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POTENTIAL COUNTERMEASURES TO MITIGATE SUICIDES ON THE RAILROAD RIGHTS-OF-WAY

Scott Gabree Ph.D.
Volpe Center
Cambridge, MA, USA

Stephanie Chase Ph.D.
Volpe Center
Cambridge, MA, USA

Ann Doucette Ph.D.
George Washington University
Washington, DC, USA

Michael Coplen, M.A.
Federal Railroad Administration
Washington, DC, USA

ABSTRACT

In 2010, 38,364 individuals intentionally ended their lives in the United States (US).¹ It is estimated that less than 1% of these individuals took their life on the railroad rights-of-way. Despite the infrequency of this type of event they can have a great impact not only for the individual involved and their family and friends, but also for train crews, first responders, and bystanders. The railroad carriers also experience impact from these incidents through scheduling delays, and the potentially debilitating physical and psychological effects on those involved in the incident.

Suicides on the railroad rights-of-way represent a large proportion of all railroad fatalities. In 2012, 242 fatalities on the railroad rights-of-way were determined by a coroner or medical examiner to be suicides. During that same time period, the railroad industry experienced 429 trespasser fatalities and 192 grade crossing fatalities that were *not* determined to be suicides, indicating that suicides were the second leading cause of death on the railroad rights-of-way in 2012.ⁱ

Research has investigated countermeasures to mitigate suicide in a general sense (i.e., not railway specific suicides, but suicides by all means). The FRA Office of Research and Development made an effort to document suicide countermeasure strategies which have been implemented or conceived for implementation in the railroad environment worldwide. The focus of this paper is to increase the reader's

knowledge about the potential benefits and limitations that a specific countermeasure may impose for the railroads specific circumstances. This document is a summary of a more comprehensive paper that is expected to be published later in 2014.

INTRODUCTION

In the United States the majority of suicides that occur on the railroad rights-of-way are the result of an individual trespassing on the railroad right-of-way.ⁱⁱ Trespassers are defined by the FRA as unauthorized “persons who are on the part of railroad property used in railroad operation and whose presence is prohibited, forbidden, or unlawful.”² Of the 863 total fatalities which were reported in 2012, 542 were trespass incidents and 242 were classified as suicide incidents, indicating that over 90% of all fatalities were either trespass or suicide related.³ Additionally, a large number of individuals who are struck by a train do not die, but are injured. In 2012, there were 683 trespass and suicide injuries reported by the FRA, indicating that approximately 53% of all collisions between a trespasser and a train result in a fatality.

Though already a concern for the FRA and the railroad industry; the number of trespassing incidents is likely to grow as the use of railroad public transportation increases across the nation. In FY2013, 31.6 million passengers rode on Amtrak, the largest recorded ridership in Amtrak history, and tenth ridership record in the past eleven years.⁴ With an increase in ridership comes an increase in the opportunities for incidents and thus an increased need to ensure that those that ride the railroad system are safe and that delays in commutes are minimized.

ⁱ There were a total of 232 grade crossing fatalities in 2012, however, 40 of these were determined to be acts of suicide and are thus counted among suicides.

ⁱⁱ A suicide may *not* be considered a trespasser if the individual is fatally struck at a grade crossing or other pedestrian crossing.

Though trespasser prevention is emphasized, suicides on the railroad right-of-way may be overlooked when trespasser-specific research and countermeasures, actions taken, or strategies implemented to reduce or prevent undesired outcomes are developed. Suicide and trespasser fatalities have nearly identical impact on the railroad industry in terms of cost and delay. The difference between the two is in the intent of the individual involved; a trespasser either misjudges or is unaware of the oncoming train whereas an individual attempting suicide is intent on being struck and killed by the train. Countermeasures for one group may not be generalizable to the other, and may in fact have differential effects.

