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# Artificial Intelligence in Healthcare: An Interdisciplinary Look at the Use of Devices


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Panelist: Jeffrey Carter, M.D., FACS

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HEALTHTRUST® UNIVERSITY CONFERENCE

# Disclosures

- Jeffrey Carter, M.D. has a vested interest in or an affiliation with Avita Medical, Spectral M.D., PolyNovo and Vericel.
- The other presenter(s) have no real or perceived conflicts of interest related to this presentation

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# Learning Objectives

*At the end of this session, participants should be able to:*

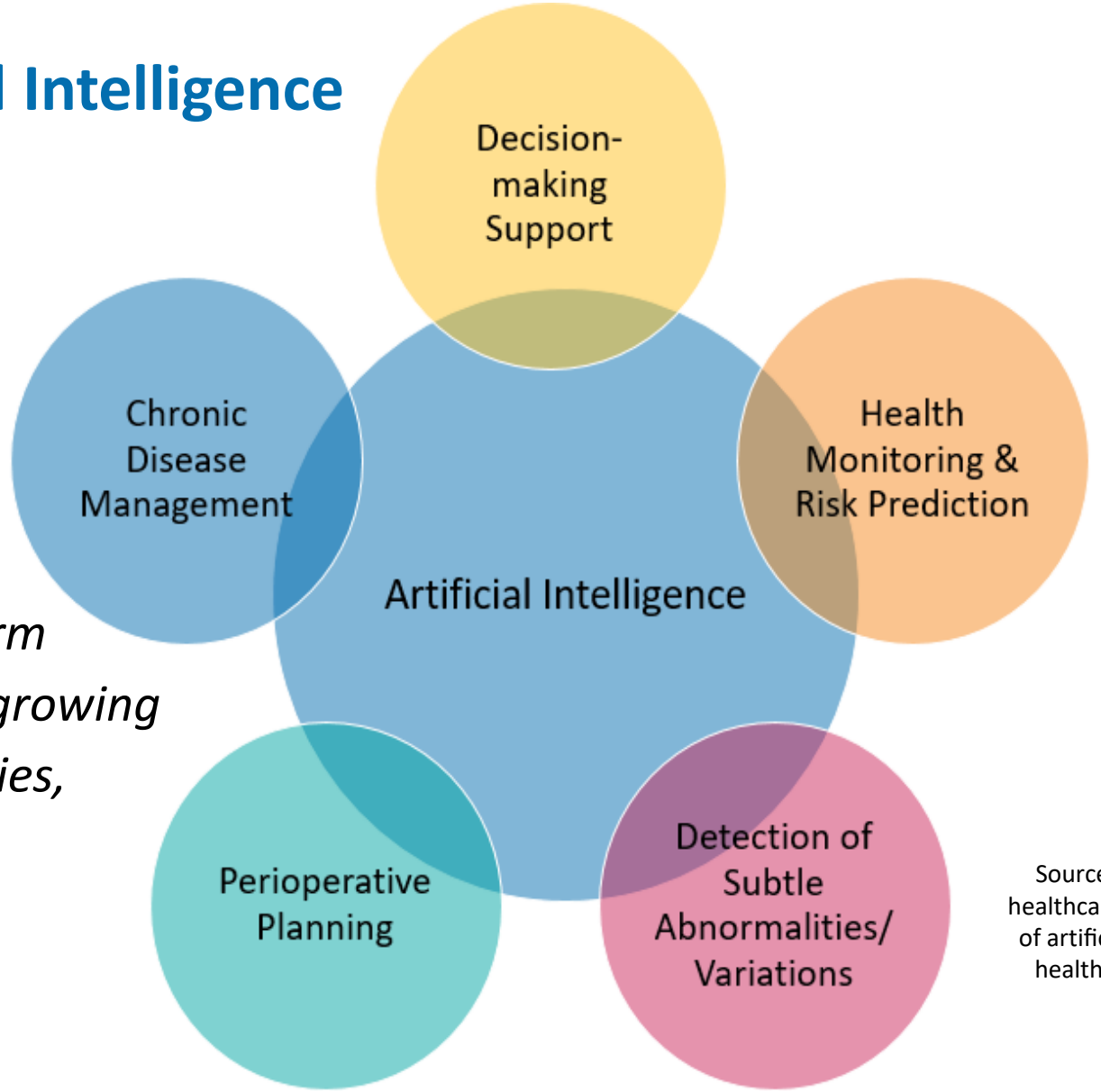
1. Recall how AI in healthcare impacts delivery of care in the areas of cardiology, burn/trauma and orthopedic spine care.
2. Describe key elements to consider in gaining acceptance for integration of AI.
3. Recognize if the benefits of AI implementation outweigh potential risks of use in their organization.

# Artificial Intelligence in Healthcare: An Interdisciplinary Look at the Use of Devices

A Panel Discussion

# Evolution of Artificial Intelligence in Healthcare

*"AI is not a single piece of technology, but rather a term used to describe a large & growing range of functions, categories, terminologies & types of computer technology."*




Source: Shinners L, Aggar C, Grace S Smith S. Exploring healthcare professionals' understanding and experiences of artificial intelligence technology use in the delivery of healthcare: An integrative review.Health Informatics J. 2020; 26 (2): 1225-1236. https: /www.ncbi.nlm.nih.gov/pubmed/31566454. doi:10.1177/1460458219874641.

# Artificial Intelligence in Healthcare

*Advantages & Disadvantages*

## Advantages

- Increasing efficiencies
- Improved workflows
- Automation of repetitive tasks

## Disadvantages

- Possibility of disrupting treatment process
- Data breaches or unauthorized use of medical information (patient confidentiality)
- Concerns of AI replacing human interactions

Source: Ognjanovic I. Artificial Intelligence in Healthcare.Stud Health Technol Inform. 2020; 274: 189-205. https: /www.ncbi.nlm.nih.gov/pubmed/32990674. doi:10.3233/SHTI200677. .

# Gaining Acceptance


Source: Petersson L, Larsson I, Nygren JM, Nilsen P, Neher M, Reed JE, et al. Challenges to implementing artificial intelligence in healthcare: a qualitative interview study with healthcare leaders in Sweden.BMC Health Serv Res. 2022; 22 (1): 850. https: /pubmed.ncbi.nlm.nih.gov/35778736. doi:10.1186/s12913- 022-08215-8.

## Top 10 Specialties Utilizing AI

1. Radiology
2. Cardiovascular
3. Hematology
4. Neurology
5. Ophthalmic
6. Clinical chemistry
7. General & Plastic surgery
8. Microbiology
9. Gastroenterology/ Urology
10. Anesthesiology

*~Becker's 2022*

### Cardiology

- CT scans; AI is used to analyze CT data
- On ECGs to detect presence of a weak heart pump
- AI-guided ECGs to detect faulty heart rhythms (atrial fibrillation)

### Burn/Trauma

- ID high risk or those who need specialized care
- Automated analysis of pre-op clinical data for risk scores (operative planning & post op care)
- AI assisted predictions about staffing models, resident & trainee opps

### Orthopedic/Spine

- AI-assisted diagnosis & classification of tumors
- AI-assisted classification of disc degeneration
- Preoperative planning

Sources: https://www.mayoclinic.org/departments-centers/ai-cardiology/overview/ovc-20486648
https://academic.oup.com/burnstrauma/article/doi/10.1093/burnst/tkab022/6354035

# Polling Question #1

Will Artificial intelligence permeate healthcare in the future?

