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# *Emerging Technology + Community health*

LAEDC – Current Trends and the  
Future of Healthcare Innovation

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**pwc**

# Community Health + Technology

Highlight **Societal trends by element of life** that serve as a backdrop to the future of community health:

- Where do we **Live**?
- How do we **Move**?
- What do we **Learn**?
- How do we **Work**?
- How do we **Eat**?
- How do we **Care**?
- How do we **Engage**?
- How do we **Recreate**?

<p><b>Behaviors</b></p>  <ul style="list-style-type: none"> <li>Tobacco use</li> <li>Diet</li> <li>Exercise</li> <li>Alcohol &amp; drug use</li> <li>Sexual activity</li> </ul>	<p><b>Social &amp; Economic Factors</b></p>  <ul style="list-style-type: none"> <li>Education</li> <li>Employment</li> <li>Income</li> <li>Family &amp; social support</li> <li>Community Safety</li> </ul>
<p><b>Physical Environment</b></p>  <ul style="list-style-type: none"> <li>Air &amp; water quality</li> <li>Transit</li> <li>Housing</li> </ul>	<p><b>Clinical Care</b></p>  <ul style="list-style-type: none"> <li>Access to care</li> <li>Quality of care</li> </ul>

Explore **each technology**, their application in health and the potential market opportunities/outlook

- 1. What It Is:** The basis of what the technology is, how it works
- 2. In-practice Applications:** Current and potential applications
- 3. Market:** The projected market opportunity and key players
- 4. Outlook:** Where the technology falls on the spectrum of nascent (conceptual use cases, untested value proposition); applied (use cases proved and available); adopted (widely available and accessible, with sustainable business model)
- 5. Implications to Community Health:** +/- Potential prices and pay-offs for the social determinants of health



3D Printing



Artificial Intelligence



Augmented Reality



Virtual Reality



Drones



Robotics



Internet of Things (IoT)

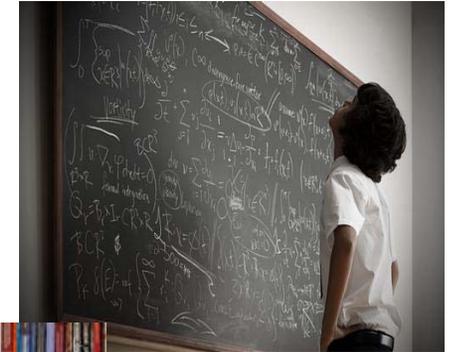


Blockchain  
2

# Societal trends

## By element of life

<b>Live</b>	<b>Learn</b>
<b>Move</b>	<b>Work</b>
<b>Eat</b>	<b>Engage</b>
<b>Care</b>	<b>Recreate</b>



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## Live



### 2X

**By 2050, the number of Americans over the age of 65 will double, and the number of 85 year olds will triple.** Nearly 60% of aging baby boomers live in the suburbs, and most want to stay put—or “age in place” (The Atlantic, Pew Trust).

### 550,000

**On a single night, nearly 550,000 people experience homelessness in the United States— 35% of which were families with children.** African Americans account for 40% of the homeless population (US Department of Housing and Urban Development).

### 13M

**Nearly half of all Americans—** an estimated 150 million people—**live in areas that do not meet federal air quality standards.** By 2100, sea-level rise due to **climate change could displace as many as 13 million Americans** living in coastal regions (UCSUSA, Reuters).

### 50%

The standard of “affordable” housing is that which costs roughly 30% or less of a family’s income. However, more than **half of all poor renting families spend more than 50% of their income on housing costs,** and more than one in four spends more than 70% (UN).

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## Move



### 25M

**Approx 25 million workers in the US spend more than 90 minute each day getting to and from their jobs,** and about 6,000,000 “mega commuters” travel at least 90 minutes each way (HBR).

### \$23B

Congestion can cost as much as 2 to 4% of GDP and the average American family spends 19-25% of their income on transportation. **Traffic is so bad in Los Angeles that the cost of wasted time and fuel per resident is about \$6,000 annually, or a total cost of \$23 billion** (INRIX, The Atlantic).

