Health Care Workforce and Future Technologies

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Ripple effects of technology

- Workforce
- Innovation & Adoption
- Clinical Care
- Patient Experience
- Regulations & Standards
- Costs & Coverage
- Facilities

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Perfect Storm Brewing

Growth Rate of Elderly Population will accelerate just as Labor Force growth is slowing

![Graph showing the growth rate of the elderly population and the working age population over time.](image-url)
An Example: Emergency and Trauma Services
Technology-Driven Healthcare Trends

- There are six fundamental technology-driven healthcare trends with direct relevance to future workforce characteristics.
- Each trend has specific service and technology components that will shape the future of care delivery and workforce requirements.
- The industry should look to technology as an integral piece of its strategy for meeting workforce needs.

Technology innovation will drive fundamental changes in care delivery and workforce.
Technology-Driven Healthcare Trends

- Shift to Earlier Interventions Drives Delivery System Reconfiguration

- Innovations Drive New Volumes to Minimally Invasive Surgery

- Diagnostics and Monitoring Shift to Less Invasive

- Technology Offers the Potential for Greater Workforce Productivity

- Care is Provided Remotely – from the Clinician’s Perspective

- New Models of Care Emerge Using Existing Technologies
## Technology Trends and Workforce Changes

<table>
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<th>Technology Trend</th>
<th>Workforce Implications</th>
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<tr>
<td>Shift to Earlier Interventions Drives Delivery System Reconfiguration</td>
<td>ê  Broader array of settings&lt;br&gt;ê  Increased focus on biologics, IT and physics</td>
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<tr>
<td>Innovations Drive New Volumes to MIS</td>
<td>ê  More intense, specialized inpatient staff and care&lt;br&gt;ê  Broader, more general outpatient care&lt;br&gt;ê  “Worse before better” effect on productivity</td>
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<tr>
<td>Diagnostics and Monitoring Shift to Less Invasive</td>
<td>ê  Increase in imaging and merged technology positions&lt;br&gt;ê  Imaging and diagnostics responsibilities assumed by other specialties, job categories</td>
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<tr>
<td>Technology Offers the Potential for Greater Workforce Productivity</td>
<td>ê  Technology will both assist and exacerbate shortages&lt;br&gt;ê  Decreasing clinical demand and rapidly increasing IT demand&lt;br&gt;ê  Introduction of modeling and simulation for training and planning</td>
</tr>
<tr>
<td>Care is Provided Remotely – From a Clinician’s Perspective</td>
<td>ê  Increased geographic scope of practice&lt;br&gt;ê  Large IT requirements&lt;br&gt;ê  Licensing and regulatory barriers</td>
</tr>
<tr>
<td>New Models of Care Emerge Using Existing Technologies</td>
<td>ê  Increased involvement of non-classically trained staff&lt;br&gt;ê  Patient and family at the center of the care process</td>
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Many infectious diseases and chronic conditions that drive inpatient utilization today will respond to new technologies, become less debilitating and require less acute care. This will allow patients to be cared for in less intensive settings and lower acuity services. This shift will occur progressively over the ten-year period, based on the convergence of several key technologies:

- Informed use of imaging technologies for earlier diagnosis and monitoring of care.
- Increased understanding and use of genetic information for treating patients, developing pharmaceuticals, vaccines, and biologics.
- Improved and earlier patient monitoring, treatment and drug delivery systems for acute and chronic conditions.
Genetics and Personalized Medicine

Increasing effectiveness of treatment based on genetic characteristics

Examples:
- Breast Cancer and Herceptin
- CML and Gleevec
**Ultrafiltration**

### The Problem: CHF on the Rise

- 1.1 million hospital admissions per year
- Leading cause of hospitalization for age $\geq$ 65 years
- Admissions Increased by 155% over the last 20 years
- 30% admitted in NYHA Classes III & IV
  - Class III: moderate
  - Class IV: most severe
- 550,000 new CHF cases diagnosed every year

*Heart Disease and Stroke Statistics– 2006 Update, American Heart Association, 2006.*

### The Solution: Ultrafiltration

- Positive clinical results from use of UF technology:
  - Lowered Average LOS from 5 to 3.5 days
  - Contributed to reduction of severity
  - Decreased re-hospitalization
  - Decreased ED, unscheduled office visits
- Advances in technology allows more flexibility
  - Minimal staff for monitoring
  - Shift to less intensive sites of service
- Significant financial impact
- Increasing numbers of CHF patients = increasing potential for savings

