

# Epidemiology of Lower Extremity Amputations among US Veterans

Miao Cai

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## Overall objective

1. Present the epidemiologic trend of Lower Extremity Amputations (LEA) incidence rates among US veterans,
2. Profile the risk factors for LEA among US veterans,
3. Explore the driving factors for the trend of LEA incidence rates.

## PART 1 - Epidemiologic trend of Lower Extremity Amputations (LEA)

# Aim 1

## Objectives

1. Presenting the epidemiologic trend of LEA among US Veterans 2008 - 2018,
2. Depicting the trend of LEA stratified by major risk factors (CKD<sup>1</sup>, diabetes<sup>2</sup>, and smoking),
3. Showing the geographical distribution of LEA.

## Inclusion criteria

1. The veteran had at least one inpatient or outpatient visit at VHA in that year,
2. One veteran can be counted for no more than once in that year (denominator).

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<sup>1</sup>CKD is identified using eGFR

<sup>2</sup>Diabetes is identified using ICD-9 codes

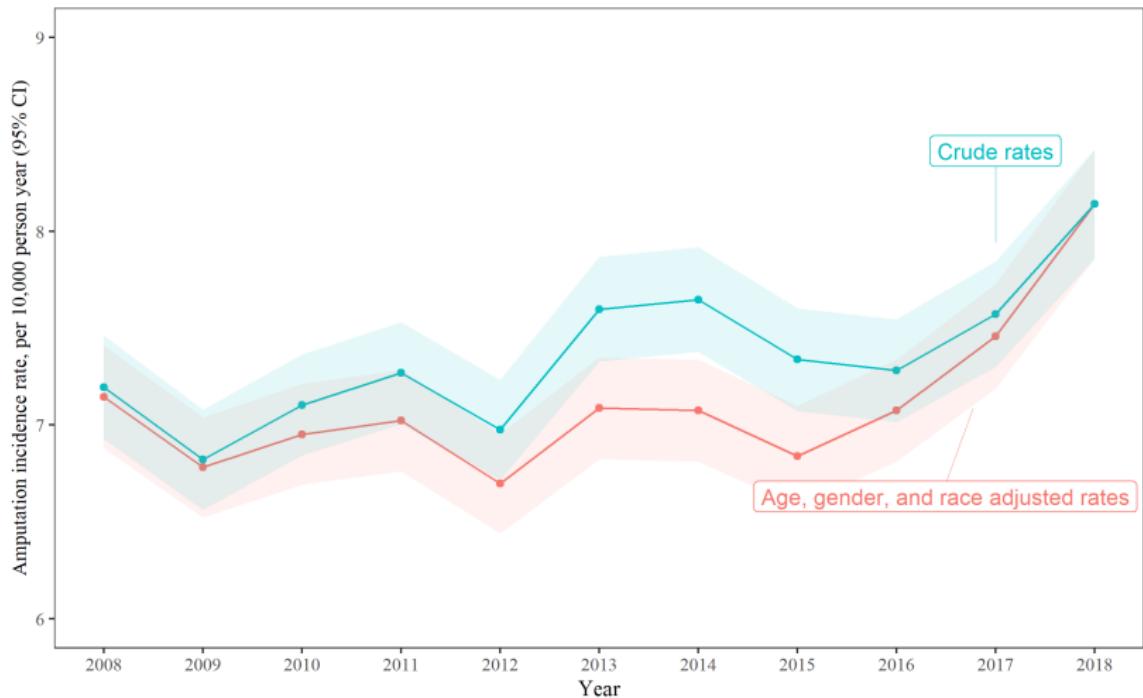
## Sample description

Year <sup>3</sup>	VHA users	Amputation	Incidence rate <sup>4</sup>
2008	3,952,321	3,031	7.669
2009	4,008,694	2,909	7.257
2010	4,069,248	3,098	7.613
2011	4,106,647	3,156	7.685
2012	4,096,343	3,044	7.431
2013	4,086,825	3,284	8.036
2014	4,093,489	3,315	8.098
2015	4,080,956	3,192	7.822
2016	4,066,217	3,275	8.054
2017	4,051,901	3,382	8.347
2018	4,034,173	3,629	8.996

