Economic and technological changes drive frequency and severity growth for auto insurers – what can we expect moving forward?

Casualty Actuarial Society

2018 Ratemaking, Product and Modeling Seminar

March 2018

Susanna Gotsch, CCC Information Services Inc.

powering Forward.

Trends to watch in 2018

Auto Physical Damage

Vehicle bookends

- Strong vehicle sales increase share of repairable vehicles current-3 years up to 40% in CY17 versus 32% in 2011, but older vehicles still remain

Severity increasing

- Claim costs to see 2-3% increase in CY2018

Advanced vehicle tech

- Vehicle construction has changed – new materials and repair techniques and tooling required
- 70%-plus of OEs' position statements require a pre- and/or post-repair scan with repair

ADAS Impact

- 19% of MY2017 vehicles come with ADAS as standard feature
- 50% reduction in front-to-rear crashes for vehicles equipped with AEB and FCW
- ADAS-equipped vehicles see 3-5% shift in impact point from front to rear

Casualty

Medical costs rise

- CPI for medical care rises faster than All Items

Low speed crashes remain area of concern

- 16.4% of police-reported crashes are at reported speed of 30 mph or less; among injury multi-vehicle accidents it accounts for 22.3%
- 72% of third party casualty claims referred for causation analysis are for low impact crashes

Motor vehicle fatalities rise – especially outside the vehicle

- Nearly 6K pedestrians killed in motor vehicle accidents – 27% increase since 2007
- Vehicle crashworthiness improvements not helping those outside the vehicle

New factors driving up pedestrian fatalities

- Marijuana and opiod use increasing among drivers
- States with legalized recreational use of marijuana saw a 16.4% increase in pedestrian fatalities in 1st six months of 2017 versus same period prior year versus only 5.8% for all other states

Source CCC Information Services Inc.

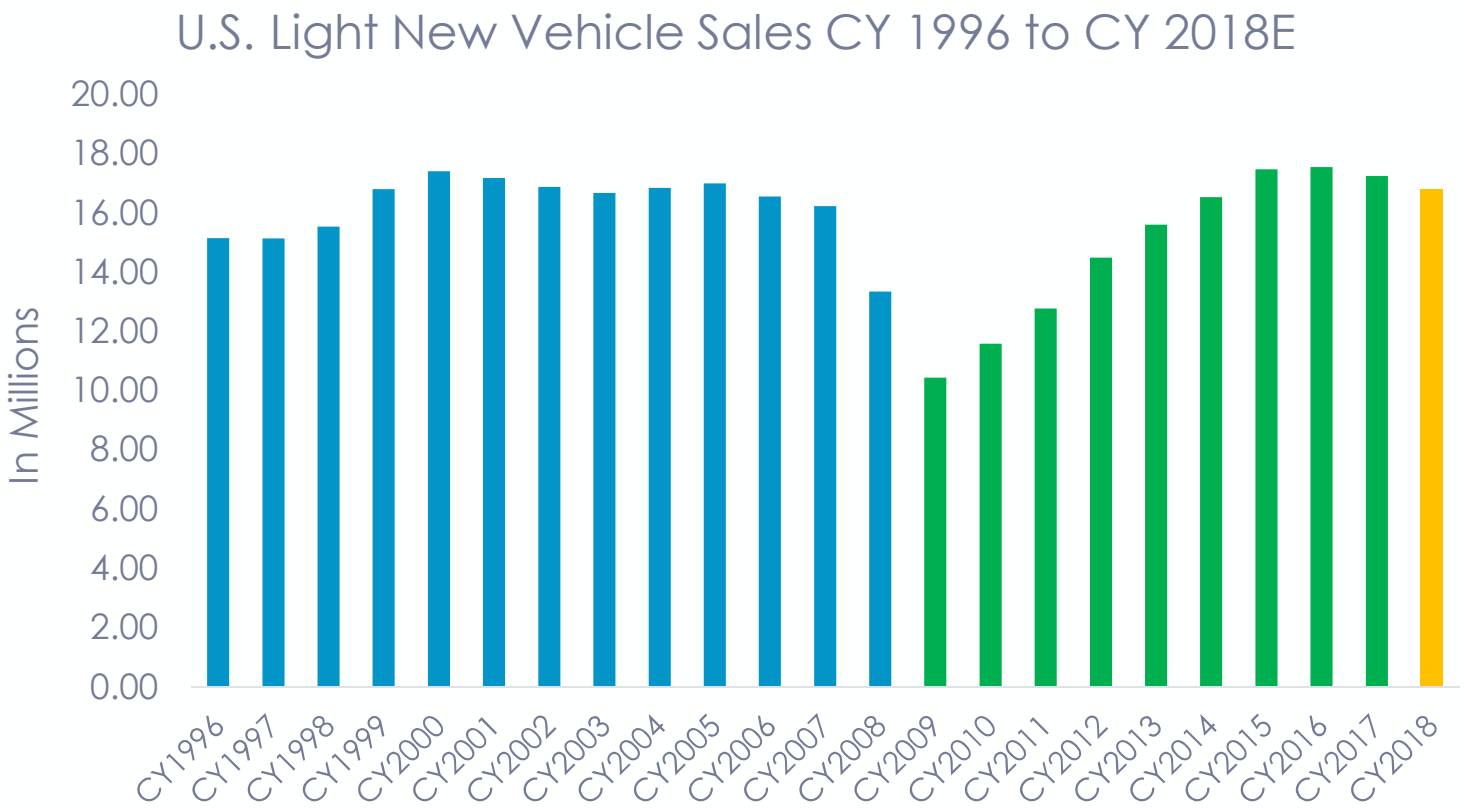
Strong New Vehicle Sales – U.S. VIU Growing Again

17.245M
CY17 sales down 1.8% from CY16

16.5-16.9M
Analysts project CY18 sales

86%
New vehicle sales with financing CY16

$35K
Average MSRP new vehicles sold in CY17



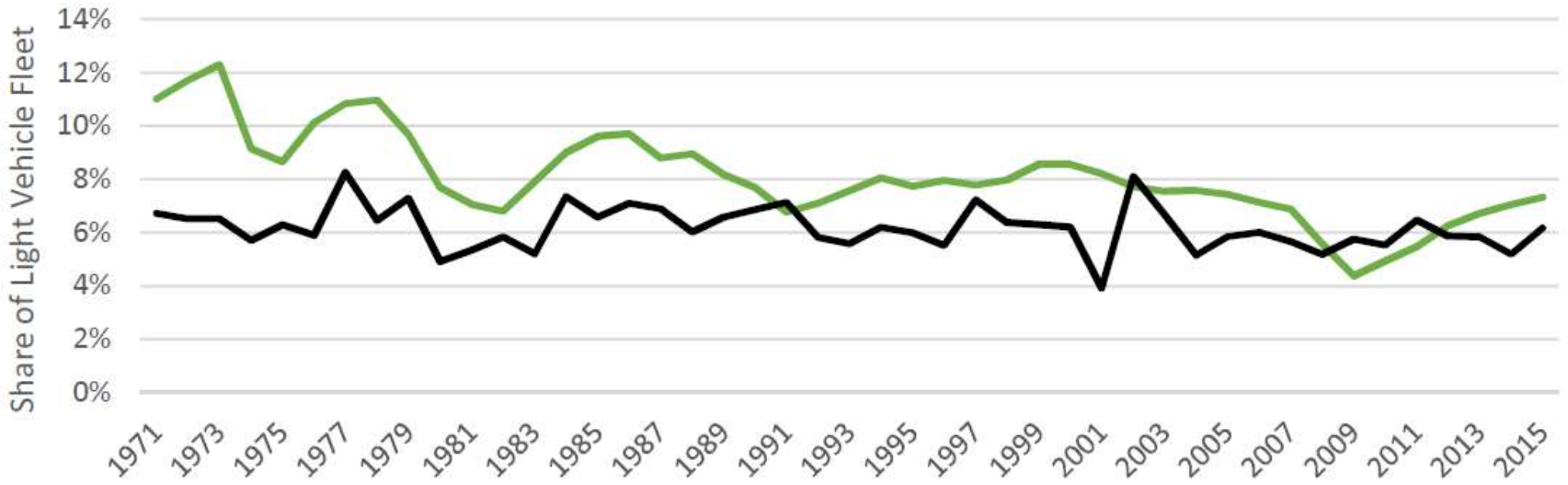
Source: *Automotive News*

U.S. Vehicle Fleet Continues to Grow

Vehicle sales and retirement rates have remained relatively constant over a period of 30+ years

With U.S. sales at roughly 8% of the overall light vehicle fleet annually, and retirements at about 6%, the overall fleet has grown at a rate of 2% a year.

Dynamics of the U.S. Light Vehicle Fleet: Sales and Retirement Rates, 1971-2015

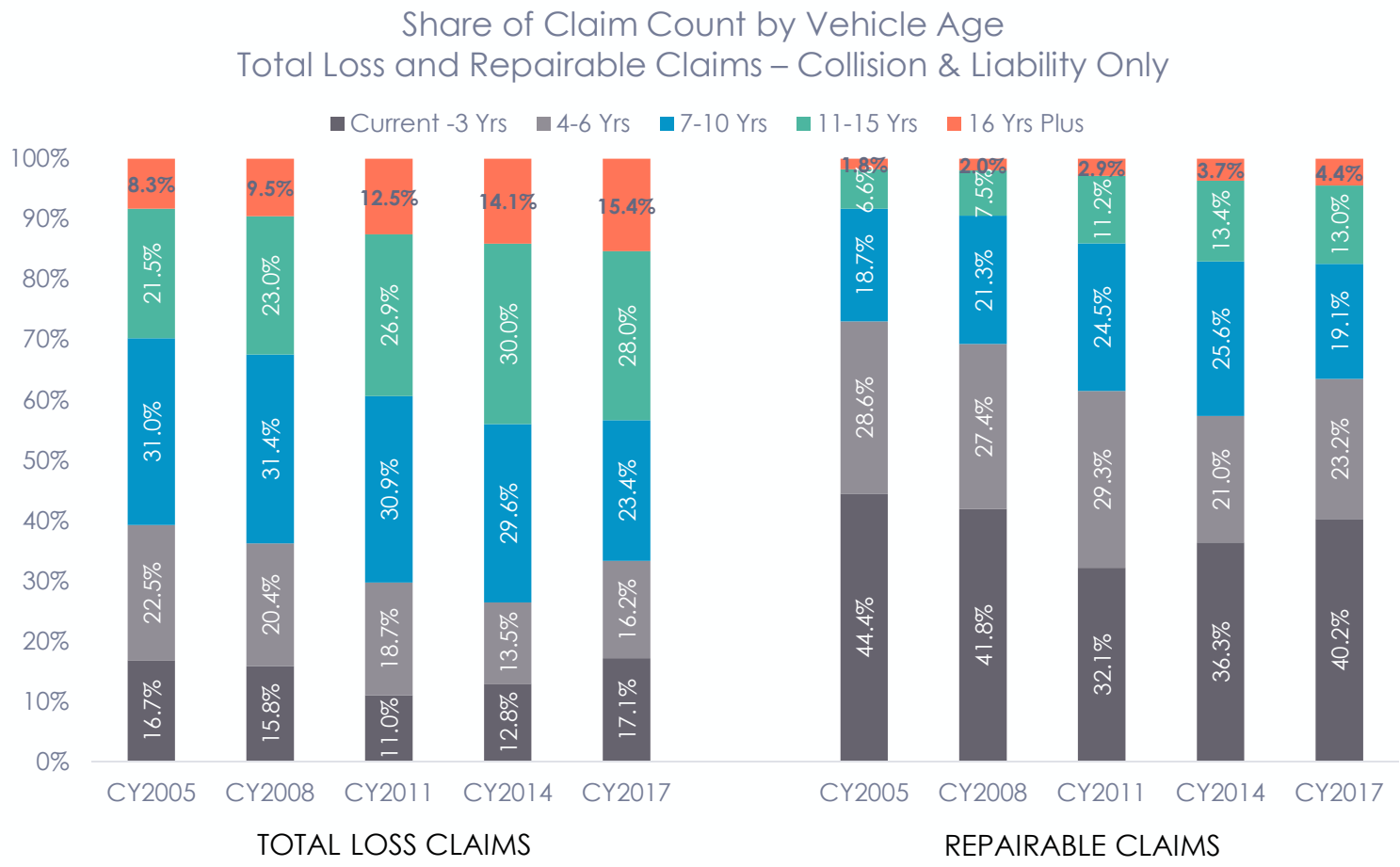


Source: CAR calculations using data from Oak Ridge National Laboratory and Automotive News

Source: Center for Automotive Research. "The Great Divide." February 2018.

