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Spatial Clustering of Type 2 Diabetes in Youth and Associated Determinants of Health in a Rural American Indian Community

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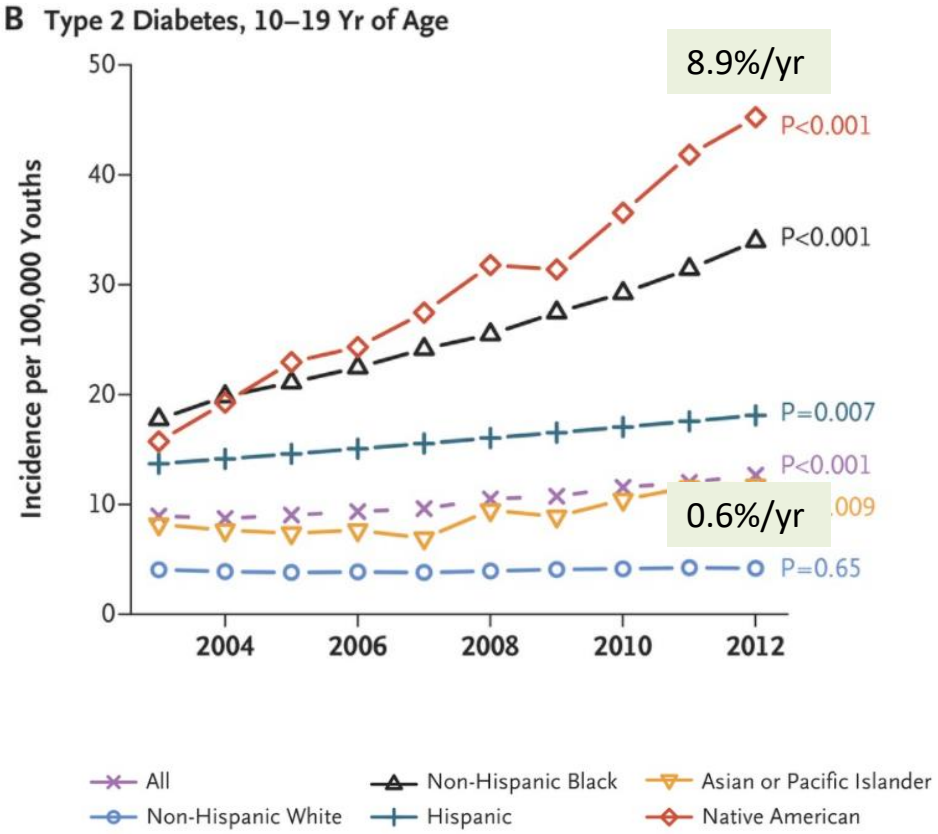
Overview

- Background and Rationale
  - Impact of diabetes
  - Colonization and diabetes
  - Social determinants of health
- Methods and Approach
- Results
- Discussion
- Future Directions

Background and Rationale

- Type 2 diabetes (T2D) incidence in youth is increasing globally and disproportionately affects indigenous people worldwide. (Chen et al, 2011)
- Native American youth have higher incidence of T2D than other racial/ethnic groups (Dabelea et al, 2007; Mayer-Davis et al, 2017)



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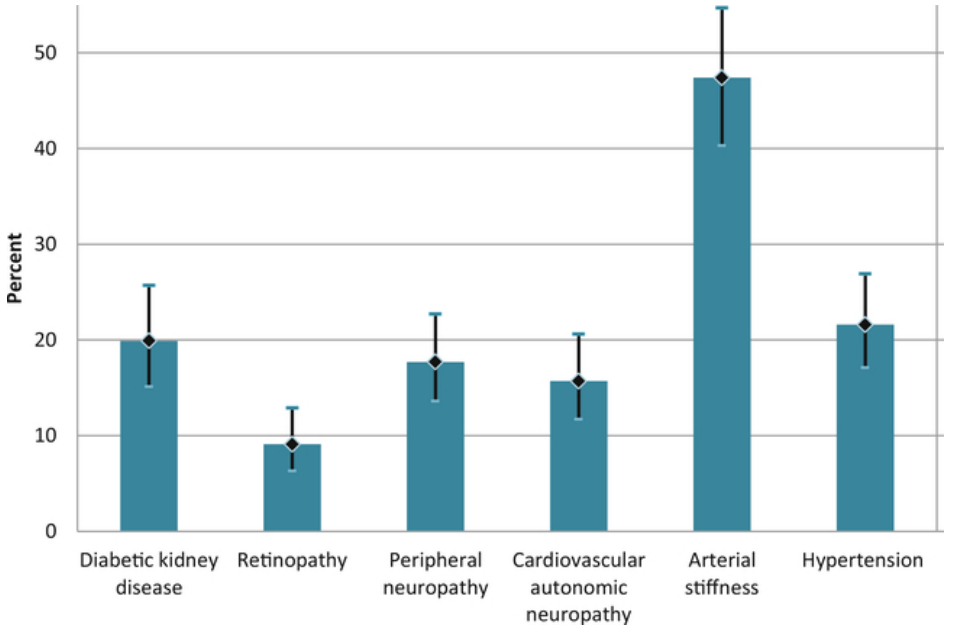
Background and Rationale

- Complications and comorbidities in youth with diabetes may initiate early in the diabetes process. (Jensen et al, 2017)
- Type 2 diabetes contributes to a high burden of disease-associated complications and comorbidities. (Dabelea et al, 2017)



Estimated prevalence of complications and comorbidities in type 2 diabetes at age 21 in SEARCH

