Emerging Technologies in Healthcare: Challenges and Opportunities

Carol Huston, MSN, MPA, DPA, FAAN

Professor Emerita, School of Nursing,
California State University Chico
Thank you for inviting me to be here today!
Technology and the reform of health care will continue to bring both significant challenges and opportunities in the future!
All nurses will be challenged to develop the skillsets and leadership behaviors they need to address emerging technologies.
Visioning: A Daunting Task
Demonstrating caring in an era of technology driven healthcare can be challenging...
Even the COVID-19 pandemic has accelerated technology growth.

Fisk (2019) notes that the 2020s will be a decade of transformation. Indeed, Fisk suggests there will be more change in the next 10 years than the last 250 years.
Technology has already changed our lives dramatically!
What are some of the technologies that will change the practice of healthcare?

What skill sets will nurses need to develop to acquire, use, and integrate these emerging technologies as health care reforms?

What new roles will emerge for nurses in this new era?
Select Technologies
Reforming Healthcare

1. Genetics and genomics
2. Less invasive and more accurate tools for diagnosis and treatment
3. Robotics
4. Biometrics
5. Electronic health records
6. Computerized physician/provider order entry and clinical decision support
GENETICS AND GENOMICS
Precision Medicine

An emerging approach for disease treatment and prevention that takes into account individual variability in genes, environment, and lifestyle for each person.

Carroll (n.d.) suggests the healthcare system will transition from one which “fixes people after they’re sick” to one of preventative, diagnostic genomic-based medicine where patients will be treated for conditions, we know they are likely to develop.

Gene therapy will continue to make significant inroads in curing cancer or preventing birth defects.
Organ transplants may no longer be needed because we’ll be able to grow new organs from a patient’s own tissues.
Stem cells will be used to generate replacement cartilage tissue to repair damaged joints, especially for osteo-arthritis patients.
We may be able to grow new teeth instead of buying dentures.

New Drugs To Treat Cancer...
LESS INVASIVE AND MORE ACCURATE TOOLS FOR DIAGNOSIS AND TREATMENT
Did any of you ever see Dr. McCoy on Star Trek and how he diagnosed patients?
Diagnostic body scans will become part of showering!
Circulating nanobots will identify and repair disease processes.
We’ll have blood tests which will detect potentially harmful cardiac artery blockages, avoiding the more risky angiograms.
Prescription Tattoos: Coming to a Pharmacy Near You
We are likely to see the increased use of magnets to treat depression.
Deep Transcranial Magnetic Stimulation can perform non-invasive yet deep stimulation to the brain, increasing neurotransmitter levels and possibly improving the symptoms of brain disorder.

New scanning technology will eliminate the need for exploratory surgery and invasive procedures.
3-Dimensional (3D) Printing
Bioprinters, using a "bio-ink" made of living cell mixtures can build a 3D structure of cells, layer by layer, to form human tissue and eventually human organs for replacement.
Bionic Ears Created Using 3D Printing
Researchers 3D Print Prototype For 'Bionic Eye'

ROBOTICS
The Covid-19 pandemic accelerated the development and use of autonomous robots that emit germ killing ultraviolet light to decontaminate rooms in 15 minutes…

...and radio-frequency identification (RFID) technology to track how long — and how often — employees wash their hands.

Biomechatronics

Merging the human with the machine...
Robots in Surgery
Robots in Diagnostics and Therapy

This is a robotic breast examiner!
Robots as Direct Care Providers

Physical Service Robots
Robots as Mental Health Care Providers

- Mental service robots
PARO

- A therapeutic robot
- Retails for about $6000
- 8 generations have been produced since 2003
After the 2011 Tsunami in Japan.....
Huston (2017) suggests that the lack of emotion in patient care robots is the element of human caregiving that can never be replaced. However, as technology continues to advance, the ability to distinguish robot from human caregiver is declining.

