Do nighttime train horns hurt more than help?

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Abstract

In 1991 the Federal Railroad Administration (FRA) issued Emergency Order No. 15 preempting Florida state law–which had allowed for local train horn bans–and required train horns to be sounded at train crossings 24/7. The order was written on the basis of an FRA study showing that accidents could increase by as much as 150% attributable to a lack of routine train horn use. However, the adverse public health impacts of noise exposure—particularly sleep disruption and related health outcomes—were not considered. This paper adds to the literature by quantifying the inherent cost/benefit trade-off of nighttime train horn usage by comparing the safety benefits from accident prevention against the health costs measured in Disability-Adjusted Life Years (DALYs). Drawing on FRA accident reports, U.S. Census population figures, and Global Burden of Disease estimates, the analysis shows that the DALYs lost due to noise-induced sleep disturbances and annoyance likely exceed those saved from reduced accidents by 1.5 to 3 times or more. Furthermore, a recent natural experiment in the state of Utah where train Quiet Zones were suspended shows a 1.5 to 3 times or greater incremental loss in DALYs beyond what would have been expected without the suspension. These results suggest that current train horn policy may inadvertently harm public health. The results also suggest that suspending Quiet Zones for lower risk compliance lapses may not be justified on public safety grounds. The results highlight an urgent need for policy reevaluation and further research to optimize public health and safety in a holistic way.

1 Introduction

In the late 1970s Florida residents began advocating for legislation to silence train whistles at night which they found disruptive to their communities. These efforts led to a 1984 Florida state law allowing local governments to ban train whistles from 10:00 p.m. to 6:00 a.m.—as long as crossings had safety features including gates, flashing lights, bells, and road signs alerting drivers to the absence of train horns. Florida localities quickly began adopting whistle bans eventually covering over 500 crossings by 1990.

The Federal Railroad Administration (FRA) studied the impact of these bans, focusing exclusively on accident rates at train crossings. Their study concluded that the nighttime accident rate at affected crossings increased 195% in the 5-year post-ban period. Meanwhile, crossings where train horns remained in use saw between a 23%-67% increase (net impact of 150% when the mean of these is subtracted from 195%). Several groups challenged the results of the study but none of them altered the FRA's conclusion that train whistles at night were an effective accident deterrent.

As a direct result of this study the FRA issued Emergency Order No. 15 in 1991, requiring train whistles to be reinstated at impacted crossings. Local Florida officials petitioned against the order, arguing that quality of life was also a factor to be considered. The FRA acknowledged "that nighttime train whistles can be an inconvenience" but because they "save lives" their nighttime use is necessary on public safety grounds. ("Florida's Train Whistle Ban" (1995))

This conclusion led to the passage of Public Law 103-440 in 1994 which states that:

"the Secretary of Transportation shall prescribe regulations requiring that a locomotive horn shall be sounded while each train is approaching and entering upon each public highway-rail grade crossing.

In issuing such regulations, the Secretary may except from the requirement to sound the locomotive horn any categories of rail operations or categories of highway-rail grade crossings (by train speed or other factors specified by regulation)—

(A) *that the Secretary determines not to present a significant risk with respect to loss of life or serious personal injury"*

In response to this law the FRA published their Final Rule in 2005 requiring trains to sound their horn at all at-grade crossings day and night unless the requirements of a "Quiet Zone" are met. Quiet Zones can be established if train crossings are upgraded with certain additional safety features.

The required upgrades are typically cost prohibitive for cities to implement reaching up to millions of dollars per crossing. In the 20 years since the Final Rule was published just 3% of active train crossings in the United States have qualified for Quiet Zone status.

The Final Rule has now been in effect for nearly 20 years despite the trade-off between the safety benefit and costs of train horn noise never having been studied by the FRA or U.S. Department of Transportation.

As of the 2020 census there are nearly 1 million U.S. residents estimated to be living within 500 feet of a gate, bell, and light equipped train crossing where train whistles sound at night making the train horn cost/benefit trade-off one of significant public health and safety interest.

