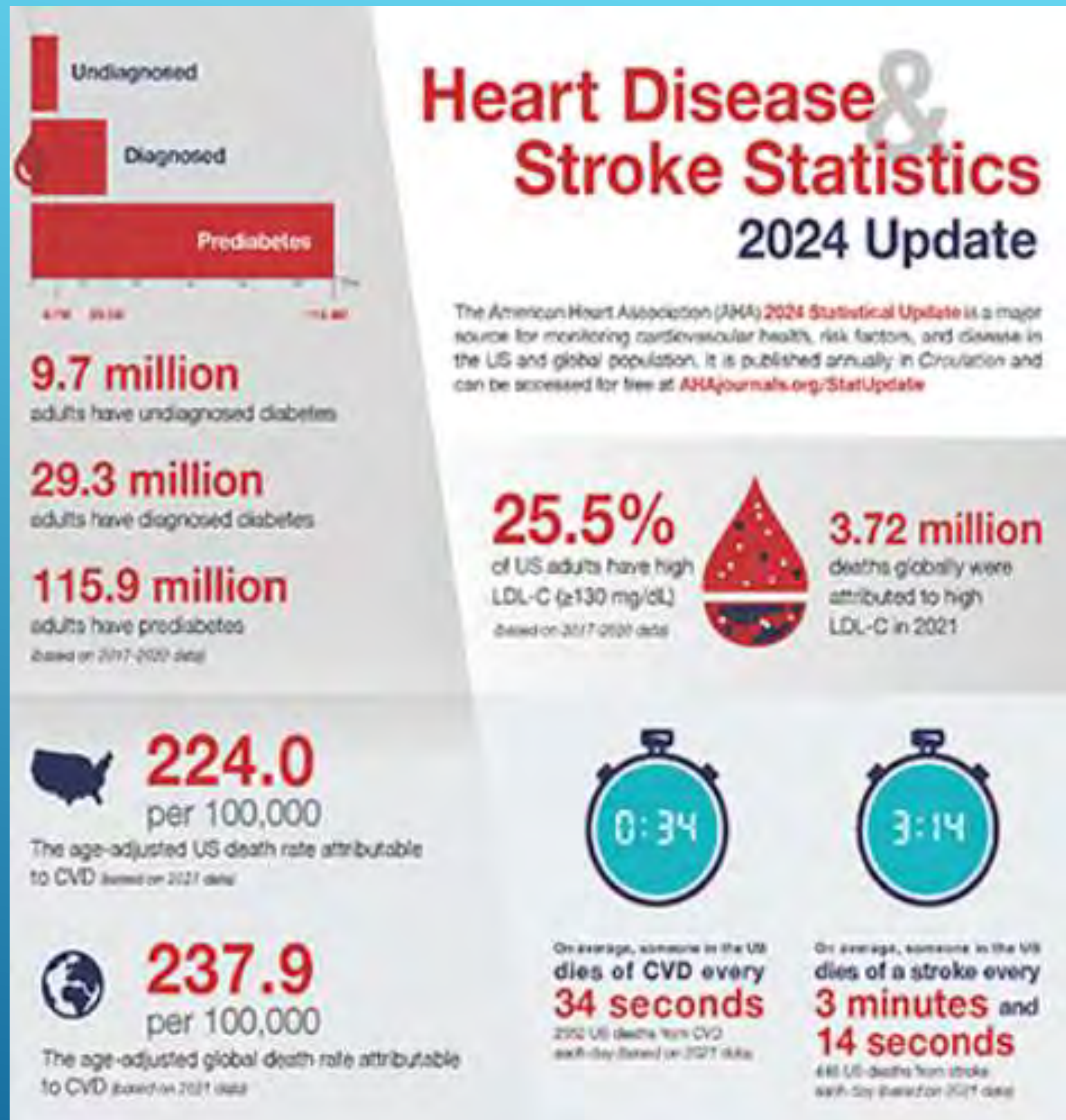
NSF AND CARDIAC RESEARCH

Wendy Nilsen, PhD

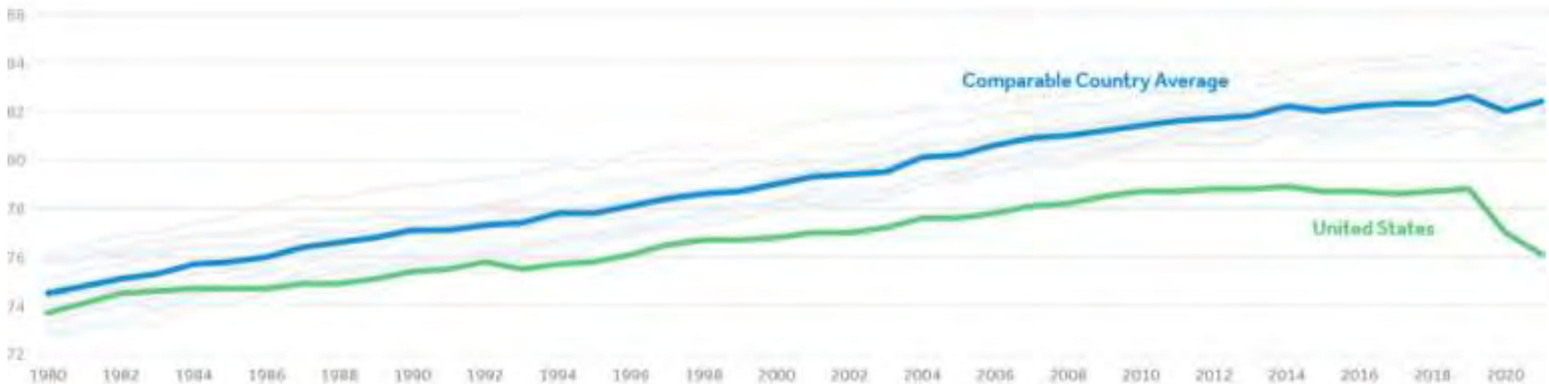
National Science Foundation

Computer & Information Science & Engineering Directorate

Heart Disease and Stroke 2024



Martin et. al. 2024 Heart disease and stroke statistics: a report of U.S. and global data from the American Heart Association. *Circulation*.