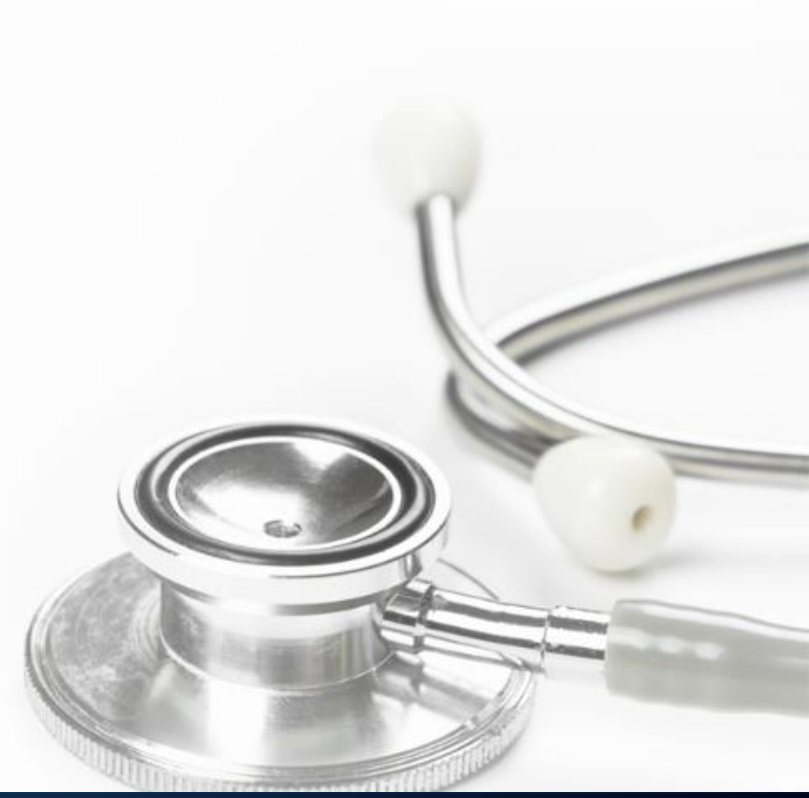
1. No; it will result in useful tools, but the core of what we do will remain the same
2. Yes; it will eventually be a part of everything we do and in significant ways
3. It’s already here... And bigger than I thought

# AI Applications in Cardiology

Genevieve Everett-Sigwalt, M.D.

# Technologies Used in Cardiology

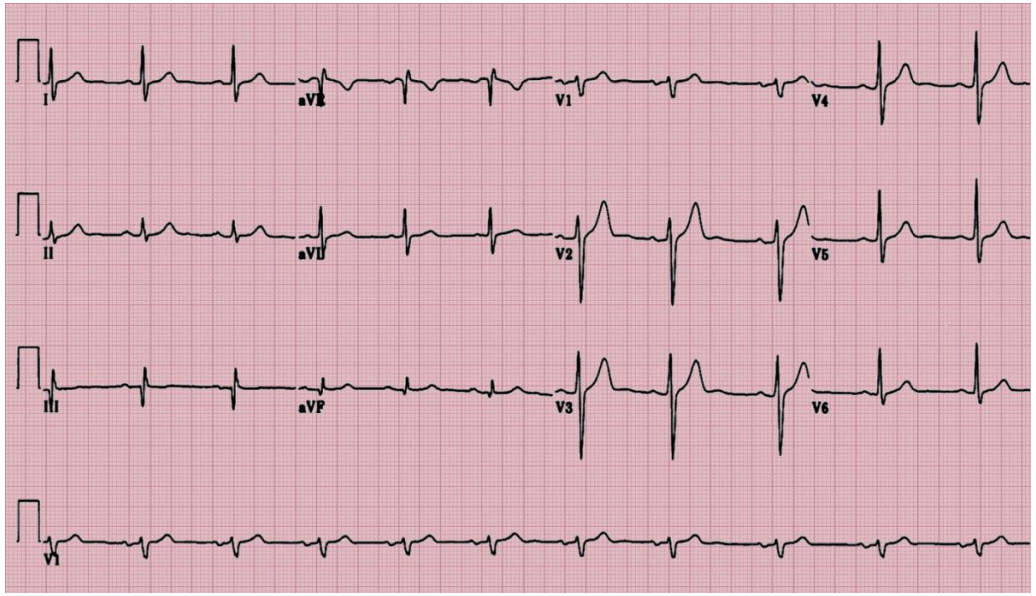
- EKGs/Telemetry
- Echocardiogram
- Nuclear & Pet Imaging
- CTA/Catheterization(Fluoroscopy)
- Cardiac Magnetic Resonance Imaging



# EKG/Telemetry

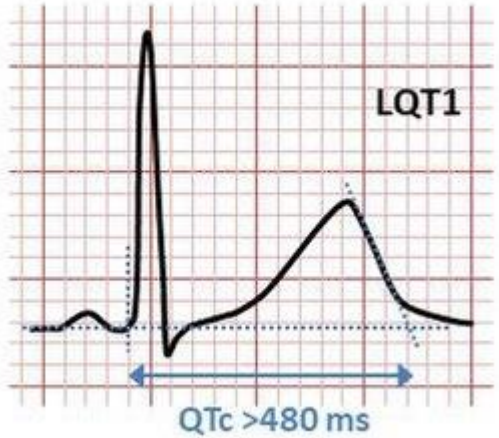
- 12-Lead EKG
  - Inexpensive
  - Low-tech
  - Quick & Easy to Perform

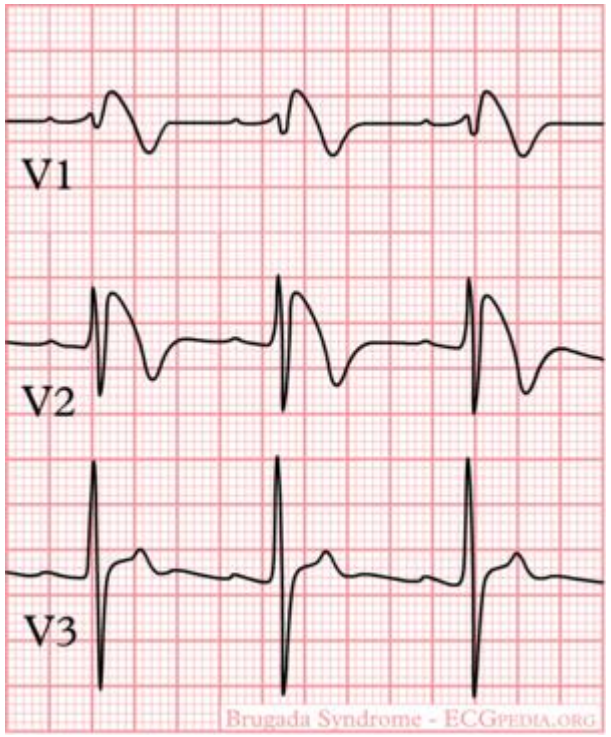
- Telemetry Monitoring
  - In-patient Telemetry (Monitoring for Dynamic ST Changes)
  - Mobile Telemetry Monitoring
  - Direct-to-consumer Telemetry Tools (Kardia Mobile)
  - Wearables (e.g., Apple Watch)