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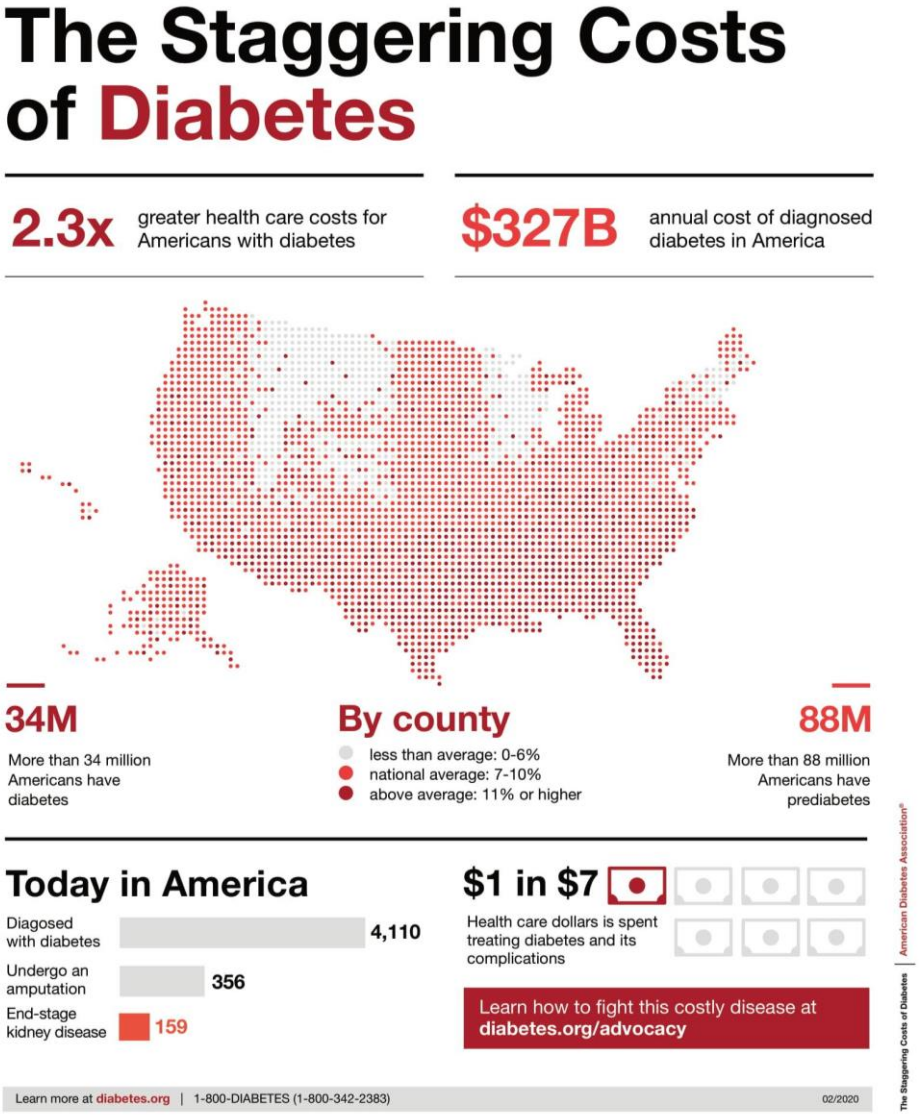
Background and Rationale



…THIS IS SERIOUS!!

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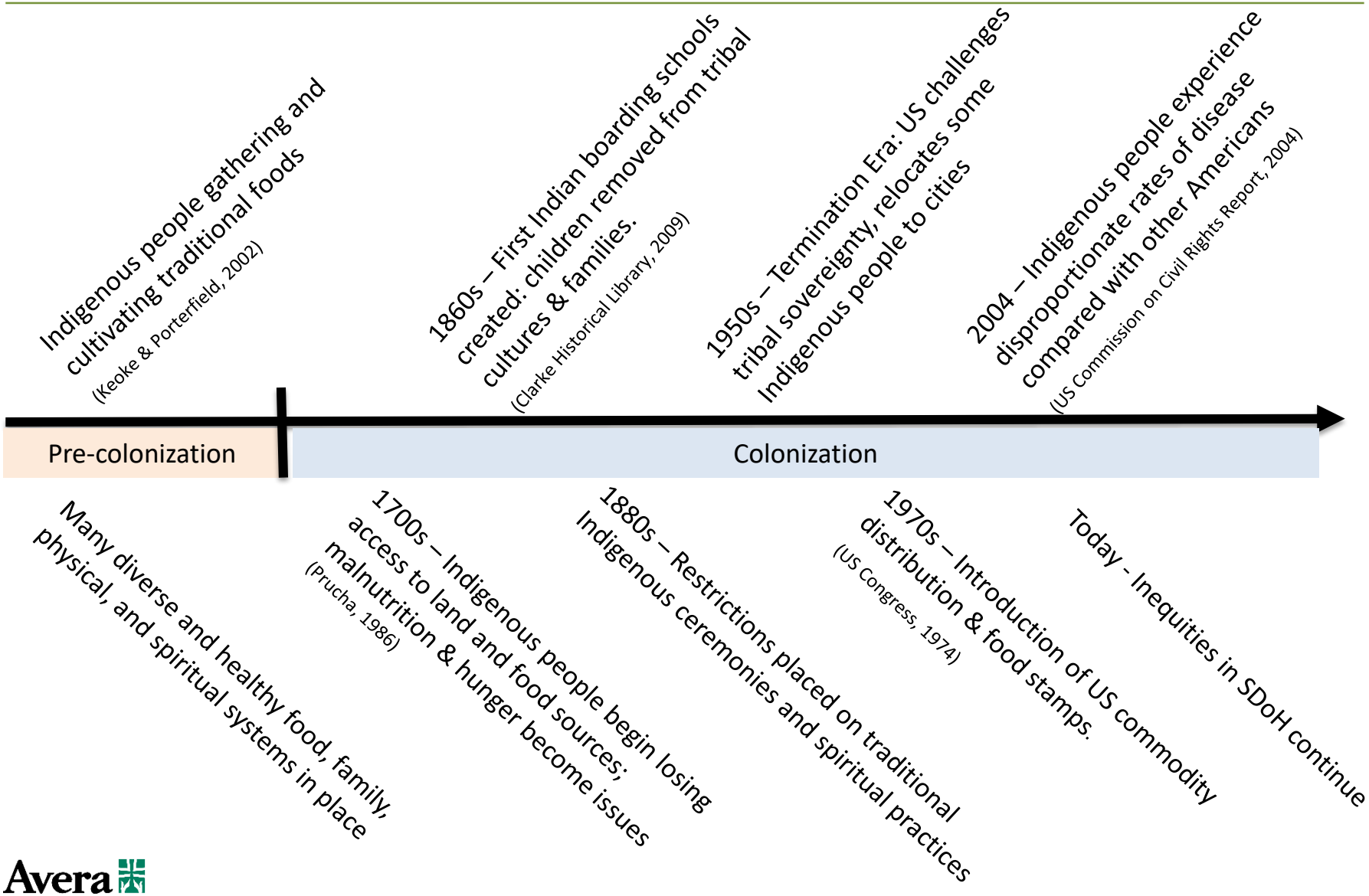
Background and Rationale

