limited exposure for most practices to academic research, and potential disruption in the clinical enterprise.

Concern was expressed about research teams viewing this area of study too narrowly. For instance, those from ISyE may only view the study of access and scheduling through the lens of optimization, underestimating the inherent variation present when dealing with the management of human beings and disease states. Participants from the health care domain, including patients, may have little to no appreciation of ways in which ISyE can be of benefit in solving access and scheduling problems, resulting in these experts being viewed as interlopers or carpetbaggers. The group felt that focused efforts must be made by research teams studying this area to explicitly acquaint all research team members and subjects about expertise being brought to the project. Additionally, emphasis should be placed on the dynamic nature of access and scheduling work, and the importance of this work being adaptive to the variation embedded within.

Addressing All Health Needs

The group summary noted that a whole-person orientation that addresses all healthcare needs has been the traditional foundation of primary care and of the current PCMH model. This group was charged with moving the perspective of healthcare beyond the walls of the clinic and the individuals already in the care system to consider the health needs (as opposed to health services) of the population. Just as reframing from patient to whole-person care required significant changes in how we redesigned practices with respect to cognitive burden on care providers, staffing, logistics, technology, and visualization of the "whole person," reframing the concept to all health needs of the entire population requires a systems perspective in rethinking and retooling primary care to address health needs in this broader ecology. Healthcare is seen as but one factor in addressing all health needs. This blurs lines of demarcation and responsibility

between the primary healthcare system and other allies in the health ecosystem: education, transportation, nutrition, commerce, and community.

Discussion began with consideration of the meaning of "all health." This focus moves upward from the individual with their values and health beliefs through communities, countries and ultimately the world, to encompass all people's health. Key elements of health include prevention, disease, injury, behavioral health, social determinants of health, and self-care. Within this framework, the group envisioned the primary care system as a hub and point of entry into a network of relevant sociotechnical systems aimed at addressing health needs in a population (Figure 1, Appendix C). In this way, care would occur across the life spectrum, connect better to community and other "systems" related to health and perhaps, most importantly, connect better to individual preferences and needs related to health.

Primary care would play a critical role in guiding people in the directions needed to achieve or improve health, serving as a compass or road map. A truly holistic system of primary care would require both proactive and reactive approaches, through provision of conventional healthcare services and, more broadly, in creating and nurturing healthy communities. Only through understanding the true needs of each person and then working to connect with and integrate into a broader community of health, can primary care truly achieve a whole person, whole population orientation. Associated research questions are displayed in Table 2.

Issues explored by this group included information overload and how to sift through this information for answers to determining and predicting desired and needed levels of care for individuals, addressing the social aspects of health, and describing primary care roles and boundaries with a new orientation towards health within our communities vs. healthcare. In addition, one role of primary care is to help people access health information.

The group noted that the present system was designed as a payment model and is not sustainable. Additional discussion addressed the need for a systems view (or multiple systems) and whether the chronic care model could serve as a guide for primary care. The group also identified a need to conceptualize and implement balance in the health system, as demonstrated in the Systems Engineering Initiative for Patient Safety model which describes the relationships between the person, tasks, technology and tools, organization and environment.[9] The potential roles of ISyE in helping primary care move forward were outlined and are summarized in Table 1.

Results: Summative

In total there were 118 unique ideas summarized in Figures 2 and 3 below. Figure 2 presents these ideas in rank order based on counts, with ideas mentioned only once listed in the footnote. Figure 3 presents identified subthemes within the larger workgroup ideas. There were over 60 research questions generated by the seven groups (Table 2). The majority of ideas aligned along two dimensions - System Design Factors and Problems and Issues in Primary Care. Within these

areas, the three general categories of System Design Issues were: Teams and Workload Distribution, Technology, and Policy (Governmental and Healthcare Organizations). The five general areas of Problems and Issues were: cognitive needs, patient engagement, care of community, integration of care, and care transitions. These System Design Issues and general areas of Problems and Issues in Primary Care are displayed in Table 3 along with examples of research needs generated by the workgroups.

Conclusions

This conference has successfully outlined several areas for transdisciplinary work between ISyE and the primary care specialties. A rich research agenda emerged which could be categorized into two general areas. One major line of potential topics were those addressing the basic science of primary care (e.g., What are the cognitive and task issues clinicians and staff face for which technological and other support is required?). The other line of inquiry would be direct evaluations of the influences that technological and other support, as currently or potentially used, have on primary care quality and efficiency.

Table 3 provides a summary of potential research areas with the System Design Factors being explored and evaluated in terms of the cognitive needs, patient engagement, community, integration, and care transitions. For example, the research could explore and evaluate the cognitive needs relative to team functioning, the use of technology or policy. The results of this conference were used to develop a funded application to AHRQ for a continuing 3-year conference series (R13 HS23028-01).