# EKG – AI Applications Under Study

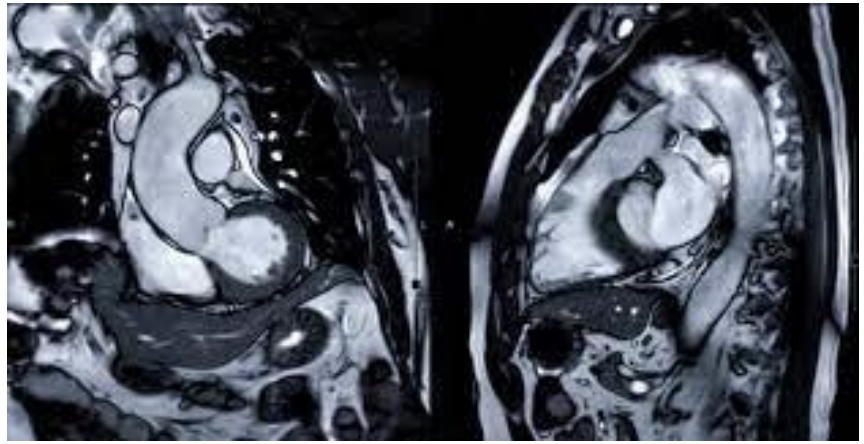
- Predicting Atrial Fibrillation from Sinus EKG
- Evaluating likelihood of Cardiopulmonary Disease
- Assessing for Genetic Diseases with Dynamic EKG Changes
  - Long QT Syndrome (& Acquired Long QT)
  - Brugada Syndrome



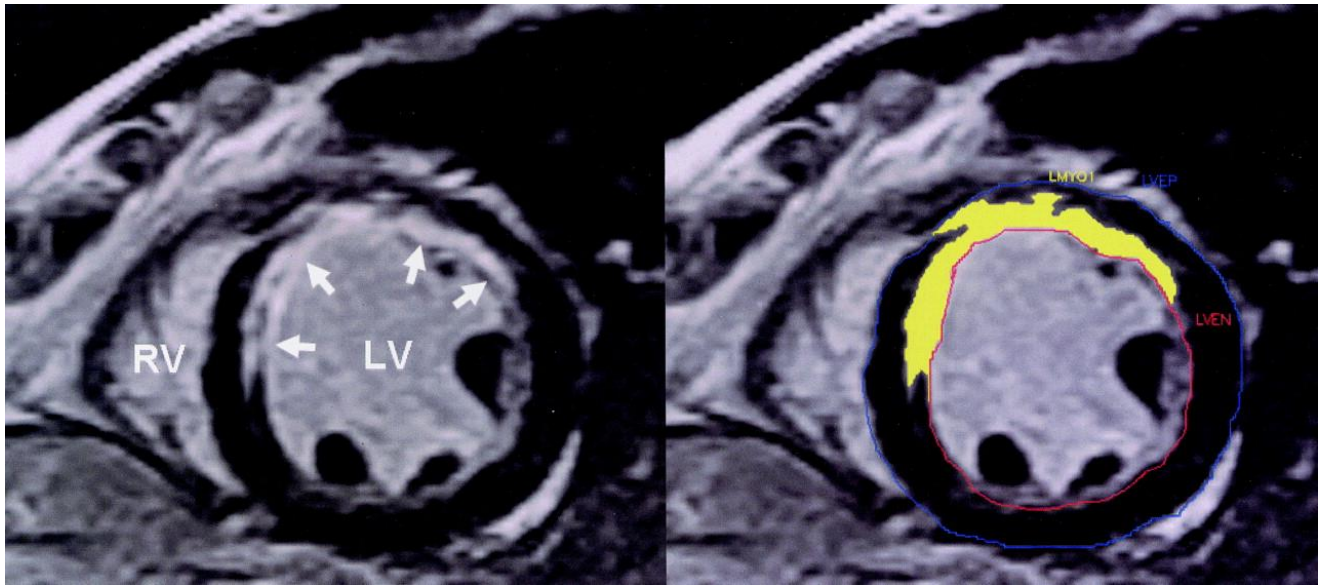
# Cardiac MRI

- Expensive equipment & per procedure cost
- Longer procedure, but still non-invasive
- Requires very specialized training for reading
  - MRI imaging evaluation is complex
  - Understanding dynamic imaging requires specific knowledge of cardiac physiology
  - Reading by Radiologist &/or Cardiologist



# Cardiac MRI – AI Applications

- Evaluating Myocardial Substrate
  - Differentiation of Infiltrative Diseases – Sarcoid/Amyloid
  - Hypertrophic Cardiomyopathy
  - Quantifying Scar Burden – Predicting Risk of SCD




https://www.ahajournals.org/doi/10.1161/circulationaha.105.570648

# AI in Burn/Trauma

Jeffrey Carter, M.D., FACS

# Burn/Trauma

- Injury is the leading cause of death from ages 1–44 in the United States
- Access is critical to survival
  - >600 Level 1/2 Trauma Centers in U.S.
  - <130 Burn Centers in U.S.
- Accurate assessment is important for timely treatment, triage or transfer of the injured

**10 Leading Causes of Death, United States**
**2019, All Races, Both Sexes**

| | Age Groups | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Rank | <1 | 1-4 | 5-9 | 10-14 | 15-24 | 25-34 | 35-44 | 45-54 | 55-64 | 65+ |
| 1 | Congenital Anomalies 4,301 | Unintentional Injury 1,149 | Unintentional Injury 714 | Unintentional Injury 778 | Unintentional Injury 11,755 | Unintentional Injury 24,516 | Unintentional Injury 24,070 | Malignant Neoplasms 35,587 | Malignant Neoplasms 111,765 | Heart Disease 531,583 |
| 2 | Short Gestation 3,445 | Congenital Anomalies 416 | Malignant Neoplasms 371 | Suicide 534 | Suicide 5,954 | Suicide 8,059 | Malignant Neoplasms 10,695 | Heart Disease 31,138 | Heart Disease 80,837 | Malignant Neoplasms 435,462 |
| 3 | Unintentional Injury 1,266 | Malignant Neoplasms 285 | Congenital Anomalies 192 | Malignant Neoplasms 404 | Homicide 4,774 | Homicide 5,341 | Heart Disease 10,499 | Unintentional Injury 23,359 | Unintentional Injury 24,892 | Chronic Low. Respiratory Disease 133,246 |
| 4 | SIDS 1,248 | Homicide 284 | Homicide 155 | Homicide 191 | Malignant Neoplasms 1,388 | Malignant Neoplasms 3,577 | Suicide 7,525 | Liver Disease 8,098 | Chronic Low. Respiratory Disease 18,743 | Cerebro-vascular 129,193 |
| 5 | Maternal Pregnancy Comp. 1,245 | Heart Disease 133 | Heart Disease 91 | Congenital Anomalies 189 | Heart Disease 872 | Heart Disease 3,495 | Homicide 3,446 | Suicide 8,012 | Diabetes Mellitus 15,508 | Alzheimer's Disease 120,090 |

Sources:
National Injury Resource Database, BData, Minneapolis, MN
National Vital Statistics System, National Center for Health Statistics, CDC

# Burn/Trauma

- Burn wounds are diagnosed primarily on physical exam, which is a crude & unreliable method
- Emergency medicine accuracy rate for MI in age ≥65 →**99.48%**


Source: Wilson M, Welch J, Schuur J, O'Laughlin K, Cutler D. Hospital and Emergency Department Factors Associated with Variations in Missed Diagnosis and Costs for Patients Age 65 Years and Older with Acute Myocardial Infarction Who Present to Emergency Departments. *Acad Emerg Med* 2014;21(10):1101-08.
Source: Monstrey S, Hoeksema H, Verbelen J, Purayesh A, Blondeel P. Assessment of burn depth and burn wound healing potential. *Burns* 2008;34:761-69.
Source: Karim AS, Shaum K, Gibson AL. Indeterminate-Depth Burn Injury- Exploring the Uncertainty. *Jou Surg Res* 2020;245:183-97.
Source: Gursu KG. An experimental study for diagnosis of burn depth. Burns 1978;4(2):97–103.
Source: Godina M, Derganc M, Brcic A. The reliability of clinical assessment of the depth of burns. Burns 1978;4:92–6.

