



FINAL REPORT

2018 Direct Observation Survey of Child Restraint and Booster Seat Use and Misuse in Michigan

**Prepared for:
Office of Highway Safety Planning
7150 Harris Drive
Dimondale, MI 48821**

**Prepared by:
Michigan State University
Department of Civil and Environmental Engineering
East Lansing, MI 48824**

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The opinions, findings, and conclusions expressed in this publication are those of the author(s) and not necessarily those of the Michigan Office of Highway Safety and Planning, the U.S. Department of Transportation, or the National Highway Transportation Safety Administration. This report was prepared in cooperation with the Michigan Office of Highway Safety Planning and the U.S. Department of Transportation, and the National Highway Traffic Safety Administration.

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16. Abstract This study provides the results of the 2018 statewide direct observation survey of child restraint device (including booster seats) use and misuse in Michigan. Child restraint device (CRD) use rates were determined through a direct observation survey conducted at daycare centers, fast food restaurants, shopping centers, and recreational areas throughout Michigan, as well as the adjacent streets to each selected location. The direct observation survey, conducted between June and August of 2018, showed statewide child restraint use rates of 98.2 percent among 0 to 3-year-old children and 54.5 percent among 4 to 7 year-olds. CRD misuse rates were determined through on-site inspections conducted at daycares, festivals or other events, health care centers, inspections stations, and shopping centers. The statewide inspections found that only 20.5 percent of the CRDs were correctly utilized, which is somewhat lower than prior inspections in Michigan. In particular, forward facing CRD show higher rates of misuse than rear-facing seats. The most common seat-related misuse was the improper positioning of the harness retainer clip (typically too low), which was observed in nearly 52 percent (a decrease from 2015) of the rear-facing seats and 56 percent of the forward-facing seats (an increase from 2015). It was also determined that nearly 22 percent of 1-year old children were prematurely seated in a forward-facing CRD, which is a substantial decrease from 2015. Similarly, 18 percent of 2- or 3-year old children were prematurely seated in a booster seat. Improper harness routing below the shoulders was a common problem for forward-facing seats, which is likely a carry-over from prior rear-facing utilization of the particular seat. Excessive slack (greater than 1-inch) in the harness strap remains a common misuse for both rear- and forward-facing seats, although these rates have declined from prior surveys. Loose CRD attachment to the vehicle seat was observed in approximately one-quarter of all rear- and forward-facing CRDs. Misuses of forward-facing seats presented a greater severity risk than rear-facing seats, although both remained above the safe threshold.			
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1.0 INTRODUCTION

Motor vehicle crashes are one of the leading causes of death and injury for children under 8 years of age. From 2010 to 2014, a total of 52,774 child passengers under the age of 8 were involved in 39,344 traffic crashes in Michigan [1]. Among those child-aged vehicle occupants for whom restraint use information was recorded, only 35,695 (67.6 percent) were restrained in some type of child-specific restraint, either a child restraint device or a belt-positioning booster seat. Amongst these children restrained in some type of child safety seat, 191 (0.4 percent) suffered fatal (K) or incapacitating (A) injuries [1]. Prior research confirms the appropriate use of child restraint devices (CRDs) and booster seats can greatly reduce the risk of serious injury to children involved in traffic crashes. The risk of serious injury for children between 12 and 47 months of age is 78 percent lower for children seated in forward-facing CRDs than for children restrained in safety belts alone [2]. Similarly, the risk of injury for children between ages 4 and 7 is reduced by 59 percent when the proper CRD is used and the risk of head or brain injuries is reduced by 75 percent [3].

Over the prior two decades, Michigan has experienced increases in the use of CRDs among children under 4 years of age from 74.5 percent in 1997 to 95.7 percent in 2015 [4-8]. In spite of these gains, about half (45 percent) of the children under the age of 4 who were killed in traffic crashes in Michigan from 2010 to 2014 were improperly or completely unrestrained [1]. Although non-restraint of a child passenger presents obvious safety implications, many of the children killed in these crashes may also have been improperly restrained within a functional CRD.

The improper use of CRDs may expose a child to a heightened risk of injury when involved in a crash. CRDs are most effective when: (1) the devices are appropriate for the age, height, and weight of the child being restrained, (2) the devices are properly and securely installed in the vehicle using seatbelts or a Lower Anchors and Tethers for Children (LATCH) restraint system, and (3) the child is properly and securely restrained in the device. Recent studies by the Wayne State University Transportation Research Group (WSU-TRG) have shown roughly 70 to 80 percent of CRDs in Michigan are improperly used to some degree [4-8]. The most recent CRD study performed by the WSU-TRG in 2015 found that the most common CRD misuses were (1) improper positioning of the harness retainer clip (typically too low), (2) excessive seat recline from vertical (rear-facing only), (3) routing harnesses below shoulders (forward-facing only), and (4) loose harness straps [8]. This is concerning as improper seat recline and loose harnesses have been identified in previous research as one of the most severe forms of misuse [8,9]. Other severe CRD misuses include: internal harness not buckled, not buckling the seatbelt or attaching the LATCH anchor, improper routing of the seatbelt when restraining the CRD to the vehicle seat, shoulder harness straps too high (rear-facing only), and excessive space between the CRD and the vehicle seat [9,10]. Fortunately, the other severe misuses were found to occur relatively infrequently during the most recent CRD inspections performed for OHSP.

While child restraint use has increased dramatically among children under the age of 4, restraint use among 4 to 7-year-olds has been shown to be substantially lower [11]. There are several potential explanations for the low booster seat use rate, including a lack of knowledge of the state law and best practice regarding the benefits of booster seats

compared to seat belts alone, in addition to differences in risk perception among parents [12-18]. Following the enactment of statewide legislation in July 2008, booster seat use was found to increase substantially in Michigan [19,20]. However, the most recent survey (2015) found less than half (49.7 percent) of 4 to 7-year-old child passengers continue to travel while inappropriately restrained [8].

2.0 STUDY OBJECTIVES

The purpose of this study was to determine the rates of child restraint device use and misuse among children passengers under the age of 8 in Michigan. The survey results provide valuable information regarding changes in child restraint use patterns throughout the state of Michigan as well as help to identify areas of opportunity for increasing the use of appropriate child restraint devices by Michigan drivers. Understanding the degree of nonuse and misuse will also assist in developing educational efforts, public awareness campaigns, and enforcement initiatives.

The proposed study built off of the methodologies from previous surveys, such as the 2009, 2010, 2011, 2013 and 2015 studies conducted by the WSU-TRG [5,6,7,8,19,20], in order to accurately and efficiently estimate the rates of use and misuse of CRDs and booster seats in the state of Michigan. Use rates were determined through a series of destination surveys conducted at locations subject to high volumes of target-age children. Misuse rates were based on visual and hands-on inspection of children under the age of 8 who were seated in a CRD. Each device was inspected for type of seat, location in the vehicle, direction of placement, attachment to the vehicle, and the placement and restraint of the child in the device. Such data may assist the Office of Highway Safety Planning in the development of public awareness messages specifically targeted to common or critical CRD/booster misuses.

3.0 METHODOLOGY

The study methodology essentially consists of two separate, but related, components. The first component involves direct observational surveys of CRD and booster seat use. This allows for a longitudinal comparison of use rates over time and provides data for use by the state of Michigan to develop targeted educational and public awareness programs to positively impact child safety. This portion of the study resulted in the determination of overall rates of CRD and booster seat use in Michigan.

The second component focuses on CRD and booster seat misuse and was based upon visual and hands-on inspections. The main objectives of this analysis were to determine both the rate and degree/severity of misuse, as well as to identify patterns of common and severe misuse of CRDs and booster seats.

The study methodology is similar to prior surveys, utilizing a destination-based sampling strategy for both the surveys and inspections. This sampling scheme is based upon the methodology utilized during the 2009, 2010, 2011, 2013 and 2015 surveys and involves collecting data from a random sample of target age children at daycare centers, fast food restaurants, recreational sites, and shopping centers, as well as the street adjacent to each selected location.

3.1 Site Selection

In order to accurately determine rates of CRD and booster seat use and misuse, a representative sample of target-aged groups of children were required as a part of this study: (a) children from ages 0 to 4 and (b) children from ages 4 to 7. In order to ensure the representativeness of the sample, these observations were to be diverse in terms of geographic coverage, vehicle mix, and the socioeconomic characteristics of the drivers. To ensure such representativeness while maintaining data collection efficiency, sites were sampled from 23 counties representing greater than 78 percent of the target population (children ages 0 to 7). The counties were similar to those included in the 2009, 2010, 2011, 2013 and 2015 surveys [5,6,7,8,19,20]. The 2017 county census estimates for children ages 0 to 3, and children ages 4 to 7 are provided in Table 1 [21]. To provide similar levels of precision in comparison to previous studies, a target sample size of at least 2,500 children within each age group was established for the child restraint use survey while a target sample size of 250 children was established for the inspections of misuse.

The candidate counties were previously partitioned into four strata based upon historical safety belt use rates and vehicle miles traveled (VMT) as per the direct observation surveys of safety belt use. This stratification was based upon the fact that CRD and booster seat use have been shown to be related to the driver's safety belt use by previous studies [5,6,7,8,19,20]. Combining counties with similar use and/or misuse rates into strata reduces the within-stratum variability and allows for a reasonable number of observations within each stratum while ensuring desired levels of precision. Stratum 1 includes those counties with the highest historical restraint use rates while Stratum 4 has exhibited the lowest use rate. These counties were partitioned as shown in Table 2.

The specific observation sites were selected from a statewide sample of locations expected to yield high volumes of target-aged child passengers, including daycare centers, fast food restaurants, recreational sites (e.g., zoos, museums, parks, etc.), and shopping centers. To allow for a direct comparison between the results of these surveys and those conducted as a part of previous surveys, the same sites were utilized where feasible. Some of the observation sites from previous surveys had subsequently closed or were found to yield very low volumes of target-aged children. Such locations were replaced by alternate sites within the same county and these alternate sites were of the same type as the initial sites they replaced. Complete lists of locations used for the child restraint device use surveys are included in Appendix I.

Table 1. 2017 Michigan Population Estimates of Children Ages 0-3 and 4-7, by County

County	Population Ages 0 to 3	Percent of Statewide Population Ages 0 to 3	Population Ages 4 to 7	Percent of Statewide Population Ages 4 to 7
Barry	2,638	0.6%	2,850	0.6%
Berrien	7,159	1.6%	7,451	1.6%
Branch	2,065	0.5%	2,163	0.5%
Calhoun	6,699	1.5%	6,602	1.4%
Cass	2,046	0.4%	2,221	0.5%
Clinton	3,411	0.7%	3,757	0.8%
Eaton	4,686	1.0%	4,943	1.1%
Genesee	19,303	4.2%	19,805	4.3%
Hillsdale	2,150	0.5%	2,047	0.4%
Ingham	13,205	2.9%	12,717	2.7%
Ionia	2,923	0.6%	3,091	0.7%
Jackson	7,178	1.6%	7,372	1.6%
Kalamazoo	12,579	2.7%	12,810	2.8%
Kent	35,499	7.8%	34,690	7.5%
Livingston	7,666	1.7%	8,167	1.8%
Macomb	38,487	8.4%	38,847	8.3%
Muskegon	8,441	1.8%	8,833	1.9%
Oakland	54,812	12.0%	55,207	11.9%
Ottawa	14,170	3.1%	15,359	3.3%
St. Joseph	3,195	0.7%	3,214	0.7%
Van Buren	3,642	0.8%	3,890	0.8%
Washtenaw	14,534	3.2%	14,793	3.2%
Wayne	92,248	20.2%	91,171	19.6%
Sample	358,736	78.4%	362,000	77.8%
Statewide	457,720	100.0%	465,402	100.0%

Site selection for the misuse inspections was largely based upon the methodology of the 2011, 2013, and 2015 studies [6,7,8]. In both studies, inspections were performed at daycare centers, permanent inspection stations, and various organized events, including those held at shopping centers, community or church festivals, or health care facilities. Several of the high-yield inspection sites from the 2011, 2013, and 2015 studies were again contacted to determine their willingness to participate in the 2018 study.

