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# Medical Education Needs a Reboot!!

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# There have been many, many, many, many, many, many, many, many, many calls for medical education reform

“Every decade brings calls for improvement in  
medical education”<sup>1</sup>

1. Skochelak SE. A decade of reports calling for change in medical education. Acad Med 2010;85:S26-S33.

# Why has this been the case?

- Medical education is full of untested assumptions
- The curriculum is a collection of requirements, trends, topics du jour, and “mini-me’s”
- It is somewhat disconnected from actual practice
- Accreditors have vested interests in maintaining control, thereby making real change and innovation hard to come by

# The changes that *have* occurred have been incremental, not fundamental

- They have not, for example, dealt fully with key issues like:
  - Lack of UME-GME continuum
  - Actual practice needs and trends
  - Workforce and market interactions
  - Changing technologies and scientific advances
  - (Student debt)

# But fundamental change is on the way...

- 21<sup>st</sup> century trends are transforming some of the most basic and timeless qualities of medicine, such as:
  - The nature of the “guild” and the locus of knowledge
  - The sacrosanct doctor-patient relationship
  - The ability to solve patient problems single-handedly
  - A medical marketplace driven by technology and artificial intelligence
  - Practices focused on precision medicine

# Some drivers of 21<sup>st</sup> century medicine

[alphabetically]

- 1. Changing market forces**
  - Politics and policies
- 2. Consumer empowerment**
  - Population demographics
  - Disease patterns
  - Globalization
  - Pace of change
- 3. Science**
  - Societal needs and values
- 4. Technology**

# 1. Changing market forces

- The market seeks profits wherever they may be found
- Trillion-plus dollar spend on healthcare offers enormous opportunities for companies and entrepreneurs
- Wave of consolidation in healthcare
- Restraints on practices are weakening
  - Information and services delivered directly to patients, bypassing the profession

# Some obvious examples

- Ambulatory Care<sup>2</sup>
  - Retail Clinics – now over 1900 and growing. CVS, Walgreens, Kroger, and Target have clinics in only 8% of their 20,000 stores
  - Urgent Care Centers – about 6400 with annual growth rate of 300-600 per year
- Direct to consumer marketing and advertising
  - Drugs
  - Diagnostics
  - Wearables

2. Convenient Ambulatory Care – Promise, Pitfalls, and Policy. Chang JE, Brundage SM, Chokshi DA, N Engl J Med 2015;373:382-388/July 23, 2015.



## 2. Consumer Empowerment

- Through:
  - Knowledge
  - Technology
  - Social Media
  - Loosening of restrictions (e.g., direct to consumer advertising)

# What this might portend...

“...self-testing and self-interpretation could cause even more problems than they aim to solve...it is not clear that healthy people or patients can be trained to use diagnostics more wisely.”<sup>3</sup>

**How do we train healthcare providers to deal with this?**

3. Ioannidis JPA, Stealth research and Theranos. JAMA 2016;316:389-390.

# 3. Science

- We are entering a new era in medical discovery that will focus on precision medicine
- This changes the paradigm for care delivery, drug discovery, and virtually everything else

# 4. Technology

- We are moving from a print-based industrial society to a technology-based Internet society<sup>4</sup>
- This changes fundamentally the nature of the professions
- IBM Watson is but one early example

4. Susskind R and Susskind D. The Future of the Professions. 2015: Oxford University Press

# A few game-changing technologies<sup>5</sup>

- Portable Diagnostics
- AI in decision-making
- The end of human experiments
- Augmented reality
- Social media
- DIY biotechnology
- Direct-to-consumer genomics
- Surgical and other robots
- Augmenting human features
- Nanorobots in our bloodstream

5. The Medical Futurist, 4/12/16

# But let's not discount the other drivers

- Disease patterns
- Globalization
- Pace of change
- Politics and policies
- Population demographics
- Societal needs and values

# What's really changing in 21<sup>st</sup> century healthcare is:

1. **Changing market forces** • Politics and policies
2. **Consumer** • Population

## THE FUNDAMENTAL NATURE OF MEDICAL PRACTICE

- Pace of change
- values
- 4. **Technology**

# In effect, a “new physics of patient care” is being created

- This presents a compelling platform for the transformation of medical education



# The new “physics” of patient care

$$E = mc^4$$



$$E = mc^4$$

The Emerging model of healthcare<sup>6</sup>, where:

- m = the population, both individually and collectively
- c<sup>4</sup> =
  - c<sup>1</sup> = care anywhere
  - c<sup>2</sup> = care in teams
  - c<sup>3</sup> = care by large data sets
  - c<sup>4</sup> = care by machines

6. Inspired by Eric Dishman's Ted Talk at [http://www.ted.com/talks/eric\\_dishman\\_health\\_care\\_should\\_be\\_a\\_team\\_sport.htm](http://www.ted.com/talks/eric_dishman_health_care_should_be_a_team_sport.htm).

