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## **RE: Request for Proposals in 2014**

### **Background**

Insurance companies are key stakeholders in the health care industry but they have not generally participated in proactive research and innovation in order to simultaneously increase the affordability, simplicity, and accessibility of healthcare. In 2013, CMU announced the formation of the Disruptive Health Technology Institute (DHTI) that has been launched with support from Highmark and the Heinz Endowments. DHTI is in place to facilitate research that lies at the intersection of science, engineering, business and healthcare delivery. DHTI's link to Highmark Health Services and the Allegheny Health Network, which is defined within a Master Research Agreement, will foster innovation in healthcare that can be tested in a clinical setting, rapidly translated and delivered to patients.

Over the first two years \$2.5 million was made available to teams of researchers that were awarded seed funding for projects that might reasonably be expected to show significant results within 1-2 years. In this round of funding, we expect to be in a position to fund 5-10 projects. Through a series of on-going research retreats we have identified areas of particular interest that serve as focus areas for project submissions. DHTI areas of focus have expanded beyond the initial identified areas as we continue to monitor and examine issues and unmet clinical needs as they pertain to the delivery of healthcare solutions.

The DHTI Joint Research Committee (JRC) is requesting brief proposals that will be peer reviewed for both technical and business relevance. Individual projects will be funded through this mechanism and each project will proceed with project-specific deliverables. The JRC is charged with focusing on science and engineering that is not subject to exclusive licenses with third parties. There is a real desire to use DHTI funding to stimulate interdisciplinary collaborations between clinicians who are part of the Allegheny Health Network and CMU faculty. The JRC meets quarterly to assess progress in each of the projects requiring input from the project PI's on a quarterly basis.

Funds are available immediately to support research. The deadline for receipt of proposals is **May 8, 2014**. Funding decisions will be made shortly thereafter. DHTI will be delighted to discuss details and field any questions prior to the investigator's submission. Please contact [cemig@cmu.edu](mailto:cemig@cmu.edu) (x85214.) and visit [www.dhti.cmu.edu](http://www.dhti.cmu.edu) to review the online submission forms.

## **Request for Proposals**

DHTI is seeking proposals from CMU faculty directed at addressing pressing issues in health care and improving community health and wellness. Proposals will be competitively reviewed based upon the following factors:

- Impact to the population and appropriate leverage of benefit to the individual and the population as a whole with cost consideration.
- The likelihood that success would improve quality of life and/or safety for patients
- Inclusion of tangible work products / deliverables that represent meaningful (further fundable) milestones if successful
- Science/Engineering
- PI experience
- Novelty of approach
- Technical risk (moderate risk is acceptable)

Awards are intended to support research that identifies disruptive health care innovations which can be clinically tested and rapidly delivered to a clinical setting or practice in the field. The research team for the project must be in place and details about the team should be included in the proposal submission. Fully funded projects are expected to have a 1-2 year duration and generally range in cost between \$100-300k (Total cost including full indirect costs). Proposal budgets that reflect an effort to minimize costs while delivering high impact have an increased chance of being funded. **Preference will be given to projects that offer near-term deployment potential.**

In 2013, based on the results of more than a year of strategic horizon-mapping and subject matter retreats, seven key areas were identified as the first areas of focus for the institute. DHTI reviewed 50 project proposals and awarded nearly \$2M to 15 projects.

2014 proposals shall consist of the following:

- Completed proposal template with budget form (included in this document)
- White paper not to exceed 5 pages including brief description of background and technical approach
- Work experience of the team and the value proposition for the innovation
- Quad chart (template included with this document)
- Budget (CMU costs only) (template included with this document)

We have identified technical focus areas in which we believe innovation is likely to lead to rapid gains in healthcare quality and affordability. DHTI specifically seeks proposals in the technical focus areas listed below but we are open to any proposals that the faculty deems relevant, provided they meet the criteria for leading to measurable, short term, impact on healthcare quality and affordability.

## **Technical Focus Areas**

**I. Medical Diagnostics:** Medical diagnostics continue to improve in their ability to detect biomarkers for diseases and the symptoms brought on by such diseases. Oftentimes improvements to lab tests and imaging come at a significant financial cost, adding significantly to the total cost of healthcare. This focus area seeks the development of diagnostic tests that are simple and inexpensive to administer, are widely accessible to the general population, and may identify conditions that will alert a patient to a significant health risk. The tests need not be definitive but should have sufficient sensitivity and specificity to generate a referral to a medical specialist without imposing a financial burden on the patient and payer.