# Burn/Trauma

- Biomedical Advanced Research Development Authority (**BARDA**) – promote advanced developments to better prepare for health security threats
- 3 of 9 BARDA Burn Investments in AI
  - U.S. & AI to assess inhalation injury
  - U.S. & AI to assess fractures
  - MSI & AI to assess burn wounds

| BARDA Chemical, Biological, Radiological, and Nuclear (CBRN) Medical Countermeasures | | |
|---|---|---|
| **Company** | **Product** | **Contract & Options** |
| Argentum Medical | Silverlon | **$16,500,000** |
| Avita Medical | ReCell | **$54,000,000** |
| Keranetics | Kerastat | **$3,500,000** |
| Mediwound | Nexobrid | **$112,000,000** |
| Philips North America | Lumify Ultrasound | **$35,000,000** |
| PolyNovo | BTM | **$36,000,000** |
| Rivanna | Accuro XV | **$65,000,000** |
| Spectral MD | DeepView | **$98,600,000** |
| Stratatech/Mallinckrodt | Stratagraft | **$247,000,000** |

Source: Biomedical Advanced Research & Development Authority: BARDA (hhs.gov)
Source: Department of Health and Human Services. Fiscal Year 2022. Public Health and Social Services Emergency Fund. Justification of Estimates for Appropriations Committee.

# Burn/Trauma

- **<300 Burn Surgeons** in the U.S.
- Burn injury is often **misdiagnosed & under/over treated**
  - Delays in Treatment → **25%**
  - Unnecessary Surgery → **30%**
  - Unnecessary Transfer → **50%**

**2 Hours After Injury**

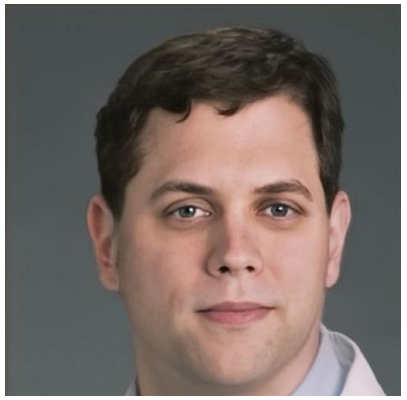
**8 Hours After Injury**

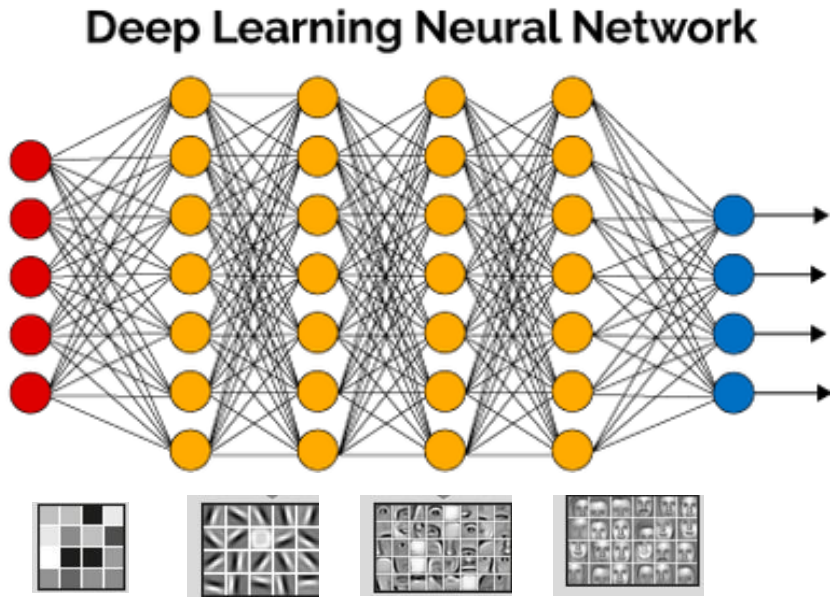
**24 Hours After Injury**

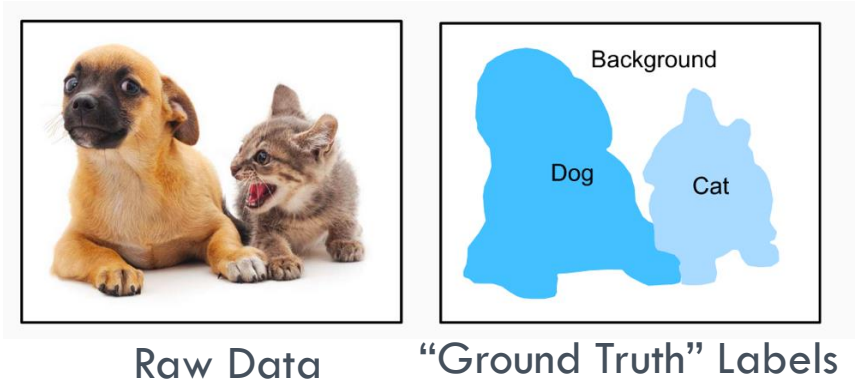
Source: American Burn Association Workforce Survey Report, Chicago, IL
Source: National Injury Resource Database, BData, Minneapolis, MN
Source: National Vital Statistics System, National Center for Health Statistics, CDC

# Burn/Trauma

- **Deep Learning Neural Networks**
  - Mimic the human brain
  - Weighted data & biases
  - Recognize, classify & describe patterns
- Created by programming large data sets to create algorithms from established truths