# Care anywhere (c<sup>1</sup>)

- Technology is moving with and inside the patient's body, wherever the patient may be
- Large, fixed infrastructures are necessary, but could be configured differently
- Consumers want convenience and one-stop shopping

# Care in teams (c<sup>2</sup>)

- The one-to-one doctor patient relationship is being replaced by relationships with multiple health professionals
- Figuring out how to gain the most value from team care is key
- Reimbursement must be supportive
- Scope of practice needs careful re-design

# Care in large data sets ( $c^3$ )

- Collections of huge meta-data sets are becoming standard for patients, eventually leading to continuous monitoring
- A new interpretive and functional infrastructure is required to manage this data
- Locus of decision-making is shifting

## Care by machines (c<sup>4</sup>)

Machines are a real threat to conventional medical practice

They don't get tired

PERHAPS THE BIGGEST  
DISRUPTORS?

— they are HR friendly

Let's focus on them a bit

mistakes than humans

# The rise of the (smart) machines

- No human can effectively process the exploding volume of medical knowledge and data
- Machines will know more and be able to perform more tasks than care givers
- Devices can out-perform human capacity in both the cognitive and physical senses

“What is the compelling urgency of the machine that it can so intrude itself into the very stuff out of which man builds his world?”<sup>7</sup>

7. Joseph Weizenbaum. *Computer Power and Human Reason*. W.H. Freeman: San Francisco, 1976



- The market for the mixture of intelligent algorithms and robots is growing seven times faster than traditional manufacturing robots<sup>8</sup>

8. Business Insider, February 2015

# Robots trending in healthcare

## - Examples -

- Data management: Watson-like models
- Dispensing meds: robot pharmacists
- Administering cancer treatments: Nano robots
- Diagnosing diseases: pap smear screening
- Caring for the elderly: 24 hour live-in robots
- Surgical robots: now a billion dollar industry in a growing range of medical specialties

- Medicine is becoming digital...we'll eventually be able to use artificial intelligence instead of doctors for much of our health care

- Vivek Wadhwa<sup>9</sup>

9. Forbes, 12/14/15, <http://www.forbes.com/sites/chasewithorn/2015/12/14/artificial-intelligence-doctors-and-virtual-reality-vacations-are-on-the-horizon/#6935f6bd544a>

- You'll be paid in the future based on how well you work with robots<sup>10</sup>

10. Kevin Kelly, quoted in Brynjolfsson and McAfee, The Second Machine Age, Norton: 2014.

# Working with machines

“...machines and systems will work alongside tomorrow’s professionals as partners. The challenge here is to allocate tasks, as between human beings and machines, according to their relative strengths...Human professionals will have to come to terms with the need to defer to the superior capabilities of machines.”<sup>11</sup>

11. Susskind and Susskind, op. cit.

# JAMA Viewpoint 2-9-16

“The profession of medicine has a tremendous opportunity and an obligation to oversee the application of this technology to patient care.”<sup>12</sup>

12. Darcy AM, Louie AK, Roberts LW, JAMA 2016; 315: 551-2.

# The Challenge: Medicine and Machines

## QUESTION:

- “Will smart machines replace humans like the internal combustion engine replaced horses?”<sup>13</sup>

13. <http://www.esquire.com/lifestyle/a34630/viv-artificial-intelligence-0515/>

# Of course, machines are already busy disrupting medical education

- New learning technologies and interfaces
- Demanding new skill sets for teaching faculty
- Raising questions about what constitutes the “best” in medical education



**“Healing, whether physical or emotional,  
is an experience of life, one that  
technology can never replace.”<sup>14</sup>**

- Is this [still] true? –

14. Polacco MA. The \$6 million physician. *The Pharos* 2015; 78(2): 11-15.

# We can love machines

## But can they love us back?

- The issue is *not* can humans develop deep emotional attachments to machines, but rather *can* machines develop deep emotional attachments to humans?
- The science of *affective robotics*, using robotic sensing to respond to the emotional states of their users, is still in its early stages

**Patient care is clearly being  
transformed**

**But are we teaching  
the skills needed?**

# New skills that are needed

“The new tools for tailoring treatment will demand a greater tolerance of uncertainty and greater facility for calculating and interpreting probabilities than we have been used to as physicians and patients ...Assessing and acting on these probabilities will require approaches to data presentation, risk quantification, and communication of uncertainty for which we are largely ill equipped and that we already struggle with.”<sup>15</sup>