**Sensors in Health Care:** Infection is an important complication of medical implants surgeries with rates of 1% for hip replacement and 0.7% for knee replacement interventions. Even if the rates might seem low, the increasing number of interventions being performed means that the absolute number of such infections will remain significant while negatively impacting surgery outcomes, patient quality of life as well as individual and system wide costs. Moreover the readmissions rates for knee and hip replacement significantly increase after a surgical site infection (SSI) leading to high costs, penalties and increased risk of limited reimbursement.

In a different but related field, the overall infection rate for cardiac implantable devices is 2.9% and is being associated with increases in patient mortality rates and costs. The costs of surgical site infections following failed implants are estimated to be in excess of \$100MM for Highmark. Early diagnosis and the accurate identification of the responsible microorganisms followed by an appropriate antibiotics regimen are essential elements in the infection management strategy. The ideal detection technique is non-invasive to attain clinical acceptance and to achieve adequate compliance in monitoring protocols. However the challenge resides in the polymicrobial composition and the antibiotic resistance nature of these deep tissue infections which impede traditional non-invasive sensing.

One set of envisioned detection solutions require methods that distinguish between healthy and infected implant interfaces. Technological approaches both to the transduction method and to the engineered device are expected to be dependent on the nature of the implant. For example, infections of hip implants may be detected by monitoring for changes in the physical characteristics of the interface due to significant differences between a healthy bone-implant interface and an interface having biofilm formation in voids formed from detached bone. In contrast, detecting infections around cardiac pacemakers may require biochemical rather than physical methods since measurable physical characteristics of biofilms and fleshy tissue are similar. *We are not limiting our interests in diagnostics to the examples described above.* **We are seeking proposals that pursue viable detection devices that integrate solutions to infection sensing, sensor immobilization, signal transduction and processing, power, packaging and communication that overcome barriers to acceptance by health providers.**

**II. Transforming Care Delivery:** Changes in behavior that can result in the transformation of care delivery may originate from patient-initiated change or from clinician-initiated change.

It is widely acknowledged that patient's choices related to leading a healthy life style including stress management, weight management, exercise habits and other factors have a significant impact on the outcomes of their therapies, costs of care, and quality of life. Moreover the effects of these individual decisions may lead to important added costs to the national health care system.

**We are seeking proposals that aim to explore behavioral medicine aspects and therapies.** Two areas of particular interest with focus on patient-initiated change are highlighted below:

**Child Trauma:** Exposure to trauma (child abuse, domestic violence and community violence, accidents, terrorism or disaster, sudden death of a loved one) places children at risk for serious and chronic mental health and medical problem, both in their childhood and adulthood. Following exposure to trauma, some children may develop posttraumatic stress disorder, depression, anxiety, behavioral problems, cognitive problems and loss of interest in the future.

Trauma Focused Cognitive Behavioral Therapy (TF-CBT) is an evidence based, component-based treatment model that has been successfully used to treat childhood trauma. We seek proposals that identify technologies to improve the patient outcome related to psychological trauma and its subsequent behavior and health issues.

**Palliative Care:** The aim of hospice and palliative care is to help patients have the best quality of life possible during their final weeks or months of life. Moreover, end of life care encompasses complex social aspects related to religion, spirituality, family life, quality of life and our conscience at societal level.

**We seek proposals that would equip patients, their families and the clinicians with tools to better understand, plan, communicate and enforce their choices regarding end of life care.** These tools may consist of a new technologies, processes or strategies that will align individual desires with the health care system delivering the care while maintaining the patient's quality of life.

As health care reform's emphasis begins to change how health care is delivered to patients, the use of incentives for clinicians creates an opportunity for both potential improved outcomes and also for concern that incentives can potentially undermine clinicians' professionalism and motives for performance and treatment choices.

**We are seeking proposals that examine the effects of clinicians' incentives such as pay-for-performance bonuses but also on the full array of financial and nonfinancial**

**incentives that may be implemented by an entire health care delivery system as they pertain to efficiency, affordability and accessibility of improved care.**

**III. Chronic Disease Management:** Chronic diseases such as diabetes, CHF, and COPD are major contributors to US healthcare spending in many areas including chronic wound healing and treatment. There are many initiatives underway to educate the population on key risk factors, improve disease management and improve patient compliance with prevention and treatment programs.

