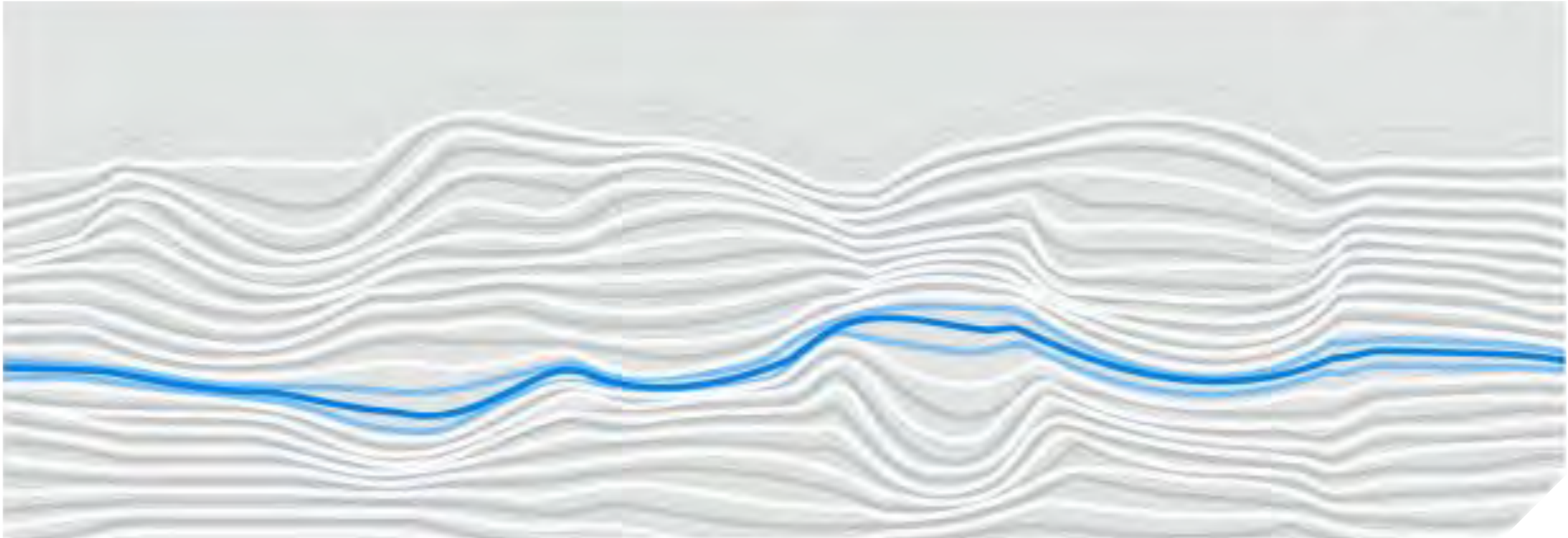


Quantitative Imaging and a New Population Health Paradigm: Lung Cancer, COPD, Coronary Artery Disease