### \$1.5M

Electric vehicles (EVs) in the US have grown at a 32% compound annual growth rate (CAGR) over the past four years. **More than half of all EV sales took place in California, whose goal is to put 1.5 million EVs on the state’s roads by 2025** (Forbes).

### Double

60% of millennials say that access to high quality transportation is one of the top three criteria they consider when deciding where to live. As compared to other generations, **millennial commuters are the most frequent walkers and users of public transportation—double the rates of older generations.**

## Eat



### 13%

Over the past 100 years, food production in the US has become more efficient and less expensive compared to wages, and the share of the **family budget spent on food has declined from 43% in 1900 to just 13% in 2003** (The Atlantic).

### 50%

Over the course of just one decade (1997 - 2011), there has been a **50% increase in food allergies among children** in the US (Nielsen).

### \$55B

For the first time in history, **Americans spent more money at bars and restaurants in 2015 than they did on groceries**, \$54.9 billion vs. \$52.5 billion (Motley Fool).

### -27%/+24%/>50%

Since the 1980s, **the cost of sugary non-alcoholic beverages—most sweetened with corn syrup—has dropped by 27%; meanwhile, the real cost of fruits and vegetables has increased by 24%. As a result, more than 50% of all calories consumed in the US now come from “ultra-processed” foods**, which are high in sugars, sodium, and saturated fat (National Geographic, CBS).

## Care



### 1 in 2

**1 in 2 Americans aged 12 or older use prescription drugs** of some kind—and 1 in 5 Americans take more than 3 medications a day. The US consumes 99% of the world's hydrocodone and Americans are prescribed 6x as many opioids per capita as citizens of Portugal or France (CDC, INCB).

### 17M

**Telemedicine** continues to gain traction as a convenient, integrated experience for patients, and is estimated to have **17M patient users by 2018** (Beckers).

### 12M

**12 million Americans are misdiagnosed each year at a rate of one out of every twenty adult patients;** about half of these misdiagnoses lead to severe harm (CBS).

### 5.4%

State-level expansions of **Medicaid under the ACA have increased the number of preventive services among low-income childless adults by 5.4%**.

### 87%

In the US, **87% of older adults want to age in place**, which will result in a necessary shift in healthy aging practices at home (AARP).

## Learn



### 13:1

In 2016, **13 STEM jobs were posted online for each unemployed worker that year—or roughly 3 million more jobs than the number of available, STEM trained professionals** who could potentially fill them (NAE Research).

### 34%

**Today's millennials are the best-educated generation in history; fully a third (34%) have at least a bachelor's degree** as compared to only 13% in 1965. Between 1965 and last year, the median annual earnings of 25-32 year olds with a college degree grew from \$38,833 to \$45,500 in 2012 dollars, nearly a \$7,000 increase (Pew Research).

### >\$17.5k

**On virtually every measure of economic well-being and career attainment, young college graduates are outperforming their peers with less education.** Millennial college graduates ages 25 to 321 who are working full time earn more annually—about \$17,500 more—than employed young adults holding only a high school diploma. (Pew Research).

### 2/3

**New micro or nano degrees and skills-based trainings help make the nearly two-thirds of US adults without a four-year college degree competitive job applicants** (NYT).

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## Work



### 47 Hours

Adults employed full time in the **US report working an average of 47 hours per week**, almost a full workday longer than a standard five-day, 9-to-5 schedule (Gallup).

### 3.7M

**3.7 million employees (2.8% of the workforce) now work from home at least half the time**, an increase of 103% since 2005. 24% of people employed did some or all of their work at home in 2015 (vs. 19% in 2003) (Global Workplace Analytics, Wired).

### 56%

**In 1950, service work made up 40% of working class labor in the US. By 2005, that share had climbed to 56%.** Similar to past trends, service industry jobs are expected to continue to grow, in particular taking care of the aging baby boom population (NYT).

### 65%

Most industries, particularly retail, manufacturing, and delivery, will undergo dramatic transformation as a result of the Fourth Industrial Revolution. By some estimates, 47% of US jobs are at risk from automation and **65% of children entering primary school today will ultimately end up working in completely new job types that don't yet exist** (WEF, The Guardian).