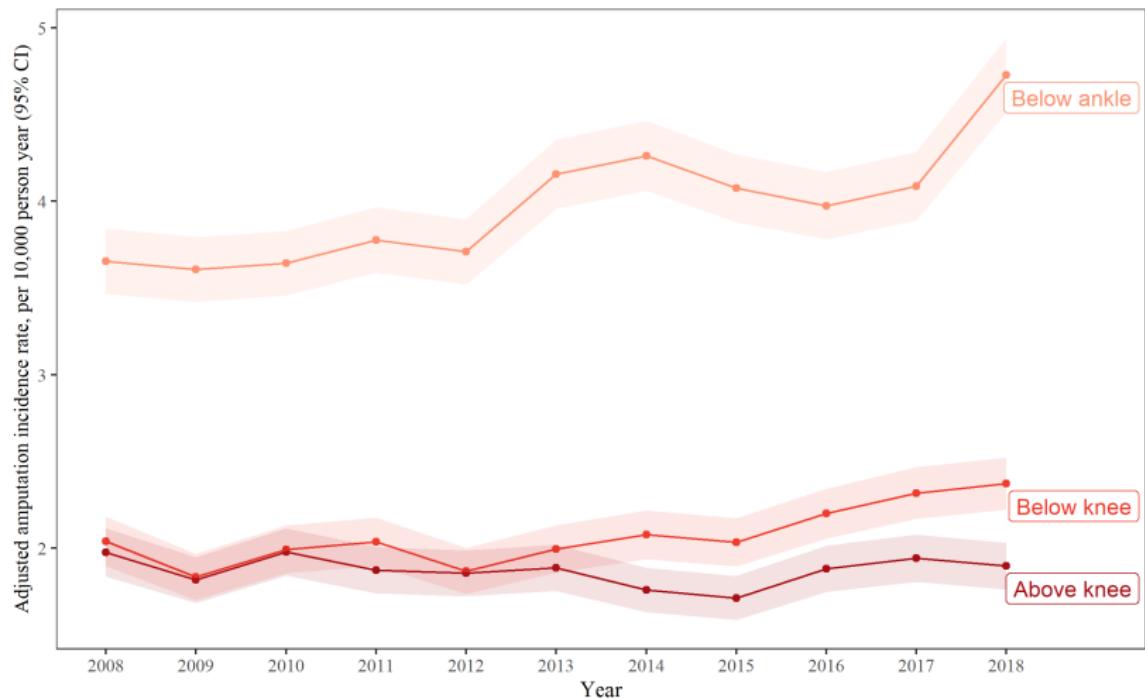
<sup>3</sup>Fiscal year starts from October 1st of last year and ends on September 31st.

<sup>4</sup>Amputation per 10,000 person year.