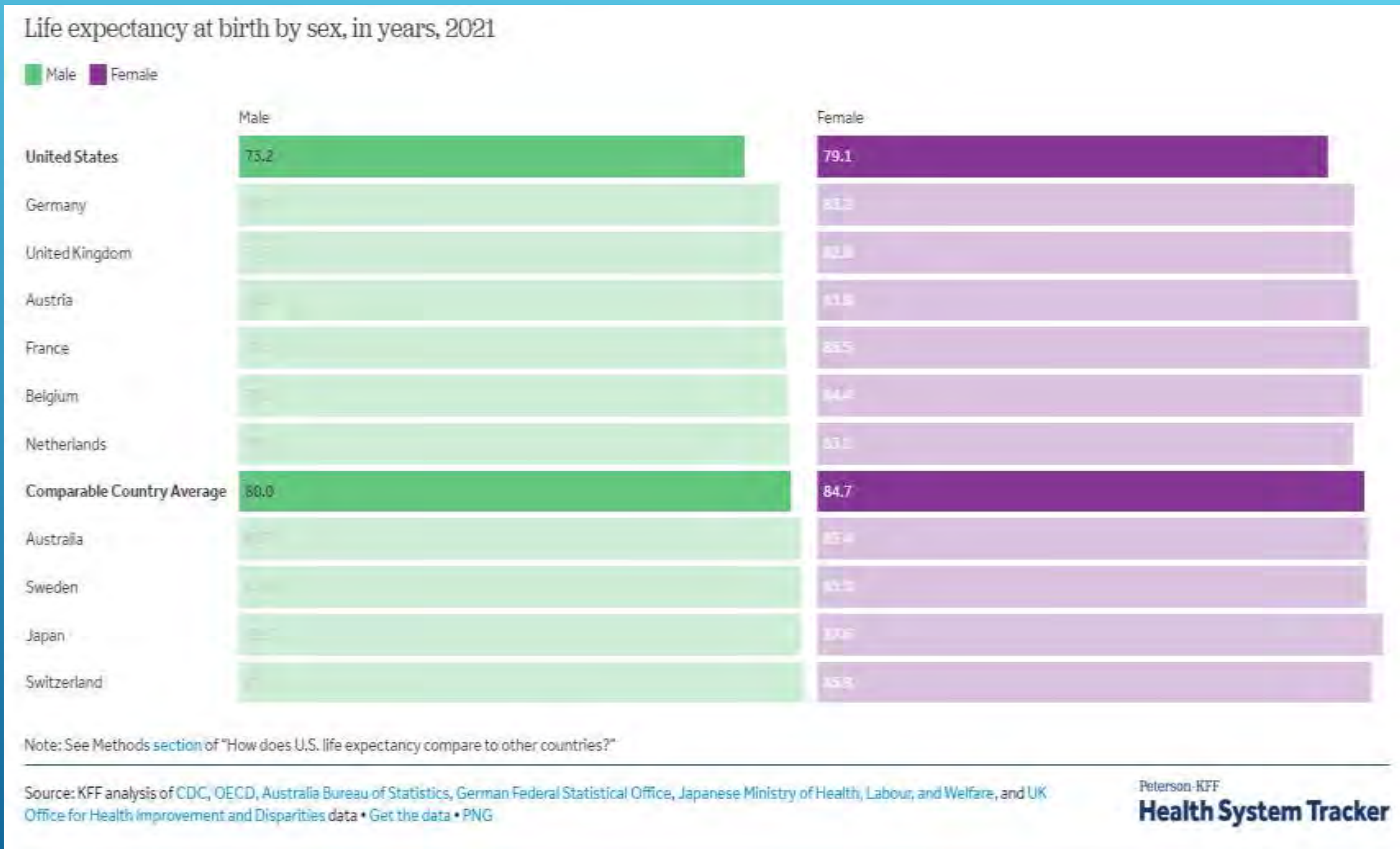
Notes: Comparable countries include: Australia, Austria, Belgium, Canada (except for 2021), France, Germany, Japan, the Netherlands, Sweden, Switzerland, and the U.K. See Methods section of "How does U.S. life expectancy compare to other countries?"