Table 2. Counties Utilized for Direct Observation Survey, by Stratum

Stratum 1	Stratum 2	Stratum 3	Stratum 4
Ingham	Calhoun	Barry	Macomb
Kalamazoo	Eaton	Berrien	Wayne
Oakland	Jackson	Branch	
Washtenaw	Kent	Cass	
	Livingston	Clinton	
	Ottawa	Genesee	
		Hillsdale	
		Ionia	
		Muskegon	
		St. Joseph	
		Van Buren	

The county strata assignments for the inspections were identical to those used in the CRD direct observation surveys, although the minimum necessary sample size for the inspection of the restraint use characteristics of passengers under the age of 8 was much smaller due to the time and human resources necessary to perform the inspections. A list of all CRD inspection locations is provided in Appendix II.

3.2 Observer Training

Two targeted training programs specific to this project were conducted during the spring of 2018: (1) training for inspection of CRD/booster seat misuse; and (2) training for direct observation of CRD/booster seat use. All training occurred during May and early June of 2018. Classroom training for the inspections was conducted on June 6, 2018 by a NHTSA-certified Child Passenger Safety Technician Instructor. This training session included both classroom instruction and hands-on in-vehicle instruction on child safety restraint use and misuse. Each data collector received a training manual summarizing the information received during the training session. At the end of the training session, each data collector was required to successfully demonstrate inspections of actual CRD/booster seat installations prepared by the instructor. After the initial training, each new technician “shadowed” an experienced technician during his/her initial inspection event.

Classroom training for the direct observation survey of child restraint use was conducted on May 14, 2018. During the classroom training, data collectors were provided with information to aid in assessing the age of child passengers, including height/weight information and sample photographs. At the conclusion of the training session, field personnel were tested on their ability to assess the age of child passengers based upon a series of photographs. The classroom training session was followed by practice field data collection at a local recreational location. The purpose of the field data collection was to provide observers with an opportunity to gain field experience in assessing child passenger age and determining the type of child restraint use. Observers worked as a group at the start of the field training, quickly followed by a mock session where they were instructed to record the information needed to the best of their ability. Following the field training, their performance was monitored to ensure consistency among observers. This included comparing the number of target-aged children identified by each observer, as well as the type of restraint used by each observed child. In addition to these training exercises, each data collector received a training manual, as well as all necessary field supplies.

3.3 Data Collection Procedures for Direct Observation Survey

During weekday surveys, the data collection schedule was arranged such that observations could be conducted at a fast food restaurant at the start of the day, followed by shopping center locations in route to a daycare center scheduled to be visited later the same day. Each daycare center was researched to determine start and release times, and other locations (e.g., shopping centers, fast food restaurants, recreation centers) were also researched to ensure they were still in operation. In order to minimize the travel time and distance required to conduct this study, the observation sites were clustered into geographic regions. Weekend data collection was performed at all types of locations, excluding daycare centers.

During the direct observation use surveys, several factors were assessed as a part of data collection. For all vehicles identified to have a 0 to 7-year-old child passenger, the driver and all target-age child passengers were observed for restraint use and non-use. A sample field observation form is shown in Figure 1.

Vehicles were observed at the entrance or exit of the observation site. At the primary observation sites where traffic volumes were relatively low, data were also collected from vehicles on the adjacent street. The vehicles were categorized into four groups: passenger vehicles, sport utility vehicles, vans/minivans, or pickup trucks. Driver restraint use, gender, age group, and ethnicity were assessed and recorded. Driver restraint use was categorized as belted, not belted, or unknown. An age assessment was required for each child passenger under age 8, in addition to the type of restraint and seating position within the vehicle. The seven restraint categories for each child were: belted, not belted, unknown, rear-facing child safety seat, front-facing child safety seat, high-back booster, or backless booster.

<input type="checkbox"/> SAME VEHICLE AS PREVIOUS							<input type="checkbox"/> OBSERVED ON ADJACENT STREET						
VEHICLE TYPE:													
<input type="checkbox"/> Passenger Car		<input type="checkbox"/> SUV		<input type="checkbox"/> Van/Minivan		<input type="checkbox"/> Pickup Truck							
DRIVER													
RESTRAINT USE:		AGE:		GENDER:		RACE:							
<input type="checkbox"/> Belted		<input type="checkbox"/> 16-29		<input type="checkbox"/> Male		<input type="checkbox"/> White							
<input type="checkbox"/> Not Belted		<input type="checkbox"/> 30-59		<input type="checkbox"/> Female		<input type="checkbox"/> Black							
<input type="checkbox"/> Unknown		<input type="checkbox"/> 60+		<input type="checkbox"/> Unknown		<input type="checkbox"/> Other							
		<input type="checkbox"/> Unknown				<input type="checkbox"/> Unknown							
CHILD PASSENGER													
RESTRAINT USE:			AGE:			SEATING POSITION:							
<input type="checkbox"/> Belted			<input type="checkbox"/> Rear-Facing CSS			<input type="checkbox"/> Under 2							
<input type="checkbox"/> Not Belted			<input type="checkbox"/> Front-Facing CSS			<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 25%;">D</td> <td style="width: 25%;"><input type="checkbox"/></td> <td style="width: 25%;"><input type="checkbox"/></td> <td style="width: 25%;"><input type="checkbox"/></td> </tr> </table>				D	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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Figure 1. Sample Data Collection Form

3.4 Data Collection Procedures for Misuse Inspections

A separate data collection effort included visual and hands-on inspection of the child restraint devices for children under the age of 8 at targeted locations. The same vehicle and driver data were collected as for the use rate survey. Data collected with respect to the child passengers were similar, but also included age, height, and weight information, either measured or reported by the adult driver or passenger. The vehicle year, make, and model were also noted. An initial assessment of the restraint type, location in the vehicle, direction of placement, attachment to the vehicle, and placement of the child in the device was made. LATCH availability and utilization were also noted.

Each child seated in a child restraint device or booster seat was inspected for several common misuses, as well as the degree or extent of each misuse. Particular attention was paid to the prevalence of severe misuse categories, including loose internal harness, internal harness not buckled, not buckling or adequately securing the seatbelt or attaching the LATCH anchor, improper routing of the seatbelt when restraining the CRD to the vehicle seat, shoulder harness straps routed incorrectly, and excessive space between the CRD and the vehicle seat. All observed restraint misuses were carefully recorded onto the data collection form along with descriptive notes. The complete inspection checklist is included in the inspection form, which is displayed in Appendix III.

3.5 Data Analysis

Rates of appropriate child restraint use were determined at the statewide- and stratum-level, as well as with respect to each of the characteristics previously described. For the purposes of the direct observation survey, “appropriate” child restraint use was defined based on current Michigan law. Thus, children under the age of 4 that were seated in a rear-facing or forward-facing child safety seat were considered to be using the appropriate restraint. Premature graduation to a booster seat or safety belt was classified as inappropriate restraint use for this age group. Appropriate restraint use for children ages 4 through 7 included rear-facing restraint, forward-facing restraint, or booster seat (high back or backless). Premature graduation to safety belts (without a booster) was classified as inappropriate. The procedures used to calculate the appropriate use rates and their associated variances are outlined below.

3.5.1 Statewide Child Restraint Device Use Rate Calculations

In order to determine the statewide child restraint use (or misuse) rate, a procedure was utilized similar to previous studies [4-8,19,20]. This procedure is illustrated here with respect to the appropriate use rate calculation. First, the child restraint device use rate at each study location was calculated as shown here:

$$g_{ij} = \frac{b_{ij}}{o_{ij}}$$

where:

g_{ij} = use rate at location i in stratum j

b_{ij} = number of target age children restrained appropriately at location i in stratum j

o_{ij} = total number of target age children observed at location i in stratum j

Then, the child restraint device use rate within each stratum (r_j) was determined as follows:

$$r_j = \frac{\sum_i b_{ij}}{\sum_i o_{ij}}$$

Once the child restraint use rates were determined within each stratum, the statewide use rate was calculated using the following equation:

$$r_{TOTAL} = \frac{\sum_j(p_j r_j)}{\sum_j(p_j)}$$

where:

r_{TOTAL} = statewide child restraint device use rate

p_j = population of target age children in stratum j

The ‘p’ values in the preceding equation are weighting factors that are necessary because strata with higher populations of target age children will have a greater impact on the statewide use rate. Separate estimates were obtained for the 0 to 3, and 4 to 7-year-old age groups.

3.5.2 Statewide Child Restraint Device Use Variance Calculation

Upon obtaining estimates of the child restraint device use and misuse rates for each of the four strata, the variance for each stratum was determined using the following equation [21]:

$$Var_j \approx \frac{n_j}{n_j - 1} \sum_i \left(\frac{o_{ij}}{\sum_i o_{ij}} \right)^2 (g_{ij} - r_j)^2 + \frac{n_j}{N_j} \sum_i \left(\frac{o_{ij}}{\sum_i o_{ij}} \right)^2 \frac{(g_{ij} - r_j)^2}{g_i}$$

where:

Var_j = variance for stratum j

n_j = number of sampled observation locations in stratum j

N_j = number of available observation locations in stratum j

The second term in the above equation can be dropped from the equation with no significant impact on the resulting estimate, providing the following formula where all variables are as previously defined:

$$Var_j \approx \frac{n_j}{n_j - 1} \sum_i \left(\frac{o_{ij}}{\sum_i o_{ij}} \right)^2 (g_{ij} - r_j)^2$$

Given the variance of child restraint device use within each stratum, the statewide variance in use can then be calculated using the following formula:

$$Var_{TOTAL} = \frac{\sum_j(p_j^2 Var_j)}{(\sum_j p_j)^2}$$

where:

Var_{TOTAL} = statewide variance in child restraint device use

The calculated variances were used to construct 95-percent confidence intervals for the strata and statewide use rates using the following equation:

$$\text{Strata-level } 95\%Cl = r_j \pm 1.96\sqrt{Var_j}$$

$$\text{Statewide } 95\%Cl = r_{TOTAL} \pm 1.96\sqrt{Var_{TOTAL}}$$

3.5.3 Misuse Rate Determination

The CRD/booster seat misuse rates for each stratum and statewide were determined based on the data obtained from the inspections. Separate misuse rates were also computed for rear-facing CRDs, forward-facing CRDs, and booster seats. A CRD/booster seat was considered to be “misused” if one or more of the itemized misuse characteristics was observed during the inspection or if no CRD was utilized to restrain the child. The misuse rate was computed based on the number of inspected CRDs with one or more misuses divided by the total number of inspected CRDs. The overall statewide misuse rate was calculated by weighting the misuse rates for each of the three seat-type categories (rear-facing, forward-facing, and booster seat) based on seat use proportions obtained from the direct observation survey. The misuse rates were also compared with those obtained during prior inspections.