Call to Action

America, and indeed the world, needs effective and efficient primary care if healthcare is to be excellent and less costly. Nonetheless, as noted above, primary healthcare continues to be in critical condition with too-few students selecting careers, multiple competing demands causing clinician stress, and increasing numbers of elderly patients with multiple health problems. This, coupled with interventions (e.g., technology, regulations) that may not be based an adequate conceptual or evaluative science will make care more difficult, less efficient, and more costly.

We need to engage in high-quality research to improve this situation. This research should involve disciplines with approaches and methods that help our understanding of the realities of primary care and have the potential to evaluate technological and systematic support for care. Transdisciplinary research using ISyE approaches and methods to study and improve the quality and efficiency of primary care is essential if the challenges are to be met. Such collaborations should be funded and encouraged.

Group Participants

Team-Based Care
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Health IT – Registries
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Health IT – Clinical Decision Support and Electronic Health Records
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Tables and Figures

Table 1. Workgroup Purpose, Key Findings, and Resources Needed

Workgroup	Purpose	Key findings
Team-Based Care	To identify how teams should be developed and sustained in order to successfully achieve their goals of 1) enhancing care quality, 2) increasing individual team member's satisfaction with care, and 3) decreasing cost of care	**Team definition**: groups of interdependent people who have the emergent property of an ability to accomplish more together than any one of them could alone **Necessary ingredients for success:** • Defined population (geographical area, system, panel) • Interdisciplinary team members* including "virtual" members • Creation of a model for team-based care considering resources, quality, access, availability, regulations, licensure, and educational level of members
Integration and Coordination	To identify issues in primary care with regard to integration and coordination that can be improved using ISyE research methodologies and tools	**Research on care coordination should consider**: • Multiple transitions of patient care within and across healthcare settings • Multiple layers in the healthcare system to navigate (e.g., offices, payers, systems) • A common structure to describe patient contextual issues (e.g., family, support systems, stressors, limitations, preferences, values) • Ways that ISyE can assist primary care practices develop skills in quality improvement processes using simple methodologies and tools
HIT – Registries	To define primary care needs around registries/HIE and the perspectives that ISyEs can bring to support this work To define key elements and functions of registries and HIE, and develop a framework for evaluating the use of registry systems in primary care	**Key issues** are the HIT implementation processes, potential ISyE facilitation, and how various stakeholders utilize technology to improve the quality of care they provide. Registry aspects that need consideration include: • Definition, data source(s), content, and function • Data acquisition and entry • Implementation barriers and facilitators • Data access, security, and presentation • Protocols and policies for data sharing and governance
HIT – CDS and EHRs	To identify key issues around use of CDS tools and EHRs that decrease their effectiveness and which may be improved by ISyE or other perspectives (such as cognitive science)	**Key areas in need of investigation** include: • Distraction, alert fatigue, and patient specificity • Workload and workload distribution, including extending decision support across the team • Flexibility for standard and undifferentiated work and connections with other care systems • Creation of customized systems based on cognitive science, users, and context • How ISyE can improve these systems through sociotechnical design, cognitive process analysis, and

		modeling, and exert influence on vendors
Patient Engagement	To define patient/family engagement and describe the recent changes in patient activity, desires and capacity for decision-making around health issues and health-related goals	**Issues that were discussed included:** • The role of the care provider in information sharing and permission giving to engage patients • The role of the patient in information gathering, initiating, decision-making and guiding care • The process of engagement as a developmental one leading to empowerment/motivation and potential tools for patient engagement such as patient portals and risk-algorithms • Factors that affect this process including geography, health literacy, and prior experience • Potential approaches to patient engagement and the study of this process, including use of ISyE
Access and Scheduling	To identify potential research topics and issues related to access and scheduling within primary care	**Key findings:** • Access is seen as an indispensable activity to the provision of primary care • Areas in need of research include: current state of establishing access, scheduling, and the process and flow of patients; the definition and redefinition of a patient "visit"; the nature of variation in primary care and how this influences access and scheduling; and stakeholder expectations, satisfaction, and apprehensions around access and scheduling • Research methods to be considered include population and practice data analyses for patterns and trends, modeling and simulations, value stream mapping, and investigation into human factors and ergonomics and Industrial Psychology
All Health Needs	To describe a primary care perspective for "all health", how ISyE can help meet these needs, and pose research questions to further explore all health needs	**Key findings:** • Healthcare is but one factor in "all health needs" • Key elements of health include prevention, disease, injury, behavioral health, social determinants of health, and self-care • The primary care system should be a hub and point of entry into a network of relevant sociotechnical systems aimed at addressing population health needs • Primary care should strive to create and nurture healthy communities • Research is needed in managing information overload, determining and predicting desired and needed levels of care for individuals, addressing social aspects of health, describing primary care roles and boundaries with a population orientation, and conceptualizing and creating balance in the health ecosystem • Potential roles for ISyE include redefining the scope of "all health needs"; using a macro-ergonomic approach in exploring PC systems; identifying key cognitive tasks, challenges, and related informational needs for providers, staff, and patients; defining and

			helping to distribute and balance the "new work" among this group; finding ways to reduce healthcare costs while improving care quality; and describing the complexity of nested health systems to stakeholders, policymakers, and health leaders

