Progress & Service

THE SAFE SYSTEMS PYRAMID

A NEW FRAMEWORK FOR TRAFFIC SAFETY

Presented by Rachael Thompson Panik, AICP, PhD

Februray 2025

APA MI: 16th Annual Transportation Bonanza

OUTLINE

1 Context and Motivation

2 Transportation, Public Health, and the Safe Systems Pyramid

- Conventional Safety Practice
- Safe Systems Pyramid
- Applications

3 Examples in Action

4 Discussion

40,990 U.S. roadway deaths in 2023

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1.18 deaths per 100 million VMT

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6% of Detroit population

35% of Ann Arbor population

280% of my hometown population in rural AL

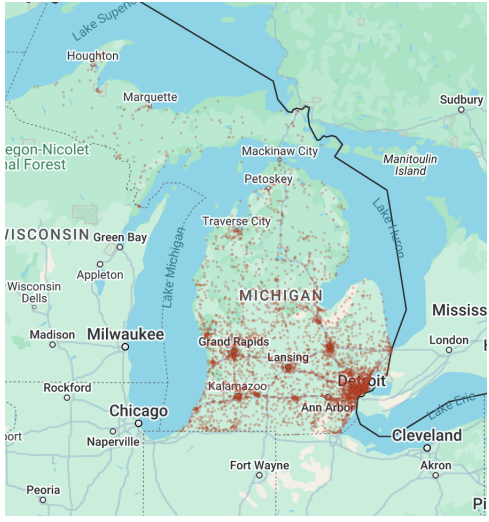

Figure: 2019-2023 Fatal Crashes in Michigan via Michigan Office of Highway Safety Planning

CRASHES ARE SYSTEMATIC

- The US National Roadway Safety Strategy: traffic crashes are **systematic**; injuries and deaths occur in a predictable, *preventable* way.
- Currently, governments, agencies, and practitioners are reshaping processes/infrastructure to reflect the systematic nature of crashes.
  - Vision Zero/Safe Systems
  - SSFA builds and plans

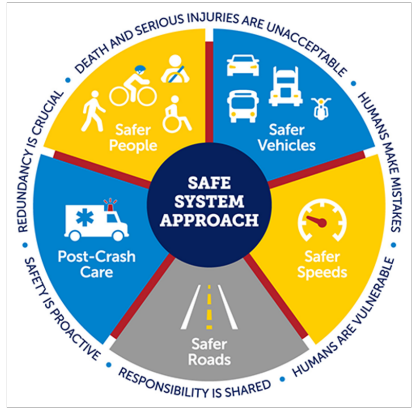

Figure: US DOT Safe Systems Approach

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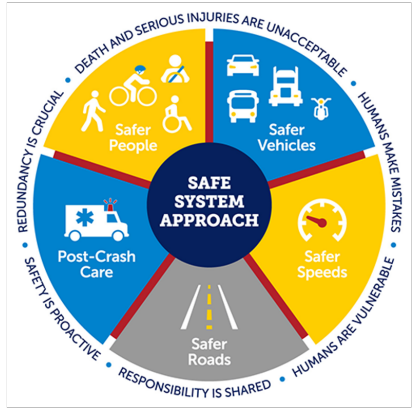

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VISION ZERO SUCCESSES? AN ACADEMIC STUDY

- Assessed success of Vision Zero commitments across 18 U.S. cities.
- **Upshot:** *Most* cities have not seen a significant decrease in traffic fatalities, especially for bikes and pedestrians.
  - Exceptions: NYC and Chicago

TRANSPORTATION LETTERS
2023, VOL. 15, NO. 8, 957–968
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U.S. Vision Zero Cities: modal fatality trends and strategy effectiveness

Nicholas N. Ferenchak

Department of Civil, Construction & Environmental Engineering, University of New Mexico, Albuquerque, NM, USA

ABSTRACT

At least 68 cities in the United States have taken a Vision Zero pledge to eliminate traffic fatalities. Which cities have improved their traffic safety outcomes and which strategies have proven effective? We examined changes in counts and per capita rates of all, pedestrian, and bicyclist fatal motor vehicle collisions between 2007 and 2019 for 18 U.S. cities that took early Vision Zero pledges. Only 2 of the 18 cities have experienced statistically significant decreases in total fatalities since taking a Vision Zero pledge and only one city experienced a statistically significant decrease in pedestrian fatalities. Cities with high walking, biking, and transit mode share and those that focused on walking and biking in their Vision Zero action plans experienced the best outcomes. Cities with high population densities and those that focused on technology in their action plans were also found to have safety performance improvements.