Bruce Pyenson, FSA, MAAA

OCTOBER 10, 2019
QUANTITATIVE IMAGING WORKSHOP



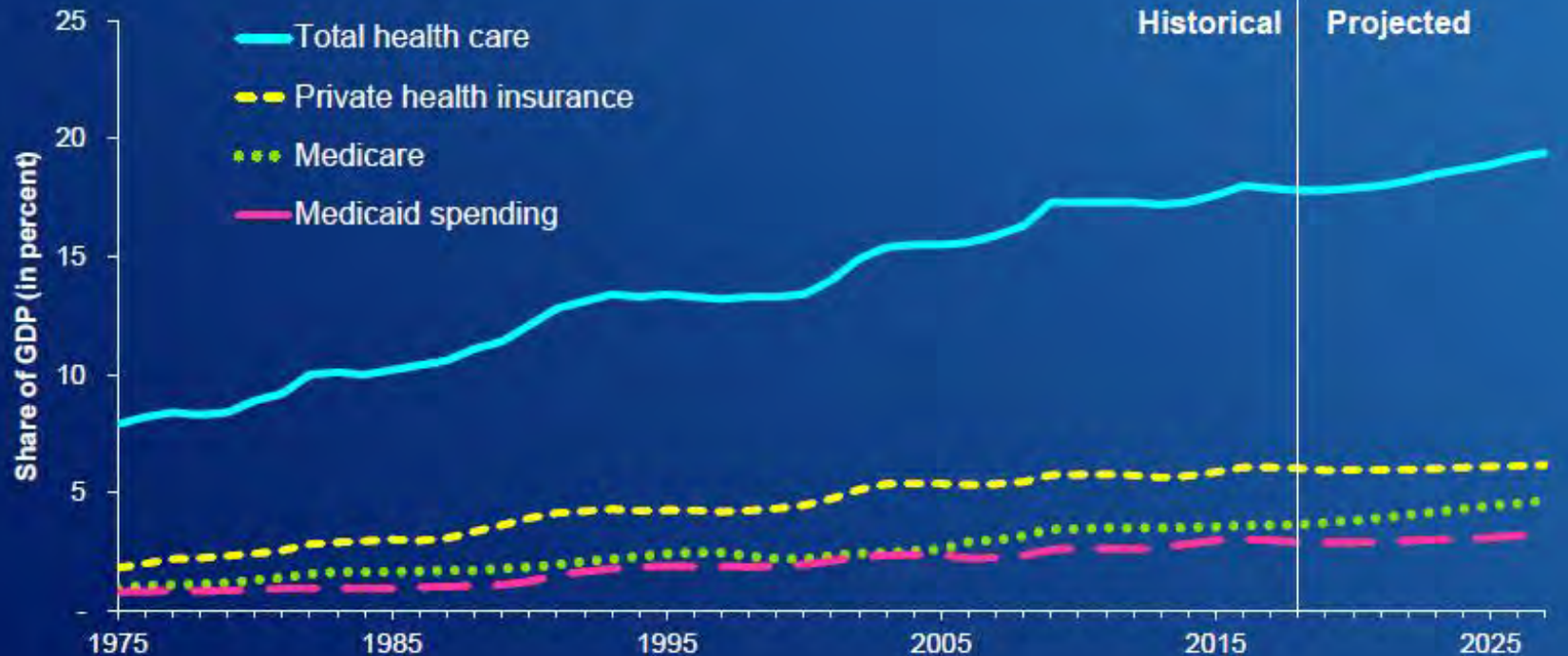
Disclosures

- Pyenson is an employee of Milliman, Inc., which consults to virtually every sector of the healthcare industry, including health insurers, employers, the bioscience industry, and governmental bodies. He has no patents or ownership stake in any healthcare venture.
- Pyenson is a Member of the American Academy of Actuaries
- This material includes opinions of the author and does not represent an endorsement by Milliman
- This presentation includes unpublished material that should be viewed as draft and subject to change

How are we doing at population health?

We are spending more and more on healthcare

Health care spending has grown as a share of GDP



MEDPAC

Source: MedPAC analysis of National Health Expenditure Accounts from CMS, historical data released December 2018, projected data released February 2019.

Results preliminary; subject to change

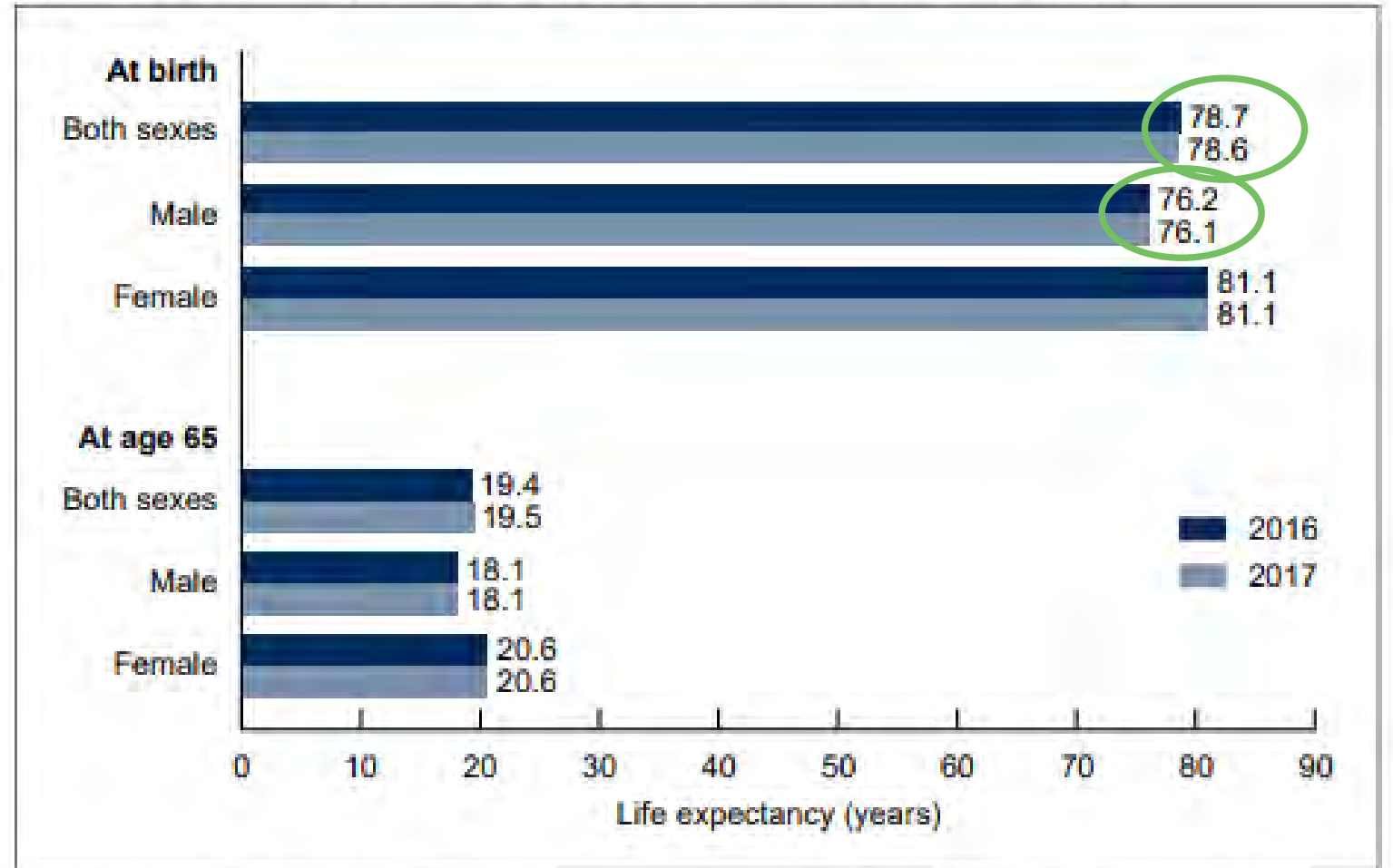
How are we doing at population health?