Source: KFF analysis of CDC, OECD, Japanese Ministry of Health, Labour, and Welfare, Australian Bureau of Statistics, and UK Office for Health Improvement and Disparities data • Get the data • PNG

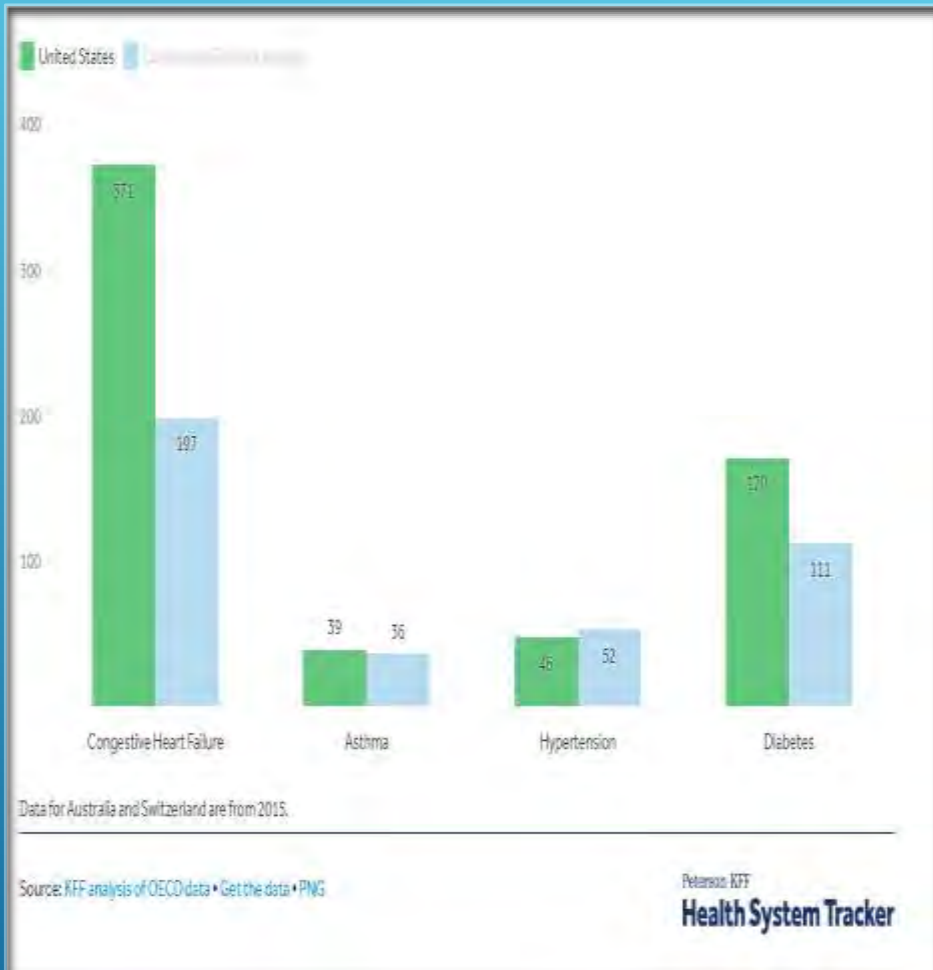
Peterson-KFF Health System Tracker

FROM 2020 TO 2021, LIFE EXPECTANCY CONTINUED TO DECLINE IN THE U.S. WHILE REBOUNDING IN MOST COMPARABLE COUNTRIES

Life Expectancy

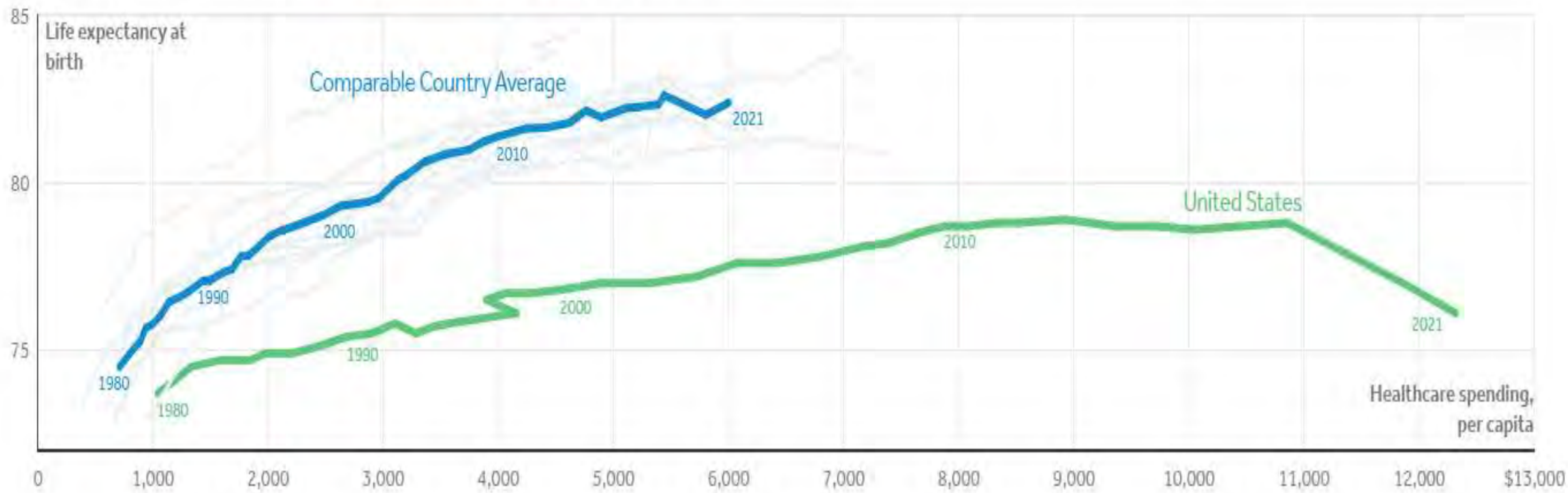


HOSPITAL RATES IN THE US AND COMPARABLE COUNTRIES