A severity score was also determined for both the forward-facing CRDs and rear-facing CRDs. The severity scores were similar to those used in a study conducted in Canada in 2002 [9], which were developed by CRD safety experts [10]. A severity score of ‘10’ indicates a misuse of the highest severity and a severity score of ‘0’ indicates the misuse has no safety impact. A severity score of ‘4’ or higher will compromise the effect of the CRD on the child’s safety during a crash [9]. The severity scores for each type of misuse were multiplied by the number of occurrences, resulting in a risk priority number for each type of misuse, which gives an indication of the most severe types of misuses. The risk priority numbers were then summed and averaged over the total number of observations for the particular seat type to determine the average risk priority number for both the forward-facing CRD and rear-facing CRD. LATCH availability and utilization was also computed and compared to prior surveys.

4.0 DATA SUMMARY

4.1 Child Restraint Device Use

The statewide child restraint device use survey was performed between June 4, 2018 and August 21, 2018. During this observation period, a total of 2,868 observations of 0 to 7-year-old child passengers were conducted at daycare centers, fast food restaurants, shopping centers, and recreation centers, as well as on streets adjacent to these locations throughout the 23-county sample. Summary statistics detailing the results of the child restraint use survey by stratum and site type are provided in Table 3.

Table 3. Summary of Observations by Stratum and Site Type

Stratum	Number of Children 0-3 Years Old Observed	Percent of Total Sample	Number of Children 4-7 Years Old Observed	Percent of Total Sample
Stratum 1	601	38.6%	401	30.6%
Stratum 2	482	30.9%	420	32.1%
Stratum 3	245	15.7%	285	21.8%
Stratum 4	231	14.8%	203	15.5%
Total	1,559	100.0%	1,309	100.0%
Site Type	Number of Children 0-3 Years Old Observed	Percent of Total Sample	Number of Children 4-7 Years Old Observed	Percent of Total Sample
Daycare	4	0.3%	5	0.4%
Recreation	869	55.7%	676	51.6%
Shopping Center	416	26.7%	378	28.9%
Fast Food	217	13.9%	226	17.3%
Adjacent Street	53	3.4%	24	1.8%
Total	1,559	100.0%	1,309	100.0%

Table 4 provides details of the number of children observed by type of vehicle and seating position. Approximately half of the target-age children in each age category were in sport utility vehicles, with lower percentages in passenger cars, vans/minivans, and pickup trucks. Approximately 3.7 percent of 4 to 7-year-old children were observed in the first row of seating. While this is a slight decrease from 2015, this issue is problematic since these seating positions put children at a higher risk of injury due to issues such as airbag deployment. More encouragingly, no 0 to 3-year-old children were restrained in the front seat. This is a slight decrease from the 2015 study. The Centers for Disease Control and Prevention (CDC) and the American Academy of Pediatrics (AAP) recommend that children less than 13 years of age not be seated in the front seat if other alternatives are available.

Table 4. Summary of Observations by Vehicle Characteristics

Vehicle Type	Number of Children 0-3 Years Old Observed	Percent of Total Sample	Number of Children 4-7 Years Old Observed	Percent of Total Sample
Passenger Car	368	23.6%	365	27.9%
Sport Utility Vehicle	775	49.7%	597	45.6%
Van/Minivan	325	20.8%	246	18.8%
Pickup Truck	91	5.8%	101	7.7%
Total	1,559	100.0%	1,309	100.0%
Child Passenger Seating Position	Number of Children 0-3 Years Old Observed	Percent of Total Sample	Number of Children 4-7 Years Old Observed	Percent of Total Sample
First Row - Left	0	0.0%	0	0.0%
First Row - Center	0	0.0%	3	0.2%
First Row - Right	0	0.0%	46	3.5%
Second Row - Left	721	46.2%	509	38.9%
Second Row - Center	180	11.5%	99	7.6%
Second Row - Right	643	41.2%	559	42.7%
Third Row - Left	9	0.6%	50	3.8%
Third Row - Center	1	0.1%	6	0.5%
Third Row - Right	5	0.3%	37	2.8%
Total	1,559	100.0%	1,309	100.0%

Table 5 presents data on the number of children observed by various driver characteristics, including gender, age, race, and belt use. Overall, approximately 66.7 percent of children aged 0 to 3 years-old and 66.1 percent of children aged 4 to 7 years-old were riding with a female driver. The majority of children (75.0 percent) were traveling with a driver in the 30 to 59-year-old age group and approximately 87.9 percent of the children observed were traveling with a Caucasian driver. Among 4 to 7-year-old children, 95.4 percent were traveling with a driver who was appropriately belted while 95.1 percent of 0 to 3-year-old children were traveling with an appropriately restrained driver.

Table 5. Summary of Observations by Driver Characteristics

Driver Gender	Number of Children 0-3 Years Old Observed	Percent of Total Sample	Number of Children 4-7 Years Old Observed	Percent of Total Sample
Male	495	31.8%	429	32.8%
Female	1040	66.7%	865	66.1%
Unknown	24	1.5%	15	1.1%
Total	1,559	100.0%	1,309	100.0%
Driver Age	Number of Children 0-3 Years Old Observed	Percent of Total Sample	Number of Children 4-7 Years Old Observed	Percent of Total Sample
16-29	291	18.7%	174	13.3%
30-59	1150	73.8%	1002	76.5%
60+	91	5.8%	110	8.4%
Unknown	27	1.7%	23	1.8%
Total	1,559	100.0%	1,309	100.0%
Driver Race	Number of Children 0-3 Years Old Observed	Percent of Total Sample	Number of Children 4-7 Years Old Observed	Percent of Total Sample
White	1387	89.0%	1133	86.6%
Black	68	4.4%	71	5.4%
Other	71	4.6%	82	6.3%
Unknown	33	2.1%	23	1.8%
Total	1,559	100.0%	1,309	100.0%
Driver Belt Use	Number of Children 0-3 Years Old Observed	Percent of Total Sample	Number of Children 4-7 Years Old Observed	Percent of Total Sample
Belted	1483	95.1%	1249	95.4%
Not Belted	15	1.0%	14	1.1%
Unknown	61	3.9%	46	3.5%
Total	1,559	100.0%	1,309	100.0%

4.2 Child Restraint Device Misuse Inspections

The misuse inspections were performed at 27 locations statewide between June 13 and August 23, 2018. A total of 244 inspections of the restraint devices used by child passengers under the age of 8 were performed, including 124 under age 2, 55 in the 2 to 3-year-old range, and 65 in the 4 to 7-year-old age range. 65 inspections were performed at ten sites in Stratum 1, 96 inspections at nine sites in Stratum 2, 44 inspections at four sites in Stratum 3, and 39 inspections at four sites in Stratum 4. Table 6 summarizes the descriptive statistics regarding the inspection locations by stratum, day of the week, and type of site. Table 7 summarizes the inspection percentages based on vehicle type, type of restraint, position of the child in the vehicle, and age of child.

Table 6. Summary of Misuse Inspections by Strata, Day of Week, and Type of Site

Stratum	No. of Sites	Pct. of Sites	No. of Inspections	Pct. of Inspections
Stratum 1	10	37.0%	65	26.6%
Stratum 2	9	33.3%	96	39.3%
Stratum 3	4	14.8%	44	18.0%
Stratum 4	4	14.8%	39	16.0%
Total	27	100.0%	244	100.0%
Day of the Week	No. of Sites	Pct. of Sites	No. of Inspections	Pct. of Inspections
Sunday	1	3.7%	3	1.2%
Monday	0	0.0%	0	0.0%
Tuesday	4	14.8%	26	10.7%
Wednesday	6	22.2%	45	18.4%
Thursday	10	37.0%	116	47.5%
Friday	3	11.1%	17	7.0%
Saturday	3	11.1%	37	15.2%
Total	27	100.0%	244	100.0%
Type of Site	No. of Sites	Pct. of Sites	No. of Inspections	Pct. of Inspections
Shopping Center	3	11.1%	24	9.8%
Health Care Center or Hospital	1	3.7%	1	0.4%
Community, Church, or Corporate Event	4	14.8%	20	8.2%
Fire or Police Station	16	59.3%	186	76.2%
Day Care Center or School	3	11.1%	13	5.3%
Total	27	100.0%	244	100.0%

Table 7. Summary of Misuse Inspections by Vehicle Type, CRD Type, Position in Vehicle, and Child Age

Vehicle Type	No. of Inspections	Pct. of Inspections
Passenger Car	66	27.0%
Sport Utility Vehicle	107	43.9%
Van/Minivan	60	24.6%
Pick-up Truck	11	4.5%
Total	244	100.0%
Type of Restraint	No. of Inspections	Pct. of Inspections
Rear-Facing CRD	118	48.4%
Forward-Facing CRD	87	35.7%
Belt Positioning Booster	39	16.0%
Total	244	100.0%
Position of the Child	No. of Inspections	Pct. of Inspections
Front Passenger	2	0.8%
Second Row Left	82	33.6%
Second Row Middle	37	15.2%
Second Row Right	97	39.8%
Third Row Left	7	2.9%
Third Row Middle	8	3.3%
Third Row Right	11	4.5%
Total	244	100.0%
Age of Child	No. of Inspections	Pct. of Inspections
Less than 1 Year	57	23.4%
1 Year – Less than 2 Years	67	27.5%
2 Years – Less than 3 Years	32	13.1%
3 Years – Less than 4 Years	23	9.4%
4 Years – Less than 5 Years	22	9.0%
5 Years – Less than 6 Years	16	6.6%
6 Years – Less than 7 Years	16	6.6%
7 Years	11	4.5%
Total	244	100.0%

5.0 RESULTS

5.1 Statewide and Stratum-Level Child Restraint Device Use Rates

The statewide child restraint device use rates were calculated based upon the procedure described in the previous section for the 2,844 children for which restraint use could be determined. The CRD use rates displayed in Table 8 represent the weighted statewide percentages of 0 to 3-year old children seated in rear-facing or forward-facing seats and of 4 to 7-year-old children seated in rear-facing, forward facing, or booster seats. The weighted statewide child restraint use rates were 98.2 percent for 0 to 3-year-old children and 54.5 percent for 4 to 7-year-old children. The 0 to 3-year-old use rate represents a 2.5 percent increase over the 95.7 percent use rate observed during the 2015 survey [8]. Further, the 54.5 percent use rate for 4 to 7-year-olds represents a 4.8 percent increase over the 49.7 percent use rate observed during the 2015 survey [8].

