Healthcare Access

- Although the United States spends more as a proportion of gross national product on health care than any other country, over 45 million Americans of ages infant to 65 (17% of persons in this age range) do not have health insurance and therefore have severely limited access to health services. All American citizens have access to free health care after age 65 through Medicare.
Healthcare Costs

- Although costs continue to rise and rates of uninsured continue to increase, Americans face a growing need for affordable, high quality health care.
  - The age structure of the U.S. population is increasing.
  - Americans are becoming increasingly obese.
  - Real wages for middle-class Americans are remaining stable or declining, depending upon the industrial sector of their employment.

State of Healthcare

- Healthcare spending USA (% of GDP)
- Proportion of population aged 60 and over

Computer Science and Engineering - University of Notre Dame
1. **Increase the quality of health care**.
   
   This is an expensive proposal because of:
   
   - Greater demand for health care (aging population).
   - Greater demand for “exceptional” health care.
   - Greater regulatory control over health care.

2. **Increase access to health care** (universal health care).
   
   This proposal will be difficult to implement because:
   
   - The functional needs of society require a competitive marketplace.
   - Powerful segments of the economy have a vested interest in maintaining the status quo.
   - Cultural expectations favor self-sufficiency.

3. **Reduce the costs of health care by**:
   
   Reducing services to patients.
   
   - People are demanding more, not fewer services.
   
   Instituting cuts in the prices we pay for health services.
   
   - This option sounds popular to the public, but is the least promising approach to cutting costs.
   
   - If profits to pharmaceutical companies were reduced by 50 percent, for example, health care expenditures would decrease by less than 1 percent because expenditures for medicines, although very high, represent a small percentage of total health care costs.
   
   - It would be difficult to lower salaries for physicians, nurses, technicians, and other highly trained staff.
3. **Reduce the costs of health care by:**
   Implementing a *single payer system*.
   - Approximately 25% of health care costs are administrative expenses.
   - Much of these costs are related to completing paperwork needed for health insurance.
   - Many different health care plans and insurance companies require that clerks at health-care providers must be knowledgeable about many different rules.
   - Because companies often change their plans and forms, clerks often make mistakes, which cost money to correct.

   The single payer system is proposed as a means of reducing administrative costs.

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**Improving Healthcare**

**The Single Payer System (SPS)**
- Single set of forms.
- Single set of rules.
- Single reimbursement schedule.
- The *federal government* would be the single payer and everyone would be covered by a single health-care plan, with multiple options for coverage as are available already with private plans.

Basically, SPS is a government-sponsored health care insurance company.

This system might effectively reduce health-care costs, but it raises issues related to ethics, economics, and politics.
Terminology

1. **Universal health care**: The government provides health care to everyone.
2. **Socialized medicine**: The government controls the health care industry.
   - The single payer system (SPS) is a form of socialized medicine. That is, hospitals and clinics, whether private or public, profit or non-profit, as well as private physicians, provide health care. The government is the “insurance company.”
   - Because Americans have strong objections to “socialism” (read: communism), opponents of the single payer system call it “socialized medicine” and associate it closely with universal health care. Proponents, on the other hand, emphasize that the health care is provided by the physicians and the insurance is provided by the government.

Healthcare Philosophy

**Right to Health Care**

- Do people have a fundamental right to health care?
  - Yes: The good society will provide its citizens with health care.
  - No: Universal health care violates individual rights because it is an unnecessary form of wealth redistribution (i.e., unnecessary welfare).

**Government Involvement**

- Should the government get involved in health care?
  - Yes: Government intervention can improve health care.
  - No: The government is not qualified to provide health care.
**Single Payer System**

- Those who would otherwise go without care receive it.
- People are more likely to seek preventative care, which costs less in the long run.
- Death rates are lower in societies with socialized medicine.
- Because doctors do not have to worry about paperwork, they can concentrate more on treating patients.
- Socialized medicine reduces waste in the delivery of medical care.

**State of Healthcare**

- **Improve quality of life**
  - Improving patient outcomes by earlier diagnosis

  ![Graph showing survival and treatment cost for breast cancer (USA)](source)

- **Reduce cost**
  - Enabling earlier diagnosis and thus lowering cost of subsequent treatments

![Graph showing new cases, related deaths, and potential lives saved by early diagnosis](source)

Source: [www.r2tech.com](http://www.r2tech.com), based on data from American Cancer Society.
Single Payer System: Downsides

- Government-sponsored programs do not encourage competition and the development of new technologies.
  - SPS is a payment system; not a health-care delivery system.
- SPS is “socialized medicine.”
  - SPS is not universal health care; it is a government-sponsored administrative system.
- The government, not doctors, would be in the business of making health care decisions.
  - Business managers already dictate health care guidelines for providers as part of private health care plans (i.e., Health Maintenance Organizations: HMOs).
- Insurance companies would be hurt financially.
  - Society often sacrifices industries for progress.

