CLUSTER HIRE PROPOSAL
ASSISTHealth - Institute for Personalized Healthcare Technology

1. INTRODUCTION

Faculty in the College of Natural Sciences and Mathematics, the School of Nursing, the School of Public Health and Health Sciences, and the College of Engineering are developing the UMass Institute for Personalized Healthcare – ASSISTHealth. This cluster hire proposal is aimed at creating strengths in areas that are critical to the Institute’s success as a scientific enterprise, as a lightning rod for sponsored research, and as a means of attracting industrial members and sponsorship. Despite the fact that the US spends more on healthcare than any other country (both in absolute dollars spent as well as per capita) the health status of Americans ranks relatively low as compared to other developed nations (Reinhardt, et al. (2004), Bashshur et al. (2009)). Moreover, there is a general discrepancy in expenditures and outcomes among segments of the population—socioeconomic, geographic, cultural and ethnic (Blendon et al., 2004). These issues stem largely from the non-uniform access, inefficiencies in delivery, escalating costs, and unfortunate/uninformed lifestyle choices (Pear(2009)). Electronic Health Records (EHR) are only a partial solution—they do nothing to improve access where it does not exist or increase the frequency of healthcare counseling, patient empowerment, and self-management. Electronic acquisition, processing, storage, retrieval and exchange of information is the missing link in an approach to promoting health, preventing disease, treating the sick, managing chronic illness, rehabilitating the disabled, intervening in developmental pediatrics, and protecting the public health and safety. A diverse set of healthcare academicians, researchers, providers and industry are beginning to express a common belief that telehealth is a key part of meaningful healthcare reform. This cluster hire proposal aims to build a critical mass of expertise at UMass Amherst toward:

- universal access that extends the reach of providers so that the best expertise is available where it is needed;
- patient-centered care at lower cost in the places where people live and work;
- improved efficiency in the management of illness and chronic disease in institutions and in the home;
- widespread availability of diagnostic and educational resources, thereby empowering patients with a greater variety of tools and information with which to choose for themselves among treatments, healthier lifestyles, and self-care;
- reduced costs, improved care and outcomes, and enhanced public safety.

To achieve these goals, new advances in technologies are required that simultaneously address the processes of a new distributed healthcare industry with devices and mechanisms for medical telemetry that are embedded seamlessly in the culture and provide unprecedented access to high-resolution personal health histories. New tools are required for self-management of an array of health related lifestyle choices that preserve privacy and security and yet support a variety of access points for clients and providers.

2. VISION: AHEAD OF THE CURVE AND OUTSIDE OF THE BOX

Our vision of healthcare services in the 21st century involves ubiquitous access to healthcare support in the places where we live, work and play—the home, the office, the gym, assisted care facilities, hospitals and nursing facilities. Our mission is to engage cutting edge computing, distributed sensing, information management, and personal assistive technology healthcare services into the places people live.

At the root of this vision is a distributed array of public and private devices for gathering lifestyle telemetry minute-by-minute. Blood pressure, heart rate, blood sugars, movement and activity, dietary habits, social-communicative engagement, humanoid robotic clinicians for individuals with multiple and complex communicative disabilities (i.e., Autism Spectrum Disorders), acquired, degenerative, and developmental neurological disorders affecting communication and socialization, and a myriad of other such sensors that will publish anonymized data at a frequency that is currently impossible in traditional medical and rehabilitative practices. Aspects of this data stream are anonymized and summarized in a national database for use by public health agencies. Importantly, this infrastructure also streams medical, lifestyle, and rehabilitative data directly to personal devices (e.g., cell phones, PCAs, and assistive technology devices) carried by individuals as they go about their daily lives. This data is a personalized, high fidelity private record—a Life Record—to be used however the individual wishes with a growing suite of tools for health, lifestyle self-management, and medical rehabilitation.