*Team members can include patients

Abbreviations: CDS, clinical decision support; EHRs, electronic health records; HIE, health information exchange; ISyE, industrial and systems engineering; HIT, health information technology; PC, primary care

Table 2. Research Questions Generated by Workgroups

Workgroup	Questions and Qualifiers
Team-Based Care	1. Do we need to refine our definition of healthcare? 2. What population are we serving with our teams and when? This is likely dynamic. 3. How do we develop a model for team development and function? This should be informed by healthcare workers' and patients' perceptions, determination of the best team leader, maintenance of a patient-centric view, and apply to care beyond the healthcare site. 4. How do we engage patients as team members? 5. How do we implement new models of team-based care in clinical practices? Activating the care team not only when a patient presents for care. 6. How do we sustain high performing teams? Consider optimal use of feedback, reward systems, team performance metrics, evaluation of outcomes of care, and ongoing training. 7. How, when, and what type of information should be presented to individual team members in order for them to fully utilize their expertise?
Integration and Coordination	8. What are business/value-added models, including an extended care team, for patient-centered care coordination? Value added refers to the six IOM quality aims and in consideration of dynamic contextual awareness.
Health IT – Registries and Exchanges	9. What are the key aspects (e.g., content including a minimal dataset and function) of registries for individual patient and population management? 10. How do we incorporate patient data with other data sources to create a 360 degree view? 11. How can patients be involved in all steps in creating registries and HIE? 12. How can we define functionality and performance so that products can be compared? 13. What are the optimal ways for data entry by patients, staff, and clinicians? 14. What are the best ways to implement use of registries and promote their acceptance? This includes consideration of purpose, data capture, users, barriers, and payment; each of these might need further study. Also, lessons learned from the international communities and in country best practice should be incorporated. 15. Who should have access and how do users want information presented? 16. Where should a registry exist and can they be universal vs. proprietary? Issues of data storage, agreements, policies, and legal issues must be discussed and resolved. 17. How can ISyE best be involved to help define the processes for designing and implementing systems and influence EHR vendors about registries? 18. Does the use of a registry improve care?
Health IT – CDS and EHRs	19. How can EHRs be improved (increasing useful and eliminating redundant or irrelevant information, reducing information overload, improving synthesis and presentation of information at right time)? 20. How can EHR and CDS alerts best be used, minimized, and prioritized for specific patients? Which types of alerts are most effective? How do patients respond to these alerts (positive and negative)? 21. How can CDS systems be improved (considering how team members think about process alerts, using crowdsourcing, alternatives to alerts, incorporating patient values in shared decision-

	making)? 22. What is the influence of CDS and EHR on: workflow, face-to-face and outside of visit clinician-patient interaction, and on quality of care and patient safety? 23. How can clinician-patient shared use (real-time in visit) of CDS and EHR be developed and promoted? 24. Which tasks are best done by HIT and which during team-member/patient interactions? 25. What are other effective approaches to patient reminders and how do they support workflow? 26. What are the best ways to train team members (including residents) in systems-based care?
Patient Engagement	27. *Information sharing/education*: What kinds of information are most helpful in enabling patient and family engagement and shared decision-making? How can information be presented to be most useful and engaging to patients and providers? How can healthcare providers best tailor messages to patient's needs? What is the best way to present information to patients to help with decision-making? 28. What are patient factors that contribute to engaging in healthcare? 29. How can we effectively incorporate patient-gathered information into the PC encounter (and system)? 30. *Process enhancement*: What is currently available to facilitate patient engagement and questioning and to help patients and providers engage in shared decision-making? What processes can be used to "optimize" patient engagement in health outside of the healthcare system (or patient caring for themselves) and with engaging with their healthcare providers? What are the roles of the team members in patient engagement? What is the role of group or family visits on patient engagement? 31. *Practice environment*: Which environments and systems (e.g., staffing models) facilitate and systematize innovation and patient engagement? How can practice redesign be used to enhance patient engagement? How do we create more platforms/apps that are engaging? How do we best measure patient-centricity? How can we best match patient need with the best resource to meet that need? 32. How can patients be supported in executing clinical tasks? 33. Does patient engagement improve satisfaction, efficiency, and health outcomes?