Vehicle Fleet at "Bookends"

- 7 years of new vehicle sales growth
- Average age of U.S. vehicle fleet 11.7 years as vehicle reliability has improved
- Low scrappage rates

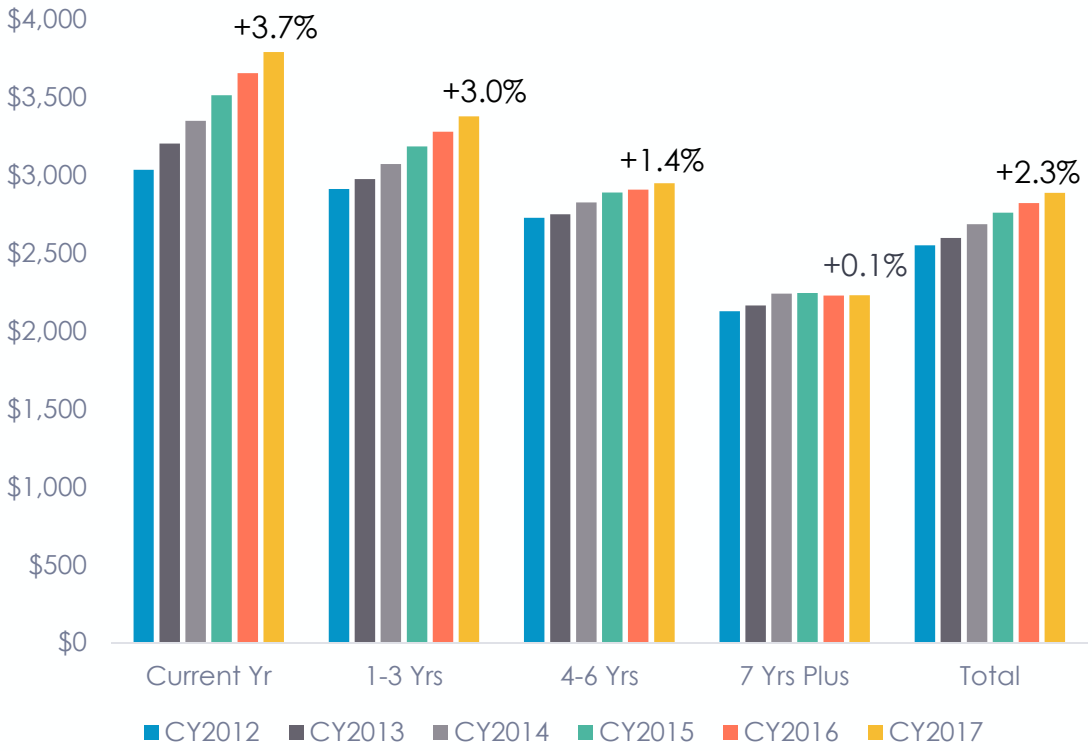


Source CCC Information Services Inc.

Repair Costs and Total Loss Frequency Climb

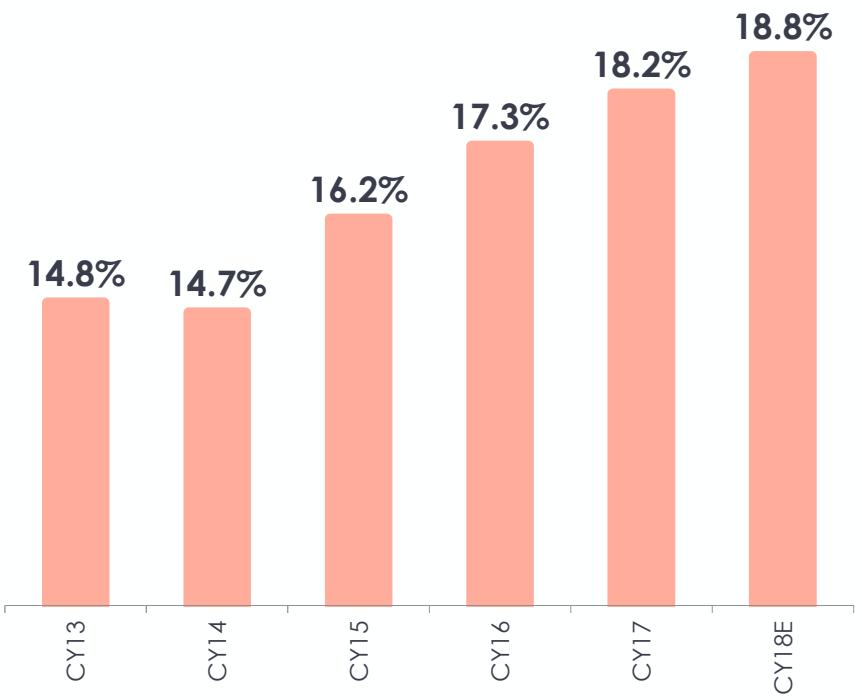
Repair Costs Climb

Repairable Vehicles – **Collision & Liability** Losses
Average Total Cost of Repairs by Vehicle Age Group



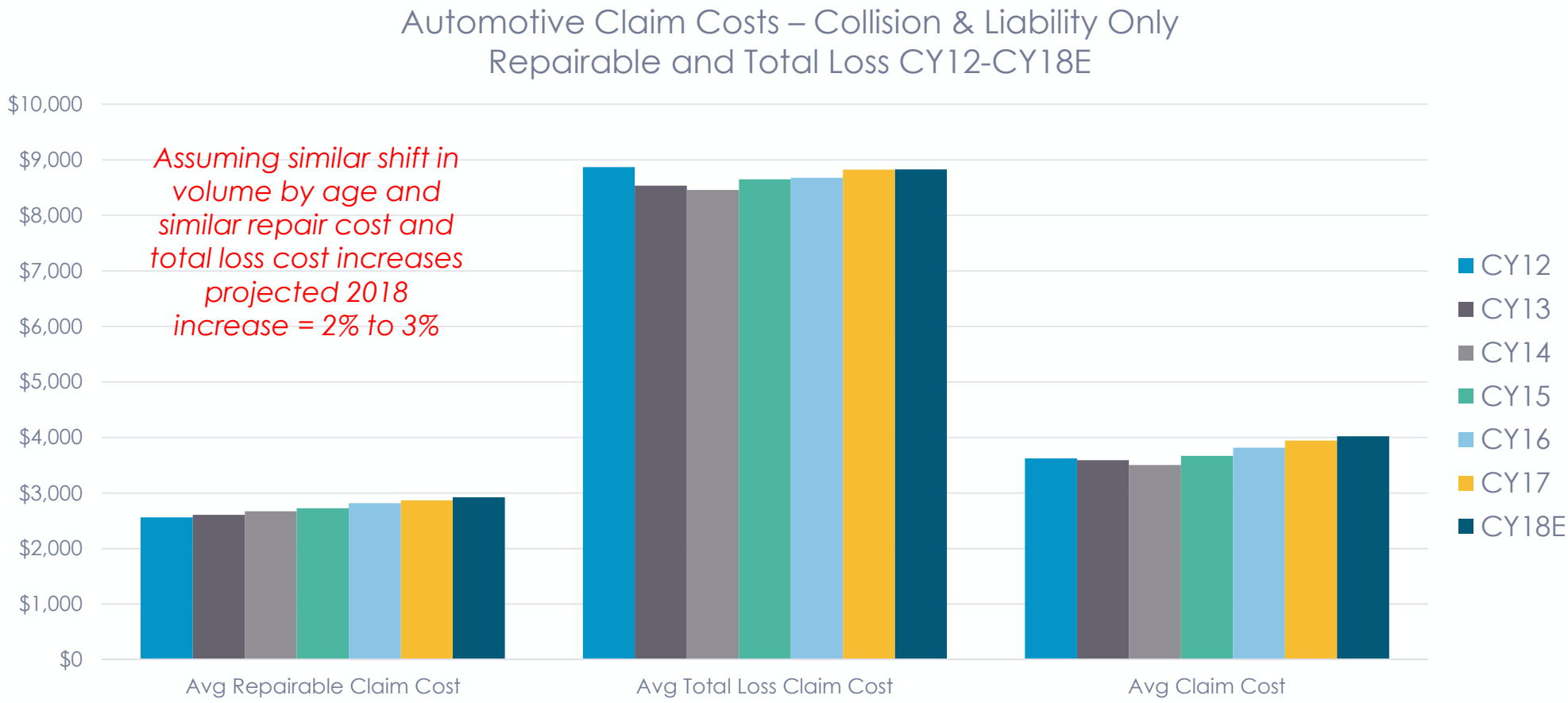
Total Loss Frequency Remains Elevated

Non-Comprehensive Losses Total Loss Share of
Claim Count CY 2013-CY 2017



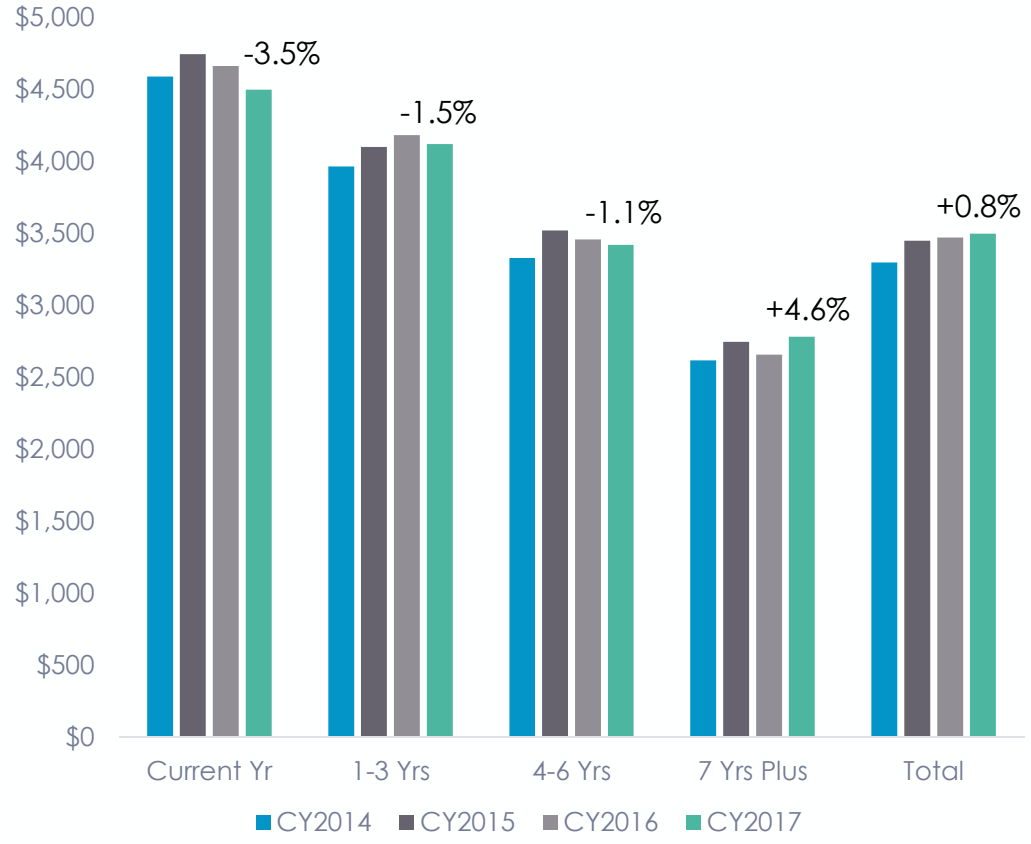
Source CCC Information Services Inc.

