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Development and Implementation of an Interactive Data Dashboard for Inclusive Public Transit: Design and Dissemination

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Abstract

Public transit systems represent structural conditions that constrain or liberate how people travel through space. However, data documenting the accessibility of public transit systems in the United States (U.S.) is sparse, not nationally integrated, and rarely communicated in plain language. This research aimed to fill this gap by generating an interactive dashboard for the dissemination of public transit system accessibility data across the top 99 federally funded fixed-route transit systems within the U.S. The University of Michigan Public Transit Accessibility Dashboard was generated by an interdisciplinary team of academic researchers, web developers, artists, and members of the disability community. The resulting product hosts information about public transit accessibility along four dimensions: Accommodation, Adjacency, Availability, and Affordability. The data reveals a wide variability across systems in the U.S. Scores ranged from 16 to 40 for Accommodation, 0.41 to 3564.18 reachable destinations within a 30-min trip for Adjacency, 0.41 to 3.91 arrivals per hour for Availability, and $0 to $161.85 revenue per trip for Affordability. These findings suggest that where riders live may shape whether and how people with disabilities can plan for and use public transit. Sustainable, lasting change depends on accurate information and making information publicly accessible is a first step.

Keywords: public transportation; accessibility; data visualization; open science; disability justice; geospatial data; scientific communication

Check for updates

Academic Editor: Meredith Perry

Received: 26 May 2026
Revised: 18 September 2026
Accepted: 18 September 2026
Published: 7 October 2026

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1. Introduction

Dashboards are a powerful data visualization platform widely adopted within transportation planning and operations to either assist with decision-making, track progress, promote innovation, or summarize key data measures [1,2]. For example, the Michigan Department of Transportation Bridge Conditions dashboard helped track conditions of infrastructure and inform funding applications for bridge improvements and maintenance [3]. Other key transportation metrics have been tracked using dashboards, including safety (e.g., crash analytics [4]), project delivery (e.g., construction and maintenance [5]), and system performance (e.g., travel time [6]). Transportation dashboards often vary greatly in aesthetic details and functionality, as they differ in objectives and subsequently targeted user groups [7]. As a result, successful dashboards center their design decisions on

the targeted user group to attain productive utility, possibly contributing to the lack of standardization in dashboard design [8].

Despite the variation in design [7,9], dashboards share a common purpose: democratizing access to data. Data democratization aims to minimize challenges accessing, understanding, and utilizing data [10]. A well-executed dashboard embeds principles of data democratization in its design by anticipating the needs and data literacy of potential users. User demographics vary substantially by expertise, accessibility needs, and intent [1]. For example, data-literate users may prefer flexibility in manipulating raw data while users with a lower data literacy would benefit from a lower volume of data and increased messaging that explains the data in plain language [1]. Even expert users often request messages explaining the data in plain language because they help guide understanding and application of the data [11]. It is also important to note that data accessibility concerns extend beyond data literacy. Dashboards should adopt universal design principles to improve access to information. Because dashboards with different purposes require different information to steer decision making [12], designers may benefit from adopting a Purpose–Subject–Consumer framework to clarify their dashboard's aims, topic, and target user group [13]. This approach enhances the clarity in its design [13]. Ultimately, understanding the demographics of a dashboard's potential user base can allow designers to thoughtfully tailor the dashboard's information architecture for the translation of findings. Attentiveness to user demographics is a critical cornerstone of data democratization.

Democratizing public transit data is essential for advancing the accessibility of the entire public transit system. Although government bodies oversee public transit systems nationwide, the evaluation of accessibility on a national scale is limited. The Federal Transit Administration (FTA) is an agency that plays a central role in ensuring that public transit systems comply with the Americans with Disabilities Act (ADA). The ADA defines a person with a disability as "someone who (1) has a physical or mental impairment that substantially limits one or more major life activities, (2) has a history or record of such an impairment, or (3) is perceived by others as having such an impairment", a definition adopted in this paper [14]. While the FTA ensures compliance with ADA, the current evaluation process requires a tremendous amount of time and resources [15]. The FTA's in-depth analysis of few public transit systems (<2% annually) makes it challenging to evaluate if public transit systems are upholding federal non-discrimination laws on a national scale [15]. As a result, inaccessible public transit systems in the United States (U.S.) have been held accountable through reactive mechanisms such as major civil rights lawsuits and court-ordered settlements [16,17]. A reactive approach is problematic because it results in (1) a significant lag in the time between the identification of a problem and resolution, (2) expense, in terms of the time and money that disabled people invest to have their rights upheld, and (3) the cost to transit systems for legal fees and retrofitting systems. A national evaluation of public transit accessibility can support tracking and monitoring accessibility over time and reduce the over-reliance on complaint-based mechanisms.

Therefore, systematically capturing information about the accessibility of transportation systems throughout the U.S. remains a top priority [18]. Research on transportation accessibility increasingly emphasizes that access is not only a matter of distance to transit infrastructure, but also of service frequency, affordability, usability, information access, and the ability to complete a full trip chain [18]. For disabled riders, barriers may occur before, during, or after a trip, including inaccessible information about vehicles or stations, limited service frequency, unaffordable fares, and limited destinations [19–21]. These barriers make a disability-oriented mobility assessment essential for understanding transit equity [21]. Public transit is accessible when people with disabilities can acquire the same information, engage in the same interactions, and enjoy the same services as

people without disabilities with an equivalent ease of use [22]. An estimated 39.8% of adults with travel-limiting disabilities, as defined by the 2017 National Household Travel Survey, do not drive [23]. Therefore, accessible public transit is critical for participation in daily living [24,25]. Inaccessible public transit serves as a modifiable barrier to participation among people with disabilities [26]. To date, most knowledge about accessible public transit systems has been gathered through surveys, interviews, and focus groups [27]. These methods provide valuable insight into the lived experiences of people with disabilities; however, translating findings into system-level reforms can be challenging. To contextualize the current dashboard, Table 1 presents illustrative examples of publicly available transportation accessibility and transit performance dashboards. Existing accessibility dashboards are limited by a narrow focus on one dimension of accessible transit (e.g., financial [28], ridership [29,30], and destinations [31]), restricted geographic areas [29,32], or limited compositional information about the service population [29,31,33]. Furthermore, there is a dearth of evidence documenting how such dashboards are designed.