This paper fills a significant gap in the literature by quantifying the cost/benefit trade-off of routine use of train horns in the United States. The remainder of the paper proceeds as follows:

- Section 2: Reviews the sleep loss, environmental noise, and relevant public health and safety literature
- Section 3: Proposes a straight forward framework to measure the cost/benefit trade-off inherent in train horn use
- Section 4: Describes the data used for analysis
- Section 5: Quantifies the cost/benefit trade-off in terms of healthy life years lost
- Section 6: Discusses policy implications
- Section 7: Concludes and suggests future research opportunities
- Section 8: Provides a link to a GitHub repository where all code and data can be obtained to reproduce the results in this paper and to extend the analysis

The final section contains references.

2 Literature review

Much recent research links sleep loss and environmental noise to a large number of adverse public health and safety outcomes.

Jephcote et al. (2023) found that "noise from road traffic, rail, and aviation transport" "are major contributors to the overall environmental disease burden."

Cappuccio et al. (2010) performed a meta-analysis on 16 sleep loss studies and found an "unambiguous and consistent pattern of increased risk of dying" from short sleep duration defined as getting less than 4-7 hours of sleep per night (short sleep threshold varied based on the context of each study). They estimated a 12% increase in risk of death for "short sleepers."

Yan et al. (2024) calls attention to the "escalating economic toll attributed to short sleep [and] underscores the urgent need for public health interventions."

Altevogt and Colten (2006) dedicated an entire book to summarizing the literature on how sleep loss leads to "increased risk of hypertension, diabetes, obesity, depression, heart attack, and stroke."

Shaik et al. (2022) document the increases in "occupational accidents and errors" with a focus on medical errors made by healthcare workers.

Chattu et al. (2018) report that "reduced sleep duration has been linked to 7 of the 15 leading causes of death in the U.S., including cardiovascular disease, malignant neoplasm, cerebrovascular disease, accidents, diabetes, septicemia, and hypertension."

World Health Organization (2011) reports on the costs of noise exposure induced "cardiovascular disease, cognitive impairment, sleep disturbance and tinnitus."

Eriksson, Bodin, and Selander (2017) found that "road traffic and railway noise contribute significantly to the burden of disease in Sweden each year."

Begou and Kassomenos (2021) "revealed the magnitude of the health damage caused by the transportation noise" in Greece.

Simak (2022) "quantified [the] number of years of healthy life [that] were lost as a result of traffic noise in Toronto"

Tobollik et al. (2019) measured the loss in years of healthy life from "railway noise" in Germany.

Khomenko et al. (2022) found that "3,608 deaths from [heart disease] (95% CI: 843–6266) could be prevented annually" across European cities if transportation noise exposure were reduced to WHO recommended levels.

Sohrabi and Khreis (2020) found the "estimated premature death rate attributable to transportation-related noise was also comparable to the death rate caused by suicide, influenza, or pneumonia in the US," and highlighted the "urgent need for imposing policies to reduce transportation noise emissions and human exposures."

Aasvang et al. (2023) found that "the health-related burden of traffic noise was comparable to that of air pollution."

Fernández-Quezada et al. (2025) conducted "a meta-analysis of eight primary studies published between 2001 and 2023" and concluded that "noise exposure significantly impairs cognitive performance in children and adolescents."

Another striking illustration of the health and safety impacts of sleep loss is found in the Day Light Savings Time (DST) literature where the impact of losing as little as 40 minutes of sleep on the Mondays following the transition to DST led to an increase of "5.7% more workplace injuries."

Smith (2016) found similarly that a single hour of sleep disruption when switching to DST on a large number of people "caused over 30 deaths at a social cost of $275 million annually" between 2002–2011.

Train horns are particularly disruptive to sleep because of how loud they are (up to 96-110 dB by law). During a three-week experimental sleep study Griefahn, Marks, and Robens (2006) found that "physiological sleep parameters were most severely affected by rail noise."

It's no wonder that as early as 2006 Pandi-Perumal et al. (2006) called for a "social awareness program to educate the public" about the public safety impacts of sleep loss.

