

Report on the Challenges of Air Transportation Experienced by People with Disabilities

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IE490/BME495: Grand Challenges in Accessibility

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Table of Contents

Executive Summary	1
Chapter 1	2
Section 1.1: Trends	2
Section 1.2: Gaps for Innovation	3
Section 1.3: Upcoming Solutions	4
Section 1.4: Implementation Strategies	5
Chapter 2	7
Section 2.1: Current Laws.....	7
Section 2.2: Noncompliance with current laws	9
Section 2.3: Law solution and comparison	10
Section 2.4: Current Staff Training.....	11
Section 2.5. Staff training solutions.....	13
Chapter 3	16
Section 3.1: Introduction.....	16
Section 3.2: Airport Navigation.....	17
Section 3.3: Airport Emergency Protocol	21
Section 3.4: Baggage Handling.....	23
Section 3.5: Airport Security	25
Section 3.6: Conclusion	29
Chapter 4	29
Section 4.1: Passenger Preparation	30
Section 4.2 Airline Notification and Preparation.....	33
Chapter 5	36
Section 5.1: Introduction.....	37
Section 5.2: Problem #1 – Boarding Chairs.....	37
Section 5.3: Problem #2 – Damage to Wheelchair	40
Section 5.4: Problem #3 – Access to restrooms in flight.....	42
Section 5.5: Problem #4 – Airplane Seats	45
Section 5.6: Hypothesis #1 – Detachable Wheelchair Plane Seats.....	47
Section 5.7: Hypothesis #2 – Personal Wheelchair Accommodations	48

Section 5.8: Hypothesis #3 – Universally Accessible Bathrooms	50
Chapter 6	56
Section 6.1: Introduction.....	56
Section 6.2: Background	56
Section 6.3: National Database	57
Section 6.4: Airplane Accommodations for Service Animals	60
Section 6.5: Airport Accommodations for Service Animals	61
Section 6.6: Conclusion	64
Recommendations	65
Methodology	67
References	69
Appendix A	75
Appendix B	85

Executive Summary

Air travel offers considerable stress to those with disabilities resulting in over 30,000 disability-related complaints annually and over 700 damaged scooters, wheelchairs, or other mobility devices in December 2018 alone. In this report several pain points have been identified along with potential recommendations. Innovation gaps are prevalent in legal regulations and outdated air transportation design. Accessible design features, accommodations, level of staff training, and customer satisfaction click save are some proposed metrics for evaluating compliance to current regulations and to show improvement in air travel conditions for people with disabilities.

Lack of air transportation accessibility has been persistent due to lack of awareness and accommodations, inaccessible design, and poor enforcement of laws. There are huge differences between accessibility requirements and standards throughout air transportation leading to a lack of communication and frequent serious mishaps between different airports and airline carriers that can cause confusion and poor travel experiences for persons with disabilities. For example, accessibility of airports is governed by the Americans with Disabilities Act (ADA); whereas airplanes fall under the mandate of the Air Carrier Access Act (ACAA).

People with disabilities act numerous barriers when entering an airport. Their layout and design, stores and restaurants, and walkways and seating areas are often cumbersome or inaccessible. Navigation of airports and among the different transition points during air travel present challenges to passengers with mobility, sensory, and cognitive disabilities. This is coupled by accommodations to assist those individuals, including wheelchair assistance, navigational aids and information about accessibility services, often being unavailable or requests for these accommodations not being properly relayed. Databases to control this information along with appropriate notifications can help facilitate the allocation of travel accommodations more thoroughly. Transportation Security Administration (TSA) checking and emergency planning also do not adequately consider the needs of customers with disabilities.

Boarding an airplane is difficult for persons with mobility impairments and increases the risk of injury to both passengers and employees. Airplane seats are uncomfortable and lack the necessary support for many individuals with disabilities. Additionally, airplane restrooms can be inaccessible to wheelchair users. Potential solutions for these issues include the use of detachable plane seats or personal wheelchairs on board and an airplane redesign to provide additional restroom space. The number of service and emotional support animals being brought on airplanes have also increased substantially over the past few years. Passengers that travel with their service animals must contend with having to follow different rules for different airlines carriers and not having sufficient space for animals to be safe and comfortable.

Chapter 1

Title: **Potential Problems and Solutions**

Authors: Hayley Engstrom, Abhi Mishra, Hailey Mueller, Tyler Villa

Section 1.1: Trends

Difficulty accessing air travel is the primary complaint for many individuals with disabilities, and trends show a clear increase in dissatisfaction with airports and airplanes for these individuals. They face a multitude of challenges with mobility accessibility, service animals, preparative procedures, and air staff personnel. Since airline carriers are not bound to the regulations of the American Disabilities Act (ADA), airplanes and airports lack many of the basic accessibility features required for individuals with disabilities, such as walkways with a minimum width of 36-inches and slopes with a grade ratio of one-to-twelve. In 2017, the Paralyzed Veterans of America (PVA) conducted a survey study on the air travel experiences of passengers with disabilities with questions addressing a broad range of issues—wheelchair damage, use of service animals, and airplane seating. The PVA reported one of the most telling survey questions to be, “How many times have you flown commercially in the last five years?” Amongst the responses of people who had not flown at all during that period were fears of the airline personnel breaking customers’ wheelchairs, horror stories of air travel with a wheelchair, and medical complications, such as pressure sores or skin issues. To raise awareness about these issues and showcase progress, the PVA developed a website meant to document the positive and negative experiences of travelers with disabilities. Recently, this website features stories about a passenger’s ankle breaking while the airline personnel attempted to help him board the airplane, a quadriplegic man being transferred five times for the duration of a flight for the convenience of an able-bodied passenger, and multiple recounts of feeling extreme anxiety throughout the entire flying process.

The Tourism Management journal included a study in 2010 examining the perceived importance and satisfaction with air transportation services for individuals with impaired lower extremity function. The results of this study of 130 valid participants concluded that the top three important items were slip resistant floors in the airport, boarding priority, and convenience of wheelchair consignment and retrieval. The top three satisfaction items were the cabin crew’s attitudes, assistance in boarding and deplaning, and the staff’s attitudes at the check-in counter, and the top three least satisfactory items were distance between the restroom and cabin seats on board, user-friendly on-board restroom, and the cabin seats.

These organizations primarily address the technical, mechanical issues with aircraft transportation accessibility for individuals with disabilities. Another aspect that is touched on is

the personal, emotional difficulties that arise during procedures involving observation from surrounding passengers. Many individuals surveyed in these studies and those who submitted stories to the PVA's website mentioned experiencing embarrassment and humiliation in situations, such as boarding the airplane last, inaccessibility of toilets on the flight, and seat transfers once boarded on the plane. These issues are often overlooked when considering the design of airports and airplanes, but they contribute significantly to the passenger's mental health and to the overall customer satisfaction, making them worthy of addressing as well.

Another element to consider is the "caregiver" role that is often paired with a traveling individual with disabilities. The caregiver is responsible for helping with transportation of luggage, assisting with transfers of the passenger with disabilities, and being the lead through the entire traveling process. The caregiver's job can be extremely chaotic and demanding, as they are essentially carrying out hectic, airport and airplane tasks for two individuals. Any emotional distress that the passenger with disabilities is experiencing are reflected onto the caregiver as well, increasing their stress levels. Furthermore, with inconsistency between the protocols of many airports, caregivers cannot rely on a standardized system or approach to travel.

In 2016, passengers filed 32,445 disability-related complaints through 184 foreign and domestic air carriers, with the top complaints for individuals with paraplegia and quadriplegia being a failure to provide assistance and seating accommodation. In the same year, passengers filed 862 disability-related complaints directly with the U.S. Department of Transportation (DOT). These numbers are an increase from previous years and are projected to continually increase unless preventative action is taken.

Our class is thoroughly reviewing and extracting relevant data from several sources, such as those previously mentioned, to summarize the difficulties individuals with disabilities face when flying and develop strategies to combat these problems. We have interviewed experts and personnel in the aviation industry as well as air travelers to better understand the scope of this broad issue.

Section 1.2: Gaps for Innovation

Innovation in the aviation industry largely depends on which disability is being targeted. As highlighted by the New York Times in June 2018 (Brockman, 2018), airports have become largely accessible to blind people in terms of getting there, but travel within the airport itself remains troublesome. They detail a few solutions to this issue such as an app that will allow an agent to give the customer with the disability directions based on camera feed, but this ultimately means reliance on another person, and requires a subscription, which can be costly. In terms of mobility-related disabilities where the customer uses an assistive device, they may face challenges in different locations than the visually impaired. In particular, in spaces such as travel to the airport, between different subsections of the airport if it is large, and getting on or off the plane, there are specific trouble spots that can be managed with more innovation. All of this

means that an innovator looking to make the aviation industry more accessible needs to heavily evaluate which specific disability they want to target.

Additionally, the laws governing an airport are entirely different than the laws governing the airplane, which fall under the Americans With Disabilities Act and the Air Carrier Access Act, respectively. The latter, has significantly less accessibility requirements according to the previously mentioned New York Times article, which is possibly a large reason why most people with disabilities are hesitant to fly in response to the airplane experience more than the airport experience. This problem is particularly interesting because it offers innovation on two fronts: legislative and physical. One on hand, the Air Carrier Access Act can be improved and expanded upon to simply provide more regulations for airplanes in terms of accessibility. This would likely improve the flying experience for all customers. In addition, engineers and designers can take the responsibility into their own hands and create solutions that are more accessible than current regulations call for. In either case, there is a large gap for innovation.

Section 1.3: Upcoming Solutions

As the world population begins to live longer and the push for social equality considering persons with disabilities grows stronger, solutions for accommodating air travel must keep pace. Solutions must be geared toward increasing the safety, comfortability, and efficiency of the aging and persons with disability populations' experiences within the ticket purchasing process, the navigation of the airport, and the time spent on the airplane itself (Chang & Chen, 2011). With a wide range of recognized disabilities, it is necessary to fully understand the wants and needs of all airline passengers with disabilities. One of the best ways to discover possible accessibility solutions is to review the successes of high-rated airports, which for example can be found in the Civil Aviation Authority's Airport Accessibility reports (Civil Aviation Authority, 2018). Airports that are classified with the rating of 'very good' have been proven to provide the most excellent service to passengers with disabilities, which is displayed through customer satisfaction surveys. Even with the increasing number of airport passengers who require assistive services, the highest-rated airports share many similarities. These analogous traits include: well-trained and standards adherent airport staff, short waiting times for disability assistance, and dignified and attentive treatment of passengers with disabilities. These airports also partner with various disability organizations to keep pace with the most current equipment and technology to ensure continuous improvement with regard to airport accessibility (Civil Aviation Authority, 2018).

Airport accessibility solutions tend to focus on the satisfaction of customers with disabilities. Successful airports ensure that all staff are trained with frequent and comprehensive disability awareness programs and are able to identify and address gaps within the staff's service quality, which in turn ensures customers will be treated respectfully. Therefore, we are recommending that all airport staff should have a basic level of training and training for disability assistance should be greatly expanded and renewed at least once per year. Special task

forces are also created with the primary purpose to enhance airports through the implementation of accessibility improvements, such as consistently updating terminal signage to promote simpler wayfinding (Civil Aviation Authority, 2018). These programs and groups not only promote the customer-driven improvement of the airport experience for people with disabilities, they are also promoting the customer experience for all passengers through the implementation of universal design principles.

A model example of an upcoming solution in the field is Aira, an application that provides customers who are blind and low-vision with augmented reality assistance. Airports such as the Houston Airport System, including Hobby Airport and George Bush Intercontinental, Minneapolis-St. Paul International Airport, Seattle-Tacoma International, and Memphis International Airport have adopted the new technology and are offering it to their customers for free (Baskas, 2018). Since not all airport employees have sufficient training to assist passengers with vision impairments, providing the Aira service at no cost allows airports compensate for a lack of staff training. The service utilizes a smartphone application, wearable glasses technology, and trained live agents to offer guidance and independence to airport passengers with vision impairments (Baskas, 2018). Since the service was introduced in airports in 2015, Aira users have been able to transform their airport experience and become more independent (Baskas, 2018). By adopting and providing Aira services to passengers, airports that are leading the industry in accessibility accommodations are able to “ensure greater accessibility and convenience for all passengers” (Baskas, 2018). By implementing new and upcoming technologies, such as Aira, to mediate problems that passengers with disabilities face, airports are able to greatly increase passenger satisfaction and comfort.

Many airports need improvement with respect to their disability accommodations due to their lack of data gathering and available information (Civil Aviation Authority, 2018). We envision a database integration for customers with disabilities within the airline ticket purchasing process. This database will directly display which airports provide the necessary accommodations that customers with disabilities require to safely fly. By providing this information to customers in a straightforward way, it will improve the communication between airports and their customers, which will subsequently lead to a more effortless and comfortable trip for customers who require additional assistance. Increasing the visibility of this information could also increase the competition between airports to provide more accommodating services.

Section 1.4: Implementation Strategies

Airports and airplanes can be unpredictable places, as such, having a multitude of strategies in place to deal with unexpected occurrences is essential (Morris, 2017). Strategies could include protocols, plans, shutdowns, and the contacting of outside forces. Successful implementation of these strategies is equally important as their effectiveness, especially in emergency situation which can be life threatening (Morris, 2017). Emergency situations encompass a range of events, from surprise landings on land or water, delays while taxiing on the

airport runways, extreme turbulence, terrorist attacks, medical emergencies, issues with landing or takeoff, poor weather, and diverted flights (Morris, 2017). These types of situations can be frustrating and challenging for any passenger and crew member (Morris, 2017). However, for customers with disabilities, these events pose additional challenges that can cause detrimental effects on passengers and staff (Morris, 2017).

All air carriers have different emergency response protocols, however, most are adapted from similar templates (Oladimeji, 2018). Regardless of airline or airplane, in an emergency evacuation, those who are able bodied and do not need extra assistance are removed first (Morris, 2017). The flight attendants and pilots will then assist those who rely on additional help to evacuate; if the customer with the disability is traveling with a personal attendant or caregiver, that person will instead provide the assistance during the evacuation (Morris, 2017). Most travelers with mental disabilities, vision impairments, and low mobility impairments typically need only guidance and light assistance to get off of the plane, whereas those with severe mobility impairments will need to be carried from their seat and off of the aircraft, or transferred to an aisle chair from their seat and then carried off of the plane (Morris, 2017). In cases where inflatable slides are used for exiting aircraft, customers with disabilities may suffer injuries, anxiety, or embarrassment (Morris, 2017). Currently, there exists limited data concerning emergency evacuations involving travelers with disabilities, nonetheless there are several potential problems that are evident from current protocols (Morris, 2017). For example, it may be very difficult for any employee or even groups of employees to carry one passenger out of the aircraft, let alone multiple; in cases of emergencies, aisle chairs may often be unavailable, or difficult to obtain in potentially chaotic circumstances (Morris, 2017). Lastly, the passengers with disabilities could easily be injured when using an exit slide or metal staircase (Morris, 2017).

Comprehensive training that includes emergency plans for working with customers with disabilities would be greatly beneficial in both emergency situations and in everyday airport operations. Not only would this training prevent confusion among staff and customers with disabilities, but the safety of both the crew and customers would be improved. Furthermore, a customer's stress levels would be reduced if they are aware that the staff is well prepared to assist them in emergency situations in addition to typical operations. The training would be required of any and all staff members, which should prevent problems at any stage of the air travel process, and resolve a common complaint of customers with disabilities (McCarthy, 2011).

Furthermore, both airport staff and customers with disabilities have expressed that differences in operation protocols between airlines and airports can lead to further confusion and irritation (McCarthy, 2011). As such, a universal protocol, to be used by all airlines and airports for application to every customer, regardless of disability, that includes the in-depth training mentioned previously along with resources and general information, would increase satisfaction among flyers and airport staff (McCarthy, 2011). An important part of the protocol would include suggestions given by our surveys and interviews, and information gathered from

literature sources. Additionally, employee training for situations involving customers with disabilities is typically required at the start of employment, but in some cases it is not required for employees to be retrained or have additional training after the initial session (U.S. Cong., 2017). Making it a requirement to have employees renew training would solve some of the staff issues and resolve passengers' worries.

Stronger legal enforcement is also needed to ensure that airlines and airports implement the correct training practices and actions. Literature reviews and past events have shown that even if laws or protocols are created and implemented, they are not always followed. Before 2008, the DOT typically relied on customer complaints about the regulation of disability laws in relation to airlines and airplanes (U.S. Cong., 2017). In recent years, the DOT has been conducting more consumer-related compliance reviews at airports and airline headquarters of at all airport sizes, which includes ACAA compliance of the different air carriers (U.S. Cong., 2017). These actions provide more opportunities to investigate the breadth and depth of violations. When considering legal enforcement, increased fines along with repeated reviews of more problematic airlines should lead to less law violations.

Chapter 2

Title: Current Policies and Practices

Authors: Peter Celeste, Kallista Dentice, Eugene Ferrari, Lei Shen, Greer Smith

This chapter focuses on the current policies and practices used by airports and airlines to provide accessibility to passengers with disabilities. It discusses the current laws set in place by the United States federal government and issues with noncompliance. Additionally, the laws are compared to those in other countries to identify areas where the US laws are lacking. Current staff training is discussed to obtain a clear perspective on what airport and airline staff are expected to do in terms of passenger assistance. Finally, modifications to staff training procedures are suggested, with an aim of improving the experience of passengers and staff members alike.

Section 2.1: Current Laws

There is a very large disconnect between what the disabled community believes the law is and what it really is. More than half of the disabled population surveyed by Purdue University did not know that there were different laws and forms of enforcement. Airports, surrounding parking lots, and transportation around the airport are fall under the Americans With Disabilities

Act (ADA), the Rehabilitation Act of 1973 (504), along with state and local laws and statutes. ADA laws are best known among the disabled community as they pertain to items such as door width, signage, fire alarms, ramps, and bathrooms that persons with disabilities encounter daily in public areas and buildings. These laws are enforced by the United States Department of Justice.

However, airplanes are governed under a very different set of rules. Congress passed the Air Carrier Access Act (ACAA) in 1986 (four years before the ADA). The ACCA governs similar spaces such as bathroom size, seat size, and aisle width. The sizes of these areas are extremely different by the laws that are common architectural spaces within the United States. The ACAA standards are enforced through the Department of Transportation and mostly do not apply to airplanes under 60 seats or without two aisles.

<u>ADA vs ACCA</u>		
	ADA	ACCA
Hallway / Aisle Width	36 inches	20 inches
Bathroom Stall Size	60x56 inches	24x28 inches
Door Width	34 inches	24 inches
Seating Size	20x48 inches	Not Regulated
Closed Caption Entertainment	Required	Not Required

Table 2-1. Differences between the Americans With Disabilities Act and the Air Carrier Access Act

As shown in the chart above, the disabled community have adapted to standards in everyday life and predictably encounter major challenges to more stringent guidelines used during airline travel. Most wheelchairs do not fit down airplane aisles or restrooms. Required door widths do not even fit a standard size wheelchair. On all other public transit, such as busses and trolley transportation, wheelchairs are able to be secured to the floor, so the user does not have to transfer eliminating potential accidents and being able to board and depart the airplane more quickly while maintaining the seating ergonomics and comfort of the wheelchair user. In the airport, most wheelchair users must transfer to an airport manual wheelchair as their wheelchair gets loaded onto the airplane, they then transfer to an aisle chair at the gate, be wheeled to the airplane seat by airline personnel, and then the user must transfer to their airplane

seat. The reason for this, is the airplane is not able to accommodate a standard size wheelchair. This involves three transfers to board an airplane, often requiring assistance from airline personnel, which leaves the wheelchair user susceptible to injury due to falling or getting hurt upon transfer. Then the user's chair is placed in the cargo hold of the plane with the luggage and any other parcels being shipped. This leaves the wheelchair vulnerable to damage. Serious damage can cause real consequences to those who rely on the device. In December of 2018, President Trump signed in an amendment to the ACAA that stated that airlines must report when mobility devices were broken within transport (HR 5004).

In February 2019, the first report released by the Department of Transportation that stated in December of 2018 alone, 701 mobility devices such as wheelchairs and scooters were damaged. This equates to about 25 mobility devices were damaged per day leaving these passengers stranded without means of ambulation. In comparison, regular luggage was only damaged at a rate under 4% during the same time period.

Section 2.2: Noncompliance with current laws

Despite the existence of laws such as the ADA and ACAA, airports and airlines in the United States continue to present major challenges for passengers with disabilities. One study found that over 70 percent of adults with disabilities experience a major obstacle with an airline, and that 65 percent of adults with disabilities had issues with the airport itself (Cerchiai & Lieberman, 2018). Of the complaints, issues seem to stem from three main areas: awareness, enforcement, and infrastructure.

Lack of awareness. Airports and airlines tend to encourage passengers to provide feedback, but many of those who have a complaint do not file it with the appropriate office, leaving administrations unaware to issues that arise (Morris, 2018). In addition, there is an overwhelming lack of training across airport and airline staff that causes an array of issues for disabled passengers. For example, Transportation Security Administration (TSA) officers only receive one to two hours of training on disability screening procedures, limiting their knowledge severely (Morris, 2018). The vast spectrum of disability can provide an almost infinite number of possible circumstances that officers can experience, all of which affect the screening process. This variability often creates inconsistency with the screening process from experience to experience, leaving passengers unsure of what to expect. In fact, many passengers often have to train the TSA officers on how to perform a security check to accommodate their specific circumstances on the spot, causing unnecessary and potentially significant delays (Morris, 2018).

Lack of enforcement. Many airlines and airports do not comply with the current laws because of a perceived lack of repercussions. In a way, they can. The ADA is a law with little to no money and enforcement policies behind it, meaning that there often is not someone checking to see if access is provided to passengers with disabilities (Cerchiai & Lieberman, 2018). However, the ADA does not regulate air travel discrimination; this job is left to the ACAA

(Thomson Reuters, 2019). The ACAA is enforced by the Department of Transportation, but it's power is not used to promote enforced access. In fact, the ACAA is only enforced after alleged noncompliance is leaked to the press (Cerchiai & Lieberman, 2018). In addition, the ambiguity of the ACAA makes it hard to enforce, as airlines and airports can bend the criteria and make it work for them rather than the passengers (Goldstein, 2017). Another factor that makes these laws difficult to enforce is the fact that, while the ACAA is enforced by the Department of Transportation, the ADA is enforced by the Department of Justice, and the inter-departmental communication is severely lacking, meaning noncompliance often goes unchecked.

Issues with infrastructure. The infrastructure of air travel itself plays a major role in law noncompliance. It is not updated as frequently as buses or roads used for public transportation. One airplane costs upwards of \$82 million, and because of this, it is common for a specific plane to remain in service for 25 or more years (Morris, 2017; Haines, 2017). In fact, most airlines have fleets that are an average of 15 years old, meaning that some of the planes were likely built before these laws could fully come into effect (Haines, 2017). Additionally, the cost to renovate an airport varies widely, with some renovations costing nearly \$16 million, so it may be that airports and airline simply do not have the funding to accommodate passengers with disabilities in an appropriate manner (Statista, 2012).

Technology also seems to play a large role in airport inaccessibility. Passenger information is classified via Special Service Request codes, which are four letter acronyms that alert staff to passenger needs (Goldstein, 2017). This system has many flaws, as a general code is often used in place of more specific ones, the codes tend to get confused between airports, and some airlines have a habit of using their own unofficial codes, all of which make the system difficult to work with and causes delays in passenger assistance (Goldstein, 2017). There is also a lack of smaller accessibility features, such as subtitles on plane entertainment consoles and alternatives to overhead announcements relaying important information such as gate changes (Goldstein, 2017). With airports and airline becoming increasingly tech savvy, some of these issues are being resolved, but elements such as the timeliness of app notifications leaves much to be desired.

Section 2.3: Law solution and comparison

To improve the access for disabled passengers, we can compare the current regulation with other countries to see the difference. In the United Kingdom (UK), according to the Civil Aviation Authority (CAA) 2016/17, every passenger with reduced mobility should be provided with extra cargo space for medical equipment, and up to two mobility aids per passenger. The CAA also forbids airlines from limiting the number of disabled passengers or mobility devices on larger aircraft, even if these devices can take a significant amount of spaces. And even for any person using wheelchair not for the reason of disability, if they self-declare to be a PRM (Passengers with Reduced Mobility), the airline cannot reject their requirements for free extra space. For passenger with reduced mobility, one does not need any proof to get quicker access

through security on departure and clearance through Customs and Immigration on arrival (CAA, 2010).

The European Union (EU) has specific regulations requiring airlines and airports to provide service to persons with disabilities. According to EU Regulation No. 1107/2006, any individual with reduced mobility due to any disability or impairment or age or other condition should be able to access to the service they need. Since the increasing population with disabilities and obesity, the rights of disabled persons and PRM when travelling by air became a concerning point for airline industry. The EU wants companies to afford social obligation, thus the Regulation 1107/2006 became a unique legal frame for protecting the basic rights for disabled passengers. Starting from July 26, 2008 with fully implementation of regulation 1107/2006, providing assistance to disabled passengers was a part of airport operator's obligation. Similar to the UK regulation, the EU regulation 1107/2006 also put attention on prevention of denied air carriage and prohibition of discrimination. The air carrier would deny a passenger usually due to the size of aircraft or an inability to help transfer passengers with disabilities. It is also a common situation that PRM will be allocated on the seats by the window or in the middle of the row, while the carriers would usually explain it as a necessary act to prevent PRM from obstruct the crew and evacuation. The regulation puts efforts on improving the situation that PRM's carrying objects get denied or be treated unequally.