Table 1. Current dashboards displaying information about accessible public transit, United States, 2026.

Dashboard Name	Dimensions Represented	Geographic Extent	Composition Information
TransitCenter [34]	• Adjacency (number of destinations (grouped into 9 categories) that can be reached within 30, 45, 60, or 90 min) • Affordability	7 cities (San Francisco Bay Area, Los Angeles, Chicago, Washington, Philadelphia, New York City, Boston)	Population, race/ethnicity, single-mother households, older adults, low-income population, zero-car households
Accessibility Observatory [31]	Adjacency (number of jobs that can be reached from 10 to 60 min in 10-min increments)	National	None
CivMetrics Public Transit Data Dashboard [28]	• Affordability (average cost per trip, average fares per trip)	National	Population, service area
NoVaTransit Data Dashboard [32]	• Adjacency (distance to population, number of jobs that can be reached in 30, 45, 60, and 90 min) • Availability (ridership, vehicle miles, vehicle hours)	Northern Virgina Transportation Commission	Population, households, jobs, proportion transit commuters
City Manager's Performance Dashboard: Transportation & Infrastructure—Public Transit [29]	• Availability (ridership, % of actual miles driven vs. scheduled, on-time performance)	City of Phoenix	None
APTA Ridership Trends [30]	• Availability (ridership)	National	Transit system size
Public Transit Disability Dashboard [33]	• Accommodation (TRACT tool)	National	None

To fill this gap, this paper describes the development, implementation, and dissemination of the University of Michigan Public Transit Accessibility Dashboard. This study aimed to translate a multidimensional public transit accessibility database into an interac-

tive dashboard that supports the comparison, visualization, and public access to underlying data. The dashboard builds on previously published measurement work [15,35–37]. The Public Transit Accessibility Dashboard aims to integrate administrative, geospatial, and website-based data across the 99 largest federally funded fixed-route transit systems in the U.S. It is organized around four distinct measures of public transit accessibility, including Accommodation, Adjacency, Affordability, and Availability [38,39]. By documenting the dashboard design and dissemination process, this manuscript contributes to future data democratization efforts and supports the proactive monitoring of structural conditions that shape accessible public transit [40].

2. Materials and Methods

2.1. Community Involvement

Dashboard development was informed by input from target users, including disabled transit riders, disability advocates, researchers, and transit stakeholders. Consultants were engaged under a defined scope of work and compensated according to that agreement. During the information-gathering phase, the study team conducted five formative consultation sessions with five consultants representing expertise in disability advocacy, public transit planning, disability research, and lived experience as disabled transit riders. Experts were recruited through disability advocacy networks, professional networks, and prior research partnerships. Sessions were conducted virtually and lasted approximately 60 min. Feedback was documented through meeting notes and written summaries. Feedback focused on anticipated use cases, barriers encountered in existing data tools, preferred data formats, and the types of information users would need to support advocacy, research, and policy action. The study team reviewed feedback, identified recurring recommendations, and incorporated feasible changes into the dashboard design. When recommendations differed, decisions were made based on alignment with the dashboard's purpose, accessibility priorities, and advisory board review. The sessions formed the foundation of user personas, which described how different individuals might interact with the dashboard. User personas guided the information architecture for the website.

A disability community expert advisory board of five local disabled transit riders and disability advocates also provided feedback throughout dashboard development. Advisory input was gathered over the course of three 90-min meetings, as well as through email correspondence. The expert advisory board informed several key decisions. For example, advisory board members recommended incorporating overlapping transit systems, developing an interactive city comparison tool, and curating guides for potential users. Feedback was incorporated iteratively throughout the dashboard development, and revisions were presented to the advisory board to confirm alignment with recommendations.

2.2. Geographic Extent

This dashboard presents descriptive accessibility information among the 99 fixed-route public transit systems receiving the most federal funding in the U.S. Utilizing the National Transit Database (NTD), systems were selected based on 2020 fiscal year funding allocations [36]. The 2020 fiscal year funding allocation was used to define the initial cohort [15]. This cohort selection provided a stable sampling frame for subsequent data collection and analysis. Accessibility measures reported in the dashboard reflect the most recent data available during the 2025 dashboard release. While representing a subset of all agencies, these 99 systems account for 87% of national passenger miles traveled [41]. The selected systems are fiscally obligated to abide by anti-discriminatory federal laws (i.e., ADA, Section 504 of the Rehabilitation Act of 1973) and thereby provide inclusive services for all riders. To maximize accuracy and spatial granularity, accessibility dimensions

were measured at the smallest administrative geographic unit available (e.g., Census Block, Census Tract, Transit System). In response to feedback from the disability community expert advisory board, the analysis also incorporated overlapping transit systems operating within the service areas of the top 99 federally funded transit systems. Overlapping transit systems were identified using public data from the Federal Transit Administration about cities that public transit systems operate within. Twenty-seven additional systems were identified and included in measures of Adjacency, Availability, and Affordability analyses to better represent multi-agency travel environments. While these 27 systems were included in measurements of Adjacency, Availability, and Affordability, they were excluded from the overall system ranking due to the absence of information on all four dimensions.