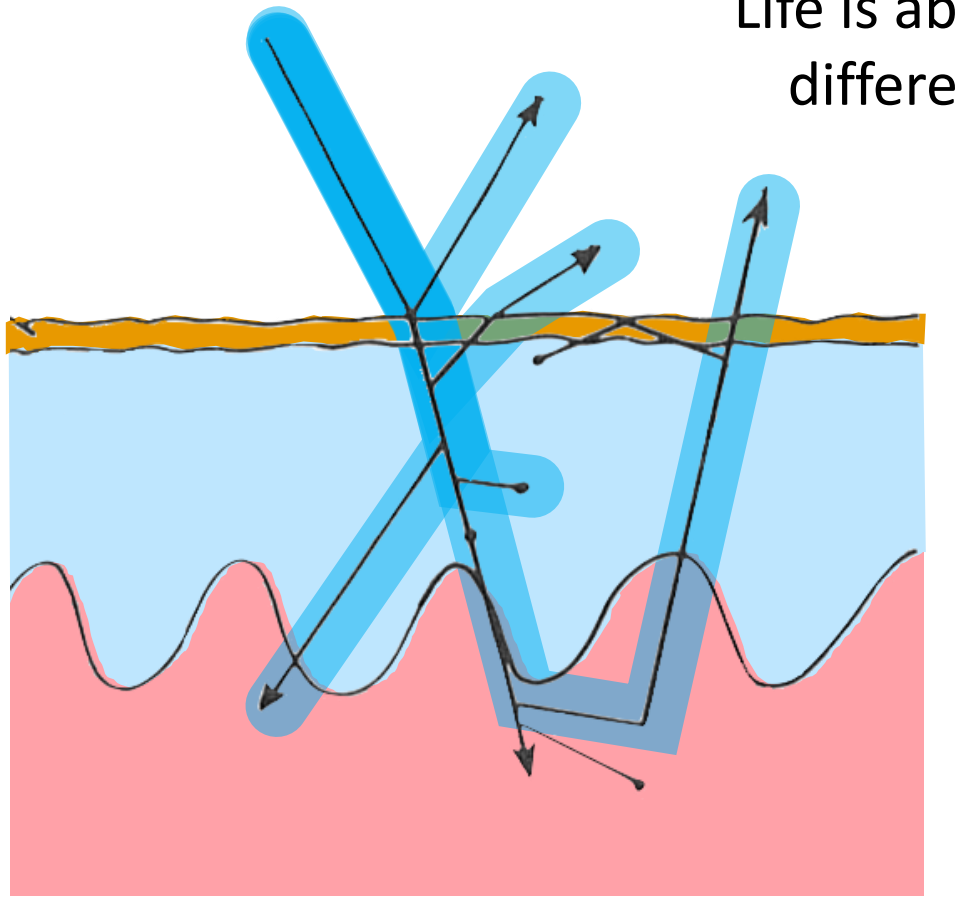




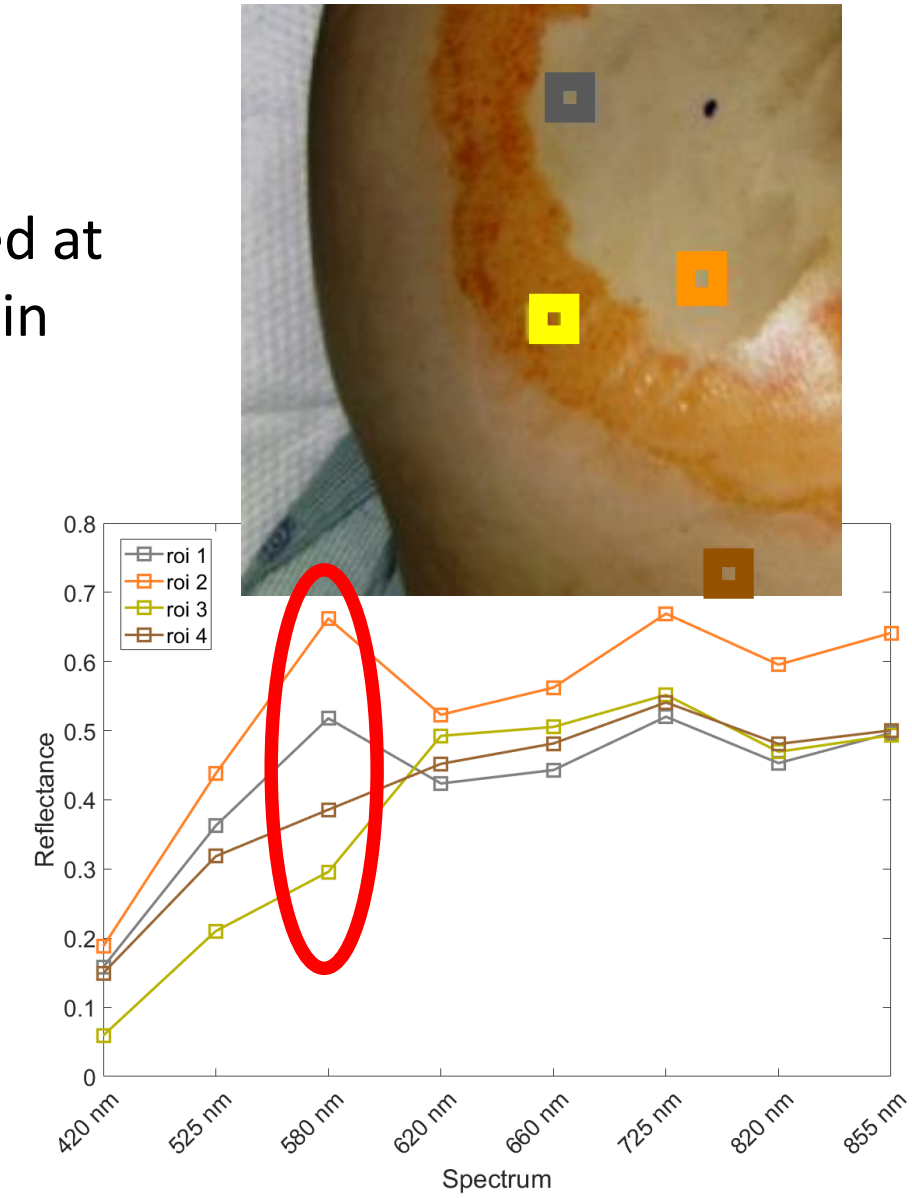




Raw Data "Ground Truth" Labels

# Burn/Trauma



Life is absorbed & reflected at different levels in the skin

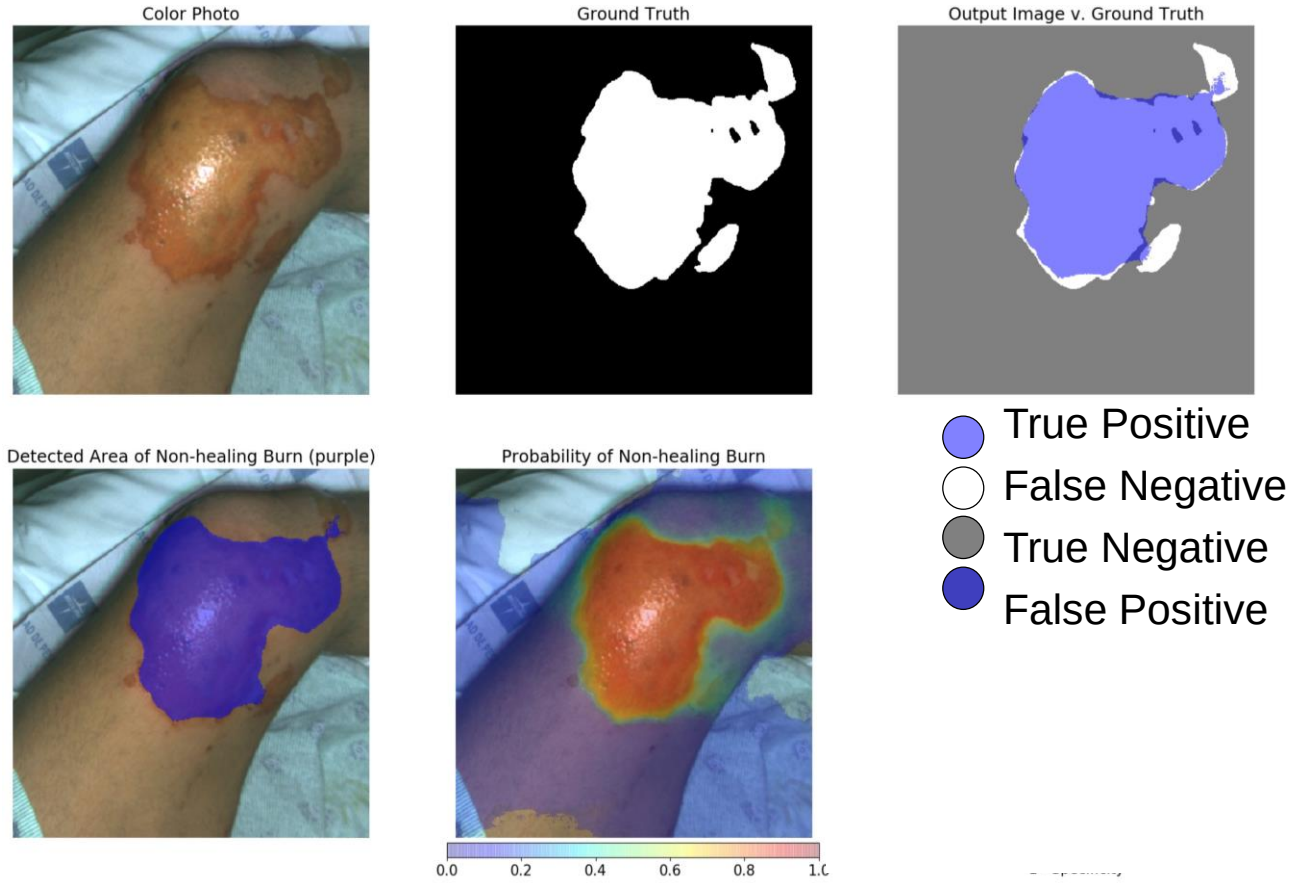



Source: R R Anderson, J A Parrish. The optics of human skin. J Invest Dermatol. 1981 Jul;77(1):13-9

# Burn/Trauma

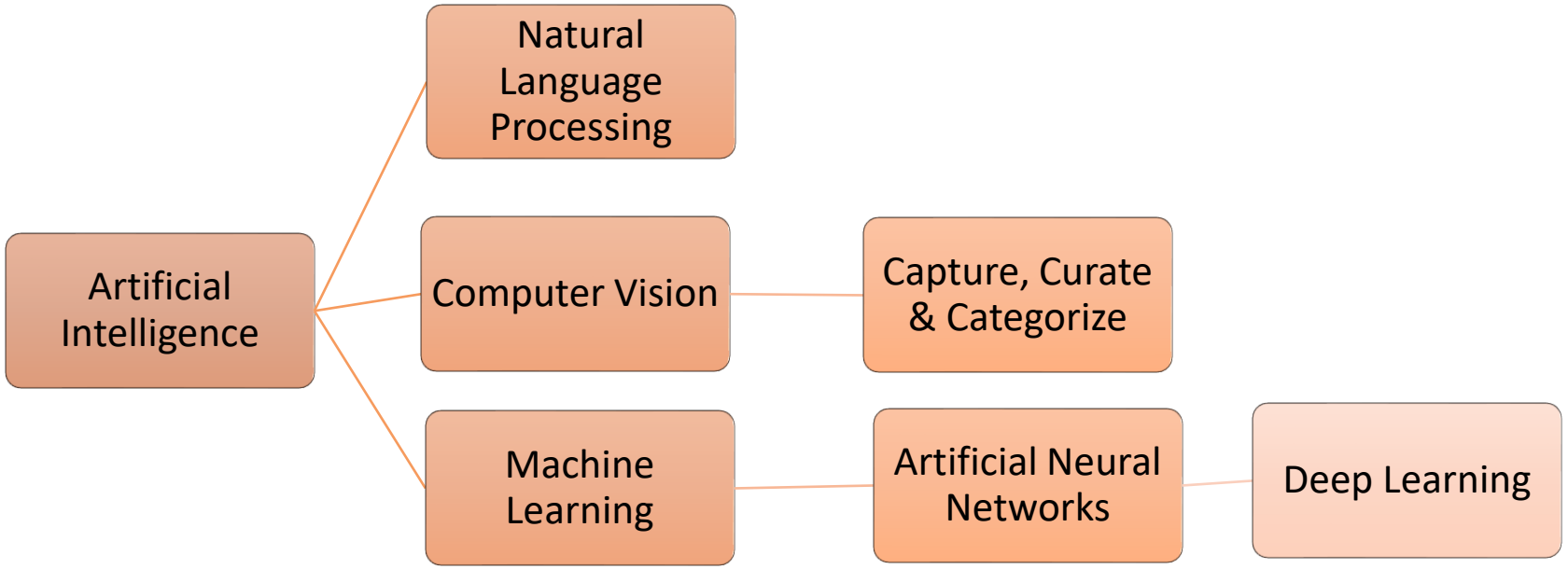
AI was used with Multi-Spectral Imaging to develop an algorithm capable of discerning healing & non-healing wound

| Pixel Based | |
|---|---|
| Accuracy | 91 ± 1 % |
| AUC | 97% |
| Sensitivity | 92 ± 2 % |
| Specificity | 91 ± 1 % |



# What is Artificial Intelligence

- Artificial Intelligence is ***the use of a computer to model intelligent behavior with minimal human intervention***.
- Alan Turing, "***Computing Machinery & Intelligence***"




Source: Pavel H, Tremblay J. Artificial intelligence in medicine. *Metabolism* 2017;69S:S36-40.
Source: A.M. Turing (1950) Computing Machinery and Intelligence. Mind 49: 433-460.

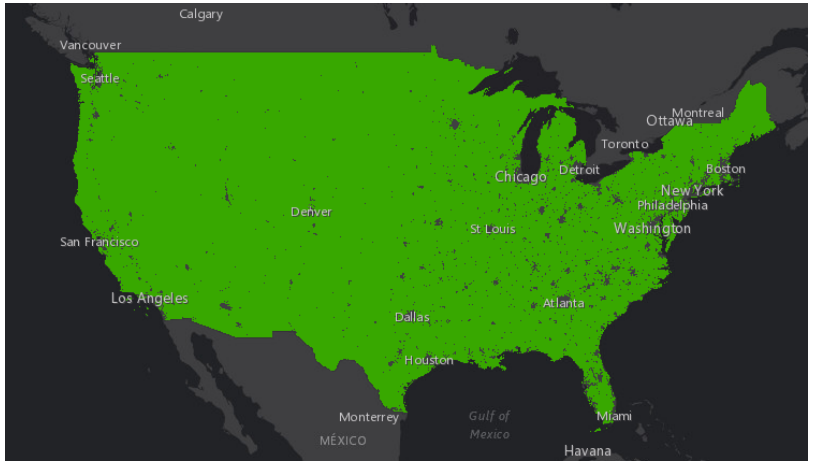
# Artificial Intelligence in Healthcare

| | |
|---|---|