Table 8. Statewide Rate of Appropriate Child Restraint Device Use, by Age Group

Age Group	CRD Use Rate*	Standard Error
0-to-3 years old	98.2% ± 1.01%	0.51%
4-to-7 years old	54.5% ± 5.19%	2.65%

*Use rate based on 0 to 3-year-old children seated in rear-facing or forward-facing seats and 4 to 7-year old children seated in rear-facing, forward facing, or booster seats.

Table 9 displays the proportional breakdown of observations by seat type. When examining each of the specific restraint types, 30.5 percent of 0 to 3-year-old children were restrained in rear-facing child safety seats and 67.9 percent were in forward-facing safety seats. Among 4 to 7-year-olds, approximately 25.0 percent of children were restrained in front-facing child safety seats, 17.6 percent were observed in high-back boosters, and 13.3 percent were in backless boosters as shown in Table 9. The percentage of children ages 0 to 3 traveling completely unrestrained was 0.3 percent, while the percentage of unrestrained children among 4 to 7-year-olds was 2.6 percent. Most concerning was the 41.4 percent of 4 to 7-year-olds that were restrained using only the safety belt.

Table 9. Restraint Use Proportions, by Child Age Group and Seat Type

Age Group	Rear-Facing CRD	Forward-Facing CRD	High Back Booster	Backless Booster	Safety Belt Only	Not Restrained
Ages 0-to-3	30.5%	67.9%	0.5%	0.2%	0.7%	0.3%
Ages 4-to-7	0.1%	25.0%	17.6%	13.3%	41.4%	2.6%
OVERALL Ages 0-to-7	16.7%	48.4%	8.3%	6.2%	19.2%	1.3%

When examining child restraint device use by stratum, the use rates among 0 to 3-year-olds ranged from 97.6 percent in Stratum 3 to 98.8 percent in Stratum 2. Among 4 to 7-year-olds, the use rates were highest in Stratum 3 (58.5 percent) and lowest in Stratum 4 (50.0 percent). These results are reflected in Table 10.

Table 10. Child Restraint Device Use, by Stratum

Stratum	Age 0-3		Age 4-7	
	CRD Use Rate	Std. Error	CRD Use Rate	Std. Error
Stratum 1	98.5% ± 0.88%	0.45%	57.2% ± 10.21%	5.21%
Stratum 2	98.8% ± .079%	0.40%	56.0% ± 4.48%	2.29%
Stratum 3	97.6% ± 2.21%	1.13%	58.5% ± 12.30%	6.28%
Stratum 4	97.8% ± 2.46%	1.26%	50.0% ± 10.59%	5.40%

5.2 Child Restraint Device Use Rates by Location, Vehicle, and Driver Characteristics

This section provides details of the (unweighted) child restraint device use rates based upon vehicle and driver characteristics among the 2,844 children for which restraint use could be determined. Again, the CRD use rates represent the percentages of 0 to 3-year-old children seated in rear-facing or forward-facing seats and of 4 to 7 year old children seated in rear-facing, forward facing, or booster seats. Comparisons are provided with respect to each characteristic, as well as with respect to prior studies on child restraint device use.

Table 11 presents child restraint use rates by type of site. CRD use rates were the highest at daycare centers for children aged 0 to 3 and at day care centers and recreational locations for children aged 4 to 7. The lowest CRD use rates were observed along adjacent streets for children aged 0 to 3 as well as for children aged 4 to 7.

Table 11. Child Restraint Device Use, by Site Type

Location Type	Age 0-3 in CRD	Age 0-3 Total	Age 0-3 CRD Use Rate	Age 4-7 in CRD	Age 4-7 Total	Age 4-7 CRD Use Rate
Daycare Center	4	4	100.0%	3	5	60.0%
Recreation	851	868	98.0%	401	668	60.0%
Shopping Center	411	414	99.3%	209	374	55.9%
Fast Food	213	217	98.2%	110	222	49.5%
Adjacent Street	48	50	96.0%	0	22	0.0%
Total	1,527	1,553	98.3%	723	1,291	56.0%

Table 12 displays very little variability between the CRD use rates across vehicle types for 0 to 3-year-olds. However, among 4 to 7-year-olds, CRD use was clearly highest for drivers of minivans and lowest for passenger cars. CRD use was also particularly low for children restrained in the first row of vehicles.

Table 12. Child Restraint Device Use, by Vehicle Characteristics

Vehicle Type	Age 0-3 in CRD	Age 0-3 Total	Age 0-3 CRD Use Rate	Age 4-7 in CRD	Age 4-7 Total	Age 4-7 CRD Use Rate
Passenger Car	352	364	96.7%	157	358	43.9%
Sport Utility Vehicle	762	774	98.4%	348	589	59.1%
Van/Minivan	324	324	100.0%	163	246	66.3%
Pickup Truck	89	91	97.8%	55	98	56.1%
Total	1,527	1,553	98.3%	723	1,291	56.0%
Child Passenger Seating Position	Age 0-3 in CRD	Age 0-3 Total	Age 0-3 CRD Use Rate	Age 4-7 in CRD	Age 4-7 Total	Age 4-7 CRD Use Rate
First Row - Left	0	0	-	0	0	-
First Row - Center	0	0	-	0	2	0.0%
First Row - Right	0	0	-	1	46	2.2%
Second Row - Left	705	721	97.8%	305	502	60.8%
Second Row - Center	173	178	97.2%	37	95	38.9%
Second Row - Right	634	639	99.2%	322	554	58.1%
Third Row - Left	9	9	100.0%	32	50	64.0%
Third Row - Center	1	1	100.0%	2	6	33.3%
Third Row - Right	5	5	100.0%	24	36	66.7%
Total	1,527	1,553	98.3%	723	1,291	56.0%

Table 13 displays the rate of child restraint device use by various driver characteristics. The use rates within both child age groups were slightly lower among male drivers as compared to female drivers. Analysis by driver age group showed little distinction in CRD use rates for 0 to 3-year-old passengers, while drivers between 16 and 29 were less likely to appropriately restrain 4 to 7-year-olds. White drivers showed higher rates of appropriate child restraint use, while black drivers displayed the lowest use rates, particularly for 4 to 7-year-olds. Finally, unlike prior CRD surveys in Michigan, child restraint device use was similarly lower for 0 to 3-year-old children traveling with drivers who were belted vs. unbelted. However, this result is likely due to the very small sample of unbelted drivers.

Table 13. Child Restraint Device Use, by Driver Characteristics

Driver Gender	Age 0-3 in CRD	Age 0-3 Total	Age 0-3 CRD Use Rate	Age 4-7 in CRD	Age 4-7 Total	Age 4-7 CRD Use Rate
Male	480	494	97.2%	220	421	52.3%
Female	1,026	1,037	98.9%	501	856	58.5%
Unknown	21	22	95.5%	2	14	14.3%
Total	1,527	1,553	98.3%	723	1,291	56.0%
Driver Age	Age 0-3 in CRD	Age 0-3 Total	Age 0-3 CRD Use Rate	Age 4-7 in CRD	Age 4-7 Total	Age 4-7 CRD Use Rate
16-29	287	291	98.6%	86	171	50.3%
30-59	1,127	1,147	98.3%	571	991	57.6%
60+	90	91	98.9%	63	110	57.3%
Unknown	23	24	95.8%	3	19	15.8%
Total	1,527	1,553	98.3%	723	1,291	56.0%
Driver Race	Age 0-3 in CRD	Age 0-3 Total	Age 0-3 CRD Use Rate	Age 4-7 in CRD	Age 4-7 Total	Age 4-7 CRD Use Rate
White	1,365	1,384	98.63%	662	1,121	59.1%
Black	65	68	95.59%	23	70	32.9%
Other	69	71	97.18%	37	81	45.7%
Unknown	28	30	93.33%	1	19	5.3%
Total	1,527	1,553	98.33%	723	1,291	56.0%
Driver Restraint	Age 0-3 in CRD	Age 0-3 Total	Age 0-3 CRD Use Rate	Age 4-7 in CRD	Age 4-7 Total	Age 4-7 CRD Use Rate
Belted	1,457	1,481	98.4%	709	1,242	57.1%
Not Belted	15	15	100.0%	7	13	53.8%

5.3 Misuse Rates

The inspection data were utilized to compute the statewide misuse rate, as well as the misuse rate for each stratum, restraint type, and age group. As stated previously, a CRD/booster seat was considered to be “misused” if one or more of the itemized misuse characteristics was observed during the inspection. As the inspections were concerned with utilization of the seat itself, cases where no CRD or booster seat was utilized were not considered. Table 14 shows the statewide misuse rate in addition to the misuse rate broken down by CRD type (rear-facing, forward-facing, and booster seats only), age group, and stratum.

Table 14. Child Restraint Device Correct Use and Misuse Rates

Type of CRD	No. of Inspections	Correct Use Rate	Misuse Rate
Rear-Facing	118	25.4%	74.6%
Forward Facing	87	12.6%	87.4%
Belt Positioning Booster Seat	39	41.0%	59.0%
Age Group	No. of Inspections	Correct Use Rate	Misuse Rate
0 - 3	179	18.4%	81.6%
4 - 7	65	29.7%	70.3%
Stratum	No. of Inspections	Correct Use Rate	Misuse Rate
Stratum 1	65	26.2%	73.8%
Stratum 2	96	27.1%	72.9%
Stratum 3	44	29.5%	70.5%
Stratum 4	39	2.6%	97.4%
Statewide (Weighted)*	244	20.5%	79.5%

*Weighted based on seat use proportions from direct observation survey of 21.0%, 60.8%, and 18.2% for rear-facing, forward-facing, and booster seats, respectively.

Statewide, only 20.5 percent of the inspections of the restraint characteristics of children under age 8 showed utilization of the appropriate CRD, correct CRD installation, and correct restraint of the child within the CRD. The remaining 79.5 percent of the inspections showed one or more improper restraint characteristics (i.e., misuses), which represents the weighted overall statewide misuse rate for children under the age of 8. The overall misuse rate is higher than the 74.0 percent observed during the 2015 inspections. The overall misuse rate for children under 4 was 81.6 percent, which decreased to 63.1 percent for children ages 4 to 7, who were typically in booster seats. Only marginal differences were observed between misuse rates for strata 1-3, although stratum 4 showed considerably higher misuse.

Rear-facing CRDs had an overall misuse rate of 74.6 percent, which was considerably lower than the 81.1 percent observed during 2015. However, forward facing CRDs showed an increase in misuse, increasing from 80.0 in 2015 to 87.4 percent in 2018. As expected, the lowest observed misuse rates were for children seated in booster seats, with a misuse rate was 59.0 percent, which was similar to that observed in the 2015 inspections. Booster seats have historically had lower rates of misuse compared to rear and forward facing CRDs, which is likely due to the relative simplicity of booster seat utilization compared to the other CRDs. Itemized misuse rates were also computed based on several different characteristics of the CRD use and installation and restraint of the child within the CRD. Table 15 provides a summary of the correct and incorrect CRD selection and position percentages based on the child's age, height, weight, and orientation of the CRD within the vehicle.