Access and Scheduling	34. What is the current status and perceptions of process/flow for scheduling?
	35. What are the tasks, tools and technology used during the process of scheduling, what facilitates this activity, and what are the potential new tools?
	36. Who controls and coordinates the scheduling process, what data are used and whose needs does it meet?
	37. What are potential drivers for access and scheduling within PC? Potential drivers include regulations; compensation/reimbursement; administrative pressure (productivity, enrollment, minimizing complaints); practice culture, variation, and ways that practices cope with that variation; provider skill level; stakeholder fear/apprehension (e.g., privacy); pressure to improve care rapidly and inexpensively.
	  • With respect to practice variation, what parallels can be found to other work domains in which variation is recognized, expected and adapted to, most especially in those settings where variation is valued?
	  • Could these processes be applicable to structuring access and scheduling matrices in PC?
	  • Are there tools that can monitor variation within the work system of PC and the patient population being served?
	38. What are potential performance-shaping factors related to access and scheduling? Considerations include domain complexity (e.g., single office, series of clinics, telemedicine), practice innovations and incentive programs, variations in patient types/needs and time allotments, distribution of administrative duties to providers, use of cognitive supports and tools (e.g., CDS), degree and type of access to patient clinical data by scheduling staff when making appointments, communication methods and understanding of the work system by

	stakeholders, usability of scheduling software, and practice climate. 39. What opportunities exist for recruiting time from existing clinical appointments that could be used to create more time slots (e.g., administrative tasks performed by the provider, examination room design that would support provider efficiency, moving some activities to in-home or virtual visits)? 40. What types of compensation models are possible for non-traditional patient "visits" (e.g., Skype visits, telemedicine visits, and email consultations)? 41. Can more precise "agenda setting" during a "visit" lead to more closely matching of types, modalities and length of a patient visit and improve access? If so, what resources and skill sets would be needed for such an approach? 42. Can better mapping of provider skill sets onto patient co-morbidities/complaints improve scheduling and access? 43. What methods of process improvement from other domains, such as manufacturing, could be discretely applied to access and scheduling to enhance quality and effectiveness of the patient provider encounter? 44. What are the existing taxonomies (e.g., sick visit, routine visit, prescription refill) and can these be used as better guidelines for mapping patient needs onto a scheduling matrix? 45. What is the role of technology (e.g., e-visits, telemedicine) for increasing access and expanding scheduling opportunities? 46. What role could continuous monitoring and early warning systems performed via smart technology have in projecting the frequency of needed access and scheduling PC visits? 47. What are stakeholder's expectations, degrees of satisfaction, and fears/apprehensions related to scheduling and access care?
All Health Needs	48. What are "all health needs" of people in a panel/population and how can we prioritize them? 49. What are the key tasks and cognitive implications for addressing all health needs in PC? 50. How can health needs be mapped to appropriate people and resources? 51. What are the interfaces and communication between and within systems involved in addressing all health needs? 52. What are the levels (e.g., individual, family, community, population) that address "health needs of all people" and the associated PC roles and responsibilities? 53. How can the distribution of new work of "all health" be allocated across PC teams and how can we measure this work? 54. What is the gap between "all health needs" and the current focus/content of PC? 55. How will "meeting all health needs of people" affect (positively or negatively) health work and health workers? What changes, stressors, burdens (e.g., responsibility vs. authority) are associated with meeting these needs and how can the stresses be avoided or mitigated? 56. How can existing systems be optimized to support cognitive tasks, resources, task allocation, handoffs and information flow? 57. To what extent are systems generalizable; how much variation is there and should there be? 58. What technology is needed to support a changing role of primary care in a broader ecology of health systems? 59. Can ISyE help reduce costs without compromising quality in PC? 60. Can ISyE help allocate tasks better according to skill (help PC providers perform at the "top of their license")

Abbreviations: CDS, clinical decision support; EHRs, electronic health records; HIE, health information exchange; HIT, health information technology; PC, primary care; ISyE, industrial and systems engineering; IOM, Institute of Medicine