The FRA and railroad industry not only have a concern regarding individuals who use the track as a means for completing or attempting suicide but also those associated with the event who may witness or assist in the management of a potentially traumatic event. While the railroad is not able to identify suicidal individuals, or directly assist them in seeking treatment, railroad carriers are neighbors to the communities they serve and may be in a position to work with these communities to attempt to block the means of suicide at certain locations or provide resources (such as crisis hot line number on signage) to deter the act from being attempted on the railroad right-of-way. Such mitigation strategies may be implemented by the railroad carrier alone or with assistance from local communities or care providers. There is no “correct” way to mitigate or prevent suicide on the railroad rights-of-way. Each railroad will need to assess their particular concerns in terms of when and how these incidents are occurring and then plan a course of action which is most likely to be effective.

For example, railroad stations are highly visible locations where large numbers of individuals pass through. This may afford the opportunity to disseminate information about available help services or to observe behaviors that may indicate that an individual may be considering suicide at or around the station. This strategy would be of little use to freight operations which do not frequent passenger stations. Many rail-related suicides occur on the open track with vast area to cover.

Although ideally the railroad carrier would want to restrict access to the entire right-of-way that is likely not feasible either physically. However, the communities and railroads may be able to identify and develop ways to physically restrict access to locations of concern on their right-of-way to reduce the possibility that these incidents occur; especially at “hotspot” locations.ⁱⁱⁱ

The purpose of this report is to provide an overview of suicide mitigation efforts (countermeasures) that have already been

implemented or have been conceived for implementation in the US or worldwide. Each countermeasure discussed would involve, if implemented, at least partial railroad carrier participation. While not all countermeasures presented are recommended or even feasible for railroads to adopt, the FRA purposively included all known concepts as they may centralize knowledge of countermeasures and provide insight in terms of characteristics that inform efforts to reduce and/or prevent suicide on the railroad right-of-way.

Countermeasures may attempt to reduce suicides in a variety of different ways. Some countermeasures may attempt to mitigate suicides through physically restricting access, while others may take a more psychological approach or attempt to alter behavior without physically modifying the train or railroad environment. The document is categorized into sections which describe the way that each proposed countermeasure aims to mitigate suicide acts on the right-of-way. The five categories are:

1. Countermeasures for the Reduction or Prevention of Suicidal Ideation in the Railroad Environment
2. Countermeasures for the Reduction of Perceived Viability of the Rights-of-Way as a Means for Suicide
3. Countermeasures for the Prevention of Access to the Tracks
4. Countermeasures for the Increased Ability of Avoid a Train-Person Collision
5. Countermeasures for the Reduction in Lethality of a Train-Person Collision

The document is structured such that potential countermeasures are listed with the section that suits how they attempt to address suicides on the rights-of-way. If successful, countermeasures which address the issue from any of these angles may mitigate suicides on the rights-of-way, though through different means. In many cases, attempting to mitigate suicides through countermeasures in more than one category may prove most effective. For each countermeasure listed within a category two sections are provided: first, a high level summary of the countermeasure; and second, select details which pertain to what is known about this countermeasure. For more comprehensive information about each countermeasure the FRA Countermeasure R&D report will be available later in 2014.

1. COUNTERMEASURES FOR THE REDUCTION OR PREVENTION OF SUICIDAL IDEATION IN THE RAILROAD ENVIRONMENT

A discussion of potential countermeasures that could be used in a railroad environment with the aim to reduce an individual’s suicidal ideation is presented in section one. Suicidal ideation refers broadly to the thoughts about suicide that an individual has prior to considering ending their life. Reducing a person’s suicidal ideation will reduce the likelihood that they attempt suicide. These countermeasures may impact not only

ⁱⁱⁱ A hotspot location is defined as a region of track where multiple suicides have occurred over a brief timespan. The specifics of both the region of track and the timespan used to define a hotspot may vary depending on the purpose of the analysis. Hotspots may occur for trespassers in locations that are commonly used shortcuts to illegally cross the right-of-way or for suicides where a prior suicide may have elicited copycat acts.

individuals who consider completing suicide on the railroad rights-of-way, but also those who use the railway system and may have considered suicide by another means. Potential countermeasures discussed in section one include: Blue Lights, Gatekeeper Training, Public Awareness Campaigns (Suicide Focused), Signage (Crisis Center), and the Training of Mental Health Providers.