The Regulation 1107/2006 also required the airport operators to provide notification and transmission of information. EU recommends informing the PRM passengers about their rights through web pages of carriers, airport operators and other form like on air tickets. The carrier who received the request for assistance at least 48 hours before scheduled time of departure has to forward the information at least 36 hours before the departure. Also, for arriving PRM passengers, the airport operator is required to provide assistance at their arrival, transfer or departure. Before departure and landing, the airport should be informed about the PRM passengers' information. The regulation also required the airport to designate points of arrival and departure for PRM passengers, they should be clearly signed as the passengers can get necessary information about the airport and require assistance from the operator when they need to arrive or depart the airport (EU, 2006).

The regulation also recommends, but not oblige, airport to perform training on their staff in order to provide service to PRM passengers. The reason of recommendation rather than obligation could be due to economical reasons, since many airports may not have a special department to assist disabled passengers, in which case the service could be provided by normally trained staff persons (Ridanovic, 2017). The economic burden is unclear, particularly in regard to an increasing PRM population.

Section 2.4: Current Staff Training

Passengers with disabilities may interact with several different types of staff members in airports and airplanes during their travels. Each of these staff members has different

responsibilities and jobs, and they each have had different types and amounts of training. While all passengers would hope for excellent service at every step along the way, unfortunately many disabled passengers do not feel as they receive excellent, or even adequate service from staff when traveling through airports (International Airport Review, 2017).

Many passengers with disabilities find traveling through an airport as a rather demeaning experience, as staff members can treat them disrespectfully, even if the staff members are doing their best to help. For example, passengers with disabilities when traveling with a companion have reported that frequently staff members automatically address the companion assuming that they are the caregiver of the person in the wheelchair. Another example is that many blind passengers, who are completely mobile and capable of walking on their own, have been led to wheelchair when they ask for assistance (Cerchiai & Lieberman, 2018). This act is typically upsetting to blind passengers, because it incapacitates them more than necessary. These stereotyping views are due to a lack of proper training. It also shows stereotyping and lack of thought to put every passenger with a disability into a wheelchair, when there is a wide diversity of disabilities a passenger might have, and many would not require a wheelchair.

In addition to the demeaning treatment from staff, there are safety risks associated with staff assisting disabled passengers, especially those who are severely mobility impaired. Risks are presented to both the staff member and the disabled passenger. The actions that most commonly result in injury are transfers to and from the aisle chair and seat. During transfers, it is possible for staff members to sustain back injuries. The patients can suffer from falls, skin tears, and shoulder dislocations during transfers (Fadul et al., 2014). Aisle chair transfers are usually performed by ground staff or a third party contractor. However, there are instances that flight attendants must help transfer disabled passengers, such as if they need to use the lavatory during flight. A survey with questions about flight attendant's experiences serving disabled passengers was posted in the subreddit "r/flight attendants." 43 flight attendants responded to the survey, and 52.4% of them have ever helped transfer a wheelchair user. Out of these flight attendants, 14% have injured themselves during a transfer. This correlates to over 1 in 10 flight attendants who transfer disabled passengers receive injuries from doing so. This is not a negligible percentage, especially while considering that over half of those who do transfers report doing so less than once a month.

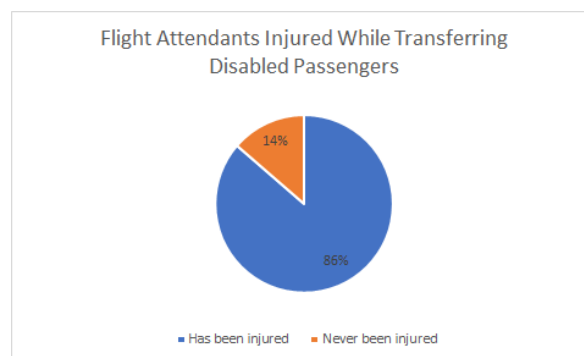


Figure 2-2. The percentage of flight attendants who have injured themselves when helping transfer passengers with disabilities.

In the same survey of flight attendants, many of the flight attendants indicated that for liability reasons, they are not allowed to assist disabled passengers. They stated that for that reason, they receive no training on how to best serve disabled customers. This can lead to awkward situations after the ground staff leaves, and there is no one to assist the disabled customers but the flight attendants. However, 50% of respondents stated that they receive yearly training on how to serve disabled customers, but the most popular method for this are watching video modules. At the end of the survey, 60% of respondents admitted they believe that additional training on how to best serve disabled customers would be beneficial. It is also notable that several flight attendants noted that they are extremely uncomfortable when having to assist disabled passengers, and that several noted that specifically in emergency situations they would not feel prepared to help a multitude of disabled passengers.

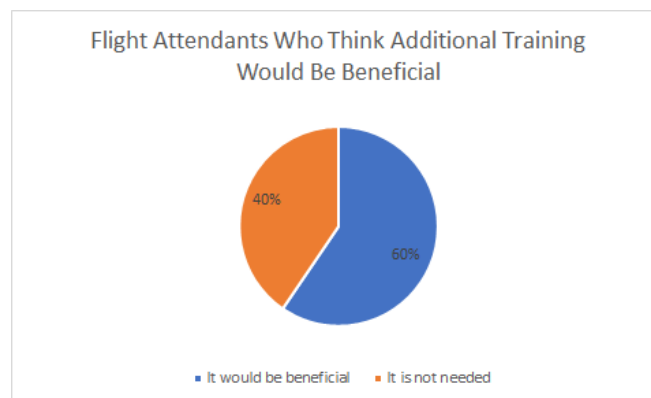


Figure 2-3. Chart shows percentage of surveyed flight attendants who think they would benefit from additional training on how to best serve disabled customers.

Section 2.5. Staff training solutions

All staff members that interact with passengers must have an increased knowledge and awareness regarding adequate accommodations and assistance for passengers with disabilities who require a certain level of support. The training of those specifically tasked with helping passengers with disabilities in situations where assistance is requested must also be consistent and specific. This also requires reaching staff that operate under third-party vendors hired by airports. These staff undergo separate training, but universal procedural understanding will encourage consistency in experience (“What We Do,” 2018).

Even if they are not tasked with physically aiding passengers with disabilities who require assistance, airline and airport staff, especially those in customer service, need a baseline

understanding of the accommodations needed (and not needed) by particular passengers. Service providers and their supervisors noted that training was occasionally lacking. In one specific example, an airport service provider was unfamiliar with an aisle chair, which is the current standard for transporting passengers with mobility issues onto airplanes (McCarthy, 2011). Passenger testimonies have echoed this sentiment. As part of a voluntary survey sent to an online community ([reddit.com/r/disability](https://www.reddit.com/r/disability)) of individuals with disabilities regarding air travel, some persons with disabilities used open-ended complaint questions to identify issues with the assistance that they received from a variety of sectors. Complaints targeted airplane attendants, TSA officers, and baggage handlers, among others. As such, training for all airline and airport workers needs to have an established baseline for care and appropriate assistance. Problems related to damaged wheelchairs and communication regarding assistance needs are addressed elsewhere in more detail (see Chapters 1, 4, and 5) and require more thorough investigation beyond improvements to staff training. However, service providers should be well-versed on varying types of disabilities and their assistance requirements.

Passengers with mobility-related disabilities often require assistance in boarding and departing airplanes. A majority of respondents to the widespread survey conducted through Purdue University indicated that they need some level of assistance, as shown in Figure 2-4.

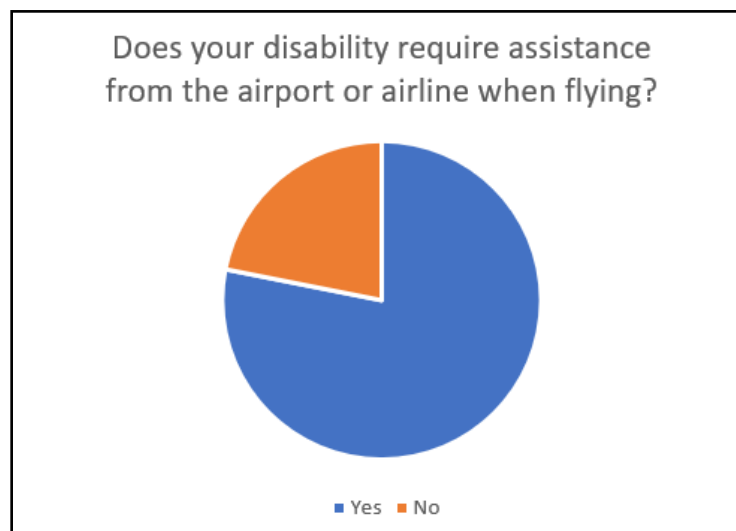


Figure 2-4. Distribution of responses regarding whether passengers with disabilities require assistance from airline or airport staff. 78% of respondents indicated they require assistance.

Beyond the broad engineering solutions for improving boarding procedures (see Chapters 1 and 5), communication between staff can be refined to eliminate vague instructions or barriers to successful accommodation. Passengers with disabilities can elect to notify airports that they need assistance; supervisors should be aware of the number of aisle chairs and service providers needed per flight. This preparation from airline service agents can occasionally seem lacking, as shown in Figure 2-5.

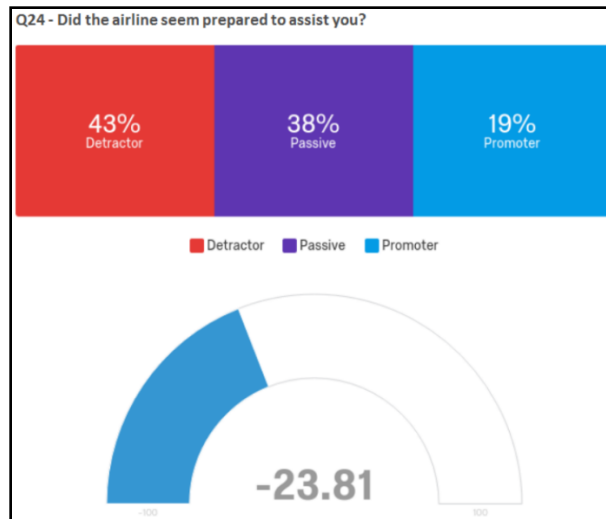


Figure 2-5. Distribution of responses regarding whether the expected level of assistance from airline or airport staff was met. On a scale of -100 to 100, where 0 is perfectly neutral, the aggregation of all responses was scored as a -23.8, which indicates that airlines did not seem prepared to assist passengers who needed assistance.

Supervisors should be trained on staff management for specific disability cases. Ideally, they are advised in-person upon hiring and are assessed annually on their communication and human organization skills. Additionally, all service staff, including TSA agents, should be trained on various disabilities and their accommodation requirements. Passenger testimony revealed that, in some cases, service staff are not aware of the effects or visible presentations (or lack thereof) of certain disabilities. Responses to general questions within the online survey for passengers with disabilities indicated that, in some circumstances, “staff is generally unwilling to help because [the passengers are] young and look healthy” despite having a disability that causes discomfort or pain, or a passenger might “have to give up [their] cane to attendants” despite needing it to mitigate pain. Thus, staff should be informed of the various ways disabilities can affect flying. As with the previous anecdotal examples, some disabilities may not have visible health effects but can cause extreme irritation or pain to passengers; if these passengers do not have pre-arranged accommodations, they may be refused help due to their visible health. An interactive, module-style course upon hiring can provide a thorough knowledge base, and yearly assessments will ensure that service staff are remaining informed about various presentations of disabilities.

Moreover, staff that directly assists passengers with disabilities, such as those who help passengers with mobility issues board the plane, should be trained equally thoroughly on various effects disabilities may have on travel. Their training should be equivalent nationwide. In-person training sessions with live demonstrations and practice should be implemented to teach these specific staff members proper technique in boarding, off-loading, seat transfers, and traversal through the airport (including through security). These training sessions should be held until the staff member is proficient at these techniques, as improper movement of a passenger with

mobility assistance needs can cause injury and severe discomfort to both parties (Darcy, 2012). Furthermore, staff training has been noted as inconsistent with regards to accommodating passengers with disabilities (McCarthy, 2011). Therefore, in-person training programs must follow a specific script, and each staff member present should demonstrate a specific proficiency before their training is complete, whether through a hands-on demonstration (in the case of transferring procedures) or through an online module which must be passed with a sufficient score.

All levels of service staff in air travel need improved training procedures. Any staff member that may assist passengers with disabilities should be better informed about the effects that disabilities may have on passengers through interactive modules and assessments. Supervisors should be trained and assessed on their ability to manage their subordinates to assist passengers. Staff members who directly assist passengers with disabilities should be given through hands-on training and demonstrate proficiency in performing correct techniques.

Chapter 3

Title: **Airport Operations**

Authors: Ahkiya Allen, Brandon Lach, Mariah McDonald, Alex Miller

Section 3.1: Introduction

According to the 2018 Annual Report on People with Disabilities, 13.2 percent of the civilian non-institutionalized population have a disability in the United States. This is an increase from 2010 when disabled individuals only made up 12.5 percent of this population. With the disabled community growing each year and the population of elderly people increasing as average lifespan increases, airports are starting to serve more and more disabled passengers. The 2015 Open Doors Organization (ODO) Market Study reports that between 2013 and 2015, over 26 million adults with disabilities traveled for pleasure or for business. However, many airports are not very accessible for this growing population, despite the passage of the Americans with Disabilities Act (ADA), which was made to eliminate discrimination faced by people with disabilities and to ensure that public facilities and services, including airports, are accessible and non-discriminatory (Grady & Ohlin, 2009). The 2015 ODO Market Study reports that 65% of adults with disabilities who traveled by air during this time frame encountered significant obstacles in airports. Because of this pressing issue, many experts have researched this topic, and several articles outline the top complaints from passengers with disabilities. According to Chang

and Chen (2012), the top recommendations to airports from the 1979 United States Federal Aviation Administration (FAA) directed working group were that:

- the staff should be trained to handle emergencies involving elderly and disabled passengers,
- bathrooms should be accessible for disabled individuals,
- airports should have wheelchairs at the arrival and departure areas of the terminal for mobility-impaired passengers, and
- there should be ramps and elevators at all level changes in the airport.

Based on information from current sources and personal experiences described in interviews, this paper will focus on the current state of accessibility in airport navigation, airport emergency protocol, baggage handling, and airport security, as well as how it can be improved in these areas.

Section 3.2: Airport Navigation

Airport navigation can be a problem for individuals with disabilities for a number of reasons, mainly because airports vary significantly in design and layout; therefore, depending on the disability, wayfinding can be a challenge. When discussing wayfinding within the airport, the primary obstacles for individuals with disabilities are the multiple physical barriers presented in the design of the airport, point-to-point distances on airport property, and signs and announcements in the airport that may be difficult to understand. Some of the most common physical barriers at the airport include slippery floors, inaccessible restaurants and waiting areas, and inconvenient bathroom stalls. The main complaint for distance according to Chang and Chen (2012) is the distance between the parking lot and the terminal. Finally, signage and announcements can be an issue for individuals who are visually or hearing impaired because of the font size and color contrast of signs and the volume, clarity, and speed of the announcements (M. Linett, personal communication, March 7, 2019).

Based on interviews and research on the problems described above, the following possible solutions have been formulated. A manual wheelchair user and frequent national and international flyer, explained that restroom and restaurant barriers have been an issue for him in airports (personal communication, March 8, 2019). He shared that many of the non-fast food restaurants are starting to move towards the trend of tall tables, which makes it hard for him to eat at these restaurants as he cannot reach the tables from his wheelchair. Others have tight seating which prevents him from moving freely throughout these restaurants. Regarding restrooms, he has noticed that many able-bodied people tend to use the handicap-accessible stall first when given a choice, which forces people who need that extra space to wait for an unnecessary reason. Also, some restrooms are set up to where the stall doors open in rather than out which makes closing the door behind him impossible. A solution for these barriers would be

for airports to ensure that the restaurants within it are accessible to all because they are considered public areas; even though they are separate business entities from the airport, they still must abide by the ADA. This could be accomplished by allowing some tall tables in restaurants for style but also making sure that enough standard table seating is available as well for individuals who are unable to dine at the higher tables. By making this change, not only would airports be more accessible, but the restaurants could gain more customers. A simple barrier-free design change for restrooms, as recommended by the ADA in Figure 3.1, is to make sure that the handicap restrooms have doors that open out rather than in to ensure full accessibility. Another recommendation is to either add signs to motivate other guests to use the smaller stalls first if they can, add more handicap-accessible stalls, or increase the size of the smaller stalls so that other guests will not be as tempted to use the larger stall. These changes can make the overall experience for all guests better, while also meeting the ADA guidelines.

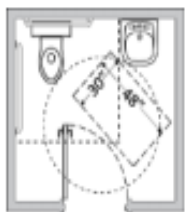
<p>3.18 In a single user toilet room if the door swings in and over a clear floor space at an accessible fixture, is there a clear floor space at least 30 x 48 inches beyond the swing of the door? [603.2.3 Exception 2]</p>	<p><input type="checkbox"/> Yes <input type="checkbox"/> No</p> <p>Measurement:</p>		<p>Photo #:</p>	<ul style="list-style-type: none"> • Reverse door swing • Alter toilet room •
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Figure 3-1: ADA recommendation for bathroom stall doors (Institute for Human Centered Design, 2016).

Another physical barrier in the airport is accessible seating at the gate waiting areas. Many of the seats are situated very close to each other, and even the few seats with the International Symbol of Access, as shown in Figure 3.2 below, are inaccessible because, as noted by the interviewee mentioned previously, no one is going to get out of their wheelchair to sit in the marked seats. Therefore, it would be beneficial to eliminate some of the standard and marked seats and instead add space for individuals to park their wheelchairs, as well as add more space between the rows. Since many able-bodied people do not sit in these seats anyway due to the lack of outlets near them or the great distance from the boarding line, this change should not significantly hinder any guests.



Figure 3-2: Airport gate waiting area seats with the International Symbol of Access (Danisewicz, 2014).

When asked about distance challenges, the interviewee stated that he often must pay more to park closer to the airport and that some airports do not have a backup plan in case the handicap parking is blocked off due to weather or construction. This is an issue because it extends the time disabled individuals must look for parking, which could make wayfinding inside the airport harder because they now have less time to get through security and to their gate. A possible solution is to ensure that a set number of handicap parking spaces is always available closer to the airport and is protected from snow pileup and other weather-related incidents to eliminate the extra fees and extended timing associated with the current system. Also, some airports have shuttles to carry passengers to the airport or to more distantly located terminals. It is important that these too comply with the ADA and are accessible with barrier-free lifts or ramps which may be needed by some disabled passengers. A new feature in most airports to decrease travel time to the gate are moving walkways, which wheelchair users are prohibited from using due to safety concerns. To make airports more accessible and to eliminate discrimination, this technology should be revised in a manner that makes it safe for all to use.

Finally, signage and announcements in the airport can create problems for some disabled individuals, including those with sensory or cognitive impairments, but also those who are foreign speakers. If a passenger misses an announcement made over the public address system or is unable to interpret information from a sign due to a visual or hearing impairment or a learning disability, they could miss a flight, go on the wrong flight, or find themselves lost in an unfamiliar airport. Possible solutions to these issues include making the font on displays larger and to adjust the brightness if they are lit; this especially applies to the arrival and departure screens which can be hard to read. For navigation signs, airports should ensure that they are large enough for guests to follow, and symbols should be used when possible to limit the amount of reading required. Another possible solution that addresses both proposed issues is that airports create a website with interactive maps on them for passengers to visit while at the airport. This website link can be posted on the airport complimentary WiFi page, an example of which is shown in Figure 3-3 below. Since most passengers connect to the airport WiFi on their smartphones, this would be a convenient location. These websites could also include timely

airport notifications to notify the guests of any cancellations, delays, etc. that have been announced or displayed traditionally. By making this site available on personal smartphones and tablets, its use will be personalized because it will use the same settings the individual normally uses on their mobile device, including special contrast, brightness, and font size. Additionally, airports could add videos where necessary with subtitles to the site to ensure that travelers with hearing impairments also have access to the information. While these websites will have to be updated any time a change is made within the airport and will take time to develop, in the long term they will help all passengers, not only those with disabilities.

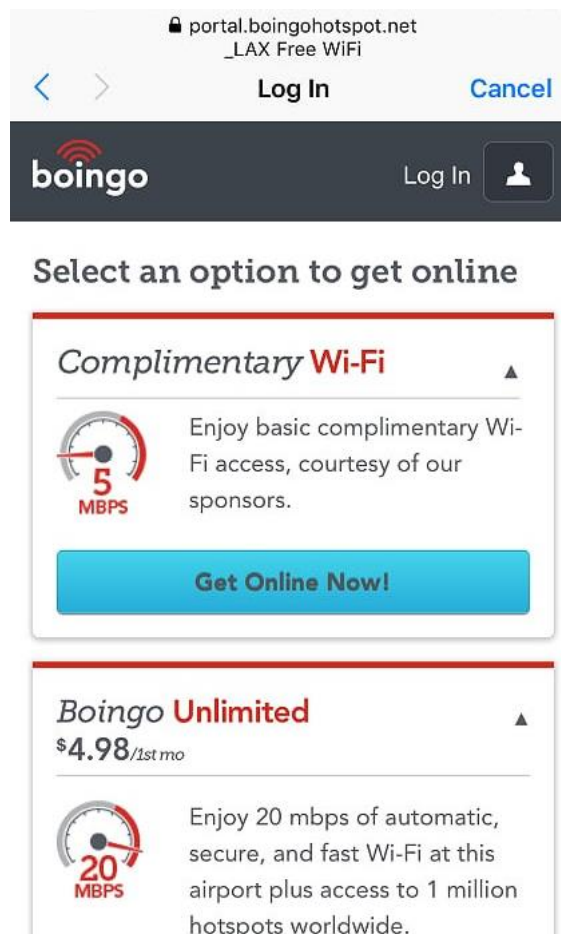


Figure 3-3: Airport Complimentary Wi-Fi Page (Traveler Tips).

In conclusion, there are three main navigation challenges for individuals with disabilities throughout the airport: physical barriers, distance, and signs and announcements. By utilizing a barrier-free design for the layout of airports, airport operators will make the airport more accessible to all guests. Ensuring closer accessible parking to the airport and making shuttles and moving walkways accessible for most disabled passengers will decrease the challenge of distance and ultimately decrease the overall wayfinding time for travelers with a disability. Finally, by creating a smartphone and tablet friendly web application, airports can make

wayfinding and notification more accessible for all passengers. Many of these changes can be made for a low price while others will take time and money to create, but ultimately, each of these will create a more accessible environment for all travelers.

Section 3.3: Airport Emergency Protocol

Thousands of people pass through major commercial airports every day, making airports vulnerable to terrorist attacks and shootings. Airport security has tightened significantly since the terrorist attacks of September 11, 2001, but an estimated twenty-two airport shootings have occurred since then (Millstein, 2017). By reevaluating their emergency evacuation plans, airports can better respond in the event of a mass shooting or act of terrorism. Emergency evacuation plans are also vital to airport safety in case of a fire or natural disaster. Designing an emergency plan that safely evacuates the able-bodied is a challenge as is; creating a plan that evacuates those with disabilities just as effectively is an even more complex task.

There are methods available to analyze how efficiently travelers can evacuate from a given airport. Numerous studies evaluating the mean evacuation times of both non-disabled and disabled individuals in various airport configurations have been conducted using agent-based modeling, or ABM. One such study simulates the evacuation of individuals with and without disabilities due to bomb placement in an unnamed international airport in the Western United States (Manley, Kim, Christensen, & Chen, 2011). The layout of this particular airport is shown in Figure 3-4.

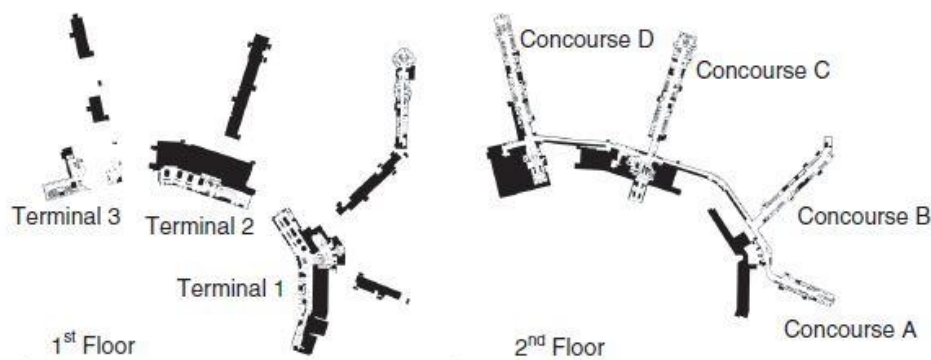


Figure 3-4: Layout of airport analyzed (Manley et al., 2011).