| Bariatric Surgery | Real-time analysis of laparoscopic sleeve gastrectomy video-noted a **92.8% accuracy** automated identification of the steps & **noted missing or unexpected steps** |
| Pathology | Pathologists decrease their error rate in recognizing cancer-positive lymph nodes from **3.4% → 0.5%** |
| Breast Oncology | Reducing the rate of benign lumpectomies by **30%** in patients with high-risk needle biopsies |

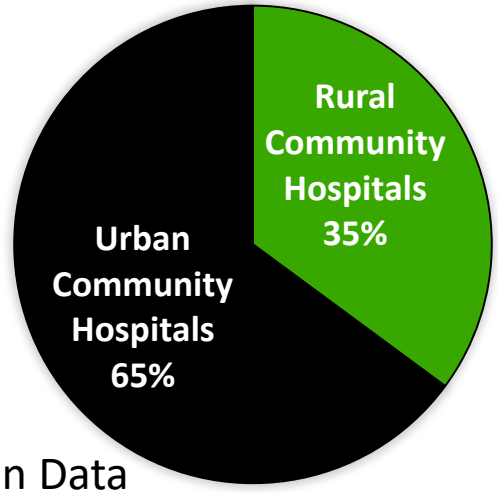
Source: Volkov, M., Hashimoto, DA., Rosman, G., et al. IEEE International Conference on Robotics and Automation. Singapore: 2017. Machine Learning and Coresets for Automated Real-Time Video Segmentation of Laparoscopic and Robot-Assisted Surgery; p. 754-759
Source: Hashimoto DA, Rosman G, Rus D, Meireles OR. Artificial Intelligence in Surgery: Promises and Perils. *Ann Surg*. 2018;268(1):70-76.
Source: Wang D, Khosla A, Gargeya R, et al. Deep learning for identifying metastatic breast cancer. arXiv preprint arXiv:1606.05718. 2016
Source: Bahl M, Barzilay R, Yedidia AB, et al. High-Risk Breast Lesions: A Machine Learning Model to Predict Pathologic Upgrade and Reduce Unnecessary Surgical Excision. Radiology. 0(0):170549.