2.3. Measures of Public Transit Accessibility

A multidimensional framework was used to guide core components of transit accessibility. This framework was adapted from access frameworks in healthcare and health services literature and modified for the public transit setting [39]. It is also conceptually related to other frameworks, including the U.S. Government Accountability Office [42]. In this research, accessibility was conceptualized as comprising of five core dimensions: Accommodation, Adjacency, Availability, Affordability, and Acceptability (Figure 1). However, only four of these dimensions were measured. The terminology was modified intentionally for public transit and disability context. First, because 'Accessibility' is used as the overarching construct, 'Adjacency' refers to the spatial relationship between transit infrastructure and reachable destinations within a modeled transit journey. Second, 'Accommodation' refers to the extent to which transit systems communicate and provide features, services, policies, and resolution pathways that support disabled riders.

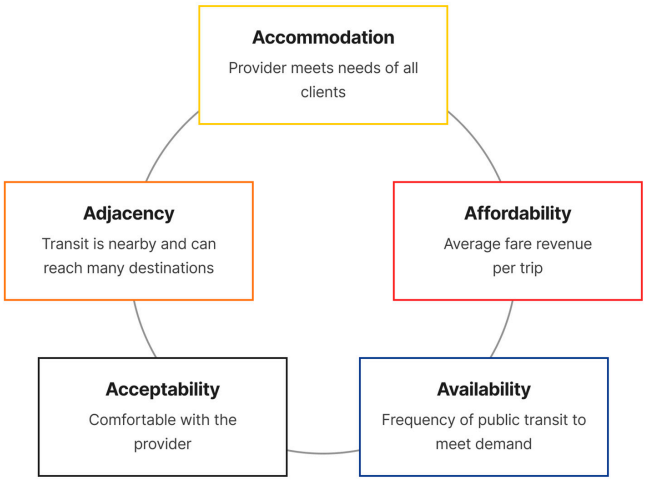


Figure 1. Adapted from Penchansky and Thomas access to healthcare framework [39]. Accessible public transit is multidimensional and only as strong as the weakest dimension of the system. Four of the five dimensions of accessible public transit are measured on the dashboard: Accommodation, Adjacency, Availability, and Affordability.

Measurement of four of the five dimensions are complete and are presented in this manuscript; however, the Acceptability dimension is currently undergoing primary data collection via participatory qualitative interviews and surveys and will be presented separately. Measures are intended to be comparative in nature and should not be interpreted as definitive assessments of whether a transit system provides fully inclusive rider experience. A high score indicates stronger performance on measured dimensions, but it cannot confirm the real-world reliability, dignity, safety, or acceptability of transit use for disabled riders. All measures are geospatial in nature, allowing for data to be displayed on a map.

Dashboard visualizations illustrate the variability in four accessibility dimensions across the U.S. and provide opportunities to integrate accessibility with other geospatial data (e.g., demographic and policies).

2.3.1. Accommodation

Public transit systems can accommodate people with diverse needs and disabilities by adopting universal design principles to create accessible physical (e.g., facilities, vehicles, and websites), social (e.g., accommodations, and grievances), and policy (e.g., public involvement) environments [43,44]. Accommodation measures an agency's communication of accessibility features on their public websites. The previously published TRansit ACcessibility Tool (TRACT) developed the scoring approach used here to measure the Accommodation dimension of transit accessibility [15]. Briefly, TRACT includes a 60-point rubric across six domains: facility accessibility (20 pts), vehicle features (10 pts), inclusive policies (12 pts), rider accommodations (9 pts), paratransit information (6 pts), and web accessibility (3 pts). Data were synthesized from annual audits of public transit system websites conducted in 2025. The TRACT-based Accommodation score does not verify whether reported accessibility features exist, function properly, or remain consistently available in real-world service conditions. Guided by universal design principles, the measure focuses on whether services communicated by public transit agencies are accommodating all riders.

Accommodation at the city level was calculated by averaging the accommodation of the top 99 transit systems that primarily operated within that city. Categorical ratings for Accommodation were generated by dividing the total possible TRACT score into three equal categories: low, 0–20 points; medium, 21–40 points; and high, 41–60 points (Table 2). These categories were used to support transparent public communication and reproducibility.

Table 2. Overall public transit accessibility composite status scoring criteria, United States, 2025.

Dimension	Units of Measurement	Rating Justification	Rating		
			High	Medium	Low
Accommodation	Points	Equal categories for transparency	41–60	21–40	0–20
Adjacency	Number of destinations	Data distribution & advisory board input	≥100	100 > X > 10	≤10
Availability	Arrivals per hour of operation	Transit priorities & prior research	≥4	4 > X > 1	≤1
Affordability	U.S. dollars	Data distribution	≤$1	$3.50 > X > $1	≥$3.50

2.3.2. Adjacency

Adjacency quantifies the number of destinations for social participation and physical activity that are reachable within a 30-min transit journey. Using the r5r R package (version 2.4.0), Adjacency was measured using a routing analysis for every census block within 293 m of transit stops [35]. The 'r5r' package integrates R^5, a Java-based engine that allows for multimodal real-world routing. Time of departure was incorporated by running analyses within a time window between 8 AM and 6 PM on a non-holiday weekday within the transit schedule. The previously established model developed by Conveyal R5 (version 7.6) leveraged five secondary data sources (Table 3) to generate door-to-door pathfinding [45]. Scores reflect the total count of reachable destinations, assuming a walking pace of 2.2 km per hour [46] and a maximum walking time of 8 min [47], to simulate the mobility patterns of an older adult (65 or older) with a disability. Transfer assumptions followed the default setting in the R5 routing engine and were held constant across systems.

Areas with multiple operating systems were processed together to account for transfers between systems. The model did not account for inaccessible sidewalks, curb ramps, station entrances, elevators, or temporary disruptions because comparable national data on these features were not available. A series of scripts detailing the necessary datasets, processes, and tools needed for measurement of adjacency are available at the CIME GitHub (https://github.com/cime-research/public-transit-accessibility, accessed on 18 September 2026).