The study utilizes stochastic bottom-up modeling of mass pedestrian flows for the implications for the effective egress of individuals with disabilities, or BUMMPEE, and it includes agents that are nondisabled, motorized wheelchair users, non-motorized wheelchair users, visually impaired, have low stamina, or hearing impaired. For this particular airport, the study identifies the slowest agents to evacuate as individuals with low stamina, non-motorized wheelchairs, and motorized wheelchairs and the most vulnerable evacuees as those with low stamina, visual impairments, and wheelchair users of any type. The researchers note that the

majority of stairwells in the airport under study are only wide enough to fit two non-disabled people abreast or one wheelchair user with a stair-climbing device. This slows down all evacuees as they can only evacuate as quickly as the individual in a wheelchair in front of them. The study also observes that more crowded terminals naturally take longer to evacuate if there are not enough stairwells to compensate for the crowds and that the pier design of the airport may have more bottlenecks and greater walking distance for the average traveler compared to a linear layout. Limitations of the study include the fact that different floor textures are not accounted for and the assumption that wheelchair users are accompanied by an able-bodied assistant at all times to help them go down the stairs. Varying floor surfaces can affect how quickly wheelchair users can travel in an airport as surfaces with more friction can slow them down significantly. Wheelchair users may not always have the luxury of a companion to assist them in climbing stairs.

Another study also using BUMMPEE to analyze a very similar airport only includes agents that are nondisabled, use a motorized wheelchair, and use a manual wheelchair but reaches similar conclusions (Christensen, 2011). This study found that there was a strong relationship between having a mobility impairment and increased evacuation time in the event of an emergency. This study also varied the familiarity of the agents with the airport among a range of four levels and concluded that greater porosity of the building more strongly contributed to lowering the evacuation time for individuals with mobility impairments than greater familiarity with the building. Conversely, for individuals without disabilities, familiarity was more important to faster evacuation than porosity. In this context, porosity is a measure of the number of usable exits for the evacuee in the airport and is typically much lower for an individual with a disability than an individual without. Familiarity still plays a role in the evacuation time for the disabled; however, if an agent with a mobility impairment finds that the nearest exit is not accessible, he or she may be unable to go against the flow to move to another exit. If the agent is more aware of where the accessible exits are in the airport, they can go straight to these exits rather than having to waste time searching for them.

Based on the findings of the two studies described, it was recommended that airports generally have numerous wide stairwells and wheelchair-accessible exits throughout in order to quickly flush out all evacuees, especially considering the fact that elevators and escalators are typically shut off during an emergency. It was also recommended that wheelchair-accessible exits be clearly labeled to minimize searching based on the two studies as well as input from the interview with our interviewee (personal communication, March 8, 2019). For travelers with visual and hearing impairments, inclusive emergency communication systems are vital to their safety. These individuals were found to evacuate more slowly in the two studies; furthermore, in an interview with an individual with a hearing impairment, she expressed concern with respect to how airport emergency instructions are delivered in a way all travelers can understand (personal communication, March 7, 2019).

In addition to the problems identified in the aforementioned studies, all airport administrations should evaluate ABM models to simulate emergency evacuations and better

identify problem areas in their own airports. Every airport is laid out differently and has different numbers and dimensions of emergency exits and stairwells, thus generating different bottlenecks. If airport staff are more aware of which parts of the airport are more accessible to individuals with different disabilities, they can better customize their emergency evacuation plans to direct these individuals to these locations while directing able-bodied travelers to other locations. These models can also inform the layout of new airports under construction as they can identify designs that are more accessible to individuals with special needs.

Currently, the Federal Aviation Administration, or FAA, requires that all U.S. passenger airports complete a full-scale emergency simulation exercise once every three years (Cutts, 2018). It also has specific guidelines regarding airport emergency plans that all U.S. passenger airports must abide. It requires that provisions for special needs groups be made in noting special geographic and topographic features of the airport that may influence emergency operations. It also assumes that special needs groups will require special attention when implementing an alert notification and warning system and requires that an airport's emergency plan describes how to deliver this. The FAA's guidelines further mention how airport emergency plans should consider how the airport will communicate instructions to individuals with special needs and language barriers in the event of an emergency. They also mention that plans must describe provisions made for special needs groups regarding evacuation areas and travel routes. Lastly, the FAA allocates medical care for individuals with special needs to the American Red Cross and requests that social service agencies also provide for these individuals (Airport Safety & Division, n.d.).

While it is beneficial that the FAA addresses individuals with special needs multiple times in their document outlining requirements for airport emergency evacuation plans, the document provides few suggestions for how airports can go about meeting these requirements. Additional legislation is needed to better advise airports on how to evaluate their individual levels of accessibility and account for their own shortcomings in this area.

Section 3.4: Baggage Handling

Air travel has become increasingly popular in recent decades, and with that the number of bags traveling with passengers increases. It is estimated that the Transportation Security Administration (TSA) scans about 4.9 million carry-on bags and 1.4 million checked bags daily (Transportation Security Administration, 2019). This raises questions about how each passenger's baggage is handled when going through security protocols, and if the passenger has a checked bag, how it is handled from when the passenger drops it off to when it is received. If the bag is a carry-on, it will be scanned at the security checkpoint and searched by a TSA agent if it seems suspicious or disorganized. If the bag is checked, however, it is given to an airline employee and placed on a conveyor belt where it will be monitored and randomly searched by TSA agents. There are sensors in the conveyor belt to track every bag to ensure that no bags are lost. If a bag is too large, the conveyor belt will sense this and send the bag to a TSA agent to be investigated. Otherwise, the baggage is sent to an examination machine where it is scanned and

judged for safety. If it is determined to be safe, then it is transferred to the plane to be stored (Transportation Security Administration, 2019). After all this careful inspection and handling, many checked bags and wheelchairs still end up damaged, broken, or even lost, most likely in the plane or during the transfer from inspection to the plane (Lentz, 2018). In order to prevent the loss and damage of baggage, airports need to evaluate the training of employees and the process with which they handle baggage.

Individuals with disabilities, specifically those that require wheelchairs, tend to have fragile or important baggage required for their everyday lives, making the process of checking a bag very stressful and magnifying the consequences of damage to the bag. In order to prevent damage to checked baggage and wheelchairs, the storage method for these items must be examined, as well as the way the bags are treated when transferring them from inspection to the plane. Baggage is stored in two ways based on the size of the aircraft. For smaller aircraft, luggage is stored in a small area under the plane as shown in Figure 3-5 below.



Figure 3-5: Luggage storage area for small planes (Aviation Stack Exchange, n.d.).

If the plane is larger, however, it is stored in a slightly more organized area shown in Figure 3-6 below.



Figure 3-6: Luggage storage area for large planes (Aviation Stack Exchange, n.d.).

Here, there is a larger area where the bags can be placed in a slightly more organized manner. Nonetheless, it is still very disorganized. Employees are also not instructed to handle any baggage more carefully than others, so it is obvious how under these conditions fragile baggage can be damaged. Currently the solution to handling medical equipment and storing medical equipment is to let the airline know about medical equipment prior to flying. Qantas airlines, for example, distributes a medical equipment clearance form along with the allowed medical devices in the cabin area (Qantas, 2019). To lessen the chances of medical equipment being damaged, airports need to train employees to stow wheelchairs and other medical equipment more carefully and potentially implement a system in which medical equipment are always labeled as fragile. To coincide with this system, aircraft need to have specific shelving and storage for medical equipment. If there is a labeling system, specific shelving, and a way to secure wheelchairs and medical equipment on the shelves, employees will be more aware of the special care with which is needed during loading and stowing and they will be placed in more secure areas resulting in less damage during in flight. These changes will ultimately decrease the chances of baggage getting damaged and in turn help protect those with disabilities that are traveling with items necessary for their health and well-being.

Another way to decrease the stress of checked baggage and air travel for those with disabilities is to ensure that all people who have notified airlines and airports that they are disabled can bring their most important medical equipment as carry-ons. Airlines typically board passengers with disabilities before other passengers. Because of this, airlines should allow passengers with disabilities to store their important medical equipment in a specified area where they can ensure its proper stowing. This would reduce stress and incur much lesser damage to their medical equipment. If the airline and airport still require the passenger to use an airport-supplied wheelchair on the plane, then the wheelchair can be stored in this specified area on the plane; otherwise, a way to streamline this process further would be to have an area where the passenger can sit in their wheelchair and have the wheelchair be secured to the plane itself.

The proposed solutions would ease the traveling experience for those with disabilities greatly. Updating the process of handling baggage and the storage area underneath planes would help protect the checked baggage of every passenger but would especially help those with disabilities traveling with delicate medical equipment. Allocating room for the storage of this equipment as a carry-on on the plane would provide additional peace of mind and decrease damage to the essential belongings of those with disabilities.

Section 3.5: Airport Security

In 2016 alone, there were over 27,000 complaints about poor treatment and accommodations filed to domestic airlines by persons with disabilities (Annual Report, 2016). A large portion of these complaints pertained to poor treatment, invasion of privacy, or lack of

accommodations and assistance while being screened by the Transportation Security Administration (TSA). Security checks that are routine for able-bodied passengers can cause serious injuries to some individuals with disabilities. According to USA Today, “One disabled military veteran suffering from a spinal cord injury said he was patted down and told to remove his shoes at a checkpoint in June 2011 while traveling from Des Moines to Washington, D.C.” (Petroski, 2014). Requiring disabled persons to bend over, get in and out of their wheelchair, and submit to extra searches of their medical devices is also commonly complained about. Moreover, travelers with disabilities are currently grouped in with the general population while going through TSA, and extra assistance is rarely provided. Also, the current procedure for alerting TSA ahead of time of a disability requiring additional assistance is very out of date and not widely known by travelers. During an interview conducted with a frequent traveler who is hard of hearing, she stated she was not aware of TSA Cares, the current program the TSA has in place to assist those with any questions related to the security process nor of the disability notification card available. Additionally, she mentioned that she has flown many times with her mother who is in a wheelchair and has on multiple occasions had negative experiences while going through the TSA process (personal communication, March 7, 2019).

The current state of airport security protocols leaves much room for improvement for those with disabilities as well as the general population. The TSA requires all passengers to go through time consuming, invasive, and generally unpleasant security measures. These precautions are necessary to ensure the safety of all passengers; however, it is an especially inefficient process for those with disabilities due to the poor advertisement of pre-notification measures and the lack of assistance provided to those with disabilities. There is a significant high rate of complaints filed with the TSA from passengers with disabilities as compared to able-bodied passengers (Annual Report, 2016). This is a result of extra pat-downs and searches conducted on those with disabilities since they generally have more equipment and personal items that they need to keep on their person when flying. Persons traveling with wheelchairs, crutches, and wearable or implantable medical devices must endure more TSA searches than those without; these searches are almost always unwarranted. Additionally, the services offered by TSA Cares is poorly advertised, the phone helpline is inefficient and outdated, and there is no proper pre-notification system in place for those with disabilities to alert TSA ahead of time that they will be at the airport.

One major cause of TSA-related inconvenience for those with and without disabilities alike is the fact that older airports such as John F. Kennedy International Airport in New York were designed before the establishment of the TSA. These airports have limited space to dedicate to security, so the TSA area is often cramped and obstructs the flow of passengers through the screening areas. Newer airports tend to have a better setup for their TSA screening areas, and some new airports even allow for a separate TSA line for first class passengers and passengers with disabilities (J. Ziulkowski, personal communication, March 7, 2019). These airports demonstrate that it is indeed possible to provide better security accommodations for individuals with disabilities, but airport operators lack incentive to do so, especially in older airports where

expensive renovations are necessary to house a more inclusive security area. Airports sign contracts with the TSA and have full control over the layout of TSA, but they do not have much authority over how the TSA conducts security inspections. A way to incentivize airports to redesign their security areas lies in increasing revenue; airports get paid an “airport fee” from airlines for every plane ticket bought which essentially bases airport income primarily on volume of flights. (Dr. Schreckengast, personal communication, April 4, 2019). Airport fees are currently the same for any ticket level so as to not provide the airport with any incentive to cater towards first class passengers as opposed to coach passengers. If airport fees for disabled passengers were raised to be higher than all other passengers and if the airlines received benefits for selling tickets to persons with disabilities, the airlines would pay more money to the airport for each ticket sold to a passenger with disabilities. This would raise more funds for the airport as a whole and would also allow for the allocation of funds towards improving security measures so that they are more suitable for travelers with disabilities.



Figure 3-7: TSA Agents Screening a Person with a Disability (Travel Questions/Concerns, n.d.).

TSA Cares services offers a hotline for questions regarding air travel for those with disabilities. The website advertises that this hotline is available 24/7 for immediate assistance while traveling or for information regarding future travel plans. However, after calling the hotline multiple times, the authors of this review were put on hold, and it took over fifteen minutes to be put in contact with an employee. Based on this experience, there needs to be a more efficient way to get immediate help for individuals with disabilities while traveling. The TSA Cares website states, “You may provide the officer with the [TSA notification card](#) or other medical documentation to describe your condition. If you have other questions or concerns about traveling with a disability, please contact [passenger support](#)” (Disabilities and Medical Conditions, n.d.). These are the only instructions provided regarding notifying TSA of a disability requiring additional assistance, and the notification card process is very inefficient and could use improvement, as shown in Figure 3-8. The current process requires a passenger to print out a card at home, fill in the information, and bring it to the airport. This does not notify TSA in

advance of the flight and is no more efficient than if the passenger were to verbally state their need for assistance upon arrival at the TSA area. In order to improve this process, the TSA Cares website needs to have a notification card that is stored in a database with each passenger's disability information stored on the virtual card. If this is implemented, it would immediately notify the TSA agents of each person's individual needs and accommodations when they are checked in via personal identification.

<p>TSA Notification Card: Individuals with Disabilities and Medical Conditions</p> <p>I have the following health condition, disability or medical device that may affect my screening:</p> <div style="border: 1px solid black; height: 20px; width: 100%;"></div> <p>I understand that alternate procedures providing an equivalent level of security screening are available and can be done in private. I also understand that presenting this card does not exempt me from screening.</p>	<p>Information • Assistance Requests • Compliments • Complaints</p> <p>TSA Cares</p> <p>1-855-787-2227 (Federal Relay 711) Weekdays: 8 a.m. to 11 p.m. ET</p> <p>TSA-ContactCenter@tsa.dhs.gov Weekends/Holidays: 9 a.m. to 8 p.m. ET</p> <p>Hablamos Español Automated information offered in 12 languages</p> <p>Call 72 hours prior to traveling to request the assistance of a Passenger Support Specialist (PSS) at the checkpoint. If a PSS is not available, you may ask for a Supervisory TSA Officer at the checkpoint.</p>
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Figure 3-8: TSA Cares Pre-Notification Card for Persons with Disabilities (Disabilities and Medical Conditions, n.d.).

The introduction of a program similar to TSA Pre-Check but more specific to those with disabilities would be very beneficial for all parties involved. TSA requires travelers to remove jackets, shoes, and outerwear prior to scanning. In the case of persons with disabilities, completing these tasks is often uncomfortable and unnecessary. If there were a program similar to TSA Pre-Check that is able to screen travelers who have a disability notification card and clear them so they can pass through security without having to remove essential items, it would greatly reduce the hardship on those who are disabled and would improve the overall efficiency of the TSA screening process. Because individuals with disabilities may travel less on average via airplane than able-bodied individuals due to the hassle of the overall ordeal, it may not always be economical for these individuals to subscribe to the standard TSA Pre-Check service due to the fee involved. Therefore, TSA Pre-Check for persons with disabilities should be free of charge to incentivize subscription and ease the stress of air travel for individuals with disabilities. Furthermore, airports should work towards providing a separate TSA screening lane for those in need of extra assistance. This would increase accessibility within screening areas and the overall TSA experience for those with physical and mental disabilities.

Passing through TSA can be a very daunting process for those with disabilities, and allowing these travelers to have more space, time, and peace of mind during the screening process would lower congestion and decrease the total wait time for all travelers. While the TSA has taken measures to improve the efficiency of the security screening process, there are still numerous improvements that can be made to increase overall customer satisfaction for persons with disabilities traveling by air. Airports bring in significant revenue, but it is not currently allocated to benefit all passengers equally. The TSA experience can be greatly improved by

incentivizing airports to emphasize accessibility when designing TSA screening areas and to redesign old airport screening areas constructed prior to the existence of TSA to be more inclusive.

Section 3.6: Conclusion

Airports can increase accessibility in four main areas; navigation, emergency protocol, baggage handling, and security, to cater towards a growing population of travelers with disabilities. They must reevaluate their design and layout to make them more accessible for individuals with disabilities, specifically their signage, restrooms, retail establishments, walkways, and seating areas. More specific legislation surrounding requirements for emergency evacuation protocols as well as information supplied by individualized agent-based models of airport evacuations can be used to increase the efficiency and safety of airport evacuation plans for individuals with disabilities. A baggage labeling, handling, and storage system specially designed for the care of vital medical equipment and devices can be implemented to protect the most important belongings of passengers with disabilities. Incentivizing airports to cater towards persons with disabilities would result in designing new TSA screening areas and redesigning old airports constructed prior to the existence of TSA to be more accessible to all passengers. Lastly, a revitalized pre-notification process and specialized subscription service like TSA Pre-Check for persons with disabilities would inform the TSA of any travel limitations prior to arrival and advance all passengers more comfortably and efficiently through security screening.

Chapter 4

Title: **Passenger Preparation and Notification**

Authors: Katherine Brennan, Monica Chanda, Josh Damman, Jack Jaeger, Jaibir Khera

Passengers with disabilities encounter challenges when traveling by air which need to be mitigated through improved airline preparation and communication between the airlines and passengers (Wang & Cole, 2013). This includes long wait times for passengers needing wheelchairs, airport navigation, and distribution of information. In order to assure the best experience for a passenger with disabilities, this section proposes solutions that will assist both the passengers with disabilities and the airlines or airport in planning travel accommodations. Airlines typically provide accommodations for those with mobility impairments, cognitive disabilities, deaf or hard of hearing, blind or have reduced vision, with allergies, requiring medical equipment or medication, and using service or support animals (“Customers with

Disabilities,” 2019). Though there are a wide range of disabilities, according to the United Airlines Disability Help Desk, the one that airlines accommodate for the most are mobility issues. Therefore, this section will focus on how airlines prepare for passengers with mobility issues and how these passengers notify the airlines that they require assistance at the airport.

Section 4.1: Passenger Preparation

When traveling through an airport, individuals of all abilities rely on several different modalities to navigate the airport, beginning from the parking lot and ending at the terminal. Some individuals will use personal experience to navigate, others will use airport posted signs, the help of a caretaker, or an airline worker to help direct them to where they need to be (Wang & Cole, 2013). However, there are cases where these common modalities are either not present, or inadequate to ensure successful navigation of the airport. Especially in the community of individuals with disabilities, navigation is potentially a difficult challenge and not every person is willing to give up their independence to have someone navigate for them. In a survey from individuals connected with the Purdue Disability Resource Center (DRC), approximately half of respondents reported that current airport navigational signage needed either some improvement or needed major improvement, with the majority of the respondents reporting need for major improvement.

Regarding individuals of the disability community, there are accommodations or facilities that may need to be located that a passenger without any disability may not need to utilize or may not think about in a routine trip through the airport. Individuals with decreased mobility due to disability or age may require an elevator to navigate the airport and will need to locate these during their travel experience. Individuals with a disability who travel with a service animal will need to locate an area for the animal to relieve themselves. An inability to locate something such as a relief station or an elevator could pose as an impassable barrier for an individual with a disability and this could greatly complicate air travel for that individual (Rabinowitz, 2018).

Additionally, normal airport signage may not suffice for an individual with a disability affecting their movement or their vision. For individuals unable to see well enough, they would require the ability to read the sign up close or have some sort of audio cue to alert the to the direction they are supposed to travel. For individuals with decreased mobility, there are instances where a person’s disability inhibits their ability to view signs above a certain height and with many directional signs in an airport hanging from ceilings or posted above the heads of passengers, which can cause difficulty navigating through the airport (Rabinowitz, 2018).

We propose a solution in which airports incorporate into their websites a comprehensive list of all navigational information, the contents of which will be discussed later, a passenger with disability would find useful. A link to this webpage would be sent along with the confirmation email to all passengers who purchase a ticket. Our understanding is that the relay of information to passengers with disability is one of the most detrimental factors when choosing to fly. The Purdue DRC survey indicated that 43% of passengers did not receive any information

that was pertinent to their travel plans. They were ill-informed and resultantly encountered difficulties. If given instructions beforehand on how to prepare for their day of travel many issues may be prevented.

With current standards, individuals with disability either garner extreme anxiety when flying or choose not to fly. As mentioned previously in the DRC survey, almost half of the passengers with a disability did not have any information available to them at all on how to prepare to travel. Those that did find information found it through a variety of sources: websites, emails, travel agents, and online blogs. The distribution of how these passengers acquired information is shown below in Figure 4-1.

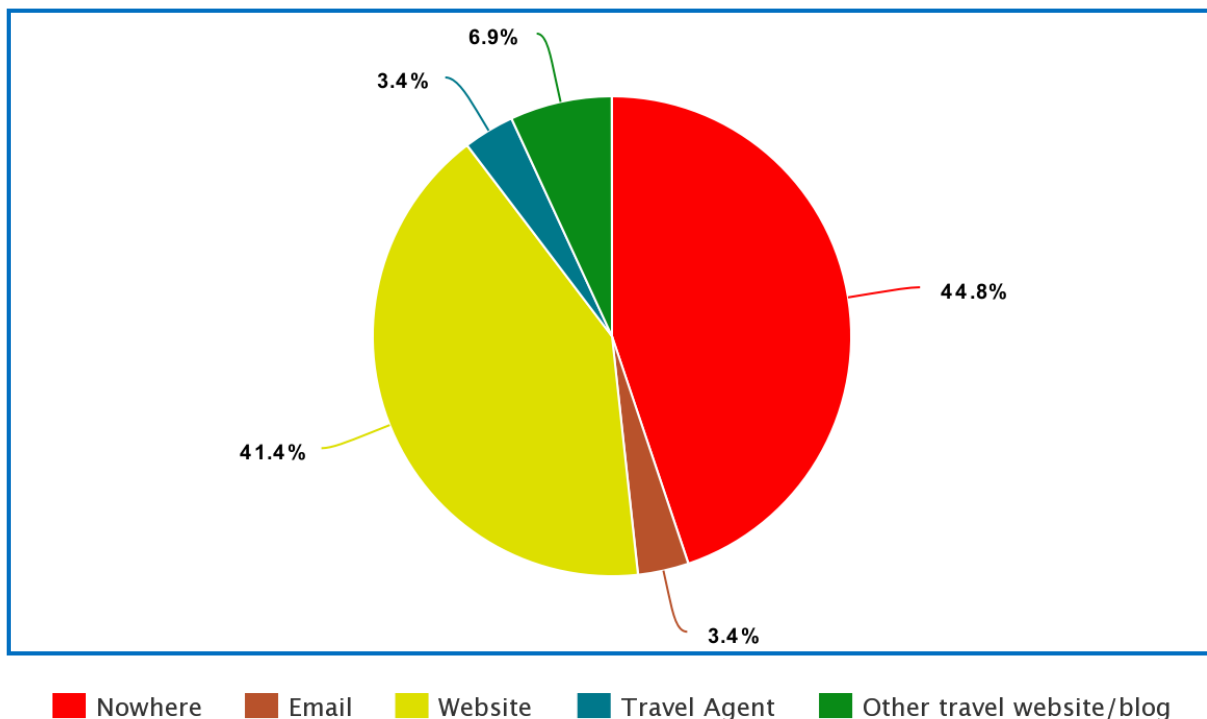


Figure 4-1. Distribution of how passengers with a disability find information related to flying.

There was no definite, reliable source that fliers with disability could access. *Based on this information, a proposed solution is to organize and direct information to a single webpage on the airlines' site that is directly distributed to passengers with a disability.* Amassing all pertinent information into a single, credible source would relieve the anxieties that spawn from the unknowns of flying.

Although there are sources available with some tips on how passengers with a disability should prepare to fly, they are not thorough enough. Many details are left out of these sources. According to the DRC survey, 35% of passengers do not receive information on how to request accommodations, which is a common piece of information requested. Airport maps, access to laws and policies, and complaint reporting instructions are also some frequently requested information that is not regularly provided. As low as 11% of flying passengers receive this kind of information. This lack of available information is also reflected in the survey's responses to

what information passengers with disability wished they had prior to flying. 70% of passengers wished they the handling instructions or allowances for medical equipment, check-in process guidelines, and how to find the aforementioned policies and laws. 65% wanted more information on what accommodations are available and how to request these accommodations. Airport maps, airplane information, recommended arrival time, and guidelines for return trips involving other countries were some more examples of the information that passengers with a disability wish they had. The list of this can be seen below in Figure 4-2. The other column includes wanting more information on return trips, dealing with other countries, and how to request things other than wheelchairs and service animal accommodations.