15. Hunter DJ. Uncertainty in the era of Precision Medicine. NEJM 2016;375:711-713.

# Skills to be refined

- The greatest clinicians...have a sixth sense for biases...The discipline of medicine concerns the manipulation of knowledge under uncertainty<sup>16</sup>

16. Siddhartha Mukherjee, *The Laws of Medicine*, TED Books, 2015

# Skills to be refined

“There are some things people come to know only as a consequence of having been treated as human beings by other human beings.”<sup>17</sup>

17. Joseph Weizenbaum, *Computer Power and Human Reason*. W.H. Freeman and Company, 1976, p209

# Skills to be refined

“I like to argue that technology serves to get the *unneeded* variation *out* while the physician is there to keep the *needed* variation *in* health care.”<sup>18</sup>

18. Paul Rothman, Dean of the Johns Hopkins University School of Medicine, Commencement Address, Northwestern University Feinberg School of Medicine, May 23, 2016.

# Questions to ponder

- In healthcare (and other fields), what is the role that humans will play?
- What is the reality of the “human touch?”
- How to best match medical school and residency output with societal needs?
- How do we need to change our curricula and care practices for 21<sup>st</sup> century medicine?



# More questions to consider

- How does the human factor in medical decisionmaking go beyond probabilities to address uniquely human complexities?
- Who ultimately manages the machines – and how?

The “new physics” of patient care needs a  
“newer” formulation!

**newer**  
**The ~~new~~ “physics” of patient care**

$$E = mc^5$$



**c<sup>5</sup> = Character, Choice, and Compassion**

MGMA Oct 2013

# c<sup>5</sup>= Character for ethical practice

- “...the physician’s duty is not to stave off death or return patients to their old lives, but to take into our arms a patient and family whose lives have disintegrated and work until they can stand back up and face, and make sense of, their own existence.”<sup>19</sup>

19. Paul Kalanithi, When Breath Becomes Air. 2016: Random House.

# c<sup>5</sup>= Choice

- Respecting the right of patients to make choices according to their values and understanding how these values impact care decisions

# c<sup>5</sup>= Compassion

- *Not every patient can be saved, but illness may be eased by the way doctors respond*<sup>20</sup>

20. Adapted from Intoxicated By My Illness, Anatole Broyard, 1992: Ballentine Books.

# c<sup>5</sup> requires:

- Empathy
- Having real and tested abilities to provide the *uniquely human services* that patients and communities need
- Knowing how to manage the machines
- Mathematical (i.e., statistical) and communications skills necessary to understand and communicate the meaning of probabilities (including big data and predictive analytics)

# Some of the additional skills required for future physicians<sup>21</sup> (in addition to “c<sup>5</sup>”)

- Management/oversight of delegated responsibilities within multiprofessional care teams
- Monitoring/managing large amounts of patient data generated by ubiquitous wearable and/or implantable health technology and large biobanks – **Data Science**
- Integrating artificial intelligence and big data into day-to-day clinical practice
- Adapting clinical practice to performance measurement and value-based payment
- Proactively promoting population health in addition to treating individual patients

# Curricular Goals

- Producing physicians that are fully adept at practicing 21<sup>st</sup> century medicine
- Educating and training a workforce that meets societal needs
- Making the accreditation process part of a learning health system
- Changing faculty and institutional behavior and culture
- (Reducing/eliminating student debt)

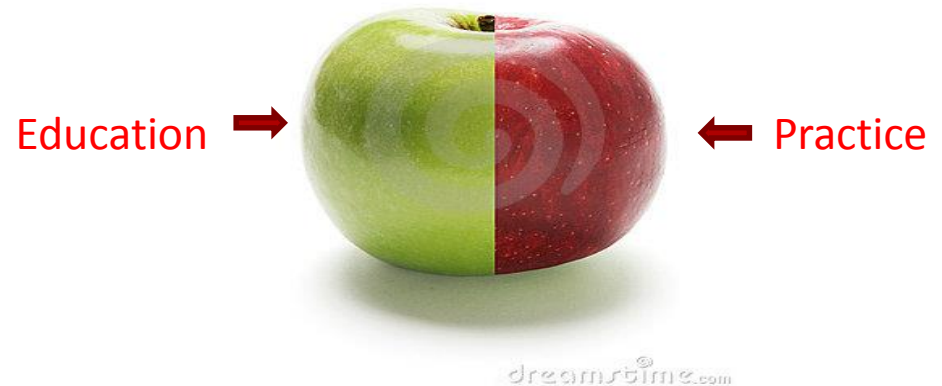


# A new approach to curriculum development is needed

- Begins by challenging the *untested assumptions* in the current curriculum
- Having an entrepreneurially nimble mindset as healthcare rapidly evolves
- Creating the new set of knowledge and skills required for 21<sup>st</sup> century medicine