- Emerging research links social determinants of health with T2D (Utz et al, 2014)
- Few studies have examined youth T2D and:
  - Spatial differences (Liese et al, 2010; Geraghty et al, 2010; Lee et al, 2008; Green et al, 2003)
  - Rural areas (Lee et al, 2008)
  - American Indians
- History of colonization and continued inequalities in the Indigenous populations may explain this increase in diabetes.

Background and Rationale



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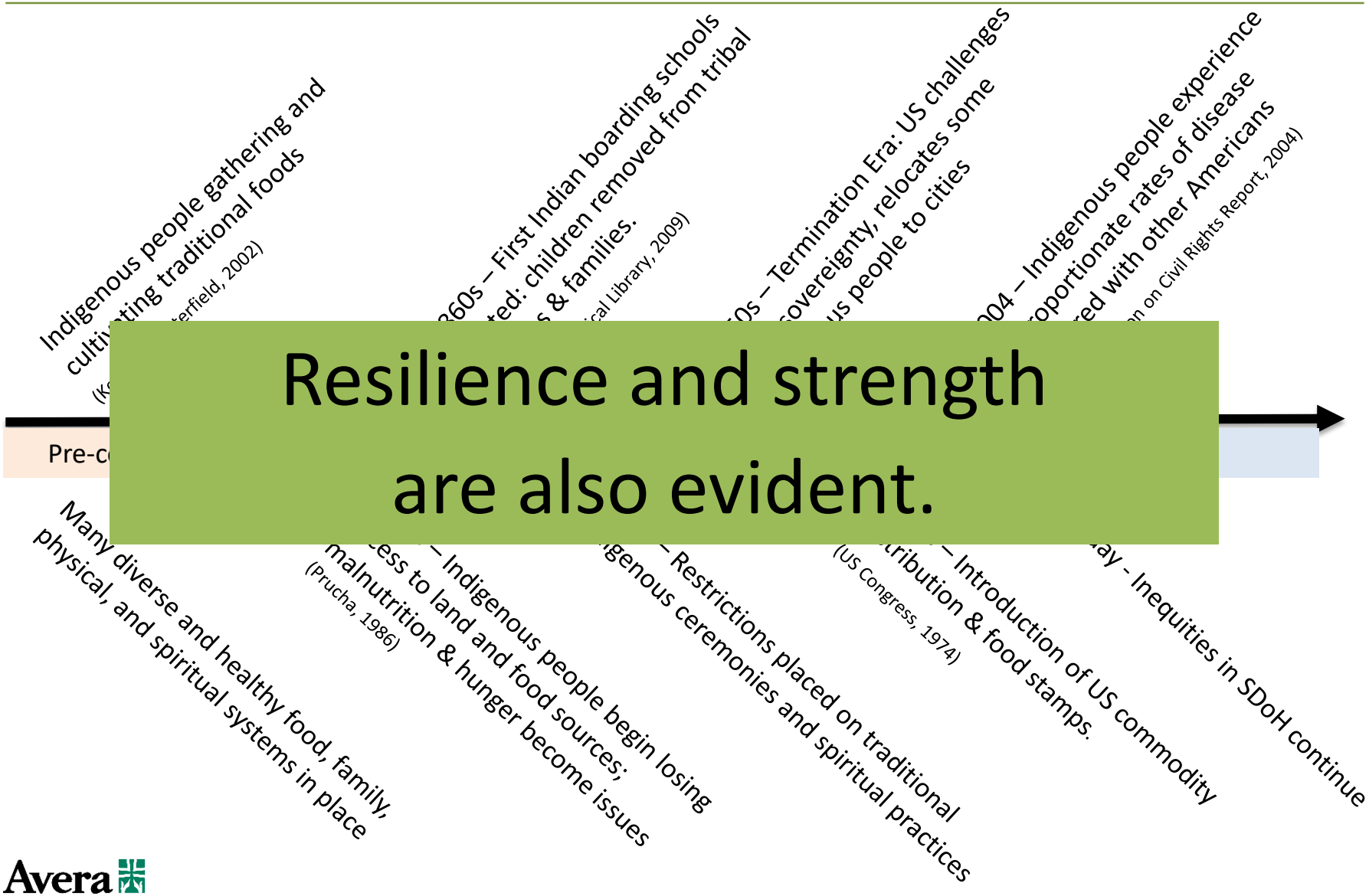