A Revolution in Public Health

As people grow increasingly capable of managing their own health, the byproduct public health record can lead to a revolution in the diagnosis and treatment of chronic disease with environmental factors. Modern data mining techniques can be used to sort through streams of anonymized feedback in the public health record and help us re-think how we safeguard the public health, perform early diagnosis, model the etiology and progression of disease processes, create policy for disease prevention, and assist individuals in rehabilitation and outpatient services. Moreover, distributed medical
infrastructure can assess, contain, and remediate chemical, biological, neurological, developmental, nuclear, and radiological threats to public health efficiently. The tools created as result of unprecedented access to public health data, can be used by individuals in consultation with their healthcare provider and medical specialists to inform their personal medical choices. To make this vision a reality, improved mechanisms are needed for assuring security and privacy, gathering, assimilating, evaluating, and mining data, and analyzing and improving healthcare processes and rehabilitation mechanisms by incorporating robotic and other forms of assistive, augmentative, and automated personal assistance.

Home Health
To complement this revolution in medical telemetry and service delivery, new mechanisms and technologies for delivering individualized services will also become possible. Older clients and individuals with severe and profound disabilities, who would otherwise require institutionalization, will now have cost-effective alternatives that allow them to thrive for a longer period in their own homes. The isolation of people with impaired mobility can be reduced by using social interfaces and virtual house calls, by delivering social-communicative and rehabilitative services, and facilitating connections to healthcare providers, family, and friends who can be accessed in their home via the internet. Personal robotics will lend a helping hand and act as an embodied interface for telehealth and teletherapy -- a cyber-infrastructure through which healthcare providers and others can monitor and deliver critical services. This infrastructure will make practitioners more efficient and more effective especially in light of demographic challenges and shortages in the workforce. For example, 70 million baby boomers will enter retirement in the next decade and, over the decade after that, increasing numbers of these individuals will require eldercare support. Moreover, the number of healthcare specialists, including speech-language pathologists and nurses, are estimated to reach critical levels of shortages by the year 2010. A new healthcare cyber-infrastructure can be used to support these and other technologies for delivering valuable medical services to people where they live and work.

Lifestyle Medical Informatics
A huge potential exists at the intersection of information science, computer science, and healthcare that concerns the acquisition, storage, retrieval, and use of information in the practice and processes of medicine. ASSISTHealth aims to advance the state-of-the-art in the ubiquitous use of electronic medical/lifestyle records in research, patient care, billing, scheduling, and decision support both within medical institutions and in virtually all the places where clients live. Best evidence-based practices in the industry can be improved using tools from the software engineering community to analyze, evaluate, and verify distributed processes so that protocols for handling lifestyle and medical information and coordinating distributed communication and interaction adhere to standards of quality and correctness.

Impact
The consequences of such a vision for our society can be profound. Public health statistics can provide customized healthy life strategies that prevent disease rather than just treating it, and significant new opportunities for effective self-management of chronic health problems will become possible. The costs of healthcare can be reduced and quality can be improved which will make workforce productivity higher. We believe that such a vision will aid in diagnosis and intervention over a huge range of public health issues ranging from childhood developmental disorders, acquired and degenerative diseases, to eldercare. These mechanisms will support clients by making it possible for them to remain safe and productive in their own homes for a longer period, thereby enhancing dignity and reducing overall healthcare costs.

Interdisciplinary Methodology
ASSISTHealth is an incubator for innovation in healthcare technology. Our goal is to foster collaborations between medical institutions, clients, industry, and academia to create new technology that has an impact on health outcomes. ASSISTHealth implements a closed-loop innovate-evaluate-transfer development cycle in which candidate technologies are assessed and refined using feedback and outcome clinical data from clients and healthcare practitioners. Industrial, educational, and healthcare partners identify markets and provide direction for service delivery, technology development and field testing. Social and healthcare scientists measure the impact of new technology by interviewing and acquiring objective data from clients, their families, technicians, and healthcare providers. Feedback from the client is incorporated iteratively to select high-impact technological services and to optimize them over time. Technologies with proven impact will be transferred to the commercial sector.

The ASSISTHealth Institute for Personalized Healthcare Technology is designed to foster collaboration and build critical mass within the University of Massachusetts campus, other UMass campuses (Lowell, Worcester), the 5-college community, member hospitals and clinics, assisted-care facilities, industry, and public schools to address the weighty issues confronting 21st century healthcare and to build bridges to international partners. The center will facilitate collaborations of
various scales aimed toward attracting industrial, educational, and healthcare members, and culminating in center-scale sponsorships.