Ten year later in 2016, the American Academy of Nursing renewed the warning, writing: "Noise is more than an annoyance; it is a public health hazard, having a significant impact on the health of our nation and its economic well-being. It has been well documented that noise exposure contributes to hearing loss, tinnitus, heart disease, stroke, anxiety, stress, depression, learning difficulties, job performance, sleep disorders, and reduced cognitive abilities." See Lusk et al. (2016).

Despite the preponderance of evidence on the public health and safety costs of sleep loss, no such analysis has informed the cost/benefit trade off implicit in current federal train horn rules when nearly 1 million Americans living near gate, bell, and light equipped train crossings likely have their sleep disrupted nightly.

In 2012 the Federal Railroad Administration, in collaboration with the Harvard Medical School Division of Sleep Medicine, launched "a major educational initiative for the railroad industry about the importance of sleep" in preserving the health and safety of railroad workers but sleep loss impact on residents near train crossings was not addressed. See Grice and Howarth (2018).

When the train horn rule was first implemented Cushing-Daniels and Murray (2005) found that when measured in terms of financial impact "that even using the highest estimates of the benefits, the costs imposed by the increased train noise are likely to be greater by an order of magnitude."

This paper fills a critical gap in the literature by evaluating both costs and benefits of train horn use on public health as measured by DALYs.

3 Methodology

3.1 Disability-Adjusted Life Years

The methodology to measure the cost/benefit of train horns is straightforward using the DALY (Disability-Adjusted Life Year) framework first introduced by the World Health Organization in 1993 (Mathers (2020)). DALYs and similar metrics have since become widely accepted and used as an effective and important policy tool. DALYs combine into a single measurement both fatal and non-fatal health impairments. This is represented mathematically as:

$$DALYs = YLL + YLD$$

where YLL are the Years of Life Lost due to premature mortality, and YLD are Years Lived with Disability for those living with the disease or other impaired health condition.

Computing YLL consists of taking the average life expectancy and subtracting from it the age of death. For example, if 100 people die at age 60 and life expectancy is 70, the number of YLL would be

$$YLL = 100 \times 10 = 1000$$

Computing YLD consists of multiplying a *disability weight* between 0 and 1 to the number of people affected by a certain condition and the number of years suffered. A disability weight of 0 means a condition has no impact on quality of life, a weight of 1 would be equivalent to a fatality. For example if 100 people suffer from a condition with a disability weight of 0.3, YLD would be calculated as

$$YLD = 100 \times 0.3 \times 10 = 300$$

And hence total $DALYs$ in this example would be

$$DALYs = 1000 + 300 = 1300$$

3.2 Disability Weights

The Global Burden of Disease (GBD) study has estimated disability weights for 440 health states. See Disease Collaborative Network (2024). Additional disability weights have been derived in subsequent studies. "Annoyance" from noise exposure and "sleep disturbance" are two such states that have received significant attention because of their importance to overall health and well-being. World Health Organization (2009) provides a detailed literature review, derivation logic, and the following estimates drawing on all of the available research:

1. "annoyance" from aircraft, road traffic and railway noise with a weight of 0.02
2. "sleep disturbance" from transportation noise with a weight of 0.07

These two weights are used in the Results section to generate upper and lower bounds for the public health cost of current train horn policy in terms of DALYs. The resulting number of DALYs are compared against the number of DALYs presumed to be saved as a result of train horn usage. To perform the comparison it is assumed that the 195%-45% = 150% increase in train accidents following whistle bans from the FRA Florida study's is not only correlational but causal (subtraction if of the mean 45% effect not attributable to train horn bans according to the study) . Assuming the 150% increase is fully causal is a conservative assumption that ensures the train horn accident deterrent effect is given the benefit of any doubt.

3.3 Counterfactual Analysis

Next, a counterfactual analysis is conducted under the assumption that, if a nationwide train horn ban were implemented, train accidents would increase by 195%-45% = 150% over the following five years (where 45% is the portion of increase that the Florida study could not attribute to train horns). It is assumed that all of these additional hypothetical accidents would have been prevented by the use of train horns.

The overall impact of the policy is then evaluated by comparing two factors:

1. The health burden from noise exposure, as measured in DALYs.
2. The DALYs saved by preventing the additional accidents.