Claim Costs Will Continue to Rise

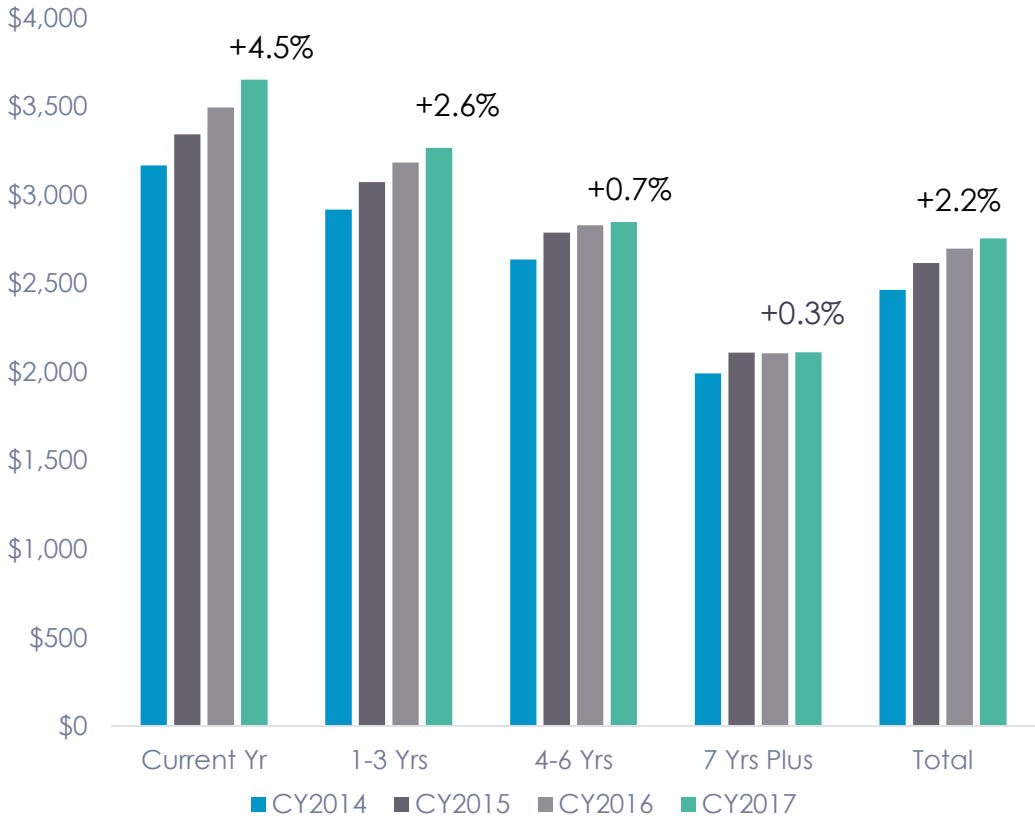


Repair Costs Commercial vs Personal Lines

COMMERCIAL LINES
Repairable Vehicles – **Collision & Liability** Losses
Average Total Cost of Repairs by Vehicle Age Group

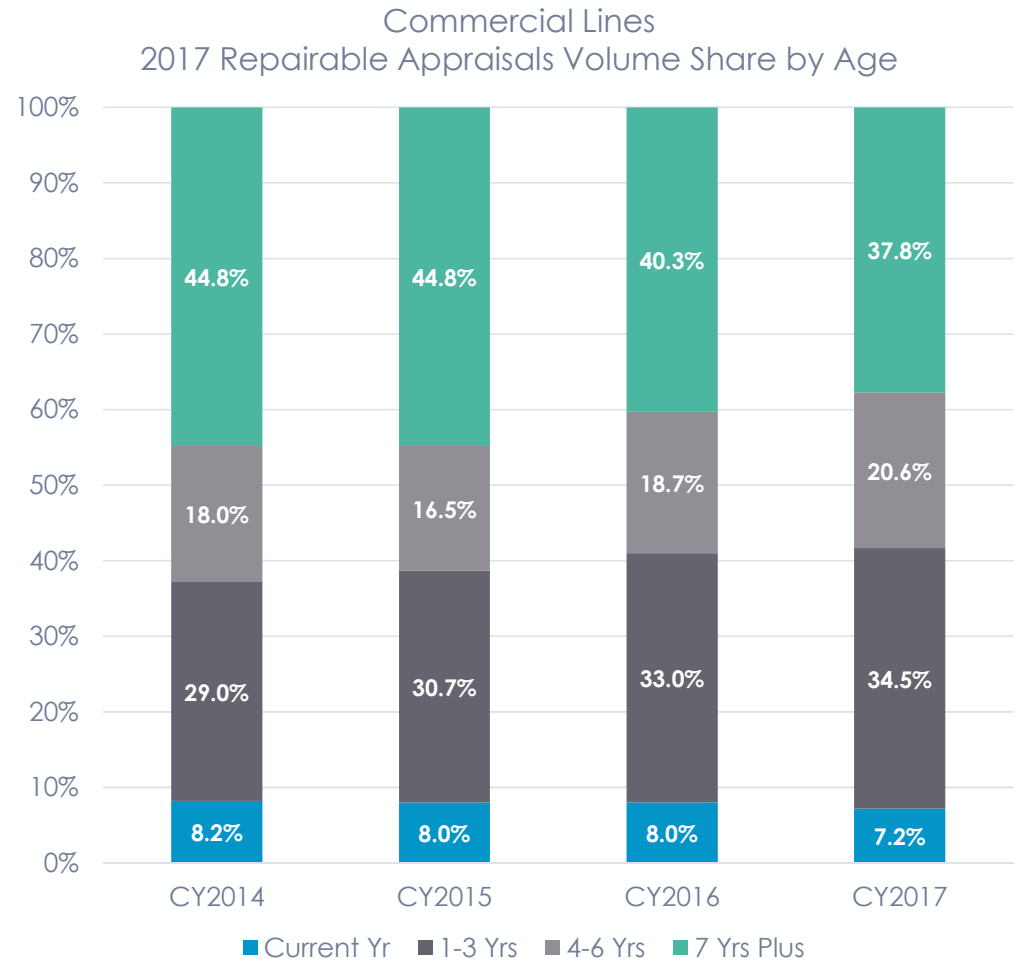


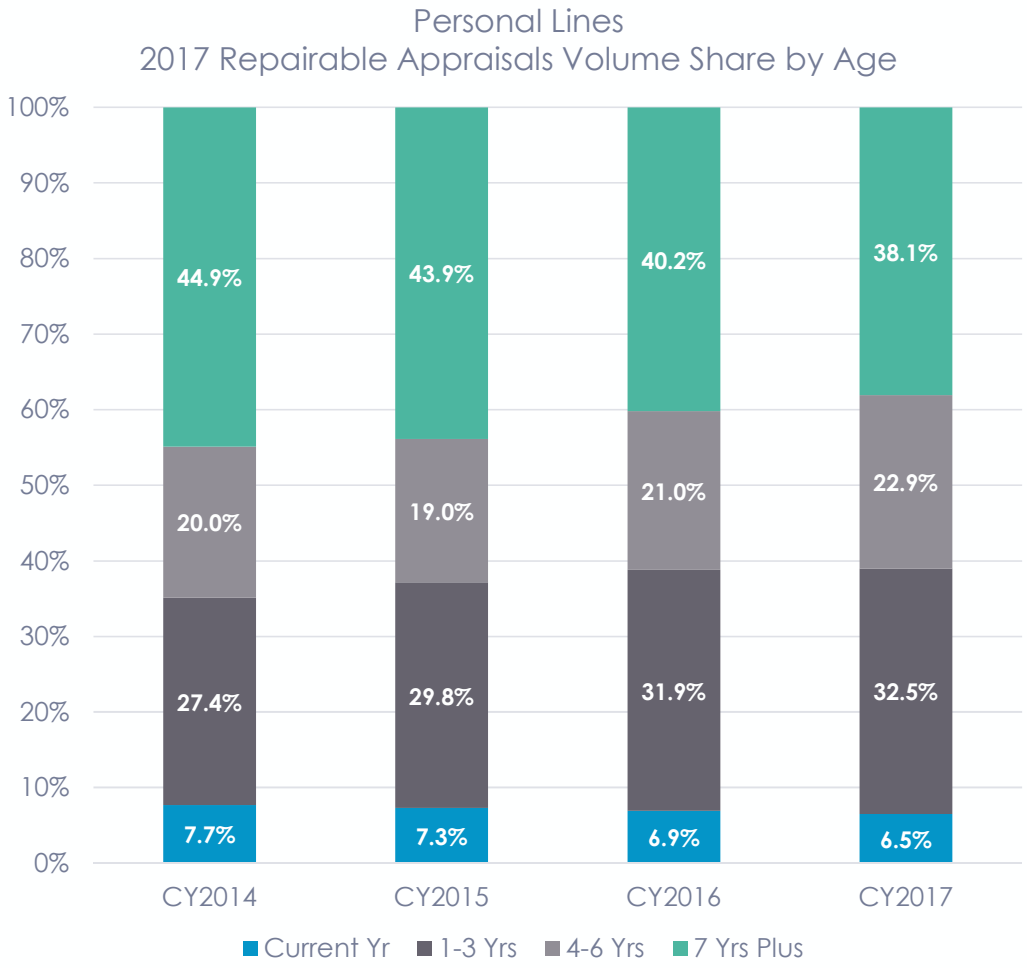
PERSONAL LINES
Repairable Vehicles – **Collision & Liability** Losses
Average Total Cost of Repairs by Vehicle Age Group



Source CCC Information Services Inc.