KEYWORDS

Vision Zero; action plan; multimodal; technology; population density; traffic safety culture

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WHAT IS GOING ON?!

- Roadway deaths kill more than entire towns' population each year.
- State, local, and federal governments are trying to reduce crashes and deaths each year – time, resources, infrastructure, political will, and more!
- We understand that crashes are systematic –> Vision Zero Plans, safe design, education, policies,...
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Poll time!

What is the *cause* of roadway injuries and deaths?

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Conventional Safety Practice: People take action that results in crashes

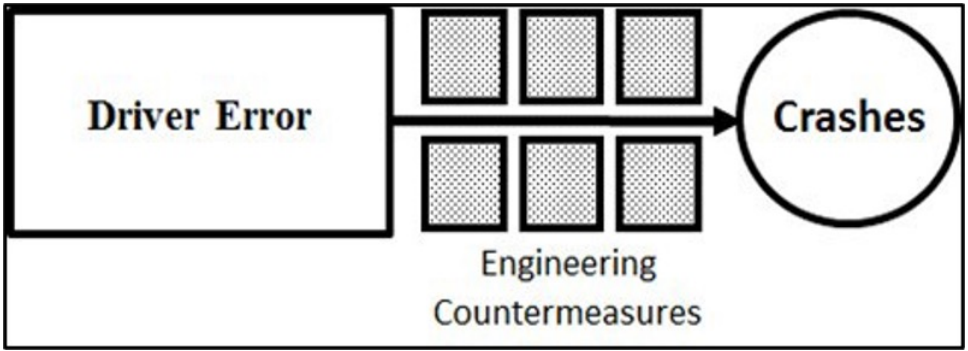

Figure: Dumbaugh et al (2020). Toward Safe Systems: Traffic Safety, Cognition, and the Built Environment. *Journal of Planning Education and Research*

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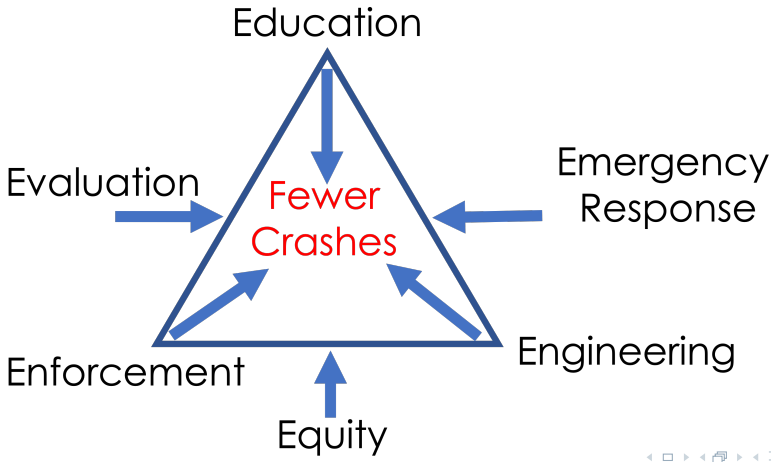

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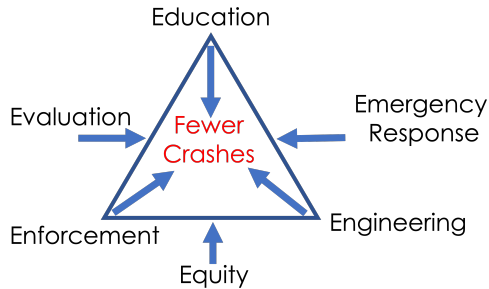
- Does not specify what *causes* crash-related injuries/death
- Does not direct how to *break the causal chain*