1.1. BLUE LIGHTS

Summary: The installation of blue lights in railway stations has been implemented with the goal of reducing suicide rates through the properties of the light itself. In theory (though not yet proven) the blue light would cause a calming effect for individuals and make them less likely to attempt suicide. Blue LED lighting has been installed in railroad stations in Japan for this purpose.

Select Details: In November of 2009, the East Japan Railway Company has installed blue lights at each end of the platform at all 29 stations on the central train loop (Yamanote line) in Tokyo with the goal of reducing the number of suicides. Similarly in 2010, the West Japan Railway company has also installed blue lights at 94 railway crossings. Although a significant reduction in suicides was found with the use of the blue lights in Japan, researchers concede that there has been no examination of the mechanism by which the blue lights actually reduce the number of suicides.⁵ Additionally the study included a small sample size and tested in short duration, limiting the meaning behind the findings.⁶ Without understanding how the blue light is expected to affect suicidal individuals, it is difficult to interpret any changes in suicide rates in a meaningful way. Additionally, known hazards of blue light on visual health and sleep schedules may caution railroads to rush towards implementation of such a countermeasure. This countermeasure should be better understood before being implemented widely in the US.

1.2. GATEKEEPER TRAINING

Summary: The training of station personnel or other individuals to identify at risk behaviors and intervene appropriately. Individuals at risk for suicide often display warning signs prior to a suicide attempt, thus interventions by nearby personnel may be possible.

Select Details: Currently, there are no known empirical studies assessing the impact of gatekeeper training on suicides on the railroad rights-of-way. The effectiveness of gatekeeper training depends on the individual's ability to identify risk based observable behaviors. Therefore behaviors which are common preceding suicides on the railroad right-of-way can be very important predictors for individuals in the gatekeeper role.^{7,8} These individual behaviors may be used to identify those who are at risk of attempting to enter the right-of-way with the intention to die. For example, German Federal Police were

surveyed about what behaviors they had witnessed prior to suicides on the railroad right-of-way and more than half had observed the dropping or leaving behind of personal belongings and an avoidance of eye contact and more than a third had observed erratic gestures or movements.⁹ Making personnel aware of these types of behaviors could become part of gatekeeper training in addition to training for how to intervene appropriately once these types of behaviors are observed. Gatekeeper training programs are currently employed by Network Rail in the UK through the support of Samaritans, a suicide focused charity.¹⁰ Over 4,000 railway staff have been trained and an increase in successful interventions have been reported. However, in the US many suicide incidents occur most often on open track, so it is not clear how well these successes would translate.

1.3. PUBLIC AWARENESS CAMPAIGNS (SUICIDE FOCUSED)

Summary: An effort to educate the general public about suicide on the railroad rights-of-way via advertisements and targeted messaging. These campaigns may be presented in the railroad environment, but would pertain to suicide in general.

Select Details: Currently, there are no known public awareness campaigns in the US which directly address suicides on the railroad right-of-way. Public awareness campaigns which target suicide in general or advertise help for those in distress are more common, however, and these types of campaigns may be presented in the railroad environment. For example, in the UK a public awareness campaign known as "We're in your Corner" was implemented through a partnership between Network Rail and the Samaritans. The campaign displayed posters in and around railway stations to encourage middle-aged men, who make up approximately 80% of UK suicides on the railroad rights-of-way, to seek help for mental health issues. To date there is no direct evidence in support or against the potential of railway suicide specific awareness campaigns to reduce suicides on the railroad right-of-way.

1.4. SIGNAGE (CRISIS CENTER)

Summary: Placing signage that promotes a crisis hotline in railroad stations and near crossings or along open track with the goal of having individuals with suicidal intent call the hotline number before deciding to take their life.