Commercial Lines More Light Truck Volume

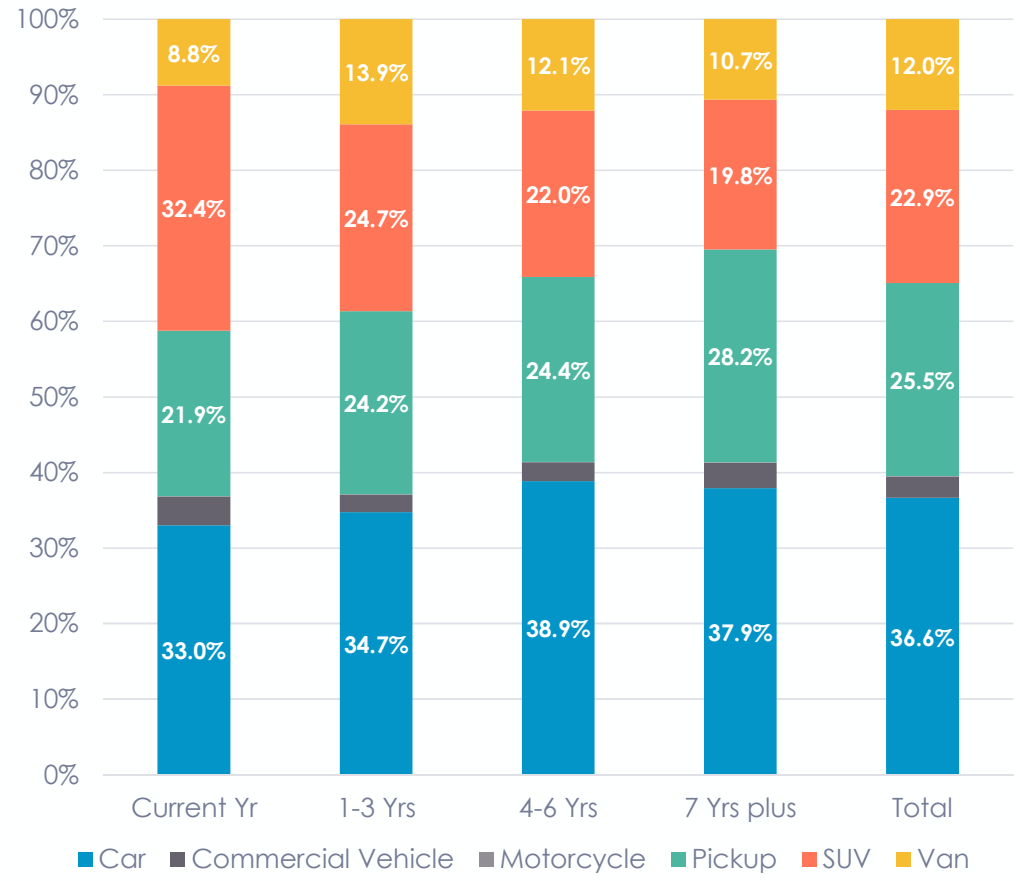




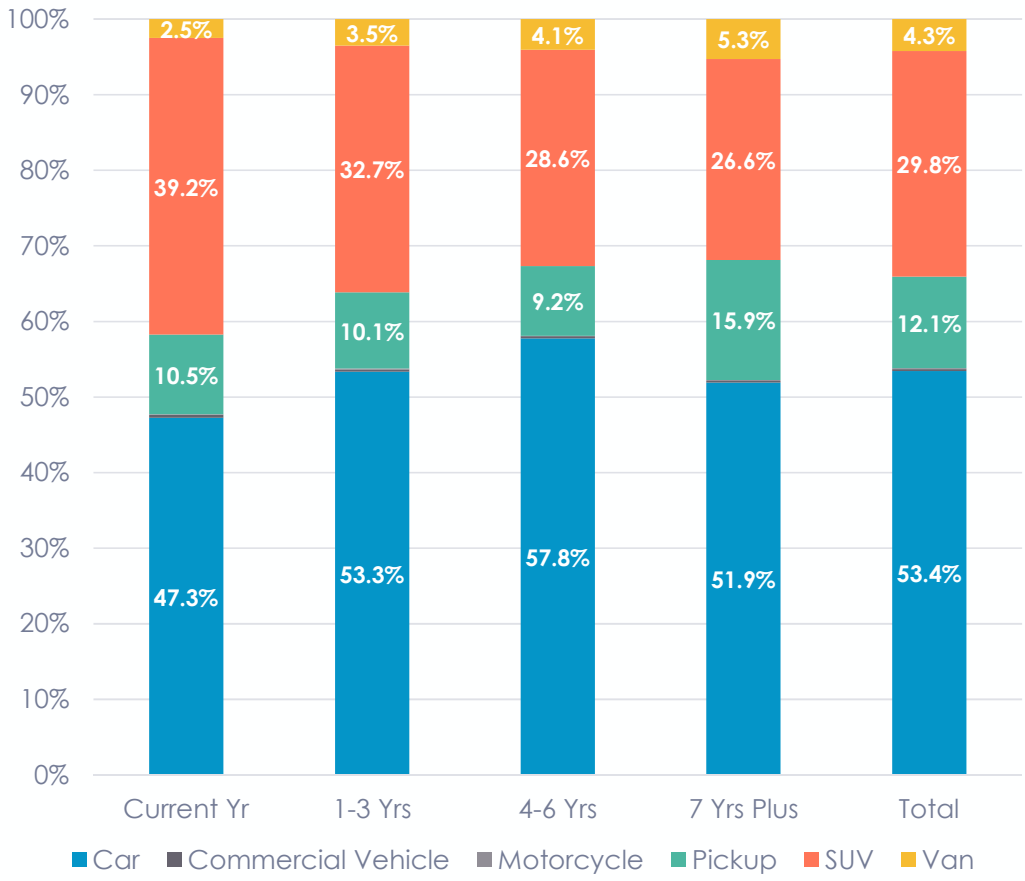
Source CCC Information Services Inc.

Commercial Lines More Light Truck Volume

Commercial Lines
2017 Repairable Appraisals by Vehicle Type and Age



Personal Lines
2017 Repairable Appraisals by Vehicle Type and Age

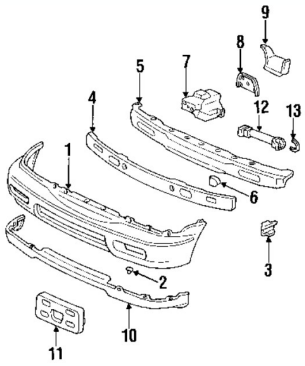


Source CCC Information Services Inc.

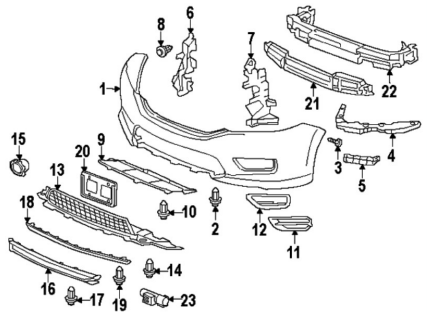
Vehicle Complexity Rises

Honda Accord LX example

1996



2015



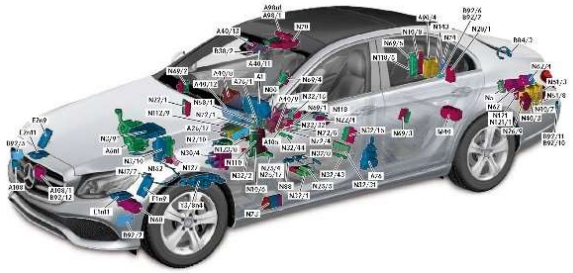
11.4 *average parts replaced per collision claim across all CCC vehicles*

Audi A8 example

Right adaptive cruise control camera

Left adaptive cruise control camera

Mercedes-Benz E-Class example



Claim #:
Workfile ID:

Supplement of Record 1 Summary

2015 AUDI S8 QUATTRO 4D SED 8-4.0L-T BLACK

198	#			Flex Additive		1	5.00 T
199	#			Cover Car		1	5.00 X
200	#			Corrosion Protection		1	5.00 T
201	#	S01		Seam Sealer / Caulk		1	31.00 T
202	#	S01	Rpr	Set up and Measure- jig			
203	**EMISSION SYSTEM**						
204	*	S01	Repl	A.I.R. pump	079959231C	1	600.00
210	#	S01		Color Tint-inner panels		1	
211	#	S01		Reset Electrical Components		1	X

4 Wheel Alignment w adaptive cruise calibration	1	1,200.00

Complexity increases cost and value of repairs

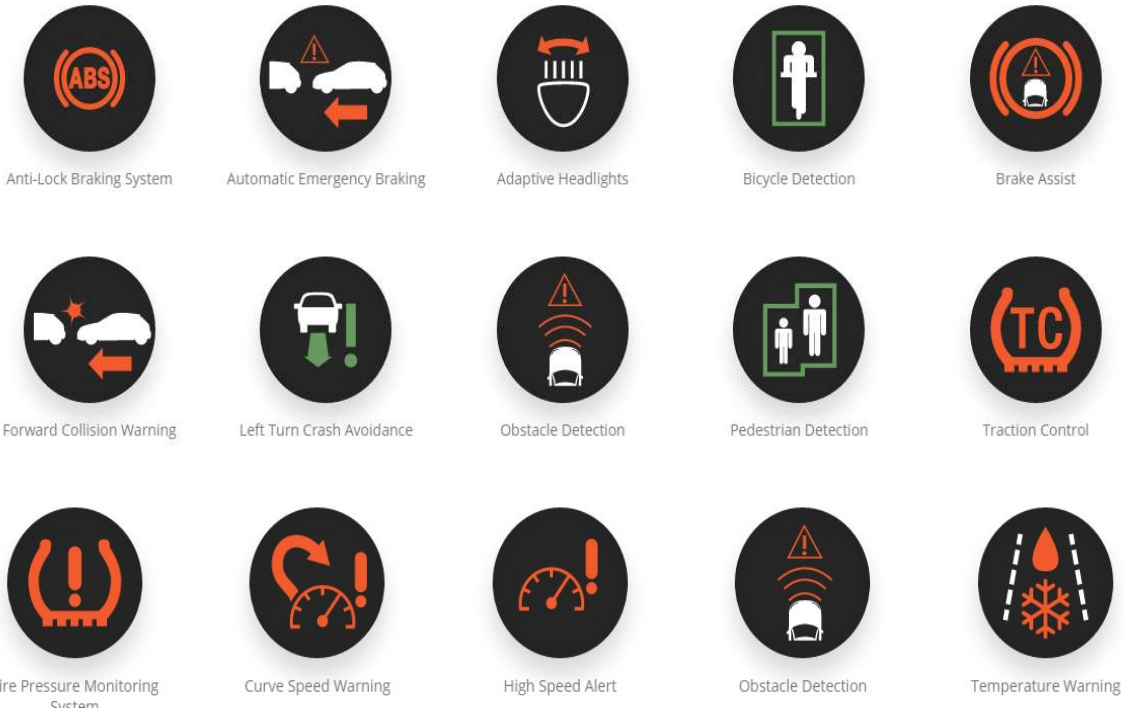
Source CCC Information Services Inc.

Even safety features can be distracting

- Electronic content of vehicles has soared
- More vehicles with safety features – all work differently; consumers often unaware of how they work

Standard options on a base F-150 pickup over the last 30 years.

YEAR	1985	1995	2000	2015
	3-Speed Transmission	5-Speed Transmission	5-Speed Transmission	Air Conditioning
	AM Radio	AM Radio	AM Radio	AM Radio
	Dual Mirrors	Drivers Airbag	Cloth Seats	Anti-Lock Brakes
	Power Brakes	Dual Mirrors	Drivers Airbag	Automatic
	Power Steering	Intermittent Wipers	Dual Mirrors	Cloth Seats
	Styled Steel Wheels	Overdrive	FM Radio	Disk Brakes
		Power Steering	Intermittent Wipers	Drivers Airbag
		Rear Anti-Lock Brakes	Overdrive	Dual Mirrors
		Styled Steel Wheels	Power Steering	FM Radio
		Tinted Glass	Power Brakes	AM Radio
			Rear Anti-Lock Brakes	Head Curtain Airbags
			Seek/Scan	Cloth Seats
			Step Bumper	Intermittent Wipers
			Stereo	Overdrive
			Styled Steel Wheels	Passenger Airbag
			Tinted Glass	Power Brakes
				Power Steering
				Seek/Scan
				Side Impact Airbags
				Stability Control
				Step Bumper
				Stereo
				Styled Steel Wheels
				Telescopic Wheel
				Tilt Wheel
				Tinted Glass
				Traction Control



These icons have been not standardized across vehicles – they all have different warning lights. These icons are from mycardoeswhat.org, a website created by National Safety Council to help educate consumers about these features – not all work the same.

Source: CCC Information Services Inc. www.mycardoeswhat.com

Replacement Parts Grow with Newer Vehicles

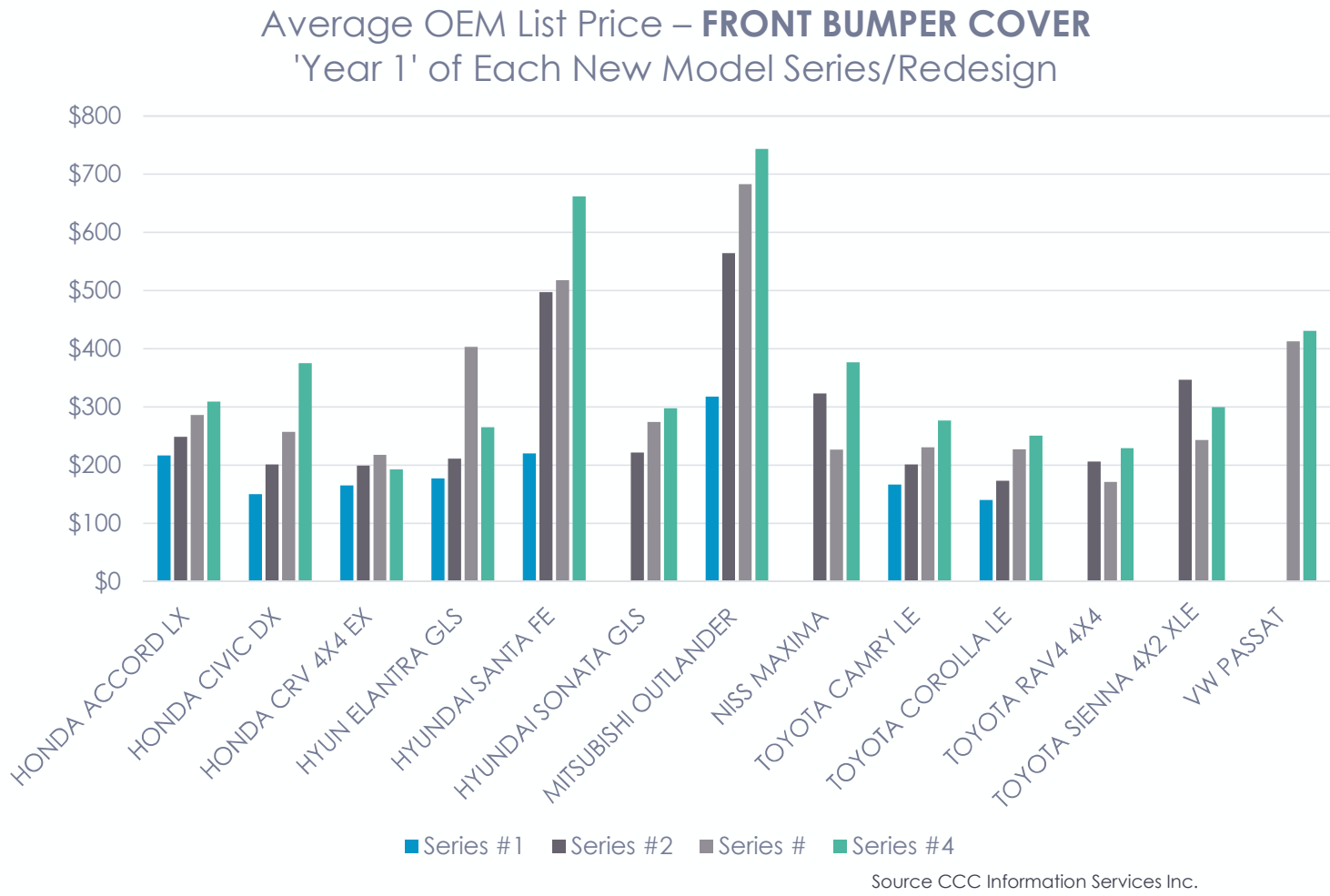
Collision and Liability Repairable Appraisals by Vehicle Age Group
Calendar Years 2001 / 2009 / 2017

