The Operational Domain and the Human Driver as the Baseline for AV Metrics

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Periods of Violent Deaths in the U.S.
(deaths/day)

Periods of Violent Deaths in the U.S. (deaths/day)
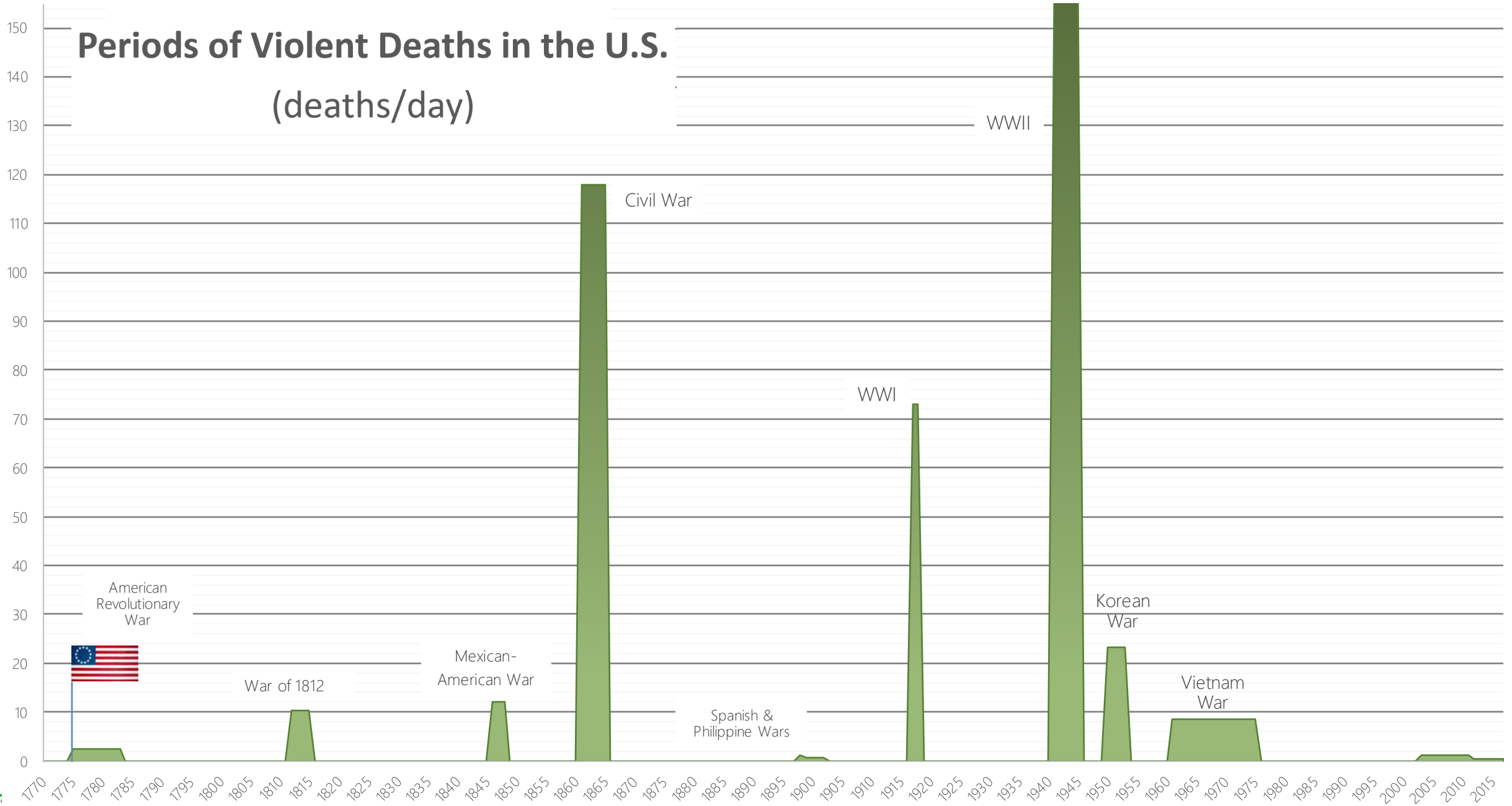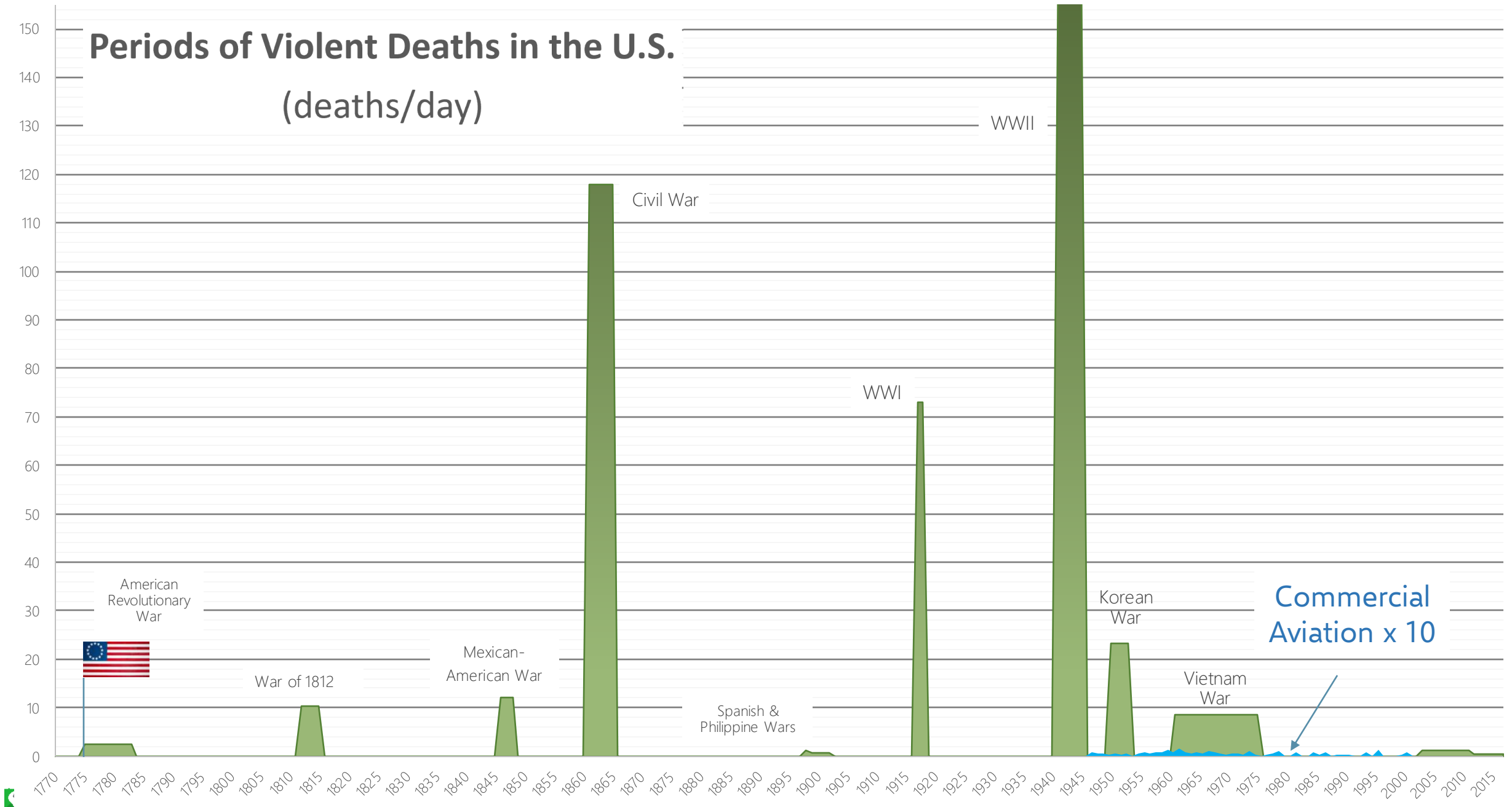
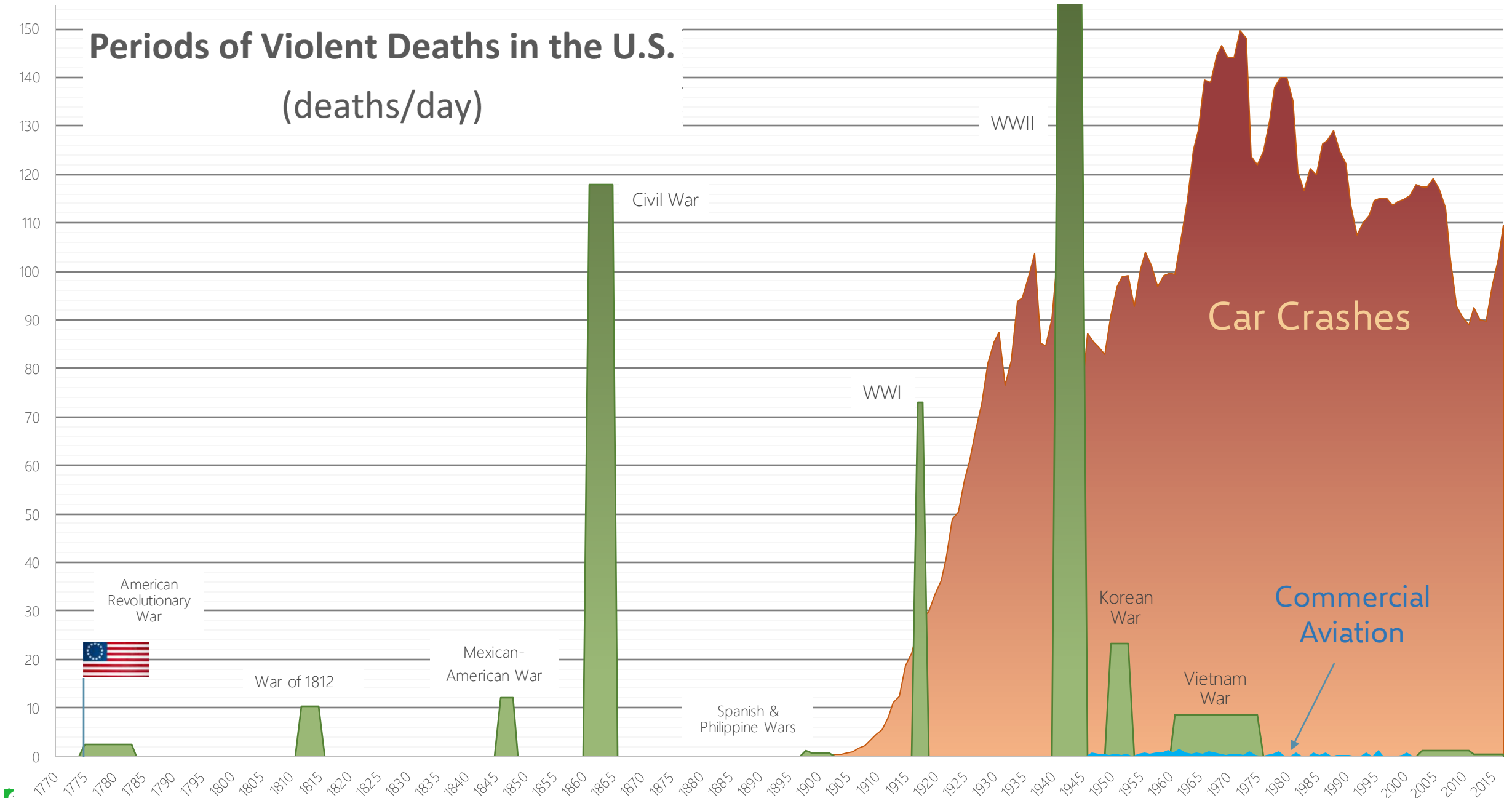American Revolutionary War · War of 1812 · Mexican-American War · Civil War · Spanish & Philippine Wars · WWI · WWII · Korean War · Vietnam War · Commercial Aviation x 10