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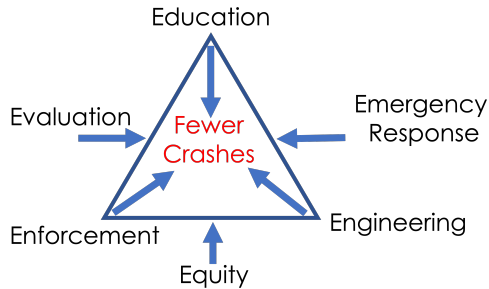

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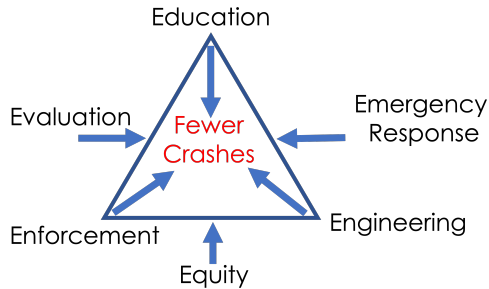

The causal chain of traffic crash injury is not addressed by the E's Framework –

So what is the casual chain?

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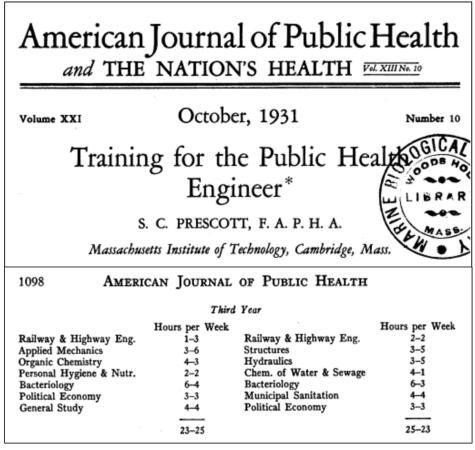
So what is the casual chain?

Let's ask public health professionals!

PUBLIC HEALTH & ENGINEERING



American Journal of Public Health
and THE NATION'S HEALTH Vol. XIII No. 10

Volume XXI October, 1931 Number 10

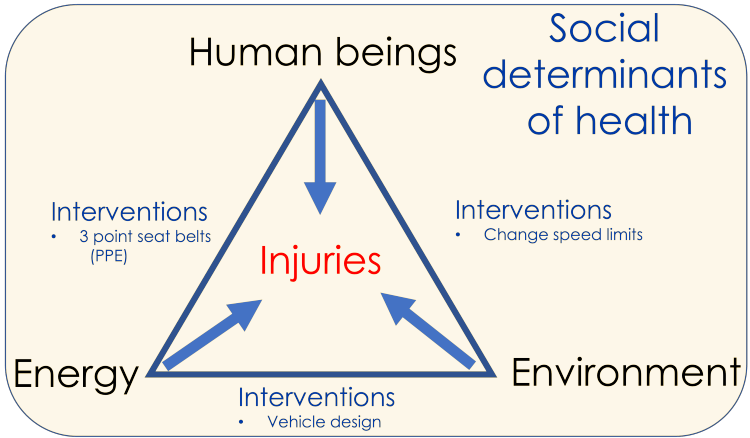
Training for the Public Health Engineer*

S. C. PRESCOTT, F. A. P. H. A.
Massachusetts Institute of Technology, Cambridge, Mass.

Third Year

	Hours per Week		Hours per Week
Railway & Highway Eng.	1–3	Railway & Highway Eng.	2–2
Applied Mechanics	3–6	Structures	3–5
Organic Chemistry	4–3	Hydraulics	3–5
Personal Hygiene & Nutr.	2–2	Chem. of Water & Sewage	4–1
Bacteriology	6–4	Bacteriology	6–3
Political Economy	3–3	Municipal Sanitation	4–4
General Study	4–4	Political Economy	3–3
	23–25		25–23