## Engage



### 11 Hours

Americans aged **18 and older now spend 11 hours per day using electronic media like** TVs, smartphones, and computers. As screen time has increased, so too has “digital eye strain” - the physical eye discomfort felt after two or more hours in front of a digital screen that now affects nearly two thirds of American adults (WEF).

### 55%

Voter turnout in the 2016 Presidential election dipped to nearly its lowest point in two decades, with **only about 55% of voting age citizens casting ballots** as compared to 64% in the 2008 election (CNN).

### 45%

Rates of loneliness and social isolation are increasing dramatically. In the **1980s, 11-20% of Americans frequently felt lonely; by 2010, this rate increased to between 40 to 45%**. Some studies show that lacking social connections is as damaging to health as smoking 15 cigarettes a day, and that loneliness increases odds of an early death by 26% (HuffPost, Fortune).

### 84%

Only 10% of internet-using adults in the US used at least one social networking site in 2005. More than a decade later, that number has grown exponentially, with **84% of US adults claiming to have at least one social media account** (Business Wire).

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## Recreate



### 4.5X

Recreational facilities are not equitably distributed, **as low income neighborhoods are 4.5 times more likely to not have facilities** than high income areas. This can have a direct impact on how often people work out, as people who have to commute more than 5 miles go much less often (NCBI, WSJ).

### 22%

Only 4% of elementary schools, 7% of middle schools, and 2% of high schools have daily physical education class for the entire school year. **22% of schools don't require physical education class at all** (HuffPost).

### 51%

**Only 51% of children go outside to walk or play once a day with either parent.** Of those, boys are more likely to be taken outside than girls (Pediatric & Adolescent Medicine).

### 2X

**Millennials are twice as likely as their Generation X counterparts to participate in team sports as adults.** The most popular social sports leagues include kickball, basketball, soccer, hockey, tennis, volleyball, and golf (The Press).

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## **Technology – Impact on Society**

**“3-D printers are more accurate and versatile than any other mode of production— be it human or machine - at fabricating a complex design into a physical object, combining raw materials in ways that were once impossible.”** -Hod Lipson, Prof. of Engineering & Data Science at Columbia University, 2013

**“Virtual reality was once the dream of science fiction. But the internet was also once a dream. The future is coming and we have a chance to build it together.”** - Mark Zuckerberg, Co-founder and CEO of Facebook, 2014

**“The last 10 years have been about building a world that is mobile-first. In the next 10 years, we will shift to a world that is AI-first.”** - Sundar Pichai, CEO of Google, 2016

**“Drones overall will be more impactful than I think people recognize, in positive ways to help society.”** - Bill Gates, Co-Founder of Microsoft, 2013

**“The most important frontier for Robots is not the work they take from humans—but the work they do with humans—which requires a lot of learning on both sides.”** - Kim Tingley, NYTimes, 2017

**“A significant portion of the population of developed countries, and eventually all countries, will have AR experiences every day, almost like eating three meals a day. It will become that much a part of you.”**  
- Tim Cook, CEO of Apple, 2016

**“IoT is the most fundamental change. Every person, your home, your car, the way you do healthcare, your sporting activities will become connected.”**  
- John Chambers, CEO of Cisco, 2015

**“What the internet did for communications, blockchain will do for trusted transactions.”** - Ginni Rometty, CEO of IBM, 2017



## 3D Printing

You may know: 3D Systems, Apreece, byFlow, ExOne, Formlabs, Hewlett-Packard, Invisalign

### What is it?

**3D printing is the process of creating a 3D object by successively printing layers of materials on one another until an object is formed.** When first introduced, 3D printers relied primarily upon plastic filaments, but have since expanded to incorporate numerous other materials including wood, rubber, glass, metal, and even living cells for bioprinting. 3D printing has **revolutionized the practice of rapid prototyping** without the need for expensive re-tooling and custom fabrication.