Periods of Violent Deaths in the U.S. (deaths/day)

Autonomous Vehicle Performance Metrics

- There is a need for effectively measuring AV performance

- A highly significant aspect of driving is crashes and fatalities

- Benchmarking AV to human safety performance provides starting point

Not addressing here:
- Travel performance (speed)
- Comfort performance

The Human Driver Causes 94% of All Crashes
(NHTSA)

What metric is used for measuring performance?

One Year in U.S. (2022)*:

-Humans drove 3.12 trillion miles

-42,795 fatalities occurred

73 million miles / fatality

*NHTSA

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The Human Driver Causes 94% of All Crashes
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What metric is used for measuring performance?

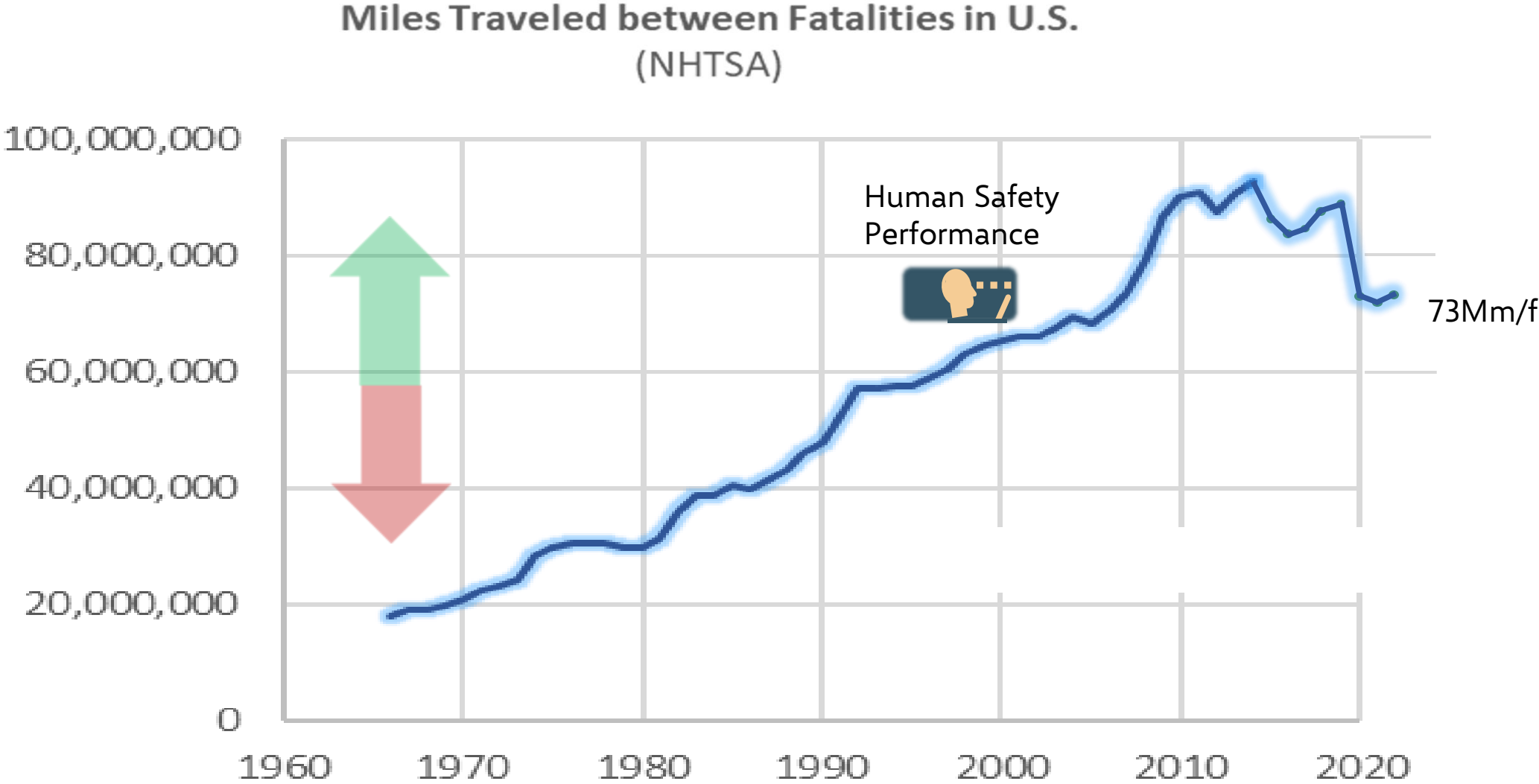One Year in U.S. (2022)*:

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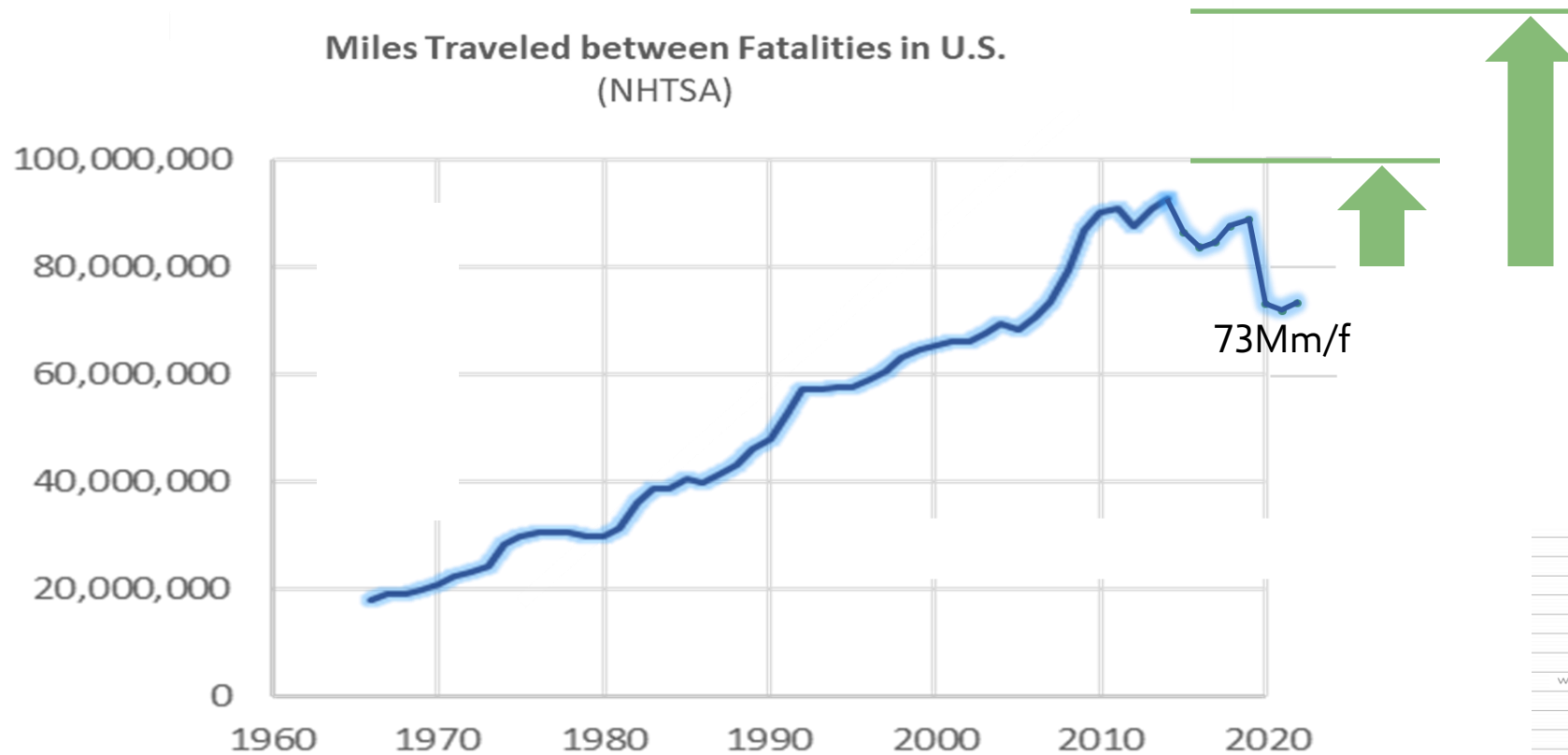**million-miles/fatality   or   fatalities/million-miles**

*NHTSA

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This Metric Changes from Year to Year

Miles Traveled between Fatalities in U.S.
(NHTSA)

Human Safety Performance

73Mm/f

From NHTSA data

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What is the Target for AV's?

Miles Traveled between Fatalities in U.S.
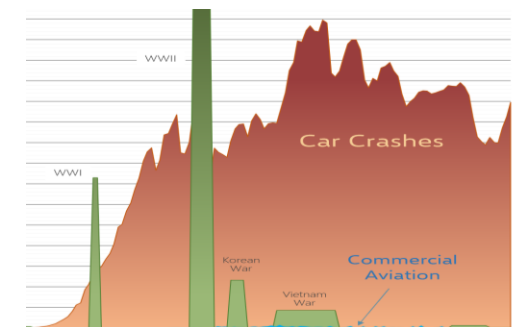(NHTSA)

73Mm/f

AV Capability?

equal or better than human?

AV Safety Performance Expectations
One Approach

Current State

73 million miles between fatal mistakes

10 x Better

AV

to eliminate 90% of accidents, AV must be better ~ 10x

so **AV target**: **730 million miles**
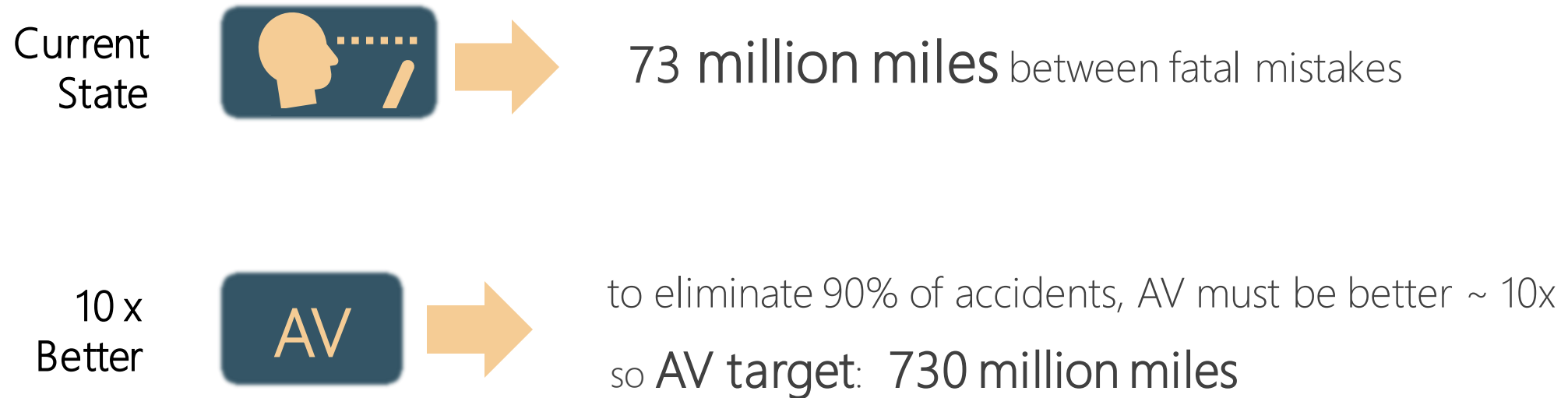
AV Safety Performance Expectations
One Approach