Table 3. Summative Workgroup Findings with Examples

Problems and issues for Research		System Design Factors		
		Teams and Workload Distribution	Technology	Policy
	Cognitive Needs	• Understanding and supporting the cognitive challenges in individual and team decision making	• Improve synthesis and presentation of information at the right time • Design usable and useful information • Avoid alert fatigue, distraction effects	• Addressing patient complexity • Registry definition and use to improve care
	Patient Engagement	• Understanding patient wants and needs • Effective ways to present information and incorporate information from patient	• Involving patients in EHRs and creating registries • Tools for shared decision making • Assisting patients in finding resources	• Keeping pace with what is happening in the market place • Conducting needs assessment
	Community	• Reaching out to stakeholders and understanding their needs	• What should we be asking HIT to do?	• Systems needed to integrate PC with broader community • Improving access to care
	Integration	• Sustaining high performing teams • Clarification and optimization of team roles	• Effective design and use of HIT within and across systems • Enhancing communication	• Tradeoffs and consequences of care innovations • Involvement of stakeholders in quality improvement

| | Care Transitions | • Optimize care continuity | | |
| | | • Navigating multiple care transitions and interfaces | • Information flow during handoffs | • Handoffs across the system |

Abbreviations: HIT, health information technology; PC, primary care

Figure 2*. Ranking of Themes Based on Counts of Ideas within Themes

Ideas
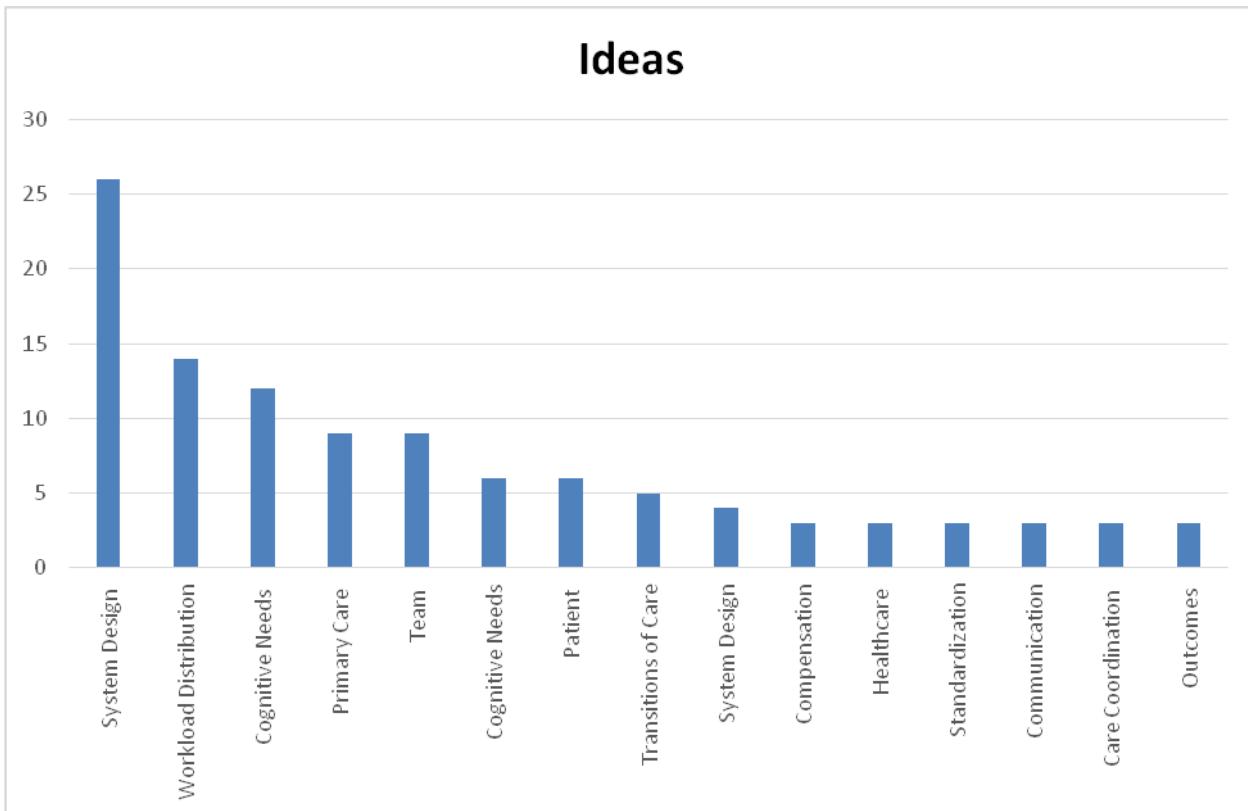
*Figure 1 can be found in Appendix C.
System Design (26), Workload Distribution(14), Cognitive Needs (12), Primary Care (9), Team (9), Cognitive Needs(6), Patient (6), Transitions of Care(5), System Design(4), Compensation(3), Healthcare (3), Standardization(3), Communication(3), Care Coordination (3), Outcomes (3), Patient Engagement (3), Vendor Partnership(2), Administrative(2), Regulatory(2), Satisfaction(2), Staffing(2), Relationships (2), Population Management(2), Relationships(2), Data Access (2), Interoperability(2), Fear(1), Logistics(1), Longitudinal Care(1), Visualization(1), Change Management(1), Coordination(1), Data Access(1), Registry Definition(1), Healthcare Definition(1)