US is 43rd in 2017 life expectancy

(CIA, The World Fact Book, <https://www.cia.gov/library/publications/the-world-factbook/rankorder/2102rank.html>)

Life expectancy at birth decreased from 2016 to 2017

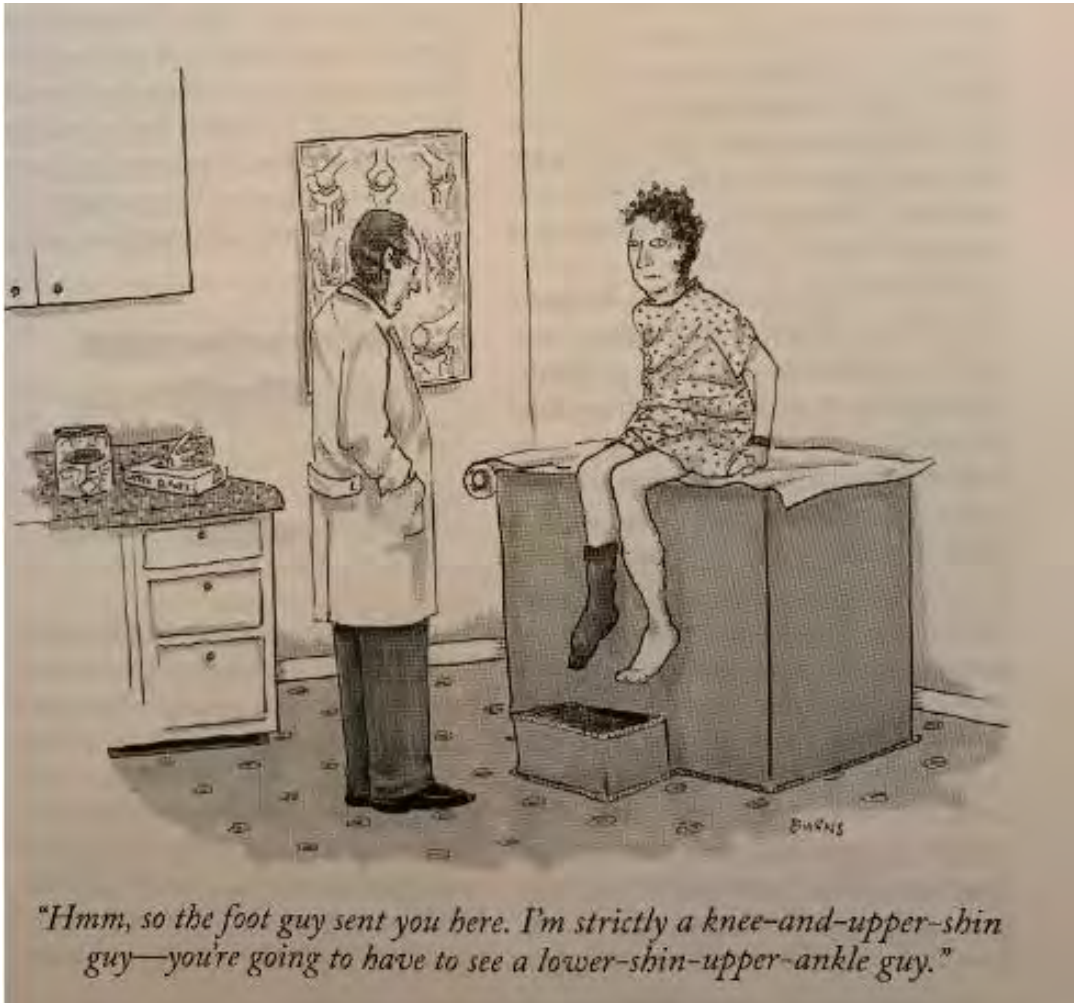
Figure 1. Life expectancy at selected ages, by sex: United States, 2016 and 2017



NOTES: Life expectancies for 2018 were revised using updated Medicare data; therefore, figures may differ from those previously published. Access data table for Figure 1 at: https://www.cdc.gov/nchs/data/databriefs/db328_tables-508.pdf#1, SOURCE: NCHS, National Vital Statistics System, Mortality.