*Aliases: Additive Manufacturing*



### In Practice –Custom Design

**3D printing is being used to enable on-demand, custom medical devices and products, including bio-printed organs, prosthetics, custom orthopedics, and individualized medicine doses.**

### Market / Outlook

**The 3D printing market is expected to be worth \$32.8B by 2023, at a CAGR of 25.8% from 2017-2023.** 3D printing is moving beyond mere prototyping and is making an impact on manufacturing all the way from design to full-scale production. **The enthusiasm for on-demand, customized (and individualized) products is building, but consumer use cases are still evolving. Clinical use cases such as 3D printed skin and implantable products are similarly emerging.**



## Artificial Intelligence (AI)

You may know: Amazon Alexa, Boxever, Cognito, Nest, Netflix, Siri, Tesla

### What is it?

**The theory and development of computer systems that exhibit human-like intelligence. AI (Narrow) is not to be confused with General Intelligence which is AI's long term goal of human level reasoning and intelligence.** AI (Narrow) refers to when a computer does what a human can do, but only within narrow bounds or specific use cases. For example, one specific use case for AI can play chess, while another can play Go.

*Aliases: Big Data, Analytics, Machine Learning*



### In Practice – Brains of Autonomous Vehicles

**AI is what enables cars to drive autonomously without human intelligence. Their ability to communicate and learn remotely is what will make vehicles safer and more efficient for humans. AI enabled vehicles may someday integrate medical monitoring equipment for detecting medical emergencies & patient transportation.**

### Market / Outlook

**Global spending for cognitive and AI systems expected to reach \$12.7b in 2017 (60% increase from 2016) and grow to \$46b by 2020 (IDC). AI could contribute up to \$15.7 trillion to the global GDP in 2030 (PwC).**

AI will eventually have a hand in most components of almost every business and everyday life. Currently, AI is being used for adding intelligence to very specific tasks and is a spot solution. **We are still years away from General Intelligence which is AI's long term goal of human level reasoning and intelligence.**



## Augmented Reality (AR)

You may know: Google Glass, Ink Hunter, Recoil, Snapchat, Spectacles, Pokemon Go, Zombies! Run

### What is it?

**Augmented Reality (AR) is the addition, or augmentation, of the physical world with sensory input such as sound, video, graphics or data. AR is dependent on supplemental devices (wearables, phones, headsets) to render and display information, which enable a user to view the real world with an added overlay. Unlike Virtual Reality, which creates a totally artificial environment, AR uses the existing environment and overlays new information on top.** AR shares many traits with “Mixed Reality” which aims to merge AR and real life interaction so as to blur the boundaries of our digital and physical world.

*Aliases: AR, Synthetic Overlay*



### In Practice – Medical Visualization

**Doctors and medical students can wear AR headsets during surgery to provide them real-time and relevant patient information during surgeries and procedures, thus reducing risk of an operation.**

### Market / Outlook

**The AR market was over \$570M in 2015 and is expected to grow at 80.8% CAGR from 2016 to 2024; US market share is forecasted to exceed \$24B by 2024 (GM Insights).**

**Augmented reality is still in the early stages of adoption but has great potential to enhance many business processes by overlaying computer generated information over the real world.** Analysis shows there are 110 million desk-less workers in the world whose job it is to fix, repair, or install products and/or services (doctors, service technicians, factory workers, truck drivers, etc.). **Until a cost effective solution is delivered, it will continue to be a novelty in the consumer space.**



## Virtual Reality (VR)

You may know: Hololens, Houzz VR, HTC Vive, Lowe's VR, Microsoft, Oculus, Sony Playstation VR

### What is it?

**Virtual Reality (VR) simulates, using computer technology, a 3D image or complete environment where a user can interact in a seemingly realistic way. VR is intended to be an immersive experience and typically requires equipment, most commonly a headset.** Often times wearables are worn to further simulate the user's motion in the environment, and make it even more realistic. *Aliases: VR*



### In Practice – Safe Training

**VR provides an immersive substitute to costly and often dangerous real-world training. Examples include healthcare surgeries, mining, and manufacturing.**

### Market / Outlook

**On a geographic basis, the United States will deliver \$4.3B in AR/VR spending in 2017, followed by Asia/Pacific at \$2.6B and Western Europe at nearly \$2.5B (Business Wire). The venture world has poured \$3.4B into both AR and VR ventures.**

Virtual Reality has many potential industry benefits that **could disrupt standard practices of many industries, including trainings, meetings, collaboration, education, and travel. However, there are still quite a few factors limiting VR's ability to scale**, incl. lack of software/hardware standards, difficulty designing VR content, and high bandwidth/visual requirements.



