Healthcare in the Digital Age:
The Future of Telehealth

Thomas Nesbitt MD MPH
Associate Vice Chancellor, Strategic
Technologies and Alliances
Director, Center for Health and Technology UC
Davis Health System
DISCLOSURE:

I have no relevant financial interest/arrangement or affiliation with any organizations related to commercial products or services to be discussed at this program.
Health Care with the ACA

- Millions more with coverage
- Pay for quality not quantity
- Pay for outcomes rather than process
- Emphasis on efficiency and effectiveness
- New models of care will be essential
- Technology can help facilitate these new models which can drive value over volume
The “Perfect Storm”

- Aging and Chronic Disease
- Caregiver Shortages
- Increased numbers covered thru ACA

Increasing demand for care with no viable means of supply
We need more than just improvement …

...We need transformation
### What Does Transformation Look Like?

<table>
<thead>
<tr>
<th>Now</th>
<th>Future</th>
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<tbody>
<tr>
<td>Responsible for health of individuals</td>
<td>Responsible for health of populations</td>
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<td>Treat in institutions</td>
<td>Treat in the home and community</td>
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<td>Focus on “professional” caregivers</td>
<td>Involve family, friends, other informal caregivers, and patients</td>
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<td>Accept fragmentation</td>
<td>Drive integration</td>
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<tr>
<td>Use technology to support current process</td>
<td>Use technology to disrupt current process</td>
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Care at Home and in the Community
A doctor's diagnosis "by radio" on the cover of the February, 1925 issue of Science and Invention magazine
The Need

• Greatest need is in chronic disease which affects 100 million Americans and is responsible for approximately 75% of health care expenditures

• Traditionally, we have used an episodic office-based model of care for managing chronic disease rather than a care management model with frequent patient contact and regular physiologic measurement
VA Care Management Process

Education, monitoring and feedback at home

Personalized, remote care management and support.

Scripted messaging, monitoring and reporting platform
Hospitalizations declined from 630 inpatient days pre to 122 during intervention period

Bed Days Of Care fell from 8.63 to 1.65 (p < 0.001)

Blood Pressure: 129/73 to 119/69 (p < 0.05)

Weight: 196 to 192 (p < 0.01)

Shortness of Breath 0-10 Scale: 4.0 to 2.7 (p = 0.02)

ACE Inhibitor Avg Daily Dose: 24mg/d to 35 (p < 0.01)

β-Blocker Avg Daily Dose: 84 mg/d to 94 (p = 0.05)
Longer term analysis of the data obtained for quality and performance purposes from a cohort of 17,025 in the program demonstrated:

- 25% reduction in numbers of bed days of care
- 19% reduction in numbers of hospital admissions
- Mean satisfaction score rating of 86%
- Cost of $1,600 per patient per annum
VA Home Telehealth Census

Fiscal Year

Darkins (2012), Institute of Medicine
NEHI’s Home Telehealth Technology Analysis

• Reported that the appropriate use of these technologies result in reductions of:
  – Emergency department visits
  – Hospitalizations and hospital readmissions
  – Hospital LOS
  – Overall costs of care

Self-management of hypertension in combination with telemonitoring of blood pressure measurements represents an important new addition to control of hypertension in primary care
Chronic Heart Failure


Twenty-one original studies on home telemonitoring for patients with CHF were included (3082 patients). Home telemonitoring reduced mortality (risk ratio = 0.64; 95% CI: 0.48-0.85) compared with usual care. Patient quality of life and satisfaction with home telemonitoring were similar or better than with usual care.
• Home telehealth for diabetes management: A systematic review and meta-analysis. Polisena et al., *Diabetes Obesity and Metabolism, 11*(10), 2009
A pooled meta-analysis evaluating HbA1c in 12 RCTs found that included RPM (\(n = 2,647\)) and found a statistically significant decrease in HbA1c

A review of RPM in type 2 diabetes found that RPM resulted in significant improvement in HbA1c and reduced complications while empowering participants to be involved in their own care.
Where we are going
SecuraPatch Sensors

- Heart Rate
- Respiration Rate
- Fall Detection
- Stress
- Skin Temperature
- Activity, Steps
- Caloric Burn
- Body Posture

Echo Therapeutics noninvasive glucometer

- This biosensor ... is placed on skin surface to read interstitial glucose levels and wirelessly provides readings each minute to a remote monitor (smart phone), ...
Monitoring Adherence
<table>
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<th>Digital Health Feedback System Summary</th>
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**Ingestion Identifier**
- **What it identifies**: That a specific pill, tablet or other ingested product (or combination) was ingested by patient.
- Composed and powered entirely from materials found in the daily diet.