Source: *UNLOAD Clinical Trial*
New Job Roles Develop As Technology and Treatment Converge
Workforce Implications - Reconfiguration

- Reconfiguration will drive significant change in care locations making jobs move to a variety of sites including:
  - Home Care
  - Outpatient/Offices/Clinics
  - Offshore
  - Bunkers/Tele-commuting

- Existing staff need to quickly become competent with new technologies which will continue to change the nature of care
  - Intensifying and shortening the inpatient experience
  - Shifting care to less acute sites

- The convergence of Biologics, Information and Physics will drive the need for more convergent training and expanded job roles
- While many jobs require a wider base of knowledge, many become more focused and sub specialized to retain competence
Innovations Drive New Volumes to Minimally Invasive Surgery

Minimally invasive surgeries will replace more than 80% of current open surgeries. Imaging technologies and evolving MIS devices will propel healthcare to adopt less invasive interventions. These include:

- Improvements in endoscopic, laparoscopic and transluminal surgical tools
- **Image-guided surgery** used in open cavity, cardio-thoracic, abdominal, and cranial procedures
- **Directed-energy surgical devices** for tumor ablation, tissue removal, and cauterization
- Refined **robotics** for use in surgeries that require extreme precision and benefit from limited invasive methods
Innovations Drive New Volumes to Minimally Invasive Surgery

Where is the growth occurring?

**Neurology**
- Microcatheter intervention for stroke treatment
- Neurovascular stenting
- Carotid artery stenting
- Endovascular embolic coiling of aneurysms
- Radiosurgery of brain tumors and AVM’s

**Cardiology**
- Robot-assisted beating-heart cardiac surgery
- Endovascular ablative treatment of arrhythmias
- PTCA with biodegradable stent

**Urology**
- Uterine artery embolization of fibroids
- Cryosurgery and HIFU of prostate cancers
- Laparoscopic radical prostatectomy

**Gastrointestinal and General Surgery**
- Gastric pacing
- Gastric bypass
- Gastric lap-banding
- Endoluminal treatment of GERD
- Renal stenting
- Endovascular stent-graft of abdominal aortic aneurysms

**Musculoskeletal**
- Minimally invasive hip and knee replacement
- Intervertebral disc replacement
Cardiovascular Surgeries Moving to MIS

**Typical CABG - 2000**
- Median sternotomy
- Heart-Lung Machine
- Saphrenous vein dissection
- Hospital stay of 6 days
- Lifetime chance of reoperation
  - 5-10%
- Return to work in 10 weeks

**CV Minimally Invasive Surgery Innovations**

**PCI with stent placement <1 day?**
- **Valve repair, edge-to-edge technique**
  - eValve Inc., Menlo Park, CA
- **Valve repair, annulus remodeling**
  - Coapsys Inc., Minneapolis, MN

**Endoscopic Vein Harvesting**
- Guidant Inc., Santa Clara, CA

**Mini MAZE procedure**
- Atricure, Inc., Cincinnati, OH & Guidant, Inc.

**Robotics, da Vinci Surgical System**
- Intuitive Surgical, Sunnyvale, CA

**Percutaneous aortic valve replacement**
- Percutaneous Valve Technologies (now Edwards Lifesciences), Irvine, CA

**Typical CABG - 2010**
- Key hole opening
- No Heart-Lung machine
- Endoscopic saph. or robotic internal mammary vein harvest
- Hospital stay 3 days
- Lifetime chance of reoperation
  - 5% or less
- Return to work 3 weeks
Workforce Implications - MIS

- MIS opens up additional patient populations to new, less invasive procedures, increasing overall patient demand.

- New levels of technology may create a “worse before better” phenomenon -- less productivity early as technology is being adopted, improving later with skills maturity.

