Advancement of the Medical & Health Care

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20th Century: Progress of Health Care

- Vaccines
- Radiology
- Antibiotics
- Surgery
- Devices

Prevention ➔ Diagnosis ➔ Treatment ➔ Post Treatment
Fetus
Neonatal
Child
Adult
Elderly

Medical Problems

Congenital
Infection
Trauma
Tumor
Degenerative
NCD & Others
Bio Intelligence Age

TIME (year)

2000 BC 0 1500 1800 1900 2000 AD

TECHNOLOGY DEVELOPMENT

AGRICULTURAL AGE

INDUSTRIAL AGE

INFORMATION AGE

BIOINTELLIGENCE AGE

CONSUMER ACCEPTANCE
Bio Intelligence Age
Prevention

- **Fetus**
  - Hereditary
  - Anomaly
  - Infection

- **Child**
  - Infection
  - Injury

- **Adult**
  - Infection
  - Injury
  - Degenerative
  - NCD & Malignancy

- **Elderly**
  - Infection
  - Injury
  - Degenerative
  - NCD & Malignancy

**Diagnosis**
- Imaging
- Chromosome
- Gene level

**Immunization**
- Vaccine
- Antibiotics

**Protection**
- Antibiotics
- Protect/assist devices
- Health care policy

Molecular Biology

Bioengineering

Pharmacology
## Diagnosis

<table>
<thead>
<tr>
<th>Macro</th>
<th>Micro</th>
<th>Molecular</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Physical exam</td>
<td>• Chemistry</td>
<td>• Markers</td>
<td>• Electronic</td>
</tr>
<tr>
<td>• Imaging</td>
<td>• Histopathology</td>
<td>• Gene study</td>
<td>• Wave</td>
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</tbody>
</table>

Additional images of CT scans and microscopy are shown on the right side of the slide.
Diagnosis

**Physical**
- Gross structure
- Endoscopic
- Imaging: X-ray, U/S

**Chemical**
- Lab profile
- Tumor markers

**Electrical/Magnetic**
- EKG, EMG, EEG
- MRI

**Gene**
- Gene study
Treatment: Non Surgical

- Chemical
  - Gas/fluid
  - Drugs

- Wave
  - Radiotherapy
  - Pace makers
  - Ultrasonic

- Physical
  - Rehabilitation
  - Assistive devices

- Gene
  - Gene Therapy
Surgical Treatment

- Logistic
  - Transfer
  - Mobile OR

- Training
  - Virtual
  - Navigation

- Setting
  - Micro/Endoscopic
  - Robot/Tele-surgery

- Devices
  - Implants
  - Artificial devices
Advanced Technologies
Advanced Technologies

3D-Imaging

3D-US

3D-Printing

Tele-Med

Advanced Tumor Metrics

Med-App
Trend in Health Care

'Sick' Care versus 'Health' Care

Next Steps in Healthcare
Volume Based ---> Value Based

<table>
<thead>
<tr>
<th>Payment</th>
<th>Fee-for-Service</th>
<th>Outcome Based</th>
</tr>
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<tbody>
<tr>
<td>Incentives</td>
<td>Volume</td>
<td>Value</td>
</tr>
<tr>
<td>Focus</td>
<td>Acute Episodes</td>
<td>Populations</td>
</tr>
<tr>
<td>Role of Provider</td>
<td>Single Episode</td>
<td>Care Continuum</td>
</tr>
<tr>
<td>Information</td>
<td>Retrospective</td>
<td>Predictive</td>
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</tbody>
</table>
Tele-Health: Overview

Digital Technology, Data Mx & Connectivity are keys
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Telemedicine Overview

- Telepathology
- Telesurgery
- Expert
- Real-time Ultrasound
- Home Healthcare
- Grand Rounds
- Teleradiology
- Telecardiology
- Continuing Medical Education
Solutions Available Today

Cardiology

Radiology

Neurology

Psychiatry

Dermatology

CardioRad

Teleradiology

Ophthalmology

DermatologistOnCall

HubbleTelemedical
Telehealth +/- Robotic System

Telehealth vs. Telemedicine

Telehealthcare
- Telehomecare
- Telenursing
- Telecoaching
- Telerehabilitation

E-health/Education
- E-Medical Records
- E-Resources (Web)
- E-Services (Web)
- E-Exchange (Web)

Operation Lindbergh:
Remote Transatlantic Tele-Surgery
Molecular diagnostics is at the core of the personalized medicine vision.