Figure 3. Ranking of Subthemes Based on Counts of Ideas
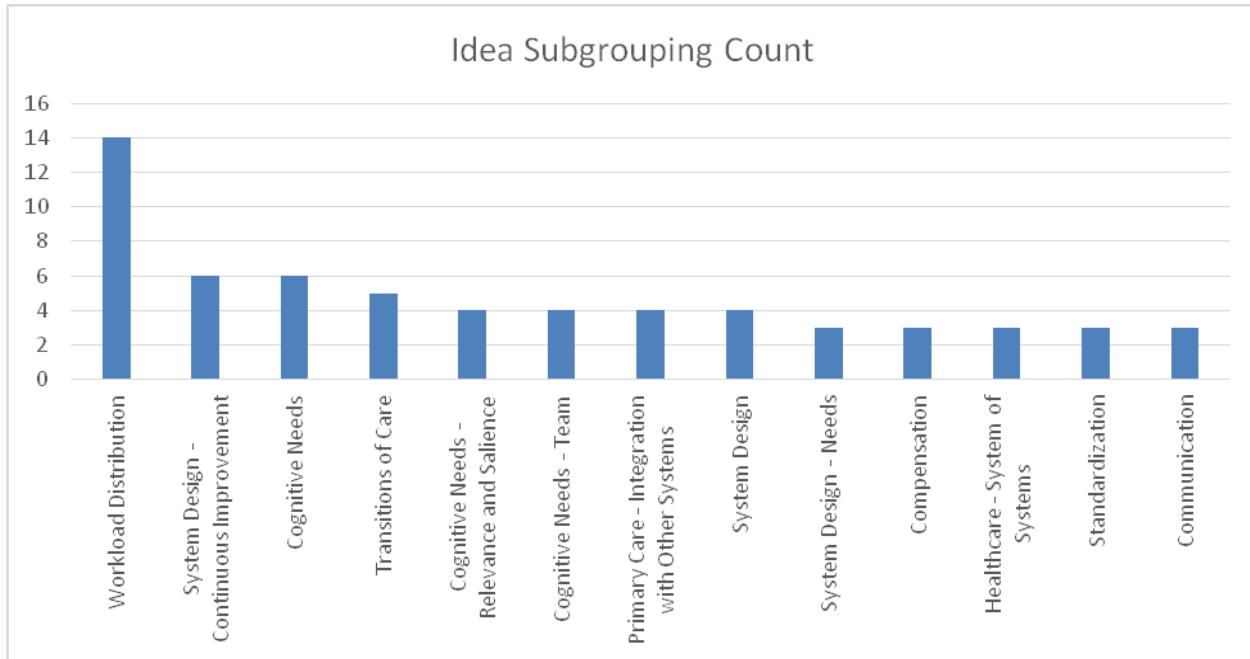
Primary Care - Integration with Other Systems(4), System Design(4), System Design - Needs(3), Compensation(3), Healthcare - System of Systems(3), Standardization(3), Communication(3), System Design - Efficacy(2), Cognitive Needs - Patients(2), Team - Dynamics(2), Patient - Complexity(2), Vendor Partnership(2), Administrative(2), Regulatory(2), Satisfaction(2), Staffing(2), Relationships - Clinician and Patient(2), Population Management(2), Relationships(2), Interoperability(2), System Design - Multiple Points of Entry(1), System Design - Needs Assesment(1), System Design - Needs of Patient(1), System Design - Patient Information(1), System Design - Pushing Innovation(1), System Design - Rapid Cycle(1), System Design - Shared Decision Making(1), System Design - Smart Automation(1), System Design - Technolgy Choices(1), System Design - Clinician Involvement(1), System Design - Decision Maker Alignment(1), System Design - Efficiency(1), System Design - Implementation(1), System Design - Usability(1), System Design - Scope(1), Cognitive Needs - Patient(1), Cognitive Needs - Individual(1), Primary Care - Community(1), Primary Care - Definition(1), Primary Care - Role of Providers(1), Primary Care - Complexity(1), Primary Care - Scope(1), Team - Composition(1), Team - Development(1), Team - Feedback(1), Team - Modeling(1), Team - Performance(1), Team - Foster Engagement(1), Patient - Needs(1), Patient - Wants(1), Patient - Whole Person Care(1), Patient - Variation(1), Care Coordination - Obstacles(1), Care Coordination - Pt centered(1), Care Coordination - Technology(1), Outcomes - Cost(1), Outcomes - Efficiency(1), Outcomes - Satisfaction(1), Patient Engagement - Fostering Partnership(1), Patient Engagement - Optimization(1), Patient Engagement - Resources(1), Data Access - Schedulers(1), Data Access - Patients(1), Fear(1), Team -(1), Logistics(1), Longitudinal Care(1), Visualization(1), Change Management(1), Coordination(1), Data Access(1), Registry Definition(1), Healthcare Definition(1),