Census block scores were weighted by the census block population with access to public transit [48]. This was computed by multiplying the census block scores by the total block population and the percentage of the area of the block serviced by public transit. The population within a census block was assumed to be evenly distributed. The weighted census block scores were aggregated to the transit system and city level by summing the weighted census block scores for all census blocks within a public transit system or city and then dividing the sum by the total population with access to that public transit system or to public transit within a city.

Categorical ratings for Adjacency were determined by examining the data distribution (e.g., deciles and mean) and adjusting cut points to align with feedback from the advisory board. Values of 10 or fewer were categorized as low, which corresponded to the 1st tertile of data, values greater than 10 and less than 100 as medium, with 100 reachable destinations being approximately the mean, and values of 100 or more as high (Table 2).

Table 3. Data sources integrated into measurements of public transit accessibility, United States, 2025.

Dimension	Description	Source
Adjacency	Census blocks and census tracts	United States Census [49]
	Street networks	OpenStreetMap [50]
	General transit feed specification	Urban iNTD [51]
	Elevation	USGS Digital Elevation Models [52]
	Destinations	DataAxle [53], ParkServe [54]
Availability	Census blocks	United States Census [49]
	Street networks	OpenStreetMap [50]
	General transit feed specification	Urban iNTD [51]
Accommodation	Primary data collection	TRACT audits, WebAIM evaluation
Affordability	Unlinked passenger trips and total fare revenue	National Transit Database [41]

Note: iNTD = Integrated National Transit Database; USGS = United States Geological Survey; TRACT = TRansit ACessibility Tool; WebAIM = Web Accessibility In Mind.

2.3.3. Availability

Public transit Availability scores were calculated using general transit feed specification data. Arrivals per hour were generated for each unique stop serviced by the transit system during the hours of operation. The average number of arrivals per hour of operation were calculated by dividing (a) the arrival frequency of a unique route traveling in the same direction during hours of operation by (b) the total hours the unique route was in operation at a stop. For stops serviced by multiple routes, an average of the arrivals per hour were calculated for that stop.

To generate values for an area surrounding each stop, a Euclidean distance buffer of 0.18-miles (0.29 km) was generated around every public transit stop within ArcGIS Pro (version 3.7.0). This distance represents the maximum walking distance for an average older adult (65 or older) with a disability [47]. Any census tracts intersecting the public transit stop buffer were identified. A census tract's Availability score was calculated by taking the average frequency of service for all transit stops whose buffer intersected with

the census tract. Transit level availability was calculated by taking the mean arrivals per hour of all individual stops within a transit system. City level availability was calculated by aggregated transit system level data. This was done by weighting system level availability by the total number of transit stops in that system, summing the weighted system level availability for all systems operating within a city, and dividing that sum by the total number of transit stops in a city. Scripts to calculate stop-level availability data are available at the CIME GitHub.

Availability categories were informed by local transit policy priorities and literature [55–60] (Table 2). Values of 1 or fewer arrivals per hour were categorized as low, values greater than 1 and fewer than 4 as medium, and values of 4 or more as high, reflecting a frequent-service threshold of approximately one arrival every 15 min [61].

2.3.4. Affordability

Affordability of a transit system was derived from NTD operating data statistics time series, organized by mode and type of service (NTD Table TS2.1) [41]. The primary variables used to derive the Affordability measure included: fare revenues and unlinked passenger trips. Dividing the fare revenues by the unlinked passenger trips provided an estimate of the average fare per trip on a transit system. This captures the cost across all riders, accounting for subsidized passes and discounted fares. Measures were calculated by taking the average fare per trip across all modes offered by the transit system.

Affordability at the census tract and city level was calculated by averaging the Affordability of the top 99 transit systems that primarily operated within that tract or city. Categorical ratings were determined by examining the data distribution (e.g., deciles and mean) and using natural cut points in the data. Because lower fares indicate greater affordability, systems with an average fare of $1 or less were categorized as high, with $1 or less representing the first tertile of the data, systems with fares greater than $1 and less than $3.50 as medium, and systems with fares of $3.50 or more as low (Table 2).

2.3.5. Accessibility Composite Status

To evaluate the overall performance across the 99 transit systems, this study employed a non-compensatory composite score model. This approach acknowledges that transit accessibility functions as a chain and the entire journey is compromised if a single dimension fails to meet a functional threshold [39,62]. Prior to creating the Accessibility composite status, raw data for each of the four dimensions were transformed into categorical ratings (i.e., high, medium, and low). This discretization was informed by disabled transit riders, current policy priorities, and academic literature (Table 2). The composite status was determined using four mutually exclusive categories: (1) Optimal Accessibility: systems with high ratings across all four operationalized dimensions; (2) Sufficient Accessibility: systems with at least a medium rating across all four dimensions, but not high ratings across all dimensions; (3) Fragmented Accessibility: systems that receive a low rating in one to three dimensions, regardless of performance in other dimensions; and (4) Inadequate Accessibility: systems with low ratings across all four dimensions. This approach was chosen to illuminate equity in transit planning. From the perspective of a rider, high Adjacency does not provide utility if the fare is prohibitive (Affordability) or if the digital information required to navigate the system is absent (Accommodation). By anchoring around the "weakest link" in the transit system, the composite score identifies cities and transit systems that require targeted policy intervention.

2.3.6. Accessibility Ranking

The accessibility rankings were calculated as a separate descriptive measure for the top 99 federally funded transit systems and the cities in which they primarily operate.