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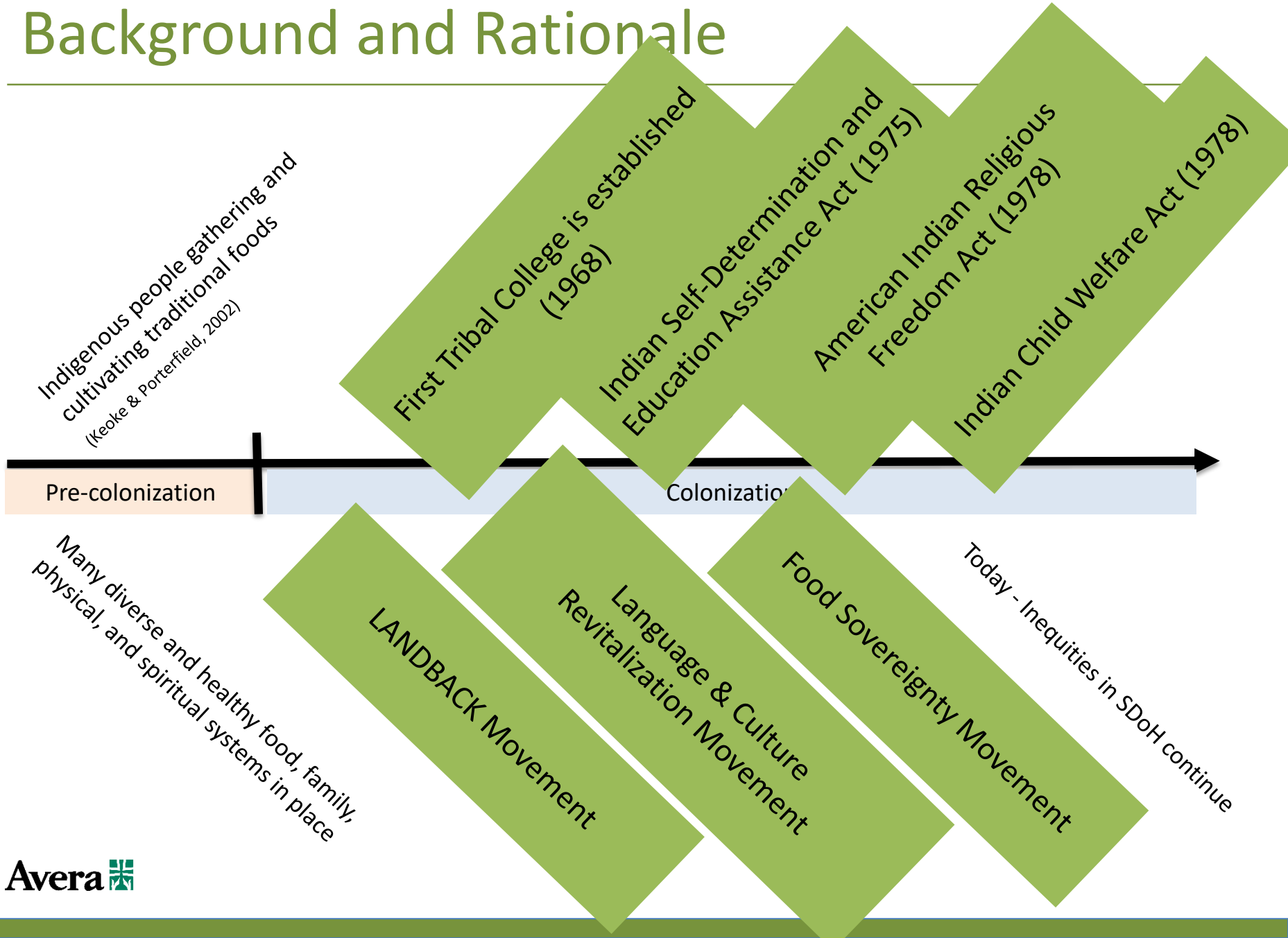