Healthcare Reform

The debate over health care reform in the United States:
- whether there is a fundamental right to health care,
- who should have access to health care and under what circumstances,
- who should be required to contribute toward the costs of providing health care in a society,
- whether the government should support health care commerce by forcing citizens to buy insurance or pay a tax,
- the quality achieved for the sums spent,
- the sustainability of expenditures that have been rising faster than the level of general inflation and the growth in the economy,
- the role of the federal government in bringing about such change,
- concerns over unfunded liabilities.
Health Care and Education Reconciliation Act of 2010

- **Cost:** $940 billion over 10 years.
- **Deficit:** Would reduce the deficit by $143 billion over the first ten years. Would reduce the deficit by $1.2 trillion dollars in the second ten years.
- **Coverage:** Would expand coverage to 32 million Americans who currently are uninsured.
- **Paying for the Plan:**
  1. Medicare Payroll Tax.
  2. Excise Tax on High End Health Insurance.
  3. Tanning Tax.
- **Changes:**
  1. Closes gaps in Medicare.
  2. Expands Medicaid.
  3. Insurers cannot deny coverage to children.
  4. Does not pay for abortions.
  5. All citizens, except the very poor, must purchase health insurance.

State of Healthcare

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Technology for Early/Fast Diagnosis

- Early diagnosis
  - 3-D Ultrasound allows for early detection of heart anomalies

- Fast diagnosis
  - Whole Body scan for Trauma patients in 21 seconds

Sudden Cardiac Arrest

- At home 80%
- Public 20%
- Witnessed 55%
- Unwitnessed 45%

- Early CPR 25%
- Late CPR by EMS 75%

Survival at home only 5%
Cardio Monitor

- ECG + activity
- Continuous monitoring
- Continuous diagnosis
- Ultra-low power
- 64 MB memory

Motivation & Challenges

- **Motivation**
  - Department of Health projects by 2050 over 20% of the population will be above 65.
  
  - Possible Consequences:
    - Acute shortage of medical professionals.
    - Decline in the quality of medical care.
    - Increase in the medical costs.

- **Challenges**
  - Automated & continuous monitoring of patients can reveal problems at an early stage leading to better control.
  
  - Integrating diverse technologies (micro – macro computing entities) for health monitoring is a challenge.
  
  - Designing safe, dependable, secure, and scalable system for health management is a very challenging task.
Pervasive Computing & Healthcare

Personalized computing power available everywhere, by embedding computing in user’s environment.

Features:
- Merge of Physical and Virtual Space
- Uses computing entities which are:
  - tiny/cheap
  - specialized
  - unperceived
  - interconnected

Use Pervasive Computing for day-to-day healthcare management (monitoring + treatment), made possible by development of biomedical sensors.

Features:
- Extends PAN with embedded medical sensors
- No time & space restrictions for healthcare
- Better coverage and quality of care to all.

Some Applications
- Sports Health Management
- Assisted Living
- Disaster Relief Management
- Medical Facility Management
- Micro-needles array for Drug Delivery
  Developed @ Georgia Tech
- Nano-scale Blood Glucose level detector
  Developed @ UIUC
- Medical Tele-sensor
  Can measure and transmit Body temperature
  Developed @ Oak Ridge National Laboratory

Overview

GOAL: Enable independent living, general wellness and disease management.

Differences & Advantages

Current Healthcare
- Detect symptoms
- Go to medical facilities (professionals)
- Medical professional performs diagnosis and treatment.

- Manual
- Slow
- Costly
- In-efficient

Pervasive Healthcare
- Continuous Patient Monitoring.
- Automated diagnosis and treatment.
- Utilizing medical facilities only if condition very serious.

- Automated
- Real-time
- Inexpensive
- Very efficient

Pervasive Healthcare Technology is Necessary to Meet Future Needs
Ayushman*: A Pervasive Healthcare System

* Sanskrit for long life

- Project @ IMPACT Lab, Arizona State University

- To provide a dependable, non-intrusive, secure, real-time automated health monitoring.

- Should be scalable and flexible enough to be used in diverse scenarios from home based monitoring to disaster relief, with minimal customization.

- To provide a realistic environment (test-bed) for testing communication protocols and systems for medical applications.

K. Venkatasubramanian, G. Deng, T. Mukherjee, J. Quintero, V. Annamalai and S. K. S. Gupta,


Ayushman: Remote Medical Monitoring

- Testbed consists of medical devices interfaced using Crossbow motes to a PDA.

- Medical devices integrated include: BP monitor (Suntech), EKG monitor (Vernier), Gait Monitor (MicaZ based sensors) and TelosB based environmental sensor

- Supports query based and continuous data collection.

- System constraints:
  - Low reliability
  - Lack of bandwidth
  - Low memory for processing.

BP and EKG Monitoring

Gait Monitoring
Ayushman: Client Screen Shot

Other Similar Projects

- **Proactive Health** Project @ Intel
  - Developing sensor network based pervasive computing systems
  - Managing daily health and wellness of people at homes
  - Proactively anticipate patient’s need and improve quality of life.

- **Code Blue** Project Sensor network based health monitoring @ Harvard
  - Developing sensor network based medical applications for:
    - Emergency Care
    - Disaster Management
    - Stroke patient rehabilitation

- **AMON** Project @ ETH, Zurich
  - Developing multi-functional wearable health monitor
  - E.g.: BP, pulse, Sp02, ECG, Temperature

- **Aware** Project @ the Center Pervasive Healthcare, University of Aarhus, Denmark.
  - Applying context aware computing to hospital scenarios
  - Developing context aware hospital bed, pill box which is aware of its patients.
Conclusions

• The global e-healthcare and telemedicine market is currently valued at $7 billion (Cap Gemini Ernst & Young) and is showing an explosive growth.

• Such systems will become increasingly more useful because of the aging world population and increase in chronic diseases.

• Next generation medical systems are being designed to provide pervasive, scalable, cheap, non-intrusive health care to all (quality, access, cost).