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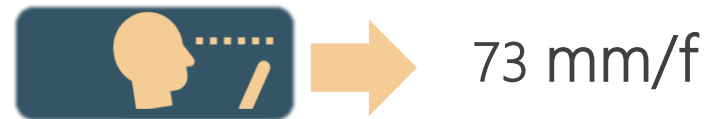
so **AV target**: 730 million miles

But the conditions and the scope of the driving matters ...

Operational Domain for the Driving Situation
The Conditions and the Scope of Performance Metric

73 mm/f

- All U.S. roadways
- All driver ages
- All Times of Day
- All driver behaviors
  - Aggressive
  - Drunk
  - Drowsy

What if you are a 47yr-old driver only drive in Wisconsin?

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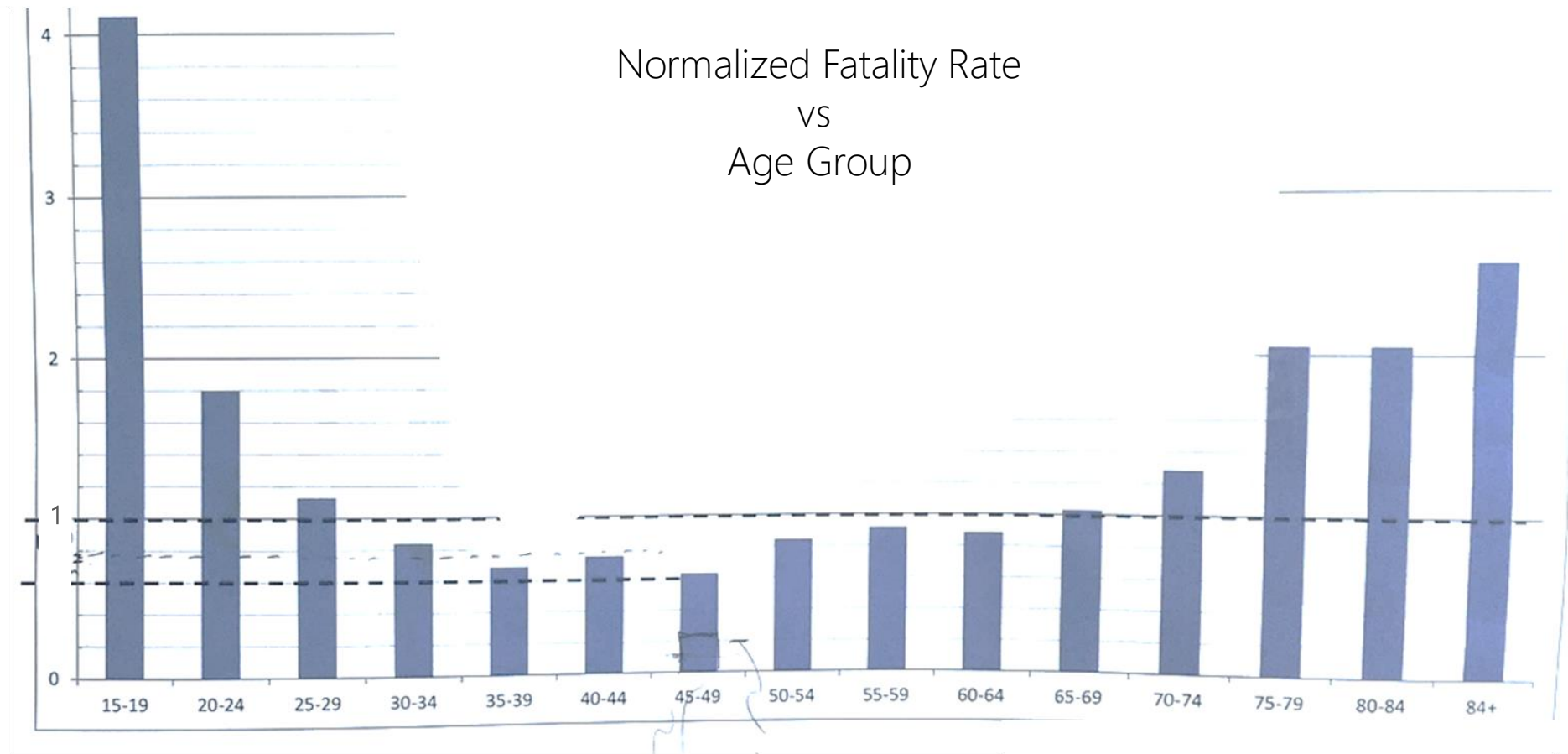# Operational Domain: Region or State where Driving