If the DALYs lost due to noise exposure exceed the DALYs saved by accident prevention, the policy will be net harmful. Conversely, if the DALYs saved by preventing accidents outweigh the DALYs cost from noise exposure, the policy is achieving its objective of maximizing public health and safety.

Population Estimation for Each Train Crossing

The first building block in the analysis is an estimate of the population of residents whose sleep is disrupted by train horns at night.

For a given train crossing i, let $\mathcal{C}_i$ be the set of census blocks that intersect a 500-foot radius circle centered on the crossing. For each census block $j \in \mathcal{C}_i$, let:

- A_{ij} be the area of census block j that lies within the 500-foot radius,
- A_j be the total area of census block j,and
- P_j be the population of census block j.

Then, the estimated population within the circle for crossing i is given by:

$$P_i = \sum_{j \in \mathcal{C}_i} \left(\frac{A_{ij}}{A_j} \right) P_j.$$

The total affected population across all N train crossings is:

$$P = \sum_{i=1}^{N} P_i = \sum_{i=1}^{N} \sum_{j \in \mathcal{C}_i} \left(\frac{A_{ij}}{A_j} \right) P_j.$$

If crossings are close enough together that the same census block falls within the 500 foot radius of multiple crossings, the population of the census block is only counted towards the crossing where its maximum area falls within. This ensures avoidance of double counting and will result in an moderate under count since non-maximum, non-overlapping A_{ij}s from two different train crossings but the same census block will be excluded from the count. The under count means DALYs lost from noise harm, $DALY_{\text{noise}}$, will be biased downward. This approach is adopted to be ensure the final $DALY_{\text{noise}}$ is a conservative estimate.

DALYs from Noise Exposure (5-Year Horizon)

Assuming a disability weight w for noise exposure and the study period of $T = 5$ years, the total DALYs due to noise exposure over the 5-year period are estimated as:

$$DALY_{\text{noise}} = T\, w\, P = 5\, w \sum_{i=1}^{N} \sum_{j \in \mathcal{C}_i} \left(\frac{A_{ij}}{A_j} \right) P_j.$$

DALYs from Accident Prevention

Let:

- $U_{F,i}$ be the number of crossing user fatalities in the i-th accident occurring in the study period (2020-2024)
- $E_{F,i}$ be the number of employee fatalities in the i-th accident
- $P_{F,i}$ be the number of passenger fatalities in the i-th accident
- $U_{I,i}$ be the number of crossings users injured in the i-th accident
- $E_{I,i}$ be the number of employees injured in the i-th accident
- $P_{I,i}$ be the number of passengers injured in the i-th accident
- $w_{\text{inj}} = 0.6$ be the disability weight for injuries. This choice of disability weight is consistent with major long term injuries.
- A_i be the reported age of the crossing user in i-th accident. Since only one crossing user age is reported, if there are multiple crossings users, ages are assumed to be the same for all.
- $YLL_{\text{fatal},i}$ be the total Years of Life Lost in the i-th accident
- YLD_i be the total Years of Life Lost in the i-th accident
- N_{acc} be the number of accidents in the study period

A baseline life expectancy of 77.5 years is assumed per CDC estimates, See Kochanek et al. (2024). Furthermore if a crossing user's age is greater than this it is assumed they live another 7 years.

Ages are not reported for employee and passenger injuries or fatalities. Deloitte (2014) reports the average age of a train conductor in the US as 42 so this are is used in the calculations. Average passenger age data is not available so a conservative assumption is made that all affected passengers are an average of 35 years old.