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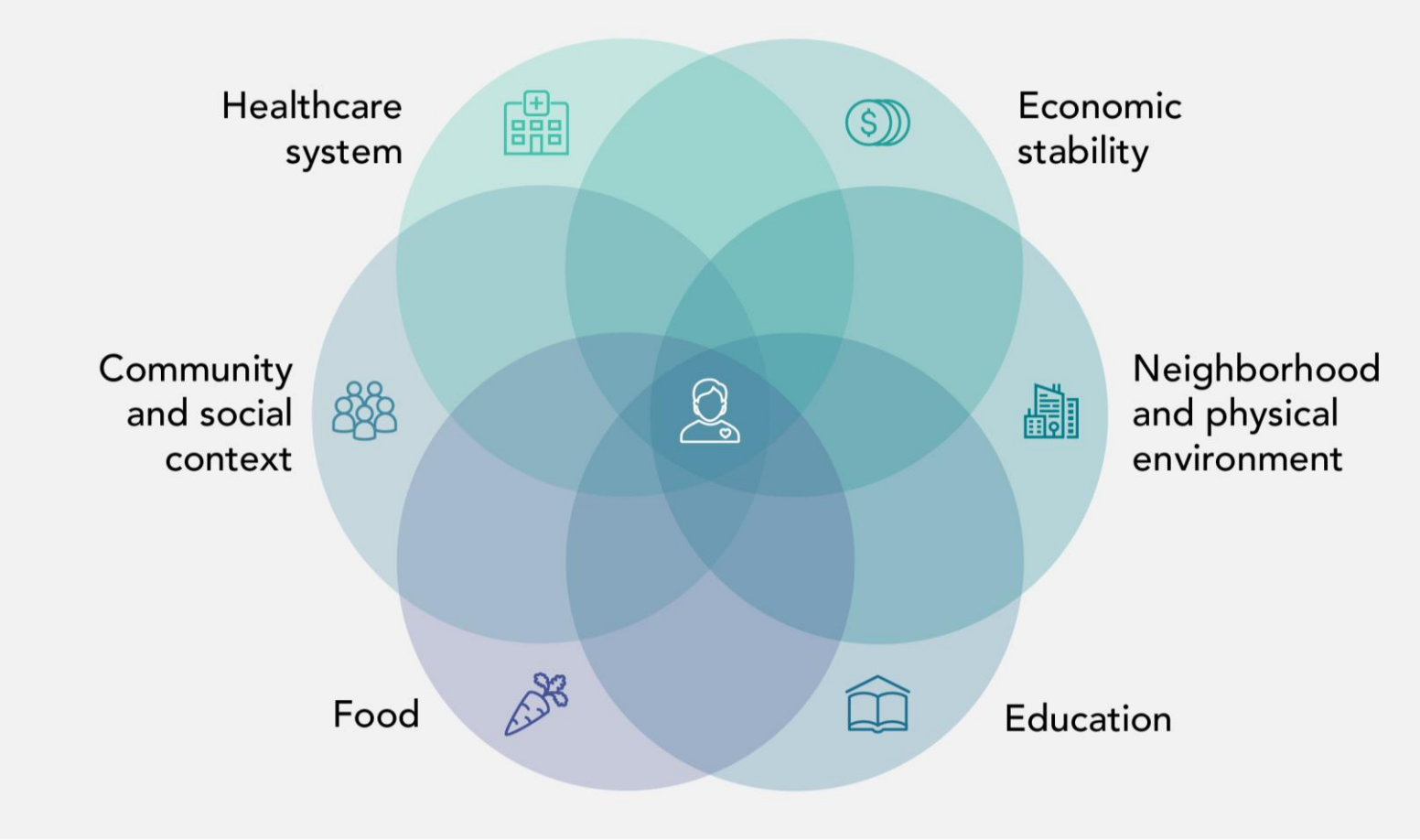
Social Determinants of Health



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Research Objectives

1. Identify spatial clusters of incident type 2 diabetes cases in American Indian youth aged 0-19 years.
2. Determine what social determinants of health characteristics are associated with increased incidence of T2D among American Indian youth.

Outcome: Incidence of T2D

- Data Source: SEARCH for Diabetes in Youth
- Youth aged 0-19 years who
  - were active health system users of tribally-operated or IHS-operated regional health facilities.
  - diagnosed by a physician with T2D, confirmed by medical record abstraction
- Cases ascertained from 2002 through 2016 were used.

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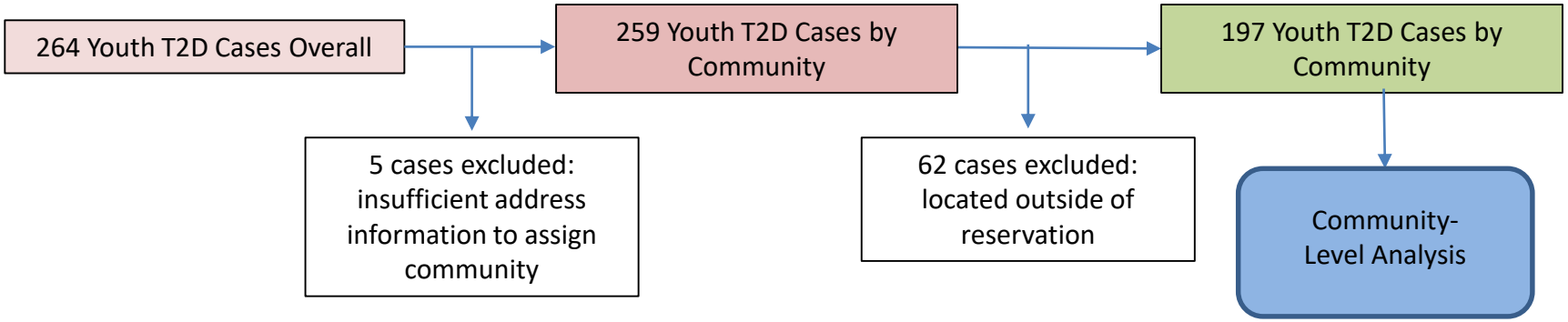
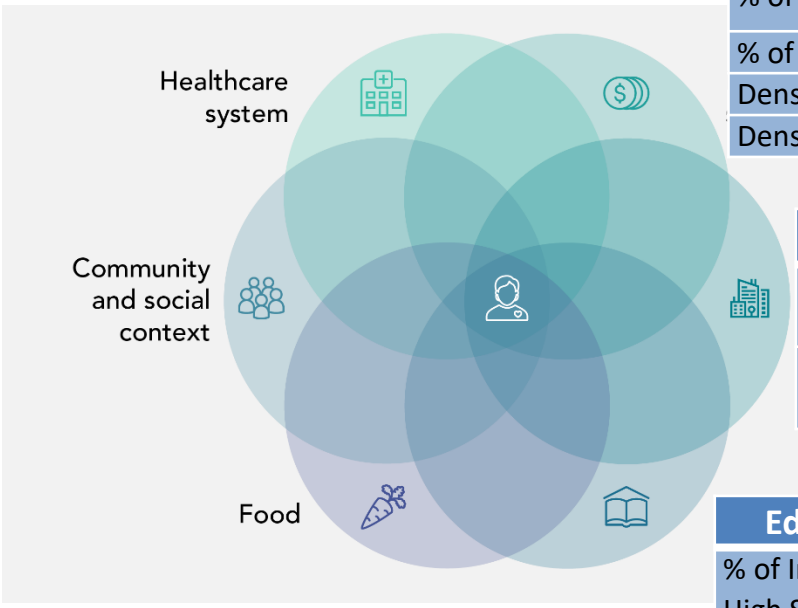
Outcome: Incidence of T2D