**Toward Universal Access**
This vision aims to revolutionize the way that healthcare technology is developed and delivered. Central to the ASSISTHealth vision is a desire to expand the "mainframe" medical paradigm by contributing distributed, information-based assisted healthcare systems that empower individuals and engage global healthcare assets and information networks and teletherapies. Information can flow both ways in these networks and can project moderate amounts of "work" (mobility and manual interactions) to remote locations. Work can be projected across information networks to assist a client directly or to facilitate interaction among a client and remote service providers. ASSISTHealth aims to evaluate the potential for this exciting new form of telehealth.

**Targeted Populations**
ASSISTHealth is designed to respond to needs expressed by clients and healthcare practitioners; however, several target applications are already emerging. Among these:

- **Children's Health** - We are considering tools for enhancing early childhood education, infant and young child home medical monitoring, therapeutic technologies for special needs children with multiple and complex communicative disabilities, such as children with Autism Spectrum Disorders, and personalized interventions for children.
- **Veterans** - Returning vets present a wide spectrum of disabilities often requiring specialized technology to address individualized therapies and outpatient services. We are developing adaptive technologies that provide customized cognitive, communication, and physical supports. The technology can be used in inpatient settings as well as residential and outpatient settings to provide support for veterans with disabilities whatever their living situation.
- **Elders** - With baby boomers approaching retirement worldwide, industrialized countries face incredible challenges regarding cost effective delivery of quality healthcare and current as well as imminent critical shortages of specialists in speech-language pathology and nursing. ASSISTHealth aims to extend the period during which people can live independently with healthy social and community engagement as well as improve the quality, safety, and impact of personalized care. We are focusing on ubiquitous medical telemetry; private, secure personal medical data; and tools and assistive technologies for social engagement, telehealth, and teletherapy.

### 3. PROVEN RESEARCH EXCELLENCE OF THE PARTICIPANTS
There are a growing number of healthcare related affinity groups forming on the Amherst campus. The evidence of a growing momentum in these areas is reflected by other cluster hire proposals in this area (Center of Excellence in Aging Research and Training – Becky Ready et al., and Healthcare Delivery: Process Improvement – Donald Fisher et al.). Our cluster hire concept is aimed at an overarching structure that can engage these sizeable efforts in a nationally prominent and forward looking Institute centered at UMass Amherst that can be competitive for center-level funding (NSF Engineering Research Center (ERC), NIH Nursing Center (T32) Award, and/or Federal Science and Technology Awards) and establish a prominent long-term leadership role in this 21st century challenge.

The core of our group spans:

**Computer Science**
- Laboratory for Perceptual Robotics, Roderic A Grupen, Director (robotic support for assisted living)
- Computer Vision Laboratory, Allen R Hanson, Director (technology aids for the elderly)
- Laboratory for Advanced Software Engineering Research (LASER), Leon J Osterweil, Co-Director (process definition, medical safety) and Lori A Clarke, Co-Director (process analysis, medical safety)
- Medical Device Security Center, Kevin Fu, Co-Director (security, privacy, medical devices)
- Information Assurance: Gerome Miklau (data security), Prashant Shenoy (multi-media), David Jensen (data mining), James Allen (information retrieval), Yanlei Diao (streaming databases)

**Mechanical and Industrial Engineering**
- Don Fisher (ergonomics and human factors), Hari Balasubramanian (logistics of medical care), Jenna Marquard (information systems)

**School of Nursing**
- Nursing: Cynthia Jacelon (elder self-management of chronic disease), Elizabeth Henneman (medical safety)

**School of Public Health and Health Sciences**
- Communication Disorders: Mary Andrianopoulos, Shelley Velleman, Jacquie Kurland, Yu-kyong Choe
- Epidemiology: Lisa Chasan-Taber

**School for Social Work, Smith College**
- Phoebe Sessions, David Burton

**Department of Computer Science, Mt. Holyoke College**
Barbara Lerner (process definition, data provenance)

Note, that the faculty listed above are already involved in interdisciplinary research in this area. We are requesting faculty hires that will build, strengthen, and extend this interdisciplinary and transdisciplinary foundation, moving UMass to the next level in terms of impact and recognition. In addition, we intend to build new connections with the UMass School of Medicine, further strengthening UMass leadership in this area.