## Drones

You may know: Flirtey, Draganflyer, TU Delft, Zipline

### What is it?

**Drones are devices that participate in flight or movement without the presence of a pilot. They are often used in areas of high risk or requiring a high level of flight precision and can be operated on a pre-defined flight plan or be controlled remotely.** GPS, video surveillance, voice recording, and remote communication of data are commonly integrated into the vehicles. Drones have found industrial use for land surveillance, media creation, safety surveillance, and shipping and logistics. Commercial use has grown drastically with small, affordable drones that can be controlled with a mobile device, often with HD video cameras. *Aliases: Unmanned Aerial Vehicles (UAVs)*



### In Practice – Drone Deliveries

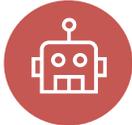
**In countries where roads are either not maintained or non-existent, drones provide a delivery mechanism for food, essential medicine and vaccines, timely collection of lab/medical data, etc. saving hours or days on delivery, and potentially many lives.**

### Outlook

**Sales of drones are expected to surpass \$12B in 2021 (up from \$8.5B in 2016), with a CAGR of 7.6%.** Growth is expected to focus across three main segments of the drone industry: consumer drones, enterprise drones (i.e. commercial drones), and government drones. **Drones will significantly impact the shipping and logistic industry by providing more efficient delivery of products (e.g., food, consumer, medical).** The impact will be most acutely felt in remote areas or with limited infrastructure (e.g., roads).

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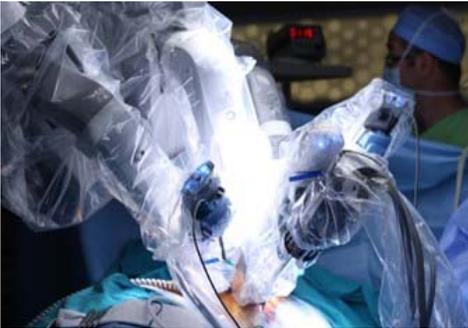


## Robots

You may know: Anybots, Aethon, Ekso Bionics, Toyota

### What is it?

**Robotics is the combination of engineering and computer science to create, design, and operate mechanical devices (i.e., robots) on land. Robotics broadly includes all electro-mechanical machines that can perform an operation either autonomously or according to set instructions, often a computer program.** Today, main focuses in robotics are on high precision robots as well as robots looking to bridge sensory perception and incorporate artificial intelligence to operate completely autonomously. As technology increases both in computing power and mechanical construction, robotics can directly benefit people, e.g., robotics in the form of humanoid bipedal prostheses can increase human capability and function exponentially.



### In practice – Sterilization in hospitals

**Robots are used for waste management and sterilization in hospitals, improving patient turnover and cleanliness scores. Using robots also decreases the chance of hospital staff becoming infected from patient disease.**

### Market / Outlook

**Global spending on robotics and related services is expected to reach \$135.4B by 2019, with CAGR of 17%. Robots, which have traditionally been used for industrial applications, have become more widely applicable across a range of service-industry applications.** Robots have become smarter, with the ability to learn new skills and complete tasks that require both intelligence and dexterity, e.g., complicated surgeries, engineering. Although bots have become more mainstream and commercially available, there is still general mistrust among the public about the role of robots in everyday life.