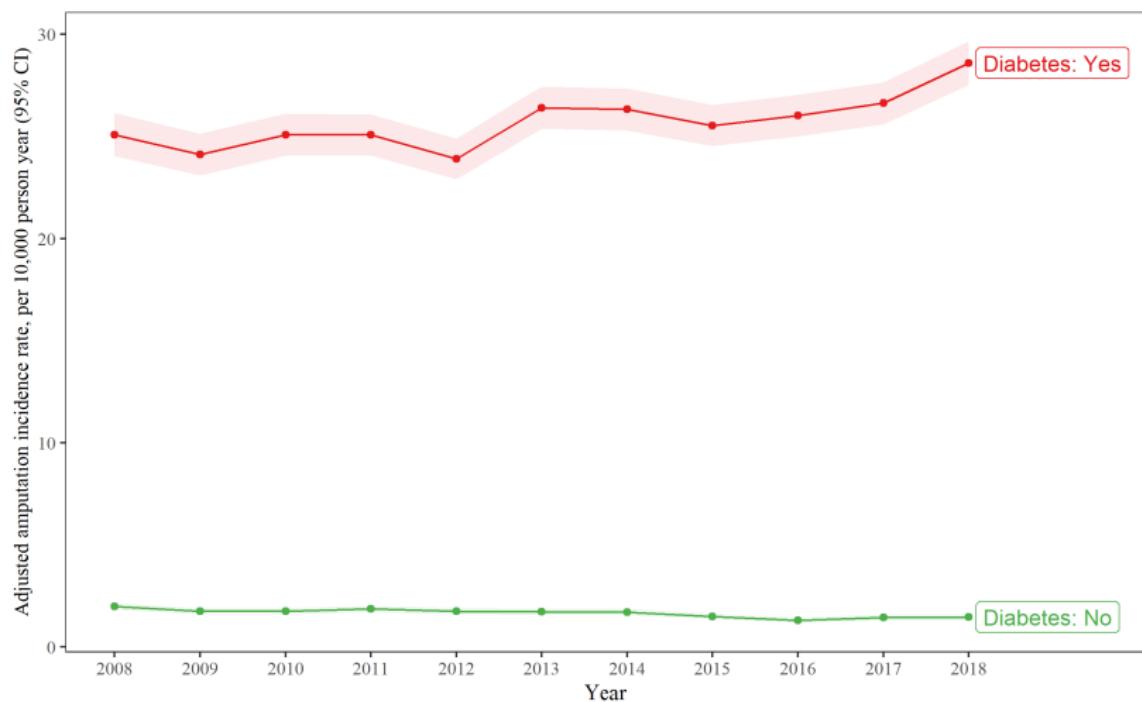
## Overall trend



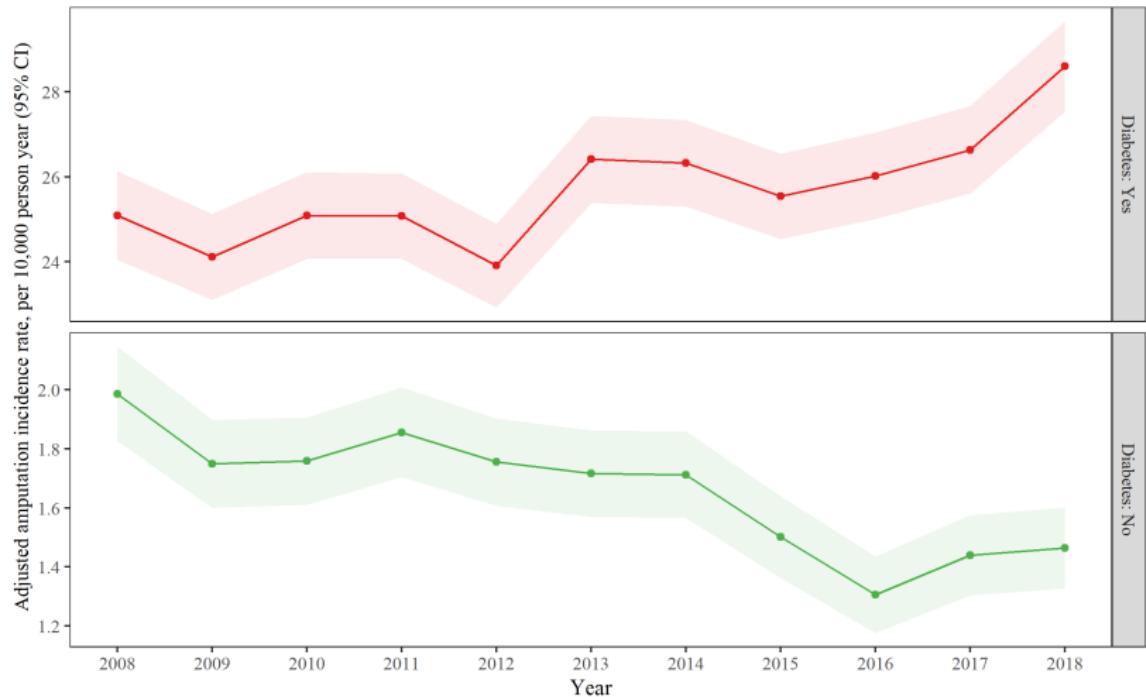
## Overall trend - three types of amputations