The rankings were created to provide an unweighted summary of relative performance across the four operationalized dimensions and should be interpreted separately from the non-compensatory composite status. The accessibility rankings were created in a three-step process: (1) each of the raw accessibility dimensions were ranked from best to worst, (2) the rankings for each dimension were averaged for each transit system/city, and (3) the average dimension ranking was re-ranked. For each transit system and city, the ranking of the four accessibility dimensions was averaged. This average was then re-ranked to create the overall accessibility ranking. The transit system- and city-level rankings are based on averages of dimension-specific ranks; therefore, they are compensatory and should not be interpreted as equivalent to the weakest-link accessibility composite status. Ties were handled using the minimum-rank method, such that tied systems received the same rank, and the next rank was skipped.

2.4. Dashboard Generation

2.4.1. Information Architecture

The information architecture of the dashboard included the content inventory, sitemap, content map, and wireframing. A content inventory represents a comprehensive list of the scope and quantity of information to be hosted on the dashboard. This step provided a snapshot image of the website's content landscape and was used to identify gaps and redundancies. Next, a sitemap was produced to index and structure where the website's information would reside. Lastly, wireframing communicated the basic flow of the dashboard and was used to support clear structure and content organization for potential users. Throughout the study, a priority was designing the dashboard to support access, comprehension, and use among members of the Disability Community.

2.4.2. Design

Websites with inspirational design features were identified by the study team and consolidated into a mood board where similar design features were clustered together. Three clusters emerged, from which two were selected to move forward into design concepts. The two design concepts included key features of the website, such as text font, image and content placement, stroke characteristics (e.g., color, thickness, and transparency), and interactive elements. Four consensus meetings were used to discuss and refine the design concepts with study team members and disabled transit riders. Once the design was finalized, breakpoints were optimized to improve usability across platforms (e.g., mobile). A final component library (e.g., buttons, input fields, and navigation menus) was generated to ensure consistency in elements across pages.

2.4.3. Development and Quality Assurance

Development of the dashboard was conducted with longevity in mind. Search Engine Optimization was incorporated to improve the discoverability through web search engines. Relevant keywords were identified and integrated into page titles, headings, metadata, descriptive text, and alternative text. A content management system (CMS), Sanity Studio, was integrated to allow data owners to control the language and imagery on the site. As data was intended to change year-to-year and reflect the most recent analyses of transit systems, scripts were created to utilize the Census API to retrieve the most up to date demographic information. To accommodate new data uploads without manual input, additional scripts were created to convert data to a backend SQL database and hosted on CloudFlare.

After completion of development and an initial data upload, a period of quality assurance took place. Quality assurance allowed for testing of the functionality of the site as well as data validation. This process was used to identify functionality errors and verify

that the site displayed expected data. As the dashboard ages, two monitoring systems (Cloudfare and Google Analytics) will identify how individuals are using the site and when. These metrics will be used to inform future directions of the site, including how to increase traffic and which data is downloaded most often.

2.5. Statistical Analyses

Descriptive statistics were calculated for the four operationalized public transit accessibility dimensions among the 99 largest federally funded fixed-route public transit systems in the United States. For each dimension, the range, mean, median, and interquartile range were calculated. The distribution of systems across accessibility dimensions were summarized and dimension-specific values were reported for the three highest- and three lowest-ranked public transit systems by overall accessibility. All analyses were conducted using R version 4.6.1 [63].

3. Results

The results are organized in two parts. First, we summarize the descriptive patterns observed across the four operationalized dimensions of public transit Accessibility: Accommodation, Adjacency, Availability, and Affordability. Second, we describe the resulting dashboard pages, comparison tools, and features.

3.1. Descriptive Patterns Across the Four Operationalized Accessibility Dimensions

The results demonstrate substantial variability in accessibility across all measured dimensions (Table 4). Accommodation scores ranged from 16 to 40, with a median of 28. Adjacency showed the widest distribution, ranging from 0.41 to 3564.18 reachable destinations within a 30-min transit journey, with a median of 17.41 destinations. Availability, expressed as arrivals per hour, ranged from 0.41 to 3.91, indicating large differences in the service frequency across systems. Affordability also varied considerably, with the average cost per trip ranging from $0 to $161.85, although the median was $1.17. Categorical ratings differed across the four operationalized dimensions. For Accommodation, 93 systems were classified as medium and 6 as low, with no systems classified as high. For Adjacency, 15 systems were classified as high, 55 as medium, and 29 as low. For Availability, 92 systems were classified as medium and 7 were classified as low, with no systems classified as high. For Affordability, 34 systems were classified as high, 55 as medium, and 10 as low. These results show that accessibility category distributions varied across dimensions and were shaped by the selected thresholds and system-level aggregation.

Table 4. Descriptive statistics for the four operationalized public transit accessibility dimensions among the 99 largest federally funded fixed-route public transit systems in the United States, 2025.

Dimension	Range	Mean	Median	IQR
Accommodation	16–40	27.94	28	25, 31
Adjacency	0.41–3564.18	105.81	17.41	9.03, 62.87
Availability	0.41–3.91	1.70	1.58	1.32, 1.90
Affordability	0–161.85	3.31	1.17	0.92, 1.62

Note: Accommodation is a unitless score based on the TRansit ACcessibility Tool. Adjacency represents the average number of destinations reachable within a 30-min public transit journey. Availability is expressed as average arrivals per hour for all public transit stops within a unique public transit system. Affordability represents average fare per trip on a transit system in U.S. dollars. IQR = interquartile range.

3.2. Highest- and Lowest-Ranked Public Transit Systems

Table 5 presents the three highest- and three lowest-ranked public transit systems based on overall Accessibility among the 99 systems included in the dashboard ranking. These examples illustrate how the dashboard can identify variation across systems and highlight cases where one or more dimensions may constrain the overall Accessibility. Among the highest ranked systems, the average cost per trip was low and the average number of reachable destinations, arrivals per hour, and Accommodation scores were comparatively higher. Among the lowest-ranked systems, a limited Adjacency, fewer arrivals per hour, higher average costs, and lower Accommodation scores contributed to a lower overall Accessibility.