In 1980, the U.S. and comparable countries had similar life expectancies and health spending, but the trends have diverged in the last few decades

Life expectancy and healthcare spending per capita, 1980-2021



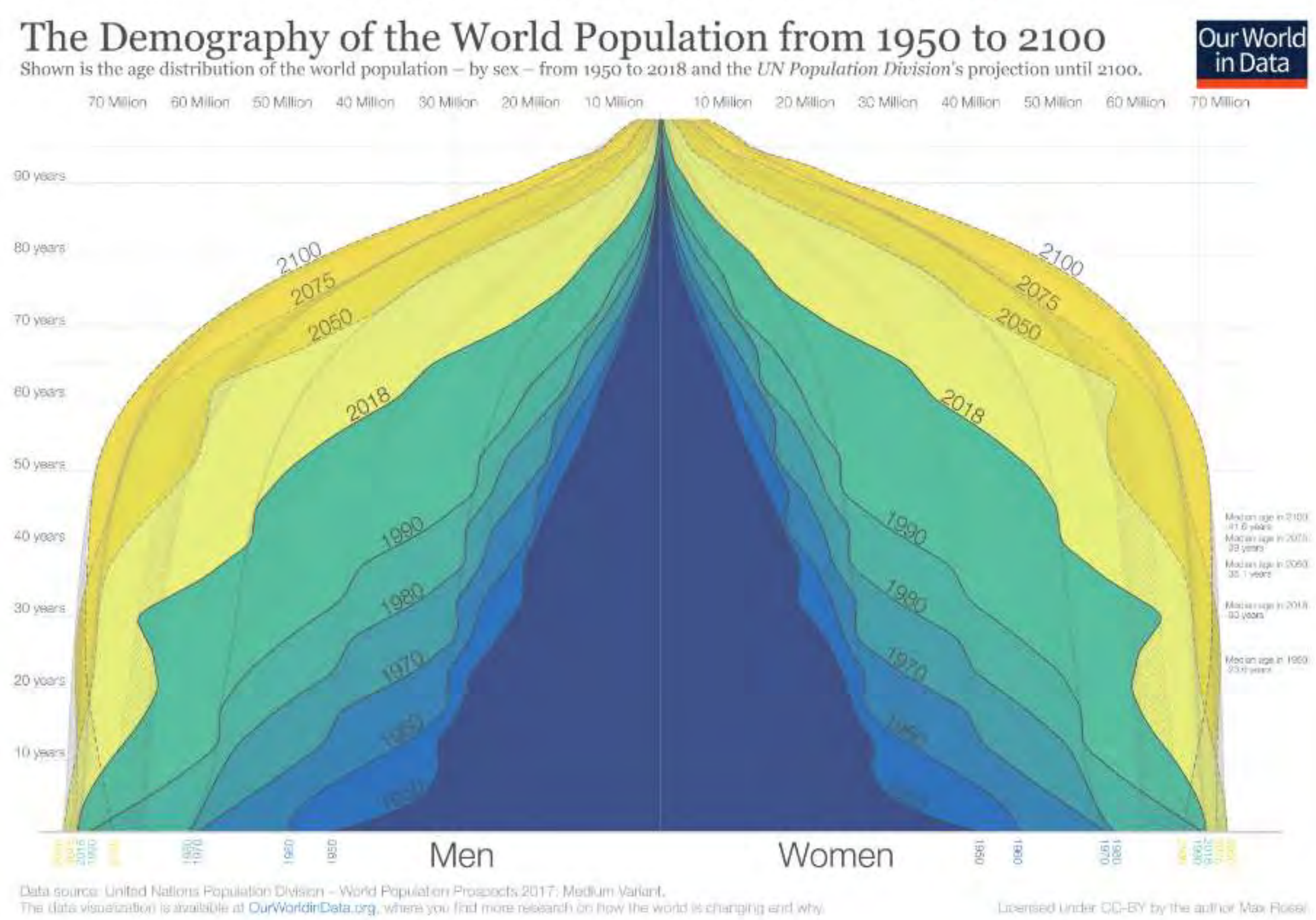
Notes: Comparable countries include: Australia, Austria, Belgium, Canada (except for life expectancy average in 2021), France, Germany, Japan, the Netherlands, Sweden, Switzerland, and the U.K. See Methods section of "How does U.S. life expectancy compare to other countries?"