Another strength of this proposal is the participation of faculty from Smith and Mt. Holyoke College. Currently, women are underrepresented in engineering and computer science. Since both these institutions are women's colleges, these efforts should help attract women students to these areas. In addition, the interdisciplinary nature and social relevance of this research should also help to attract women and students from other underrepresented groups to these disciplines.

Scholarship and Funding Track Record
The faculty involved in the cluster have well-established records of obtaining external funding from many different federal agencies. The distinguished faculty involved in this cluster have published extensively. Publications span a wide range of healthcare concerns, starting with prevention, rehabilitation, entry into the hospital and the hospital stay, and following with care after hospitalization, promoting wellness and prevention as well as security, data mining, human-computer and human-robot interaction, and epidemiology. Table 1 shows the funding and publication records during the last five years for primary faculty involved in these efforts. Appendix B contains just a partial list of some of the potential funding sources available in this area.

<table>
<thead>
<tr>
<th>Faculty</th>
<th>Funds received from healthcare related grants, since 7/1/2004 (PI only)</th>
<th>Funds received from other external grants since 7/1/2004 (PI only)</th>
<th>Healthcare related refereed publications since 7/1/2004</th>
<th>Other refereed publications since 7/1/2004</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allan</td>
<td>$80,000</td>
<td>$2,000,000</td>
<td>-</td>
<td>22</td>
</tr>
<tr>
<td>Andrianopoulos</td>
<td>$1,599,411</td>
<td>$20,000</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Balasubramanian</td>
<td>-</td>
<td>$20,000</td>
<td>-</td>
<td>7</td>
</tr>
<tr>
<td>Clarke</td>
<td>$1,972,468</td>
<td>$3.25M</td>
<td>10</td>
<td>25</td>
</tr>
<tr>
<td>Diao</td>
<td>-</td>
<td>$1,707,692</td>
<td>-</td>
<td>22</td>
</tr>
<tr>
<td>Fisher</td>
<td>$1,020,500</td>
<td>-</td>
<td>35</td>
<td>-</td>
</tr>
<tr>
<td>Fu</td>
<td>$644,685</td>
<td>$1,700,000</td>
<td>5</td>
<td>12</td>
</tr>
<tr>
<td>Gruppen</td>
<td>$140,000</td>
<td>$1,381,000</td>
<td>7</td>
<td>27</td>
</tr>
<tr>
<td>Henneman</td>
<td>$109,975</td>
<td>-</td>
<td>27</td>
<td>-</td>
</tr>
<tr>
<td>Jensen</td>
<td>-</td>
<td>$3,100,000</td>
<td>0</td>
<td>30</td>
</tr>
<tr>
<td>Jacelon</td>
<td>$48,000</td>
<td>-</td>
<td>18</td>
<td>-</td>
</tr>
<tr>
<td>Marquard</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>13</td>
</tr>
<tr>
<td>Miklau</td>
<td>-</td>
<td>$1,131,352</td>
<td>-</td>
<td>10</td>
</tr>
<tr>
<td>Osterweil</td>
<td>$50,000</td>
<td>$1,873,442</td>
<td>9</td>
<td>33</td>
</tr>
<tr>
<td>Shenoy</td>
<td>-</td>
<td>$1,600,000</td>
<td>2</td>
<td>61</td>
</tr>
<tr>
<td>Velleman</td>
<td>$895,726</td>
<td>-</td>
<td>7</td>
<td>-</td>
</tr>
</tbody>
</table>

Table 1

4. Hiring Priorities
Healthcare process improvement has caught the attention of the President, House, and Senate and, as part of general healthcare delivery, should enjoy very significant increases in research spending. To assume a leadership position in this exciting enterprise, UMass Amherst must expand on the existing distinguished core of technologists, policy and process experts, experts in doctor-patient interactions that use the global computer network, device experts and system integrators, security experts that can protect patient privacy, augmentative and assistive technologies, and new practices in data mining and data-intensive epidemiology that can empower individuals at the same time that they provide unprecedented power and resolution in protecting the public health. To build upon and extend our current strengths, we seek faculty candidates with expertise in the following areas:

Computer Science: The work of this cluster would be materially enhanced by the addition of new faculty members in any of the areas of robotics, software/systems engineering, security and privacy, and information
assurance. As noted above existing researchers are already active in these areas, and have identified more promising research challenges than they can pursue. New faculty hires are needed in each area, but attention will be paid to the identification of new faculty members whose interests span combinations of these areas, as such hires would augment the cohesion of the current faculty efforts and suggest still more interdisciplinary research directions.

Nursing: The work would also benefit from the hiring of a new School of Nursing faculty member whose research emphasizes healthcare decision-making behavior and the prediction of how people are likely to respond to technology and process-related intervention.

Public Health and Health Sciences: The work would also benefit from the hiring of a new Public Health and Health Sciences faculty member whose research emphasizes the effective evaluation of computer and robotic technology, especially as it applies to populations that are elderly, that suffer from autism spectrum disorders, or that suffer from acquired and degenerative neurological diseases, and Post-Traumatic Stress Disorder, especially among veterans serving in the Iraqi war. We seek a faculty member with expertise in severe to profound neurological disorders, including technology used to facilitate the communication and learning of persons with such disorders (e.g., alternative and augmentative communication, assistive devices, and teletherapy).

Industrial Engineering: The work would also benefit from the hiring of a new Industrial Engineering faculty member whose research emphasizes macro ergonomics, namely measuring and monitoring the interacting factors that form current and future processes. This faculty member would help synergize the work of systems engineers and health economists, ideally focusing on how an individual’s decisions are likely to affect processes and outcomes.

Support letters from the departments and various schools are provided in Appendix A.

5. LEADERSHIP FOR INITIATIVE

The leadership of this cluster will reside with an advisory board drawn from the principals listed above and associated with the Institute for Personalized Healthcare – ASSIST/Health. Care will be exercised to assure representation for all of the constituencies and to guarantee that all disciplines are represented in the hiring priorities, searches, and mentoring of new hires. Plenary meetings will be held at least once a semester to discuss research, outreach, fund raising goals, grant-related outcomes, and the development of industrial/clinical members. One immediate goal is to organize a fund raising initiative on the level of a national Engineering research Center and/or a Science and Technology Center within two years.

6. PROSPECTS THAT THE PROJECT WILL ESTABLISH AND CONFIRM UMass Amherst AS THE LEADER IN THE PROPOSED AREA OF SCHOLARSHIP, RESEARCH AND TEACHING

The project will build upon activities in which UMass researchers have already established clear international leadership positions. In integrating these activities to provide support for the larger problem domains identified here, the project should establish UMass leadership more firmly and across even broader, internationally prominent domains. Some examples of areas in which UMass already has established its leadership include:

- medical informatics - an astounding number of lives are at risk due to medical processes that are either incorrectly designed or improperly performed. The Laboratory for Advanced Software Engineering Research (LASER) has pioneered the application of techniques for defining, analyzing, continuously improving, and executing medical processes. The work has demonstrated how this approach can help reduce errors and guide process performance in order to improve safety and efficiency in the delivery of medical care.

- security and privacy - as medical devices pervade the environments in which humans live, issues surrounding the security and privacy of the devices and the data sets are paramount. The Medical Device Security Center has attracted national and international attention as a leader in studies of security and privacy for the devices that will deliver ubiquitous medical telemetry in future approaches to distributed medicine and remote patient monitoring.