DALYs from the 5 year study period (2020-2024) for fatalities and injuries are computed as follows:

Fatalities:

$$\begin{aligned} YLL_i &= P_{F,i}\ \max\Big(77.5 - A_i, 7\Big) \\ &\quad +\ E_{F,i}\,(77.5 - 42) \\ &\quad +\ P_{F,i}\,(77.5 - 35) \\ YLL_{\text{fatal}} &= \sum_{i=1}^{N_{\text{acc}}} YLL_i \end{aligned}$$

Injuries:

$$\begin{aligned} YLD_i &= w_{\text{inj}}\, P_{I,i}\ \max\Big(77.5 - A_i, 7\Big) \\ &\quad +\ w_{\text{inj}}\, E_{I,i}\, (77.5 - 42) \\ &\quad +\ w_{\text{inj}}\, P_{I,i}\, (77.5 - 35) \\ YLD_{\text{inj}} &= \sum_{i=1}^{N_{\text{acc}}} YLD_i \end{aligned}$$

Thus, the total DALYs over the 5 year study period are:

$$DALY_0 = YLL_{fatal} + YLD_{inj}$$

In the absence of train horns it is assumed that

$$DALY_{\text{counterfactual}} = DALY_0 \times (1 + 1.95 - 0.45)$$

Under the counterfactual, all of the accident burden beyond $DALY_0$ is attributable to the hypothetical train horn ban or equivalently, this is the amount of DALYs saved by use of train horns using the Florida study assumption:

$$DALY_{\text{attributable}} = DALY_{\text{counterfactual}} - DALY_0$$

Policy Comparison

The current policy is beneficial (i.e., maximizes public health and safety) if the DALYs saved from accident prevention exceed the DALYs incurred from noise exposure over the 5-year study period:

$$DALY_{\text{noise}} < DALY_{\text{attributable}}$$

In this case, the current rules governing train horn use have been effective at fulfilling the lawful mandate to avoid "significant risk with respect to loss of life or serious personal injury".

Conversely, if

$$DALY_{\text{noise}} > DALY_{\text{attributable}}$$

the policy would be net harmful and the "loss of life or serious personal injury" has actually been exacerbated by the current regulations.

Estimates are presented in the Results section.

4 Data

The data sources used in this study are the following:

4.1 U.S. DOT Crossing Inventory

From FRA Form 71 containing detailed information–including lat/long to identify precise location–about each train crossing in the United States from Office of Railroad Safety, Federal Railroad Administration (2025)

The dataset was refined by applying a set of rigorous filters to ensure the validity and relevance of the train crossing data for this analysis. Specifically, crossings that were not at-grade, closed, or privately managed were excluded. Additionally, any crossings that ran down the street or were operated by local transit services (e.g., light rail) or tourist trains were omitted. Finally, only crossings with paved surfaces, gates, bells, and lights were retained for further analysis to align with the types of crossings in the FRA's Florida study.

4.2 FRA Form 57 data

The Highway-Rail Grade Crossing Accident/Incident Report is used by railroads to report to the FRA all collisions between railroad on-track equipment and highway users at a highway-rail grade crossing and is sourced from Federal Railroad Administration, Office of Railroad Safety (2025)

The Form 57 data is joined with the Form 71 accident data by the unique DOT Crossing Inventory Number in order to analyze only those accidents at the relevant crossings.

4.3 U.S. Census

2020 population figures at the census block level from U.S. Census Bureau (2024)

This data is used to estimate population density surrounding each train crossing.

4.4 DALY disability weights

Obtained from World Health Organization (2011)

5 Results

We evaluate the cost/benefit trade off of train horn use in both the US as a whole and in the state of Utah where two of the largest Quiet Zones in the country are located and recently suspended for a period of 4 and 6 months, respectively.

5.1 Nationwide analysis

According to FRA Form 71 data there are 31,596 active, public, at-grade train crossings in the United States with similar characteristics to those in the FRA Florida study (i.e. crossings with gates, bells, and lights) that are not part of a Quiet Zone. Using the population approach outlined in the Methodology section

30,240 of these crossings are estimated to have a non-zero affected population. Specifically, using 2020 U.S. Census data it is estimated that 918,000 residents live within 500 feet of these crossings. See sdmurff (2025) for calculation. Many of these residents likely have their sleep disrupted from train horns at night.

In the 5-year period 2020-2024, there were 249 train nighttime accidents at the 30,240 crossings that resulted in a fatality or injury costing roughly 9,914 DALYs.

Using disability weights of 0.02 for annoyance and 0.07 for sleep disruption a range of DALY estimates are made to reflect the public health and safety burden of train horns. These estimates can then be compared to the counter-factual cost of NOT sounding the horns to see which is greater.