**Physiologic Sensor**
- **What it senses**: Precise time & identity of ingestions. Certain physiologic responses and consumer behaviors over time. - HR, HRV, activity, sleep, temperature
- Also acts as communications hub between ingested product and phone.

**Mobile Applications**
- **What it influences**: Consumer reported wellness metrics.
- Correlations between ingestion adherence, patch physiologic measures, and data from other telemetric devices.
- Displays information to enable collaboration with caregivers.
wii “Active” & Kinect “Your Shape”
Virtual Characters based on sensors
VR Solutions for Remote Physical Therapy
Future Opportunities, Issues and Challenges

• Patient preferences and acceptability of devices. How much intrusion is acceptable?
• Managing and transforming data into clinically actionable information for the provider in EMR
• How to create technology enabled chronic disease management models outside of large health care organizations
• How to involve patients and families in care
• How to use off the shelf devices in standards-based health care – Mobile phones, gaming systems, gamification of chronic disease, etc
Office-based Telemedicine
Photograph courtesy of the American Telemedicine Association, Washington, D.C.
Logan International to MGH 1968

Photograph courtesy of the American Telemedicine Association, Washington, D.C.
Case originated...
Alaska Federal Health Care Access Network

...Case received.
Clinic-based Telehealth Today
Medical Peripherals

General Exam Camera

Otoscope

Nasopharyngoscope

Electronic stethoscope
Asynchronous or Store and Forward
Select Outcome Studies - Dermatology

• Diagnosis agreement high comparing (differential) diagnosis via telemedicine and clinic-based examiners (Whited, 1999, 2001; Wootton, 2000)


• Clinical outcomes in skin cancer management via S&F TM as measured by times to diagnosis and to surgical treatment can be comparable to conventional management (Hsiao J. et al. J Am Acad Dermatol 2008)
Select Outcome Studies – Mental Health

Diagnosis and management plan agreement high between in person and telemedicine (Elford, 2000; Ruskin, 1998)


Psychiatric consultation and short-term follow-up can be as effective when delivered by telepsychiatry as when provided face to face. O'Reilly R, et al. Psychiatr Serv. 2007 Jun;58(6):836-43
One of the problems is that we are applying new technology to a broken model of care instead of using technology to facilitate a change in the model of care.
VA Clinical Video TM Encounters

Fiscal Year

Clinical video telehealth encounters

2008 2009 2010 2011 2012

0 500000 1000000 1500000 2000000 2500000 3000000 3500000

Fiscal Year

Darkins (2012), Institute of Medicine
VA Asynchronous TM Encounters

Fiscal Year

Store and forward encounters

2008  2009  2010  2011  2012

Fiscal Year

Darkins (2012), Institute of Medicine
Future Drivers for Outpatient TM

- Shortage of specialty physicians
- Increased enrollment from the ACA
- Timely access requirements for specialty care by regulatory bodies
- Consumer demands for second opinions and "best specialist"
How does this save money?

• Much of the process in out-patient specialty care is a duplication of the primary care office visit. (waiting room, staff, exam room, etc)

• In many cases, telemedicine allows for more efficient access to the specialists expertise and still moves the process to the next evidence-based clinical decision.

• This pure consultation model can lead to reductions in specialty time, capital and staff costs.
Where we are going
Handheld cellphone-based Otoscope
Integration of Video, EHR & Decision Support
New technology enabled models of care

Outcomes of treatment for hepatitis C virus infection by primary care providers.


- A total of 57.5% of the patients treated at the UNM HCV clinic (84 of 146 patients) and 58.2% of those treated at ECHO sites (152 of 261 patients) had a sustained viral response (difference in rates between sites, 0.7 percentage points; 95% confidence interval, -9.2 to 10.7; \( P=0.89 \)).

- Serious adverse events occurred in 13.7% of the patients at the UNM HCV clinic and in 6.9% of the patients at ECHO sites.