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## **Internet of Things (IoT)**

You may know: AECOM, Air Quality Egg, Awair, Bosch, Kardia/Alivecor, Phunware, Samsung

### **What is it?**

**The Internet of Things (IoT) extends internet connectivity beyond traditional devices like desktop and laptop computers, smartphones and tablets to a diverse range of devices and everyday things. These devices and things utilize embedded technology to communicate, record and interact with the external environment using the Internet as a means of communication.** The connected embedded systems include small micro-controller-based computers that do not require a human interface, but rather function independently. *Aliases: IoT, Internet of Everything*



### **In Practice – Smart, Connected Homes**

**Smart Home devices connected across IoT enable increased efficiency, reduced energy and water consumption, and improved health. Wearables, including baby monitors, can sync with Smart Home devices to create a seamless home experience.**

### **Market / Outlook**

**An estimated 24b IoT devices will be installed by 2020, of which IoT healthcare devices will account for 646 million devices (Business Insider). IoT could be an \$11.1 trillion market by 2025.**

**Adoption of IoT is off to a slow start and 75% of IoT projects will take two times as long as planned (McKinsey, IoT for All).** IoT can be applied to consumers, businesses, and manufacturing (Industrial IoT). However, despite being touted as “the next big thing,” early adopters have discovered that the challenges of scaling IoT are very real. As a result, their IoT deployments are moving at a much slower pace than they originally hoped, and many organizations are still in the POC (proof of concept) stage for IoT.

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## Blockchain

You may know: AirBnB, Chronicled Patientory, Gem Health, IBM, Siemens & LO3 Energy, SWIFT, Transactive Grid

### What is it?

**Blockchain technology is a trusted system of record. It's a public distributed ledger where transactions are recorded and confirmed anonymously. It is a record of events that are shared between many parties, and once information is entered, it cannot be altered as the downstream chain reinforces upstream transactions. Any transaction or data exchange is recorded permanently.** Blockchain does not reside on a single centralized server but rather it is managed by distributed nodes and is decentralized. All nodes have a copy of the entire blockchain, and by distributing copies and access, the chain cannot simply "go down" or disappear. *Aliases: Bitcoin, Consensus Based Ledger, Distributed Ledger, Smart Contract*



### In Practice – Electronic Health Records

**Using blockchain, patient records can be stored and shared more effectively without the risk of privacy breaches, enabling improved continuity of care across medical professionals.**

### Market / Outlook

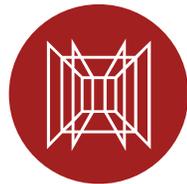
**The blockchain market is estimated to grow from \$210.2M in 2016 to \$2.3B by 2021, at a CAGR of 61.5%.** Initially focused around Bitcoin, potential blockchain applications have expanded far beyond cryptocurrency and financial services. Blockchains can record and validate information or physical products and is potentially un-hackable. New use cases for blockchain are being created every day (e.g., health records, prescriptions, property ownership, birth certificates, passports).

## Potential prices & payoffs for community health – Behaviors

### Behaviors



Tobacco use  
Diet  
Exercise  
Alcohol & drug use  
Sexual activity



Augmented Reality

### Augmented Reality (AR)

- + AR provides immersive exercise experiences that can get people moving more, e.g., people who played Pokemon Go were twice as likely to meet their 10,000-steps goal for the day, walking an additional 2,000 steps daily (TIME).
- Engaging in engrossing technological experiences may foster addictive tendencies rooted in escapism, denial, and fantasy. AR also raises risk of injuries or death from distracted walking, which increased 35% from 2010-2015 (Milliman).



Virtual Reality

### Virtual Reality (VR)

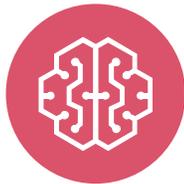
- + VR can help people to visualize how their behaviors (e.g., driving a gas-guzzling car, eating an unhealthy meal) contribute to a problem that may only manifest itself in the future (e.g., climate change, obesity). VR can also be used to help reduce opioid addiction as doctors increasingly 'prescribe' VR, e.g., in one study, VR did as well as narcotics in reducing pain. (Stanford, MIT).
- VR encourages a more sedentary lifestyle, as immersive experiences can transport a person to a different location without requiring physical re-location.