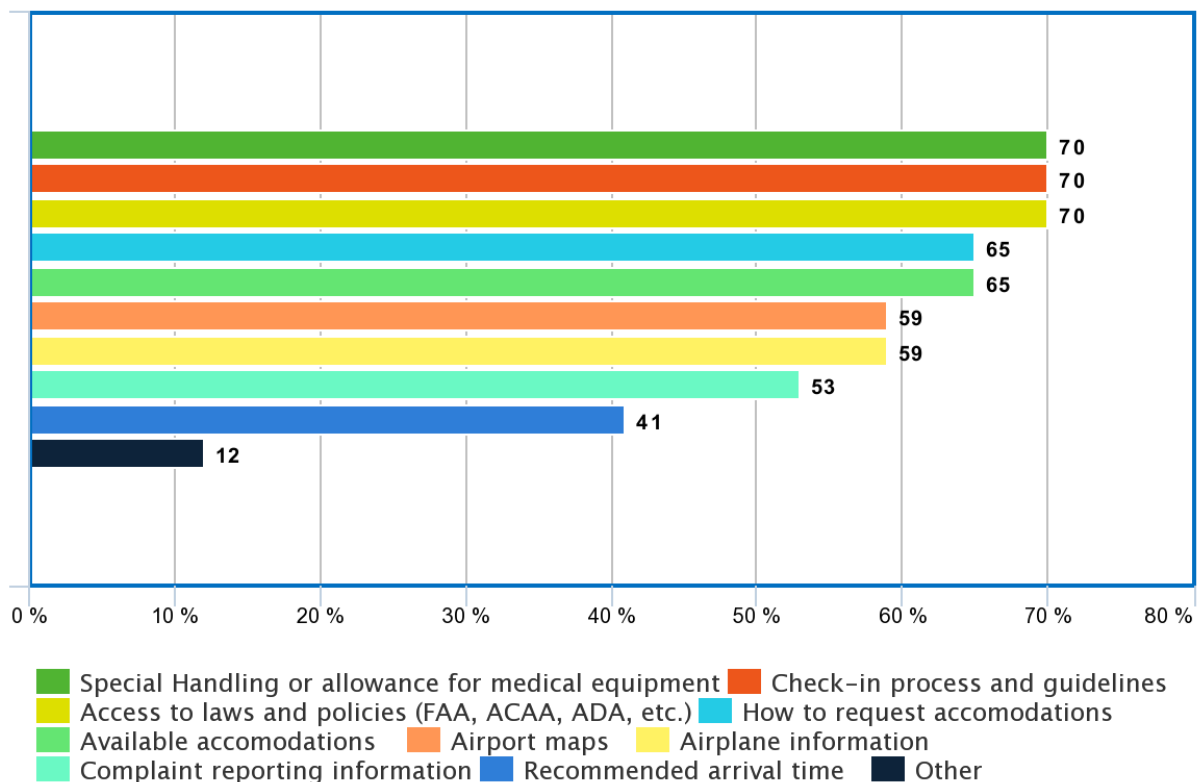


Figure 4-2 Percentage of passengers with disabilities that wish they were given various kinds of information.

This lack of information contributes to the anxiety that these passengers feel about flying (Davies and Christie; 2017); they are stranded in a fog of scattered and unclear details. They need a source that organizes and explicitly tells them all of the information that they would need.

An easily accessible link available both when ordering and after purchasing will help passengers feel confident that they will be prepared for their flight by directing them to a step by step guide to navigating the airport and airport processes. These guides would vary based on airport location, travel experience, and/or type of disability, and they would be sent to all passengers who need them. This should overall increase not only the likelihood of passengers with disability choosing to fly but also their quality of travel.

Section 4.2 Airline Notification and Preparation

The other side of this preparation process focuses on the how the airlines and airports prepare for incoming travelers with disabilities. After interviewing different airlines the current process of requesting and receiving accommodations at airports was determined. Currently, passengers who require accommodations, must request these by calling or emailing the airline, or requesting an accommodation through the airline's website. The airlines notify the wheelchair vendors at the applicable airport. The vendor then provides the requested wheelchair or assistance to the passenger in preparation of their flight. This can be a tedious process for a passenger that is planning a trip which involves flights with different airlines, as the passenger must notify each airline of their request separately. Figure 4-3 depicts the current process and highlights the problem area with the red box where passengers must contact every airline individually.

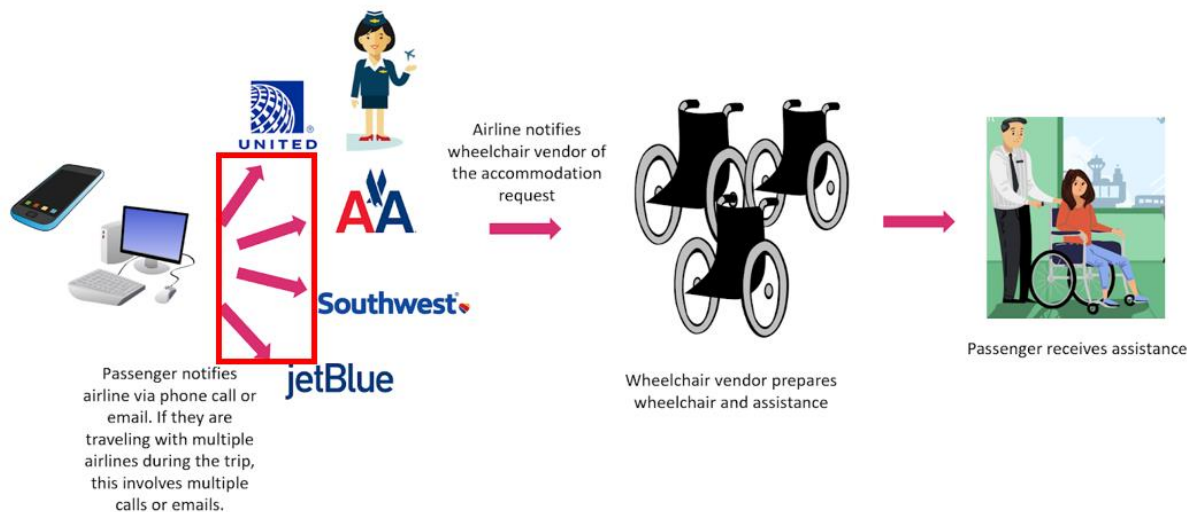


Figure 4-3. Current chain of events for airline notification of a passenger in need of assistance. The red box highlights the problem area within the process.

Although airlines cannot require advanced notice, most ask that a passenger request a wheelchair at least 48 hours in advance so they can be prepared. Through interviews with the United™ accessibility desk and the Southwest Airlines™ customer relations line it was determined that after booking a ticket, passengers with disabilities can call the airline to request a wheelchair for the date of flight. The customer service representative will then put a “requires special assistance” note in their reservation record and notify their departure, arrival, and any transfer airports to have a wheelchair ready. From a survey of people who have travelled by air with a disability it was found that passengers may also notify airlines of accommodation requests by emailing the airlines, or specifying while purchasing a ticket. Many airports require that the passenger arrives to the airport at least two hours in advance to ensure that there are wheelchairs available for them. If passengers arrive too close to their boarding time, there may not be

wheelchairs available and the passenger will have to wait (“Wheelchair passenger airport experience”, 2019). It is worth noting that although the airlines, such as United and Southwest, request a 48 hours advance notice, it is also possible to get a wheelchair prepared without pre-notification after check-in as well as having a wheelchair ready at the passenger’s final destination.

According to a passenger who uses a power wheelchair and frequently travels through the LAX airport, some problems that arise include a limited number of wheelchairs. This passenger uses a motorized wheelchair, and checks it when she flies a few times a year, so she relies on the airport to provide her with a temporary wheelchair to get her from check in to the plane. Typically, she said that it is unpredictable whether the airport is ready with a wheelchair when she arrives, so from experience she shows up early enough in case she needs to accommodate an extra wait of about 15-20 minutes to retrieve a manual wheelchair. However, during holidays or busy times, the lack of wheelchairs causes a wait of over an hour sometimes. If they are all in use, she has to wait for a passenger to board, then for the wheelchair to be brought back to the front for her use. When she expects the airport to be busy, she arrives 3-4 hours before her flight departs as a precaution.

A wheelchair attendant is commonly provided to transport passengers with disabilities to the flight before departure, between gates at layovers, and out of the airport at the final destination. If the passenger needs to use the restroom and there is one on the way, the attendant must stop and allow the passenger to go (“Wheelchair and Guided Assistance”, 2019). By law the attendant does not have to stop for food (“How to Request a Wheelchair or Cart at the Airport”, 2019), however after interviewing passengers who use wheelchairs at the airport, they reported that the attendant will usually stop if the passenger requests to use the restroom or get food. If the airport is not busy, the attendant will ask the passenger if they want to stop at the restroom or get food or water. If the airport is busy, the attendant might not suggest stopping but still will if the passenger requests so.

When requesting a wheelchair from the airport, the wheelchair is used to get the passenger on the plane then brought back to the airport to be used for future passengers. A different wheelchair at the destination airport is used to get the passenger off the plane and to their next gate or baggage claim. Another option for flyers with disabilities is to use their own wheelchair, bring it on the plane with them, and use it again at the next airport. For many airlines, planes have designated space to hold one collapsible wheelchair on board and non-collapsible wheelchairs, scooters, or other battery powered chairs are to be checked at the ticket counter or departure gate. Mobility and medical devices brought on board do not count toward carry on limits, but if they do not fit and do not need to be accessible during the flight, they may be determined by flight crew to be checked. For power wheelchairs there are specific regulations around battery management depending upon the type of battery used. Though this information is usually posted on the airline’s website, airline personnel may interpret these regulations differently and require negotiation between the passenger and the airline. Those airlines with

more experienced personnel on wheelchair stowing eliminates much of this misunderstanding and anxiety for passengers with disability (“Customers with Disabilities” 2019).

To improve the efficiency of the airlines, and to minimize waiting times for passengers with disabilities, a database to control the information flow from passenger to airline to airport (vendors) regarding air travel accommodations would be helpful. The passenger could go on the online database to request an accommodation and select from a list of proposed accommodations or input a personalized one. This database would take information from passengers regarding what accommodations they need and their flight plans while alerting the necessary airlines/vendors about what accommodations are needed and where and when to have them delivered. The database would notify the vendor at the departure airport of the accommodation that is needed and the passenger’s plan of arrival time. The database would also send the information to the layover airports, and destination airport so those vendors are also prepared with the accommodations. The database would be linked to each airline’s information and would provide updates to the vendor about delays or changes in gates just like the messages passengers receive to ensure the accommodation is at the right place at the right time. *The database would allow for constant updates of passenger numbers and plans so that vendors would always be prepared.* The vendors and airlines would be able to access this information to see what and how many accommodations are needed at any given time. This database essentially eliminates the airline’s role in providing accommodations, since they contract vendors anyway, but still allows them access to the information for tracking purposes. The database could be a website that also connects to an app. Passengers can use the app the day of travel to alert the vendor when they will be arriving and needing their accommodation or to update their request after submitting the information. When passengers input the flight(s) they are flying on the website could pull up that airline’s specific regulations and requirements. It would include what to expect, what is allowed, and the airline’s accommodation policy. A quick notification system after check-in would allow for passengers to easily be helped after arrival and ensure that their accommodations are met quickly and efficiently. Furthermore, by compiling a list of necessary accommodations for the day, the airport could be prepared with the appropriate number of wheelchairs and employees to address the needs of the passengers for that day. A wheelchair tracking system could also be implemented so that the location of all the wheelchairs in service could be known. This would allow supervisors to easily find passengers in need of assistance if needed. The database proposed solution is visually depicted in Figure 4-4.

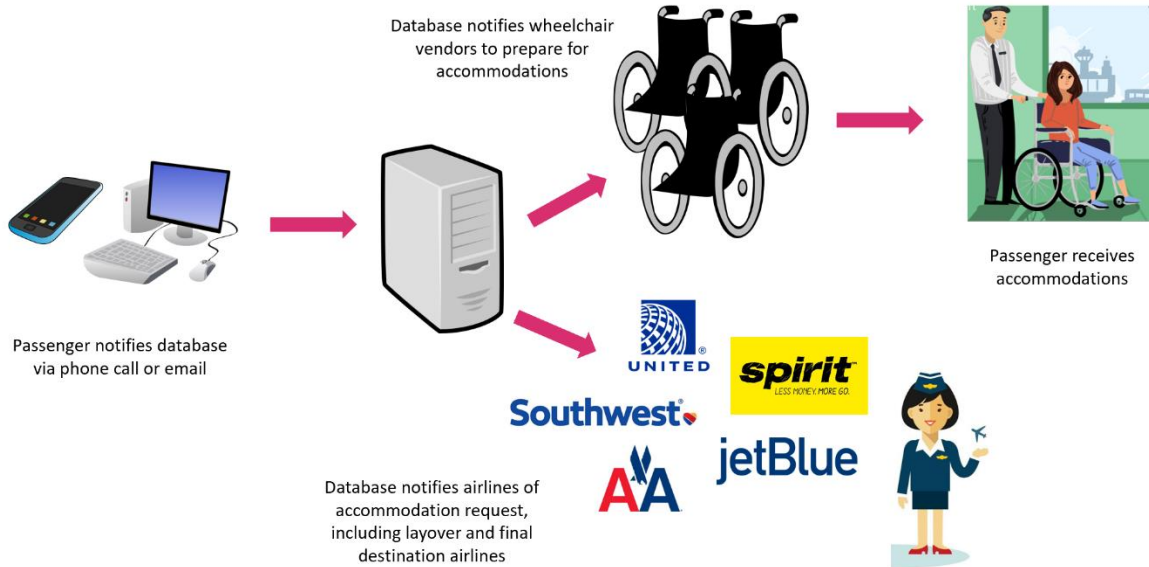


Figure 4-4. Recommended for airline notification of a passenger in need of assistance.

As seen in Figure 4-4, this database reduces the steps that the user has to take to request their accommodation, especially if they are flying on multiple airlines. Instead of having to reach out to each airline, they can input their request once and it can be sent to the respective airlines, airports, and vendors. Hopefully, by implementing this system, the airlines will be better prepared to assist those who require accommodations. Some may be concerned with the privacy of the information they provide the airport, however the system would not link information to names. It would be able to track people by their ticket confirmation number. This information would be deleted after use so there is no issue about the data being stored or shared. The system could also just record the accommodations that the passenger requests, so there would be no need for the passenger to identify their disability. This would allow the user to maintain privacy of their disability.

Chapter 5

Title: Mobility Accessibility: Problems and Solutions

Authors: Haley Brouwer, Nicolet Elsbury, Catherine Berger, Haritha Ramadorai

Section 5.1: Introduction

According to the International Air Transport Association (IATA) there has been a 7% increase in use of air travel from 2015 - 2016 (IATA, 2017). Also, there are 3.3 billion wheelchair users in the United States and this number has been gradually increasing every year (SmartChair, 2015). Hence, with the increase in the number of passengers and people with restricted mobility there is a need to make air travel comfortable, safe and hassle free. This chapter aims to analyze the problems faced by passengers with reduced mobility during air travel, current solutions to accommodate passengers with disability and explores the gap in the market for developing better accommodations. Furthermore, it also points out areas for improvement and proposes solutions for the aviation industry to make air travel safer and more comfortable for passengers with disabilities.

Four main problems faced by passengers include:

- Unsafe and uncomfortable design and use of boarding chairs (Journal of Industrial Ergonomics, 2019)
- Cramped airplane seats (Journal of Industrial Ergonomics, 2019)
- Bathrooms without wheelchair access in the flight (Grant, 2013)
- Damage to wheelchairs that occur during flight (Wheelchairtravel.org)

Current solutions to these problems are minimal and there is a large room for improvement. Three main solutions have been proposed in this report include designing wheelchairs to be compatible for boarding and in flight use, detachable wheelchair plane seats to replace standard boarding chairs, and universally accessible bathrooms in flight.

Section 5.2: Problem #1 – Boarding Chairs

Boarding or aisle chairs are used to help those who use wheelchairs and cannot walk even a few steps get onto a plane. These modified manual wheelchairs are specifically designed to fit within the plane aisle width (Fig. 5-1). Acting as a middle man between the transference of passengers with disabilities from wheelchair to plane seat, the aisle chair sounds like an effective use of equipment. However, it can be physically dangerous for the passenger and airline staff involved and emotionally taxing and stressful. Significant training of airline employees is required in order for them to be prepared for the process of boarding a passenger with a disability onto the aircraft.



Figure 5-1. Right: Staxi Aisle Boarding Chair (Staxi, 2019); Left: Aisle Master boarding chair sold in North America (Inspired by Drive, 2019)

The current process of helping a passenger with a disability onto an aircraft and into their seat involved many opportunities for injury of the passenger and of the airline employees. When the passenger is moved to and from an aisle chair, they are typically lifted by two airline employees. It takes a considerable amount of force to lift a fellow adult that may potentially weigh the same or more than them. From an interview with an airline employee who assists in boarding chair transference, sometimes passengers near 300 pounds would have to be lifted. Any passengers that weighed more than 300 pounds had to be moved by paramedics. This activity leaves airline employees susceptible to back, arm, and shoulder injuries. According to the Workplace Safety department at the University of North Carolina at Chapel Hill, heavy lifting is a leading cause of workplace injuries. When lifting, it is recommended that employees lift with their legs, bending at the knees not the back, and to avoid twisting (moving their feet instead) in order to prevent injuries (The University of North Carolina at Chapel Hill, 2019). Unfortunately, when transferring a passenger from a boarding chair to a plane seat, employees have a very limited amount of space given narrow plane aisles. This scenario can lead to employees being unable to avoid bending their back or torso, which increases risk of injury.

Testimonies of passengers with disabilities state that the experience of flying and having to board with the use of an aisle chair is extremely difficult and even deters passengers with disabilities from flying again in the future. Being strapped down onto an aisle chair has made some passengers, “feel like a prisoner,” (Spin the Globe, 2019). Others including a disabled blogger went as far as to say, “You get to board first so that you have more time to get situated, but also so dozens of strangers don’t stare at you while getting rolled down the aisle strapped to a

chair like Hannibal Lecter” (Spin the Globe, 2019). It is challenging enough for passengers who are physically disabled to navigate an airport. To finally be boarding a flight and feel embarrassed during seat transfers makes for an overall negative flying experience for passengers with disabilities. For passengers with disabilities to feel such physiological strain and discomfort during air travel compared to other passengers is unacceptable and emphasizes the need for new methods of airplane accessibility.

There have been cases where airlines have failed to provide an aisle chair in a reasonable amount of time leaving passengers with disabilities with no options other than to wait or move themselves from the aircraft. Within a single round trip with United Airlines a passenger paralyzed from the waist down had to scoot himself down the aisle to get off of two separate flights (Theresa Braine, 2019).

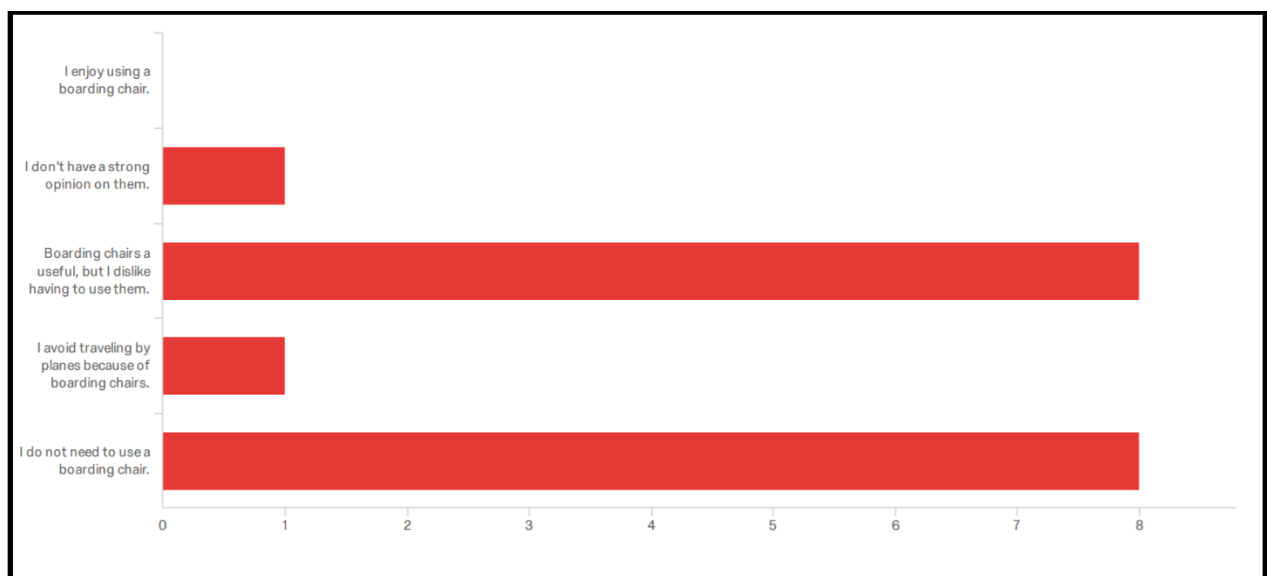


Figure 5-2: Survey question response: Which description most closely matches your opinion on boarding chairs?

A total of 18 people with restricted mobility were surveyed to understand their experience with using a boarding chair during air travel (Fig. 5-2). The survey results showed that:

- None of them enjoyed using a wheelchair
- 80% of passengers found boarding chairs useful but disliked having to use them.
- 10% mentioned that they avoided air travel due to the need to use boarding chairs.

Hence, there is definitely a need to improve the current boarding chair design or find an alternative solution to aid passengers with reduced mobility board the aircraft safely and comfortably.

For how difficult boarding chairs are to use and how much distress they cause, they are surprisingly very expensive. In order to purchase a base unit costs \$3,548. Including a seat and back cushion can cost an additional \$716. To purchase a chair with all available features costs \$6,682 (Inspired by Drive, 2019). Therefore, an airport purchasing only 10 boarding chairs may

have to pay up to \$66,820. Given the overall dislike of aisle chairs, and their high cost, it is surprising that they are still used by so many major airlines.

Section 5.3: Problem #2 – Damage to Wheelchair

Air travel is the only form of travel where wheelchair users cannot stay in their chair. Instead, wheelchairs are stored in the cargo holds of planes - where they have a high chance of being damaged or broken. Wheelchairs and other luggage are placed on a conveyor belt, which carries the luggage from the tarmac to the cargo hold. (Hobica, 2012). Power chairs in particular are extremely difficult for baggage handlers to load onto the belt as they can weigh between 200 and 450 pounds (Willison, 2019). They can be damaged when they are dropped by handlers or fall off the conveyor belt. One passenger's \$25,000 wheelchair was destroyed when it fell out of the cargo hold and down to the tarmac (Wheelchairtravel.org). If a wheelchair has successfully made it to the cargo hold, it is still at risk of damage from the other luggage in the hold. According to an anonymous baggage handler, "Airplanes only make money while in the air, and no airline wants an airplane on the ground too long. Due to the nature of some aircraft, it would be impossible to turn around a [plane] in an hour or less without throwing bags because it's just faster," (Hobica, 2012). Bags and suitcases are often thrown 50 feet down the length of the hold where they collide with the previously packed luggage. An agent then rearranges the luggage so that they can fit the bags as compactly as possible "as if it were a game of Tetris" (Hobica, 2012). Unfortunately, this poor handling leads to a large portion of wheelchairs returning to their owners with some type of damage. According to the survey, 39% of respondents have had their wheelchair or scooter damaged on a flight (Fig. 5-3).

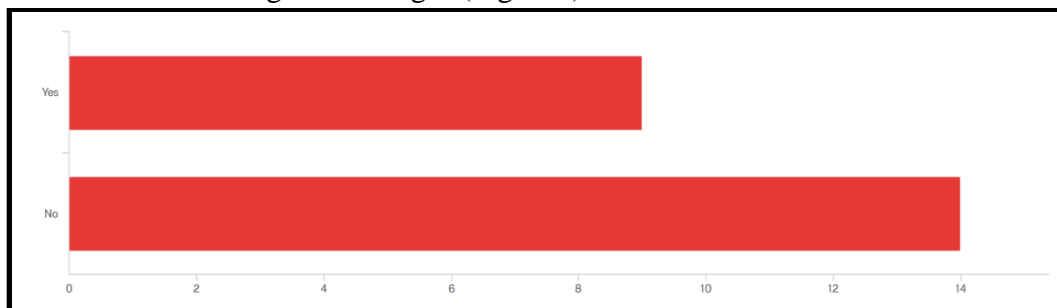


Figure 5-3: Survey question response: Has your wheelchair or scooter ever been damaged by the airport or airline?

While airlines are supposed to be required to pay for the full cost of damages caused by mishandling, airlines rarely admit fault. It can also be extremely difficult to get insurance to pay for repairs or a new chair. Often, the insurers and the airline place the blame on each other and both refuse to pay (Willison, 2019). According to the survey, 55% of respondents received only partial or no compensation after their wheelchair was damaged on a flight (Fig. 5-4). In situations like this, the passenger is stranded without a means of mobility or they are out hundreds or thousands of dollars for repairs or a temporary replacement.