Kansei Robots
Could you have a therapeutic conversation with a robot? Can patients?
Are the elderly and other vulnerable populations at risk for deception? Can these populations clearly differentiate between man and machine?
Do mental health robots improve or further the problem of social isolation in the elderly and other vulnerable populations?
Highly refined simulation will increasingly be used as an adjunct to or replacement of clinical learning experiences.
BIOMETRICS
Biometrics

The science of identifying people through physical characteristics---fingerprint, handprint, retinal scan, voice recognition, and facial structure
The use of handprints, retinal scans, facial geometry and dynamic signatures as biometric signatures will become commonplace.
Palm vein scanning as a biometric tool

Emerging biometric technologies are providing more choice and increased accuracy
Electronic Healthcare Records
• Multi-physician practices pay between $180,000 and $200,000 for their EHR systems.
• First-year maintenance costs average between $80,000 and $100,000.
• Training costs between $2,000 and $3,000.
• System hardware averages between $5,500 and $6,000.
• IT-related issues and support average between $3,000 and $4,000.

Source:
The 24-hospital Sutter Health in California paid out more than US $1 billion for its EHR and the 38-hospital Kaiser Permanente invested US $4 billion for its system.


The Challenges of EHRs

- Not easy to implement
- Expensive
- Lack of funding
- Debates about who “owns” the data in the system
- Getting computers to “talk to each other”
Patients feel less satisfied if providers focus on their computers instead of them as it depersonalizes the encounter. In addition, the patient’s medical record may become “yes” or “no” data points.

Computerized Physician/Provider Order Entry And Clinical Decision Support

A promising technology that allows providers to enter orders into a computer and to access the latest information on best practices.
What is CPOE and Why Do We Need It?

Drug Safety Alerting in Computerized Physician Order Entry
Unraveling and Counteracting Alert Fatigue

Handwritten notes:
1. PO
2. Influenza H1N1
3. Antibiotic MD MD
4. Find flow to be
   NFL 940 NIV/ECMO
   Layer B 295 cm
Clinical Decision Support (CDS)
Skill Sets Needed To Respond To These Emerging Technologies
Three Skill Sets Needed in an Era of Technology Driven Healthcare

1. Being Able to Use Technology to Facilitate Communication and Relationships
2. Having Expertise in Knowledge Information, Acquisition, and Distribution
3. Understanding and Using Genomics
Emerging Critical Skill Set:

Being Able to Use Technology to Facilitate Communication, and Relationships
Technology as a Leadership Competency

The ability to integrate technology which facilitates mobility and portability of relationships, interactions, and operational processes
Emerging Critical Skill Set:

Having Expertise in Knowledge Information, Acquisition, and Distribution
Knowledge information, acquisition and distribution will continue to multiply exponentially.

In a profession where clinical knowledge doubles every 18 months, nurses can no longer be the keeper of knowledge; instead they must become the master of collecting and learning new knowledge.
The Internet and The Expert Patient
For example, Genetic testing can now prevent disease, but it also creates a new set of moral, legal, ethical, and policy issues:

- If the testing is useful, how do we provide equal access? What are the potential privacy issues and how do we protect this very personal and private information?
- Which genetic abnormalities warrant some kind of intervention? How do we ensure that the information provided by genome analysis is correct (especially in the case of at-home tests)?
- Are we headed towards a new era of therapeutic intervention to increase quality of life, or a new era of eugenics?

Emerging Critical Skill Set:

Understanding and Using Genomics in Practice
Healthcare providers must know how to obtain family histories, identify individuals at risk, help people make informed decisions about the results of their genetic/genomic tests and therapies, and refer at-risk people to appropriate health care professionals and agencies for specialized care.
Low cost genetic sequencing is now readily available to all consumers..
Direct-to-consumer genetic testing companies have proven particularly popular, with more than 30 million people around the world having taken a DNA test as of 2020.