Table 15. Child Restraint Device Selection and Seat Orientation Characteristics

CRD Characteristic	Percent Correct	Percent Incorrect
Restraint appropriate for child's age*	91.8%	8.2%
Restraint appropriate for child's height	92.9%	7.1%
Restraint appropriate for child's weight**	98.0%	2.0%
CRD facing proper direction for child's age/weight*,**	92.7%	7.3%
Seat intended to be used in direction installed**	99.5%	0.5%
CRD installed on a forward-facing vehicle seat	99.5%	0.5%

*Forward-facing seat utilization is considered misuse for children under the age of 2. Booster seat utilization is considered misuse for children under the age of 4.

**Includes rear and forward facing CRDs only. Booster seats are not included.

Table 15 shows the CRD selection and orientation were typically appropriate for the child's age, height, and weight. These values are similar to those observed in the 2015 inspections. The most common CRD selection misuses were inappropriate seat selection based on age and height, due in large part to the premature transition of children between the ages of 1 and 2 into forward facing CRDs. This issue is further delineated in Table 16, which displays the types of seats utilized by each age group.

Table 16. Child Restraint Device Selection, by Age of Child

Age	Rear-Facing CRD		Forward-Facing CRD		Booster Seat	
	No.	Pct.	No.	Pct.	No.	Pct.
0	57	100%	0	0%	0	0%
1	52	78%	15	22%	0	0%
2	7	22%	22	69%	3	9%
3	2	9%	19	83%	2	9%
4	0	0%	14	64%	8	36%
5	0	0%	8	50%	8	50%
6	0	0%	6	38%	10	63%
7	0	0%	3	27%	8	73%

Note: Cases of premature transitioning into the next restraint level based on age are shown in bold

It can be observed from Table 16 that 22 percent of 1-year old children were prematurely transitioned into a forward-facing CRD prior to the age of 2, which, until recently, was the minimum age recommended by the American Association of Pediatrics (AAP) [23]. In August 2018, the AAP modified its recommendation such that "children remain in a rear-facing car safety seat as long as possible, until they reach the highest weight or height allowed by their seat", which thereby removes the specific age milestone [24]. However, due to the recent nature of this change in guidance, the 2 year old age requirement will remain in place for misuse assessments performed in this study. Similarly, 9 percent of 2- and 3-year old children had been prematurely transitioned into a booster seat, which should

not occur until the child has reached at least 4 years of age. Itemized booster seat misuse rates are summarized in Table 17. The remaining itemized misuse rates were separated into rear-facing CRD misuses and forward-facing CRD misuses, which are summarized in Table 18.

Table 17. Booster Seat Installation and Restraint Characteristics

Booster Seat Characteristic	Percent Correct	Percent Incorrect
Seat belt tight	61.5%	38.5%
Shoulder belt properly positioned over shoulder and chest	66.7%	33.3%
Lap belt properly positioned across hips and upper thighs	79.5%	20.5%
Shoulder belt flat	81.6%	18.4%
Backless Booster: Vehicle seat back high enough to restrain child's head	83.3%	16.7%
Lap belt flat	86.8%	13.2%
3-point lap-shoulder belt used	87.2%	12.8%
Proper space between booster back and vehicle seat back	94.7%	5.3%

Note: boldface indicates a common misuse (i.e., greater than 25 percent misuse). Data represents 39 booster seat inspections. Characteristics are sorted by misuse rate (highest to lowest).

Table 18. Rear-Facing and Forward-Facing CRD Installation and Restraint Characteristics

CRD Characteristic	Rear-Facing CRDs (n=118)		Forward-Facing CRDs (n=87)	
	Percent Correct	Percent Incorrect	Percent Correct	Percent Incorrect
Harness retainer clip in proper location	48.2%	51.8%	44.1%	55.9%
Shoulder harness straps route into CRD at proper height	73.4%	26.6%	60.5%	39.5%
CRD installation tight (1 in or less lateral sway)	74.4%	25.6%	74.4%	25.6%
Harness straps tight (1 in or less slack)	88.3%	11.7%	81.8%	18.2%
Seatbelt/LATCH properly buckled and tight	90.4%	9.6%	88.8%	11.2%
CRD at the proper angle	91.5%	8.5%	95.0%	5.0%
Proper belt path/LATCH connector path used	94.3%	5.7%	90.0%	10.0%
Only one vehicle system used to attach CRD	94.3%	5.7%	94.9%	5.1%
Harness retainer clip fastened and properly oriented	94.5%	5.5%	92.2%	7.8%
Internal harness buckled	95.6%	4.4%	84.7%	15.3%
Crotch strap flat	98.2%	1.8%	97.4%	2.6%
Harness straps flat	98.2%	1.8%	77.9%	22.1%
Top tether routed correctly over/under headrest	N/A	N/A	69.3%	30.7%
No excess space between CRD and vehicle seat	N/A	N/A	87.3%	12.7%

Note: boldface indicates a common misuse (i.e., greater than 25 percent misuse). Characteristics are sorted by misuse rate for rear-facing seats (highest to lowest).

A discussion of the itemized CRD and booster seat misuses displayed in Tables 17 and 18 is as follows:

- By far the most common misuse for both rear- and forward-facing CRDs was the improper positioning of the harness retainer clip (typically too low), which was observed in 51.8 percent of the rear-facing seats and 55.9 percent of the forward-facing seats. Although low harness retainer clips have historically been a problem in prior CRD misuse inspections, the problem seems to have increased for forward-facing seats since the 2015 inspections.
- Improper shoulder harness routing was observed in approximately 26.6 percent of the rear facing and 39.5 percent of the forward-facing seats, which are substantially higher than observed in the 2015 survey. In many cases, this misuse for forward-facing seats results from the harnesses being routed below the shoulders, which is likely a carry-over from rear-facing utilization of the particular seat.
- Loose seat installation remained at approximately one-quarter of rear- and forward-facing seats, which is up from the 2015 surveys for both types of seats. Not surprisingly, this typically stems from the seat belt or LATCH straps not sufficiently tight or not buckled to the vehicle seat.
- Excessive harness slack was observed in 11.7 percent and 18.2 percent of the rear- and forward-facing seats, respectively, which was down somewhat from the 2015 surveys.
- Twisted harness straps were present in 22.1 percent of the forward-facing seats, although this was not a primary misuse for rear-facing seats.
- Alarming, the internal harness was not buckled in 15.3 percent of the forward-facing seats, although this was much less frequent of a problem for rear facing seats.
- Excess space between the CRD and the vehicle seat-back remains a somewhat common problem (12.7 percent) for forward-facing seats; although this misuse rate had declined from the 2015 surveys.
- The top tether was routed incorrectly over/under the headrest in 30.7 percent of the forward-facing seats for which a tether was utilized.
- One misuse that had vastly improved from prior surveys is the seat recline angle for rear facing seats.
- The most common misuses for booster seats were seat belt too loose (38.5 percent), improper positioning of the shoulder belt over the shoulder, collar bone, and chest (33 percent), and improper positioning of the lap belt over the hips and upper thighs (20.5 percent).

5.4 Risk Priority Values for CRD Misuses

The risk priority values for the rear-facing CRDs and forward-facing CRDs were calculated as described earlier in this report and are shown in Tables 19 and 20, respectively. As shown in these tables, the rear-facing CRD misuses resulted in an average risk priority number per CRD of 5.8. The forward-facing CRDs average risk priority number of 7.6 was higher than that for rear-facing CRDs. A risk priority number of 4.0 and above indicates a negative impact on the protective capabilities of the CRD during an automobile crash. Thus, the average risk priority numbers for both rear-facing and forward-facing CRDs indicate that a majority of the CRDs inspected have protective capabilities that may be compromised if involved in an automobile crash.

Table 19. Rear-Facing CRD Severity Scores, Percent Occurrence, and Risk Priority

Rear-Facing CRD Misuse	Severity Score [8,9]	Number of Occurrences	Risk Priority Number
Shoulder harness straps routed too high	6.3	29	182.7
Harness retainer clip was too low	2	50	100.0
Seatbelt/LATCH was not buckled	7	10	70.0
Seatbelt routed incorrectly	9	6	54.0
Internal harness was not buckled	10	5	50.0
Harness too loose (2 fingers)	1.7	23	39.1
Harness too loose (3 fingers)	4.3	9	38.7
Harness too loose (≥ 4 fingers)	6.7	4	26.8
Harness retainer clip was too high	2.5	7	17.5
Harness retainer clip was not attached	2.3	6	13.8
CRD was reclined at improper angle	3	5	15.0
Crotch strap was twisted	3.5	2	7.0
Shoulder harness straps were twisted	2.7	2	5.4
Average Risk Priority Number per Rear-Facing CRD (n=118)			5.3

Table 20. Forward-Facing CRD Severity Scores, Percent Occurrence, and Risk Priority

Forward-Facing CRD Misuse	Severity Score [8,9]	Number of Occurrences	Risk Priority Number
Internal harness was not buckled	10	13	130.0
Space between CRD and vehicle seat 1”	2	39	78.0
Tether routed incorrectly	9	8	72.0
Harness retainer clip was too low	1.5	40	60.0
Shoulder harness straps routed too low	2.3	24	55.2
Seatbelt/LATCH was not buckled	6	9	54.0
Harness too loose (3 fingers)	3.7	9	33.3
Harness too loose (≥ 4 fingers)	6.3	5	31.5
Harness too loose (2 fingers)	1.3	20	26.0
Space between CRD and vehicle seat 2”	4	6	24.0
Shoulder harness straps were twisted	1.3	17	22.1
Space between CRD and vehicle seat 3”	5	3	15.0
CRD was reclined at improper angle	4.6	3	13.8
Space between CRD and vehicle seat 4”	6	2	12.0
Harness retainer clip was not attached	2	6	12.0
Shoulder harness straps were too high	1.7	6	10.2
Harness retainer clip was too high	2.5	3	7.5
Crotch strap was twisted	3.5	2	7.0
Average Risk Priority Number per Forward-Facing CRD (n=87)			7.6

In addition to providing a relative comparison between the severity of misuses between the rear-facing CRDs and forward facing CRDs, these tables also show the types of misuse that should be emphasized on correcting based on the risk priority number. The most problematic misuses for rear- and forward-facing seats are as follows:

- Rear-Facing CRDs
 - Shoulder harness straps routed too high. This is the most severe of the higher risk rear-facing misuses for rear-facing seats. Shoulder harness straps in rear-facing seats should be routed at or below the child’s shoulders to help prevent ejection from the seat.