This topic seeks novel and innovative programs that may lead to improved outcomes and reduced system-wide costs for caring for this patient population. One example is improved treatments for:

**Infection Treatment and Prevention:** The US Centers for Disease Control and Prevention estimates that preventable infections cost the US healthcare system approximately ~ \$40 billion annually. It is also estimated that 60% of all infections are caused by biofilms, often difficult to treat complex collections of microorganisms that propagate at a solid substrate. Particularly costly infections include chronic sinusitis, infected implants and prosthetic joints, ventilator associated infections (pneumonia), and infections within chronic wounds.

Proposals to reduce infection prevalence, cost, associated complications, and overall impact on patients are of interest. Proposals that address the issue of antimicrobial resistance and chronic infection and therefore have the greatest potential to reduce the system costs driven by infections are of greatest interest. **We seek proposals that address the prevention and treatment of hospital acquired infections.**

**Chronic Wound Healing:** In the United States, chronic wounds affect 6.5 million patients and an estimated excess of US\$25 billion is spent annually on treatment of chronic wounds. The burden is rapidly growing due to increasing health care costs, an aging population and a sharp rise in the incidence of diabetes and obesity worldwide. The need for post-surgical wound care is sharply on the rise. **We seek proposals that address the issue of chronic wounds and have the greatest potential for reducing health care costs of their treatment while improving outcomes.**

**Pain Management:** Chronic pain is estimated to cost the US economy \$635B, making pain more costly than cancer, heart disease and diabetes. Direct medical care accounts for as much as \$300B of this total. Individuals with moderate chronic pain have annual health care costs almost double those who report being pain-free. New approaches are needed for the treatment of acute and chronic pain. While many effective pain therapies, such as opioids, are available, the addictive potential of many pain treatments reduces their utility. **Thus, we see proposals that advance approaches that avoid or mitigate the addictive potential of the most effective current therapies.**

**IV. Computational Health Care:** Despite a strong commitment to delivering quality health care, persistent problems involving medical errors and ineffective treatment continue to plague the industry. **We seek proposals in the following areas:**

**Data Mining and Machine Learning:** Healthcare payers have medical claims data that is commonly used for member risk stratification, pricing insurance products, and financial reporting to regulatory agencies. A number of recent partnerships between data holders and analytical firms profess to make use of data for identifying healthcare trends, non-traditional disease markers, and a variety of ancillary uses. **We seek proposals for the development of automated tools that use healthcare claims data in (among others):**

- Improving the accuracy of medical claims coding
- Identifying fraudulent or errant claims
- Identifying significant outliers from commonly accepted medical practices
- Detecting trends that may identify new risk factors for future member adverse events

**Patient Empowerment:** When informed patients take an active role in managing their health, and care providers are prepared, proactive, and supported with time and resources, their interaction is most likely to be productive. This patient-centered interaction can lead to better care, more efficient and effective practices, healthier patients, and more satisfied patients, families, and providers. The goal is to customize care to the specific needs and circumstances of each individual, that is, to modify the care to respond to the person, not the person to the care. It is the patients who in reality make the important choices that affect their health and well-being, and indeed it is the patients who are in control and experience the consequences of their choices. Providers can guide patients to make better choices. The convergence between technology and medicine is providing new tools and methods that can empower patients with accurate knowledge and improve the efficacy of healthcare delivery.

**We are interested in receiving proposals that educate and guide patients as they tackle their health care challenges.** For example, we know that adult onset diabetes is often preceded by obesity and we know that intensive behavioral weight loss programs produce superior weight loss outcomes. However, intensive treatments require professional expertise that is limited in supply, rendering these treatments largely inaccessible and too costly for much of the population. Therefore, novel intervention approaches are needed that preserve the efficacy of intensive treatments while helping more of the population to succeed in adhering to weight loss behaviors. Technology-supported approaches to weight loss hold that potential. Unlike a human coach or support group that can be accessed only infrequently, virtual ones can provide near continual support and guidance. Simulated reality apps that guide behavior and information built from networks of biosensors are all examples of tools that empower patients.

**Personalized Medicine:** The emerging paradigm of personalized care based on molecular profiling and other patient specific attributes opens up a potentially overwhelming array of treatment options. It is increasingly difficult for physicians, especially in the community healthcare setting, to remain current in the ever changing courses of care. It is paramount that physicians be equipped with point-of-care accessible expert decision tools, which draw on the expertise of leading centers of excellence, to inform personalized treatment options, many of which are only available as clinical trials. Further, it is critical that patient profiles and treatment experiences be captured and analyzed in the aggregate to continuously refine the body of knowledge informing such personalized medicine.

