Healthcare 4.0

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Smart and Connected Healthcare
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- Human factors and systems engineering
- Modeling, simulation and operations engineering
  Hospital, ED, primary care, specialty care, transitions, home, ...
  Medication safety, hospital readmission, healthcare-associated infections, improving diagnosis, VTE prophylaxis, operation efficiency
Some progress, but need research innovation, dissemination and impact:
- methods adapted for health care
- engineering understanding of health care
- impact on healthcare quality and quadruple aim
Let us imagine healthcare transformation.

- How does an industry get transformed?
- What is the role of technology?
- What is the role of systems engineering?

- Industry 1.0 to 4.0
- Healthcare 1.0 to 4.0
Industry 1.0

- Industrial revolution
- Steam power, mechanization
Industry 2.0

- Mass production, electricity, assembly line
Industry 3.0

- Computer, Automation, Electronics
Industry 4.0

• Network, IoT, Cyber Physical System
Industry 1.0 to 4.0

- Industry revolutions
  - Simple – complex – intelligent
  - Single – multiple – network
  - Sole – some - all
  - Small – big – giant

- Automation
Healthcare 1.0

- Encounters
- Treatment, medications
Healthcare 2.0

- Technology
- Equipment, medical devices
Healthcare 3.0

- Electronic health record
- Computerization of processes
Healthcare 4.0

- Smart, interconnected
- AI, personalized/precision
- Patient-centered
- Patients, providers, home, clinics, hospitals, SNF, pharmacy, EHR, equipment, medication, billing, ...

Digital Health

- Clinical trials
- Wearables
- Wellness
- nHealth
- Telehealth-care (Remote monitoring)
- Visualization
- Health Analytics
Healthcare 1.0 to 4.0

- Simple – complex – intelligent
  - Medication, disease
- Single – multiple – network
  - Provider, equipment, facility
- Sole – some – all
  - Community, multiple disciplines & perspectives
- Small – big – giant
  - Data, variety, quality
- Automation
- People
Smart and Connected Healthcare
A Vision and a Journey…

• Beyond ‘black box’ model of technology:
  • What systems and processes are necessary to make ‘it’ happen?

(Carayon & Wood, 2010)

(Seips model; Carayon et al., 2006, 2014)
Smart and Connected Healthcare Challenges

Patient-centered care, access, safety, efficiency, effectiveness

Challenges:
1. People: patients, healthcare professionals
2. System and process
3. Impact on important outcomes
1. Health Care is about People

(Carayon & Wood, 2010)
2. Health Care is about System and Process

- Team, team of teams, caregiving network
- Across organizational boundaries
- Community

(SEIPS model; Carayon et al., 2006, 2014)
3. Health Care Outcomes

Quadruple aim
• To revolutionize the patient experience
• To improve population health
• To control healthcare costs
• To enhance clinician satisfaction

(Sikka et al., 2015)

• Not just technology, work (sociotechnical) system and process
• Safety of technology
• Patient(family/caregiver)-centered
SCH – Challenges:
1. People: patients, healthcare professionals
2. System and process
3. Impact on important outcomes

Healthcare 4.0
- Smart, interconnected
- AI, personalized/precision
- Patient-centered
- Patients, providers, home, clinics, hospitals, SNF, pharmacy, EHR, equipment, medication, billing,...
WIHSE Research Agenda:
1. Monitoring and anticipating safe care transitions for vulnerable populations
2. Smart automation and technologies for coordinating and communicating diagnosis and treatment
3. Smart and connected patient-centered care
4. Patient safety: modeling, forecasting and responding to healthcare-associated infections

SCH for safe & healthy aging:
Coordination for health & healthcare

Healthcare 4.0
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Digital Health

Engineering
- Health sciences & education
- Smart and connected healthcare
- Healthcare delivery

Healthcare technologies
SCH - Implications for Stakeholders

• *For engineering researchers*:
  • Develop new methodologies for healthcare 4.0
  • Think ahead of implementation and impact

• *For health scientists and educators*:
  • Collaborate with others to create innovations
  • Open up to other perspectives and disciplines

• *For technology developers*:
  • Think ahead of interaction with varied users in varied contexts [human/technology interactions]
  • Close feedback loops between design, implementation and use

• *For healthcare delivery*:
  • Invent or try new practices/new care models
  • Collaborate with others to implement innovations
We want your input...

Help us to identify and refine implications of Healthcare 4.0 for different groups of stakeholders...
WIHSE Research Agenda:
1. Monitoring and anticipating safe care transitions for vulnerable populations
2. Smart automation and technologies for coordinating and communicating diagnosis and treatment
3. Smart and connected patient-centered care
4. Patient safety: modeling, forecasting and responding to healthcare-associated infections

1. Select specific topic related to WIHSE research agenda.
2. How does SCH help to address this topic-problem?
3. What are implications for stakeholders?
4. Fill out blue worksheet by 10:45am.