- Harness retainer clip too low. Although the severity score is relatively low, this was by far the most frequent misuse for rear-facing CRDs (42.3 percent), leading to a relatively high-risk priority number. The harness retainer clip should be at armpit level.
- Seatbelt/LATCH was not buckled. Failure to buckle the seatbelt/LATCH leaves the seat free to move about within the vehicle during a collision and is considered a very severe misuse. Fortunately, the rate of occurrence was relatively low.
- Seatbelt routed incorrectly. Incorrect routing of the seat belt through the seat is a very high severity misuse as it compromises the crashworthiness of the seat. Fortunately, the rate of occurrence was low.
- Internal harness was not buckled. The internal harnesses were not buckled in approximately 1 in 20 rear-facing CRDs. Not buckling of the internal harness creates a high likelihood of ejection in the event of a crash.
- Forward-Facing CRDs
 - Internal harness was not buckled. Alarming, the internal harnesses were not buckled in approximately 15 percent of forward-facing CRDs, which resulted in the highest risk priority number for all misuses. Not buckling of the internal harness creates a high likelihood of ejection in the event of a crash.
 - Excessive space between CRD and vehicle seat. A space of 1 inch or greater between the CRD and vehicle seat back was a common problem observed for forward-facing seats. The excessive space, when observed, was typically less than 2-inches, which is fortunate as the severity score increases with increasing space.
 - Improper routing of top tether. This is both a severe and common misuse for forward-facing seats. The top tether should be routed over a fixed headrest and under a movable headrest.
 - Harness retainer clip too low. Although the severity score is relatively low, this was the most frequent misuse for forward-facing CRDs (46.0 percent), leading to a relatively high-risk priority number. The harness retainer clip should be at armpit level.
 - Shoulder harness straps routed too low. Shoulder harness straps should be at or above the shoulders for forward-facing CRDs. Although this was a relatively low severity misuse, it was observed in greater than one in four cases. This is often a result of rear/forward convertible seats typically being initially used in the rear-facing position, for which the shoulder straps should be routed at or below the shoulders.
 - Seatbelt/LATCH was not buckled. Failure to buckle the seatbelt/LATCH leaves the seat free to move about within the vehicle during a collision and is considered a very severe misuse.
 - Excessive harness slack. Another problematic forward-facing CRD misuse was excessive harness slack. The severity of this misuse obviously becomes greater as the harness loosens. An improperly tightened harness may potentially allow for the child to eject from the CRD in the event of a crash.

5.5 LATCH Utilization

The observers also noted whether or not the LATCH system was available within the vehicle and, if so, whether or not the LATCH anchors were being utilized to restrain the CRD. Table 21 presents data on utilization of the LATCH system obtained from the inspections.

Table 21. LATCH Availability and Utilization

CRD Type	Pct. of Vehicles Equipped with LATCH	Pct. of Equipped Vehicles Using LATCH	Pct. of All Vehicles Using LATCH
Rear-Facing	93.8%	53.8%	48.3%
Forward-Facing	86.6%	43.7%	35.6%
Total	90.7%	49.7%	42.9%

The LATCH system was utilized to secure the CRD in 42.9 of the inspected vehicles, even though 90.7 percent of all inspected vehicles were LATCH equipped. Although they greatly simplify the CRD attachment process, LATCH was utilized in only 49.7 percent of equipped vehicles. The percent of vehicles equipped with LATCH has remained at approximately the same level as observed during the 2015 inspections, while the percent of LATCH utilization among equipped vehicles has increased substantially, from approximately 1/3 of equipped vehicles in 2015 to nearly 1/2 of equipped vehicles in 2018.

6.0 CONCLUSIONS AND RECOMMENDATIONS

The purpose of this study was to determine the statewide rates of appropriate child restraint device use and misuse among child passengers from ages 0 through 7. The child restraint use rates were determined through a direct observation survey conducted at daycare centers, fast food restaurants, shopping centers, recreational areas, and general roadside locations throughout the state of Michigan. Misuse rates were determined through in-vehicle inspections conducted at daycare centers, inspection stations, and various organized events, including those held at shopping centers, community or church festivals, or health care facilities.

6.1 Conclusions

6.1.1 CRD/Booster Seat Utilization

The statewide child restraint device roadside direct observation survey was performed between June 4 and August 21, 2018. During this observation period, a total of 2,868 observations of 0 to 7-year-old child passengers were conducted at daycare centers, fast food restaurants, shopping centers, and recreation centers, as well as on streets adjacent to these locations throughout the 23-county sample.

The direct observation survey showed children ages 0 to 3 were seated in a rear or forward facing CRD in 98.2 percent of the statewide observations, and children ages 4 to 7 were restrained in a rear or forward facing CRD or booster seat in 54.5 percent of the statewide observations. These usage rates have increased from prior surveys conducted in 2009, 2011, 2013, and 2015, especially for 4 to 7-year-olds, which is reflected in Table 22. It should be noted that Michigan's current child restraint and booster seat law was enacted in 2008.

Table 22. Statewide Rates of Appropriate Child Restraint Device Use, by Year

Age Group	CRD Use Rate by Year*				
	2009/2010	2011	2013	2015	2018
0-to-3 years old	94.9%	95.0%	93.6%	95.7%	98.2%
4-to-7 years old	44.5%	43.9%	42.4%	49.7%	54.5%

*Use rate based on 0 to 3-year-old children seated in rear-facing or forward facing seats and 4 to 7-year-old children seated in rear-facing, forward facing, or booster seats.

Several conclusions were drawn regarding CRD and booster seat utilization, which are summarized as follows:

- CRD use rates were relatively consistent between the various facility types for children aged 0 to 3. Street corner observations at random locations and near fast food restaurants showed the lowest results for children aged 4 to 7.
- Among 4 to 7-year-olds, CRD use was highest for minivans and lowest for passenger cars. Very little variability between the CRD use rates was observed across vehicle types for 0 to 3-year-olds.
- Little difference in CRD use was observed between male and female drivers for 0 to 3-year-olds, although female drivers showed higher CRD use rates for 4 to 7-year-olds.
- Little difference in CRD use was observed across the various driver age groups for 0 to 3-year-olds, although drivers between 16 and 29 were less likely to use an appropriate restraint for 4 to 7-year-olds.
- White drivers showed the highest CRD use rates for both 0 to 3 and 4 to 7-year-olds, while black drivers showed the lowest rates, particularly for 4 to 7-year-olds. These findings are consistent with prior CRD observation surveys.
- The sample of unbelted drivers was too small to draw meaningful conclusions relating driver belt use to CRD use. However, prior CRD surveys in Michigan have found driver belt use to be a significant determinant of CRD or booster seat use for child passengers within the same vehicle. Furthermore, other research has shown that unrestrained children are generally found with riskier drivers, including those who are less likely to be properly restrained and more likely to be crash-involved [25].

6.1.2 CRD/Booster Misuse

The misuse inspections were performed at 27 locations statewide between June 13 and August 23, 2018. A total of 244 inspections of the restraint devices used by child passengers under the age of 8 were performed, including 124 under age 2, 55 in the 2 to 3-year old range, and 65 in the 4 to 7-year old age range.

Statewide, only 20.5 percent of the inspections of the restraint characteristics of children under age 8 showed utilization of the appropriate CRD, correct CRD installation, and correct restraint of the child within the CRD. The remaining 79.5 percent of the inspections showed one or more improper restraint characteristics (i.e., misuses), which represents the overall weighted statewide misuse rate for children under the age of 8. The overall misuse rate is somewhat higher than those found during the 2011, 2013, and 2015 inspections, which were 73.9 percent, 74.9 percent, and 74.0 percent, respectively. This is largely due to a substantial increase in the misuse of forward-facing CRDs,

which have increased substantially since prior surveys, which is reflected in Table 23. Rear-facing seats have experienced the opposite trend, as an overall decline in misuse for rear-facing seats has been observed since 2011. Because forward-facing seats represent nearly one-half of all CRDs observed during the surveys, they carry substantial weight in the overall misuse rate calculation. Booster seat misuse rates have remained consistent during that time.

Table 23. Statewide Rates of Child Restraint Device Misuse, by Year

Age Group	Misuse Use Rate by Year			
	2011	2013	2015	2018
Rear-Facing CRD	86.1%	87.8%	81.1%	74.6%
Forward-Facing CRD	75.8%	77.2%	80.0%	87.4%
Booster Seat	60.2%	58.7%	60.0%	59.0%
OVERALL	73.9%*	74.9%*	74.0%**	79.5%**

*Unweighted

** Weighted based on seat use proportions from direct observation survey

Several conclusions were also drawn regarding common CRD/booster misuses, which are summarized as follows:

- 22 percent of 1-year old children were (prematurely) seated in a forward-facing CRD, which the AAP now recommends should not occur until the weight or height of the seat has been exceeded for the rear facing position [24]. This rate is down substantially from the 2015 misuse surveys.
- Similarly, 18 percent of 2 or 3-year old children were prematurely transitioned into a booster seat, which should not occur until the child has reached at least 4 years of age. This rate remains unchanged from the 2015 surveys.
- The most common seat-related misuse for both rear- and forward-facing CRDs was the improper positioning of the harness retainer clip (typically too low), which was observed in nearly 52 percent of the rear-facing seats (down from 2015) and 56 percent of the forward-facing seats (up from 2015).
- Unlike prior surveys, excessive recline (from vertical) was not observed to be a common problem for rear-facing seats.
- Improper harness routing was a common problem, especially for forward-facing seats, which is likely a carry-over from rear-facing utilization of the particular seat.
- Excessive slack (greater than 1-inch) in the harness strap continues to decline from prior surveys, although nearly 1 in 5 forward-facing seats still exhibit this issue. A common reason given by parents for not tightening the harness properly was they did not want the harness to cause discomfort to the child.
- Loose seat installation was observed in approximately 1/4 of all rear- and forward-facing seat inspections - a substantial increase from 2015.
- Excess space between the CRD and the vehicle seat-back remains a common problem for forward-facing seats, although this misuse rate had declined from prior inspections.
- Twisted harness straps (twisted seat belts for booster seats) has decreased substantially for rear-facing seats but remained roughly constant for forward-facing seats and booster seats.
- The most common misuses for booster seats were seat belt tightness, improper positioning of the shoulder belt over the shoulder, collar bone, and chest, and improper positioning of the lap belt across the hips and upper thighs.

- The LATCH system has shown substantial increase in use since 2015. Although the percent of vehicles equipped with LATCH has remained at approximately the same level as observed during the 2015 inspections, the percent of LATCH utilization among equipped vehicles has increased substantially, from approximately 1/3 of equipped vehicles in 2015 to nearly 1/2 of equipped vehicles in 2018.