- Cases aggregated to community-level → ecological study design
- 2010 US Census population used for denominator

Social Determinants of Health

** means (SD) presented across all communities; densities are presented as average # per community.



Economic Stability	
% of Individuals with Income Below Federal Poverty Level†	39.9% ± 14.2%
% of Households Receiving SNAP†	24.6% ± 11.4%
% of Workers without Access to a Vehicle†	5.1% ± 10.6%
Density of Highways‡	5.0 ± 7.6
Density of Tribal and County Roads‡	76.5 ± 54.8

Neighborhood and Physical Environment	
% of Housing Units without Complete Plumbing†	47.0% ± 15.3%
% of Housing Units without Complete Kitchens†	44.4% ± 13.6%

Education	
% of Individuals Age 25-64 with less than a High School Education†	27.9% ± 11.9%
Density of Schools ᴪ	1.3 ± 1.4

Data Sources: * SEARCH for Diabetes in Youth, 2002-2016; ¤ US Census, 2010; † American Community Survey, 2010
‡ US Census MTDB, 2010; ᴪ Bureau of Indian Education and State-based Board(s) of Education, 2017-2018; ϴ Google Maps, 2019; ¥ Community Outreach and Patient Empowerment (COPE) Program, 2019; § Indian Health Service, 2019

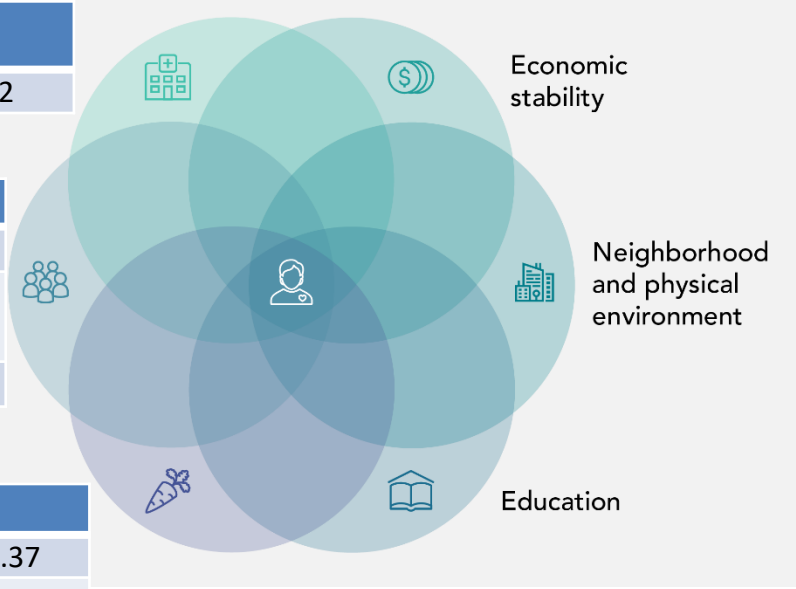
Social Determinants of Health

** means (SD) presented across all communities; densities are presented as average # per community.

Health & Healthcare System	
Density of IHS Facilities §	0.30 ±0.52

Community and Social Context	
% of Children Under Care of Grandparent†	14.7% ± 10.2%
% of Individuals who Speak Their Tribal Language†	30.8% ± 21.1%
Household Size among AI/AN Households†	3.4 ± 0.3

Food	
Density of Restaurants ϴ	0.81 ± 2.37
Density of Grocery Stores ¥	0.11 ± 0.37
Density of Farmers/Flea Markets ¥	0.09 ± 0.40
Density of Convenience Stores ¥	0.79 ± 1.06