Table 5. Highest- and lowest-ranked public transit systems among the 99 largest federally funded fixed-route public transit systems in the United States, 2025.

Rank	System (Status)	Accommodation Mean (Rating)	Adjacency Mean (Rating)	Availability Mean (Rating)	Affordability Mean (Rating)
Highest-Ranked					
1	LADOT (sufficient)	34 (medium)	125.82 (high)	2.89 (medium)	0.09 (high)
2	MUNI (sufficient)	32 (medium)	302.64 (high)	3.87 (medium)	0.61 (high)
3	LA Metro (sufficient)	36 (medium)	86.92 (medium)	2.12 (medium)	0.49 (high)
Lowest-Ranked					
97	LANTA (fragmented)	17 (low)	12.32 (medium)	0.94 (low)	1.98 (medium)
97	MetroLink (fragmented)	20 (low)	22.73 (medium)	0.79 (low)	8.29 (low)
99	ARRC (fragmented)	23 (medium)	9.03 (low)	0.84 (low)	161.85 (low)

Note: LADOT = City of Los Angeles Department of Transportation of Los Angeles, CA; MUNI = San Francisco Municipal Transportation Agency of San Francisco, CA; LA Metro = Los Angeles County Metropolitan Transportation Authority of Los Angeles, CA; LANTA = Lehigh and Northampton Transportation Authority of Allentown, PA; MetroLink = Southern California Regional Rail Authority of Los Angeles, CA; ARRC = Alaska Railroad Corporation of Anchorage, AK. Accommodation is a unitless score based on the TRansit ACcessibility Tool. Adjacency represents the average number of destinations reachable within a 30-min transit journey. Availability is expressed as the average arrival per hour for all public transit stops within a unique public transit system. Affordability represents average cost per trip in U.S. dollars. The ARRC value $161.85 was verified using National Transit Database data but should be interpreted cautiously because the system primarily serves longer-distance and tourist based fixed-route transit rather than local fixed-route transit.

3.3. Dashboard Organization and User-Facing Functionality

The home page includes a search function where users can select from two fields (i.e., state and city) to obtain information specific to the city of interest. This feature was included after the formative consultation highlighted the limitations of an open search bar when data are not available for all locations. Because the dashboard includes a defined set of cities with usable data, external advisors recommended a guided drill-down feature that allows users to narrow results to locations where dashboard data are available. The interactive lookup form uses ARIA live regions to announce status updates, loading states, and errors to screen reader users without requiring a page reload. Form validation communicates errors assertively, and the results are presented with appropriate landmark and list semantics. Immediately following the search function is a quick link to the methodology used for measuring public transit Accessibility. As a user continues to scroll down the home page, they will see the top scoring cities and top scoring transit authorities revealed for the 2025

data collection. The summary of highest-ranked cities and transit systems was included in response to a recommendation from the community expert panel. Advisors noted that these examples could help transit systems and advocates identify comparative reference points when interpreting local accessibility measures. Following the top scoring cities and transit systems is an exemplary quote. Lastly, a link to the guides page appears where users are taught how they can use these data. The ordering of information on dashboard pages was informed by the community expert panel review of a preliminary dashboard demonstration site. Frequently requested information was placed higher on each page to support faster interpretation and reduce the navigation burden.

3.4. City-Level Pages and Comparison Tools

Each city (n = 85) evaluated as part of this research has a unique page detailing the overall Accessibility rating along with dimension-specific information summarized at the city level. All transit authorities operating within the chosen city are displayed with the overall Accessibility rating and dimension specific information summarized at the transit authority level. Users can dive deeper into the data regarding the demographic characteristics about the city, map accessibility features, and compare scores across cities. Mapping public transit accessibility dimensions to a specific address allows users to compare the small-scale variation (e.g., census tract) with area-level summary statistics. The embedded map is annotated with a descriptive label conveying its purpose to assistive technology users. A skip mechanism allows keyboard users to bypass the map and proceed directly to the scored results. Interactive map controls can be navigated using a keyboard and carry descriptive labels. Within the comparison tool, users have the option to sort based on several characteristics, including the population size, proportion of people with disabilities living within the area, and proportion of people over the age of 65 years of age. Comparison tables, navigation components, and regional detail pages use semantic heading structures and descriptive labels to support screen reader navigation and comprehension.

3.5. Dashboard Features

The dashboard was designed to be approachable for a wide range of users. An accessibility evaluation was conducted using a combination of automated scanners, browser audits, and scripted testing (e.g., Siteimprove, Google Lighthouse, axe, and WAVE) supplemented by developer-led reviews of keyboard interactions, semantic HTML, ARIA implementation, focus behavior, and screen reader announcements using macOS VoiceOver (version 26.6.2). The University of Michigan Disability Equity Office also coordinated an external review with an ITS accessibility professional who uses a screen reader. This review found that the dashboard's purpose and functionality were clear, the application was navigable, and its headings, links, FAQ, and image descriptions supported effective nonvisual use. Accessibility findings were remediated iteratively during development. Inclusive color schemes were used to resemble transportation wayfinding and signage, referencing the topical focus of the webpage. High contrast between the text and background was integrated throughout the dashboard. Alternative text is required at the schema level for all image types managed through the CMS, and automated tests catch editorial regressions before they reach the published site. Nevertheless, these evaluations do not establish full WCAG conformance and were not a formal task-based usability study involving a diverse sample of disabled users.