**We seek proposals aimed at;** developing expert systems designed to identify and make broadly available advanced standard of care and clinical trial treatment options responsive to personalized patient profiles, including molecular diagnostic findings. In addition we seek proposals establishing tools for the collection and analysis of broad-based clinical diagnostic, treatment and outcome data to enable aggregate trend analysis necessary to inform personalized care decisions.

**Medical Simulation:** Medical Simulation is the approximation or representation of an action or scenario for the purpose of training, assessing performance, integration across environments, and conducting research to improve toward improving patient safety and the effectiveness, standardization and efficiency of healthcare delivery. Simulation ranges from simplistic imitation to complex replication of actions or processes and includes individual or team role-play, simple to complex simulation tools, virtual reality, manual to computerized mannequins to “full mission environments” where individuals or teams become fully immersed in a training exercise. One overall connecting element is to move healthcare from its traditional apprenticeship- training model to an environment where the trainee is permitted mistakes in a controlled environment without risk to the patient.

High-fidelity and virtual reality simulations can bridge the gap between theory and practice by immersing the healthcare provider in a realistic, dynamic, complex setting. Aviation and aerospace industries have been using simulation as a teaching tool for many years.

Simulators are now widely used in education and training in a variety of high-risk professions and disciplines, including the military, commercial airlines, nuclear power plants, business and medicine. Medical simulation has been found to have many advantages that can improve patient safety and reduce health care costs through the improvement of the medical provider's competencies. Integration of simulation forms, live, physical model, computer game-based, virtual reality, maybe combined to address a simulated training scenario. All simulation should provide measurable outcomes toward objective and fair assessment of competency and performance.

**We seek proposals that utilize medical simulation to improve the acquisition and assessment of clinical data and skills using tools that serve to simulate real patients and clinical environments.** By example, large video datasets are created during individual or team training scenarios for which an assessor must manually process. Application of computer vision and machine learning would be critical in automating the post-training

scenario evaluation phase of simulation.

We particularly seek proposals that partner with the West Penn Hospital's STAR Center. It is important that simulation-focused proposals quantitate the cost impacts of a successful outcome of the work.

**V. Re-Engineering the Health Care System:** There are many reports of impending US physician shortages caused by expanded insurance coverage and an aging population. Estimates of primary care physician shortages in the tens of thousands are projected as early as 2020. More recent studies suggest that having increased numbers of ancillary medical providers operating at the top of their licensure would significantly cut into the projected PCP shortfalls. However, without a change in the existing payment / provider reimbursement models, which are directed toward physician-led service delivery in a face-to-face encounter, major systematic changes are unlikely.

**We seek the development of a new care delivery model using an algorithmic approach that revisits the ideal structure of a cross-functional care delivery team that is compensated in a manner that drives higher quality.**

Proposals should consider a general population of individuals (i.e. 100,000 community members) that represent disease prevalence rates observed in the US.

The model should allow prevalence rates to be adjusted based upon regional demographics. The developed model should also have two primary outputs. First we seek to understand an ideal ratio of the types of caregivers present in physician-led functional teams, considering that physicians will not need to perform all clinical tasks and a significant fraction of encounters would not need to be handled in a traditional "face-to-face" manner. The second output is a new payment model that would appropriately reimburse the care team for providing high-quality care to a given population, rather than simply paying fees for services rendered. Because of their disproportionate share of healthcare expenses, optimal care for common chronic conditions like diabetes, chronic obstructive pulmonary disease, coronary artery disease, asthma and congestive heart failure should serve as the basis for setting new standards for team management and assuring improved processes and outcomes.

Successful execution of this work should provide a basis for a pilot program that would demonstrate the value / efficiency of providing care through an optimized team, not constrained by a pre-existing payment model.

**VI. Medical Robotics** – In recent years, robots have become commonplace in industry due to their high accuracy and repeatability. This is especially true for procedures that require precise, tedious movements that tax human perception and concentration. Robotic technologies are now commonplace in the orthopedic surgery and in innovative biotech labs, increasing accuracy, efficiency and decreasing the amount of time it takes to accomplish results. Medical robotic systems should aid the doctor, leveraging advantages of accuracy, precision, and rapid reaction through robotic technology. Sensor technologies coupled with decision support systems that allow the clinical team to perform manual procedures faster with better patient outcomes are the desired end result.

These systems should combine the awareness and flexibility strengths of the surgeon and the advantages of accuracy, precision and rapid reaction through robotic technology. The coming together of automation with scientific areas like biomedicine, biometrics, nanotechnology and machine learning is pushing the opportunity for robotics to make more significant contributions to the future of medicine and patient care. In addition to orthopedics, we seek technologies focused on robotics that can improve performance in anesthesia medicine. Closed-loop systems are the basis for pharmacological robots and safe anesthetic care might be delivered through tele-anesthesia whenever qualified personnel are not available or need support.