In the ultra-conservative case where it is assumed that only 1 in 4 residents are impacted and using the annoyance disability weight of 0.02 the train horn ban costs 54% more DALYs than it saves. In the medium-conservative case where 2 in 4 residents are impacted but still using the lower annoyance disability weight of 0.02, the cost jumps to 208%. The true burden may be much higher which is explored below.

To further assess the range of possible impacts, sensitivity analysis is done around two dimensions:

1. The proportion of affected residents is varied from 0.25 to 1. Different people have different sensitivities to being woken. Even within 500 feet of a train crossing, some people may sleep through a train horn while other may be quickly woken. Varying this parameter enables exploring a range of possible outcomes.
2. The disability weight is varied from "annoyance" at 0.2 to "sleep disturbance" at 0.07. Some people can quickly fall back asleep after being woken so a train horn might simple be an annoyance without causing much sleep loss. Others take a lot longer to fall back asleep if at all and may lose hours of sleep leading to more significant health issues. See Taylor (2024).

The figure below plots the full range of these possible outcomes. The large asterisk in the plot represents the point at which the cost/benefit trade off is break-even, that is DALYs saved from accident prevention equals DALYs cost from noise harm. Any point above this asterisk means $DALY_{\text{noise}} > DALY_{\text{attributable}}$ and the y-axis reports % Increase defined as:

$$100 \times \left(\frac{DALY_{\text{noise}}}{DALY_{\text{attributable}}} - 1 \right)$$

As can be see in the chart train horns are estimated to cause more DALYs to be lost than saved across a wide range of likely scenarios, hence the current policy appears to be net harmful.

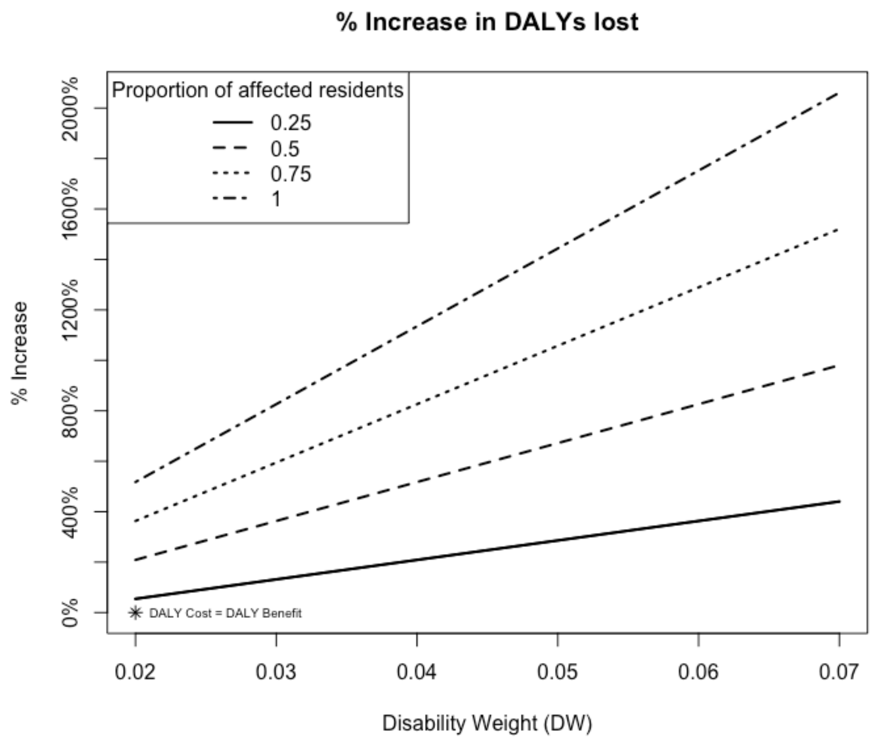

Figure 1: U.S. 200-2024

5.2 Utah analysis

Two Quiet Zones in Utah were suspended on September 30th, 2024 (the Lehi, UT and Woods Cross, UT Quiet Zones). For the following 6 months train horns sounded routinely at 67 train crossings spanning Provo to Ogden, many of them in highly populated areas. This presented a natural experiment to further assess the cost/benefit trade off of routine train horn use at night.