- personal healthcare robots - UMass researchers have developed the uBot-5 personal robot, which has gained substantial favorable attention. We are now investigating its use in providing critical home healthcare functions. In the future, we plan to examine this platform's potential to improve socialization and communication skills in children with autism spectrum disorder (ASD). Existing literature has demonstrated that robots can be compelling social partners to individuals with ASD and may be adapted to facilitate social, pragmatic, and communication skills in this population. In addition, we plan to examine whether the uBot-5 can be configured as a virtual speech therapist to promote independent speech practice and/or as a talking machine that children and adults with severe speech disorders can use as an alternative, augmentative, and/or assistive technology.
• teletherapy outpatient services and mentoring/training the next generation of researchers and leaders in Communication Sciences and Disorders – The Speech-Language Pathology Program in the Department of Communication Disorders is recognized internationally for its success in research-to-practice grants to train the next generation of healthcare specialists, faculty, and researchers in speech-language pathology. Their research includes the development of evidence-based teletherapies for child- and adult-related outpatient services, test batteries and language-free assessments to identify the presence/absence of motor speech impairment in very young and/or delayed children who are non-verbal from mono- and multi-lingual cultures. In addition, their research focuses on determining evidence-based practices of various therapies administered to populations of children with neurodevelopmental disabilities, such as Autism Spectrum Disorders. The 2008 U.S. World and News Reports ranked the University of Massachusetts’ Speech-Language Pathology Program in the top 30 nationally.

7. BUSINESS CASE
Healthcare Informatics is one of the fastest growing economic sectors in the world today. With the anticipated future advances and investments in this field, it is expected that Healthcare Informatics will become one of the dominant economic factors in the 21st century. In addition to economic importance, this field also has the potential to make substantial contributions to the comfort and longevity of every human being on the face of the earth. Moreover, the current administration has indicated that this will be an area of significant research investment.

Viewed even from the very narrow perspective of a return-on-investment argument, a faculty position in Computer Science is an excellent investment. The basic start-up package for a new Computer Science faculty member costs approximately $250,000. If additional lab equipment is needed, the cost may rise by $10,000 - $50,000. But the Computer Science Department has a remarkably strong record of hiring new faculty who are successful in attracting grant funding. A hundred percent of recent CS Department hires (since 9/1/02) have become lead PIs on sponsored research funding by their third year. Third year funding levels have averaged over $200,000 for those hired as assistant professors, and almost $1,000,000 for those hired as associate professors. Fourth and fifth year funding has averaged $350,000 for assistants professors, and nearly $1 million for associate professors. Thus, Computer Science faculty startup costs have typically been recouped within five years for assistant professors, and much faster for associate professors. This return-on-investment analysis holds true even taking into account the lower-than-standard indirect cost recovery rate charged on NSF CAREER awards.

We emphasize, however, that the real value of such a hire goes well beyond the return of impressive percentages of investment. These hires add to the quality and vitality of the research and teaching enterprise at UMass. In the case of this cluster proposal, moreover, hires such as this will help to put UMass in the lead in an area of clear and growing economic importance and intellectual inquiry.

8. REFERENCES


B. APPENDIX: PARTIAL LIST OF POTENTIAL FUNDING SOURCES FOR THIS AREA

• National Institute of Biomedical Imaging and Bioengineering Telehealth - Medical Devices and Implant Science - Rehabilitation Engineering


This program supports the development of software and hardware for telehealth studies that have broad applications as well as early stage development of telehealth technologies that may have specific focus areas. Research that is supported includes methods to address usability and implementation issues in remote settings, and methods to develop technology for standardizing and incorporating state of the art security protocols for verifying user identities and preserving patient confidentiality across remote access. Bioengineering integrates physical, chemical, mathematical, and computational sciences and engineering principles to study biology, medicine, behavior, and health. It advances fundamental concepts; creates knowledge from the molecular to the organ systems levels; and develops innovative biologics, materials, processes, implants, devices, and informatics approaches for the prevention, diagnosis, and treatment of disease, for patient rehabilitation, and for improving health.

• National Institute of Aging – Behavioral and Social Research (BSR)

The BSR program supports basic social and behavioral research and research training on the processes of aging at both the individual and societal level. It focuses on the following:
- How people change during the adult lifespan,
- Interrelationships between older people and social institutions, and
- The societal impact of the changing age composition of the population

Emphasis is placed on: (1) the dynamic interplay between individuals' aging; (2) their changing biomedical, social, and physical environments; and (3) multilevel interactions among psychological, physiological, social, and cultural levels. BSR supports research, training, and the development of research resources and methodologies to produce a scientific knowledge base for maximizing active life and health expectancy. This knowledge base is required for informed and effective public policy, professional practice, and everyday life. BSR also encourages the translation of behavioral and social research into practical applications. Research initiatives focusing on: (1) Health Disparities; (2) Aging Minds; (3) Increasing Health Expectancy; (4) Health, Work, and Retirement; (5) Interventions and Behavior Change; (6) Genetics, Behavior, and the Social Environment; and (7) The Burden of Illness and the Efficiency of Health Systems.