<table>
<thead>
<tr>
<th>Disease Risks (100)</th>
<th>Carrier Status (24)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Elevated Risks</strong></td>
<td></td>
</tr>
<tr>
<td>Gallstones new</td>
<td>Hemochromatosis</td>
</tr>
<tr>
<td></td>
<td>Variant Present</td>
</tr>
<tr>
<td>Restless Legs Syndrome</td>
<td>Alpha-1 Antitrypsin Deficiency</td>
</tr>
<tr>
<td></td>
<td>Bloom's Syndrome</td>
</tr>
<tr>
<td></td>
<td>BRCA Cancer Mutations (Selected)</td>
</tr>
<tr>
<td></td>
<td>Canavan Disease</td>
</tr>
<tr>
<td></td>
<td>Cystic Fibrosis</td>
</tr>
<tr>
<td></td>
<td>Familial Dysautonomia</td>
</tr>
<tr>
<td></td>
<td>Factor XI Deficiency</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Decreased Risks</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Prostate Cancer</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Alzheimer's Disease new</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Colorectal Cancer</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Traits (50)</th>
<th>Drug Response (19)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alcohol Flush Reaction</td>
<td>Does Not Flush</td>
</tr>
<tr>
<td>Bitter Taste Perception</td>
<td>Can Taste</td>
</tr>
<tr>
<td>Earwax Type</td>
<td>Wet</td>
</tr>
<tr>
<td>Eye Color</td>
<td>Likely Brown</td>
</tr>
<tr>
<td>Hair Curl</td>
<td>Slightly Curlier Hair on Average</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Drug Response (19)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Warfarin (Coumadin®) Sensitivity</td>
<td>Increased</td>
</tr>
<tr>
<td>Abacavir Hypersensitivity</td>
<td>Typical</td>
</tr>
<tr>
<td>Alcohol Consumption, Smoking and Risk of Esophageal Cancer</td>
<td>Typical</td>
</tr>
<tr>
<td>Clopidogrel (Plavix®) Efficacy</td>
<td>Typical</td>
</tr>
<tr>
<td>Fluorouracil Toxicity</td>
<td>Typical</td>
</tr>
</tbody>
</table>

| See all 50 traits... | See all 19 drug response... |
I’ve been genetically sequenced!!

But it’s not something that should be taken lightly.
Many ethical questions exist regarding whether relatives of someone with a positive predictive genetic test should or must be told about the results.
Four Leadership Challenges in Integrating New Technology

1. Balancing the human element with technology
2. Balancing cost and benefits
3. Training a technology enabled workforce and assuring ongoing competency
4. Assuring that technology use is ethical
Perhaps the Greatest Challenge for Healthcare Leaders?
Balancing Technology and the Human Element
Nurses need to make sure the human element is not lost in the race to expand the use of technology.
Ethical Considerations:

• Dignity/autonomy
• Technology as a potentially cold/dehumanizing part of care
• Technology as a potential contributor to disparities of care
• Nursing’s voice
What makes new technology worth the cost? What criteria should be used in making these potentially value-based decisions? (Huston, 2022-In Press)
Is need driving technology or is technology driving need?
We need to avoid being enticed by technology for its own sake—and be clear on the precise problem the new technology is designed to solve.
“Ethicists and health professionals alike are raising questions about when and from whom treatments should be withheld, as competition for scarce medical resources grows beyond the system's capacity to provide care for everyone. Already, some forms of rationing have been implemented, and more rationing of health care resources may be inevitable” (Markkula Center, n.d. para 2).

Since access to technology is often dependent on a person’s ability to pay for that technology, many health care disparities still exist in this regard.
Should health care technology ever be rationed by age? By ability to pay? By perceived potential contributions to society at large?
Other Challenges?

- Training
- Assuring Ongoing Competency
- Implementation
Other Challenges?

- Ethical Considerations
Wadhwa (2014) suggests that with the pace of technology growth, we have not been able to come to grips with what is ethical, let alone determine what laws or rules should be in place.

“We need to step back before we adopt new technology and have a conversation about how this will impact care. What do we lose by adding this technology? What will we gain? Nurses on the front lines of care 24/7 are the people to figure this out.”

Nurses must increasingly speak up and ask “how” and “why” technology should be implemented.
New or Expanded Roles for Nurses in an Era of Technology and Healthcare Reform?

- Nurse Navigators
- Nurse Informaticists
- Nurse Ethicists
• Nurse Geneticists or Nurses with Significant Genetic Expertise
• Nurse Policy Leaders
• Nurse Change Agents
“The expectation in healthcare is that a leader is able to deliver new things, sometimes not even knowing what they were yesterday, and deploy those technologies in an excellent way.”

----Russell Branzell, president and CEO of the College of Healthcare Information Management Executives

Evolving technologies offer great opportunities to improve the quality of life, but technology alone is not the answer. We must consider, however, what technology is best in each setting and how it should be used ethically. In addition, every care provider must understand every technology’s limitations as well as its benefits.
Questions? Comments? Thoughts?