Using a similar approach as described above for the National level, an analysis focused only on the impact of the suspension within the Utah Quiet Zones is presented next.

Within the two Utah Quiet Zones there were 2 nighttime accidents–between 10pm and 6am–resulting in two injuries during the 5-year period 2020-2024 causing a loss of 53 DALYs.

To compare this to the impact on DALYs cost by noise exposure after the suspension the 53 DALYs can be normalized as follows to reflect the same time period of the suspension which at the time of writing had elapsed for ~6 months:

$$53 \times (\frac{\frac{6}{12}}{5}) = 53 \times 0.1 = 5.3\ DALYs\ per\ 6\ months$$

Because these areas were designated as Quiet Zones, the above represents the threat to life from nighttime accidents over a 5-year period *without* train horns. This is slightly different from the National case above which analyzed a counterfactual *as if* train horns had been banned.

The reason for the Utah suspensions was a number of safety items that needed completion including refreshing road paint, enlarging road signs, and lengthening medians that ran a few feet short, usually because of snow-plowable sloping end caps that reduced slightly the length of median at the required height. It's difficult to say how much increased risk these compliance lapses causes but a 25% increase in risk is a conservative assumption when we look at the risk reduction impacts of various safety features published in the Train Horn Rule. See "Appendix A to Part 222, Title 49 – PART 222: Use of Locomotive Horns at Public Highway-Rail Grade Crossings" (2023).

Under this 25% increase in risk assumption it is expected for there to be $5.3 \times (1 + 0.25) = 6.6$ DALYs lost per 6 months due to nighttime train accidents with the Quiet Zone remaining in place–with elevated risk due to the lapses in upgrades.

There are an estimated 2,371 residents living within 500 feet of crossings in the Lehi Quiet Zone and 2,454 residents living within 500 feet of crossings in the Woods Cross Quiet Zone.

Even in the ultra-conservative case where it is assumed that only 1 in 4 residents is affected with the lower "annoyance" disability weight of 0.02, the DALYs lost is 10.1 in a 6 month period, a 53% increase.

The results unambiguously demonstrate that despite the suspension being done in the interest of public safety, even greater harm has been imposed on the community beyond what is attributable to the crossing compliance lapses.

Furthermore, a survey of affected residents in Utah illustrated that many who live near the train tracks were losing 2 or more hours of sleep per night due to the suspension, well beyond the range where serious health and safety impacts occur. See Taylor (2024). This combined with the written comments from affected residents from a public petition to reinstate the Quiet Zones, describe many severe impacts (e.g. increases in depression, risk of driving and workplace accidents) suggests that using a disability weight closer to 0.07 or in some case higher would be appropriate for many residents. In light of these impacts the true cost could be as high as 2,000% more incremental DALYs lost relative to no suspension. See Change.org Petitioners (2025).

Like in the National case, sensitivity analysis is performed on both proportion (ranging from 0.25 to 1) of those impacted and severity of disability weight (ranging from 0.02 to 0.07). In all scenarios tested the incremental DALYs lost exceed the baseline level of expected DALYs with no suspension even after a 25% increase in accident risk is assumed. Hence the suspension appears to be net harmful.