U.S. 73 million miles / fatality

Wisc. 105 million miles / fatality

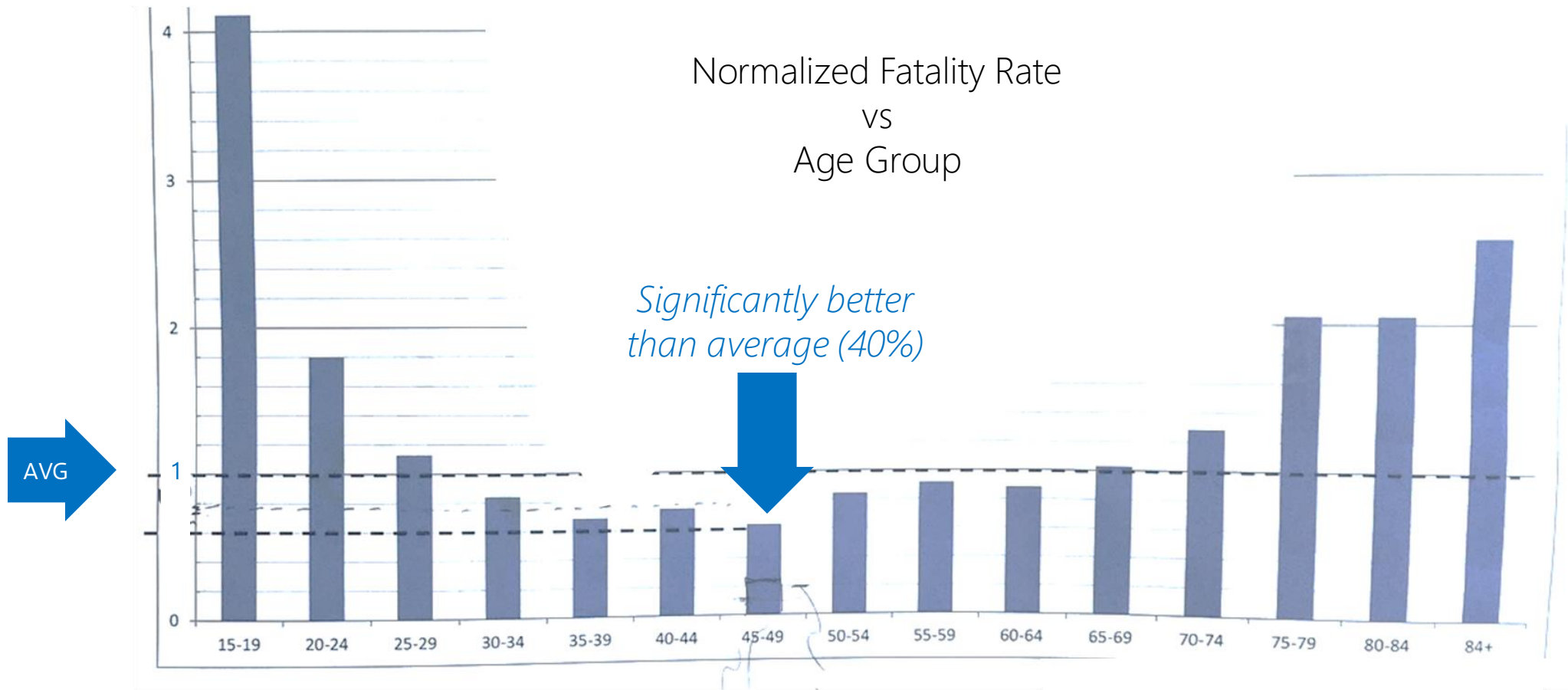*For one from Wisconsin, a US based target falls short by 44%*