- Increasing outpatient care shifts patients and jobs out of the hospital to offices, same day centers and home.
Diagnostics and Monitoring Shift to Less Invasive

New diagnostic and monitoring technologies are replacing more invasive alternatives and creating new opportunities to measure efficiency. Innovations using light, electricity, and acoustics will lead to:

- Imaging devices that provide a more comprehensive view
- Wide selections of biologic and environmental monitoring devices
- A broad array of Point of Care Testing (POCT)
- Improved monitoring of chronic conditions, resulting in more accurate medication dosing and care
The Impact of Imaging

There is compelling evidence that use of diagnostic technology results in better outcomes with less invasive activity:

- The ability of **64 Slice CT** to produce high quality cardiac images will decrease Diagnostic Catheterization volumes

- **Portable CT** units deployed in Emergency Departments will decrease workforce needs by allowing current staff to multi-task in location and prevent inpatient admissions

- Advanced abdominal imaging, including **3D Ultrasound**, will decrease biopsies and exploratory laparoscopies
64-Slice CT Disrupts Chest Pain Protocols

Minneapolis Heart Institute Foundation Study
Accuracy of Noninvasive Diagnosis Technology

<table>
<thead>
<tr>
<th>N = 1083</th>
<th>Sensitivity</th>
<th>Specificity</th>
<th>Positive PV</th>
<th>Negative PV</th>
<th>Accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>GXT</td>
<td>14%</td>
<td>75%</td>
<td>67%</td>
<td>20%</td>
<td>28%</td>
</tr>
<tr>
<td>Nuclear</td>
<td>36%</td>
<td>75%</td>
<td>80%</td>
<td>30%</td>
<td>47%</td>
</tr>
<tr>
<td>ECHO</td>
<td>31%</td>
<td>60%</td>
<td>67%</td>
<td>25%</td>
<td>39%</td>
</tr>
<tr>
<td>MSCTA</td>
<td>92%</td>
<td>93%</td>
<td>98%</td>
<td>70%</td>
<td>92%</td>
</tr>
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Source: ACC March 2006

Study using 64-Slice CT on Patients with Chest Pain found:
- Decreased need for multiple, less accurate, testing modalities
- Decreased need for diagnostic catheterizations
- Accurately diagnosed need for interventional catheterizations
- Will decrease cost and delays in care
“TriCorder” -- Point-of-Care Noninvasive Therapy

**HIFU**

High Intensity Focused Ultrasound for Non-invasive Acoustic homeostasis

[Images of medical equipment and ultrasound images]

Mechanics to energy

Courtesy Larry Crum, Univ Washington Applied Physics Lab

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Workforce Implications – Diagnostics

- More imaging clinicians will be needed to meet increased demand for Imaging tests (CT, MRI, PET, Ultrasound)
  - More hybrid training to use dual machinery
  - More ubiquitous users of imaging (i.e. US, CT, MR)

- Many image reading and production jobs will be centralized, offshored or outsourced

- Competition for deployment, testing and interpretation will occur between Radiology and other specialties

- Imaging and nursing are very conducive to second careers, don’t rule out the older volunteer, learner, student, and employee
Technology Offers the Potential for Greater Workforce Productivity

Capturing improvements in productivity through technology depends on how well health delivery systems adapt their workflow processes and manage implementation challenges:

- **Wireless Communication Systems** will increase productivity of clinicians and technicians by consolidating multiple communication platforms.
- **Remote Patient Management** will extend coverage and improve productivity but has significant technological and cultural challenges.
- **RFID** will decrease “hunting” time for supplies, staff, and patients, and will lead to better workflow analysis.
- **Point of Care Testing** will improve patient management and move more care to outpatient and home.
- **Service robotics** expand into more jobs in healthcare.
- **Modeling and Simulation** technologies important in planning and training.
Electronic White Board

- Allows real-time tracking of patients, lab and ancillary results, room status, equipment status, and triage state
- Integrated with EMR and ADT systems and can be viewed on a computer monitor or a large plasma screen by staff
- All views of information are flexible and customizable to clinician and audience preferences.
- Can be linked to test results and discharge status
- Improve throughput efficiency and better management of information, workflow and protocols
Radio Frequency Identification Tracking

Process, Interaction and Facility Overlay
Point of Care Testing (POCT)