**Orthopedic Robotics:** Orthopedic surgery is often considered an art form, requiring individual skill and experience of each specific doctor for successful outcomes. Nerves, blood vessels, and ligament structures are threatened during surgery. Direct real-time feedback during reconstruction and similar procedures is lacking. As a result, surgeons have to rely on experience to make decisions, often in the face of significant uncertainty. Decreasing the uncertainty faced by the OR team would measurably improve clinical outcomes and the patient experience.

**We are seeking proposals that consider new imaging technologies or mechanical devices that can help the orthopedic surgeon accomplish consistent and superior results by reducing risks associated with collateral damage to the surrounding areas.** Specific focus will be given to proposals leveraging low-cost, high-speed, and high accuracy clinical imaging modalities.

**Automated Decision Support for Dispensing and Monitoring of Pharmaceuticals:** The anesthesiologist role is becoming increasingly complex and risk-prone. Hospital interventions require a growing variety of anesthetics, reversal agents, and other pharmaceuticals. Effective tracking and dispensing of these materials involves significant effort and current procedures necessitate significant and costly waste for the sake of quality assurance. More importantly, patient safety is jeopardized when the wrong drug or dosage is applied. As such, pharmaceutical waste and misuse are significant issues in hospitals.

**We are seeking proposals that could use sophisticated data analytics and/or the development of an automated device that will decrease costs, increase safety, and/or create a system with improved quality control when dispensing and monitoring drugs.**

**VII. Other:** This is an open ended topic for proposals that have the potential to improve the simplicity, accessibility, and cost of healthcare while enhancing the overall quality of life of members and patients. Applications submitted to this area should include a clearly defined value proposition for the proposed innovation as well as estimates on the number of impacted individuals and financial savings should the effort be successful.

## **SUMMARY**

Our technical areas of interest and suggested proposal topics are summarized below.

**I. Medical Diagnostics:** We are seeking proposals that pursue viable detection devices that integrate solutions to infection sensing, sensor immobilization, signal transduction and processing, power, packaging and communication that overcome barriers to acceptance by health providers.

### **II. Transforming Care Delivery:**

- Child Trauma: proposals that aim to explore behavioral medicine aspects and therapies
- Palliative Care: proposals that would equip patients, their families and the clinicians with tools to better understand, plan, communicate and enforce their choices regarding end of life care.
- proposals that examine the effects of clinicians' incentives such as pay-for-performance bonuses but also on the full array of financial and nonfinancial incentives that may be implemented by an entire health care delivery system as they pertain to efficiency, affordability and accessibility of improved care.

### **III. Chronic Disease Management:**

- Infection prevention and treatment: proposals that address the prevention and treatment of hospital acquired infections.
- Chronic Wound Healing: proposals that address the issue of chronic wounds and have the greatest potential for reducing health care costs of their treatment while improving outcomes.
- Pain Management: proposals that advance approaches that avoid or mitigate the addictive potential of the most effective current therapies.

### **IV. Computational Health Care:**

- Data Mining and Machine Learning: proposals for the development of automated tools that use healthcare claims data (among others).
- Patient Empowerment: proposals that educate and guide patients as they tackle their health care challenges.
- Personalized Medicine: proposals that developing expert systems designed to identify and make broadly available advanced standard of care and clinical trial treatment options responsive to personalized patient profiles and those establishing tools for the collection and analysis of broad-based clinical diagnostic, treatment

and outcome data necessary to inform personalized care decisions.

- **Medical Simulation:** proposals that utilize medical simulation to improve the acquisition and assessment of clinical data and skills using tools that serve to simulate real patients and clinical environments

**V. Re-Engineering the Health Care System:** development of a new care delivery model using an algorithmic approach that revisits the ideal structure of a cross-functional care delivery team that is compensated in a manner that drives higher quality.

**VI. Medical Robotics:**

- **Orthopedic Robotics:** proposals that consider new imaging technologies or mechanical devices that can help the orthopedic surgeon accomplish consistent and superior results by reducing risks associated with collateral damage to the surrounding areas.
- **Automated Decision Support for Dispensing and Monitoring of Pharmaceuticals:** proposals that could use sophisticated data analytics and/or the development of an automated device that will decrease costs, increase safety, and/or create a system with improved quality control when dispensing and monitoring drugs.

**VII. Other**