Source: KFF analysis of CDC, OECD, Japanese Ministry of Health, Labour, and Welfare, Australian Bureau of Statistics, and UK Office for Health Improvement and Disparities data • Get the data • PNG

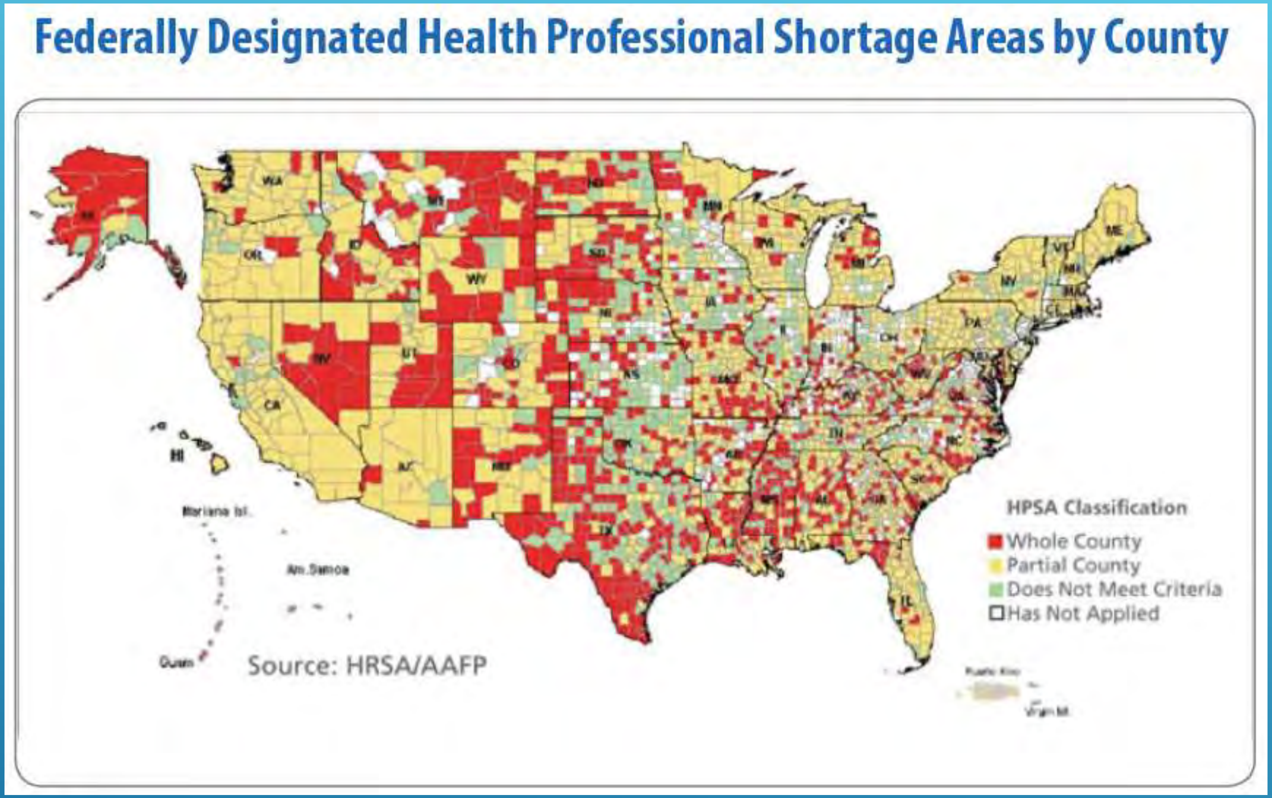
Peterson-KFF **Health System Tracker**

AGING DEMOGRAPHICS ARE NOT ON OUR SIDE

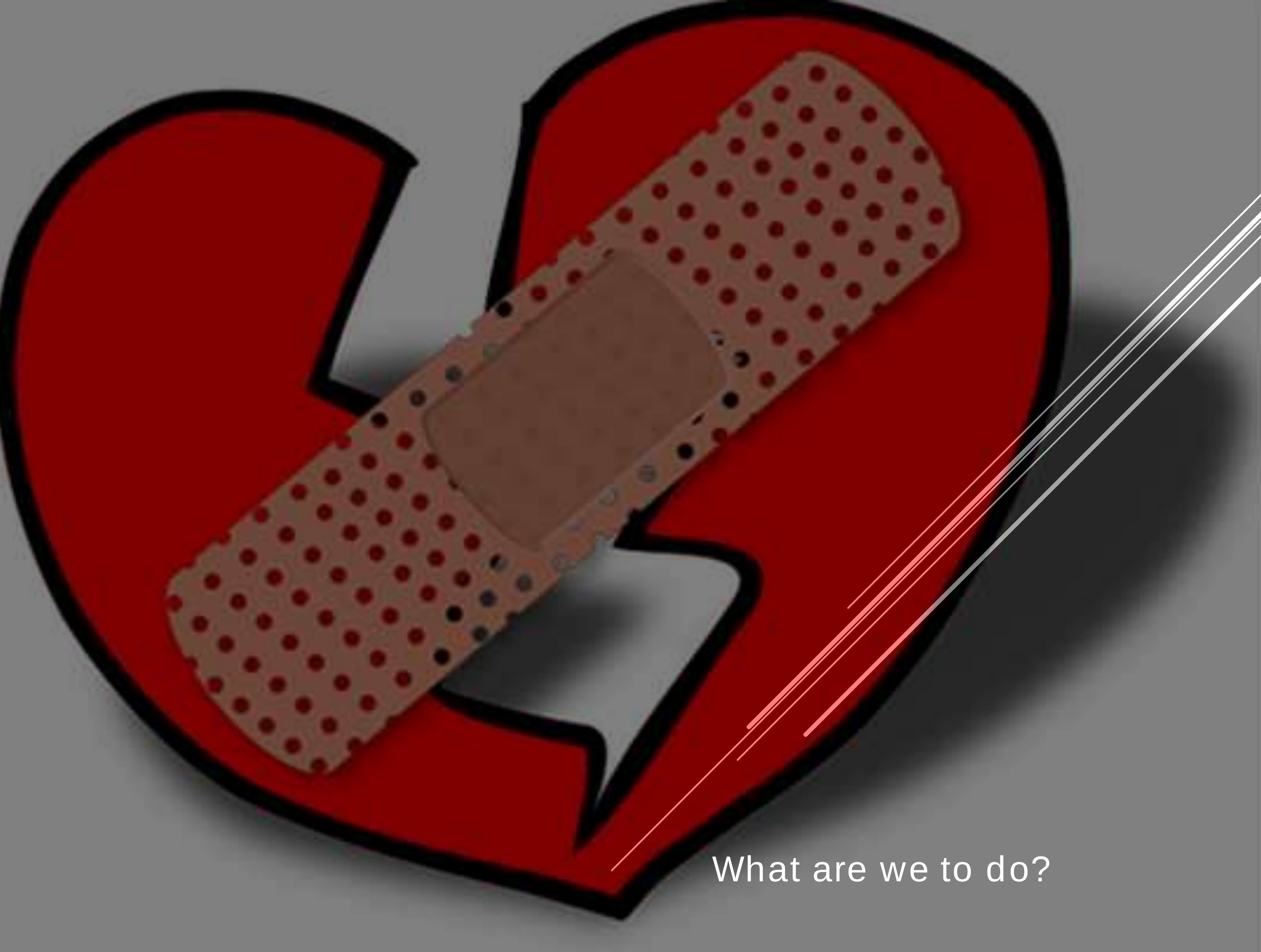
The Demography of the World Population from 1950 to 2100[2]



NOR IS THE WORKFORCE



HRSA, 2011



What are we to do?

AI to the Rescue?

SUCCESSFUL TECHNOLOGY SHOULD

- CREATE MORE PERSONALIZED TECHNOLOGY TO SERVE DIVERSE POPULATIONS, WHILE CREATING EVIDENCE-BASED, GENERALIZABLE SOLUTIONS FROM WHICH TO ADAPT.
- DESIGN TECHNOLOGIES TO EMPOWER PATIENT, CAREGIVERS AND PROVIDERS WITH TIMELY AND ACTIONABLE INFORMATION.
- ENSURE TECHNOLOGY INCREASE ACCESS AND DOES NOT ENHANCE DISPARITIES
- HAVE AN EVIDENCE BASE TO SUPPORT USAGE
- BE SAFE AND TRUSTWORTHY
- RECOGNIZE THAT MULTIPLE APPROACHES ARE NEEDED TO ADDRESS INDIVIDUAL NEEDS AND THAT CONTEXT MATTERS

DATA, DATA, DATA.

- Capture a wide array of data
- Create methods to reduce the need for annotation
- Ensure analytic methods are robust
- Balance utility and discovery – both are needed
- New methods are good, interpretable, valid and reliable methods change practice!

AI in health should not fall into the biomedical trap of building for the average and then tweaking for specific populations

- Develop the first principles that are needed to engage people in their health
- Identify those factors that will impact the user experience in different populations
- Personalize for optimal engagement
- Remember no one is average

PERSONALIZATION

FUTURE PROOFING

Building technologies that will not need expensive revisions frequently.

EMPOWERING USERS

- Technologies should empower users with understandable and actionable information. Need to explore the principles for what information is included and how it should be presented,
  - Providers/care team
  - Patients
  - Caregivers
- Ensure the timing meets the biomedical mandates and users needs.

INCREASE ACCESS

Technology should increase access to healthcare and services.