Diseases will be diagnosed long before the patient begins to manifest any evidence using traditional tools.
Logistic
Virtual Surgery: Simulations
Navigation: Fluoronavigation
Operating Room: Future
Robotic-Assisted Surgery

Laparoscopic Cholecystectomy
daVinci Robotic System
Customized Endoprosthesis:
Tumor Resection & Reconstruction
Specific Dimensions: Plate & Nail (Non-/Absorbable)
Artificial Jt/Prostheses: Specific Sized
Artificial Retina

Smart Contact Lens
Intelligent & Smart Prostheses

a) Rheo Bionic knee    Ossur, Reykjavik, Iceland
b) C-leg    Otto Bock, Minneapolis, MN
3D Printing in Medicine

How a 3D printer gave a man his face - and his life - back

Eric Moger has a partial prosthetic face after suffering from face cancer. Photo: Supplied Geoff Pugh
Assistive Technology (AT)

- Technology/Devices to enhance capability of seniors/elderly & handicaps “Less Dependence”
Assistive Device: The Blind

The Rolling Reader

HOW DOES IT WORK?

As local roll on Braille points, the pattern of uneven Braille points is entered through its pressure. The pattern input is translated for voice output, translated to voice. Put press the button once.

The Tongue-Tingling Vision Recreator

THE FIRST BRAILLE SMART WATCH

DOT WATCH

HOW: Braille

Material: Stainless Aluminum

Head: LED display

Battery: 3V battery

Screen: Contrast screen

Tongue: Touch sensor

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Assistant Device: The Blind

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Assistive Device: Impairment of Hearing
Assistive Device: Paralytic Patients

assistive technology.
Brain Machine Interface & Enhancing Memory Technology

Source: Wake Forest Baptist Medical Center
Other Progression

An artificial pancreas

Source: DW230, Tufts University
Source: Peter Clarke/RMIT University
Tissue Engineering

Liver Scaffolding

Artificial Blood Vessel

Artificial Ear

J. Vacanti, MD    MGH    March, 2000
AI in Medicine

AI for Diagnostics, Drug Development, Treatment Personalisation, and Gene Editing

The 4 Stages in Drug Development

- Identify target molecules
- Discover effective drugs
- Speed up clinical trials
- Find biomarkers for diagnostics

Detecting lung cancer from CT Scans
Assess cardiac health from electrocardiograms
Classify skin lesions from images of the skin
Identify retinopathy from eye images
AI in Medicine

**ARTIFICIAL INTELLIGENCE**
- Analyze medical data
- Identify patterns
- Speed up diagnosis & treatment

**RETINAL IMAGERY DETECTS:**
- Age
- Smoking habits
- Gender
- Blood sugar level
- Body mass index
- Systolic & diastolic blood pressure

**A.I. TO DIAGNOSE CANCER**
- Uses images of suspected malignancy
- Compares with data on cancerous tumors/lesions
Internet of Things: In Health Care
Internet of Things: In Health Care

The Three P’s x DMT:
Pervasive D, Personalised M, Persuasive T
Genomic Medicine

- Human Genome Project completed in 2003 provided access to the entire human gene sequence/genome.....
- The genome is a set of tools enabling physicians to understand the biological & disease variability.
- Understanding variability between individuals allows for more targeted/personalized healthcare based on genetic differences.
Genomic Medicine & Personalization

- Dx/ predict risk of disease
- Determine whether Rx is work
- Monitoring healthy people to detect early signs of disease
- Producing safer drugs by predicting potential for adverse effects earlier
- Gene therapy for hereditary diseases/ high risk CA
Genomic Medicine & Personalization

CANCER Rx
PD-1, or programmed death receptor 1
Unleashing the body’s immune system to fight tumors.
Summary: Future Health Care Advancement

“Physician, Scientist & Engineer are Keys”

3 Major Modalities of Progression

- Tele-Health/Tele-Medicine
- Medical Devices/Equipment
- Genomic/Personalized Medicine