<table>
<thead>
<tr>
<th>Traditional Lab</th>
<th>POCT</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Expensive equipment/cheap reagent</strong></td>
<td><strong>Lower priced equipment/cheap reagent</strong></td>
</tr>
<tr>
<td><strong>May be no equipment and cheap reagent</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Qualified, trained staff</strong></td>
<td><strong>Staff that needs to be trained</strong></td>
</tr>
<tr>
<td></td>
<td><strong>trained in something that is</strong></td>
</tr>
<tr>
<td></td>
<td><strong>out of their usual scope of</strong></td>
</tr>
<tr>
<td></td>
<td><strong>practice</strong></td>
</tr>
<tr>
<td><strong>Cost and time for specimen transport</strong></td>
<td><strong>Testing done at bedside</strong></td>
</tr>
<tr>
<td><strong>Maintenance and service contract</strong></td>
<td><strong>Maintenance and service contract</strong></td>
</tr>
<tr>
<td><strong>High level of quality control</strong></td>
<td><strong>Minimal control for some tests</strong></td>
</tr>
<tr>
<td><strong>Longer length of time to result</strong></td>
<td><strong>Quicker result may result in</strong></td>
</tr>
<tr>
<td></td>
<td><strong>shorter stay or less complications</strong></td>
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Modeling and Simulation Will Explode in Healthcare

For use in training in:
- Cardiac Catheter Laboratory
- Interventional Radiology Laboratory
- Endovascular Surgery Laboratory

Layout iQ Modeling and simulation software for:
- Facility design
- Work process flow

Blue Dragon passive recording device, Courtesy Blake Hannaford, PhD University of Washington, Seattle
Simulation, Facilities Design and Productivity

Simulation allows testing of designs for maximum workforce productivity

Typical ED Unit Layout

- Nursing to equalize workload take one patient from each acuity type increasing travel extensively
- Further Aggravated by Equipment Location and Room Size Differences

Non-Intuitive Layout

- Distribution of acuity rooms allows staff to equalize workload without increasing travel
- Equipment and supplies at the point of care will also decrease travel
Workforce Implications - Productivity

- Need an entire workforce with IT training to enable productivity
  - Include IT competencies in all job descriptions & searches

- New job descriptions need to enable more open processes
  - RFID and visualization of process systems reduce clinical workload but add additional workforce requirements to the information systems staff
  - Staff resistance to change will hinder some process modifications required to maximize operational efficiencies and improve outcomes
  - Shortages in staffing and new medical disciplines will foster new hybrid jobs and facilitate flexible staffing models

- More robotics will be used in surgery and support jobs in servicing, repair and maintenance of biomedical devices

- Use modeling and simulation to speed up education, credentialing, technical skills, teamwork, and optimize design choices
Care is Provided Remotely - from the Clinician’s Perspective

The diffusion of remote health services will drive shifts in settings, care providers, and care models. The increase in life expectancy and the rise of chronic disease will drive adoption of certain technologies, including:

- **Sensors** for independent living
- **Remote disease monitoring** of asthma, diabetes, and congestive heart failure
- **Remote device monitoring** for cardiac implants and artificial joints
- **Video-based** care for stroke, psychiatry, or dermatology
- **Cell phone** platforms for management, monitoring, and testing
- **TV, PC, and robotic** platforms for communication, education, and information and telepresence
The Benefits of an ICU Managed by Intensivists 24/7

- Decrease the cost of poor quality:
  - Cost of VAP (Ventilator Associated Pneumonia) = $40,000/case
  - Sepsis adds 11 days to LOS in ICU = $57,727/patient
- Reduce LOS
- Reduce mortality
- Improve quality and patient safety
- Integrate care processes – break down silos of care
- Create a referral network between facilities
- Deploy a scarce resource of Intensivists across a multi-hospital system
- Reduce the deficit impact and cost of intensivist coverage
- Improve workforce productivity and satisfaction
Remote and Tele-Medicine Services

**Remote Pharmacy Services** - *Health Alliance of Greater Cincinnati*
- Used in 2nd Shift
- 4 hour shifts
- Work from home
- Remote dispensing
- Patient education and counseling

**TelePharmacy** - *Methodist, Omaha*
- Satellite site 30 miles away
- Remote verification of orders
- Remote consultation

**Teletrauma: Fletcher Allen Health Care, Vermont**
- Markedly improves safety and quality of care for trauma patients, particularly in rural or isolated areas
- Provision of consultative services by trauma surgeons to rural communities using state-of-the-art videoconferencing technology
- Allows Clinicians to provide care more rapidly and appropriately

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Tele-Dermatology and Dermatology e-Visits

- Over 450 patients to date
- Increased patient convenience
- Sustainable business model; leverages lower costs of physical plant in Nantucket

Research Objectives:
- Clinical outcomes for web-visits versus in-office visits
- Impact on patient and physician satisfaction – efficiency, convenience, willingness to pay, outcomes
- Impact on wait times and access to dermatologists
- Evaluate reimbursement value with Blue Cross/Blue Shield of MA
Financial Pressure Drives Outsourcing and Centralization of Some Services

- The high cost of maintaining specialist staff 24/7 along with escalating test volumes and workforce shortages propel the move to outsourcing.