Select Details: The placement of signs to promote the accessibility of crisis hotlines is an effort that has been implemented worldwide. Signage has been placed on trains, in railway stations, or at other strategic locations along the right-of-way (e.g., grade crossings or known locations of past completed or attempted suicides). These signs can vary greatly in message and design, but many direct the reader to contact a local crisis center if they are in need of help. By placing these signs near railroad rights-of-way, individuals considering

suicide may choose to call this number before acting. As of August 2013 the following railroads are known to have implemented signage campaigns which provide a telephone number of a local or national crisis center: Caltrain, Long Island Railroad (LIRR), Massachusetts Bay Commuter Railroad (MBCR), Massachusetts Bay Transit Authority (MBTA), Metra, New Jersey Transit (NJT), and Washington Metropolitan Area Transit Authority (WMATA). Outside of the US, Toronto Transit (TTC) in Canada began using a signage campaign similar to those being used in the US in June of 2011.¹¹

The effectiveness of signage for reducing the number of suicides on the railroad right-of-way is not well understood. Only a portion of the railroads that have implemented signage have evaluated the use of the crisis center hotlines advertised on the signs. Due to the relatively small number of suicides that occur on a given railroad right-of-way in a given year, it may take several years to collect enough data to assess the effectiveness of such an intervention. Instead of assessing effectiveness solely through a count of suicides on the railroad right-of-way, some railroads have decided to include a unique crisis center telephone number on their signs so that they can work with the crisis center to better understand who is taking advantage of the signage.



Figure 1. Signage Use by Caltrain

1.5. TRAINING OF MENTAL HEALTH PROVIDERS

Summary: Supplying mental healthcare providers with sufficient information to heighten awareness of suicides on the railroad rights-of-way.

Select Details: Past research indicates that substantial proportions individuals who die by suicide on the railroad right-of-way and via other means have had contact with a mental health provider. For example, fifty-three percent of all suicides on the Dutch railway were receiving psychiatric care at the time of their death, including 49% who were in inpatient care.¹²

It may be possible for mental health providers located near the railroad rights-of-way to work with the railroad to be more

informed about the increased risk for suicides on the railroad right-of-way. Training may specifically mention the railroad and warning signs specific to suicides on the railroad rights-of-way, but it would also train providers in the identification of individuals at risk for suicide by any means. The goal is that if efforts to reduce suicides by all means are focused in locations near the rights-of-way, that suicides on the rights-of-way would likely also be reduced. Before investing in such an effort, time should be taken to understand if the proximity of a mental health facility does indeed increase the likelihood for suicide on the right-of-way nearby.

2. COUNTERMEASURES FOR THE REDUCTION OF PERCEIVED VIABILITY OF RIGHTS-OF-WAY AS A MEANS FOR SUICIDE

A discussion of potential countermeasures used to reduce the perception of the railroad right-of-way as a viable means of suicide is presented in section two. As with countermeasures presented in section one, these countermeasures may also have variable effectiveness. Individuals no longer seeing the railroad right-of-way as a viable method of suicide may still choose another means. In that case, beneficial impact would be for train operations, bystanders, passengers, and so forth. We know that the effects of a trespasser strike or suicide on those who are immediately involved or who witness such an event can be profound, so any reduction in the number of incidents that occur on the railroad right-of-way is valuable.¹³ It has also been shown that if one means of suicide can be prevented, individuals may not seek out other means to complete that act. Potential countermeasures discussed in section two include: Media Guidelines/Media Training and Public Awareness Campaigns (Railroad Focused).

2.1. MEDIA GUIDELINES/MEDIA TRAINING

Summary: Training the media or developing guidelines for the media to follow when reporting on suicides that occur on the railroad right-of-way. The goal is to encourage reporting practices that do not encourage copycat behavior.

Select Details: Media guidelines have been developed both in the United States and internationally to assist the media in reporting about suicide in a responsible way. For example, educating the public about suicide prevention, help readers identify warning signs or likely causes of suicide, and reduce the likelihood of copycat incidents. Impacts by the media on suicide rates on the railroad rights-of-way have been documented. One example can be seen from the suicide of Robert Enke, a well-known German soccer player, on the railroad right-of-way in Germany.¹⁴ An overall increase of 81% (from approximately 2.0 to 3.7 suicides per day on the railroad right-of-way) in the number suicides on the railroad right-of-way was found just after Enke's death when compared to similar, adjusted time periods from the years preceding it.