- The results of this study show that the ECHO model is an effective way to treat HCV infection in underserved communities.
Project ECHO

• Force multiplier using community primary care clinicians to provide standardized specialty care
• Uses technology for education and case conferences
• With RWJ Foundation and CMS innovation funding ECHO now replicated in Chicago, Washington State and other locations across the nation.
• Large new project in the VA
• Now being used in many specialties (Cardiology, HIV, Chronic pain, Pulmonary Care, Rheumatology, Psychiatry, Cardiovascular Risk Reduction, High-Risk Pregnancy, Geriatrics, Palliative Care, and Pediatric Obesity)
Future Opportunities, Issues and Challenges

- Use of non-traditional providers at remote site
- How telemedicine can support ACOs and the primary care medical home
- Sustainability of new technology enabled models of care (Consultation without the procedure) (ECHO)
- Telemedicine on the tablet and laptop, improved handheld devices and applications
- Development of standards (resolution, etc)
- Integration of TM with EMRs and decision support algorithms (Watson)
Emergency and In-Patient Settings

Reducing quality disparities in the hospital setting
Emergency Room Telemedicine
Emergency Medicine - Telestroke


Inpatient Pediatric and Adult Critical Care
Hospital mortality, length of stay, and preventable complications among critically ill patients before and after tele-ICU reengineering of critical care processes. Lilly CM, et al. JAMA Jun 2011 1;305

Implementation of a tele-ICU intervention was associated with reduced adjusted odds of mortality and reduced hospital length of stay, as well as with changes in best practice adherence and lower rates of preventable complications.
Meta-Analysis of Tele-ICU


- Meta-analyses showed that telemedicine, compared to standard care, was associated with lower ICU mortality (risk ratio [RR] 0.79; Reductions in ICU and hospital length of stay were also statistically significant
Where are we going?
Care in the in-patient setting
Telehealth in extended care settings

- 1.5 Million nursing home patients in the US, 8% have ED visits in 90 day period, 40% of those visits are avoidable
- Recent NEHI analysis of literature demonstrated strong evidence of clinical benefit and savings with increased use of telehealth in nursing homes
- Changes in reimbursement policy for readmissions will drive increased use of TM in LTC facilities
- Initially will use more traditional mobile video conferencing devices and monitoring systems
Telesurgery
The Lindbergh Operation

One of the earliest remote surgeries was conducted on 7 September 2001 across the Atlantic Ocean, with a surgeon in New York performing a cholecystectomy on a 68-year-old female patient 6,230 km away in Strasbourg, France, was conducted over a dedicated fiber optic link to ensure guaranteed connectivity and minimal lag.
The RoboConsultant: telementoring and remote presence in the operating room during minimally invasive urologic surgeries using a novel mobile robotic interface.


The robot was controlled by a senior surgeon from various locations ranging from an adjacent operating room to an affiliated hospital 5 miles away. The Robo-Consultant performed without connection failure or interruption in each case, allowing the consulting surgeon to immerse himself and navigate within the operating room environment and provide effective communication, mentoring, telestration, and consultation.
Collaborative research to advance the state of surgical robotics

A multi-campus, multidisciplinary development project involving

- Construction of an open-source surgical robotics platform (Jacob Rosen, UCSC)
- Development of machine learning algorithms to optimize robot task performance (Kenneth Goldberg and Pieter Abbeel, UCB)
- Design and evaluation for clinical applications (Dr. Douglas Boyd, UCDHS)

Initial testing begun in 2010
Future Issues and Challenges

• Expanded role of just in-time expertise in ED
• Finding viable business models for AHCs and others that keep patients and procedures in other locations (telemedicine in ED to SNF and Hospital to Hospital) important to assure quality in mergers and acquisitions as well as for the future of rural hospitals
• For-profit entities providing services such as tele-stroke and e-icu for selected high margin hospitals
• Business case for tele-mentoring and tele-robotics procedures
Summary

• Advanced information and telecommunications technologies have a central role to play in transforming our health care system

• Evidence based models of care, facilitated by these technologies potentially can improve access and quality across the economic and geographic spectrum

• To date, we have been attempting to layer these technologies on to a health system that often does not have incentives for their use

• The ACA and other policy changes can help drive this transformation

• More research is required to develop appropriate quality standards