- Regional reference labs, tele- and e-pharmacy, and outsourcing/offshoring radiology readings represent cost-effective models for hospitals.

- IT and middleware allow for information flow back into the hospital.

- Small systems should consider partnering with each other or larger systems to ensure affordable services.
Workforce Implications – Remote Care

- The need to leverage scarce specialists will drive remote care
  - Consider the need for continuous IT support
  - There are serious enabling issues for state licensing hospital credentialing issues

- Work-life balance demands and scarcity necessitates flexible work schedules, remote and telecommuting options for many jobs

- Telemedicine can create new opportunities and threats
  - FMG workforce pool drying up
  - Some Telemedicine facilitates patient acceptance of offshoring
New Models of Care Emerge

Providers will develop new models of care that seek to combine existing technologies and a wider range of caregivers to manage care at significantly lower cost. Examples include:

- Chronic disease management models like A-ICU
- Emergence of patient navigator and survivorship programs in Oncology
- Creation of private market “concierge services” for care management
The Ambulatory Intensive Caring Unit (A-ICU) Model

Goal:
Reduce healthcare costs by creating a radically redesigned model of care which delivers as good or better care at half the overall price.

- Focus on 20% of patients with the highest projected cost
- Combine all the “technologies” we know that can save costs while improving quality and changing overall culture
- Patients actively participate in care in exchange for radically lower premiums and cost sharing
- Assume technology that exists or could be built today

Initial Model:
Start from scratch and build from the ground up, instead of trying to improve a current practice.
The Three Floor Model

We envision care being delivered by three conceptual “floors”, which are tightly integrated by personnel, culture, and technology.

**Third Floor:**
Referral to Specialists
Performance Driven Supply Chain Management

**Second Floor:**
Redesigned Primary Care Practice

**First Floor:**
Relationship-Based Disease Management

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**The First Floor**

Each patient is assigned a “Clinical Partner” to coordinate all their care.

Served by a team of non-MD providers appropriate to their issues: RN, MA, nutritionists, pharmacists, social workers.

Teach and support the patient in self-management of health and any chronic illnesses, as well as handling acute issues amendable to protocols.

Use a wide range of tools including secure email, inbound and outbound phone calls, group and individual visits, home visits, and home monitoring.
Managing The Ladder of Acuity

- Independent Living
- Congregate Care
- Assisted Living Facility
- Alzheimer’s Facility
- Skilled Nursing
- Sub-acute Care
- Long-Term Acute Care & Acute Rehab
- Acute Hospitalization

Cost of Service $
Workforce Implications – New Models of Care

- New models of care will support a wider range of caregivers, both classically trained and consumer-oriented

- Emerging models will place a greater emphasis on the patient and family as both managers and caregivers

- Adoption of these models can be accelerated through the use of technology, particularly remote health services
Summary

Technology will have a significant impact on the delivery of care and characteristics of the future workforce.

Specific technologies will both reduce and exacerbate workforce shortages:
- Reduction will result from decreasing volume and intensity of care, as well as improving throughput.
- Exacerbation will result from generating new service demand and decreasing throughput (due to technology constraints and training).

The result will be a deeper, more diverse, less classically trained and collaborative workforce, with the patient and family at the center of the care process.
Technologies That Assist Workforce Shortages

**Decrease Clinical Staffing Demands**
- Decrease Volumes
  - Remote Patient Management
  - Telemedicine
  - Sensors
  - Ultrafiltration

**Improve Throughput**
- Point of Care Testing (POCT)
- Robotics (service)
  - RFID
  - tele-ICU (RPM)
- Bar Codes
- Electronic White boards
Technologies that Exacerbate Workforce Shortages

Increase Clinical Staffing Demands

Increase Volumes
- Biomedical implants
- Surgical Robotics

Hinder Throughput
- EMR (early curve)
- Surgical Robotics

Axial Heart Pump

Surgical Robotics

Electronic Health Record
Translating research into action

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