<https://www.cdc.gov/nchs/data/databriefs/db328-h.pdf>

How are we doing at population health?



Evidence of health care inefficiency and misspending

- Geographic variation
 - Higher use ≠ improved patient outcomes
 - Low-value services continue to be provided
- International comparison
 - U.S. spends significantly more than any other country in the world, primarily due to higher prices
 - U.S. ranks below average on indicators of efficiency and outcomes
 - Life expectancy at 65 is lower and has increased more slowly than in other industrialized countries

MEDPAC

Source: Papanicolaos I, Woskie LR, Jha AK. Health Care Spending in the United States and Other High-Income Countries. JAMA. 2018; Organisation for Economic Co-operation and Development 2017, and Commonwealth Fund 2014.

Results preliminary, subject to change

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<http://medpac.gov/docs/default-source/default-document-library/context-sept-2019.pdf?sfvrsn=0>

New Yorker, Oct 14, 2019

Screening Population

vs

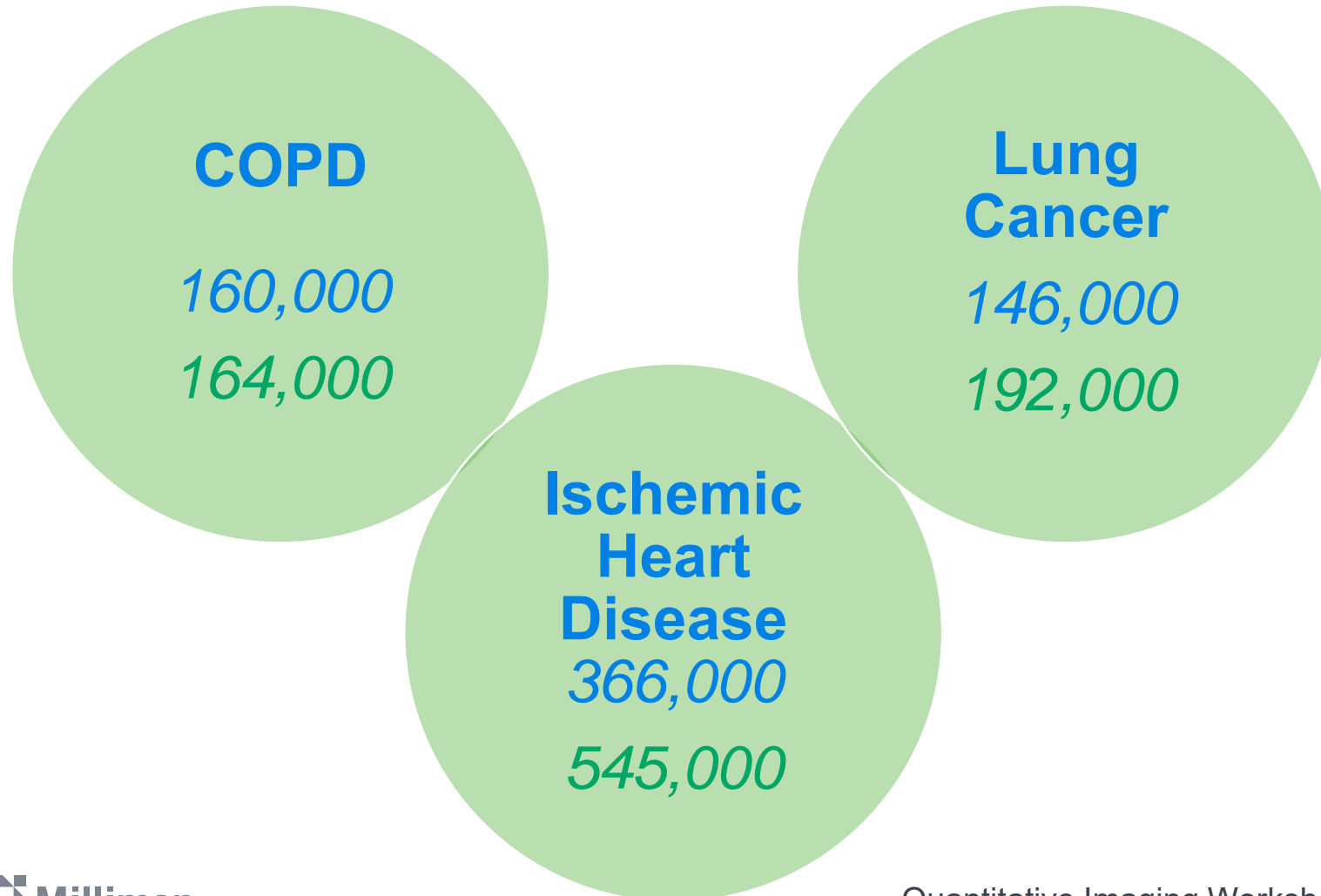
Treatment Population:

Lung Cancer, COPD,
Coronary Artery
Disease....