Geriatrics and Clinical Gerontology (GCG)

Clinical Gerontology Branch

The Clinical Gerontology Branch focuses primarily on clinically related issues regarding aging and addresses research on aging changes during the lifespan. A major focus is on the determinants of rates of progression of age-related changes that affect disease risk, particularly those affecting risk for multiple age-related conditions. Examples of current areas and future directions are:
- Healthy aging across the lifespan, including exceptional longevity
- Protective factors against multiple age-related conditions
- Longitudinal studies of factors affecting aging changes at different points in the lifespan
- Translational human research to follow-up findings from basic research on aging processes
- Long-term effects of current or new interventions that may be administered during a large part of the lifespan (e.g., antihypertensives, statins) Long-term effects of physical activity throughout the lifespan.

Clinical Trials Branch
The Clinical Trials Branch plans and administers clinical trials on age-related issues. Examples of current and possible future interventions for trials are:

- Interventions to prevent or treat "geriatric syndromes," disability, and complications of comorbidity or polypharmacy
- Trials to detect age- or comorbidity-related differences in responses to interventions against conditions found in middle age and old age
- Interventions for problems associated with menopause and other mid- and late-life changes
- Interventions that may affect rates of progression of age-related declines in function in early and midlife
- Interventions with protective effects against multiple age-related conditions
- Intervention studies on the effects of androgens in older men.

**Autism Speaks**
http://www.autismspeaks.org/

The Autism Speaks organization’s goal is to change the future for all who struggle with autism spectrum disorders. The organization is dedicated to funding global biomedical research into the causes, prevention, treatments, and cure for autism; to raising public awareness about autism and its effects on individuals, families, and society; and to bringing hope to all who deal with the hardships of this disorder. The organization is committed to raising the funds necessary to support these goals.

**Agency for Healthcare Research and Quality**

The mission of the Agency for Healthcare Research and Quality (AHRQ), formerly known as the Agency for Health Care Policy and Research (AHCPR), is to enhance the quality, appropriateness, and effectiveness of health services, and access to such services, through the establishment of a broad base of scientific research and through the promotion of improvements in clinical and health systems practices, including the prevention of diseases and other health conditions. AHRQ achieves this mission through health services research designed to (1) improve clinical practice, (2) improve the healthcare system's ability to provide access to and deliver high quality, high-value healthcare, and (3) provide policymakers with the ability to assess the impact of system changes on outcomes, quality, access to, cost, and use of healthcare services. There is a need for studies that focus on interventions aimed at reducing well-documented disparities in health status, access, use of services, and health outcomes by gender, race/ethnicity, and socioeconomic status among the elderly. Interests include:

- Developing cost-effective models of acute, preventive, chronic, rehabilitative, and long-term care delivery (including informal care) that improves the health and functioning of the elderly.
- Assessing the outcomes and effectiveness of clinical, organizational, and social interventions that improve or delay decline of functional status.
- Improving our ability to measure change in functioning across the broad range of functional levels for a diverse population and developing strategies to incorporate these functional status measures routinely in clinical practice.
- Understanding the impact of comorbidities (physical and mental) on disease management, clinical decision-making, preventive care, and health and functional outcomes, and how best to adjust clinical practice to account for them.
- Assessing models of collaborative care so that patients and their families can be active participants in the decision-making process, minimizing age bias in clinical decision making.
- Understanding how best to integrate preventive, acute, chronic, and long-term care (formal and informal care), and to coordinate the delivery of care across multiple sites and settings of care, including out-patient, hospital, rehabilitation, subacute care, home care, long-term care (institutional and community care), and community-based social services.
- Understanding the impact of financial incentives (including health-based payments) on healthcare decisions and their subsequent effect on the health and outcomes.