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Appendices

Appendix A: Additional Center for Quality and Productivity Improvement Research and Educational Activities

- Systems Engineering Initiative for Patient Safety (SEIPS), which examines systems design, quality management, job design, and technology implementations that affect safety-related patient and organizational and/or staff outcomes. SEIPS was one of 18 patient safety developmental centers originally funded by the Agency for Healthcare Research and Quality, and the only such center located within a college of engineering. Educational efforts within this initiative include bimonthly brown-bag seminars, technical reports and the SEIPS Human Factors and Patient Safety short course on how human factors and systems engineering approaches to patient safety can improve system performance and safety.
- Investigation into the human factors that affect computer information security with an ultimate aim of creating more effective security solutions.
- Research that focuses on job, organizational, and human factors that influence workforce retention and help create safe, healthy, productive workplaces.

Appendix B: Collaborators and Linkages for Research Collaboration and Dissemination

Collaborators

The University of Wisconsin, Department of Industrial and Systems Engineering (ISyE) is ranked 7th and 8th in the US for graduate and undergraduate education respectively and has 12 faculty members working on sponsored research programs in health care and health systems. These faculty members are responsible for over $50 million in active grants in healthcare research. This research spans operations research, manufacturing, human factors engineering, and quality.

The University of Wisconsin, Department of Family Medicine (DFM) ranks among the top 3 Family Medicine departments nationally in external research funding. The DFM has over 30 active grants and received nearly $3.7 million in funding in 2011. The DFM provides support to medical student, resident, fellow and faculty researchers including research design and methodology, statistical analysis, budgetary and computer support. The DFM has 200 faculty members, five residency training sites, and is active in medical student education.

The University of Wisconsin, Department of Medicine (DOM) programs rank in the top 5% of internal medicine training programs in the US and in the top 20 of academic departments of medicine with respect to National Institute of Health funding. The DOM has 353 faculty members in 13 clinical subspecialties with 100 research faculty who bring in $44.5 million dollars for research annually. Research is strongly integrated with their clinical and educational missions, including health services research.

The University of Wisconsin, Department of Pediatrics (WDP) has received over $2.5 million in funding for research over the last 3 years within the UW pediatric primary care clinics. The WDP has 147 faculty members and a thriving research program with $15.2 million in extramural funding in 2012. The department supports a dedicated internal research team consisting of five nurses and one fiscal staff member who provide regulatory, administrative and overall study coordination for all active studies.

The University of Wisconsin, School of Nursing is ranked among the top 20 nursing schools in the US in National Institutes of Health research funding and in the quality of its graduate programs. The school of nursing has 16 full-time tenure track faculty and 27 instructional faculty members. Extramural research funding, held by 50% of the faculty, totaled $1 million for the year 2011-2012. The School's mission is to generate knowledge basic to nursing practice; to provide quality education in preparing tomorrow's leaders in basic and advanced professional practice; and to apply knowledge to current professional practice through continuing education, consultation, and applied research. A departmental strength is the early involvement of nursing students in research.

The University of Wisconsin, School of Pharmacy Social & Administrative Sciences (SAS) Division has seven faculty researchers and 16 graduate students. The division investigates the social and behavioral aspect of pharmacy and medication use with a focus on the scientific and humanistic bases for understand and influencing interactions involving patients, medicine, caregivers, and health care systems. The division has a reputation nationally for its research productivity, extramural funding support, publication record, and teaching. The UW-SAS graduate program has educated generations of researchers who have taken leadership and advisory roles in challenging positions within academia, industry, and government. The School of Pharmacy as a whole brought in over $10 million in extramural funding last year.

Linkages for Research Collaboration and Dissemination

The Wisconsin Research and Education Network (WREN) is a primary care practice-based research network that was founded in 1987 by the conference grant PI, Dr. Beasley. It is housed within the DFM. WREN has a Director, Network Coordinator, Administrative Assistant, Student Assistant, Technical Writer and three Regional Research Coordinators WREN provides one mechanism to promote the dissemination of I-PrACTISE findings both directly through its Wisconsin connections and its collaborations with other networks. WREN consists of 128 members of which 105 are practicing clinicians representing 17 health care organizations across 24 communities throughout Wisconsin. WREN has participated in or supported more than 41 research projects resulting in more than 32 publications. WREN has collaborated with ISyE faculty for five studies, three of which have been federally funded. Drs. Carayon and Wetterneck, the conference Co-Is, have been PIs on two of the AHRQ funded projects with WREN and co-I on the third.