Tobacco Smoke Syndrome

Deaths in US

Estimates vary by source

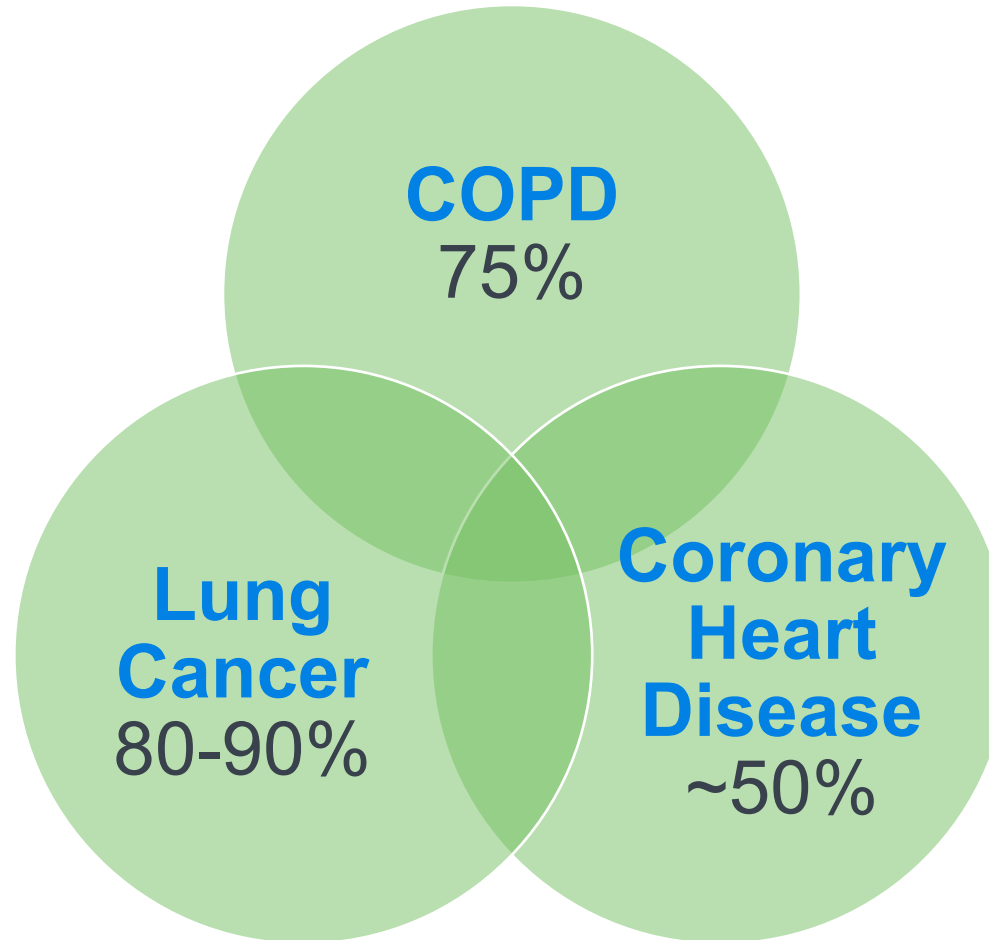


2017 deaths. Source: CDC, National Vital Statistics System, 2017 report, https://www.cdc.gov/nchs/data/dvs/lcwk/lcwk6_hr_2017-508.pdf

2016 deaths. Source: The US Burden of Disease Collaborators, JAMA 2019 <https://jamanetwork.com/journals/jama/fullarticle/2678018>