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Methods: Cluster Analysis

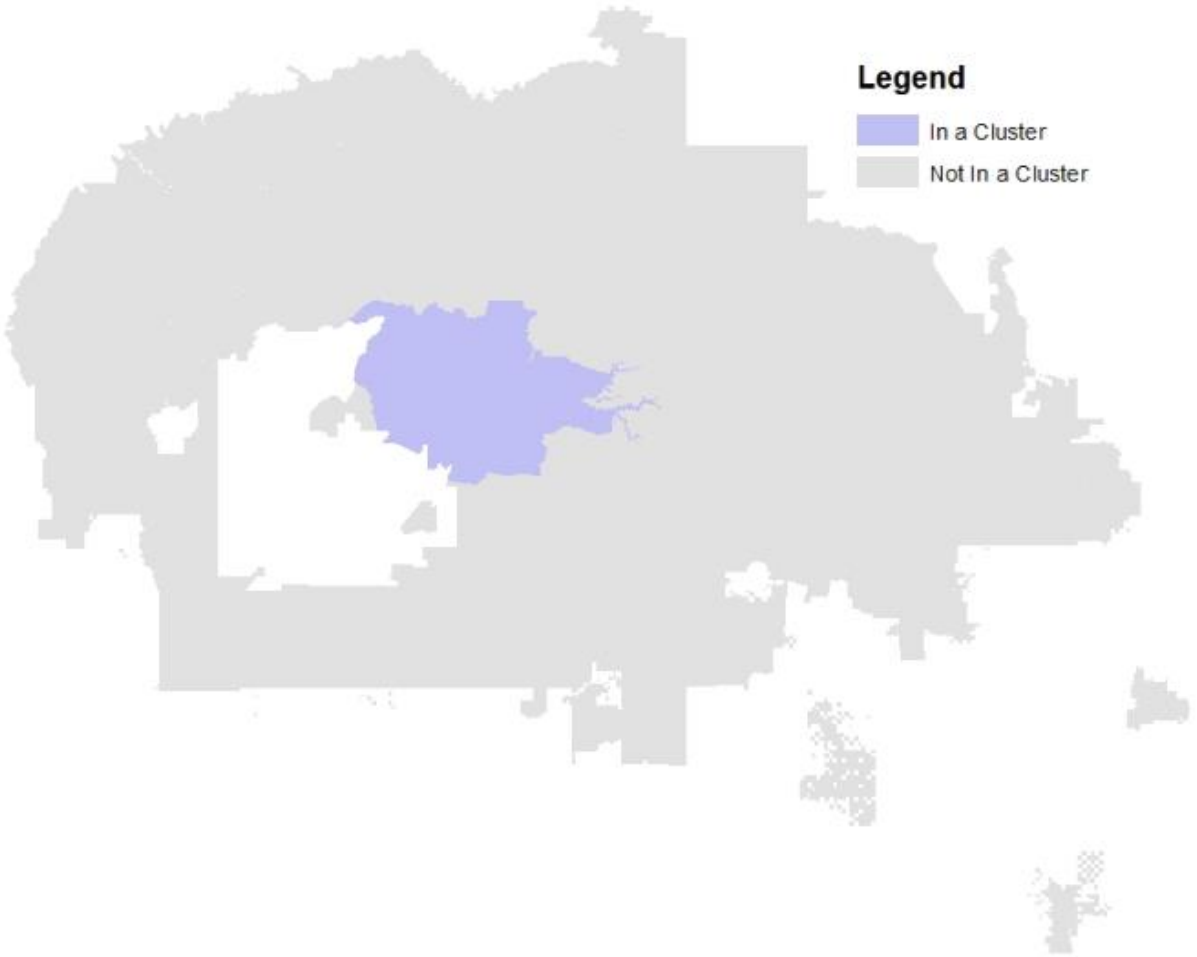
- Cluster analysis, using the spatial scan statistic, was carried out in the SaTScan software package (Kulldorff, 2018).
  - Community-level analysis, similar to counties
  - Discrete Poisson model
  - Observed vs. expected
    - Reference population: Incidence of non-Hispanic Whites (SEARCH data)
  - Spatial cluster shape and size: circular window, 25%
  - Monte Carlo simulations: 999
- Clusters of communities with high incidence of diabetes were identified at $p<0.05$.

Methods: Social Determinants of Health Regression

- Linear regression
  - Outcome: Community-level incidence of T2D
- Backward stepwise approach to identify the most significant variable(s) within each social determinants of health domain associated with the incidence of youth T2D
- Adjusted β coefficients and p-values were reported.

Results: Cluster Analysis

** Map of American Indian community



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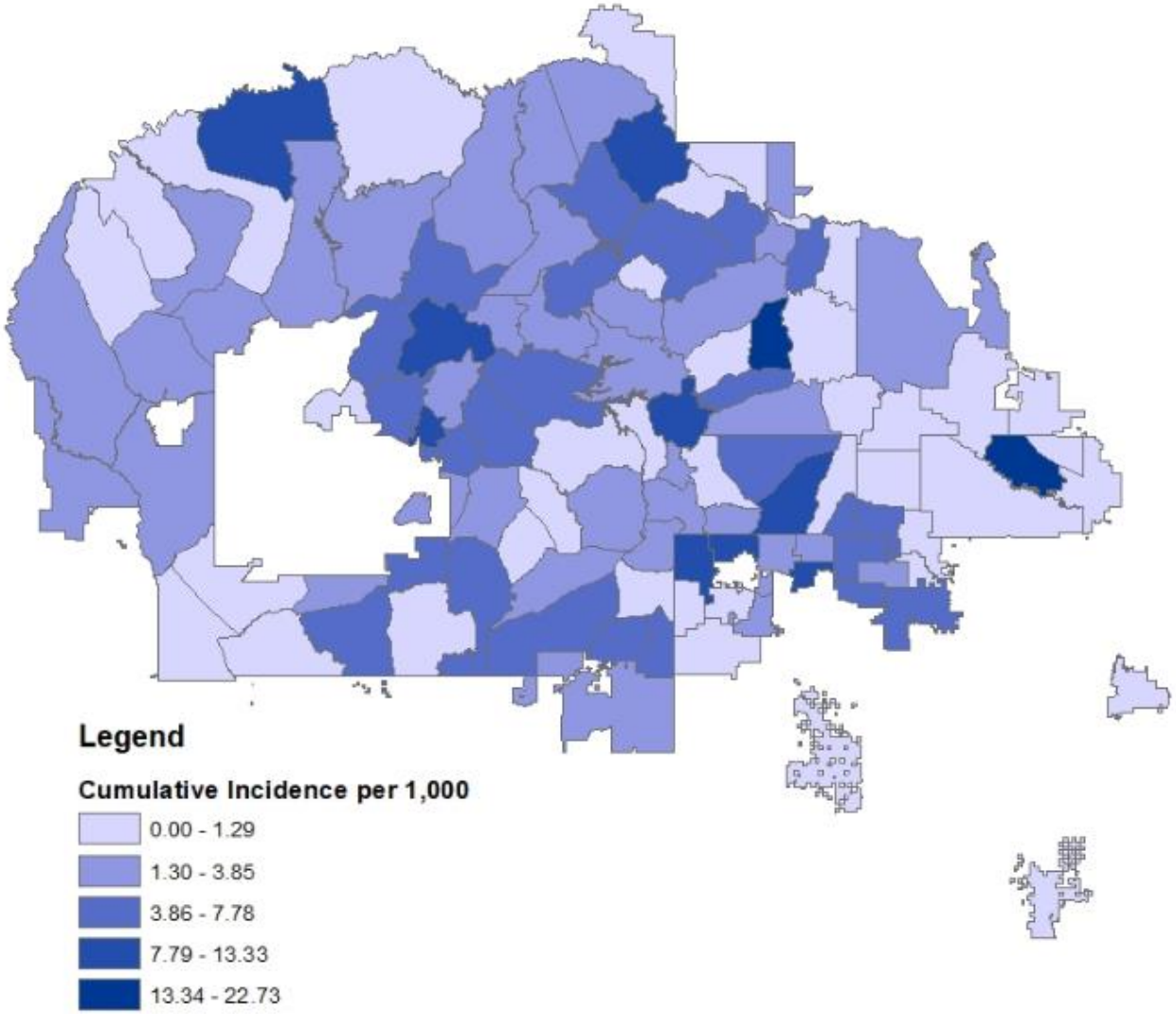
Results: Incidence of T2D