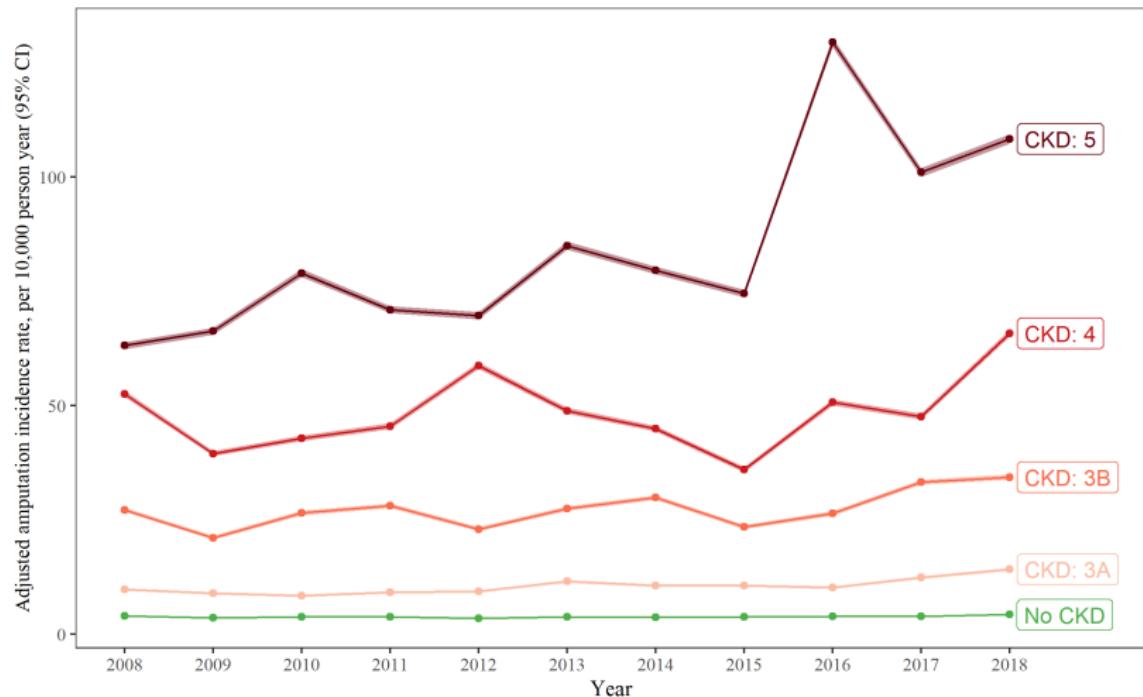
# Diabetes |



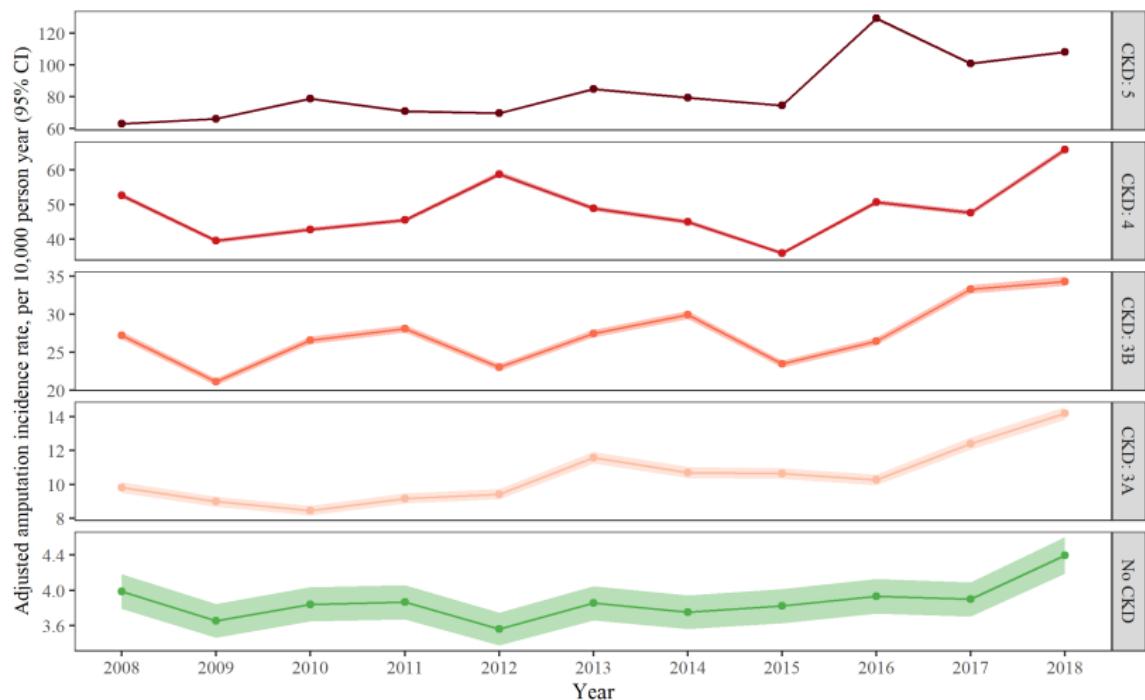
# Diabetes II



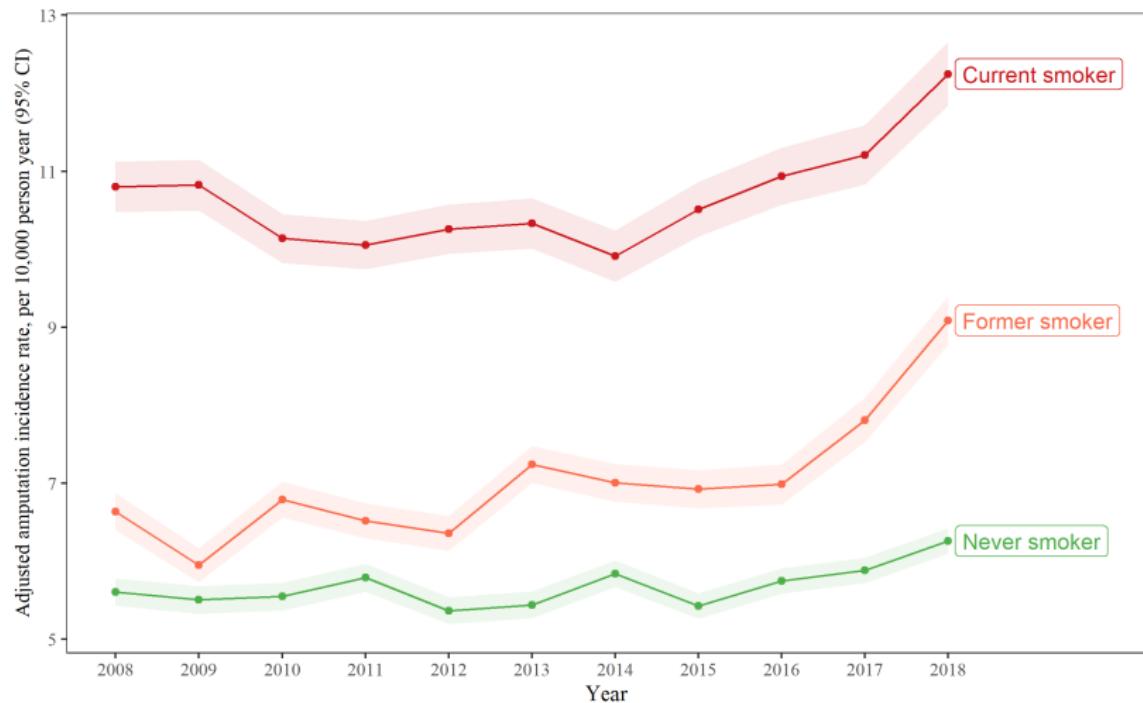
# CKD I



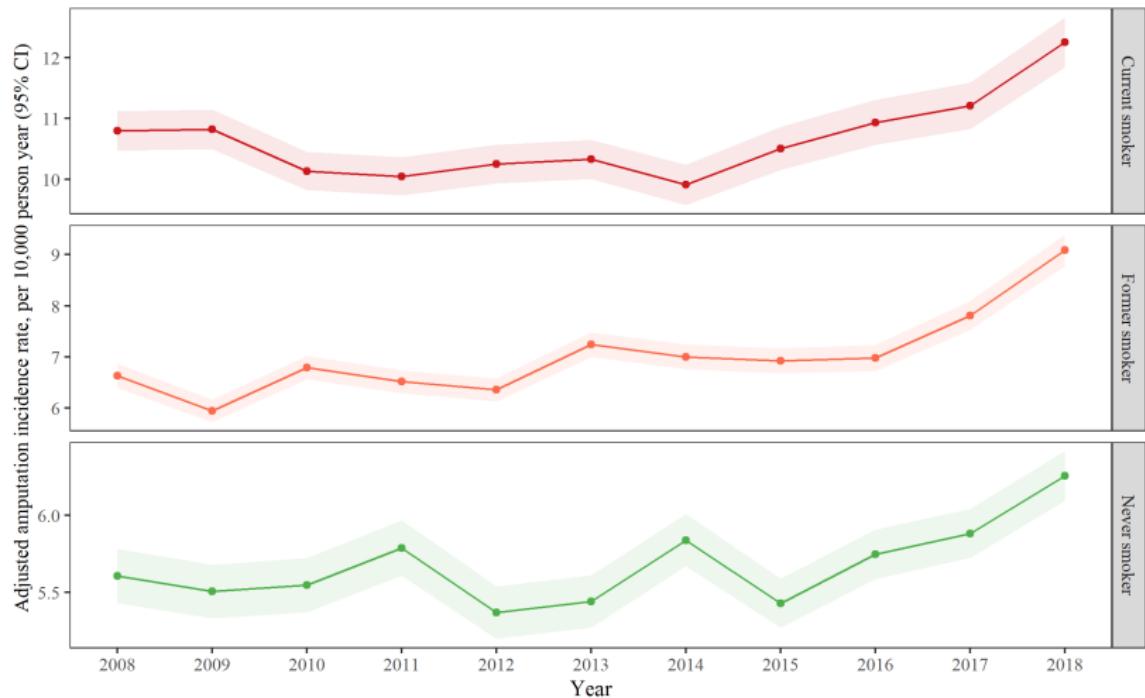
## CKD II



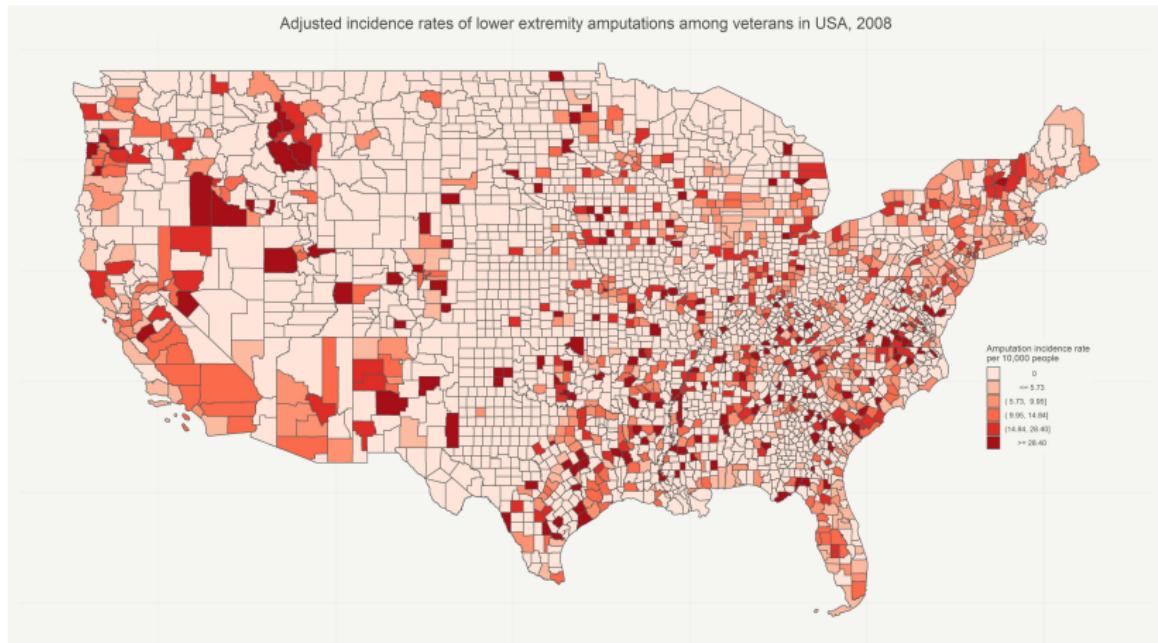
# Smoking |



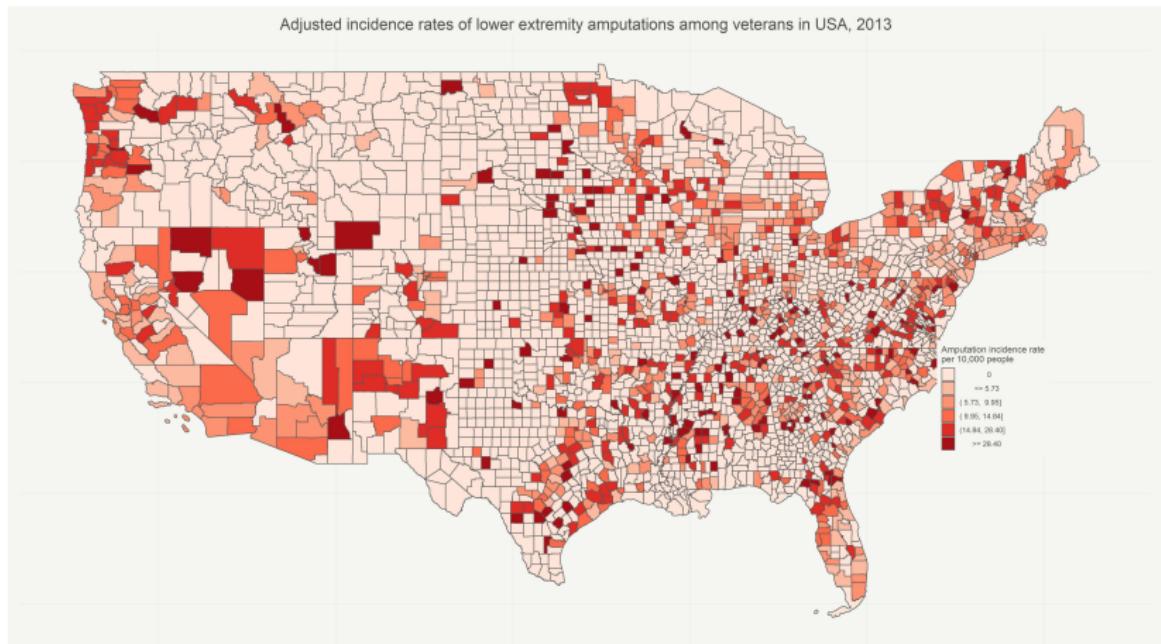
## Smoking II



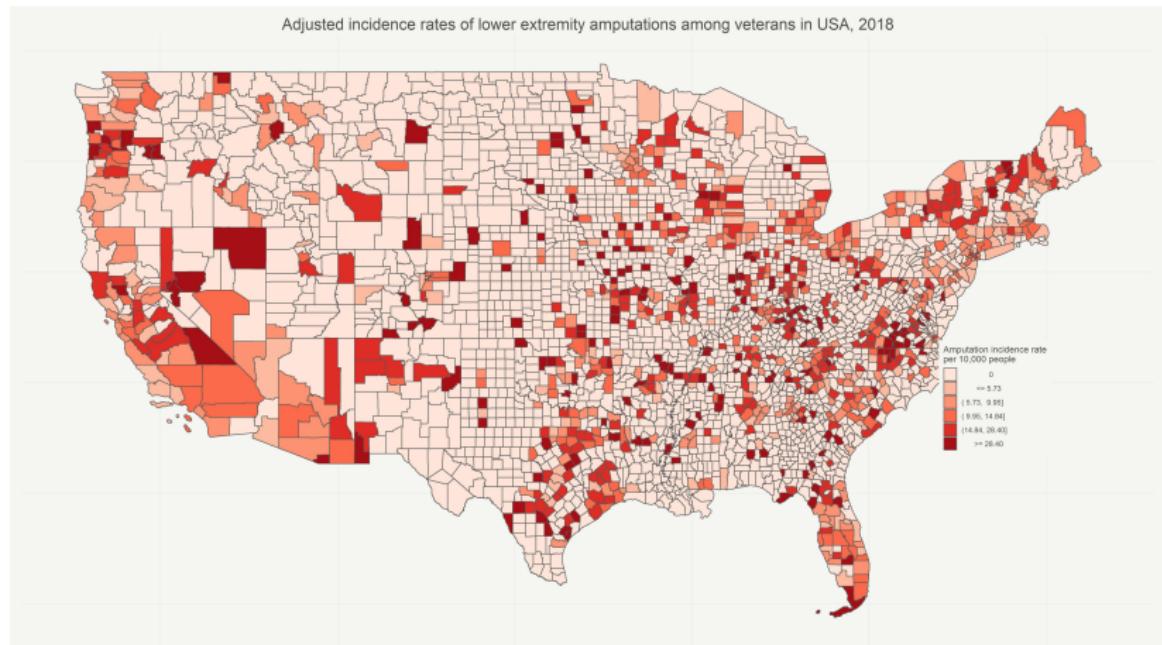
# Geographical distribution of LEA incidence rates 2008



# Adjusted LEA incidence rates, 2013



# Adjusted LEA incidence rates, 2018



## PART 2 - Risk profiling of LEA

# Objectives

1. To investigate the risk factors for any LEA,
2. To examine effects of risk factors for different types of LEAs:
  - ▶ Below ankle,
  - ▶ Below knee,
  - ▶ Above knee.

# Cohort construction



## Inclusion and exclusion criteria:

- ▶ At least inpatient, outpatient, or enrollment at VHA upto five years before  $T_0$  (2003-2008),
- ▶ The veteran has been using VHA for at least 1 year (inpatient, outpatient, or enrollment at VHA before 2007),
- ▶ No amputation or death before  $T_0$ .

## Cohort description

- ▶ 6,617,635 cohort participates,
- ▶ 10,946 LEAs,
- ▶ a median of 10.93 follow-up years (interquartile range, 5.58-11.93)

# Characteristics of the cohort participates

Characteristics	Overall cohort N = 6,617,635	No amputation N= 6,606,689	Amputation N=10,946
Female	439,450 (6.64%)	439,345 (6.65%)	105 (0.96%)
Race: white			
Black	876,878 (13.25%)	874,889 (13.24%)	1,989 (18.18%)
Other	549,834 (8.31%)	547,260 (8.28%)	2,574 (23.52%)
Diabetes	351,990 (5.32%)	346,709 (5.25%)	5,281 (48.26%)
No CKD			
CKD: 2	801,380 (12.11%)	799,370 (12.10%)	2,010 (18.37%)
CKD: 3	336,847 (5.09%)	335,509 (5.08%)	1,338 (12.23%)
CKD: 4	86,405 (1.31%)	85,774 (1.30%)	631 (2.77%)
CKD: ESRD	14,463 (0.22%)	14,250 (0.22%)	213 (1.95%)
CKD: Kidney transplant	8,749 (0.13%)	8,649 (0.13%)	100 (0.91%)
CKD: Dialysis	26,454 (0.40%)	26,004 (0.39%)	450 (4.11%)
Never smokers			
Current smokers	1,684,887 (25.46%)	1,680,262 (25.43%)	4,626 (42.27%)
Former smokers	1,612,275 (24.36%)	1,609,295 (24.36%)	2,980 (27.23%)
Cancer	562,145 (8.49)	560,571 (8.48%)	1,574 (14.38%)
Cerebrovascular disease	19,804 (0.30%)	19,564 (0.30%)	240 (2.19%)
Cardiovascular disease	1,241,902 (18.77)	1,236,747 (18.72%)	5,155 (47.11%)
Dementia	190,665 (2.88%)	189,953 (2.88%)	712 (6.51%)
Hyperlipidemia	1,757,427 (26.56%)	1,751,335 (26.51%)	6,092 (55.68%)
Hypertension	2,829,784 (42.72%)	2,817,788 (42.65%)	8,996 (82.22%)
Chronic Lung Disease	756,386 (11.43%)	753,742 (11.41%)	2,644 (24.16%)
Peripheral artery disease	118,631 (1.79%)	116,662 (1.77%)	2,969 (17.99%)