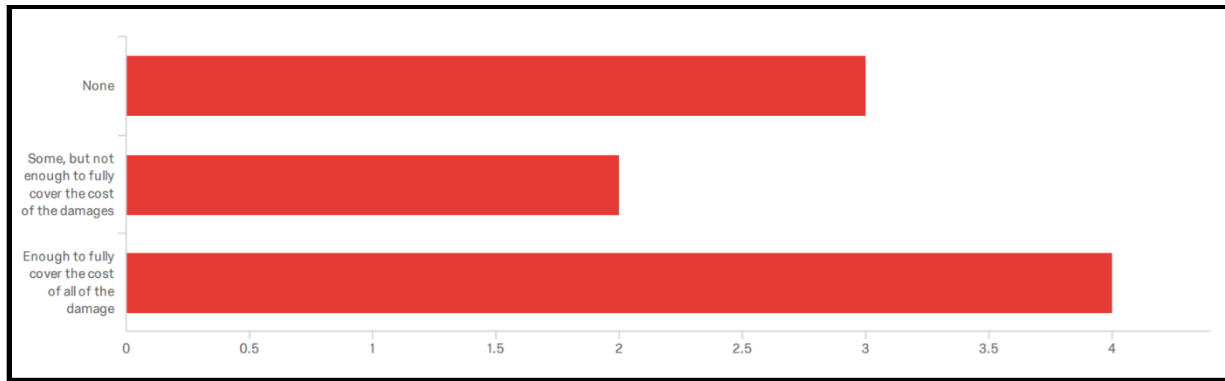


Figure 5-4: Survey question response: What level of compensation did you receive from the airline or airport?

For example, one individual's "wheelchair was broken on a short flight from Philadelphia to Detroit. "The cargo guys couldn't fit it into the cargo door so they crammed it in and broke the backrest, armrest, and a few other things on my chair," he says. "I get to Chicago and after all that, my back-up chair never made it on the first flight. Here I am two days later wondering where that chair is,"" (Webster, 2017). Another individual was left bedbound in his house for "nearly a month" after a flight from San Francisco to Washington DC. His highly-customized and pain-relieving chair was bent and rendered immobile. "I am terrified of flying now," (Webster, 2017).

One interviewee was travelling from Glasgow, Scotland, to Memphis, Tennessee for the "holiday of a lifetime" when she was told her suitcase and manual wheelchair were not on the plane.

"I was then taken off the airplane in a non self-propelling wheelchair and left in an airport waiting area with my hand luggage, crutches and small trolley suitcase... I was virtually abandoned. I had no way of getting myself a drink of water, anything to eat or even being able to get to the toilet. I had to try and stop anyone wearing a HI-Vis jacket to get someone to help me....I had also paid to go on other tours with the group, but I had to ask how much walking would be involved. As I knew I wouldn't be able to do much walking, even with my crutches. So I had to decide which tours I really wanted to go on. Obviously, I wanted to go on them all, but I had to make a decision as to which were most important to me."

After three and a half days, her wheelchair and suitcase finally arrived at her hotel.

"I could see that it was broken. The armrest connection had been broken off, which in turn, meant, that the armrest was dragging across the actual wheel....acting as a brake. By the end of my first week in America, I had missed four tours that I had paid for, I was unable to go to a special concert recital that had been organized for our group and I was,

by then, in so much pain, trying to get myself around in my broken wheelchair, that I asked my tour guide to arrange to fly me back home. I was in tears.”

Part of the problem is that airlines had, until recently, not been required to record incidents or track the frequency or severity of incidents. “Without statistics to prove how severe the problem actually is, airlines have been able to falsely claim damage to mobility equipment is rare. It has been cheaper for them to deny most cases of mishandling and quietly pay for the most egregious ones, instead of addressing the root causes of the problem,” (Willison, 2019). As of December 2018, however, all American airlines are now required by law to track data on lost or damaged wheelchairs, scooters and other mobility equipment — and share the results publically (Department of Transportation, 2016).

Section 5.4: Problem #3 – Access to restrooms in flight

Once a wheelchair user is seated on an airplane, their greatest accessibility challenge becomes restroom usage. 54% of mobility-impaired respondents to our survey were unable to use the lavatory on flights. In a survey completed in 2010, the two greatest issues were user-friendly on-board restrooms and space in on-board restrooms (Chang, 2010). These are two parallel issues that both need to be improved to make airplanes truly accessible for wheelchair users.

One challenge in airplane restrooms is the design of the door. The door is often not wide enough to allow wheelchair access. The average airplane restroom door is 24 inches wide on the inside and aisle chairs are about 16 inches wide (Aratani, 2018). That does not give space to maneuver the chair. The door design itself can block a wheelchair from entering the restroom. In some airplanes, it is impossible for a wheelchair user to enter the bathroom. A similar issue to the door challenge is the lack of space within the restroom. Even if a wheelchair user can be wheeled in, they are not able to maneuver to access the toilet. If there were to be a wide enough door and a large enough restroom, wheelchair users still need support within the restroom to move to the toilet and to the sink. One final accessibility challenge within the airplane restroom is the sink design. The sink is made so that there is no counter to wheel under. Thus, wheelchair users cannot wash their hands (RehabMart, 2016).

Although airplane restrooms should be accessible to every person, they often are not. Because of the lack of accommodations given by the airline, wheelchair users have to make their own accommodations. They will limit their fluid intake so they are less likely to need to use the restroom. If restroom usage is necessary on a flight, wheelchair users will use a catheter or an adult diaper because the inflight restroom is inaccessible (Saari, 2015) (Fig. 5-5).

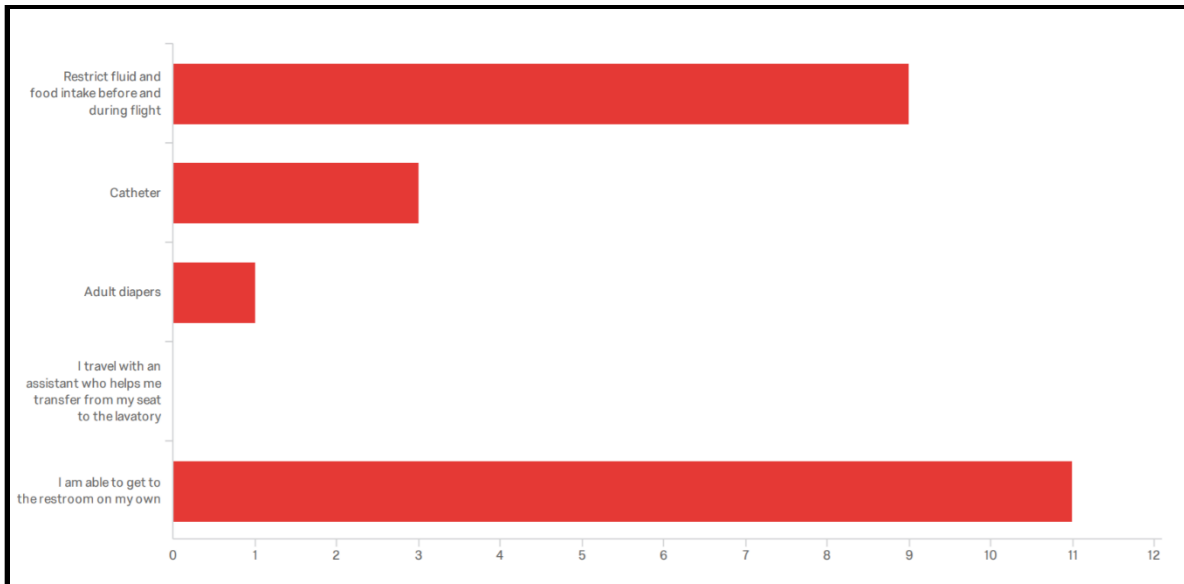


Figure 5-5: Survey question response: If you are unable to use a restroom on a flight, what do you do?

Airplane restroom design is affected by more factors than minimizing size to maximize seating space. Amenities in the restroom must be within reach of the fifth percentile of women while sitting on the toilet. The door orientation and size must be adjusted. The curvature of the airplane affects the height of the restroom. It is made so the 95th percentile of people can stand up straight within the plane. The available transfer space is based on the 95th percentile of people being able to move their knees, shoulders, and hips to the toilet. This causes wheelchairs to be placed between 45 and 90 degrees from the toilet. The location or material of assist handles and bars in the restroom affect the individual transfer of a wheelchair user. The restroom floor space affects where the aisle wheelchair can be placed in the restroom and still allow the user's legs to be in a safe position. The direction of turning the wheelchair into the restroom can injure the user if the angle is too extreme. The last factor is the ability to close the restroom door once the wheelchair user has been wheeled in (Grant, 2013). Examples of different restroom designs for single aisle aircraft are shown in Figure 5-6.



Figure 5-6: Typical lavatories on single-aisle aircraft (Grant, 2013) and “Wheelchair Accessible Lavatories” (Cumming, 2015)

Section 5.5: Problem #4 – Airplane Seats

Airplane seats are extremely uncomfortable and the lack of physical support and flexibility can be harmful to those with disabilities. One of the main issues with the current seat design is the lack of enough legroom and seat width to ensure passengers with mobility impairments to be seated comfortably and safely (Porta et al., 2019). There has been a gradual decrease in the airplane seat width and seat pitch (distance between two adjacent seats). In the 1970s the seat pitch was 31 - 25 inches and currently it is as low as 28 inches in budget airlines like Spirit, Allegiant and Frontier. Furthermore, seat width has also decreased from 18.5 inches in 1970s to 17 inches on an average currently (Brockman, 2018). Table 5-1 below shows the gradual decrease in seat pitch over 30 years with different airlines. Additionally, there has been a gradual increase in body mass and structure of human beings due to unhealthy diet and increase in meal portion size in the past few decades. A research study recommended a minimum leg room between 68.1 and 70.1 cm, and seat width between 50.2 and 52.3 cm in order to reduce health risks and improve comfort (Porta et al., 2019).

Table 5-1 Change is seat pitch size in airlines over 30 years (The Telegraph, 2018)

Airline	Seat pitch 30 years ago	Now
American	31-33	30-33
Delta	31-33	30-33
United	32-36	30-32
Southwest	31-35	31-33
BA (short haul)	30-32	29-34
BA (long haul)	31-34	31
Lufthansa (short haul)	34	30-32
Qantas (long haul)	34	31-32
Virgin (long haul)	34	29-31

Another issue with the current seat design is seat firmness and seat shape. The lack of adequate cushioning and seat shape to accommodate passengers with disabilities has been seen as a major problem. Sitting in a confined space without adequate cushioning and proper lumbar support can lead to back and body pain that could be a temporary discomfort or cause a prolonged problem that requires medical attention. While interviewing a power wheelchair user and professor about his experience with airplane seats he mentioned how many wheelchair users compensate with inadequate cushioning by putting their wheelchair cushion on the seat. This

results in raising the feet off the floor. This in addition cramped seat space, inadequate support and lack of foot movement puts passengers at high risk for pressure sores, blood clots and deep vein thrombosis (DVT). DVT results in pain, swelling, numbness in the feet and in worst case scenarios even cause pulmonary embolism when the blood clots breaks and enters the lungs via the bloodstream (Sampson, 2018).

A doctoral student at the National University of Health Sciences discussed the harmful effects with current airplane seat designs. She stated that the lack of space in economy seats, inability to fold up the armrest, and inadequate support for the neck and spine were particularly harmful to persons with mobility impairments. Furthermore, she stressed on how the human body was not designed to be confined in a particular area without room for movement or stretching and that movement is natural medicine. And hence, long flights with confined seating areas results in people suffering from muscle aches and stiffness due to lack of adequate blood circulation that could lead to pressure sores or decubitus ulcers. She stressed on the need to redesign seats to provide more room, the necessary support especially around the neck and ergonomic back support in order to keep the spine in upright/neutral position. This will aid in aligning the neck, shoulder, and pelvis in proper position and thus pain, swelling and blood clots.

The need to increase the total number of seats in the aircraft for higher profit margins has resulted in reduced comfort and in some cases injured passengers. Passengers are put at a risk of neck, knee, spine and overall body pain, discomfort or injury. While business class seats with wider seats, larger seat pitch and better cushioned seats are better for passengers with reduced mobility, not everyone would be able to afford flight tickets at higher costs.

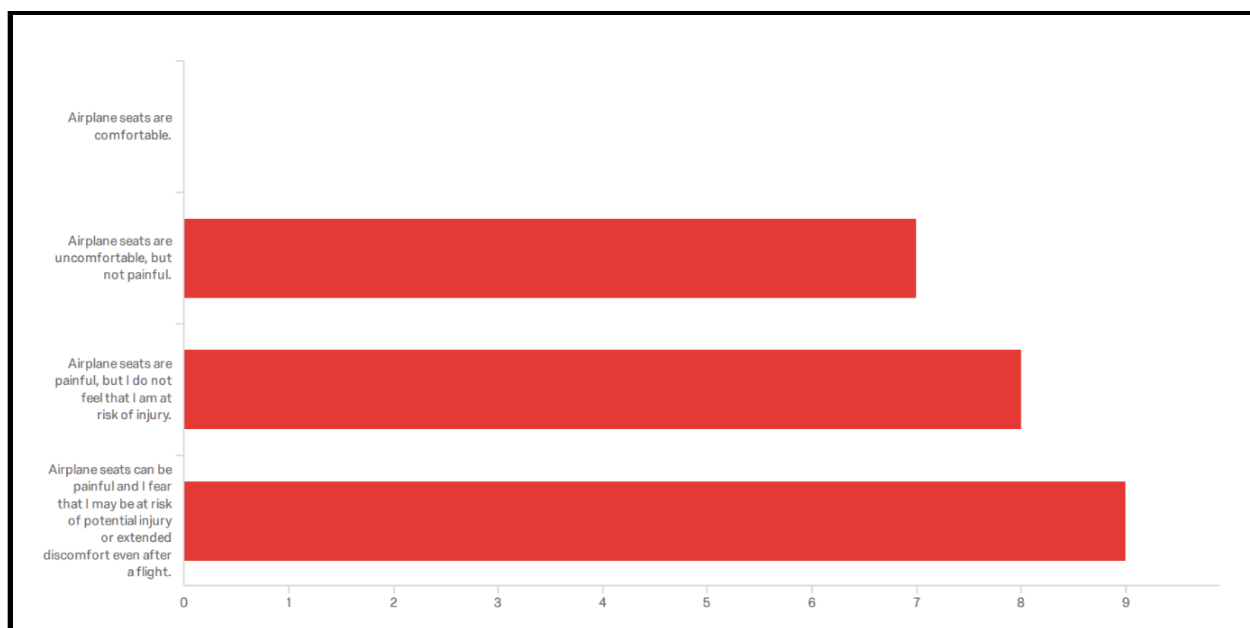


Figure 5-7: Survey question response: Do you think that the current design of airplane seats creates a potential for pain and/or injury?

A total of 18 people were surveyed to understand experience airplane seats (Fig. 5-7). The results show that none of the travelers found the airplane seat comfortable and 90% of them believed that airplane seats are uncomfortable and fear that they may be at a risk of potential injury. Hence, there is definitely a need for a better solution.

Section 5.6: Hypothesis #1 – Detachable Wheelchair Plane Seats

A potential solution that can improve air travel for those with a wheelchair is a detachable plane seat with wheels. This solution is intended to help simplify the transition of getting passengers with disabilities from the gate, onto the plane, and into their seat. A detachable plane seat would be designed to be removable from the floor of the plane and wheeled off the aircraft to the jetway waiting area. The ideal situation would be that the passengers with disabilities would be transferred from their own wheelchair to the detachable airplane seat when arriving to the airport to prevent multiple transfers between chairs. From the appropriate gate, the passenger with a disability would be wheeled on to the plane and the previously removed chair would be locked down to the floor of the aircraft for takeoff, landing, and during the flight. In theory, the implementation of detachable wheelchair plane seats would solve multiple problems associated with the current use of aisle chair, the time and frequency of transfers between multiple chairs/seats, and the embarrassment and stress of the passenger with the disability during the boarding process. The hope with this hypothesis, is that a statistically relevant number of these detachable wheelchair plane seats would be required on every new commercial aircraft vessel.

As previously discussed, there are many notable downfalls to the use of aisle or boarding chairs. Eliminating the use of these chairs for the boarding process would minimize discomfort for the passenger and airline employees. Employees would no longer be required to lift a wheelchair user from an aisle chair to the plane seat nor would they need to take time to transfer a passenger from a wheelchair to an aisle chair and strap them in. This process is not only time consuming but lifting a person is labor intensive and dangerous. Eradicating the use of aisle chairs and two extra transfers per airplane trip should be a priority need. In addition, the only transfer from the jetway wheelchair to the detachable seat would occur in the jetway waiting area where there is more room and less likely to result in lifting injuries as discussed previously. It should be noted that additional training of airline employees would be required in order to teach the proper technique of detaching and reattaching the chairs to the aircraft floor.



Figure 5-8. Detachable wheelchair seat concept Air Access by [PriestmanGoode](#)

This solution would effectively eliminate the need for an aisle chair and improve accessibility of wheelchair users within the main cabin of the plane during a flight. Also, this design can be utilized by all passengers and does not remove overall number of available seats in the plane. Figure 5-8 shows one concept by PriestmanGoode of how a detachable seat could be developed.

Section 5.7: Hypothesis #2 – Personal Wheelchair Accommodations

Another similar way to approach boarding issues for wheelchair issues is to allow people to use their own wheelchair the entire flight. They would use their wheelchair when they entered the flight, they would use it to move around the plane, and they would use it as their seat. If this were to be successfully implemented, this would eliminate several seating issues that were addressed: boarding chair discomfort and transfers, damage to wheelchairs during storage, and poor support to the user.

Using one's personal wheelchair could eliminate the process of the boarding chair. A new process would need to be made to board the plane, but the result would be a lot less discomfort to the wheelchair users. Depending on the process, this option would reduce strain on airline workers who must transport wheelchair users through the airport, transfers to the boarding chair and the plane seat, and storing the wheelchair underneath the airplane. Without transferring a person from one wheelchair to another, physical strain on the workers and wheelchair users would be greatly reduced and efficiency of boarding onto planes would be significantly increased. The greatest change that would be necessary to implement this would be to adjust the airplane cabin area where wheelchair users would enter and be securely fastened.

During a flight, a user's regular wheelchair is stored as cargo. This can lead to damage as it is placed on a conveyor belt or as it is thrown in or out of storage. According to interviewees, wheelchair users are sometimes stranded without working wheelchairs or they must pay thousands of dollars in damages. Using their wheelchair the entire flight would eliminate this damage. It would also increase the space within the cargo space to allow more luggage from

other users. Finally, using one's own wheelchair would make it so one is able to move around as soon as the flight ends, not just wait stranded for assistance.

The disabilities and injuries that cause one to use a wheelchair vary from person to person. Therefore, every person needs a different kind of physical support. A typical airplane seat is used to support the back of an able-bodied person. A person's wheelchair will support them a lot better than any airline's chair could. This especially applies to those with power wheelchairs. Power wheelchairs allow adjustments in the tilt and recline of the seat and foot rest angle for pressure releases. This will alleviate the risk of blood clots that sitting still in a manual wheelchair for an entire flight may cause (American Society of Hematology, 2018).

The varying sizes of personal wheelchairs would require considerations of best methods for attaching to the floor of the airplane. Most likely, wheelchairs would have to fit within certain size restrictions to be allowed on the flight. There may be issues with using a motorized wheelchair because of the difference in dimensions and coordinating that with hook placements on floors. Also, not every wheelchair has placement of hooks or fasteners for vehicle securement in the same locations, so standardization would be needed. This option would require airplane and wheelchair reengineering, but it would provide the most comfort and accessibility for wheelchair users, unlike the current seats and aisle seats being used on airplanes (Surelok, PlosOne, 2018).

If personal wheelchairs could be used as plane seats, there would need to be a designated area within the main cabin of the airplane for wheelchairs. Due to turbulence and the g-force associated with takeoff and landing, there would need to be a highly adjustable locking mechanism in the plane floor in which the wheels would sit. One current solution that could be implemented is shown in Figure 5-9, which is used for wheelchairs on busses. Straps are attached to hooks on the floor and the wheelchair. The best place to utilize this design would be in the front row of the plane where there is the most space (Surelok, PlosOne, 2018). If the wheelchair user is next to a wall, the seatbelt can also be attached to the wall for additional support.

Current aircraft seats are designed to meet safety regulations that ensure survivability at several times the force of gravity and hence there is a need to conduct appropriate mechanical and safety testing to ensure that this solution meets the same guidelines.

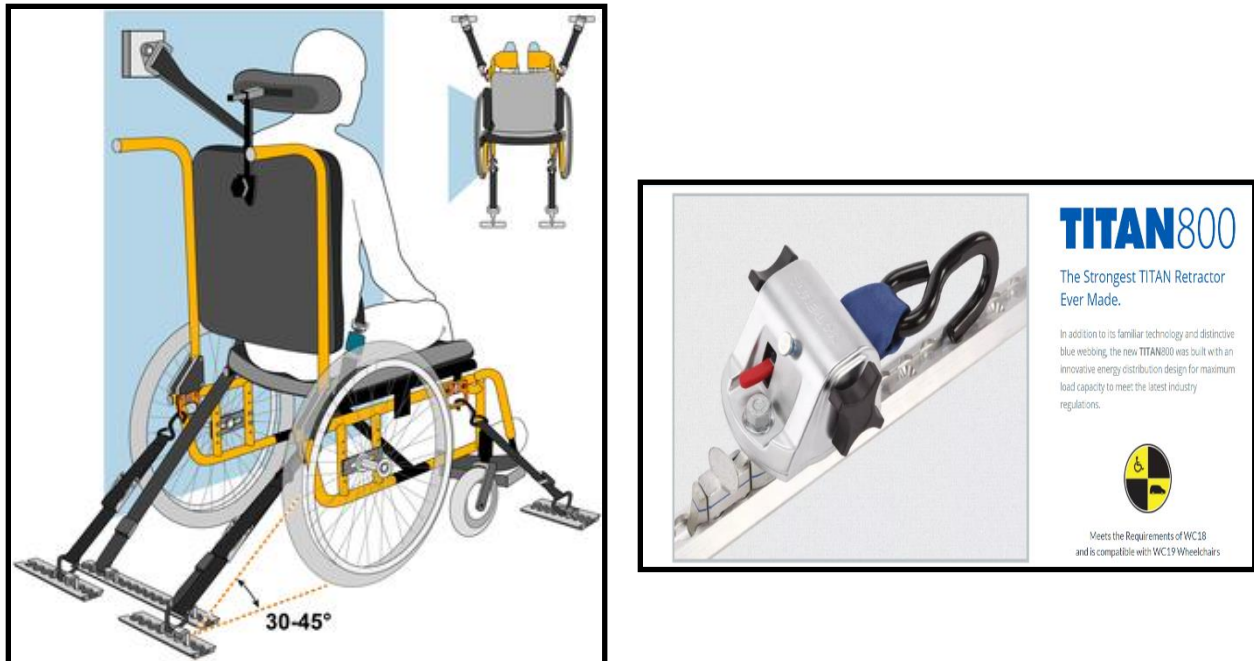


Figure 5-9. Standard four-point strap system to secure a personal wheelchair in a vehicle (Surelok, PlosOne, 2018)

This proposed solution would provide wheelchair-using passengers peace of mind regarding the wellbeing of their wheelchairs, however, it would be difficult to accommodate all types and sizes of wheelchairs and there would be a set number of wheelchairs that could be taken into the main cabin for each flight. It may also be difficult and unsafe to unstrap and re-strap a passenger's wheelchair mid-flight due to unexpected airplane motions, such as turbulence.

Section 5.8: Hypothesis #3 – Universally Accessible Bathrooms

There are numerous options for airlines that want to improve the accessibility of their airplane bathrooms for passengers with mobility impairments:

- 1) Bathrooms must have enough available area to comfortably fit the passenger, the aisle chair, and a travel companion if they require assistance transferring from the chair to the toilet. The room must allow for the movement of the passenger and their assistant, without the risk of bumping into other components or walls. There should be sufficient space so that the aisle chair can be placed at a 45 to 90 degree angle to the toilet. "Transfers of greater than 90 degrees may be considered dangerous, especially in cases where there is a relatively long exposure time during which the occupant is unsupported and is at risk of falling or being injured," (Grant, 2013).