EPIDEMIOLOGICAL TRIAD OF INJURY



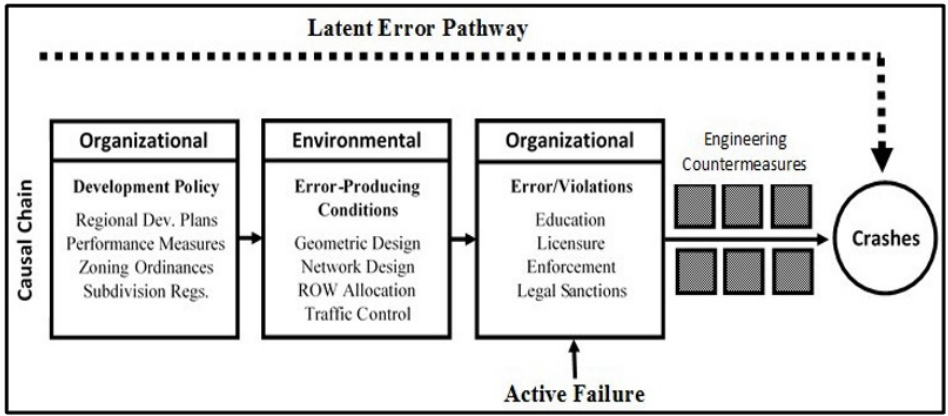
What is the cause of roadway injuries and deaths?

The pathological agent of injury in roadway crashes is **kinetic energy**.

What do we do about it?

A NEW APPROACH

Safe Systems: Dormant (i.e. latent) conditions lead to crashes → **resident pathogens**



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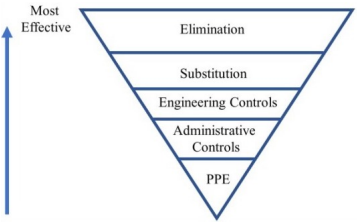
HOW DO WE OPERATIONALIZE?

Hierarchy of Controls

» **Big idea:** Countermeasures that eliminate the pathological agent are the most effective.



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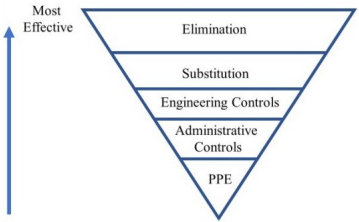

Figure: Adapted from the Centers for Disease Control and Prevention, n.d.

Health Impact Pyramid

» **Big idea:** Countermeasures that impact the largest share of the population with the least amount of effort are the most effective.

Figure: Adapted from Frieden (2010)

SAFE SYSTEMS PYRAMID


INDIVIDUAL EFFORT
EDUCATION
Driver education programs, Slow Down campaigns
ACTIVE MEASURES
STOP
Signals and signs, in-vehicle collision warnings, seatbelts, helmets
LATENT SAFETY MEASURES
Signal timing, leading pedestrian intervals, air bags, automated emergency braking
BUILT ENVIRONMENT
Roundabouts, curb extensions, raised crosswalks, sidewalks, bikeways
SOCIOECONOMIC FACTORS
Affordable housing near transit, zoning reform, safety features on commercial fleets
POPULATION HEALTH IMPACT

"Imagine if we depended on each person in the country to figure out their own plan to get clean water to their individual household, rather than investing in a shared filtration and sanitation system to provide safe, clean drinking water to the entire community."

Tiffany Smith, Vision Zero Network

WHAT DO WE DO WITH THE SSP?

- **Some clear applications of SSP thinking:**
  1. *Project Prioritization:* prioritize projects that will eliminate or minimize kinetic energy (or crossing trajectories) with little human effort required.
  2. *Systematic approaches to countermeasures:* Interventions that we know reduce kinetic energy or reduce user interaction and install them systematically or by default if possible.
     - Speed calming
     - Traffic circles
     - LPIs
     - Separated bike lanes
     - Dedicated turn signals
     - This may be a different approach to VZ/Safe Systems than you currently consider!
  3. *Coordinate across departments:* The most impactful interventions are those that change the context in which transportation happens – the socioeconomic environments:
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   - *Nuance*: kinetic energy must have opportunity to interact to be dangerous; e.g., interstate travel speed vs. local road travel speed
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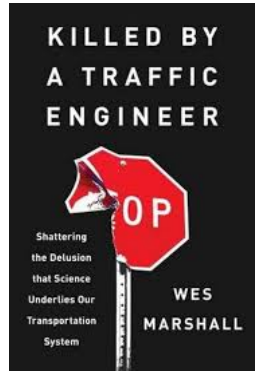
   - Effect of kinetic energy on people is uniform in the system
   - *Instead*: Systematically installing countermeasures across the whole network.