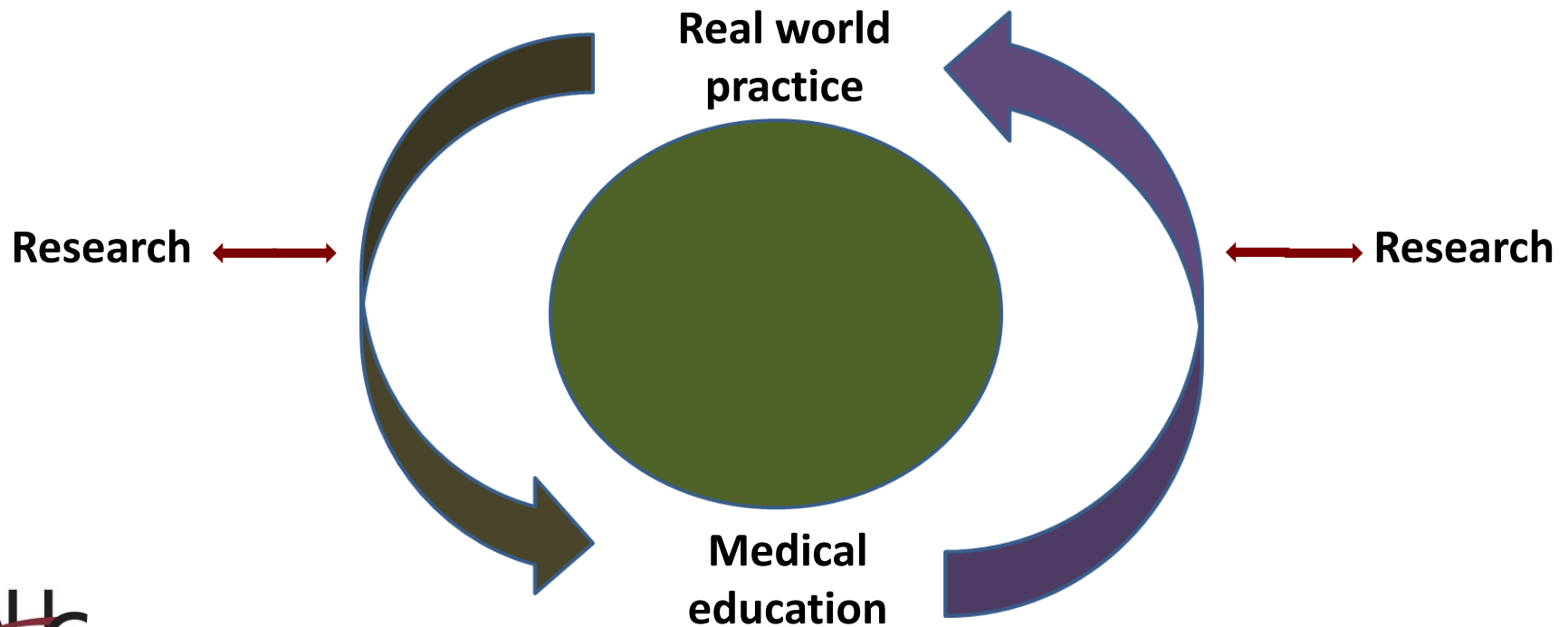
# An overarching suggestion

- Integrate medical education into a *continuous virtuous cycle* that becomes a “learning health system”
- A unique hybrid of practice and academics



# The learning health system

The practice and teaching environments support each other and make each other better and more relevant and are informed by research



# What does this imply?

- Medical education shifts from a linear continuum to a multidimensional system
- The curriculum switches from knowledge-based to communication-, management-, and systems-based
- The market plays a larger role in workforce creation and deployment

# But we have a big problem...

“all professions seem to share the bias of finding difficulty in imagining any thoroughgoing re-engineering of their own discipline.”<sup>22</sup>

22. Susskind and Susskind, op.cit.

## Or, to put it another way...

“Our concern is that our elaborate and sophisticated methods and institutions for the development of professionals are configured today to bring through a new generation of **twentieth-century** professionals....”<sup>23</sup>

23. Susskind and Susskind, op.cit. p 262

**And, perhaps more concisely...**

“Institutions [and individuals] seek to preserve the problem to which they are the solution.”

- Clay Shirky

**Ultimately, we need to face the  
existential problem of culture and  
programmatic change**

This is the challenge we must accept



# Thank you



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