Calendar Year	Vehicle Age Group	COLLISON LOSSES			LIABILITY LOSSES		
		Share of Overall Vol by Age Group	Parts % Total Repair Cost	Avg # Parts Repl per Claim	Share of Overall Vol by Age Group	Parts % Total Repair Cost	Avg # Parts Repl per Claim
CY2001	Current Yr	9.4%	42.3%	10.9	7.8%	39.1%	6.4
	1-3 Yrs	39.0%	41.9%	10.4	31.5%	38.3%	6.3
	4-6 Yrs	27.8%	40.5%	9.3	25.1%	36.7%	5.8
	7 Yrs Plus	23.7%	37.3%	7.0	35.5%	34.1%	4.5
	Total	100%	40.7%	9.3	100%	36.6%	5.6
CY2009	Current Yr	5.3%	43.0%	11.9	4.3%	37.7%	6.5
	1-3 Yrs	36.3%	42.4%	11.2	28.9%	37.5%	6.3
	4-6 Yrs	29.4%	40.7%	9.9	25.9%	36.1%	5.8
	7 Yrs Plus	29.1%	37.1%	7.3	40.8%	32.1%	4.4
	Total	100%	40.7%	9.7	100%	35.2%	5.4
CY2017	Current Yr	7.2%	47.7%	14.5	5.8%	42.5%	8.7
	1-3 Yrs	36.0%	44.8%	13.3	29.1%	39.4%	8.0
	4-6 Yrs	24.3%	41.8%	11.8	21.5%	36.6%	7.2
	7 Yrs Plus	32.6%	38.1%	8.7	43.5%	32.7%	5.1
	Total	100%	42.7%	11.5	100%	36.6%	6.6

Source CCC Information Services Inc.

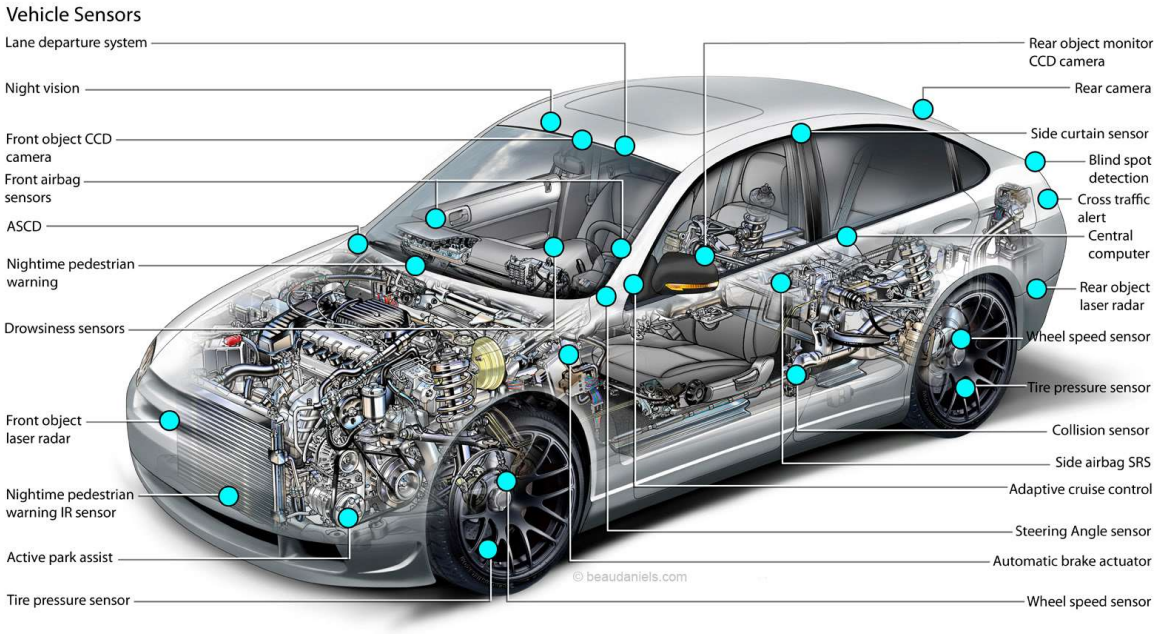
Part Costs Rise

- With each new vehicle redesign the average cost of many commonly replaced parts has also grown
- For example, with the '03-'07 Honda Accord LX redesign, the OE list price for front bumper cover increased 15% from the prior design



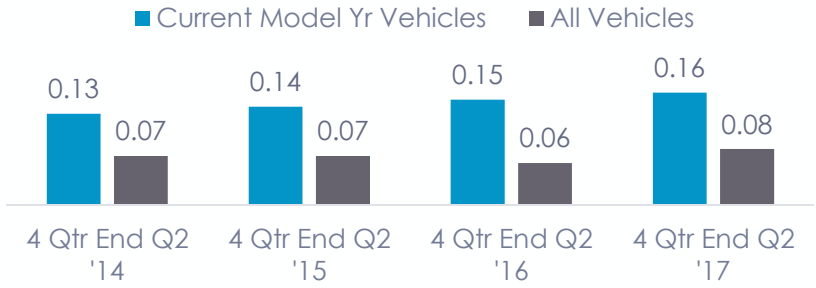
Source CCC Information Services Inc.

Vehicle Sensors and Cameras Proliferate

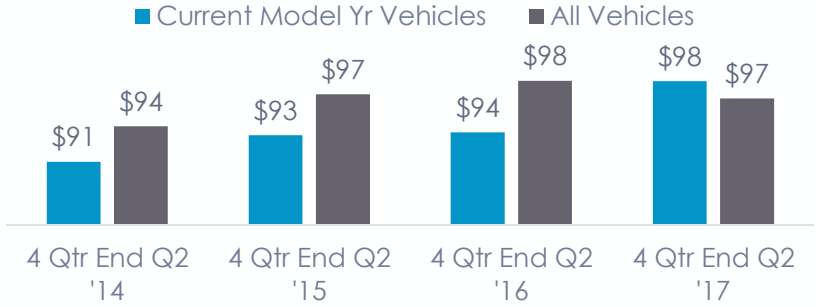


Vehicles today are equipped with many sensors designed to transmit data and monitor various vehicle functions.

Average Number of Replaced Sensors/Cameras/Radar/Lidar per Claim



Average Cost per Part for Replaced Sensors/Cameras/Radar/Lidar



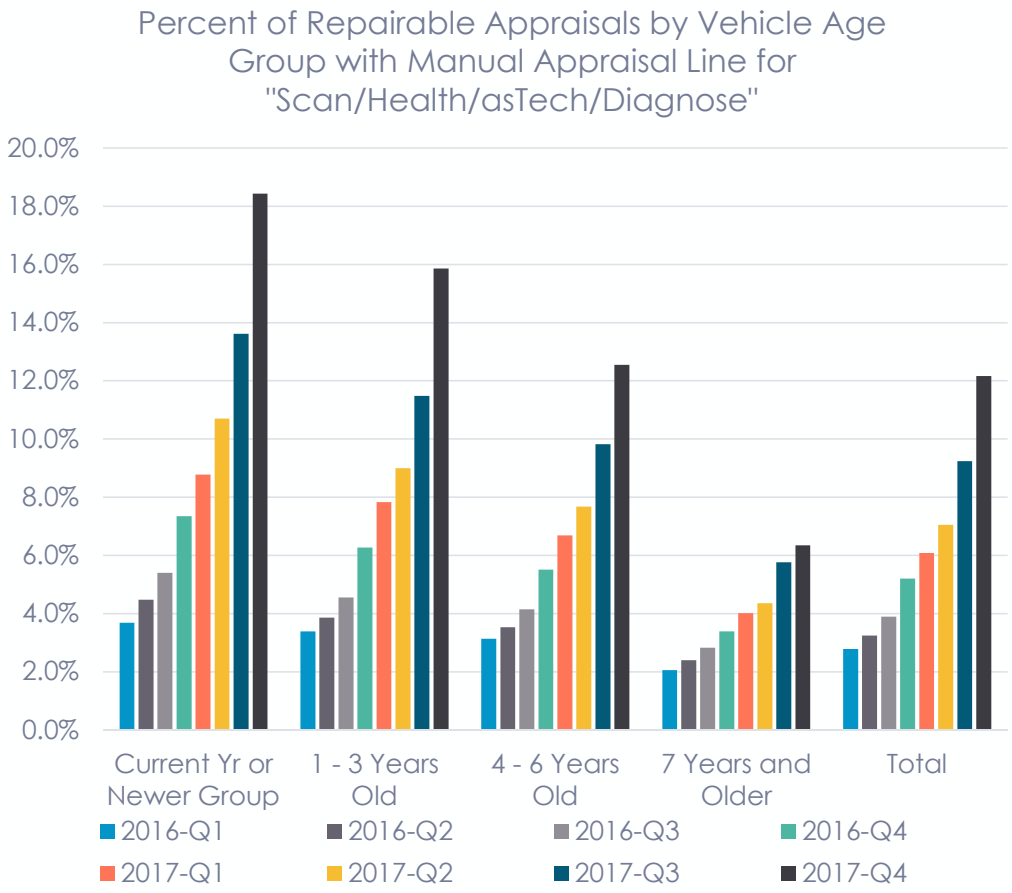
Source: http://beaudaniels.com and CCC Information Services Inc.

Vehicle Technology Requires New Technology, Training and Access to Vehicle Information

Position statements from these OE's suggest that 70% of all repairable appraisals from CY2017 should include pre-repair and/or post-repair scan(s)

Yet only 9% of all CY 2017 appraisals included an entry with average fee of $90 (including flat fee and/or labor time).

Suggests that scan may be completed, just not always recorded in appraisal.



Source CCC Information Services Inc. www.oem1stop.com.

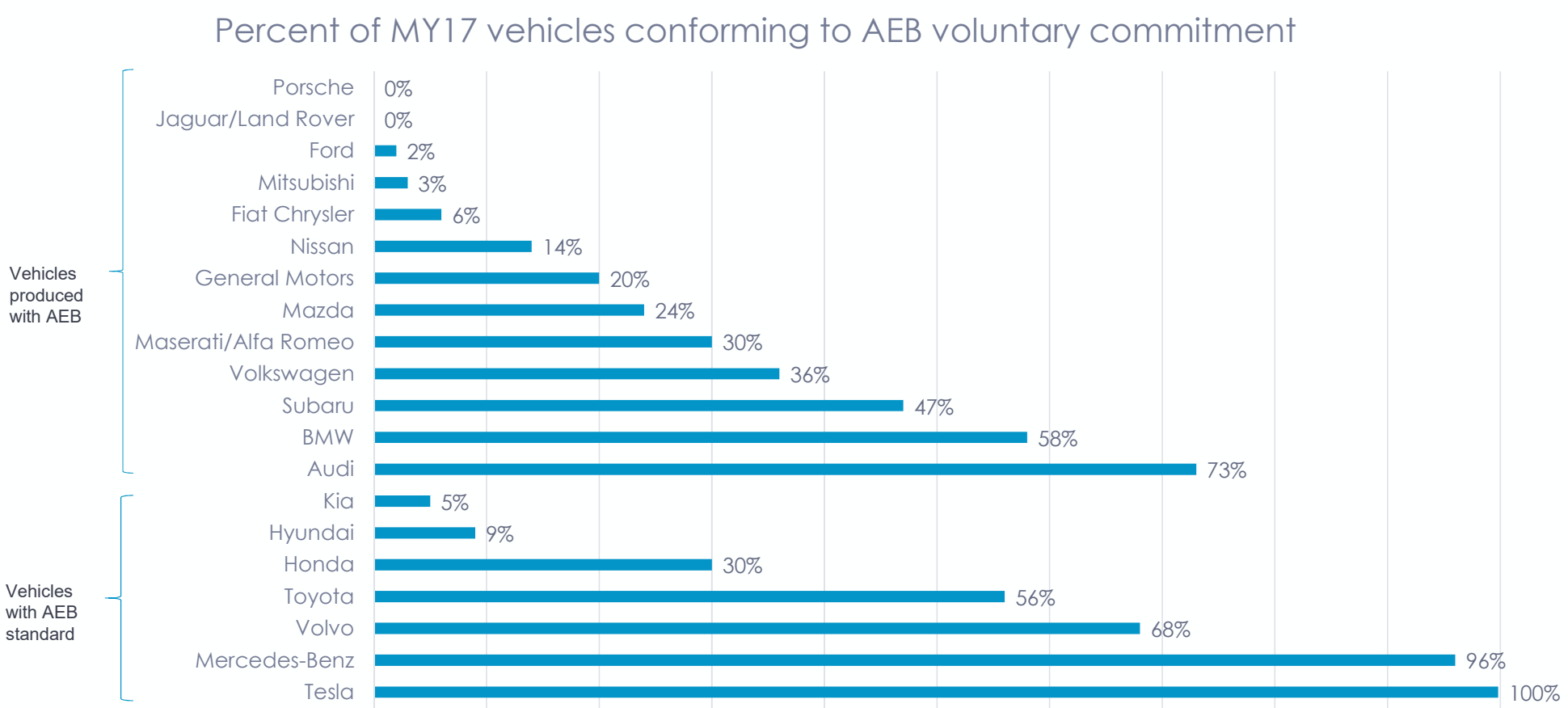
Repair Cycle Times Increase

- 'Keys to keys' has increased 1 full day industry-wide; over 2 full days for non-driveable vehicles
- The increase is driven by longer vehicle repair times, since pre-repair and post-repair days have remained stable