**Centers for Disease Control (CDC)**

CDC programs provide funding for proposals that “protect health and promote quality of life through the prevention and control of disease, injury, and disability”.

**CDC National Center for Injury Prevention and Control**
Previously funded Falls Prevention Studies [http://www.cdc.gov/ncipc/duip/FallsPreventionActivity.htm] and other studies related to aging.

- **Bill & Melinda Gates Foundation**
  Awards up to $100,000 to encourage global health solutions. For example, creating new vaccines for diarrhea, HIV, malaria, pneumonia, and tuberculosis and better global healthcare delivery processes.

- **Brookdale Leadership in Aging Fellowship Program Award**
  Awards grants on topics related to aging. Awards are for up to $125,000 each year for two years.

- **Robert Wood Johnson Foundation Health Related Funding Awards**
  Funds are primarily for healthcare delivery research aimed at developing a new set of healthcare workers (Building Human Capital), preventing childhood obesity, expanding healthcare coverage, pioneering bold ideas (e.g. using virtual reality to train healthcare workers), improving public health, ensuring healthcare quality and equity, and improving the health of vulnerable populations. Awards are up to $400,000.

- **National Science Foundation**
  Has several programs that could support work on healthcare. Some example programs are listed below.

  **Cyber-Physical Systems**
  For the tight conjoining of and coordination between computational and physical resources to enhance adaptability, autonomy, efficiency, functionality, reliability, safety, and usability. Research advances in cyber-physical systems promise to enhance societal wellbeing (e.g., assistive technologies and ubiquitous healthcare monitoring and delivery). Three sizes of research and education projects will be considered:
  - **Small Projects** are individual or small-team efforts that focus on one or more of the three defined CPS themes. Funding for Small Projects will be provided at levels of up to $200,000/year for up to three years.
  - **Medium Projects** also span one or more CPS themes and may include one or more PIs and a research team of students and/or postdocs. Funding for Medium Projects will be provided at levels up to $500,000/year for up to three years.
  - **Large Projects** are multi-investigator projects involving teams of researchers and their students and/or postdocs representing the same or multiple disciplines in computer science, engineering, and physical application domains, who together address a coherent set of research issues that either cut across multiple CPS themes or that explore in great depth a particular theme. Funding for Large Projects will be provided at levels up to $1,000,000/year for up to five years.

  The CPS program is seeking proposals that address research challenges in three CPS themes:
  - **Foundations** - develop new scientific and engineering principles, algorithms, models, and theories for the analysis and design of cyber-physical systems.
  - **Methods and Tools** - bridge the gaps between approaches to the cyber and physical elements of systems through innovations such as novel support for multiple views, new programming languages, and algorithms for reasoning about and formally verifying properties of complex integrations of cyber and physical resources.
  - **Components, Run-time Substrates, and Systems** - new hardware and software Components, Run-time Substrates (infrastructure and platforms), and (engineered) Systems motivated by grand challenge applications.

- **NSF Service Enterprise Systems (SES)**
  This program supports “research on strategic decision making, design, planning and operation of commercial, nonprofit, and institutional service enterprises with the goal of improving their overall effectiveness and cost reduction. The program has a particular focus on healthcare and other similar public service institutions, and emphasizes research topics leading to more effective systems modeling and analysis as a means to improved planning, resource allocation, and policy development.”

- **University of Massachusetts - President's Office Science and Technology Initiatives**
  Funds are available to initiate new programs that have the potential to impact the citizens of the Massachusetts commonwealth.

- **John Adams Innovation Institute Funds**
Regional Priority Award Program
This program supports early stage, small to medium scale technology-based projects that can move a region or an economic cluster forward. Fundable projects will advance opportunities for the development, retention and growth of regional employment in technology-based economic sectors. Funding range is $25K to $150K.

A  Project Award Program - new and unique technology-based economic development projects that will enhance the competitiveness of a specified technology sector within a given region - up to $500K.

B  Infrastructure Grants - large-scale, competitive awards for the purpose of catalyzing exceptional opportunities to grow/expand a specified technology-based economic sector - up to $2M.