- Ensure access in resource poor settings.
- Increase bandwidth and reduce latency for real-time communication.
- Ensure the usability of systems for those with less digital literacy.

GENERATE AN EVIDENCE BASE

- Working with biomedical researchers to appropriately test and evaluate new technology
- Need data and ground truth
- Only an evidence base changes practice
- Evidence reduces liability

SAFETY

The current lax privacy and security standards will not last. To sustain progress:

- Access control and authentication
- Confidentiality and anonymity
- Trustworthy control
- Accountability
- Medical device security

TRUSTWORTHY

- Real-time assessment of problematic data
- Dealing with biases for fairness
- Does the data represent what we think it does?
- Is the variance signal or noise?
- Cause and effect

MULTIPLE APPROACHES

- Recognize that multiple approaches are needed to address individual needs. Not all people need the same approach
- Context matters in both assessment and approach

EXAMPLES OF NEXT STEPS

Early Smart Health Research with Sound


UNIVERSITY of WASHINGTON

ABOUT UW NEWS | STORIES | MULTIMEDIA | EXPERTS | MEDIA CONTACTS

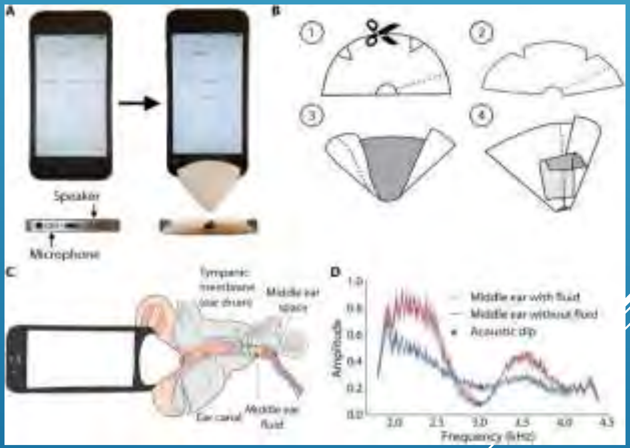
UW NEWS

May 15, 2019

First smartphone app that can hear ear infections in children

Sarah McQuate

UW News



https://www.washington.edu/news/2019/05/15/smartphone-app-can-hear-ear-infections/

- The objective of is to synthesize acoustic models and experimental optical analyses to understand the limits of an innovative robotic photoacoustic imaging system for guiding cardiac surgeries and interventions.
- 1) Generate new acoustic models to predict the likelihood of photoacoustic signal visualization and segmentation during photoacoustic-based robot control, which will be used to advocate a novel paradigm of reduced reliance on x-rays.
- 2) The currently nonexistent optical properties of multiple phrenic nerves will be characterized in order to create realistic expectations for the challenging task of nerve visualization and avoidance during cardiac procedures.
- 3) The integration of theoretical acoustic models, deep learning methods, vision-based robot control, and nerve characterization results will be evaluated

SCH: INT: Photoacoustic-Guided Cardiac Intervention
Award Number:2014088,
Muyinatu Bell

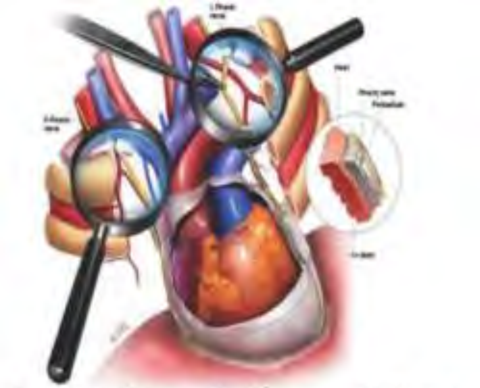
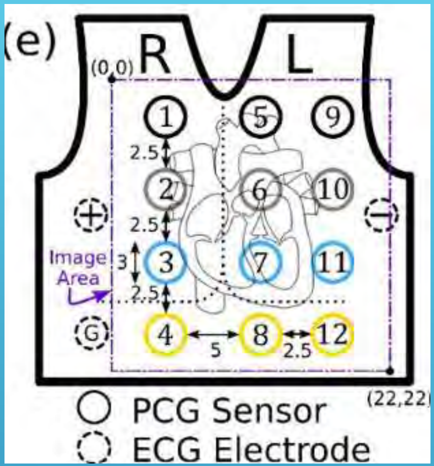