- 2) The door should be able to close with the aisle chair completely inside the bathroom for independent transfers. This is “an issue of privacy, dignity, and comfort,” (Grant, 2013). If this is impossible, a flight attendant or travel companion must remove the chair from the bathroom after the transfer and then replace it afterwards.
- 3) Some planes use partitions to expand the size of bathrooms for passengers with disabilities. However, the flight crew is not always trained on how to operate the partition and the partition can break. One passenger with a disability needed to use the bathroom and asked the flight crew to set-up the partitions so she would have enough room for an independent transfer. “[The crew] fiddled with the partition for about 10 minutes, but couldn't release it,” (Morris, 2016). The pre-flight check each plane is submitted to should include a check for the functionality of the bathroom partitions, if they are present on the plane.
- 4) In order to reduce the distance passengers with disabilities have to travel from their seat to the bathrooms, the accessible bathroom should be located at the front of the plane, and mobility-impaired passengers should also be seated at the front of the plane. This would also make boarding the plane easier.
- 5) The angle of entry from the aisle through the doorway should be as close to a linear path as possible. “When being wheeled into the lavatory, a direct/linear path is considered much safer than a sharp 90 degree turn from a narrow aircraft aisle. People with little to no physical sensation in their hands or lower extremities can be easily injured if body parts are caught on a door/door frame while being wheeled into the lavatory,” (Grant, 2013).
- 6) The width of the door way should be great enough to fit most wheelchairs, not just aisle chairs.
- 7) The custom of “grandfathering in” older planes should be ended. The Air Carrier Access Act states: “Aircraft with more than one aisle in which lavatories are provided shall include at least one accessible lavatory. This lavatory shall permit a qualified individual with a disability to enter, maneuver within as necessary to use all lavatory facilities, and leave, by means of the aircraft’s on-board wheelchair,” But this law does not mean that all multi-aisle airplanes have an accessible bathroom. Any aircraft delivered prior to April, 1992 are exempt from the rule, but only until the bathroom is replaced. Some airlines have found a loophole - by excluding the bathrooms from interior renovations (Morris, 2016). All “grandfathered in” aircraft should be given a set time period in which they are required to comply with the ACAA. This rule should also be expanded to single-aisle aircraft as well.

Figure 5-10 is a diagram of four common lavatory layouts on single-aisle planes in combination with 4 possible door locations. Diagram C3 seems to be the closest to meeting the suggestions lists above. This diagram has minimal overlap between the passenger and the sink, and the wheelchair is at about a 45 degree angle - which is an ideal angle for transfer between

their chair and toilet. Figure 5-11 shows a typical “accessible” lavatory on a twin-aisle aircraft. Clearly, there is still not sufficient room for a passenger in a wheelchair to move around comfortably.

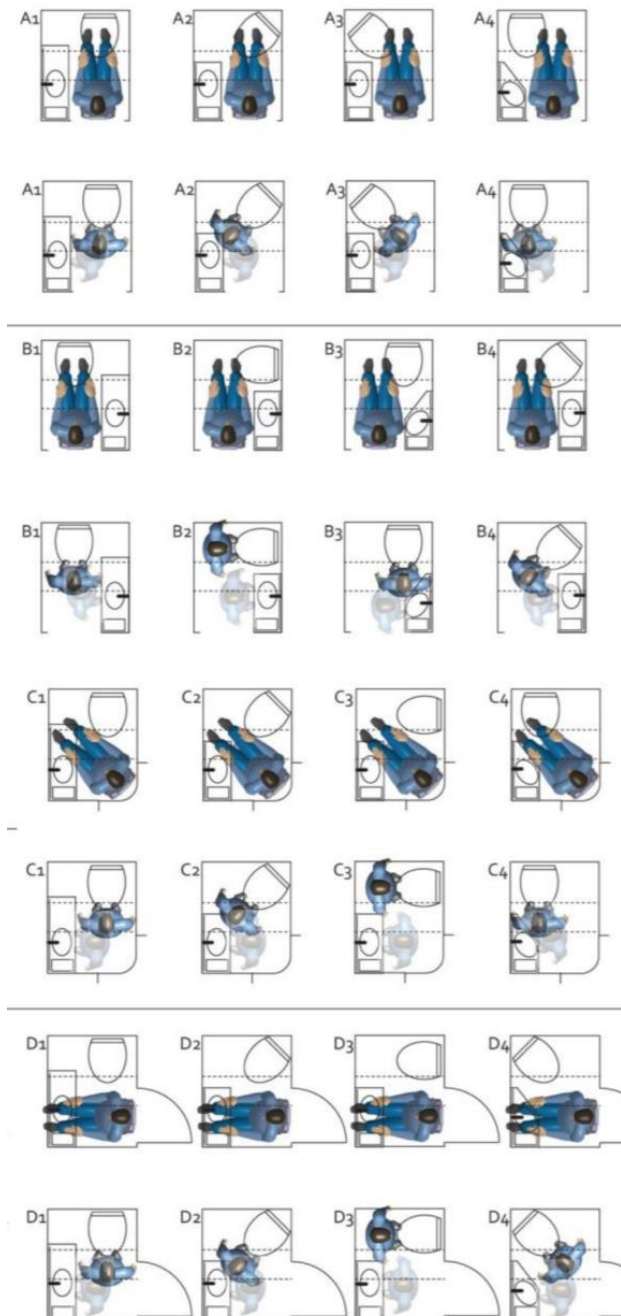


Figure 5-10: Four architectural arrangements and four possible door arrangements for single-aisle aircraft lavatories (wheelchair user vs. able-bodied user) (Grant, 2013)

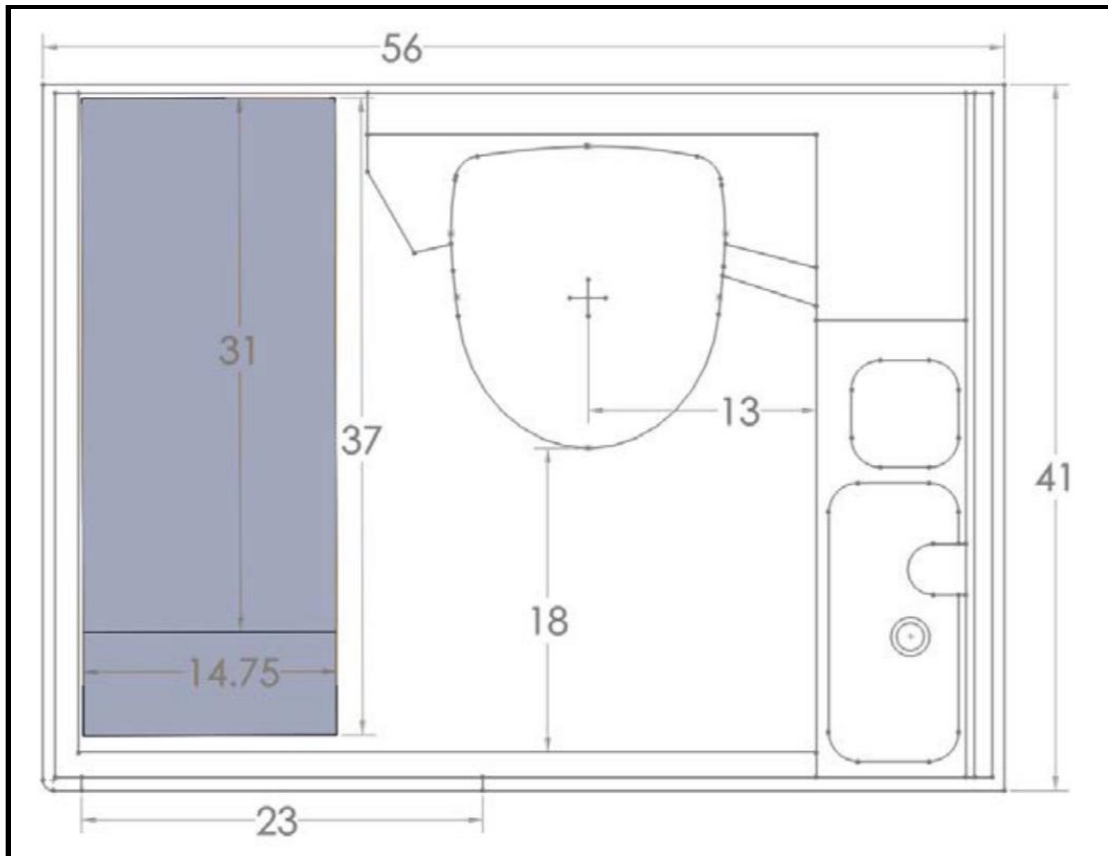


Figure 5-11: Typical accessible lavatory for a twin aisle airplane (CMS.gov doc)

Instead, our proposed accessible aircraft lavatory design can be seen in Figure 5-12. The arrangement of the room is the same as layout C3 in Figure 5-10. The door is located at the corner of the room, ideally so that the door is at a 45 degree angle to the hallway, rather than 90 degrees, since sharp corners are more difficult to navigate in a wheelchair. The door is 36" wide, wide enough to accommodate any size wheelchair and its passenger (Adaptive Access). There is a 60" diameter circle in the center of the bathroom, since that is the minimum area required for most wheelchair-users to rotate in any direction (ADA.gov). Due to the orientation of the room, the passenger will be able to enter the room and be able to close the outward opening doors. They can then transfer between their chair and the toilet at a 45-degree angle. After they are finished, the passenger should have sufficient space to reorient the wheel chair at a 90 degree angle to the sink, and wash their hands. They can then rotate their chair around and exit the room facing forward.

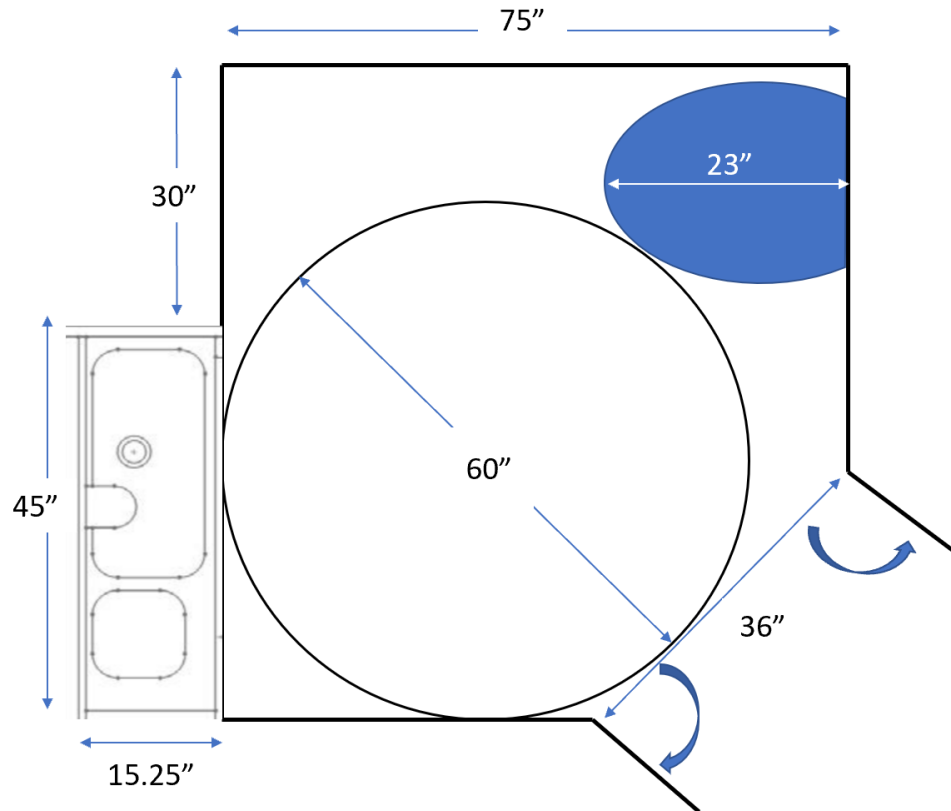


Figure 5-12. Proposed accessible aircraft bathroom

Airlines may be resistant to providing accessible bathrooms since they will have to remove seats to expand bathrooms. It is estimated that providing an accessible lavatory on single-aisle aircraft will require the loss of 3 seats (Morris, 2016 & CMS.gov). The graphic below depicts the estimated impact of a loss of 3 seats on the entire United States narrowbody fleet.

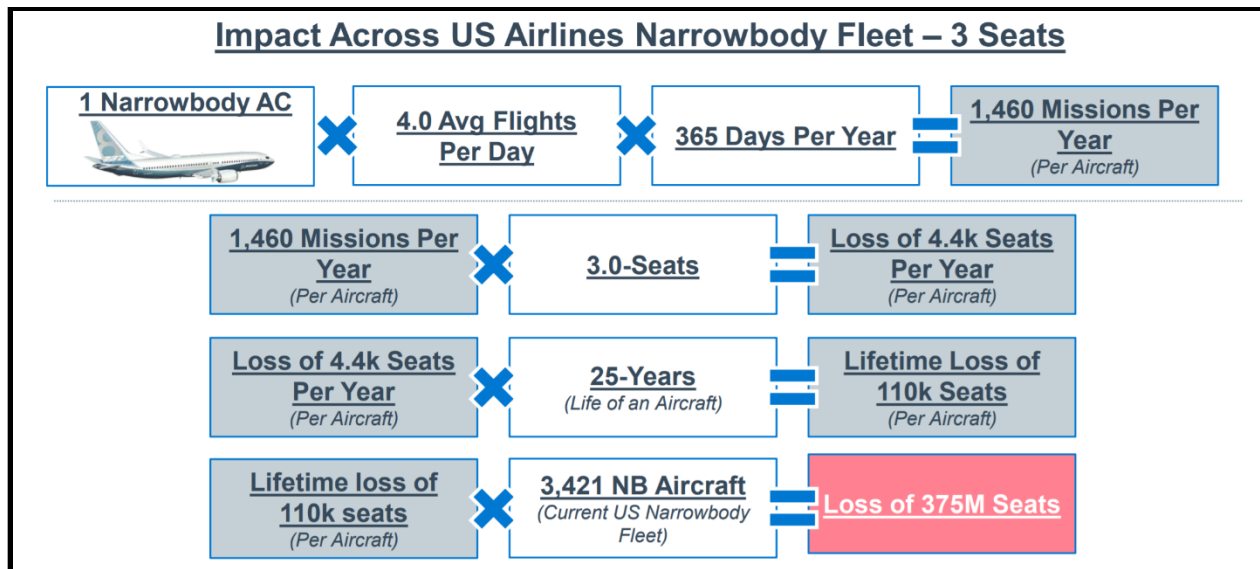


Figure 5-13: Economic impact of 3 seat loss per flight to accommodate accessible lavatory on narrow-body fleet (CMS.gov)

The average seat on an US narrowbody plane is worth \$143/flight. Due to diminishing marginal returns, the last three seats on a flight are actually worth less than the average. Instead, these seats are worth about 75% of average revenue. The reduction in passengers will also reduce some variable costs - estimated to be \$6/seat/flight. These variable costs do not include the potential fuel impact (the lost weight of three passengers and the seats could reduce the amount of fuel consumed per flight). Taking all of these factors into accounts, the estimated impact is \$98/seat/flight. The current US narrowbody fleet includes 3,414 planes, which are replaced at an average rate of 176 aircraft/year (CMS.gov). At this average rate, it will take about 20 years for the entire US narrowbody fleet to possess accessible bathrooms.

In total, the Department of Transportation estimates that it will cost the air travel industry about \$33 billion in lost revenue to replace 3 seats per flight with an accessible bathroom. This cost will most likely be absorbed by reduced flight to marginally-profitable locations and increased seat prices (CMS.gov). The average large narrowbody flight filled 173 seats/departure in 2017 (MIT.edu). In order to offset the loss of the 3 seats, the remaining 170 seats will need to increase in price. This results in $(\$98/\text{seat} * 3 \text{ seats}) / (173 - 3 \text{ seats}) =$ a price increase of \$1.73/seat or about 1.2%. But, what about smaller planes? The average small narrow body flight filled 138 seats/departure in 2017 (MIT.edu). This results in $(\$98/\text{seat} * 3 \text{ seats}) / (138 - 3 \text{ seats}) =$ a price increase of \$2.18/seat or about 1.5%.

From a social perspective, there would be public outrage if airplanes implemented a rule where passengers in other uncontrollable situations were not able to use the lavatories. If only passengers in certain seats or classes could use the lavatories, many people would be upset and would be reluctant to fly. It seems as if airlines would never do that - except that they already do. Many passengers with mobility-impairments are unable to use lavatories on single-aisle aircraft. These passengers have less access to basic amenities than the lowest class seats that can be

purchased. If passengers were told that it would cost them \$2.18 for universal restroom access, they would likely be willing to pay it. Regardless of any financial incentives, airlines have an ethical imperative to provide accessible lavatories.

Chapter 6

Title: Service and Emotional Support Animals

Authors: Jessica Franke, Connor Harrell, Kassidy Scott, and Jenna Walker

Section 6.1: Introduction

Service animals and emotional support animals (ESAs) are often needed to travel with passengers with disabilities. Current practices of air transportation with service animals in airports and airlines need modifying to make the overall travel experience more enjoyable and safer for all flyers. There is a need in improving the overall experience of animals, passengers with the animals, and those passengers likely to interact with animal during transportation. Possible approaches for addressing current problems include: an airline database that stores information of service animals, accommodation of space both on the plane and in the airport (relief stations), and more knowledgeable staff training that teaches proper interactions between staff members and individuals with service animals or ESAs. A database will save time and ease the transition period from the airport to the airplane, while the other accommodations enhance the airport and airplane conditions for service animal users. Initially, consideration for creating national guidelines was a possibility, but through multiple interviews the issue resided more with regulations and each airport having different policies. Passengers with service animals found that the issues with guidelines was related more to staff training. These ideas will be discussed further to show the need of these modifications to the current service animal travel practices through findings found through research and interviews.

Section 6.2: Background

In 2016, passenger airlines in the United States estimated that they transported around 227,000 service animals and 709,000 emotional support or comfort animals. Those numbers rose in 2017 to 281,000 service animals and 751,000 comfort animals. American Airlines®, for example, reported a 48% increase in transporting comfort animals between the two years

(Jansen, 2018). There has been a dramatic increase in the amount of animals traveling on planes, but the development in policy or accommodation has not increased at the same rate.

Today, the Department of Transportation (DOT) dictates the size and type of service animals allowed in the cabin of an aircraft when traveling within the United States. A service animal is defined by the Air Carrier Access Act (ACAA) as any animal “that is necessary for the emotional well-being of a passenger” (Department of Transportation, 2018). Airlines are not required to allow snakes, ferrets, reptiles, rodents, spiders, and sugar gliders and may also exclude animals that are considered too large and/or heavy to fit or be accommodated in the cabin. An airline may also deny any animal that poses a threat to the health and safety of anyone onboard, causes any considerable disturbances to cabin services, cannot enter a foreign country, or is not properly trained.

Therefore, there are technically universal guidelines between airlines and airports on the size and type of service animals allowed in aircraft cabins. These guidelines list animal species that *can* be denied by airlines and airports. Whether an airline will allow a specific animal of a certain size in the cabin of an airplane is up to their discretion and guidelines. For example, American Airlines says the service animal must be a cat or dog, with miniature horses being allowed as well if they are trained. The guidelines do not list weight or height restrictions, but instead explain that they must be able to fit at the passenger’s feet, lap, or under the seat in front of the passenger. United Airlines® also limits animals to being a cat, dog, or miniature horse and does not list size restrictions (USA Service Dogs, 2019).

Delta Airlines® does not allow pit bulls and states that the animal must not exceed the “footprint” of the passenger’s seat. They also have a long list of species not allowed including: the ones mentioned earlier as well as hedgehogs, insects, amphibians, non-household birds, animals improperly cleaned, and animals with tusks, horns, or hooves. Southwest Airlines® does not specify the types of animals allowed and again does not have explicit size restrictions except for that the animal must be able to be placed in the passenger’s lap or at their feet. They are not allowed to extend into the aisle or occupy a seat (USA Service Dogs, 2019).

The differences between guidelines for different airlines can be confusing and hard to keep track of for passengers. Initially, a recommendation of having clearer cut national guidelines was considered, but through multiple interviews the problem was more concentrated on airline training. Through interviews, having the airline partner up with service animal trainers could be a solution to ensure proper staff training. Due to the confusing guidelines it is vital that staff is qualified and trained to help guide passengers with service animals through the process.

Section 6.3: National Database

Currently each airline in the United States has its own policy regarding service animals and emotional support animals. These policies all have similarities, but have their own specifications. Four major airlines’ policies were investigated to determine the similarities and differences to better propose national guidelines that all US airlines will follow. The major

airlines whose policies were investigated via their public websites include Southwest Airlines®, American Airlines®, United Airlines®, and Delta Airlines®.

All of the airlines specified above have different requirements for trained service animals and emotional support animals. Emotional support animals tend to require more documentation. If the animal is not behaving or does not respond to corrective actions, then the animal can be denied boarding onto the airplane regardless if it is a service animal, emotional support animal, or pet. Another common requirement is that the animal is four months or older and fits in the passengers area inside the aircraft (American Airlines, 2019; United, 2018; Delta, 2018).

For service animals, Southwest Airlines requires verbal assurance that the passenger is an individual with a disability and the animal is trained (Southwest, 2019). American Airlines employees, at ticket counters or at the gate, are trained to ask questions to determine the classification of your animal (American Airlines, 2019). If the flight is over 8 hours long, the animal sanitation form is required. United Airlines limits service animals to cats, dogs, and miniature horses four months and older and must behave properly (United, 2018). Delta suggests the passenger travels with the animal's Veterinary Health Form or immunization record and requests that the passenger fills out the trained service animal document (Delta, 2018).

Emotional support animals require additional paperwork compared to service animals in order to fly in the aircraft. Generally, one emotional support animal is allowed per passenger. Southwest requires the passenger to have a letter stating: the passenger has a mental or emotional disability; the passenger needs the emotional support dog or cat for travel or activities at the destination; the individual providing the assessment is a licensed professional and the patient is under his or her care; and the date and type of license the professional possesses (Southwest, 2019). After the documentation is verified, an updated boarding pass will be provided. American Airlines requires the animal to be trained to behave in public and three forms must be completed. The forms include a Medical/Mental Health Professional Form, Veterinary Health Form, and Confirmation of Animal Behavior Form (American Airlines, 2019). United Airlines requires notification 48 hours prior to the flight, as well as, having a letter from a licensed medical/mental health professional. Veterinary health documentation is also needed along with vaccination records and affirmation of basic training (United, 2018). Delta similarly requires an acknowledgement form, veterinary health form, medical/mental health professional form, and confirmation of animal training form that must be filed 48 hours in advance (Delta, 2018).

Every airline requires similar documentation, but has their own forms for completing this process. If a passenger is using multiple airlines on a trip, that process can be cumbersome. A survey was conducted to receive feedback on the experience of service animal and emotional support animal owners during air transportation. The results can be seen in Figure 6-1. All respondents said they had difficulties with the paperwork proving that the animal may travel with the owner.

Q60 - What difficulties did you and your animal face during travel? (Please check all that apply)

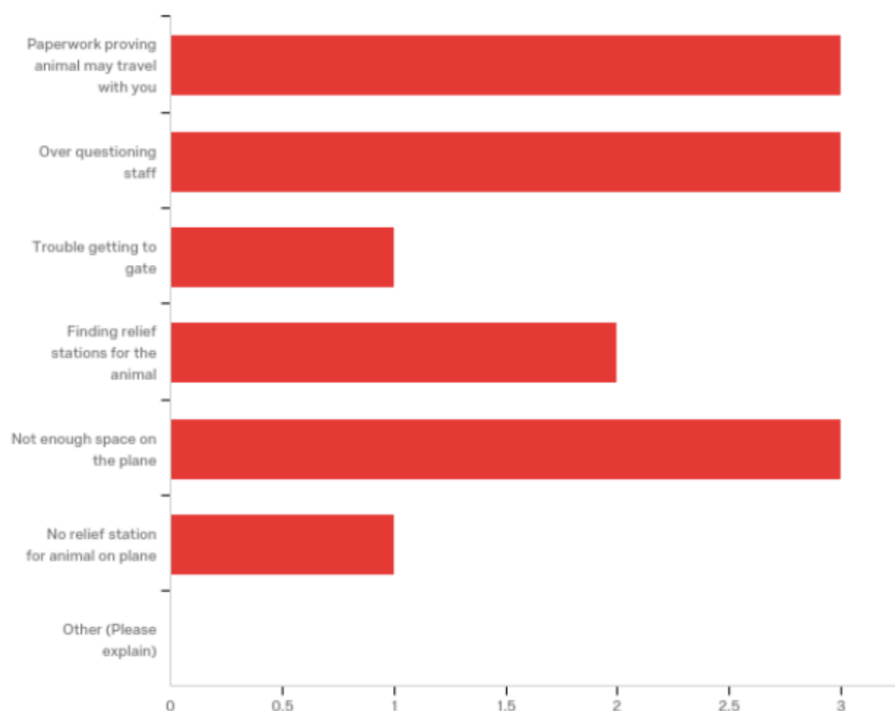


Figure 6-1: Bar graph showing what difficulties a person with a service or emotional support animal has encountered during air travel.

An interview with a college-age female owner of an emotional support animal supported these results by saying the check in process, or the paperwork portion, can vary by airport and airline. At any point in the process, a person may be asked to show their documentation for their emotional support animal, which can be difficult if you are not sure exactly where it is within your luggage.