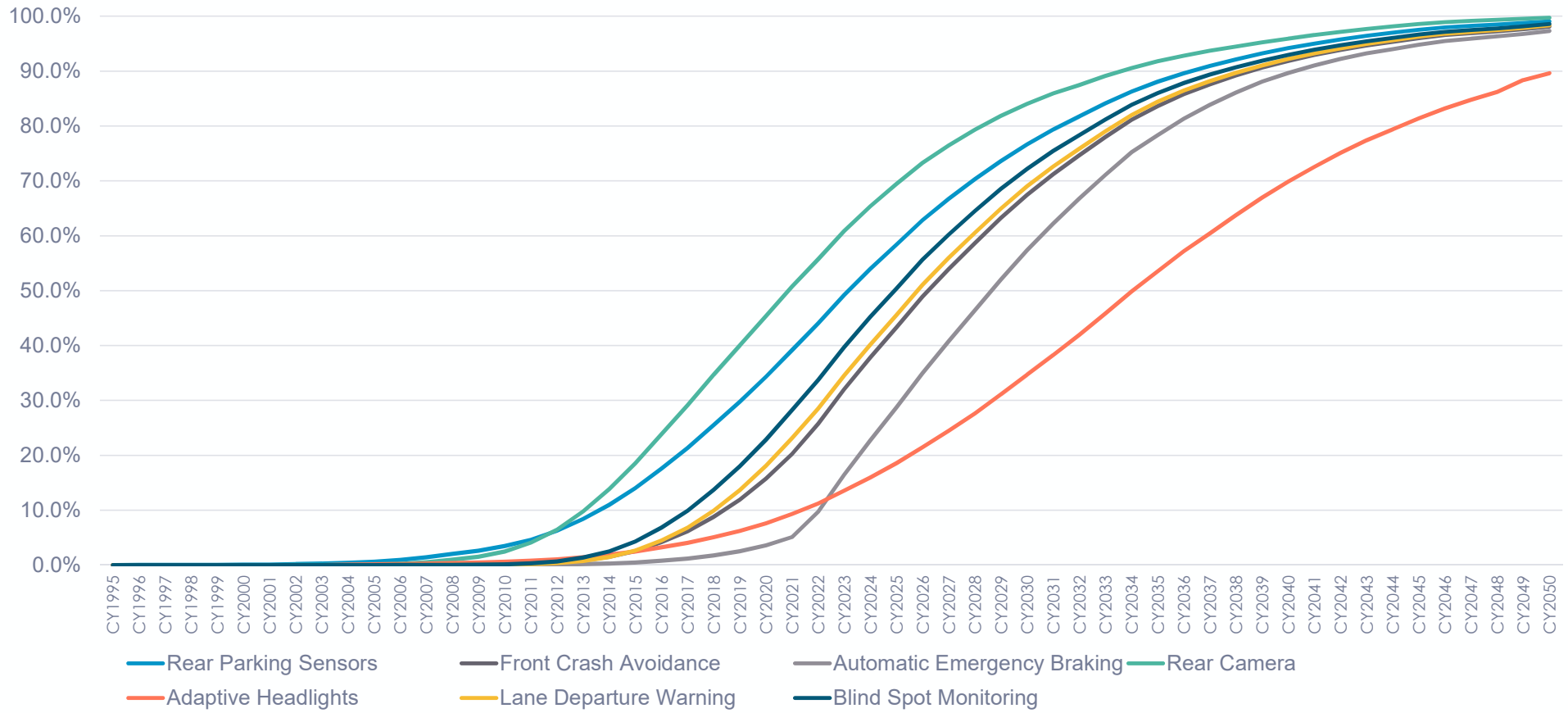
Driveable Flag	CY	Repair Cycle Time					Shop Productivity	
		Vehicle In to Repairs Started Days Avg	Repairs Started to Repairs Completed Days Avg	Repairs Completed to Vehicle Out Days Avg	Vehicle In to Vehicle Out Days Avg		Labor Hrs per Repair Day	Labor Hrs per Shop Day
Driveable	CY2013	0.6	5.3	0.8	6.7		4.2	3.4
	CY2014	0.7	5.7	0.8	7.2		3.9	3.0
	CY2015	0.6	5.8	0.9	7.3		3.8	3.0
	CY2016	0.6	6.3	0.9	7.8		3.6	2.9
	CY2017	0.6	6.3	0.9	7.8		3.6	2.9
Non-Driveable	CY2013	2.5	11.3	1.4	15.2		3.6	2.8
	CY2014	3.2	12.7	1.2	17.0		3.1	2.3
	CY2015	2.9	13.3	1.3	17.4		3.0	2.3
	CY2016	2.7	13.9	1.4	18.1		2.9	2.2
	CY2017	2.5	13.6	1.3	17.4		2.9	2.2
TOTAL	CY2013	1.0	6.6	0.9	8.5		4.0	3.2
	CY2014	1.2	7.1	0.8	9.1		3.6	2.8
	CY2015	1.0	7.2	0.9	9.2		3.5	2.8
	CY2016	1.0	7.7	1.0	9.7		3.4	2.6
	CY2017	0.9	7.6	1.0	9.5		3.4	2.7

Source CCC Information Services Inc.

NTHSA - IIHS 2017 Fleet Conforming to AEB Voluntary Commitment



IIHS/HLDI Predicted Percent of Vehicles Equipped (standard or optionally equipped) with ADAS Technologies



Source: "Predicted availability and fitment of safety features on registered vehicles." HLDI Bulletin Vol. 34, No. 28, September 2017.

IIHS/HLDI Analysis of ADAS Technologies Shows Some Reduction in Claim Frequency

insurance claims reductions in percent pooled across automakers

	Collision	PDL	BIL
Front crash warning without autobrake	2%	9%	15%
Front crash warning with autobrake	2%	14%	19%
Adaptive headlights	1%	5%	8%

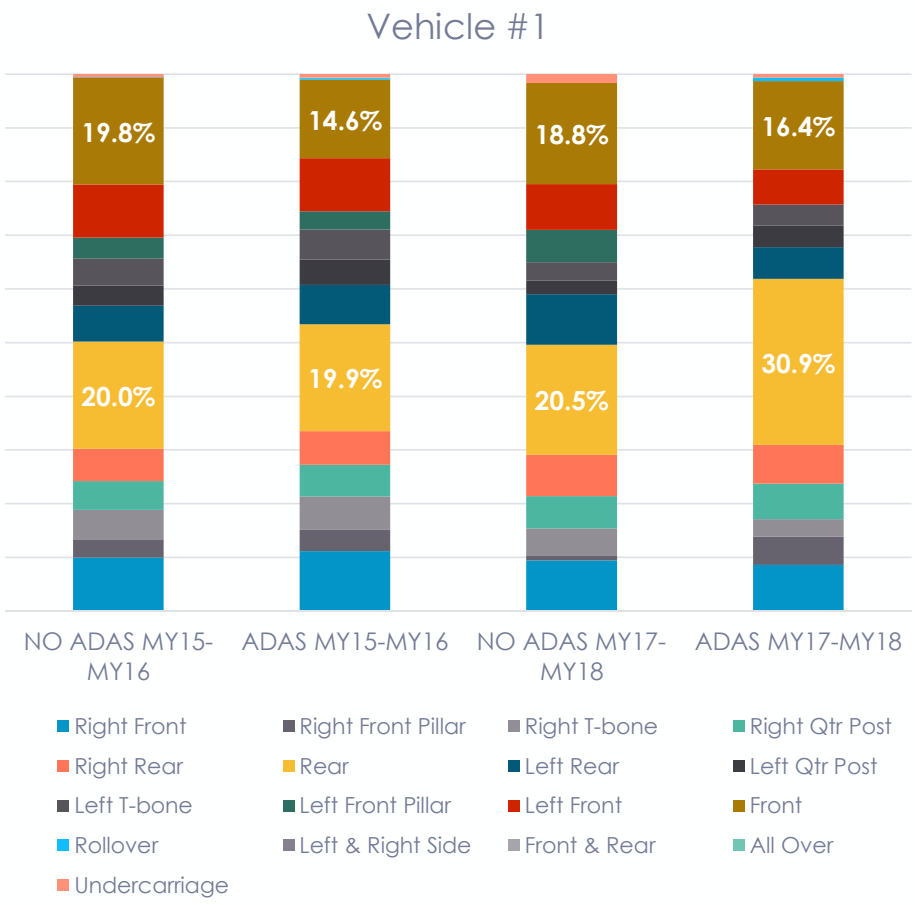
Based on IIHS/HLDI Studies completed by April 3, 2016, IIHS presentation at Lifesavers Conference 2017

Effects on police-reported crashes relevant to lane-departure and on police-reported lane-change crashes

	All Crashes	Injury Crashes
Lane-departure warning (controlled for demographic factors)	11%	21%
Blind-spot detection	14%	23%

IIHS/HLDI Research released August 2017, Status Report Vol. 52, No.6 "Stay Between the Lines"

Crash Type Frequency Changes with ADAS



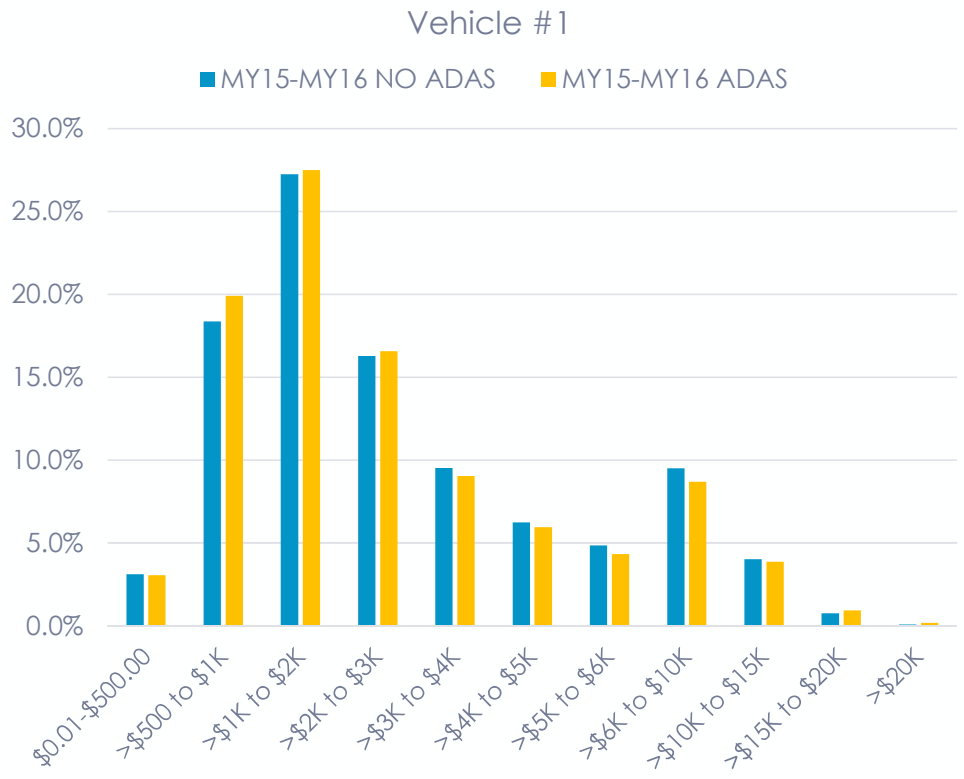
Vehicle	ADAS Equipped	Collision Front Primary Impact share of volume	Collision Rear Primary Impact share of volume
Vehicle #2 MY16-MY17	No ADAS	21.1%	24.7%
	ADAS	17.0%	26.9%
Vehicle #3 MY17	No ADAS	20.3%	22.5%
	ADAS	15.0%	29.4%