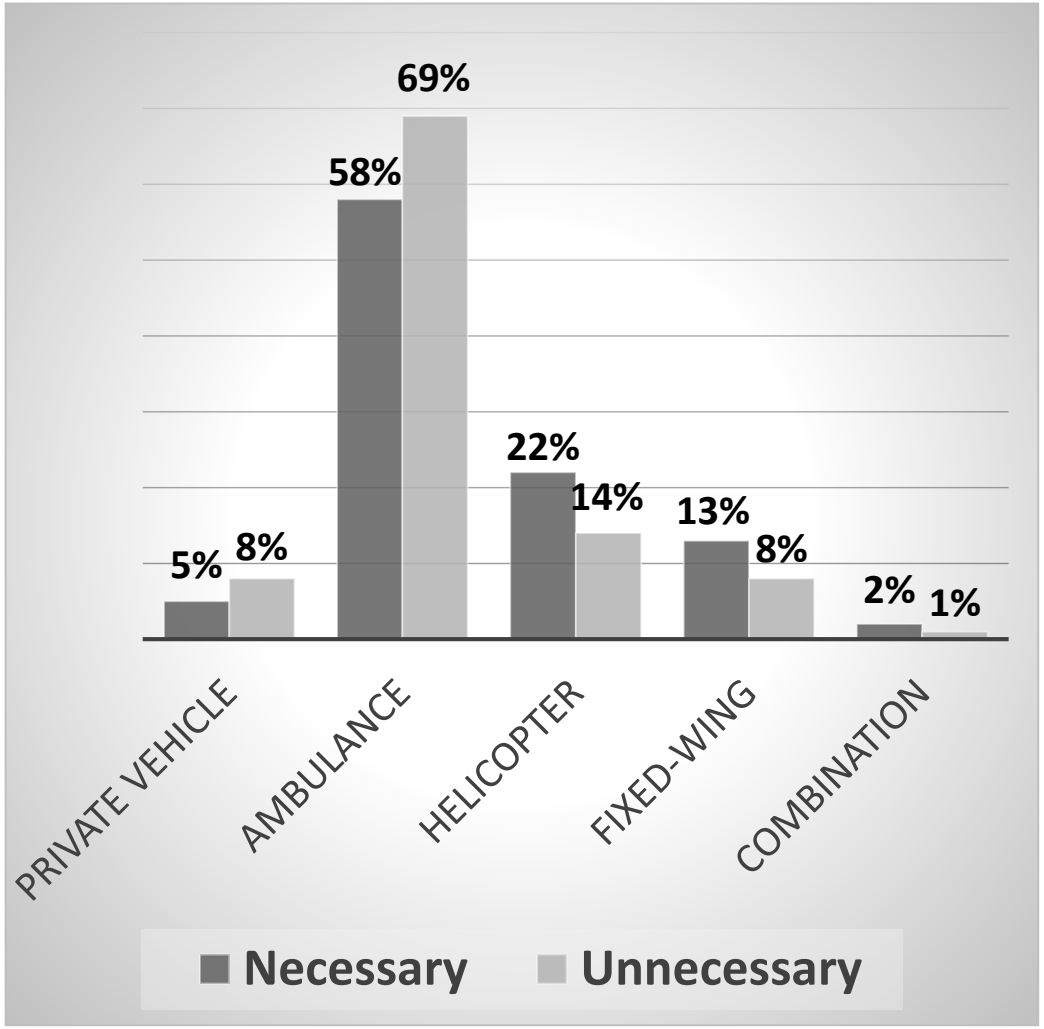
# Benefits of AI Implementation

- Improved accuracy for access to care
- Most air ambulance transportation costs range from $8,596–$15,246 & $23–$175 per mile




U.S. Census Data with AHA Hospital Location Data



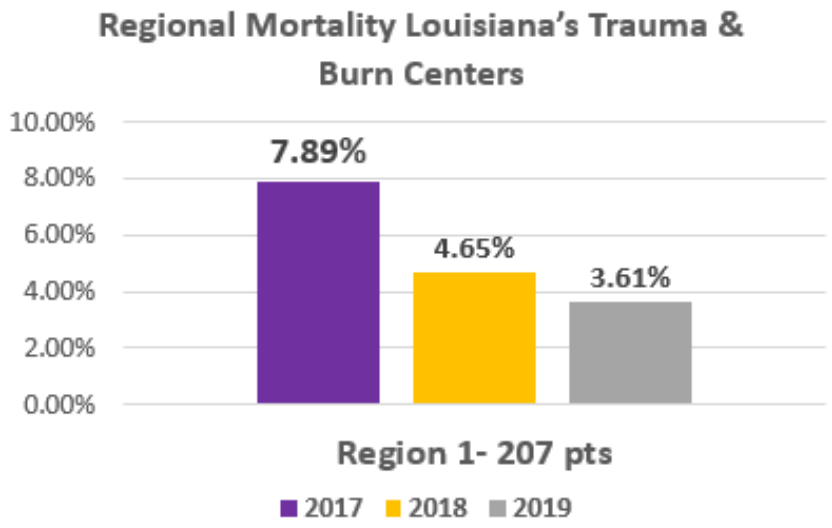



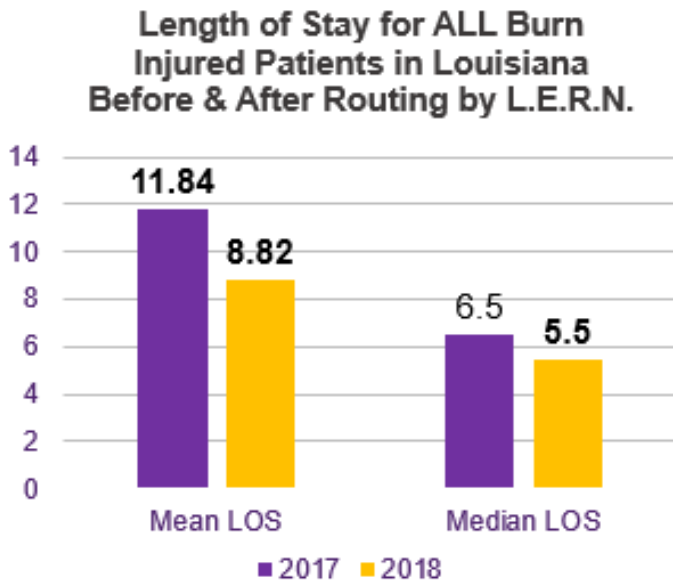

Source: Carter NH, Leonard C, Rae L. Assessment of Outreach by a Regional Burn Center: Could Referral Criteria Revision Help with Utilization of Resources? *Jour Bur Car Res* 2018;39:245-51.
Source: Montana 64th Legislature: Economic Affairs Interim Committee. Survey Responses from (Most) Air Ambulances Serving Montana by pat Murdo. *(accessed August 25th, 2021)* Source: American Hospital Association. 2021 AHA Hospital Statistics™ ISBN: 978-1-55648-458-2
Source: Healthcare Cost and Utilization Project, Statistical Brief #217, Agency for Healthcare Research and Quality