Conditions due to smoking

Portion of cases due to smoking

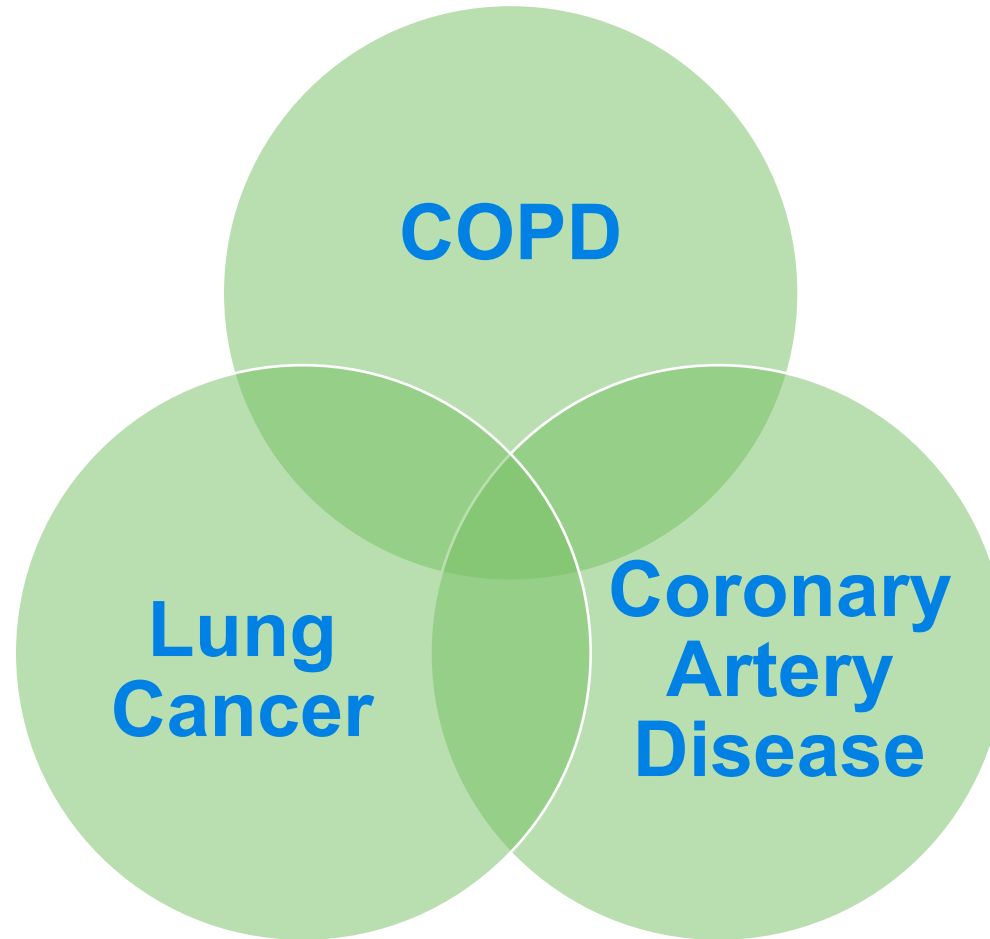


COPD: CDC,
<https://www.cdc.gov/tobacco/campaign/tips/diseases/copd.html>, Apr 1, 2019

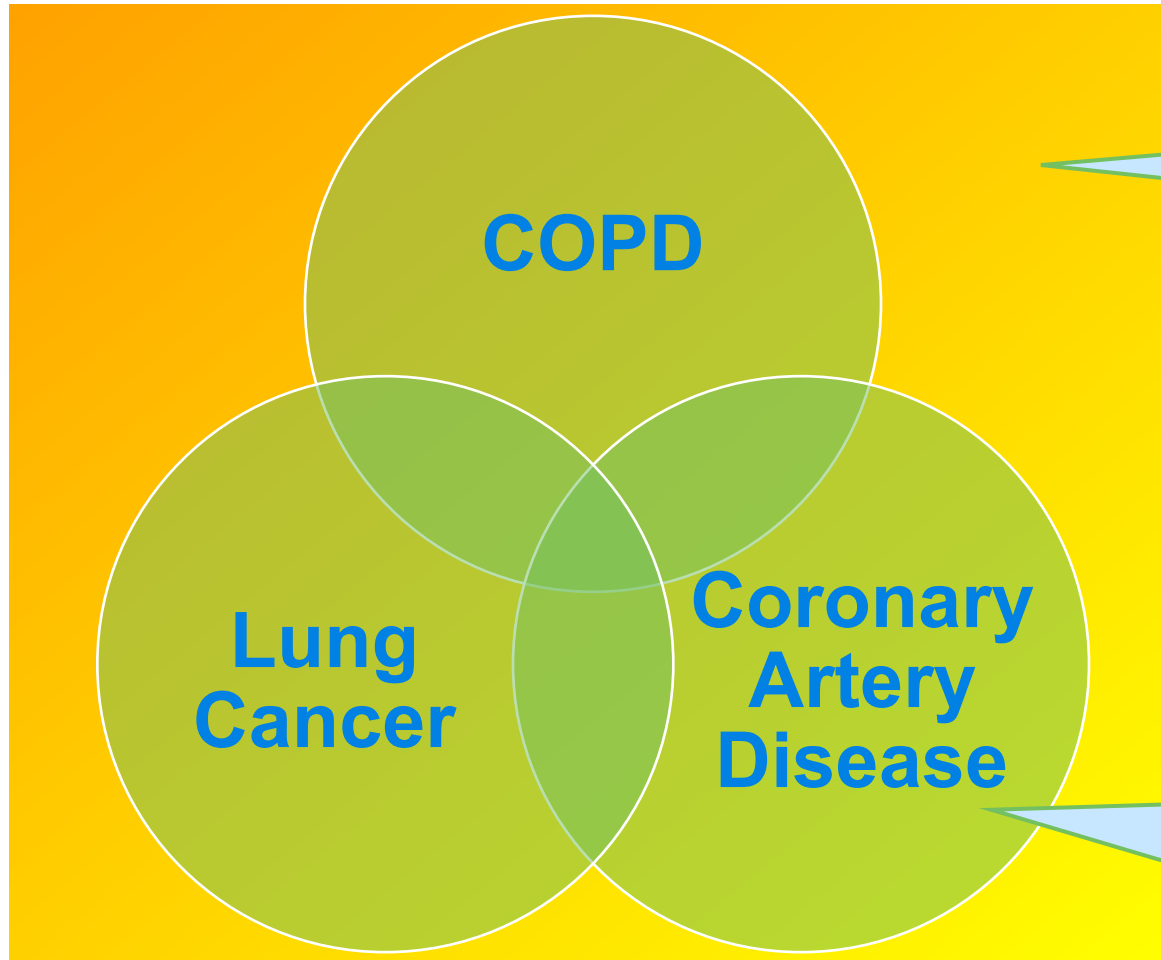
Lung Cancer: CDC
https://www.cdc.gov/cancer/lung/basic_info/risk_factors.htm Jul 19, 2018