In terms of risk-priority number [9,10], the following conclusions were drawn from the misuse inspections:

- The average risk priority numbers for rear-facing and forward-facing CRDs indicate that a majority of the CRDs inspected have protective capabilities that may be compromised if involved in an automobile crash.
- Forward-facing seats showed a higher average risk priority number per seat than rear-facing seats.
- From a risk priority standpoint, the most problematic rear-facing seat misuses are as follows:
 - Shoulder harness straps routed too high
 - Harness retainer clip positioned too low
 - Seatbelt/LATCH was not buckled
 - Seatbelt routed incorrectly
 - Internal harness not buckled
- From a risk priority standpoint, the most problematic forward-facing seat misuses are as follows:
 - Internal harness not buckled
 - Excessive space between CRD and vehicle seat
 - Improper routing of top tether
 - Harness retainer clip positioned too low
 - Shoulder harness straps routed too low
 - Seatbelt/LATCH was not buckled
 - Excessive harness slack

6.2 Recommendations

To ensure proper CRD and booster seat use, parents must be provided with child restraint education and training periodically throughout their child's growth and development, particularly when a new CRD is utilized or modification to the current CRD becomes necessary. For example, the installation of a CRD for a newborn is drastically different than for a 3-year-old child. The following age/development stages often necessitate a new CRD or modification to the current CRD:

- Birth (first use of CRD, which must be rear facing with a 45-degree incline)
- Between 6 and 12 months of age (switch from infant carrier to larger rear-facing CRD and increase in the incline from 45 to 60 degrees from horizontal when the child is able to lift his/her head)
- Switch from rear-facing CRD to forward-facing CRD, which requires re-routing of the harness straps and seat belt path, among other changes.
- Age 4 and 40 pounds (switch to booster seat)
- Age 8 or 4'9" tall (switch to safety belt in rear vehicle seat until age 13)

Parents should also be encouraged to follow the current NHTSA CRD transitioning guidelines, which advise keeping children in each restraint type, including rear-facing, forward-facing and booster seats, for as long as possible before graduating to the next type of restraint [24]. Particular emphasis should be placed on educating parents as to the appropriate timing for 1.) transitioning from a 45 to 60-degree incline, 2.) transitioning from rear-facing to forward-facing, and 3.) transitioning from forward-facing CRD to booster seat. The rear-facing position reduces stresses to the neck and spine to infants and reduces the likelihood of severe injury during a crash. Consequently, parents and caregivers should be encouraged to seat children rear-facing until the weight or height of the seat is exceeded for the rear facing position, and should also be trained on the proper repositioning of the harness and other straps when converting a seat from rear to forward facing. Similarly, forward-facing seat utilization should be emphasized until the child outgrows the seat (or the seat expires), due to the inherent safety benefits compared to booster seats.

Although the sample of unbelted drivers was too small to draw meaningful conclusions, prior CRD surveys in Michigan have found that the most significant driver-related determinant of CRD or booster seat use among child passengers was driver belt use. CRD/booster seat use has historically been significantly lower when the driver was not belted appropriately. Unbelted drivers present the greatest area of opportunity and should be the focus of future education and outreach programs aimed at informing the public of the importance of appropriate child restraint device use. Similar programs have proven particularly effective at increasing safety belt use among Michigan drivers.

Several educational/training opportunities are available to parents. Hospitals typically provide basic hands-on training of CRD and booster seat installation and use for parents of newborns upon discharge from the hospital. Day care facilities often provide basic child restraint education, but do not have the staff to provide full inspection or training. There are many locations throughout the State of Michigan where parents can have their CRD or booster seat inspected by certified individuals. NHTSA-certified technicians are often available at most fire stations and police stations, although appointments may be required. The non-profit organization SafeKids USA sponsors several CRD/booster seat inspection/training events statewide. These events have one or more NHTSA certified technicians on-site to inspect the CRD installation and inform the parents if they are using an incorrect restraint for their child or if the device has been recalled. The technicians will also show the parents how to properly install the CRD/booster seat in the vehicle and how to properly restrain the child in the seat. Parents should be encouraged to have their CRD/booster seat inspected by a NHTSA-certified technician anytime a new CRD/booster seat is utilized, a change to the existing installation or internal restraint is needed, or after the child has experienced substantial growth or development. Parents should also be informed of the benefits of the LATCH system, which simplifies correct attachment of the CRD to the vehicle. While the use of LATCH has shown great improvement from prior surveys, is still only utilized by approximately one-half of all equipped vehicles.

7.0 REFERENCES

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APPENDIX I – LIST OF OBSERVATION LOCATIONS

Strata	County	Location Name	Address
1	Ingham	Potter Park Zoo	1301 S Pennsylvania Ave, Lansing, MI 48912
1	Ingham	University Methodist Church	1120 S Harrison Rd, East Lansing, MI 48823
1	Ingham	McDonalds	3220 E Saginaw St, Lansing, MI 48912
1	Ingham	Impression 5 Museum	200 Museum Dr, Lansing, MI 48933
1	Ingham	McDonalds	2530 E Jolly Rd, Lansing, MI 48911
1	Ingham	Ingham County Fair	700 E Ash St, Mason, MI 48854
1	Kalamazoo	McDonald's	224 W. Kalamazoo Ave, Kalamazoo, MI 49007
1	Kalamazoo	Air Zoo Aerospace & Science Museum	6151 Portage Rd, Portage, MI 49002
1	Kalamazoo	McDonald's	5394 W Main St, Kalamazoo, MI 49006
1	Kalamazoo	McDonalds	6820 W Main St, Kalamazoo, MI 49006
1	Oakland	McDonalds	4819 Rochester Rd, Troy, MI 48085
1	Oakland	Troy Public Library	510 W Big Beaver Rd, Troy, MI 48084
1	Oakland	McDonald's	4819 N. Rochester Road Troy, MI 48098
1	Oakland	Great Lakes Crossing	4000 Baldwin Rd, Auburn Hills, MI 48326
1	Oakland	Detroit Zoo	8450 W 10 Mile Rd, Royal Oak, MI 48067
1	Oakland	Oakland Mall	412 W 14 Mile Rd, Troy, MI 48083
1	Oakland	Great Lakes Crossing	4000 Baldwin Road, Auburn Hills, MI 48326
1	Oakland	Detroit Zoo	8450 W 10 Mile Rd, Royal Oak, MI 48067
1	Oakland	Red Oaks Waterpark	1455 East 13 Mile Road, Madison Heights, MI 48071
1	Oakland	Troy Aquatic Center	3425 Civic Center Dr, Troy, MI 48083
1	Oakland	Troy Community Center	3179 Livernois Rd, Troy, MI 48083
1	Washtenaw	Ann Arbor District Library: Mallett's Creek Branch	3090 E Eisenhower Pkwy, Ann Arbor, MI 48108
1	Washtenaw	McDonald's	3001 Lohr Rd, Ann Arbor, MI 48108
1	Washtenaw	Huron Valley Swim Club	4101 Jackson Rd, Ann Arbor, MI 48103
1	Washtenaw	Denny's	3310 Washtenaw Ave, Ann Arbor, MI 48104
1	Washtenaw	Arborland Shopping Center	3600 Washtenaw Ave, Ann Arbor, MI 48104
2	Calhoun	McDonald's	812 W Columbia Ave, Battle Creek, MI 49015

Strata	County	Location Name	Address
2	Calhoun	Binder Park Zoo	7400 Division Dr, Battle Creek, MI 49014
2	Calhoun	Arbor Academy/Child Development Center	55 Arbor St, Battle Creek, MI 49015
2	Eaton	McDonald's	207 Lansing St, Charlotte, MI 48813
2	Eaton	Walmart	1680 Packard Hwy, Charlotte, MI 48813
2	Eaton	Delta Township District Library	5130 Davenport Dr, Lansing, MI 48917
2	Jackson	Summit Oaks Mall	2151 Ferguson Rd Ste 104, Jackson, MI 49203
2	Jackson	McDonald's	2601 Airport Rd, Jackson, MI 49202
2	Jackson	Meijer	2777 Airport Rd, Jackson, MI 49202
2	Jackson	Northwest Child Care	6900 Rives Junction Rd, Jackson, MI 49201
2	Jackson	McDonald's	1105 N W Ave, Jackson, MI 49202
2	Kent	McDonald's	3814 Plainfield Ave, Grand Rapids, MI 49525
2	Kent	Green Ridge Square Mall	3298 Alpine Dr NW, Grand Rapids, MI 49544
2	Kent	Meijer	2425 Alpine Ave NW, Grand Rapids, MI 49544
2	Kent	John Ball Zoo	1300 Fulton W, Grand Rapids, MI 49504
2	Livingston	McDonald's	3667 E Grand River Ave, Howell, MI 48843
2	Livingston	Meijer	3883 E Grand River Ave, Howell, MI 48843
2	Livingston	Tanger Outlets	1475 N Burkhart Rd, Howell, MI 48855
2	Livingston	Kensington Park	13160 Highridge Dr, Brighton, MI 48114
2	Ottawa	Ottawa County Fair	1286 Ottawa Beach Rd, Holland, MI 49424
3	Barry	Hastings Public Library	227 E State St, Hastings, MI 49058
3	Barry	McDonald's	1215 W State St, Hastings, MI 49058
3	Barry	Barry County Fair	1350 N. M-37 Highway, Hastings, MI 49058
3	Berrien	Walmart	1400 Mall Dr, Benton Harbor, MI 49022
3	Berrien	Curious Kids Museum/Downtown Parking	415 Lake Blvd, St Joseph, MI 49085
3	Branch	McDonald's	381 E Chicago Sr, Coldwater, MI 49036
3	Branch	Heritage Park Splash Pad	1776 Heritage Sr, Coldwater, MI 49036
3	Cass	Cass District Library: Howard Branch	2341 Yankee St, Niles, MI 49120
3	Clinton	Meijer	12821 Cross Over Dr, Dewitt, MI 48820

Strata	County	Location Name	Address
3	Clinton	McDonald's	13230 Old US 27, Dewitt, MI 48820
3	Clinton	Walmart	1165 Superior Dr, St. Johns, MI 48879
3	Genesee	Flushing Public Library	120 N Maple St, Flushing, MI 48433
3	Genesee	McDonalds	2145 S. Linden Rd, Flint, MI 48507
3	Genesee	Flint's Children's Museum	1602 University Ave, Flint, MI 48504
3	Genesee	Genesee Valley Center	3341 S Linden Rd, Flint, MI 48532
3	Genesee	Babies "R" Us	3274 S Linden Rd, Flint, MI 48507
3	Genesee	Swartz Creek-Perkins Library	8095 Civic Dr, Swartz Creek, MI 48473
3	Hillsdale	Kroger	290 W Carleton Rd, Hillsdale, MI 49242
3	Ionia	Ionia Community Library	126 E Main St, Ionia, MI 48846
3	Ionia	McDonald's	2784 S State St, Ionia, MI 48846
3	Ionia	Meijer	2770 S State Rd, Ionia, MI 48846
3	Muskegon	McDonald's	2237 Holton Rd, Muskegon, MI 49445
3	Muskegon	Michigan's Adventure	1198 W Riley-Thompson Rd, Muskegon, MI 49445
3	St. Joseph	McDonald's	1016 W Michigan Ave, Three Rivers, St. Joseph, MI 49093
3	Van Buren	McDonald's	1025 South La Grange Road, South Haven, MI 49090
4	Macomb	Target	13221 Hall Rd, Shelby Charter Township, MI 48315
4	Macomb	McDonald's	13640 Southcove Dr, Sterling Heights, MI 48313
4	Macomb	Lakeside Mall	14000 Lakeside Cir, Sterling Heights, MI 48313
4	Macomb	Partridge Creek	17420 Hall Rd, Clinton Township, MI 48038
4	Macomb	Lake St. Clair Metropark	31300 Metro Pkwy, Harrison Charter Township, MI 48045
4	Macomb	Lakeside Mall	14000 Lakeside Cir, Sterling Heights, MI 48313
4	Macomb	Target	13221 Hall Rd, Shelby Charter Township, MI 48315
4	Wayne	McDonalds	26730 Eureka Rd, Taylor, MI 48180
4	Wayne	Henry Ford Museum	20900 Oakwood Blvd, Dearborn, MI, 48124
4	Wayne	Greenfield Village	20900 Oakwood Blvd, Dearborn, MI, 48124
4	Wayne	Meijer	3565 Fairlane Drive, Allen Park, MI 48101