Although these guidelines are not specific to the railroad, they can likely be applied to suspected suicides on the railroad rights-of-way. It may be possible for railroad personnel to become familiar with or be trained on how to use these guidelines so that when they interact with the media, they can provide information which encourages responsible media reporting practices. In many cases, railroads already have policies for media interaction in place, however, a better understanding of how best to encourage responsible reporting may be necessary.

2.2. PUBLIC AWARENESS CAMPAIGNS (RAILROAD FOCUSED)

Summary: Promoting awareness for the general public of the dangers of trains in a way that does not inadvertently advertise the railroad right-of-way as a potential means for suicide.

Select Details: Currently, a variety of public awareness campaigns exist to reduce the number of trespass related incidents on the right-of-way. For example, in the form of billboards, this public awareness campaign discourages trespassing by implying that being struck by a train will result in death. An example of a billboard by the Tennessee Department of Transportation (DOT) is seen below.

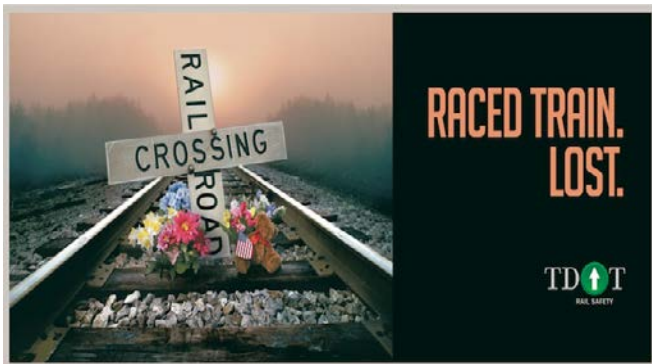


Figure 2. Tennessee Department of Transportation Railroad Crossing Billboard

This type of messaging may be thought to be an effective way to discourage trespassing; it may also have an unintentional effect of drawing the interest of an individual with suicidal intent to consider the railroad this as a possible means to complete suicide. Additionally, as described earlier, nearly 50% of trespasser strikes result in injury and not a fatality. Currently, there are no known nationwide public awareness campaigns in the US that specifically address suicide on the railroad right-of-way. However, multiple public awareness campaigns exist for trespassing on the railroad right-of-way (e.g. Brainy's World campaign). Passenger railroads may be best equipped to implement smaller scale public campaigns such as poster campaigns on trains or at stations. It is also worth noting that public awareness campaigns specifically designed for the railroad industry are not intended for other means of suicide,

but may nonetheless have beneficial outcomes for suicide in general.

3. COUNTERMEASURES FOR THE PREVENTION OF ACCESS TO THE RIGHT-OF-WAY

A discussion of potential countermeasures used to physically deter an individual with suicidal ideation and sees the right-of-way to be a viable means for suicide is presented in section three. With roughly 140,000 miles of mainline railroad track in the US, restricting access to the entire right-of-way is not feasible. However to deter the individual by physically limiting access in specific locations on the right-of-way you may remove the possibility that the train can strike them in areas of increased risk, or "hotspots". Potential countermeasures discussed in section three include: Means Restriction/Fencing and Platform Edge Doors (PEDs).

3.1. MEANS RESTRICTION/FENCING

Summary: Directly restrict access to the rights-of-way through fencing or other similar efforts, such as bushes or sound attenuating walls.

Select Details: Fencing is currently being used widely by passenger railroads in an effort to keep trespassers off of the railroad right-of-way. While fencing the entire right-of-way is not feasible, it may be feasible to fence areas which have been identified as a high risk for suicides on the railroad right-of-way. More research is needed to better understand where these high risk regions of track are and why certain regions of track see temporary increases in suicide activity. Communities working with railroads must also consider the durability of the fencing options and the cost of maintenance, especially if less durable fencing options are used. Weighing the costs (including both upfront costs and maintenance costs) and benefits may help railroad carriers to determine if fencing is a viable option and what types of fencing will be most cost effective in the long term. Railroads may be able to work with local communities to share the cost of installing or maintaining fencing along the right-of-way. Additionally, mid-platform fencing (see image below) may be considered for stations where trains pass through at high speeds.