MetaStar serves as Medicare's Quality Improvement Organization (QIO) in Wisconsin. Its mission is to improve the quality of health care delivery and health outcomes for individuals in Wisconsin. The linkage between I-PrACTISE and MetaStar, through the President and CEO, Greg Simmons, MA, (who is on the I-PrACTISE National Advisory Council) provides a route to disseminate the work of I-PrACTISE both locally and nationally. MetaStar's quality priorities include reducing adverse drug events and increasing the use of electronic health records.

The Institute for Clinical and Translational Research (ICTR) is the University of Wisconsin-Madison's Clinical and Translational Science Awardee. UW ICTR is funded by a five-year, $41 million NIH grant, and other local funding sources. The Institute is comprised of four UW schools (Medicine and Public Health, Nursing, Pharmacy, Veterinary Medicine), the College of Engineering, and Marshfield Clinic. The goal of ICTR is to create an environment that transforms research into a continuum from investigation through discovery to translation into real-life community practice, thereby linking the most basic research to practical improvements in human health. WREN and SEIPS are components of the Community-Academic Partnership

Core of the UW-ICTR, the former in the Community Engagement section and the latter in the Type 2 Translational Resources.

Appendix C:

Figure 1: Integration and Coordination within and across various healthcare settings (adapted from McDonald 2010)
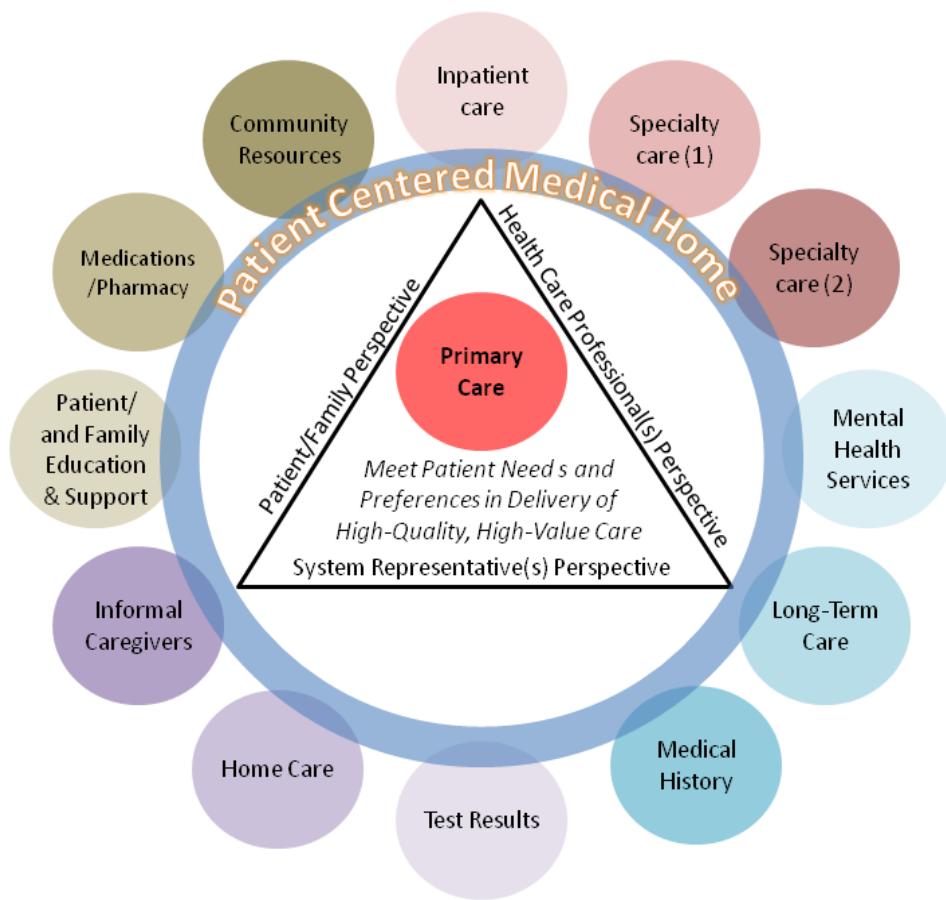
Table Shell: Issues and stakeholders to consider in studying registries/data warehouses in primary care

Issue/ Stakeholder	Patient	Nurse	Navigator	Physician	Organization/ System	Payers	ACO	Public Health
Data use								

Key processes								
Measures								
Outcomes								
Data capture responsible party								
Data quality								
Costs								
Implemen-tation								