Heart: % declines with age. 2014 Surgeon General's Report,
https://www.cdc.gov/cancer/lung/basic_info/risk_factors.htm page 444

Overlap in populations is after diagnosis



Who to Screen? Defined by risk. Diagnosis comes later!



Risk factors define the population to be screened

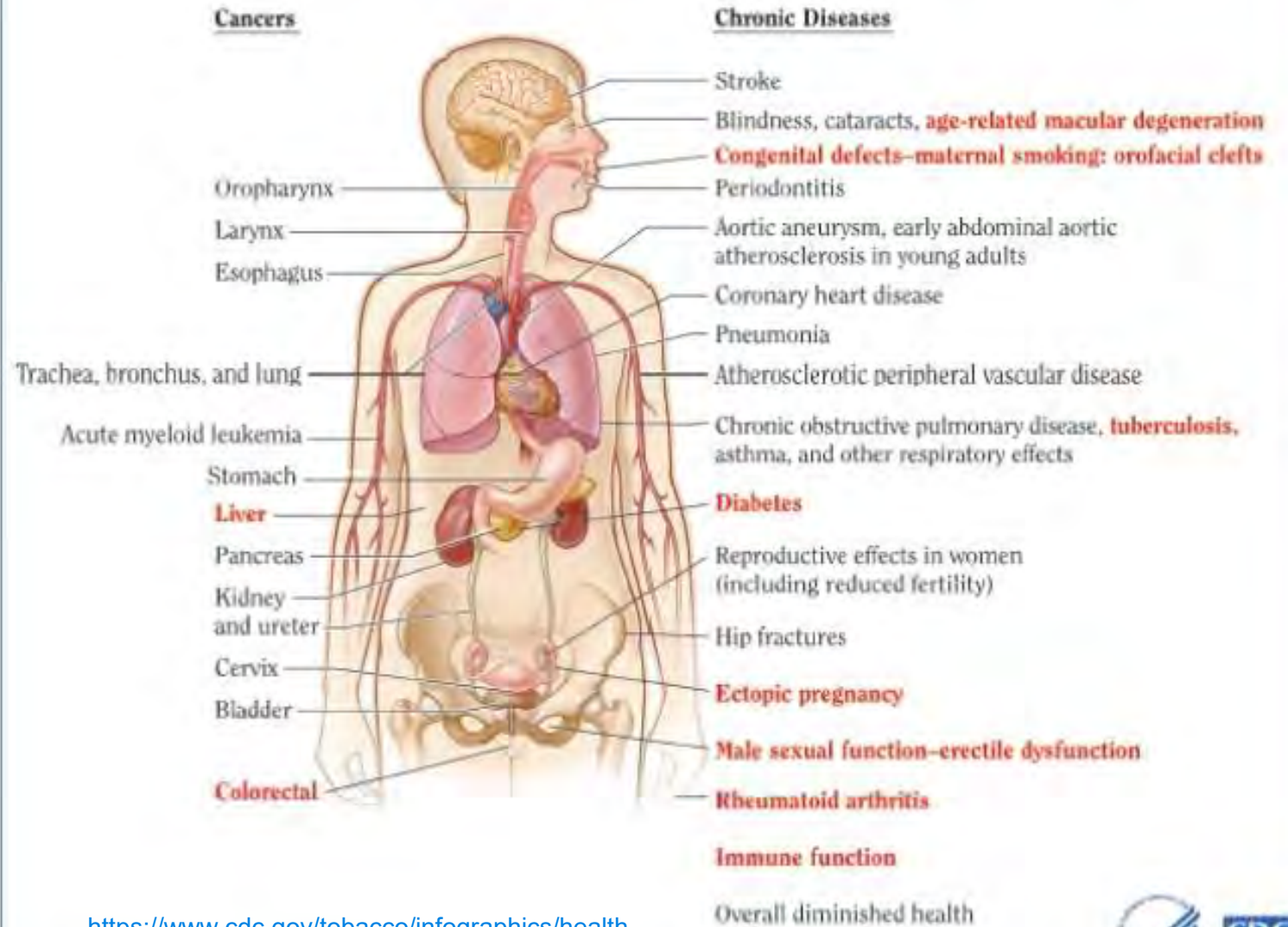
The goal of screening: find individuals with asymptomatic conditions when earlier treatment will improve the patient's future