Figure 3. Mid-platform fencing at a station in the UK

No studies in the US were found that evaluate the effectiveness of fencing to deter suicides on the railroad right-of-way. In the United Kingdom (UK) the majority of the right-of-way is fenced in part because of older laws intended to keep livestock from venturing onto the right-of-way^{iv}. In the US, such widespread fencing may not be possible due to the extensive nature of the railway system (over 13 times more track).¹⁵ However, despite having relatively few trespasser related fatalities in the UK, the number of suicides per year is still quite high. This may bring into question whether fencing, and more specifically, certain types of fencing (some of which may not be as robust, e.g., if the intention of the fencing along portions of the track is to prevent livestock access), is effective at preventing both unintentional deaths and suicides on the railroad right-of-way.

3.2. PLATFORM EDGE DOORS (PEDS)

Summary: Installation of automatic doors in railway stations which remain closed, restricting access to the tracks rights-of-way until the train has completely entered the station and the train doors open.

Select Details: Platform Edge Doors (PEDs), also known as Platform Screen Doors (PSD) are doors on a train that open after a train has completely entered a station and stopped to prevent individuals from entering the right-of-way before a train arrives. Most PEDs are made of glass may extend the full length of the right of way at the station to completely seal off the entrance until the doors open. The PED may also partially cover the right of way acting more like a fence with open space above it.



Figure 4. Platform Edge Doors on Taipei Metro

PEDs have been installed at railroad stations around the world, including the UK, Hong Kong, France, Japan, Mexico, Singapore, and even in the US on Airport Transportation Systems such as the railway at O'Hare International Airport in Chicago, Illinois, Hartsfield-Jackson Atlanta International Airport, and Washington Dulles International Airport in Washington, D.C. In many cases, the PEDs are installed as a means to better control the heating and/or cooling of the station (i.e., the PEDs minimize the warm/cool air that escapes down the right-of-way) or to keep debris from landing on the right-of-way.

The installation of PEDs in passenger railroad stations in the US holds promise, but may be costly. Additionally, the majority of suicides on the rights-of-way in the US take place on open track where PED installation is not possible, thus limiting the utility of this countermeasure in the US. However, if specific railway stations exhibit higher than expected rates of suicides, it may be worth considering a smaller scale implementation.

4. COUNTERMEASURES FOR THE INCREASED ABILITY TO AVOID A TRAIN-PERSON COLLISION

A discussion of potential countermeasures which increase the ability of the train to avoid a collision with a person is presented in section four. These countermeasures may be impactful if an individual is able to gain access to the rights-of-way and they are intent on being struck by a train. These countermeasures involve efforts to move the individual out of the path of the train or to stop the train prior to impact. Potential countermeasures discussed in section four include: Anti-Suicide Pits, Long Range Acoustic Devices (LRADs), Speed Restrictions, and Track Surveillance.

^{iv} The Railway Safety (Miscellaneous Provisions) Regulations 1997 requires railroads to ensure that unauthorized access to the railway by persons or animals is prevented. In 2011, the Office of Rail Regulation (ORR) fined Network Rail £15,000 for failing to adequately maintain a trackside boundary fence in Whisby Nature Park, Lincolnshire (see <http://www.rail-reg.gov.uk/server/show/ConWebDoc.10333>. Last retrieved April 7, 2014).

4.1. ANTI-SUICIDE PITS

Summary: Elevated tracks in railway stations which provide enough room below the tracks for an individual to avoid being struck by a train.

Select Details: Roughly half of the stations on the London Underground in the United Kingdom (UK) that are deep underground, a term used but not defined by the researchers, have pits beneath the track.¹⁶ These pits, originally built for drainage, are known as “anti-suicide pits” and have been found to help prevent death or serious injury to individuals who fall or jump onto the right-of-way. These pits are approximately three feet deep.