# Benefits of AI Implementation

- **41%** of burn transfers from referring ER discharged within 24 hours
- Median bed charges per day: **$7,554**

$$V_{\text{(Value)}} = \frac{Q_{\text{(Quality)}} + S_{\text{(Service)}}}{\$_{\text{(Cost)}}}$$




Source: Carter NH, Leonard C, Rae L. Assessment of Outreach by a Regional Burn Center: Could Referral Criteria Revision Help with Utilization of Resources? *Jour Burn Care Res* 2018;39(2):245-51.
Source: Carter JE, Amani H, Carter D, Foster KN, Griswold JA, Hickerson WL, Holmes JH, Jones S, Khandelwal A, Kopari N, Litt JS, Saveta,al A, Shupp JW, Sood R, Ferrufino CP, Vadagam P, Kowal S, Walsh T, Sparks J. Evaluating Real-World National and Regional Trends in Definitive Closure in U.S. Burn Care: A Survey of U.S. Burn Centers *Jour Burn Car Res* 2022;43:141-48.

# AI in Orthopedics/Spine

Michael R. Hicks, M.D., MBA, MHCM, FACHE

# AI in Orthopedic Practice – Potential for Transforming Patient Care

- Improved clinical decision support
  - Outcome prediction pre-procedure & intraoperatively
  - Examples include
    - Likelihood of disease progression (e.g., arthritis progression following injury)
    - Need for overnight stay in hospital following ACL or other reconstruction
    - Need for prolonged opioid use after elective knee arthroscopy
    - Injury prediction in athletic performance
- Image-based analysis & navigation systems
    - Fracture diagnosis in primary or urgent care settings
    - Automated or guided alignment of joint prosthetic components – precision surgery

Source: Martin, Ley, Pareek, Groll, Tischer, & Seil. Knee Surgery, Sports Traumatology, Arthroscopy (2022) 30:361–364. https://doi.org/10.1007/s00167-021-06741-22022.

# Polling Question #2

Artificial Intelligence in healthcare is:

1. Mostly hype
2. Well-established; a normal incremental technology advancement and existing regulatory processes and industry self-governance provide adequate oversight
3. Revolutionary; disruptive and should generate concerns about job loss, information accuracy, privacy, governance, etc.
4. Should require special oversight, governance and transparency rules before it is widely deployed

# In Summary

- ”AI” is a broad term applied to machines with complex computational capabilities that use large robust data sets to perform tasks that have previously required human intelligence
  - Perception (visual, speech, etc.)
  - Decision-making
  - Self-learning
- Based on algorithms that are applied to data sets that can be progressively complex
- Term coined by emeritus Stanford Professor John McCarthy in 1955 to describe “the science and engineering of making intelligent machines”

Source: Manning. Stanford University Human Centered Artificial Intelligence. Artificial Intelligence Definitions. 2020. AI-Definitions-HAI.pdf (stanford.edu)
Source: Russell and Norvig. *Artificial Intelligence: A Modern Approach.* Pearson Higher Ed., Fourth Edition, 2021.

# AI in Healthcare – Real & Potential Uses

- Augmenting individual patient care
  - Communication & logistics (chatbots, scheduling, etc.)
  - Home care/self care patient monitoring devices (wearables)
  - Disease prediction (e.g., sepsis prediction from EMR, cardiac issues, etc.)
  - Disease detection (imaging, etc.)
- Population health
- AI-powered procedural devices
  - Image enhancement
  - Procedural tool/robotic surgery

# Polling Question #3

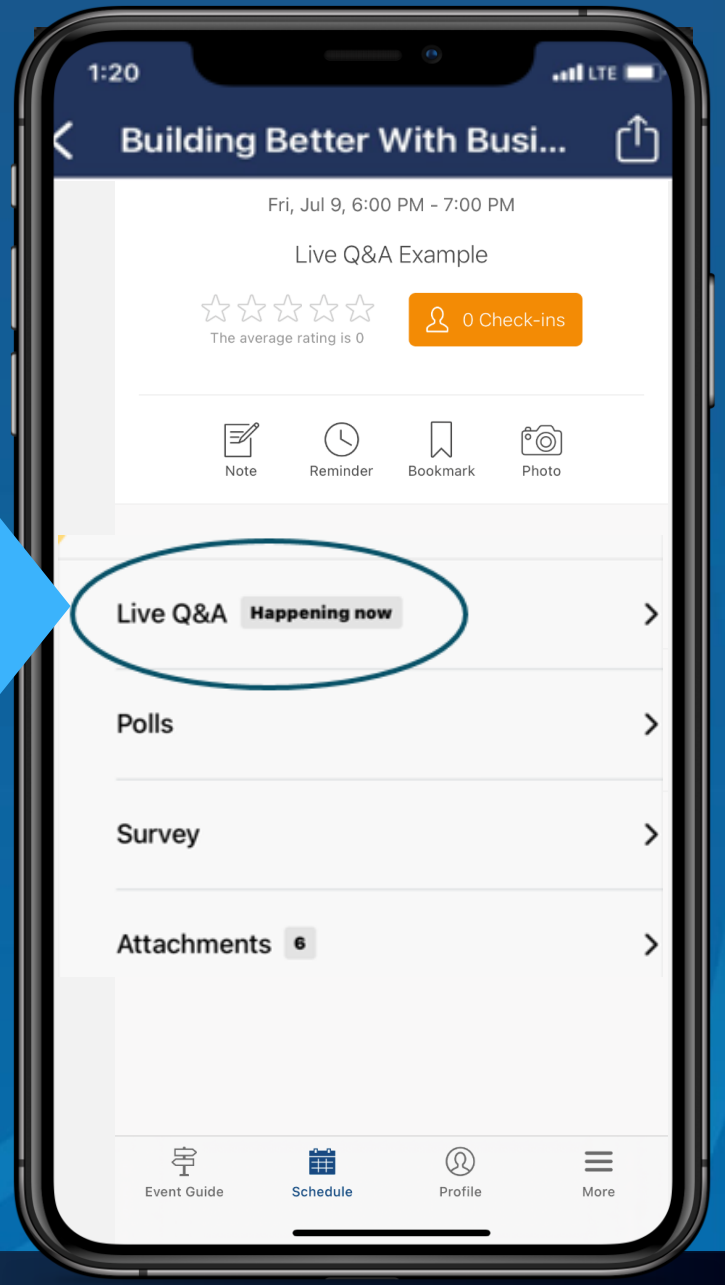
After hearing all of this, I believe the use of AI in healthcare:

1. Is still not a big deal
2. Will be significant and positive for the work we do
3. Remains to be determined in terms of scope and benefit

# Audience Q&A

Use the conference mobile app to ask your question

- Select session name
- Click on “Live Q&A,” then “Ask a Question”
- Type your question & hit “Submit”
- Send in any time; Qs will be held until the end of the session



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# Thank you...


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