LC screening identifies other smoking-related conditions and can support quitting

- Fears that LC screening would decrease quit rates were disproved
- Brain K. Impact of low-dose CT screening on smoking cessation, Thorax 2017
- Gauvreau C. Cost-effectiveness of smoking cessation. J Glob Onc 2018

Risks from Smoking

Smoking can damage nearly every part of your body



Population health at work: How quitting smoking affects many conditions

Disease	Incidence risk ratio smokers/non-smokers	Years after cessation for excess risk to decrease by half
Lung Cancer	15.0 to 22.5	n/a
COPD	4.0 - 4.3	4.5 - 6.0
CAD	3.0	5.0 - 9.0
Pneumonia	1.5	5.0
Influenza	1.5	1.0
Diabetes	1.5	7.0

Extrapolated from US Census Bureau Population Estimates, SEER Cancer Statistics Review 1975-2015, Hoogenveen (2008), Lee (2017), and other sources. Unpublished, Pyenson lab.

How strong is the evidence that screening / early detection / life-style modification helps patients?

Target Condition	Screen / modification	Strength	Evidence
Lung cancer	LDCT	Very strong	I-ELCAP, NLST, NELSON, etc
Coronary artery calcium	LDCT	Very strong	Hecht, Valenti, Shmueli, NICE, CAC Consortium, etc.
Smoking	Medications, behavioral change	Very strong	Vast number of studies
COPD	LDCT	?	Lambe (2019)--

Do we know how to help patients diagnosed with very early stage COPD?

Examples of established screening tools

How should the screening-eligible population be defined?

Conditions to be avoided	Test	Preventive Treatment 1*	Preventive Treatment 2**
Heart attack, stroke, etc.	LDL, etc. LDCT	Statins, meds	Quit smoking
Death due to LC	LDCT	LCS protocol	Quit smoking
Advanced COPD	LDCT?	?	Quit smoking
Late stage breast cancer	Mammography	BI-RADS, etc.	Quit smoking

* Typically includes life style modification

**“Quit Smoking” is treatment 2 because many or most high-risk patients have already quit smoking

**The Population Health Question:
For the process of screening
and early intervention, should
LC, COPD, CVD be considered
separate diseases?**

Treat the people, not the disease

Figuring out who to screen

- Treatment after diagnosis is, of course, specific—lung cancer, coronary artery disease, heart failure, COPD, etc.
- “NLST” target population for tobacco smoke syndrome meet this criteria:
 - Current and former smokers: 30+ pack-years, didn’t quit > 15 years ago
 - Aged 55-80
- NLST criteria are too narrow and are misinterpreted
 - “Quit smoking > 15 years ago” criteria is perhaps the biggest mistake
 - Socio-economic factors, comorbidities, biomarkers (imaging or biochemical), family history
- Who to screen?
 - About 10 million people meet NLST criteria for LC screening (Ma, Cancer, 2013), but the number who should be screened considering tobacco smoke syndrome and LC risk is probably much higher

**Are Health Benefits
Additive for Population
Health?**

Example of adding smoking cessation to LCS

Adding smoking cessation to lung cancer screening improves cost-effectiveness

- Model of different smoking cessation interventions added to LCS
(Villanti, 2013 <https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0071379>)
- Light smoking cessation intervention consisting of behavioral treatment
- Intensive smoking cessation intervention plus one of,
 - Generic nicotine replacement therapy scenario -- least expensive, least effective
 - Generic bupropion
 - Brand varenicline (Chantix™—possible low-cost generic in 2020) – most expensive, most effective

→ 18% to 43% improvement in dollars per quality adjusted life year (QALY) relative to LCS with no smoking cessation

Answering the Population Health Question

A New Paradigm for Population Health

Optimize the use of LDCT information and LCS programs to improve patient care for many conditions

Leverage Lung Cancer Screening sites:

- An identified high-risk population
- Long-term patient follow up
- The cost effectiveness of LCS
- Superior quantitative imaging
- A focus on life style management

Raphael, The School of Athens