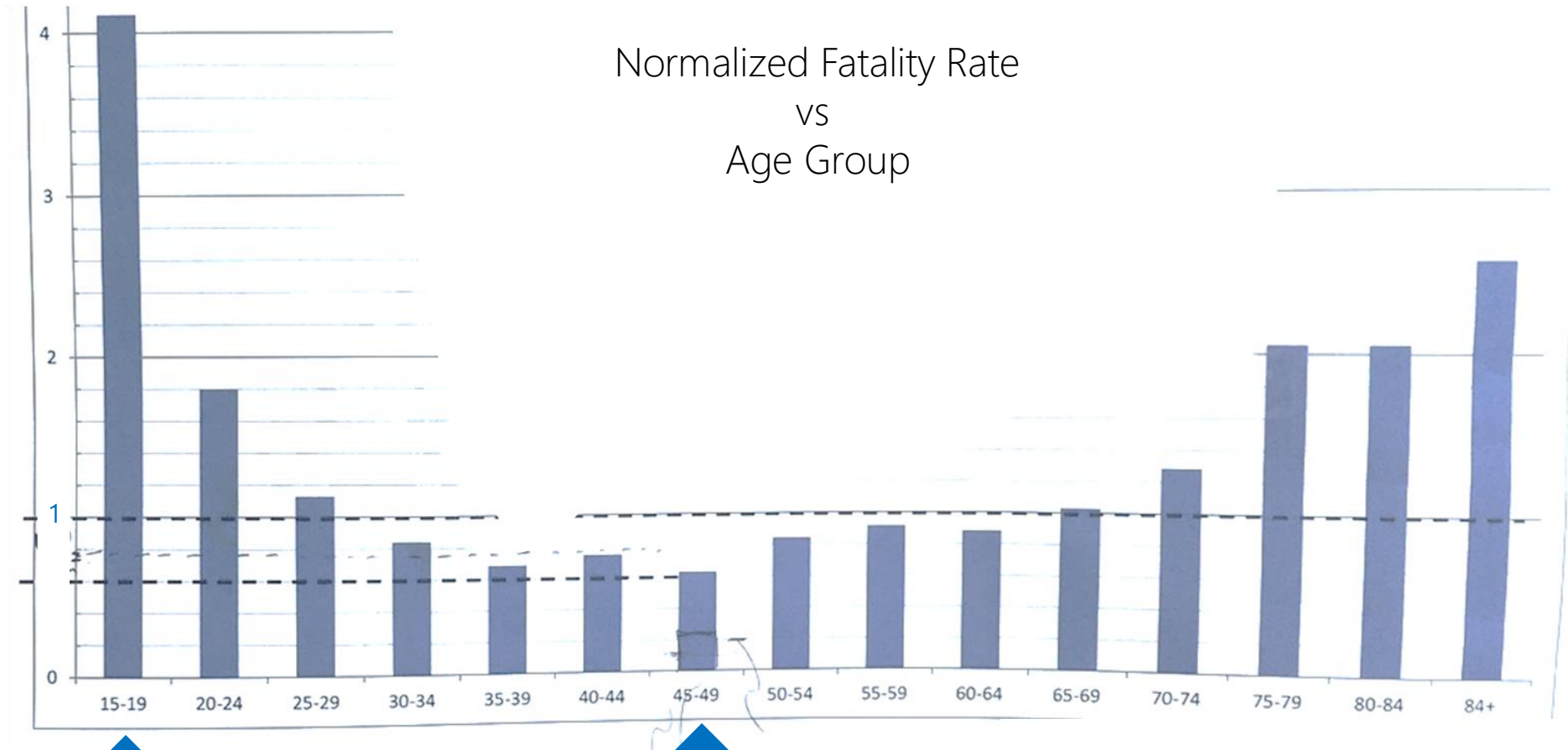IIHS 2021 Data

Operational Domain: Age of Driver

Normalized Fatality Rate
vs
Age Group

Analysis by author
Data from Texas Transportation Institute study

Operational Domain: Age of Driver

Normalized Fatality Rate
vs
Age Group

*Significantly better
than average (40%)*

AVG

Analysis by author
Data from Texas Transportation Institute study

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Operational Domain: Age of Driver

Normalized Fatality Rate
vs
Age Group

680% more fatalities

For a 47yo driving from MI to FL, would having an 18yo driving be ok?
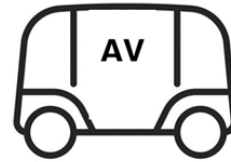
Analysis by author
Data from Texas Transportation Institute study

Operational Domain
Something to Think About

Is the AV safe enough?

Safety Capability:
5x Avg Driver

Rider **A**

Safety Capability:
10x Avg Driver

Rider **B**

Safety Capability:
1x Avg Driver

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Measuring AV Performance
In Summary

- A highly significant aspect of driving is crashes and fatalities

- Benchmarking AV to human safety performance can and will be done

- Human performance can be measured as miles-between-fatalities

- The conditions (OD) of human to AV comparison matter

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