## Potential prices & payoffs for community health – Social & Economic Factors

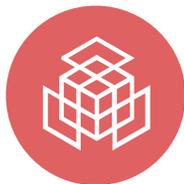
### Social & Economic Factors



Education  
Employment  
Income  
Family & social support  
Community Safety



Artificial  
Intelligence



Blockchain

### Artificial Intelligence (AI)

- + Autonomous vehicles powered by AI will enable seniors to ‘age in place’ without losing their mobility and keep all drivers safer, e.g., 90% reduction in traffic fatalities. Education software and AI ‘tutors’ can provide targeted support for students’ unique needs (Newsweek, TeachThought).
- Smart home devices’ “always on” listening may lead to privacy concerns and facial recognition risks misuse. Additionally, AI may result in the loss of manufacturing and transport jobs, e.g., 3.5 million professional truck drivers and 230,000 taxi drivers in the U.S alone (Newsweek).

### Blockchain

- + Blockchain can be a powerful tool for creating global prosperity, from financial access to property rights to controlling identities, e.g., 30% of foreign aid never reaches its destination and transaction fees for sending “remittances” to foreign relatives can reach 10-15%. Blockchain can be used to transfer digital cash, bypassing expensive or corrupt middlemen (FastCompany).
- As blockchain creates records of everything, people with criminal history may be unable to move forward from their past mistakes (NYT).

## Potential prices & payoffs for community health – Physical Environment

### Physical Environment



Air & water quality  
Transit  
Housing



Drones

### Drones

- + Drones will increasingly be deployed for natural disasters. Not only do they have certain advantages over traditional search-and-rescue, such as speed, identifying trapped individuals, delivering aid to unstable areas, but they are also useful in assessing damages (NBC).
- Although delivery drones tend to have CO2 emission advantages over trucks when carrying small packages on short trips, drones may emit 3-5 times as much as their truck counterparts on longer trips carrying heavier packages, due to the energy required to stay aloft (Elsevier, Forbes).



Internet of Things (IoT)

### Internet of Things (IoT)

- + Connected devices can be used by cities to monitor and improve environmental health, e.g., smart traffic signals can reduce congestion by 20% and smart LED street lights can save cities 70% on electricity (The Guardian, TechCrunch).
- There is a higher risk of security breach, e.g., an estimated 500,000 IoT devices will be breached in 2017. 'smart' cities will be a need to prevent cyberattack of key infrastructure, including the water supply and power grid (Forrester).

## Potential prices & payoffs for community health – Clinical Care

### Clinical Care



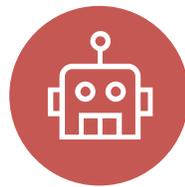
Access to care  
Quality of care



3D Printing

### 3D Printing – Clinical

- + Low-cost and highly customizable parts for both medical and educational purposes can be easily created; e.g., for children who outgrow their prostheses quickly, prosthetic hands can be produced at 0.6% of the original cost (NCBI).
- Developing FDA regulations to govern 3D printed medical devices and pharmaceutical drugs, as well as establishing international intellectual property rights, may be difficult, slowing production or risking patient safety (NCBI).



Robotics

### Robotics – Clinical

- + Telemedicine robots can allow specialists to rapidly assess and diagnose patients at remote facilities (e.g., rural hospitals) through high-resolution cameras and cloud technology that allows real-time access to patient records and vital signs. Robots can also be used by hospitals for waste management and cleaning, reducing hospital acquired infections (US News).
- The use of robots in medicine can result in higher cost of care, e.g., robotically assisted surgeries cost \$2,000 more per procedure with no significant clinical advantages (PBS).

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## ***What if, What is, How will, How might...***

- *Will 3D-printing change the way we make/manufacture things forever?*
- *What if AI could make diagnoses 100% accurate and enable greater preventative measures?*
- *What if VR was 'prescribed' for pain, in place of opioids?*
- *What if robotic exoskeletons were able to help people with limited mobility walk again? And help the elderly age in place?*
- *With technology advancements threatening traditional jobs, what kinds of skills do we need to thrive in a different kind of workplace?*
- *How might hyper-personalized, real-time recommendations or reminders improve people's behaviors?*
- *How might 'always on' AI smart home and other devices present a risk to safety?*
- *What if AR could close the gap of 5 billion people without access to safe, affordable surgery?*
- *What is a person's daily experience of a smart city or smart neighborhood, and how might it enable health, well-being and safety?*
- *How might blockchain power the future of the 'sharing economy' while also improving the health of the environment? What happens to certain professions when blockchain disintermediates entire value chains?*



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