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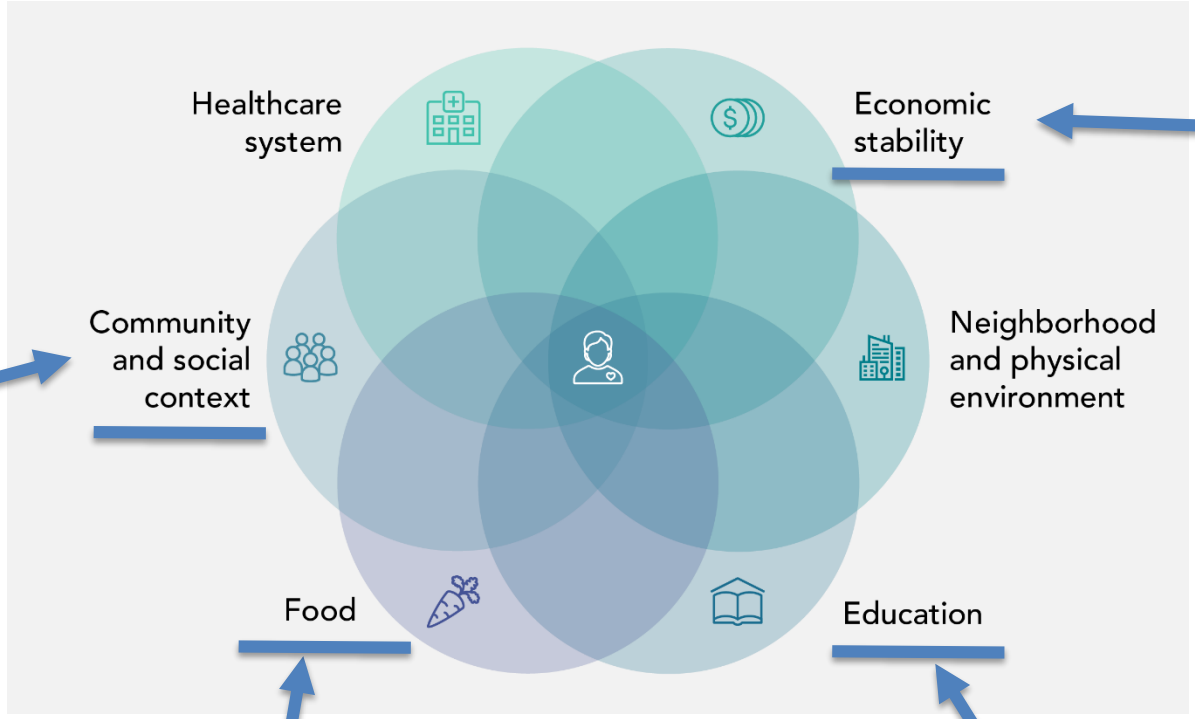
Results: Incidence of T2D



% of households receiving SNAP
β=9.5, p<0.008

Household size among AI/AN households
β=-3.2, p<0.02

Density of grocery stores
β=-2.5, p<0.04

Density of school
β=1.1, p<0.003

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Discussion

- Disproportionately higher burden of T2D in the central communities.
- Models of social determinants of health indicate that some factors are playing important roles in the higher incidence of T2D in some communities
  - Economic Stability (SNAP): Ohri-Vachaspati et al. (2015) Lower SES related to greater prevalence of childhood obesity in low-income families in New Jersey
  - Food (grocery stores): Morland et al. (2006) At least one supermarket had lower prevalence of obesity in 4 US states.
  - Community & Social Context (household size): Pasala et al (2010) More social capital reduced risk of diabetes in urban Indian (from India) adults.
  - Education (schools): no previous literature.
- First known study to attempt to link health outcomes with social determinants of health in a rural American Indian community.

Strengths & Limitations

Limitations

- Ecological design
- Temporality concerns
- No behavioral, perceived, or quality measures
- Macro-level built environment measures used may lack necessary precision
- Emerging field

Strengths

- First time these datasets analyzed together
- Objective social determinants of health measures
- First spatial analysis of rural AI youth with T2D
- Hypothesis-generating
- Community-focused

Future Directions

- Finalize and disseminate infographic summarizing results
- Present and discuss findings with community stakeholders.
- Inform public health programs
  - Department of Health et al. – targeted, culturally-tailored, multi-level pediatric obesity and diabetes interventions and resources
  - COPE et al. – food system policy and improve access to healthy foods.
  - Funding opportunities – GusNIP provides incentives to purchase fruits and vegetables using SNAP dollars.
- Future Analyses
  - Better data
  - Evaluate impact

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Colorado School of Public Health

SEARCH For Diabetes in Youth

MAVEN COLLECTIVE

Avera Research Institute
Center for Pediatric and Community Research

COPE
Community Outreach & Patient Empowerment

Centers for American Indian & Alaska Native Health
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Questions?

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