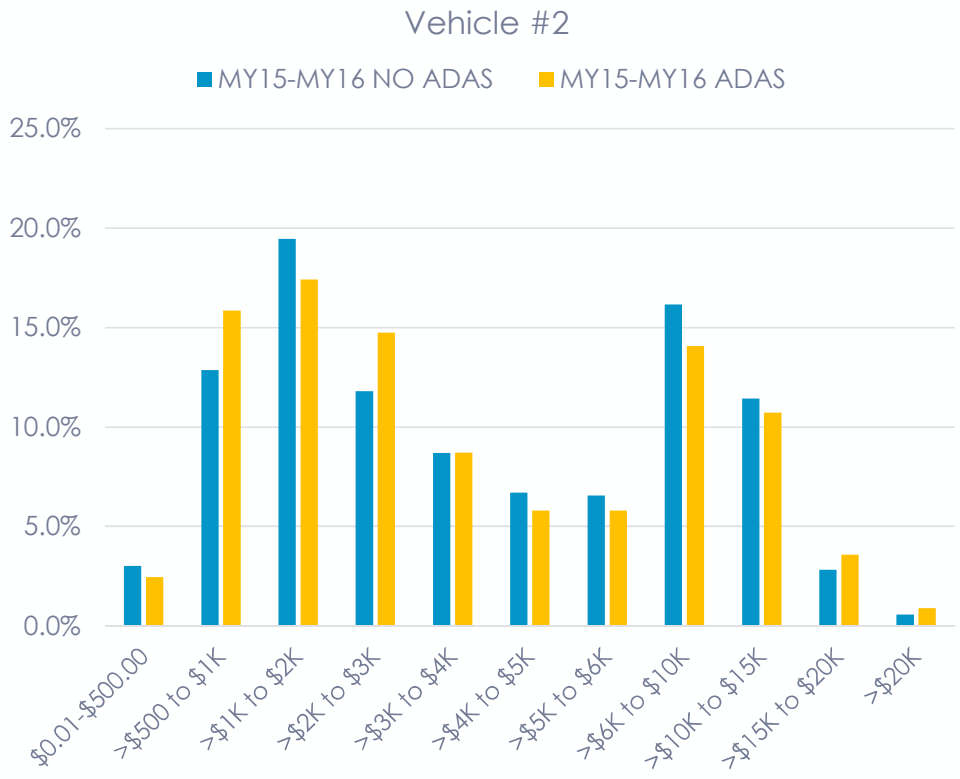
Source CCC Information Services Inc.

Collision Front Primary Impact – Share of Appraisals by Repair Cost Dollar Range Reveals Different Experience by Automaker

Vehicle #1 ADAS more higher dollar repairs than non-ADAS ***versus***

Vehicle #2 ADAS has more low dollar repairs than non-ADAS





Source CCC Information Services Inc.

Repair Costs Lower for ADAS-Equipped Collision Front Impacts

Vehicle #1 Comparion of Appraisal Metrics for Vehicle Equipped with ADAS (ADAS) and Not Equipped (NO ADAS)

Note: Vehicle #1 represents data from a popular 4-door mid-size sedan, where ADAS sold as optional.

LOSS CATEGORY / IMPACT POINT	VEHICLE MODEL YEAR	ADAS EQUIPPED	% ADAS Equipped per MY	Avg Total Cost of Repairs	Parts % Total Cost of Repairs	Avg # Parts Repl per Claim	Labor % Total Cost of Repairs	Avg Lbr Hrs per Claim	Misc % Total Cost of Repairs	% Claims with Supplement(s)	Supplement % Total Cost of Repairs
COLLISION - FRONT	MY15-MY16	ADAS	31.1%	$ 4,017	45.1%	20.1	37.2%	29.6	4.8%	64.1%	18.4%
		NO ADAS	68.9%	$ 4,037	44.6%	21.3	37.7%	30.7	4.3%	61.1%	15.1%
		TOTAL	100.0%	$ 4,031	44.8%	20.9	37.6%	30.3	4.4%	62.0%	16.1%
COLLISION - REAR	MY15-MY16	ADAS	38.0%	$ 2,558	33.1%	10.4	46.9%	24.8	5.1%	59.7%	16.5%
		NO ADAS	62.0%	$ 2,502	33.2%	10.1	47.2%	24.1	4.0%	53.1%	15.0%
		TOTAL	100.0%	$ 2,523	33.2%	10.2	47.1%	24.3	4.5%	55.6%	15.6%

Vehicle #2 Comparion of Appraisal Metrics for Vehicle Equipped with ADAS (ADAS) and Not Equipped (NO ADAS)

Note: Vehicle #2 represents data from another popular 4-door mid-size sedan, where ADAS sold as optional.

LOSS CATEGORY / IMPACT POINT	VEHICLE MODEL YEAR	ADAS EQUIPPED	% ADAS Equipped per MY	Avg Total Cost of Repairs	Parts % Total Cost of Repairs	Avg # Parts Repl per Claim	Labor % Total Cost of Repairs	Avg Lbr Hrs per Claim	Misc % Total Cost of Repairs	% Claims with Supplement(s)	Supplement % Total Cost of Repairs
COLLISION - FRONT	MY16-MY17	ADAS	17.7%	$ 4,798	48.0%	25.7	34.4%	33.0	5.5%	63.9%	16.8%
		NO ADAS	82.3%	$ 4,861	48.0%	26.7	34.7%	34.0	4.6%	64.2%	16.3%
		TOTAL	54.8%	$ 4,850	48.0%	26.5	34.6%	33.8	4.8%	64.1%	16.4%
COLLISION - REAR	MY16-MY17	ADAS	22.5%	$ 2,461	38.9%	9.3	43.5%	22.2	3.0%	52.7%	15.8%
		NO ADAS	77.5%	$ 2,394	38.1%	9.2	44.0%	21.5	2.7%	49.4%	13.8%
		TOTAL	100.0%	$ 2,409	38.3%	9.2	43.9%	21.6	2.8%	50.1%	14.2%

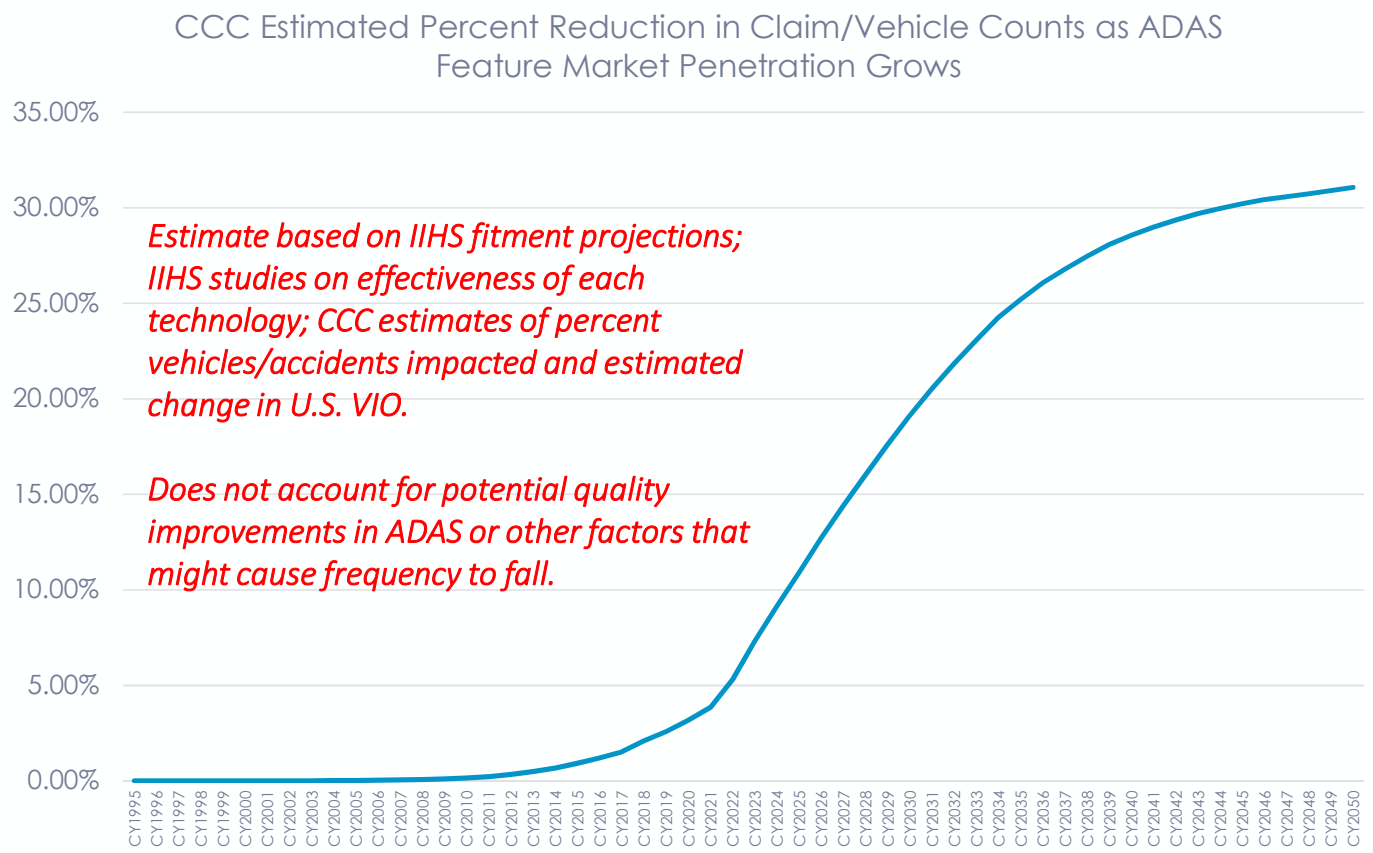
Repair costs lower for ADAS-equipped vehicles when a front impact collision loss occurs but higher for rear impact collision losses

Source CCC Information Services Inc.

What does frequency look like in the future?

Other Potential factors helping to reduce frequency:

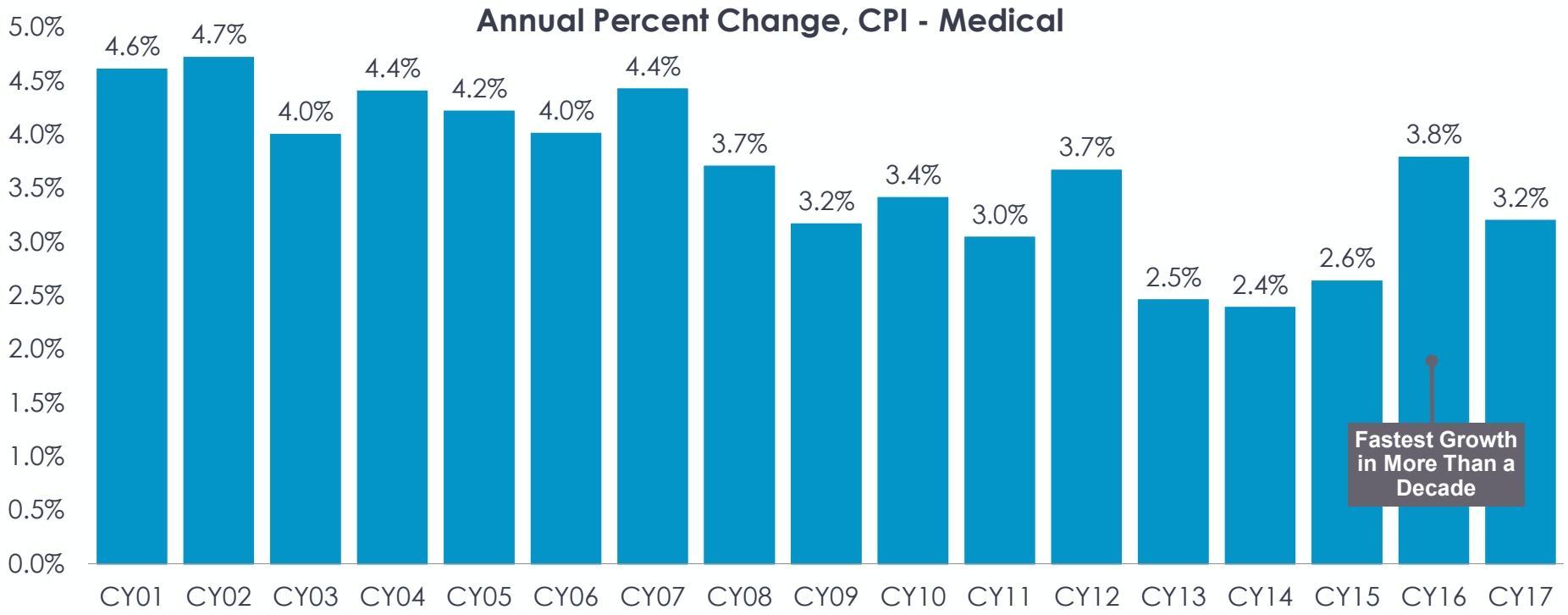
- Technology will develop to reduce distracted driving
- Slowing new vehicle sales
- Tech to promote more 'gig' employees and work-from-home capabilities
- Aging population; fewer driving during peak times



Source IIHS/ HLDI. CCC Information Services Inc.