Figure 5. Anti-Suicide Pits on the London Underground

This space provides individuals who accidentally fall onto the right-of-way or who have second thoughts about their actions a quick way to avoid being struck by the train (by laying underneath the train in the pit). The space also makes it difficult to individuals to be pulled underneath the train where additional injuries are likely to occur – instead they are knocked below the train into a space where the train will no longer strike them. Other stations, such as the Bangkok Skyrail and Paris Metro are believed to also have anti-suicide pits along some of all of the system, but less is written about these installations. There is very little evidence of the impacts of anti-suicide pits on attempted and completed suicides.

4.2. LONG RANGE ACOUSTIC DEVICE (LRAD)

Summary: Using targeted, intense sound waves to create an unpleasant setting for individuals on the railroad right-of-way, causing them to voluntarily remove themselves from the right-of-way.

Select details: The use of non-lethal acoustic devices to dissuade people from staying on the right-of-way has been discussed by individuals involved in or familiar with the railroad industry. The concept is that the train driver would be able to use High Intensity Directed Acoustic (HIDA) devices

such as the Long Range Acoustic Device (LRAD) to deliver a burst of sound (up to 130db) directly at the individual. This is unique from a train horn in that the sound is both louder and more directionally specific so that the increased noise should not affect nearby listeners, but will be uncomfortably loud for those on the right-of-way. The goal is that the LRAD will create a situation so uncomfortable for the individual that they would leave the right-of-way. However, there are other concerns with the use of such technology. First, LRAD has been found to cause ear pain, vomiting and migraines, which raises concerns over ethical issues. Secondly, LRAD has also been found to cause a loss of equilibrium in some cases, which may be an important consideration in the railway environment where a loss of equilibrium may make it more difficult for an individual exit the right-of-way.¹⁷ Lastly, this technology has never been tested in the railroad environment so it remains unclear where such a device would be mounted, how it might be activated, and how effective it would be, especially around curved track. Further testing is needed to understand if there are sounds which would be able to elicit the desired behaviors from the individuals trespassing on the right-of-way. Implementing this type of technology without understanding the potential negative effects may not be advisable.

4.3. SPEED RESTRICTIONS

Summary: Reducing the speed of trains (at least in selected areas) to reduce the severity of a collision or to provide greater likelihood of braking before the collision.

Select details: One way to avoid colliding with an individual who has entered the railroad right-of-way is to stop the train before the collision. However, a train can take a significant distance to stop even after emergency braking has been initiated. A freight train travelling at 100km/hr (62mi/hr) will require approximately 2 km (1.2 miles) to stop, while a passenger train travelling at 160km/hr (100mi/hr) will require a similar stopping distance. One of the major factors that affect the braking distance of a train is the speed it is traveling, especially for lighter non-freight trains, which have less force driving the train forward. While other factors also influence braking distance, such as the mass of the train or the gradient of the track, speed is one of the few that can be actively controlled by the train engineer. Reducing the speed of that trains travel will, to some degree, reduce the braking distance of the train; however, the small reduction in braking distance may not be sufficient in stopping the train to prevent injury, especially on the open track, nor would it be justify in terms of the delays in freight and passenger traffic that these reductions in speed will cause. Speed restrictions, if effective, would ideally avoid collisions entirely though they also may also be categorized under section five - Countermeasures for the Reduction in Lethality of Train-Person Collisions, as they may have the potential to make collisions less likely to result in a fatality. Little empirical evidence exists about the potential impacts of

reducing train speeds on fatalities, especially when considering individuals attempting suicide.

4.4. TRACK SURVEILLANCE

Summary: Continuous observation of the right-of-way either by individuals, technology, or a combination of both. A plan would be in place for authorities to be notified of suspicious behavior or individuals seen in restricted locations.

Select details: Monitoring the right-of-way is one way to potentially identify individuals on the right-of-way prior to the arrival of a train at that location. This monitoring could be done through technology, such as cameras or sensors along specified regions of track, or through direct or video monitoring by railway or law enforcement personnel. Monitoring the entire 140,000 plus miles of track in the US may prove difficult; however, stretches of track that have been identified as points of access or hotspots may be targeted for surveillance. Many railroads currently train their operating personnel to be observant of any trespassing or unauthorized personnel on the tracks and report them to the appropriate authorities. This may help to identify specific stretches of train that require frequent monitoring. Key to the potential success of such a countermeasure is a clearly defined plan for how to act once an at-risk individual is identified. In other words, a countermeasure focused on surveillance will only have the possibility of being effective if it is paired with enforcement or train crew notification. Additionally, false alarms may be a concern since animals often pass across the tracks in many locations.