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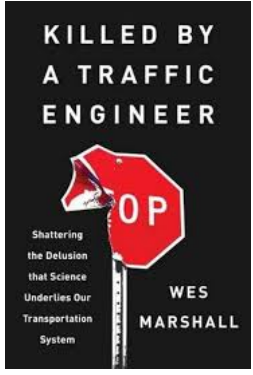

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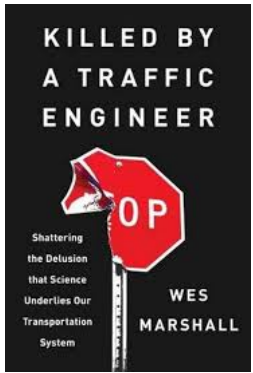

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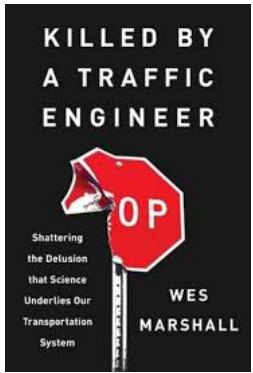

SSP SYNERGY

1. **Reducing VMT:** Less vehicle miles –> less kinetic energy
   - *Nuance*: kinetic energy must have opportunity to interact to be dangerous; e.g., interstate travel speed vs. local road travel speed
2. **Science??:** Approach to traffic safety is not based on the *cause* of traffic injuries and fatalities.
3. **E's:** Education and enforcement are less effective that population-level interventions
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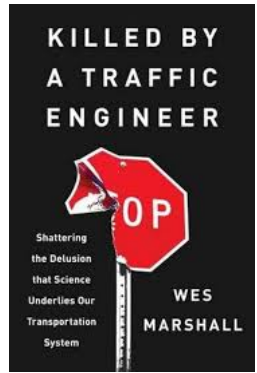

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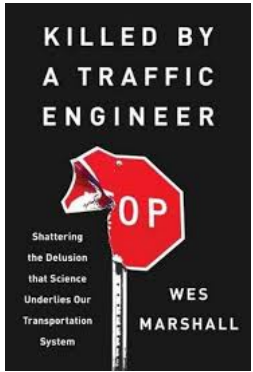

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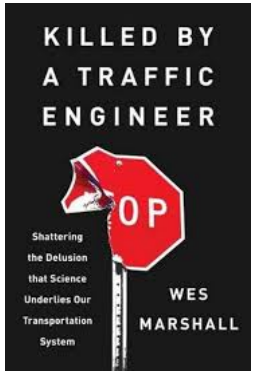

OUTLINE

1 Context and Motivation

2 Transportation, Public Health, and the Safe Systems Pyramid

- Conventional Safety Practice
- Safe Systems Pyramid
- Applications

3 Examples in Action

4 Discussion

EXAMPLE 1: NYC SAFE STREETS FOR SENIORS

- Response to senior fatalities
- **Approach:**
  - Focus on narrow population to funnel resources to specific locations
  - Within these areas, focused on "small" but consistently implemented interventions: bulb outs, LPIs, crossing islands
  - Documented success –> *institutionalized practice*
- **SSP Connection:** Broad implementation of interventions to reduce (specific) population risk at many locations.