Having national guidelines and a database to store this information could help improve this process. The national guidelines should govern what is required within the database and include notification 48 hours in advance to the airlines and the animal's identification number from the database. The database would gather different information for service animals and emotional support animals. The general purpose of the service animal would be recorded. For example, seeing eye dog, seizure detection, or anxiety could be potential purposes. The animals' vaccination records would also be stored and updated every year. For emotional support animals, the vaccination or veterinary health records will be maintained like service animals, but other information will also be gathered. The letter from the medical/mental health professional stating the need for the animal and the verification of the professional's license will be added. Another form confirming general animal training will be added with notification to the passenger that the animal may not be allowed to board the airplane if the animal exhibits bad behavior. The letter

from a medical professional would need to be updated when the paperwork expires while the confirmation of basic training could be updated every 2 years.

The airlines would then tag this information to the passenger's flight so it is accessible to staff without needing the passenger to show the animal's papers. The passenger would not have to re-submit these forms for different airlines or different flights within the valid period of the paperwork. This reduces the amount of work for the passenger while keeping the documentation consistent across airlines. Upon receiving feedback about this potential solution, it was stated that this database would have to be optional according to a professional with the American Veterinary Association. The Americans with Disabilities Act (ADA) does not require service animal owners to register their animal with any sort of group ("Frequently Asked Questions", 2015); Therefore, they could not be forced to enroll in this database, which makes the database an option for their convenience. Based on the survey and interview results, there is still a need to modify the paperwork portion of air transportation to make the air travel process easier and more convenient for service and emotional support animal owners.

Section 6.4: Airplane Accommodations for Service Animals

Air travel has an issue in the current use and layout of available space in the aircraft in regards to animals onboard. Currently, the space provided is not enough to satisfy comfortability of a service or emotional support animal. There have been multiple news articles in regards to the safety of an animal being disregarded during travel on a plane. One article from NBC discusses how a dog was placed in the overhead luggage compartment during a flight, did not receive proper ventilation, and died (Helsel, 2018). The shortage of space provided for the animals during flight impacts the animals, the owners, and nearby passengers and can lead to all parties being uncomfortable. Looking at these perspectives and taking personal interviews with those who have traveled with animals as well as those who have traveled near animals, two potential solutions were created to help solve these issues related to the space of a service or emotional support animal on a plane.

First, the plane needs to better accommodate all parties involved to ensure enough space during the flight. Some animals are too large to fit in normal seating comfortably, so it is recommended that other seating arrangements be brought into practice. There are no current guidelines on the animal size that should require or be suggested to have additional accommodations. Airlines could mandate an extra seat cost, like American Airlines does for overweight passengers, to allow more room for the animal and owner (Hignett 2019). In an interview with a college student training a service animal, the student discussed the use of bulkhead seating to provide more space for larger animals. An additional fee for an extra seat or bulkhead seating would be easily implemented by basing it off of current procedures. Furthermore, this fee should be refunded if the flight is not full. By mandating an extra seat, the animal will not be forced to be uncomfortable during flight.

Second, the airlines need to provide knowledge to the surrounding passengers about the presence of a service animal. Through interviews with passengers, it has been noted that passengers want notification of potential surprises. The surprise of a service animal onboard could be overwhelming for passengers with a phobia or allergy. It is recommended for airlines to implement a small icon during the ticket purchasing process to notify people of an animal being onboard specific flights. If a person with an animal bought a plane ticket after others, an email should be sent out to all passengers stating the presence of an animal on the flight and to call the airline's guest relation phone number to address any concerns. An airline is not permitted to the removal of a passenger from a flight due to the presence of their service animal or emotional support animal, so a notification system would help accommodate the other passengers (U.S. Department of Transportation, 2018).

Overall, space on an airplane needs to be used wisely in order to accommodate all guests while ensuring passengers with service animals or emotional support animals are able to travel safely and comfortably. Mandating an extra seat for larger animals will provide adequate space for the comfort of all passengers while notifying passengers of an animal being on flight prior to the flight departure will allow passenger concerns to be addressed. These recommendations will increase flight satisfaction for the animals and passengers onboard.

Section 6.5: Airport Accommodations for Service Animals

While all of the issues regarding service animals and emotional support animals previously discussed throughout this chapter are very stressful to the owner of the animal, the issues extend further to taking care of the basic needs of the animal while in the airport. The simple questions like “where can my animal go to the bathroom?” and “where can I appropriately feed and nourish my animal?” are ones that should have straightforward answers for every airport in the country. Based on a survey answered by people with a service animal or emotional support animal, the graph in Figure 6-2 shows the most common difficulties faced while in an airport. Survey takers were allowed to select more than one option for this question.

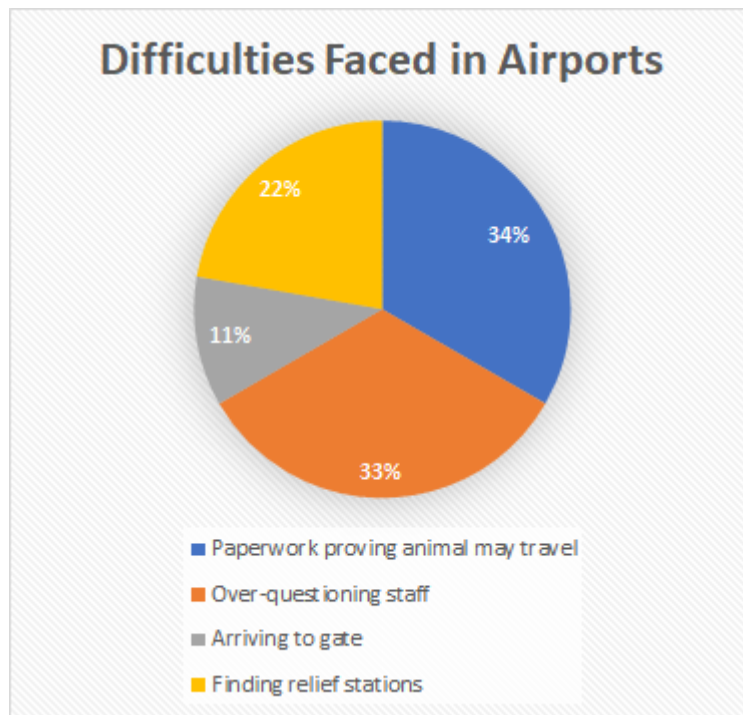


Figure 6-2: Survey responses showing common difficulties faced when traveling through an airport with a service animal or emotional support animal.

From Figure 6-2, it can be seen that providing paperwork proving that the service animal or emotional support animal is capable of flying with the handler, talking to over-questioning staff, and finding relief stations pose the most difficult challenges to handlers. Handlers having difficulties with staff as well as difficulties finding relief stations for the animals are issues that were also noticed by an Animal Welfare Scientist in the Animal Welfare Division of the American Veterinary Medical Association. This section of this chapter will focus primarily on relief stations within airports, as it is the most unaddressed problem, with a brief discussion on difficulties service animal and emotional support animal handlers have arriving to their gates and interactions with staff.

In regards to relief stations, the DOT is requiring that airlines provide relief areas for a passenger's service animal in any area that the airline owns, leases, or controls (Briggs, 2013). However, the results in Figure 6-2 show that there is still more work to be done to bring all airports and airlines up to standard.

The DOT had a lot of discussions regarding airport accommodations for service animals and looked to service animal users for comments regarding how to further specify the needs that are not met within airports for their animals. Some comments regarding the construction of relief stations specifically mentioned that non-cement surfaces would be most beneficial with an overhang to protect the animals from any stormy weather that may occur. Commenters do not believe all specifications regarding relief stations should be regulated by the DOT so airports can try different things based on the climate they are located ("Nondiscrimination on the Basis", 2015).

Among the materials and design of the relief stations, location is also a factor to regulate within airports. Commenters were conflicted as to if the number of locations should be decided by size of the airport or how long it would take for the owner to reach the station. A common suggestion by the commenters was for every airport to provide at least one relief station per terminal so no one with a service animal or emotional support animal would need to travel extensively from their gate to allow their animal to relieve themselves. Another suggestion was to provide assistance with transportation to the relief stations for the animal and owner to potentially quicken the process for them. This assistance in transportation would diminish the need to regulate the number of relief stations based on the amount of time it would take the owner and animal to reach the station (“Nondiscrimination on the Basis”, 2015).

Lastly, the majority of commenters mentioned that it would be extremely beneficial for these relief stations to be placed on airport maps and signs. These maps and signs should also take the population of people living with visual impairments into consideration by providing directions in braille and audibly to allow people with seeing-eye dogs to navigate independently to the stations. The idea of having escorts available was offered as a means of assisting individuals with service animals (“Nondiscrimination on the Basis”, 2015). Those proponents of escorts argue that this solution would decrease the need for as many accommodations. However, the use of escorts have raised many questions, which still need to be decided.

The DOT decided that at least one relief station should be located in each airport terminal within the sterile area. Materials and design of the relief station are not regulated at this time. The DOT did not decide to regulate how these relief station locations indicated on maps or signs within the airport (“Nondiscrimination on the Basis”, 2015).

Based on the needs identified by the people who took the survey and those who gave comments to the DOT, there are a few things to be recommended to airports as they implement relief stations. Regarding location of relief stations, one relief station should be located in each terminal to follow regulations of the DOT. Assistance to the handler’s gate and nearby relief station should be offered at each airport to ease any worry by the handler and help the process go more quickly and smoothly. Assistance should not be required, but it should be made very clear to those with service animals or emotional support animals that assistance is happily available and that anyone in the airport can help direct them to the nearest station.

Regarding the design and materials of the station itself, it is recommended to implement proper draining that allows the relief station to maintain a high sanitary level throughout daily use. The draining system would allow for airport workers to easily wash the relief station on a regular basis with something as simple as a pressure washer with mild chemicals or detergents depending on the extent of the usage. Visually, the floor of the relief station could be designed to look like outdoor terrain so animals can feel more comfortable. This could be done by implementing artificial turf to simulate grass. It is also recommended that some type of overhead protection is placed to allow animals full use of the relief station without needing to withstand stormy weather elements.

Looking into the issue of providing paperwork and dealing with over-questioning staff, the DOT recognizes that service animals do not need to provide paperwork in order to fly on the aircraft. Staff should be trusting that the animal is a service animal by speaking to the individual with a disability or observing that the animal is wearing a harness or tags to indicate the animal is working. For emotional support animals, an airline is permitted to require documentation regarding the need of the handler for the emotional support animal, such as a document from a mental health professional (Department of Transportation, 2018). With this information in mind, it is recommended that airlines and airport staff are trained thoroughly on how to approach individuals with disabilities and handlers of service animals and emotional support animals. Staff should be knowledgeable on what questions they may ask whom and when they are permitted to ask for paperwork. Staff should also be trained regarding common discriminations that occur towards individuals with disabilities and handlers of service animals and emotional support animals to assure that these discriminations and mistreatments do not occur.

Section 6.6: Conclusion

Service and emotional support animals in planes need to have a standard that is set for all airports and airlines. The core of the issues lies in that regulations differ from airport to airport and airline to airline. There is a need to improve the overall experience of service and emotional support animals, the animals' owners, and the surrounding passengers on the airplane. Possible recommendations to combat current problems include: national guidelines for type and size of service animals, an airline database that stores information about approved service and emotional support animals, space accommodations on the plane, location of relief stations in each terminal of airports, and proper staff training regarding communication with people traveling with service or emotional support animals. The national guidelines will provide not only much needed consistency for passengers with service or emotional support animals, but also help the airline and airport employees know what rules to follow. The database will help store records of the animal and passenger to speed up the process if they are a frequent flyer. More space will improve the comfort and safety of the animals and passengers during flight. Relief stations allow for the basic needs of the animal to be properly addressed. Staff training will improve the overall interactions between staff and those traveling with animals. The lack of consistency between airlines and airports yields confusion to all. These recommendations will improve air travel for those with a service animal or emotional support animal.

Recommendations

- A select number of plane seats should be modified so that they can be wheeled on and off the plane for passengers with wheelchairs. OR a select number of existing seats should be removed and a space designated in which personal wheelchairs can be secured to the floor of the plane.
- The airplane bathrooms need to be expanded and redesigned to be fully wheelchair accessible.
- Create a voluntary national database to store information regarding service animals and emotional support animals and use uniform forms and requirements when bringing service and emotional support animals across US airports and airlines.
- There should be passenger alerts that a service or emotional support animal will be present for passengers with animal aversions.
- An extra seat should be available for those with large service or emotional support animals.
- Every airport should have one relief station per terminal for service animals with a proper drainage system and a form of overhead protection from the weather.
- Staff needs to be trained to understand what they can and cannot ask individuals with service animals or emotional support animals in regards to certification and if the animal can travel.
- Organize and direct information regarding traveling with a disability to a single website on the airlines' site that is directly distributed to passengers with disabilities.
- A database would be helpful that facilitates communication among passengers with disabilities, airlines, airports and their vendors regarding air travel accommodations to anticipate passenger needs at forthcoming transit points during air travel.

- Improve informative training for airport and airline service staff about the effects and presentations of various disabilities through interactive modules and assessments.
- Supervisors of service staff need to be better trained to delegate their staff such that an appropriate number of personnel is present for passengers who require assistance.
- Staff members who physically assist passengers with disabilities with transfers and other direct mobility procedures need to be given more thorough hands-on training and demonstrate proficiency in performing correct transfer techniques.
- Create laws that consolidate ADA and ACAA legislation so there is a universal disability law for air travel.
- Current regulations should put forth efforts to improve the treatment and availability of passengers with disabilities' medical or assistive technology devices.
- Regulations should improve the quality of services provided in guiding passengers with reduced mobility at the departing/boarding area.
- Airports need to re-evaluate their layouts to make them more accessible for persons with disabilities, particularly paying attention to signage, restrooms, stores and restaurants, walkways, and seating areas.
- More specific legislation surrounding requirements for emergency evacuation protocols is needed.
- Create a special identifier label for medical equipment and assistive technologies and better training employees for handling these.
- Incorporate special storage in the cabin for those with disabilities so that they can carry on functionally useful baggage that needs special care.
- Better organization for stowing baggage underneath the plane incorporating shelves and straps in the storage area to avoid baggage being damaged and moving during the flight.
- Introduce a new pre-notification process for persons with disabilities that informs TSA of any travel limitations prior to arrival and stores passengers' disability accommodations in a database.

- Introduce a new security pre-check option for passengers with disabilities and a separate TSA screening lane for those in need of extra travel assistance.
- Stronger legal enforcement with increased fines for airlines and airports that violate laws and evaluate repeat offenders more frequently.

Methodology

Overview

Due to the vast nature of this topic we needed to study all areas of airline transportation from travel to the airport, check in, boarding, and takeoff and landing. Because we used human subjects in the complete study of this topic, an IRB proposal was submitted to Purdue University, West Lafayette, Indiana, United States of America and approved. The approved IRB protocol number approved by Purdue University is 1902021803.

Since the study was interested in airline travel and the effect on persons with disabilities, the focus was placed on persons of legal age (18 years old) who travel with disabilities, caretakers, airline/airport employees, and the United States Department of Transportation in cooperation with the United States Federal Aviation Administration.

Literature Review

A comprehensive literature review was completed using peer-reviewed journals, summary (lay) articles, and Congressional and Senate Laws. For a comprehensive list of articles used see the bibliography section.

Interviews

Interviews were conducted via telephone, email, and in person. These interviews included aviation researchers, long-time travelers with disabilities and their caretakers, air transportation employees, and government officials in federal transportation agencies. For a list of the interview questions see Appendix A. We particularly want to thank Dr. Michael Hiles, Dr. Sarah Hubbard, and Dr. Wesley Major for their expertise and insight.

Survey Methods

A survey (Disability Airline Experience) was conducted through Qualtrics XM made possible through Purdue University's Information Technology Department. The survey consisted of 66 questions ranging from multiple choice, approval range, and open ended. This survey listed in Appendix B was comprised of questions created from the entire research team. All data and graphs were calculated by the Qualtrics program and analyzed by each member of the team. This survey was disseminated through Facebook through the following groups: Wheelchair and Mobility Aid Users, Disabled American Veterans, Teaching Disability Studies, Wheelchair Accessible, Wheelchair Daddy, Purdue Critical Disability Studies, Orlando for Travelers with Disability or Special Needs, and Purdue Disability Resource Center. The survey was also posted on the following webpages Open Doors Organization and Southwest Airlines. The survey was also emailed to 1400 registered disabled students at Purdue University and select Purdue Critical Disability Studies Students. Results were received from a total of 40 people ranging from ages 18 to 56 across the United States and Europe.

Another survey was produced in Google surveys (Accessibility in Airplane and Airports) that consisted of eight questions that were either one to ten scale or open-ended questions. This survey was posted on www.reddit.com/r/disability.

The final survey (Flight Attendants Assisting Disabled Passengers) created on Google surveys. This was a survey that consisted of seven questions that were multiple choice or open ended. This survey was posted on www.reddit.com/r/flightattendant.

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Appendix A

Interview Questions and Responses:

Interview #1

Q: How often do you fly? And why?

Q: What airline do you prefer to use and why?

Q: What are major inconveniences/issues you experience when you fly?

Q: What assistance do you require when you fly?

Q: Has your wheelchair ever been damaged during a flight? If so, what specifically happened and much did it cost to repair? Did the airline offer you a temporary assist device?

Q: Have you ever had to pay extra for an additional seat or fly business class due to lack of enough space?

Q: Are you able to use the restroom on flights? If not, what do you do to compensate?

Q: Have you ever used a boarding chair? Please describe the experience.

Q: Do you think that the current design of airplane seats creates a potential for pain and/or injury?

Q: What is your estimation as to how long it takes between when you are at the gate to when you are sitting in the plane seat?

Q: Would you rather use a detachable wheelchair that increases accessibility onto the flight and throughout the flight, or use your own wheelchair but still have boarding struggles?

Q: As an engineer, what aspect of air travel would you like to redesign?

Interview #2

Q: Recall the last time you traveled via airport. What were the most notable accessibility barriers (if any) that you encountered that hindered your travel experience?

Q: In your opinion, is the current design of airport lobbies and waiting areas sufficient in accommodating those with disabilities? If not, please briefly describe why you think so.

Q: In general, do you feel the ergonomic layout and design of US airports caters to those with disabilities? If not, have you noticed certain airports being better than others in this regard?

Q: Do you generally notify either the airport or airline about any disabilities you may have prior to arrival at the airport? If yes, please describe the pre-flight notification process you underwent.

Q: In the event of an emergency at the airport, how confident are you that you will reach a place of safety with relative ease and efficiency?

Q: Have you ever encountered issues with lost luggage/mobility devices while traveling?

Interview #3

Q: Recall the last time you traveled via airport. What were the most notable accessibility barriers (if any) that you encountered that hindered your travel experience?

Q: In your opinion, is the current design of airport lobbies and waiting areas sufficient in accommodating those with disabilities?

Q: In general, do you feel the ergonomic layout and design of US airports caters to those with disabilities? If not, have you noticed certain airports being better than others in this regard?

Q: Would you use an app at an airport that helped make services more accessible and limited barriers leading to a smoother travel experience?

Q: In the event of an emergency at the airport, how confident are you that you will reach a place of safety with relative ease and efficiency?

Q: Have you ever encountered issues with lost luggage/mobility devices while traveling?

Q: Are you familiar with or have you personally utilized TSA Cares Services? If so, please briefly describe your knowledge/experience.

Q: Have you or someone you know personally encountered unwarranted treatment or other issues while passing through TSA due to a disability? If so, please describe.

Q: When traveling, do you generally notify TSA of your flight plans prior to arrival?

Q: Are you aware of programs like TSA Pre-Check in existence for those with disabilities?

Interview #4

Q: Where were you flying from/to?

Q: What airline was it?

Q: Were you using a powered or manual wheelchair?

Q: Was the wheelchair stored in the cargo hold?

Q: What specific damage occurred?

Q: Did you report the damage to the airline? If yes, can you describe the process?

Q: Would you mind describing your experience in which your wheelchair was damaged?

Interview #5

Q: In general, do you feel the ergonomic layout and design of US airports caters to those with disabilities? If not, have you noticed certain airports being better than others in this regard?

Q: Would you use an app at an airport that helped make services more accessible and limited barriers leading to a smoother travel experience?

Q: In the event of an emergency at the airport, how confident are you that a person with disabilities will reach a place of safety with relative ease and efficiency?

Q: Have you ever encountered issues with lost luggage/mobility devices while traveling?

Q: On a scale from 1-5, briefly explain how would you rate the availability and consistency of assistance from airport employees when dropping off and picking up luggage at the airport?

Q: Are you familiar with or have you personally utilized TSA Cares Services? If so, please briefly describe your knowledge/experience.

Q: Have you or someone you know personally encountered unwarranted treatment or other issues while passing through TSA due to a disability? If so, please describe.

Interview #6

Q: In your opinion, is the current design of airport lobbies and waiting areas sufficient in accommodating those with disabilities? If not, please briefly describe why you think so.

Q: In general, do you feel the ergonomic layout and design of US airports caters to those with disabilities? If not, have you noticed certain airports being better than others in this regard?

Q: Would you use an app at an airport that helped make services more accessible and limited barriers leading to a smoother travel experience?

Q: Looking at existing airport emergency evacuation plans (San Jose International Airport) and the FAA laws governing what needs to be included in them, what improvements can be made to account for disabled persons.

Q: Have you or someone you know personally encountered unwarranted treatment or other issues while passing through TSA due to a disability. If so, please briefly describe.

Interview #7

Q: In your opinion, is the current design of airport lobbies and waiting areas sufficient in accommodating those with disabilities? If not, please briefly describe why you think so.

Q: In general, do you feel the ergonomic layout and design of US airports caters to those with disabilities? If not, have you noticed certain airports being better than others in this regard?

Q: Would you use an app at an airport that helped make services more accessible and limited barriers leading to a smoother travel experience?

Q: Looking at existing airport emergency evacuation plans (San Jose International Airport) and the FAA laws governing what needs to be included in them, what improvements can be made to account for disabled persons.

Q: Have you or someone you know personally encountered unwarranted treatment or other issues while passing through TSA due to a disability. If so, please briefly describe.

Interview #8

Q: How extensive was your training/ what kind of training did you receive?

Q: What is/was your job description working at O'Hare?

Q: What services did you provide given your job description? What did you have to do on a normal basis?

Q: How far in advance did you know that someone would require wheelchair assistance?

Q: Were there any challenges you experienced when providing wheelchair assistance (that was not covered in training/ you felt you were not qualified for)?

Q: If you assisted with boarding (transference from wheelchair to aisle chair to plane seat), can you describe the process? Did you find this task potentially dangerous and/or labor intensive?

Q: Once you bring a disabled passenger to their gate, is there any follow up required?

Q: From your point of view, what improvements could the airlines make to be more accommodating to disabled/ wheelchair bound passengers?

Interview #9

Q: Are you aware of any trends that exist between airport actions/policies that equate to customer with disability (CWD) satisfaction?

Q: Are you aware of any solutions for CWD's that are in development?

Q: What are the best strategies for policy/solution implementation that you've seen?

Interview #10

Q: Have you flown with your service animal?

Q: How was your experience with check-in?

Q: How was your experience with security check?

Q: How was your experience in the airport?

Q: Did you face any difficulties in the airport?

Q: How was your experience on the plane?

Q: Did you face any difficulties on the plane?

Q: Where was your animal during flight?

Q: Did you and your animal have enough space during flight? If not, would having a seat for your service animal be beneficial? If yes, Would you be willing to pay a small fee to reserve that seat? Why or why not?

Q: What are the best strategies for policy/solution implementation that you've seen?

Q: Are you aware of any solutions for customers with disabilities that are in development?

Q: Creating national guidelines for type of animal and size of animal. What is your opinion on this proposed solution? Do you have any recommendations?

Q: Creating a national database that all airlines and airports can use to store animal information. (health records, doctors note for ESA, acknowledgement of behavior form, etc.) The records will need to be updated periodically (every few years). What is your opinion on this proposed solution? Do you have any recommendations?

Q: Offering/Mandating an extra seat for service animals of large size for a small fee (much less than the cost of a full seat). What is your opinion on this proposed solution? Do you have any recommendations?

Q: Accommodate for the animal's needs by adding animal relief stations inside of security throughout the airport as rooms with turf and a drainage system. The small room will also have a dog water fountain. What is your opinion on this proposed solution? Do you have any recommendations?

Q: Other comments on our solutions

Q: Are there other pressing issues that you feel should have a proposed solution?

Interview #11

Q: Have you flown with your service animal?

Q: How was your experience with check-in?

Q: How was your experience with security check?

Q: How was your experience in the airport?

Q: Did you face any difficulties in the airport?

Q: How was your experience on the plane? Did you face any difficulties?

Q: Where was your animal during flight?

Q: Did you and your animal have enough space during flight?

Q: Would having a seat for your service animal be beneficial?

Q: Would you be willing to pay a small fee to reserve that seat? Why or why not?

Q: Have you been on a flight in which another passenger had a service animal?

Q: How was your experience on this flight?

Q: Where were you on the flight in relation to the service animal?

Q: If or how did the service animal change your overall flight experience?