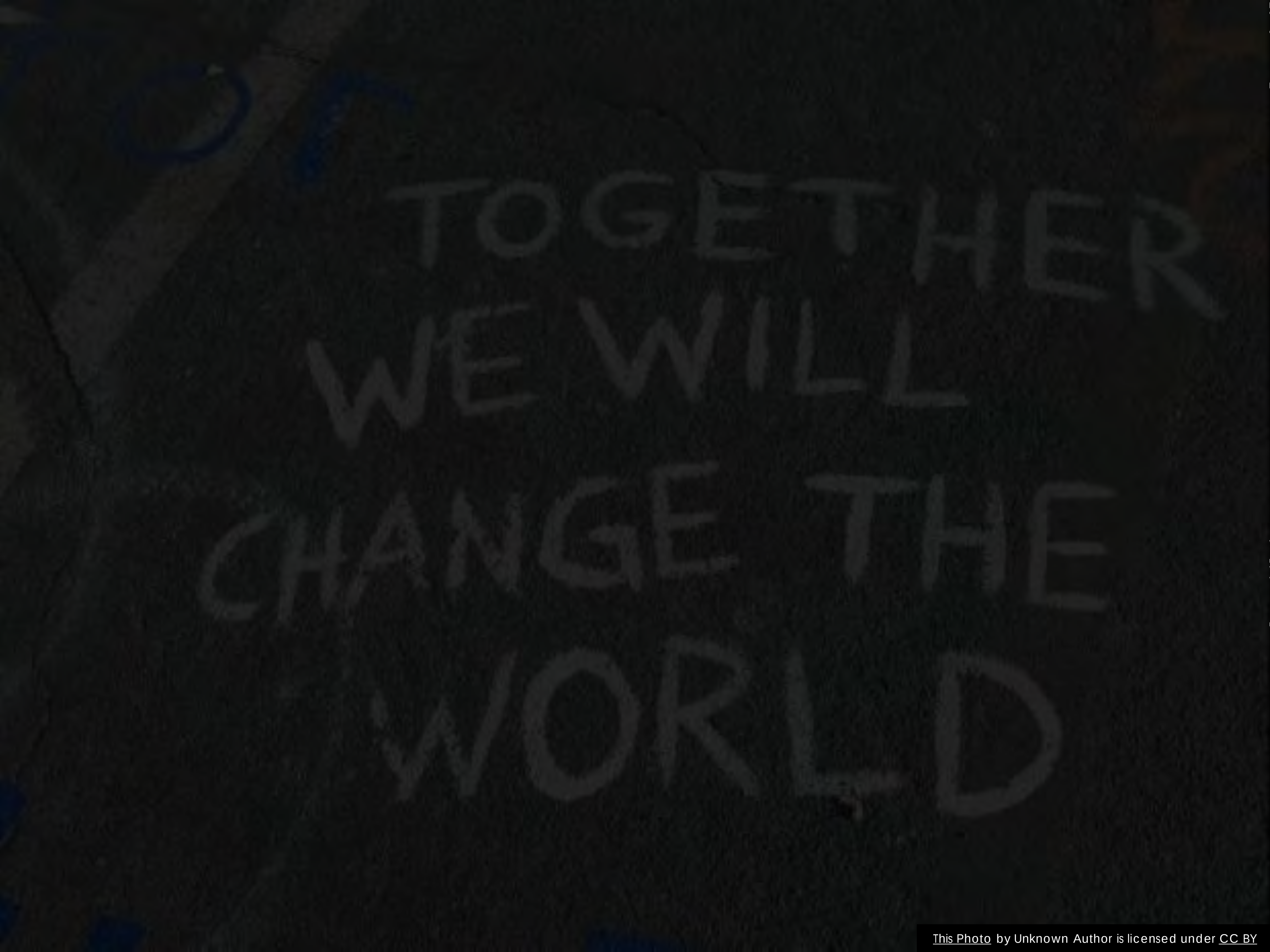
Figure 4: Schematic diagram of left and right phrenic nerves (see magnified regions) and their proximity to the heart.

SCH: INT: MAPPING THE CARDIAC ACOUSTEOME: BIOSENSING AND COMPUTATIONAL MODELING APPLIED TO SMART DIAGNOSIS AND MONITORING OF HEART CONDITIONS

IIS-2014506; Raj Mittal,



- The project develops fundamental science, knowledge, tools, and technologies for smart diagnosis and monitoring of heart conditions based on automated cardiac auscultation by using an innovative wearable multimodal acoustic array (the StethoVest).
- This sensory array localizes and separates acoustic broadband sources in space by measuring spatial and temporal derivatives of the acoustic field. Using this StethoVest, first-of-their-kind maps of the cardiac acousteome are generated. These maps include not only 4D (3D space and time) measurements of heart sounds; they are accompanied by high-fidelity hemoacoustic simulations that delineate cause-and-effect, as well as simulation-guided source-identification algorithms that provide unprecedented diagnostic sensitivity and specificity.


TOGETHER
WE WILL
CHANGE THE
WORLD

THANKS!

wnilsen@nsf.gov

➨Join IIS News

- Send an e-mail message to LISTSERV@LISTSERV.NSF.GOV
- The **body of the message** should read *Subscribe IIS_News [**your full name**]* The message is case sensitive; so capitalize as indicated!

➨Don't include the brackets.

➨The Subject line should be blank

➨For example, for Robin Smith to subscribe, the message would read

➨*Subscribe IIS_News Robin Smith*

You will receive a confirmation of your subscription

Effective Research is a Relay between basic and applied science

Questions or Comments?

WENDY NILSEN
DEPUTY DIVISION DIRECTOR
INFORMATION AND INTELLIGENT SYSTEMS
NATIONAL SCIENCE FOUNDATION
TEL: 703-292-2568
EMAIL: WNILSEN@NSF.GOV