5. COUNTERMEASURES FOR THE REDUCTION IN LETHALITY OF TRAIN-PERSON COLLISION

Once an individual has been struck by a train, the only remaining barrier to a fatal suicide attempt is reducing the likelihood that the strike is lethal. The countermeasure discussed in section five assumes that a collision between the train and person is no longer avoidable. Once a collision is imminent there are few countermeasures that may be effective at reducing lethality aside from the possibility of modifying the train itself. Only one countermeasure, Train Modification, is discussed in section five.

5.1. TRAIN MODIFICATION

Summary: Various concepts and patents have been developed with the specific goal of modifying the front of the train to reduce the lethality of the impact with an individual. None of these concepts have been tested so their potential for success is unknown.

Select Details: Modifications to the front of the train have been proposed as a way to reduce the lethality of train strikes. These

concepts are likely inspired by the pilot, or cowcatcher, that may be mounted on the front of a train to deflect debris or other obstacles from the track. Proposed patents typically involve an airbag or other collision attenuation system to be mounted on the front of the train. None of the patents that have been proposed have been tested in the railroad environment, thus the feasibility of these concepts are currently unknown. Additionally, given the immense mass of a train it is unclear how effective any modification would be at preventing or reducing injuries or fatalities.

CONCLUSIONS

Suicides on the railroad rights-of-way not only affect the individual involved and their friends and family, but also those railroad personnel involved in the incident. Although railroads have begun to implement various countermeasures which may reduce the suicides, few if any of these interventions have been evaluated for their effectiveness. Implemented countermeasures include the installation of fencing and, on some passenger lines, the posting of signage to direct at risk individuals to call a crisis center hotline. It is increasingly important for railroad carriers to consider these countermeasures in terms of their effectiveness, especially given budgetary constraints and increased demands for railroad efficiency.

Countermeasures aimed to mitigate suicides on the rights-of-way may intervene in very different ways. Some proposed countermeasures have a physical impact, such as restricting access to the tracks, whereas others act in a more psychological nature by attempting to alter an individual's thoughts about suicide or the railway. No one strategy is perfect for all scenarios and in many cases the best method for preventing a suicide on the railroad right-of-way is to implement a variety of countermeasures aimed to mitigate suicide in different ways.

Not all of the countermeasures will be feasible for railroads to implement. For example, even if there were no cost concerns, a freight railroad cannot realistically implement gatekeeper training, platform edge doors, or anti-suicide pits. Additionally, many of these countermeasures remain untested and, if implemented without careful evaluation, such efforts precipitate unintended consequences, or result in costs without positive returns on the investment. Railroads may consider which combinations of countermeasures are most likely to affect the types of incidents they wish to prevent. Railroads may also consider reaching out to other potential stakeholders, such as local communities or land owners for collaboration in implementing or maintaining countermeasures. For example, if a passenger railway line has been the location of suicides near a school, then perhaps partnerships with school counselors, targeted public awareness in collaboration with the local community or a carefully worded signage campaign may be most effective.

Additionally, suicides on the railroad right-of-way are not only an issue of concern for the FRA and railroad company, but also for the community in which these incidents are occurring.

Railroads may consider working collaboratively with local communities in areas where multiple incidents have occurred to coordinate resources to implement successful countermeasures. Many of the countermeasures discussed in this document can be implemented in targeted areas where countermeasures are most needed. This is likely to be the case when a community partnership will be most effective. For example, a community may be willing to help fund the installation or maintenance of a fence in an area that is known to be susceptible to suicide attempts. A partnership where both parties help to defray the full cost of such countermeasures is likely to help both the railroad and the community in the long run. The most effective approach will also include a careful evaluation of each countermeasure as it is being implemented.

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