4. Discussion

The University of Michigan Public Transit Accessibility Dashboard provides a centralized resource to assess, evaluate, and compare public transit accessibility across the nation's

largest systems. The dashboard shows the substantial variability across four accessibility dimensions: Accommodation, Adjacency, Availability, and Affordability. The findings reveal that public transit accessibility cannot be adequately characterized by a single measure. Systems may perform comparatively well in one dimension while still facing substantial barriers in another. The composite status and accessibility rankings serve different purposes. The composite status reflects a non-compensatory weakest-link framework, in which a low rating in one dimension can constrain overall accessibility. In contrast, the accessibility rankings are a separate descriptive measure based on average dimension-specific ranks. Because these rankings are compensatory, they should be interpreted separately from the composite status and not as a definitive measure of overall accessibility. For example, systems ranked highest under the descriptive average-rank procedure generally performed well in Affordability and Availability, whereas the lowest-ranked systems were constrained by one or more dimensions. These constraints included a limited Adjacency, fewer average arrivals per hour, higher average costs, or lower Accommodation scores. Notably, no system achieved the highest category across all four operationalized dimensions, indicating that all systems evaluated had room for improvement under the current framework. By presenting these dimensions together, the dashboard helps identify where accessibility barriers are concentrated and can support more targeted advocacy, planning, and policy discussions. These descriptive findings demonstrate the geographic variation in the accessibility dimensions operationalized within the dashboard. Future research is needed to understand the underlying causes of this variation. Such research could inform targeted opportunities for investment to improve public transit accessibility.

Current gaps in fixed-route public transit accessibility also have implications for paratransit demand and service provision. Paratransit systems offer essential transportation for many disabled riders, particularly when fixed-route systems are inaccessible. However, paratransit systems often operate at high costs per trip because they serve larger service areas with a lower passenger density [24]. Prior research has documented limitations in paratransit service, including limited scheduling flexibility, difficulty modifying routes, non-transferable eligibility across locations, long wait times, and safety risks associated with service failures or abandonment [64–66]. As the number of people with disabilities increases over time, the demand for accessible transportation is also expected to grow [67]. Future research should examine whether the accessibility measures presented in the Public Transit Accessibility Dashboard are associated with paratransit demand, paratransit use, unmet transportation need, and rider satisfaction, and whether these relationships differ by disability status.

Accessible public transit may also have broader implications for population health and societal costs. Transportation barriers are associated with missed health care appointments [68], which have been estimated to contribute substantial costs to the health care system annually [69]. Future empirical work should evaluate whether improvements in public transit accessibility reduce transportation-related barriers to health care, increase participation in daily life, and benefit riders with and without disabilities. These hypotheses are consistent with the theoretical basis of the Curb Cut Effect, which suggests that design improvements developed to meet the needs of marginalized groups, including disabled riders, can create more robust and usable systems for the broader population [70]. In this way, accessible public transit may support both transportation equity and system sustainability.

4.1. Strengths and Limitations

To our knowledge, the University of Michigan Public Transit Accessibility Dashboard is the first centralized, national-scale resource assessing multidimensional public transit accessibility across the 99 largest federally funded fixed-route transit systems in the U.S.

This data product filled a critical information gap where no unified mechanism for evaluating a multidimensional measure of accessibility previously existed. The measurement framework operationalized transit accessibility through four distinct dimensions (Accommodation, Adjacency, Affordability, and Availability). This framework provided a more comprehensive assessment in comparison to existing public transit accessibility dashboards (Table 1). The composite scoring model leveraged a non-compensatory approach by anchoring accessibility to the weakest-performing dimension. This ensured that high performance in one area could not mask critical failures in another. The non-compensatory scoring approach is consistent with the travel chain logic, where a single barrier encountered along the travel chain results in an incomplete or inaccessible journey. Additionally, the dashboard has spatial granularity (e.g., census tract) and coverage (e.g., 85 U.S. cities), which allows users to examine the small-scale variation across the U.S. Lastly, the creation and design of this dashboard was informed through a consultation with multiple stakeholders, including disabled transit riders and public transit planners. This included individual consultation sessions and advisory meetings to inform the features and the prioritization of the information architecture on the finalized dashboard website.

While this study has many strengths, it is not without limitations. First, the reliance on administrative, secondary, and primary data collected from public transit websites does not fully capture the lived experiences of transit users with disabilities. Although the presence of accessibility features was assessed based on the information available online, this approach cannot verify the actual condition, reliability, or functionality of those features (e.g., elevators are operational). As a result, the data may not accurately reflect the lived experience of navigating these systems. Second, the scope of the evaluation is limited. The study focuses on certain aspects of disability inclusion, and a high score does not necessarily equate a fully inclusive public transit experience. The results should be viewed as indicative of the information shared with the public and used to identify potential areas for improvement. However, a comprehensive understanding requires additional data collection about the Acceptability and Awareness of the public transit system to encompass all facets of accessibility. Third, Availability was measured as average arrivals per hour to support the national comparison across transit systems. This system-level aggregation may obscure the variation between peak and off-peak service. The Availability threshold of four arrivals per hour reflects a frequent-service benchmark of approximately one arrival every 15 min; however, no system-level average met this threshold in the current analysis. Future work should refine the Availability measure by examining peak and off-peak service separately. Fourth, Affordability was measured using average fare per trip, calculated at the public transit system level. Although this provides a comparable system-level measure, it does not capture the individual-level variation in the fare burden, including distance-based fares, time-based passes, reduced-fare eligibility, or transfer costs. A disaggregated measure of rider-level or household-level transportation costs may more accurately represent the affordability of a public transit system. Fifth, the analysis was restricted to the 99 largest fixed-route public transit systems in the U.S., selected based on federal funding received in 2020. While these systems represent 87% of all passenger miles traveled in the U.S. in 2020, the findings may not be generalizable to all transit systems nationwide. Sixth, the dashboard has data available at the tract, city, and transit system levels. The displayed data is aggregated from several different spatial scales. While aggregating enables data harmonization across scales, it also reduces the contextual complexity and may obscure important local variation. Lastly, because the dashboard is a newly launched resource, information on website traffic, use patterns, and formal user evaluation is not yet available. Formal usability testing, task-completion assessment, comprehension testing, screen-reader testing, and a structured user satisfaction evaluation with disabled users have not yet been

completed. Therefore, the dashboard should be interpreted as an initial implementation whose usability, accessibility, and usefulness require further evaluation.