Q: If you had known there was an animal on flight prior to booking your ticket, would you have chosen a different flight? Why or why not?

Q: Would you want to be notified if someone with a service animal booked your same flight?

Interview #12

Q: What training is required as a service animal or emotional support animal?

Q: What is the training process?

Q: Do the families need to do extra training or daily training so their service animal will continuously meet their needs?

Q: Is there size restrictions on service animals that only certain sizes are allowed to be a service animal?

Q: Are service animals currently trained for foreign environments to prepare them for unique situations, for example (planes, trains, cruise ships)?

Q: Have you been on a flight in which another passenger had a service animal? If yes, How was your experience on this flight?

Q: Where were you on the flight in relation to the service animal?

Q: If you had known there was an animal on flight prior to booking your ticket, would you have chosen a different flight?

Q: Would you want to be notified if someone with a service animal booked your same flight?

Q: Other General Comments on our ideas

Interview #13

Q: What is your area of expertise?

Q: What issues about service animals and flying have you heard about?

Q: What do you know about regarding airline policies?

Q: I heard that the AVMA was going to make a push for change in policies regarding airline policies, do you know anything about this?

Q: Should service animals just be dogs and small horses - clearer guidelines?

Q: Creating national guidelines for type of animal and size of animal. What is your opinion on this proposed solution?

Q: Creating a national database that all airlines and airports can use to store animal information. (health records, doctors note for ESA, acknowledgement of behavior form, etc.) The records will need to be updated periodically (every few years). What is your opinion on this proposed solution?

Q: Offering/Mandating an extra seat for service animals of large size for a small fee (much less than the cost of a full seat). What is your opinion on this proposed solution?

Q: Accommodate for the animal's needs by adding animal relief stations inside of security throughout the airport as rooms with turf and a drainage system. The small room will also have a dog water fountain. What is your opinion on this proposed solution?

Q: Other comments

Interview #14

Q: What are some aspects of the traveling process which deter individuals with disability from flying?

Q: What types of information sources would disabled travellers or caretakers of disabled individuals use to find information about flying and the processes involved with flying? Is there information that you would like to have more readily available or that you think is simply lacking from these sources?

Q: Where do you think that airlines/airports could most improve the preparation processes (such as preparing accommodations) for disabled individuals who are traveling by air?

Interview #15

Q: How have your flying experiences been?

Q: How do you notify the airport that you need a wheelchair?

Q: What is the process that you go through when you arrive?

Q: What happens at security?

Q: What is the order of who gets on and off the plane first?

Q: What happens when you need to use the restroom?

Q: What happens when you land?

Interview #16

Q: How do passengers request an accommodations through Southwest?

Q: Is there any fee for requesting an accommodation?

Q: Does Southwest own the wheelchairs?

Interview #17

Q: What do you do when a passenger requests a wheelchair?

Q: How does the passenger know that the accommodation request was received if they do it online?

Q: Are there any other accommodations that are requested here?

Q: How do you communicate with other airlines if the passenger's connecting flight is not United?

Q: Does United own the wheelchairs?

Interview #18

Q: What do you think are the problems with the current airplane seat design or structure in terms of spine and lower back support?

Q: What are the potential causes for pain or injury?

Q: What type of support would be necessary to make sure the passenger is safe and comfortable?

Interview #19

Q: It is our understanding that you are training a service animal, is that correct?

Q: Have you had a service animal prior?

Q: What are the steps to train and certify a service animal?

Q: Do you have any fears of going to an airport with a service animal?

Q: What's the process with service animal paperwork when it comes to flying?

Q: Do you think a database containing all this paperwork would be useful?

Q: Can you think of anything that will help the process of flying with a service animal?

Q: Do you think it would be useful to alert other passengers when they are on a flight with a service animal?

Q: What other issues do you run into with having a service dog?

Q: What is an appropriate response when asked what task the service animal can complete?

Interview #20

Q: Could you please describe a typical experience of traveling with someone in a wheelchair?

Q: What is an issue you encountered while traveling in the airport?

Q: What is the role of a caregiver like in the context of air travel?

Q: Do you have any recommendations, for passengers with physical or cognitive disabilities?

Q: Any other noteworthy experiences?

Appendix B

Survey Questions and Answer Options

Disability Airport/Airline Experience Survey

1. Age
 - a. 18-20 (1)
 - b. 21-25 (2)
 - c. 26-30 (3)
 - d. 31-35 (4)
 - e. 36-40 (5)
 - f. 41-45 (6)
 - g. 46-50 (7)
 - h. 51-55 (8)
 - i. 56+ (9)
2. Gender
 - a. Male (1)
 - b. Female (2)
 - c. Other (Please Specify) (3) _____
3. Disability Identified (Please check all that apply)
 - a. Blindness/ Low Vision (1)
 - b. Deaf/ Hard of Hearing (2)
 - c. Immune Systems Disorders/ Severe Allergies/ Respiratory Disorders (3)
 - d. Anxiety/ Depression Disorders (4)
 - e. ADD/ADHD (5)
 - f. Autism Spectrum Disorder (6)
 - g. Phobias (7)
 - h. Other Mental Health Condition (Please Specify) (8) _____
 - i. Mobility Impairments (9)
 - j. Speech Disorders (10)
 - k. Obesity (11)
 - l. Other (Please Specify) (12) _____
 - m. Caregiver (13)
4. Disability Accommodation Needed: (Please check all that apply)
 - a. Full-time MANUAL wheelchair user (1)
 - b. Full-time POWER wheelchair user (2)
 - c. Part-time MANUAL wheelchair user (3)
 - d. Part-time POWER wheelchair user (4)
 - e. Power scooter user (5)
 - f. Cane/Walker (6)

- g. Other Mobility aid (Please Specify) (7)
 - h. Hearing Aid (Low Range) (8)
 - i. Hearing Aid (Moderate Range) (9)
 - j. Hearing Aid (High Range) (10)
 - k. Cochlear Implant (11)
 - l. My hearing aid/ Cochlear Implant is Bluetooth Enabled (12)
 - m. Care-taker (13)
 - n. Service Animal (14)
 - o. Emotional Support Animal (Please specify animal type) (15)
 - p. Augmentative & Alternative Communication (AAC) Device (16)
 - q. Print Accommodations (Braille/Large Print) (Please Specify) (17)
 - r. Navigation/ Way-finding Aids (18)
6. On average how many times do you use airline travel?
- a. Never (if chosen please explain why) (1)
-
- b. Rarely (less than once a year) (2)
 - c. Sometimes (1-2 times a year) (3)
 - d. Frequently (3-5 times a year) (4)
 - e. Regularly (6+ times per year) (5)

Skip To: End of Survey If Q6 = 1

7. If you prefer not to fly, why? (Check all that apply)
- a. Financial Reasons (1)
 - b. Inconvenience (2)
 - c. Discomfort (3)
 - d. I would not have access to the assistance I need (4)
 - e. Other (5) _____
8. Please rank what persuades your choice of airline. (Drag and Drop- Top is your number 1 reason)
- a. Cost (1)
 - b. Accommodations (2)
 - c. On-Time Rate (3)
 - d. Frequent Flyer Programs (4)
 - e. Preferred Airport (5)
 - f. Other: (6)
9. Do you typically fly:
- a. First Class (1)
 - b. Coach (2)
 - c. Private (3)
11. How do you rate your overall experience in airports and on airplanes?
- a. 0 (0)

- b. 1 (1)
- c. 2 (2)
- d. 3 (3)
- e. 4 (4)
- f. 5 (5)
- g. 6 (6)
- h. 7 (7)
- i. 8 (8)
- j. 9 (9)
- k. 10 (10)

15. How would you rate assistance from the airport or airline staff?

- a. 0 (0)
- b. 1 (1)
- c. 2 (2)
- d. 3 (3)
- e. 4 (4)
- f. 5 (5)
- g. 6 (6)
- h. 7 (7)
- i. 8 (8)
- j. 9 (9)
- k. 10 (10)

16. How well do you feel that the airport and airline staff are trained to assist people with disabilities?

- a. 0 (0)
- b. 1 (1)
- c. 2 (2)
- d. 3 (3)
- e. 4 (4)
- f. 5 (5)
- g. 6 (6)
- h. 7 (7)
- i. 8 (8)
- j. 9 (9)
- k. 10 (10)

17. How comfortable (physically and emotionally) did you feel in an airport?

- a. 0 (0)
- b. 1 (1)
- c. 2 (2)
- d. 3 (3)
- e. 4 (4)
- f. 5 (5)
- g. 6 (6)

- h. 7 (7)
- i. 8 (8)
- j. 9 (9)
- k. 10 (10)

18. How comfortable (physically and emotionally) did you feel in an airplane?

- a. 0 (0)
- b. 1 (1)
- c. 2 (2)
- d. 3 (3)
- e. 4 (4)
- f. 5 (5)
- g. 6 (6)
- h. 7 (7)
- i. 8 (8)
- j. 9 (9)
- k. 10 (10)

19. How knowledgeable do YOU feel about the laws and rights that pertain to airlines and disability?

- a. 0 (0)
- b. 1 (1)
- c. 2 (2)
- d. 3 (3)
- e. 4 (4)
- f. 5 (5)
- g. 6 (6)
- h. 7 (7)
- i. 8 (8)
- j. 9 (9)
- k. 10 (10)

20. Does your disability require assistance from the airport or airline when flying?

- a. Yes (1)
- b. No (2)

Display This Question:

If Q20 = 1

21. Do you notify the airline that you require assistance before arriving to the airport?

- a. Yes (1)
- b. No (2)

Display This Question:

If Q21 = 1

23. How did you request assistance?

- a. Phone App (1)
- b. Online through airline website (2)
- c. Online through TSA Website (3)
- d. Travel Agent (4)
- e. Phone call (5)
- f. Email (6)
- g. Other (Please Explain) (7) _____

Display This Question:

If Q21 = 1

24. Did the airline seem prepared to assist you?

- a. 0 (0)
- b. 1 (1)
- c. 2 (2)
- d. 3 (3)
- e. 4 (4)
- f. 5 (5)
- g. 6 (6)
- h. 7 (7)
- i. 8 (8)
- j. 9 (9)
- k. 10 (10)

25. Was Information available to you about how to prepare to travel with a with a disability?

- a. Yes (1)
- b. No (2)

Display This Question:

If Q25 = 1

26. How was this information provided?

- a. Email (1)
- b. Text Message (2)
- c. Website (3)
- d. App Notification (4)
- e. Travel Agent (5)
- f. Other travel website/blog (6)
- g. Other (please explain) (7) _____

Display This Question:

If Q25 = 1

27. What information was provided to you? (Please check all that apply)

- ☐ Recommended arrival time (1)

- ☐ Available accommodations (2)
- ☐ How to request accommodations (3)
- ☐ Special handling or allowance for medical equipment (4)
- ☐ Airport maps (5)
- ☐ Airplane information (6)
- ☐ Check-in process and guidelines (7)
- ☐ Access to laws and policies (FAA, ACAA, ADA, ect) (8)
- ☐ Complaint reporting information (9)
- ☐ Other (Please explain) (10) _____

Q27 Was there any information you wish you had PRIOR to flying?

- ☐ Recommended arrival time (1)
- ☐ Available accommodations (2)
- ☐ How to request accommodations (3)
- ☐ Special handling or allowance for medical equipment (4)
- ☐ Airport maps (5)
- ☐ Airplane information (6)
- ☐ Check-in process and guidelines (7)
- ☐ Access to laws and policies (FAA, ACAA, ADA, ect) (8)
- ☐ Complaint reporting information (9)
- ☐ Other (Please explain) (10) _____

28. Overall, how would you rate the current design of airport accommodations for the disabled person in the following areas: Lines (Ticketing booths, TSA, Terminal Desks) (1), Sit down restaurants and shops (2), To-Go (take out) Restaurants (3), Gate waiting areas (4), Restrooms (5), Walkways/Ramp way (6), Moving walkways (7), Elevators (8), Navigational Signage (9).

- a. Positive (1)
- b. Slightly Positive (2)
- c. Neutral (3)
- d. Needs Some Improvement (4)
- e. Needs Major Improvement (5)
- f. I Do Not Use (6)

29. Would you use an app at an airport that helped make services more accessible and limited barriers leading to a smother travel experience?

- a. Yes (1)
- b. No (2)

30. If an emergency were to occur at the airport, are you confident that you would reach a place of safety with relative ease and efficiency? Please slide the bar to the appropriate number. (Zero is Not confident, Five is Neutral, and 10 is extremely confident)

- a. 0 (0)
- b. 1 (1)
- c. 2 (2)
- d. 3 (3)
- e. 4 (4)

- f. 5 (5)
- g. 6 (6)
- h. 7 (7)
- i. 8 (8)
- j. 9 (9)
- k. 10 (10)

31. Do you find yourself using carry on or checking baggage?

- a. Carry on more (1)
- b. Checking more (2)
- c. Carry on exclusively (3)
- d. Checking in exclusively (4)

32. If there was a way of only taking carry on baggage, would you utilize it?

- a. Yes (1)
- b. No (2)

33. What types of assistive technologies do you typically bring with you when traveling by air? (Please describe)

****Open Ended****

34. Have you or someone you know personally utilized TSA Cares Passenger Support?

- a. Yes (1)
- b. No (2)

Display This Question:

If Q34 = 1

35. Have you utilized the TSA pre-notification card?

- a. Yes (1)
- b. No (2)

Display This Question:

If Q35 = 1

36. Was the TSA pre-notification card useful?

- a. Yes (1)
- b. No (2)

37. Have you or someone you know personally ever encountered any issues while passing through TSA due to a disability? (Please check any of the applicable options)

- ☐ No problems (1)
- ☐ Physical strain (2)
- ☐ Lack of employee preparation (3)

- ☐ Damaged/lost personal belongings (4)
- ☐ Confiscation of important belongings (5)
- ☐ Uncomfortable physical contact (6)
- ☐ Embarrassment/lack of privacy (7)
- ☐ Other (8) _____

38. What air travel strategies or solutions have benefited you the most? (Please rank through drag and drop, "One" being the most beneficial to "Nine" being the least beneficial)

- _____ Priority boarding (1)
- _____ Providing physical accommodations (e.g. wheelchairs, transport to gate) (2)
- _____ Ease of requesting accommodations (3)
- _____ Assistance in transferring from wheelchair to seat (4)
- _____ Paying to upgrade to First Class seating (5)
- _____ Interactive signage and communication aids (6)
- _____ Attitudes of airline personnel during interactions (7)
- _____ Service dog accommodations (8)
- _____ Other (Please specify) (9)

39. What are your preferred airports? (Please highlight all that apply)

- ☐ Hartsfield–Jackson Atlanta International Airport ATL (1)
- ☐ Los Angeles International Airport LAX (2)
- ☐ O'Hare International Airport ORD (3)
- ☐ Dallas/Fort Worth International Airport DFW (4)
- ☐ Denver International Airport DEN (5)
- ☐ John F. Kennedy International Airport JFK (6)
- ☐ San Francisco International Airport (7)
- ☐ McCarran International Airport LAS (8)
- ☐ Seattle–Tacoma International Airport SEA (9)
- ☐ Charlotte Douglas International Airport CLT (10)
- ☐ Newark Liberty International Airport EWR (11)
- ☐ Orlando International Airport MCO (12)
- ☐ Phoenix Sky Harbor International Airport PHX (13)
- ☐ Miami International Airport MIA (14)
- ☐ George Bush Intercontinental Airport IAH (15)
- ☐ Logan International Airport BOS (16)
- ☐ Minneapolis–Saint Paul International Airport MSP (17)
- ☐ Detroit Metropolitan Airport DTW (18)
- ☐ Fort Lauderdale–Hollywood International Airport FLL (19)
- ☐ Philadelphia International Airport PHL (20)
- ☐ LaGuardia Airport LGA (21)
- ☐ Baltimore–Washington International Airport BWI (22)
- ☐ Salt Lake City International Airport SLC (23)
- ☐ Ronald Reagan Washington National Airport DCA (24)

- o Washington Dulles International Airport IAD (25)
- o San Diego International Airport SAN (26)
- o Midway International Airport MDW (27)
- o Tampa International Airport TPA (28)
- o Daniel K. Inouye International Airport HNL (29)
- o Portland International Airport PDX (30)
- o Other (31)

38. Why did you choose those airports?

Open Ended

39. What are your preferred airlines? (Please choose all that apply)

- ☐ Alaska Airlines (1)
- ☐ Allegiant Air (2)
- ☐ American Airlines (3)
- ☐ Delta Air Lines (4)
- ☐ Frontier Airlines (5)
- ☐ Hawaiian Airlines (6)
- ☐ JetBlue (7)
- ☐ Southwest Airlines (8)
- ☐ Spirit Airlines (9)
- ☐ United Airlines (10)
- ☐ Envoy Air (11)
- ☐ Republic Airlines (12)
- ☐ SkyWest Airlines (13)
- ☐ Other (14) _____

40. Why did you choose those airlines?

Open ended

Display This Question:

If Q4 = 1

Or Q4 = 2

Or Q4 = 3

Or Q4 = 4

Or Q4 = 5

41. Do you travel with your personal wheelchair or scooter?

a. Yes (1)

b. No (2)

Display This Question:

If Q4 = 1

Or Q4 = 2

Or Q4 = 3
Or Q4 = 4
Or Q4 = 5

42. Has your wheelchair or scooter ever been damaged by the airport or airline?
- a. Yes (1)
 - b. No (2)

Display This Question:
If Q42 = 1

43. What level of compensation did you receive from the airline or airport?
- a. None (1)
 - b. Some, but not enough to fully cover the cost of the damages (2)
 - c. Enough to fully cover the cost of all of the damage (3)
44. Have you ever had to pay for an additional seat or fly business class in order to be comfortable and have enough space?
- a. Yes (1)
 - b. No (2)
45. Do you think that the current design of airplane seats creates a potential for pain and/or injury?
- a. Airplane seats are comfortable. (1)
 - b. Airplane seats are uncomfortable, but not painful. (2)
 - c. Airplane seats are painful, but I do not feel that I am at risk of injury. (3)
 - d. Airplane seats can be painful and I fear that I may be at risk of potential injury or extended discomfort even after a flight. (4)
46. If you are unable to use a restroom on a flight, what do you do?
- a. Restrict fluid and food intake before and during flight (1)
 - b. Catheter (2)
 - c. Adult diapers (3)
 - d. I travel with an assistant who helps me transfer from my seat to the lavatory (4)
 - e. I am able to get to the restroom on my own (5)
47. From your experience, how long does the boarding process take?
- a. Less than a minute (1)
 - b. Between one and five minutes (2)
 - c. Between five and ten minutes (3)
 - d. Between ten and fifteen minutes (4)
 - e. More than fifteen minutes (5)

Display This Question:
If Q4 = 1
Or Q4 = 2

Or Q4 = 3
Or Q4 = 4
Or Q4 = 5
Or Q4 = 6
Or Q4 = 7

48. Which description most closely matches your opinion on boarding chairs?

- a. I enjoy using a boarding chair. (1)
- b. I don't have a strong opinion on them. (2)
- c. Boarding chairs are useful, but I dislike having to use them. (3)
- d. I avoid traveling by planes because of boarding chairs. (4)
- e. I do not need to use a boarding chair. (5)

Display This Question:

If Q48 = 1
Or Q48 = 2
Or Q48 = 3
Or Q48 = 4
Or Q48 = 5

49. Would you be more likely to fly if an alternative to boarding chairs existed?

- a. Yes (1)
- b. No (2)

Display This Question:

If Q4 = 14
Or Q4 = 15

Or Disability Accommodation Needed: (Please check all that apply) Emotional Support Animal
(Please specify animal type) Is Not Empty

50. Have you flown with your service or emotional support animal?

- a. Yes (1)
- b. No (2)

Display This Question:

If Q50 = 2

51. Why have you not flown with your service or emotional support animal? (Please check all that apply)

- ☐ Fear of difficulties in airport (1)
- ☐ Fear of difficulties on airplane (2)
- ☐ Other (Please explain) (3) _____

Display This Question:

If Q50 = 1

52. How was your experience with check-in with your animal?

- a. Positive (1)
- b. Somewhat Positive (2)
- c. Neural (3)
- d. Somewhat Negative (4)
- e. Negative (5)

Display This Question:

If Q50 = 1

53. How was your experience with TSA with your service animal?

- a. Positive (1)
- b. Somewhat Positive (2)
- c. Neural (3)
- d. Somewhat Negative (4)
- e. Negative (5)

Display This Question:

If Q50 = 1

54. How was your experience in the airport with your service animal?

- a. Positive (1)
- b. Somewhat Positive (2)
- c. Neural (3)
- d. Somewhat Negative (4)
- e. Negative (5)

Display This Question:

If Q50 = 1

55. How was your experience on the airplane with your service animal?

- a. Positive (1)
- b. Somewhat Positive (2)
- c. Neural (3)
- d. Somewhat Negative (4)
- e. Negative (5)

Display This Question:

If Q50 = 1

56. Where was your service animal during your flight? (Please check all that apply)

- ☐ at your feet/under seat in front of you (1)
- ☐ on lap (2)
- ☐ in isle (3)
- ☐ in seat next to you (4)

Display This Question:
If Q50 = 1

57. Did you and your animal have enough space during flight?
- a. Yes (1)
 - b. No (2)

Display This Question:
If Q50 = 1

58. Would having a seat for your service animal be beneficial?
- a. Yes (1)
 - b. No (2)

Display This Question:
If Q50 = 1
Or Q58 = 1

59. Would you be willing to pay a small fee to reserve that seat?
- a. Yes (1)
 - b. No (2)

Display This Question:
If Q50 = 1

60. What difficulties did you and your animal face during travel? (Please check all that apply)
- ☐ Paperwork proving animal may travel with you (1)
 - ☐ Over questioning staff (2)
 - ☐ Trouble getting to gate (3)
 - ☐ Finding relief stations for the animal (4)
 - ☐ Not enough space on the plane (5)
 - ☐ No relief station for animal on plane (6)
 - ☐ Other (Please explain) (7) _____

61. Did you know that airlines do not need to follow ADA law but the airports do?
- a. Yes (1)
 - b. No (2)

62. Have you been on a flight in which another passenger had a service or emotional support animal?
- a. Yes (1)
 - b. No (2)

Display This Question:

If Q62 = 1

63. How was your experience on this flight with the animal?

- a. Positive (1)
- b. Somewhat Positive (2)
- c. Neutral (3)
- d. Somewhat Negative (4)
- e. Negative (5)

Display This Question:

If Q62 = 1

64. In relation to the animal, where were you located?

- ☐ within a few seats (1)
- ☐ a few rows away (2)
- ☐ many rows away (3)

Display This Question:

If Q62 = 1

65. Did the animal change your overall flight experience?

- ☐ I enjoyed my flight more. (1)
- ☐ I disliked my flight more. (2)
- ☐ I like animals. (3)
- ☐ I dislike animals. (4)
- ☐ I am allergic. (5)
- ☐ The animal was disruptive. (6)
- ☐ The animal smelled. (7)
- ☐ The animal invaded my space. (8)
- ☐ Other (Please Explain) (9) _____

Display This Question:

If Q62 = 1

66. If you had known there was an animal on flight prior to booking your ticket, would you have chosen a different flight?

- a. Yes (1)
- b. No (2)

Display This Question:

If Q62 = 1

67. Would you want to be notified if someone with a service animal or emotional support animal booked your same flight?

- a. Yes (1)
- b. No (2)

Again, we would like to thank you for taking our survey. If you have any questions or recommendations please email Dr. Brad Duerstock or Peter Celeste. If you would like to be contacted by one of our researchers for follow up questions please leave your name and email address below (optional).

If you want to remain anonymous, please leave the below box empty and click the right arrow to complete the survey.

Thank you again for your time!
Open Ended

End of Survey

Flight Attendants Assisting Disabled Passengers Survey

1. How often do you help transfer a wheelchair-bound person to/from an aisle chair? At least once a day?
 - a. At least once a week
 - b. At least once a month
 - c. Several times a year
 - d. Less than once a year
 - e. I never have
2. Have you ever injured yourself assisting a disabled person? i.e. throwing out your back during an aisle chair transfer
 - a. Yes, more than once
 - b. Yes, once
 - c. No, never
3. How comfortable do you feel in your abilities to aid a disabled person as a part of your job?
 - a. Scale from 1 to 5, 1 being "Very uncomfortable, I hate when I have to assist a disabled person" and "Very comfortable, I'm a pro, I find helping disabled people no more uncomfortable than helping anyone else"
4. Do you receive specific training on how to best serve disabled customers?
 - a. Yes, multiple times a year
 - b. Yes, once a year
 - c. Yes, once ever
 - d. No, never
5. What kind of training do you receive on how to best serve disabled customers?
 - a. Videos/Modules
 - b. Training workshops
 - c. Other (open ended)
6. Do you think it could be beneficial to have more frequent/intensive training on how to best serve disabled customers?
 - a. Yes, I wish we did
 - b. Yes, but no one would want to do it
 - c. No, it is not needed
7. Any other thoughts you think we should be aware of?
 - a. Open ended