# Baseline risk factors

- ▶ Demographic factors:
  1. Age,
  2. Gender,
  3. Race.
- ▶ Three major risk factors:
  1. Diabetes,
  2. Chronic kidney disease,
  3. Smoking.
- ▶ Other clinical factors
  1. Cancer
  2. Cerebrovascular disease
  3. Cardiovascular disease
  4. Dementia
  5. Hyperlipidemia
  6. Hypertension
  7. Chronic lung disease
  8. Peripheral artery disease

# Cox proportional hazard models

Table 1: Cox regression results for different amputation outcomes, a cohort 6.6 million veterans in US

Parameters	Any first amputation	Below ankle	Below knee	Above knee
Female	0.320 (0.264, 0.389)	0.343 (0.279, 0.421)	0.268 (0.189, 0.381)	0.267 (0.179, 0.400)
Race: white				
Black	1.690 (1.603, 1.782)	1.630 (1.537, 1.728)	1.913 (1.757, 2.082)	2.324 (2.124, 2.543)
Other	2.342 (2.235, 2.454)	2.471 (2.350, 2.599)	2.405 (2.224, 2.600)	2.637 (2.423, 2.871)
Diabetes	6.853 (6.560, 7.159)	7.371 (7.027, 7.732)	7.817 (7.258, 8.419)	4.061 (3.749, 4.399)
No CKD				
CKD: 2	1.384 (1.312, 1.460)	1.429 (1.349, 1.514)	1.510 (1.378, 1.654)	1.144 (1.037, 1.262)
CKD: 3	1.971 (1.849, 2.101)	2.070 (1.931, 2.219)	2.313 (2.077, 2.577)	1.502 (1.330, 1.697)
CKD: 4	3.205 (2.942, 3.493)	3.330 (3.031, 3.659)	4.419 (3.866, 5.052)	2.858 (2.444, 3.341)
CKD: ESRD	5.741 (5.000, 6.590)	5.725 (4.913, 6.672)	8.066 (6.605, 9.849)	5.870 (4.590, 7.508)
CKD: Kidney transplant	4.157 (3.407, 5.072)	4.008 (3.214, 4.998)	5.864 (4.430, 7.761)	5.180 (3.663, 7.327)
CKD: Dialysis	6.466 (5.853, 7.143)	6.381 (5.695, 7.149)	10.333 (8.977, 11.893)	7.294 (6.170, 8.623)
Never smokers				
Current smokers	1.976 (1.883, 2.072)	1.963 (1.863, 2.069)	2.001 (1.848, 2.167)	2.676 (2.450, 2.922)
Former smokers	1.098 (1.044, 1.154)	1.129 (1.069, 1.191)	1.122 (1.031, 1.220)	1.039 (0.943, 1.145)
Cancer	1.095 (1.037, 1.157)	1.095 (1.030, 1.163)	1.005 (0.913, 1.106)	1.126 (1.023, 1.239)
Cerebrovascular disease	1.744 (1.531, 1.987)	1.703 (1.469, 1.975)	1.523 (1.207, 1.921)	1.824 (1.481, 2.246)
Cardiovascular disease	1.400 (1.341, 1.461)	1.366 (1.303, 1.431)	1.520 (1.414, 1.634)	1.563 (1.446, 1.690)
Dementia	1.413 (1.308, 1.527)	1.355 (1.241, 1.480)	1.043 (0.897, 1.212)	1.842 (1.630, 2.081)
Hyperlipidemia	1.837 (1.763, 1.913)	1.849 (1.768, 1.933)	1.859 (1.737, 1.991)	1.872 (1.740, 2.014)
Hypertension	2.079 (1.965, 2.199)	2.071 (1.947, 2.202)	1.889 (1.718, 2.077)	2.078 (1.881, 2.296)
Chronic Lung Disease	1.192 (1.138, 1.248)	1.143 (1.086, 1.203)	1.107 (1.023, 1.198)	1.248 (1.151, 1.353)
Peripheral artery disease	3.483 (3.304, 3.671)	3.143 (2.962, 3.336)	3.565 (3.269, 3.887)	5.309 (4.869, 5.790)

## PART 3 - Driving factors of increasing LEA incidence rates

# Objectives

1. To explore the driving factors of increasing LEA incidence rates,
  - ▶ Demographic factors,
  - ▶ Three major factors (diabetes, CKD, and smoking)
  - ▶ Other clinical factors.

## Methods

- ▶ Decomposition analysis,
- ▶ Hazard ratios from aim 2,
- ▶ Population attributable fraction.