4.2. Future Directions

There are several priority directions in which the findings from this work can lead. First, future research should prioritize the formal validation of the current dashboard with disabled users and other intended audiences. This should include task-based usability testing, a comprehension assessment, keyboard navigation testing, screen-reader testing, an assessment of user satisfaction and perceived usefulness, and a comparison of dashboard measures with disabled riders' lived experiences. Second, the present analysis was descriptive in nature. Future work should assess relationships among accessibility dimensions and conduct sensitivity analyses of the scoring framework, including alternative thresholds, aggregation procedures, and classification approaches. Third, future research should empirically examine whether dashboard accessibility measures are associated with transportation, health, and participation outcomes. Specifically, studies should assess the relationships between accessibility measures and paratransit demand, paratransit use, unmet transportation need, and rider satisfaction, including whether these relationships differ by disability status. Future work should also investigate whether improvements in public transit accessibility reduce transportation-related barriers to health care, increase participation in daily life, and benefit riders with and without disabilities. Fourth, while the current dashboard evaluates the top 99 federally funded fixed-route public transit systems, it omits thousands of smaller systems, many of which serve rural communities where transportation barriers are substantial. Future research should operationalize accessible public transit in rural contexts, which involves greater travel distances, reduced service frequency, limited routes, and increased cost [71,72]. Expansion into rural transportation systems would strengthen the measurement of national public transit. Further, it would allow for greater comparisons between urban, suburban, and rural transit contexts. Fifth, research investigating the downstream impacts of accessible public transit on health is needed. Specifically, future research should examine the association between public transit accessibility and ridership, health-promoting behaviors, civic engagement, and health care utilization. Understanding the extent to which accessible public transit systems reduce the need for non-emergency medical transportation in communities could provide compelling evidence for the investment in transit accessibility as a structural determinant of health. Sixth, as mentioned above, the acceptability and awareness of public transit systems needs to be evaluated and monitored. Incorporating lived experience data into a composite measure of public transit accessibility will provide a critical component currently omitted within the current dashboard.

5. Conclusions

Accessible public transit is a civil right and provides the foundation for sustainable, equitable transportation systems. This paper documented the development, design, and dissemination of the University of Michigan Public Transit Accessibility Dashboard. This national-scale resource systematically assessed and compared public transit accessibility across the top 99 federally funded fixed-route transit systems in the U.S. By operationalizing transit accessibility through four distinct dimensions, the dashboard provides an initial national platform for monitoring the selected dimensions of public transit accessibility.

The dashboard fills a critical information gap by consolidating system-level accessibility data into a public platform. Prior to this resource, no unified mechanism existed for community members, disability advocates, transit agencies, or policymakers to monitor a multidimensional measure of transit accessibility on a national scale. In addition, the

dashboard serves as an evidence base for public transit accessibility, which can be utilized in future research and advocacy to develop sustainable and lasting structural changes that benefit both public transit systems and the disability community. Lastly, by incorporating iterative feedback from the disability community throughout the design and development process, the dashboard demonstrates how principles of data democratization can be operationalized. In conclusion, the dashboard represents a first step toward designing public transit for the needs of disabled riders and has the potential to inform a system for all riders [72].

Author Contributions: E.T.: conceptualization, methodology, data curation, writing—original draft, supervision, project administration, and funding acquisition. J.C.: methodology, and writing—original draft. V.A.: methodology, data curation, and writing—review and editing. C.K.: data curation, formal analysis, methodology, and writing—review and editing. K.P.: methodology, and writing—review and editing. All authors have read and agreed to the published version of the manuscript.

Funding: The research reported in this publication was supported by the National Institute on Aging and the National Cancer Institute of the National Institutes of Health under Award Numbers R00AG081563 and U54CA280805. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health.

Institutional Review Board Statement: Institutional review board approval was not required because the activities involving external contributors were conducted as expert consultation for dashboard development rather than as human-subjects research. Consultants were engaged under a defined scope of work and compensated according to that agreement.

Informed Consent Statement: Research informed consent was not applicable because the consultation activities were not conducted as human-subjects research. Consultants were informed that their feedback would be used to guide dashboard development. Permission was obtained from consultants who were named as contributors on the dashboard.

Data Availability Statement: The original data presented in the study are openly available at https://transitaccessibility.kines.umich.edu/ (accessed on 17 September 2026). The underlying processed datasets and data dictionary have been deposited through the National Neighborhood Data Archive and will be available prior to publication. DataAxle is maintained by a third party and data are available from www.data-axle.com (accessed on 17 September 2026). Syntax to create the measures of availability and adjacency is available at the CIME GitHub page (https://github.com/cime-research/public-transit-accessibility, accessed on 17 September 2026).

Acknowledgments: We want to thank Nick Looney, Charles Amyx, and Ben Schaaf for their contributions to the development and design of the dashboard described in this manuscript. Their technical expertise was instrumental in bringing the dashboard to fruition.

Conflicts of Interest: The authors declare no conflicts of interest.

Disability Language/Terminology Positionality Statement: In this article, we intentionally use both person-first language, such as "people with disabilities," and identity-first language, such as "disabled people" and "disabled riders". This choice reflects the interdisciplinary nature of the work, which sits at the intersection of public health, transportation equity, disability studies, civil rights law, and community-engaged research.

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