APPENDIX II – LIST OF INSPECTION LOCATIONS

Strata	County	Date	Location	Address
1	Ingham	7/13/2018	Calvary Lutheran Church	6301 W St. Joseph Hwy, Lansing, MI 48917
1	Kalamazoo	7/20/2018	Westwood Fire Station	1310 Nichols Rd, Kalamazoo, MI 49006
1	Oakland	6/13/2018	Chrysler of Auburn Hills	1000 Chrysler Dr, Auburn Hills, MI 48326
1	Oakland	8/7/2018	Hill Elementary School	4600 Forsyth Rd, Troy, MI 48085
1	Oakland	8/12/2018	Farmington Hills Fire Station #4	28711 Drake Rd. Farmington Hills, MI 48331
1	Washtenaw	6/20/2018	Ypsilanti Fire Department	20 S. Hewitt Rd, Ypsilanti, MI 48197
1	Washtenaw	6/21/2018	LaFontaine Buick GMC	7120 Dexter-Ann Arbor, Dexter, MI 48130
1	Washtenaw	7/11/2018	Ann Arbor Fire Station	1881 Briarwood Circle, Ann Arbor MI 48108
1	Washtenaw	7/18/2018	Ypsilanti Township Fire Station	222 S. Ford Boulevard Ypsilanti Township, MI 48198
1	Washtenaw	7/19/2018	LaFontaine Buick GMC	7120 Dexter Ann Arbor Rd Dexter, MI 48130
2	Kent	6/21/2018	Plainfield Fire Department	4343 Plainfield Ave NE, Grand Rapids, MI 49525
2	Kent	6/28/2018	Grand Rapids Fire Department	2541 Kalamazoo, Grand Rapids, MI 49507
2	Kent	7/12/2018	Wyoming Fire Department	2300 Gezon Dr. SW, Wyoming, MI 49519
2	Kent	7/26/2018	Grand Rapids Fire Department	2541 Kalamazoo Grand Rapids, MI 49507
2	Kent	8/14/2018	Plainfield Fire Department	4343 Plainfield Avenue Northeast, Grand Rapids, MI 49525
2	Kent	8/22/2018	Byron Township Fire Department	2560 84th St SW, Byron Center, MI 49315
2	Kent	8/23/2018	Grand Rapids Fire Department	2541 Kalamazoo Grand Rapids, MI 49507
2	Ottawa	7/24/2018	Hudsonville Fire Station	3275 Central Blvd, Hudsonville, MI 49426
2	Ottawa	8/14/2018	Allendale Fire Department	6676 Lake Michigan Dr, Allendale, MI 49401
3	Mecosta	7/12/2018	Big Rapids Fire Department	435 N Michigan Ave, Big Rapids, Mi 49307
3	Muskegon	6/20/2018	Evanston Ave Baptist Church	1188 Evanston Ave, Muskegon, MI 49442
3	Oceana	7/19/2018	Migrant Head Start	2354 E Polk Rd, Hart, MI 49420
3	Shiawassee	6/30/2018	Shiawassee County Fair	2900 Hibbard Rd. Corunna, MI 48817
4	Wayne	6/15/2018	Western Wayne Health Center	26650 Eureka Rd, Taylor, MI 48180
4	Wayne	6/23/2018	Islamic Center of N. Detroit	12500 McDougal Detroit, MI 48212
4	Wayne	7/14/2018	Detroit Police Department	1441 W 7 Mile Rd, Detroit, MI 48203
4	Wayne	8/16/2018	Northville First Care	777 W. Eight Mile Rd 48167

APPENDIX III – INSPECTION FORM

CHILD RESTRAINT DEVICES INTERVIEW FORM (for child occupants under the age of 8)

Vehicle #: _____ Date: ____/____/20____ Time of Day: ____ am / pm Weather: _____ Observer's Name: _____

Location Name: _____ Address: _____

Instructions: Use one form for each child occupant age 7 and under. Complete page 1 first. Complete the second page for children seated in a CRD or BFB.

Vehicle Type: Passenger car SUV Van/minivan Pick-up truck

Make: _____ Model: _____ Year: _____

Is Vehicle LATCH Equipped? Yes No

Restrained Child Seating Position (circle number where child is seated):

	First Row	Second Row	Third Row	Cargo Area
Front of Vehicle	3	6	9	
	2	5	8	
	D	4	7	

Other Children Seating Position (circle numbers where children under age of 12 were seated):

	First Row	Second Row	Third Row	Cargo Area
Front of Vehicle	3	6	9	
	2	5	8	
	D	4	7	

Age (fill in): _____ yrs OR _____ (mo if < 2 yr)

Weight (fill in): _____ lbs

Height: _____ (feet or inches, please indicate)

Driver Age: 16 - 29 30 - 59 60+
 Driver Gender: Male Female

Driver Race: Caucasian
 African American
 Asian or Pacific Islander
 Hispanic
 Native American

Restraint: Rear-Facing CRD
 Forward-Facing CRD

- Belt Positioning Boosters (BPB)
- Seat Belt (Stop the observation now)
- Unrestrained (Stop the observation now)

Restraint Device Selection and Child Position:

1. Is CRD appropriate for child's height? Yes No

Rear Facing: Head must not be less than 1 inch from top edge of CRD
Forward Facing: 1) Top of the ears must not reach the top of the CRD &
 2) Shoulders must not be above the top harness slots

All Boosters: Seat belt must cross at shoulders and not across neck or face

Backless Booster: 1) Vehicle seat back must be higher than child's ears or 2) the vehicle seat must have a head restraint.

2. Please record the maximum weight limit displayed on the seat: _____ lbs

3. Is the seat an infant carrier? Yes No

4. Is CRD intended to be used in the direction it is installed? Yes No

5. Is CRD installed on a forward-facing vehicle seat? Yes No

For Children Seated in Front Seats Only:

- 6. Does the vehicle have a passenger airbag? Yes No
- 7. If there is an airbag, is it turned off? Yes No Don't Know
- 8. If the airbag is on, is the child at least 12" away from the airbag? Yes No Don't Know
- 9. If the airbag is on, is the child facing forward? Yes No Don't Know

FOR FRONT-FACING CRDs

Position/Installation in Vehicle

1. Is the seat reclined properly (upright against the seat back)?
1 Yes 2 No
2. Is the CRD installation tight (1-inch rule when checked at base of seat)?
1 Yes 2 No
0 inches 1 inch
2 inches 3 inches 4 inches
3. What is the maximum space between the CRD and the vehicle seat back?
1 Yes 2 No

Harness

4. Is internal CRD harness completely buckled at the waist?
IF BUCKLED:
(a) How tight are the shoulder harness straps (pinch and fingers)?
0 No slack when pinched
1 finger 2 fingers
2 fingers 3 fingers

- (b) Is the harness retainer clip fastened and orientated correctly?
1 Yes 2 No 3 No Clip
- (c) Where is the harness retainer clip positioned when buckled?
1 Proper (at armpit level)
2 Too high
3 Too low

- (d) Where do the shoulder harness straps rout into the CRD?
1 Proper (at or above shoulders)
2 Too high (above ears)
3 Too low (below shoulders)

- (e) Are the shoulder harness straps flat (not twisted)?
1 Yes 2 No
- (f) Is crotch strap flat (check if buckle button is facing outward)?
1 Yes 2 No

Locking/Attachment

5. Which vehicle system is used to attach CRD to the vehicle?
1 SB 2 Lower LATCH Anchors
3 Both 4 None

IF ATTACHED:

- (a) Is vehicle seatbelt securing CRD buckled or LATCH straps clipped to anchors?
1 Yes 2 No
- (b) If the vehicle seatbelt is used, is the seatbelt locked (pull on lap belt)?
1 Yes 2 No
- (c) Is the vehicle seatbelt or LATCH strap flat (not twisted)?
1 Yes 2 No

- (d) Is the proper seatbelt path or LATCH strap connector path used (path nearest the vehicle's seat)?
1 Yes 2 No
- (e) If a metal locking clip is used, is it positioned near the buckle?
1 Yes 2 No 3 Not Used

Lather (Only If Used)

6. Is the tether routed under an adjustable head restraint or over a non-adjustable head restraint?
1 Yes 2 No
7. Is tether strap flat (not more than one twist)?
1 Yes 2 No
8. When pinched, how much slack is in the tether strap (in inches)?
0 inches 1 inch 2 inches
3 inches 4 inches 5 inches

FOR REAR-FACING CRDs

Position/Installation in Vehicle

1. What is the seat incline (estimated from horizontal)?
1 -45° 2 -60° 3 <35° 4 >70°
2. Is the CRD installation tight (1-inch rule when checked at base of seat)?
1 Yes 2 No

Harness

3. Is internal CRD harness completely buckled at the waist?
IF BUCKLED:

- (a) How tight are the shoulder harness straps (pinch and fingers)?
0 No slack when pinched
1 finger 2 fingers
3 fingers 4 fingers

- (b) Is the harness retainer clip attached and orientated correctly?
1 Yes 2 No
- (c) Where is the harness retainer clip positioned when buckled?
1 Proper (at armpit level)
2 Too high 3 Too low

- (d) Where do the shoulder harness straps rout into the CRD?
1 Proper (at or below shoulders)
2 Too high (above shoulders)

- (e) Are the shoulder harness straps flat (not twisted)?
1 Yes 2 No
- (f) Is crotch strap flat (check if buckle button is facing outward)?
1 Yes 2 No

Locking/Attachment

4. Which vehicle system is used to attach CRD to the vehicle?
1 SB 2 Lower LATCH Anchors
3 Both 4 Neither

IF ATTACHED:

- (a) Is vehicle seatbelt securing CRD buckled or LATCH straps clipped to anchors? 1 Yes 2 No

- (b) If the vehicle seatbelt is used, is the seatbelt locked (pull on lap belt)? 1 Yes 2 No

- (c) Is vehicle seatbelt or LATCH strap flat (not twisted)? 1 Yes 2 No

- (d) Is the proper vehicle seatbelt path/lower strap connector path used (path nearest the vehicle's seat)? 1 Yes 2 No

- (e) If a metal locking clip is used, is it positioned near the buckle?
1 Yes 2 No 3 Not Used

FOR BOOSTER SEATS (BPB)

Vehicle Seatbelt

1. Is a proper lap and shoulder belt (3-point) system used?
1 Yes 2 No
2. Is the shoulder belt properly positioned over shoulder, collar bone, & chest?
1 Yes 2 No
3. Is the lap belt properly positioned across the hips/upper thighs?
1 Yes 2 No
4. Is the shoulder belt flat (not twisted)?
1 Yes 2 No
5. Is the lap belt flat (not twisted)?
1 Yes 2 No
6. Is the seat belt tight (not loose)?
1 Yes 2 No
7. **HIGH BACK ONLY:** Is vehicle seatbelt routed properly through the booster seat?
1 Yes 2 No

Position in Vehicle

8. If a backless BPB is being used, is the vehicle seat back high enough to restrain the child's head (vehicle seat back reaches child's ear height)?
1 Yes 2 No
3 High-back BPB
9. What is the space between the BPB back and vehicle seat back (in inches)?
0 in 1 in 2 in
3 in 4 in