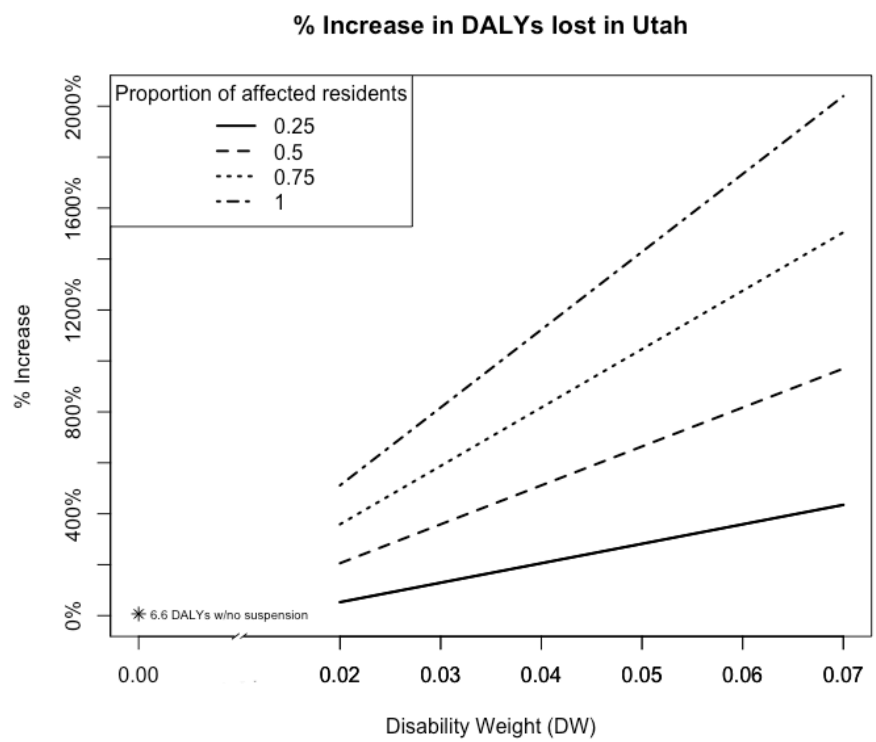

Figure 2: 6 Month impact of Quiet Zone suspension

The results point to an urgent need to revise how Quiet Zones are managed by both the FRA and cities which is discussed next.

6 Policy Implications

Given the degree and variety of adverse health effects stemming from sleep loss combined with the large number of affected residents, current policy appears to be doing significant net harm to many communities in the United States.

It's not known why the Federal Railroad Administration has never published a similar analysis as has been presented here when it's clear from their sleep advocacy for railroad employees that they recognize the importance of sleep.

The FRA should revisit their policies in order to make optimal decisions for public health and safety. Urgent action and further research are needed to address the public safety harms that have likely been imposed on communities across the United States since the FRA's Emergency Order No. 15 in 1991 and more recently in Utah and other places through Quiet Zone suspensions.

Railroad companies generally do not support Quiet Zones believing they "compromise the safety of railroad employees, customers, and the general public". See Union Pacific Railroad (2025). In light of the evidence presented in this paper they should reconsider this stance. Federal, State, and local governments should explore ways to be compensated for the negative externalities of train horn use in their communities.

New technologies should be explored to automate the use of train horns in situations where vehicles, pedestrians, or animals are on the track of a coming train. Advances in computer vision make this a likely opportunity for significant safety improvements while minimizing harmful noise exposure.

Finally, cities should be required to make mandatory disclosures on the status of Quiet Zones which the FRA provides after inspections so that residents can be informed on the risks of losing a Quiet Zone and petition their local officials to stay current on crossing safety lapses.

7 Conclusion

Under conservative assumptions the current train horn regulations in the United States are measured in DALYs to have cost 54%-208% more life than they have saved from forgone accidents in the period 2020-2024. The effect may be larger and a wide range of possible scenarios were presented. Furthermore, in the first 6 months, the recent Utah Quiet Zone suspensions have likely caused 53%-205% or more of incremental loss of life as measured in DALYs than would be expected to occur without the suspension.

Urgent action and further research is needed to address the public safety harms that appear to be being imposed on communities across the United States. Utah is the 8th locality in recent years to have their Quiet Zone suspended. See "Quiet Zone Suspensions" (2025) for a list of localities.

The analysis in this paper looked at only the most recent 5-year period. Future research should replicate and extend the analysis for all years since the FRA's Emergency Order No. 15 took effect in 1991.

Further research directions should also revisit the FRA's Florida study on which much policy has been based to evaluate the cost/benefit trade off rather than focusing exclusively on benefits.

While the population assumptions made in this paper are conservative, future research should also explore additional methods of estimating the number of residents who suffer from train horn noise exposure.

8 Reproducibility

All data and code used for this analysis are available on GitHub from sdmurff (2025) with an open MIT license to allow for reproducibility and further analysis.

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