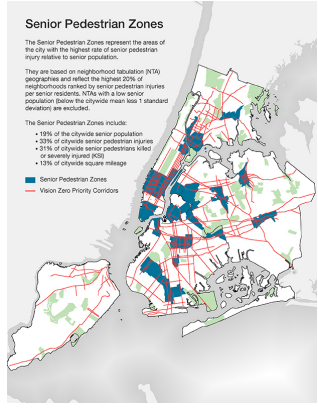

Figure: Image from NYCDOT's Safe Streets for Seniors Website

EXAMPLE 2: WSDOT LAND USE INTEGRATION

- First state to have a land use policy in safe systems approach.
- **Approach:**
  - Partner with agencies to communicate exposure/land use relationship
  - Identify land use risks along state-owned roadways to head off future problems
  - Aligning roadway design with existing land use and appropriate design speeds
- **SSP Connection:** Changing the context for travel; reducing exposure by shortening travel distances; encouraging low kinetic energy modes.

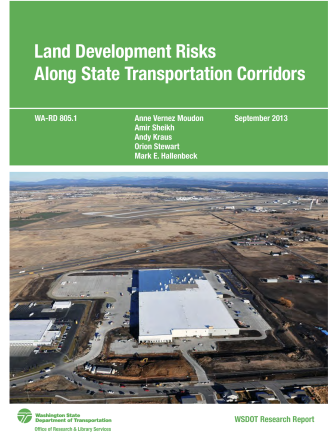

Figure: Image from WA-RD 805.1

OUTLINE

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Thank you! Let’s discuss.

Pocket Slides

HIERARCHY OF CONTROLS

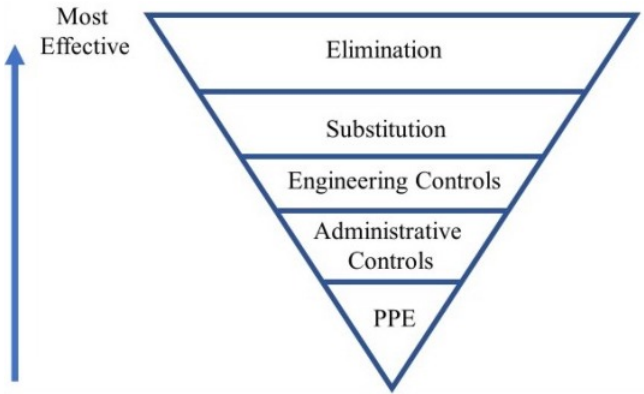

Figure: Adapted from the Centers for Disease Control and Prevention, n.d.

HEALTH IMPACT PYRAMID

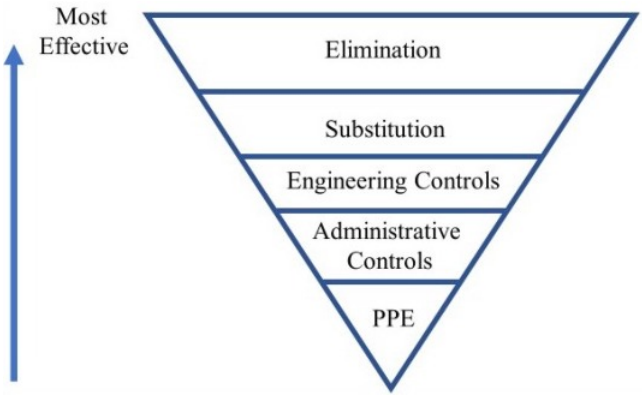

Figure: Adapted from Frieden (2010)

EXAMPLE: JERSEY CITY

- **In 2022, Jersey City had zero roadway deaths on city-owned streets.** After becoming a Vision Zero City in 2018, they have installed:
  - 19 miles of protected bike lanes
  - 679 speed humps
  - 183 locations prohibiting right turns on red
  - 14 intersections with leading pedestrian intervals
  - More than 30 parklets and pedestrian plazas
  - Over 100 quick-build curb extensions

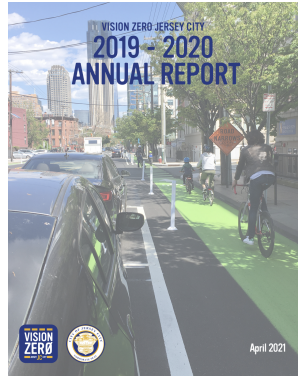

Figure: From the City of Jersey City, 2022 Vision Zero Annual report