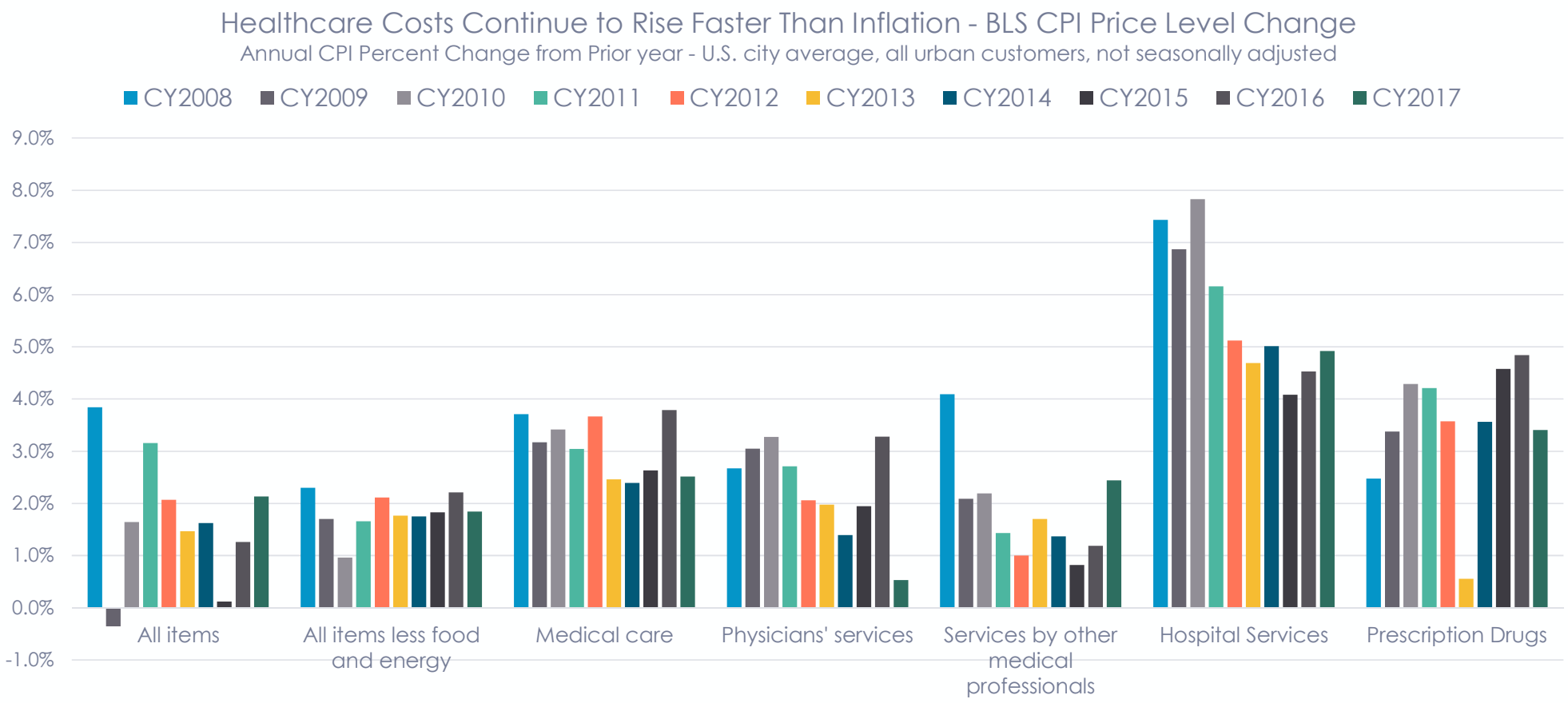
Medical Inflation Heating Up

Growth In Miles Driven. The More People Drive, The More Frequently They Get Into Accidents.



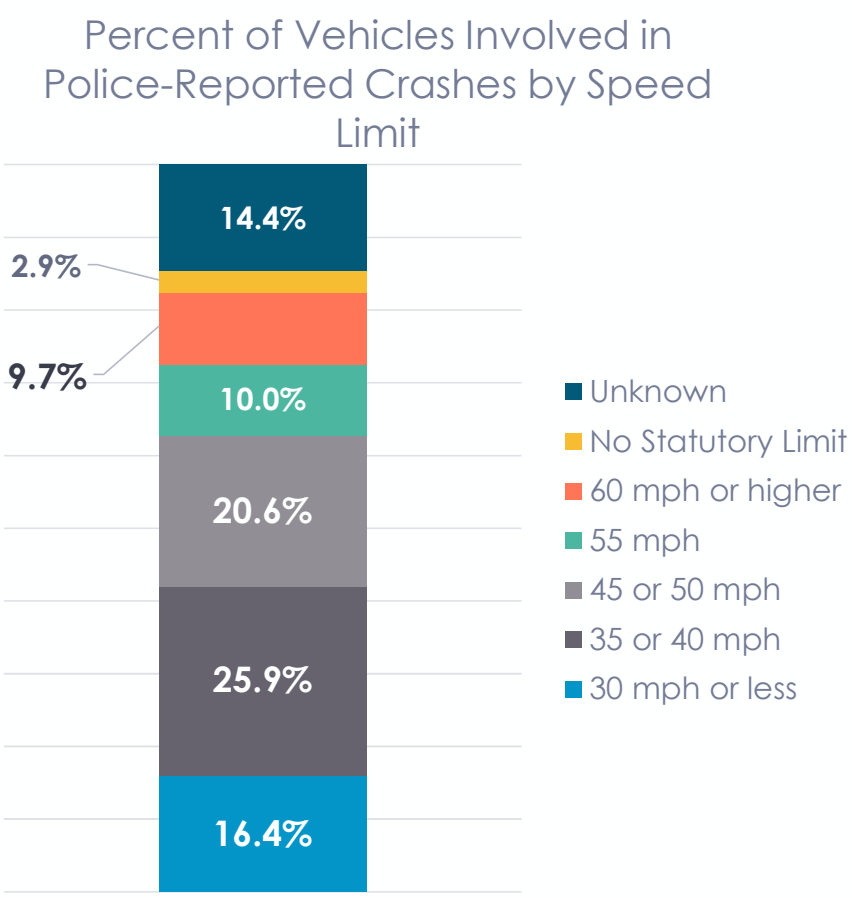
Sources: St. Louis Federal Reserve (FRED), Bureau of Labor Statistics; Insurance Information Institute.

Medical Cost Inflation Running Higher Than Overall CPI



Source: Bureau of Labor Statistics, www.bls.gov.

Police-reported Accidents by Speed Limit

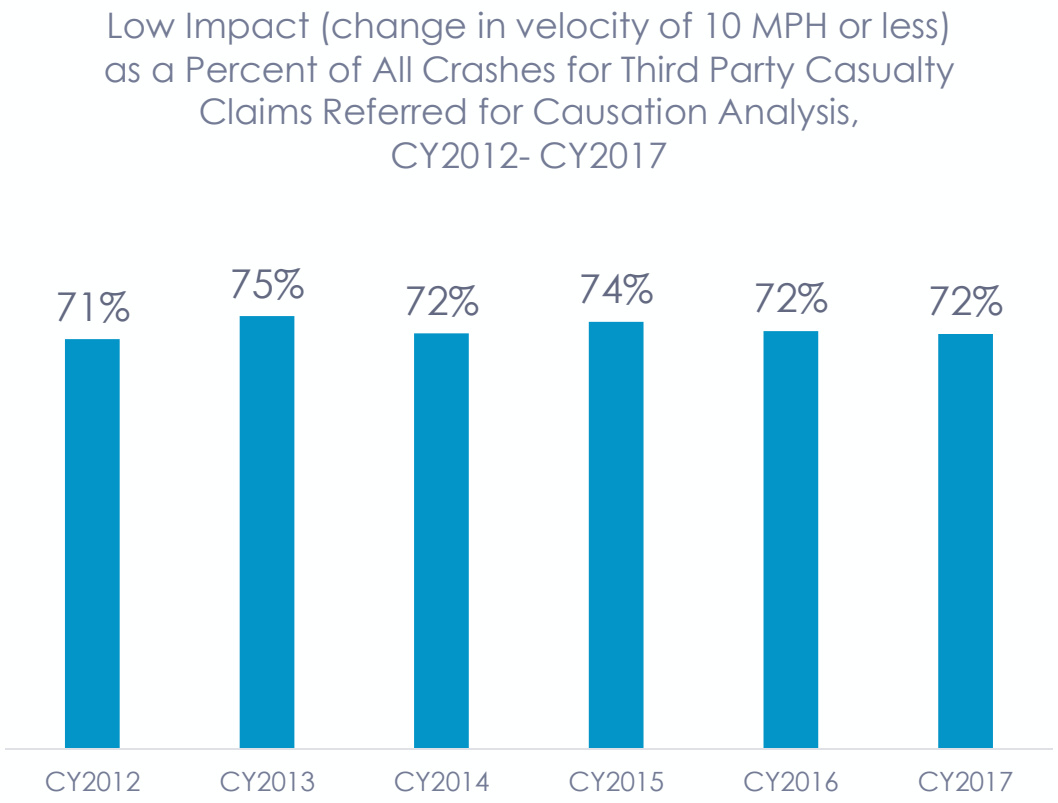


Only 16.4% of all police-reported accidents were at reported speed limit of 30 mph or less, and among injury crashes the number was higher at 23.6% for single vehicle and 13.2% for multi-vehicle

	Fatal Single Vehicle Crashes	Injury Single Vehicle Crashes	Property-Damage-Only Single Vehicle Crashes	Fatal Multiple Vehicle Crashes	Injury Multiple Vehicle Crashes	Property-Damage-Only Multiple Vehicle Crashes	TOTAL
30 mph or less	13.8%	23.6%	22.3%	6.2%	13.2%	16.0%	16.4%
35 or 40 mph	19.7%	19.4%	13.2%	15.3%	29.5%	27.5%	25.9%
45 or 50 mph	19.3%	13.7%	11.8%	20.4%	22.3%	22.1%	20.6%
55 mph	24.5%	15.5%	18.0%	27.9%	10.2%	7.8%	10.0%
60 mph or higher	18.2%	11.3%	12.8%	25.1%	9.6%	9.0%	9.7%
No Statutory Limit	0.6%	1.8%	3.8%	0.7%	2.1%	3.2%	2.9%
Unknown	3.8%	14.7%	18.1%	4.3%	12.9%	14.3%	14.4%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Source: 2015 Motor Vehicle Crash Data from FARS and GES, Table 33, page 79.

Low Impact Crashes Predominant Share of Third Party Casualty Claims Referred for Causation



Among third party casualty claims referred for causation analysis, low impact crashes (change in velocity of 10 MPH or less) as a percent of all crashes have remained relatively stable over the last several years, coming in at 72 percent in CY 2017

Source: CCC, AIS

BI Claims Diagnoses See Little Change – PIP/MedPay Similar

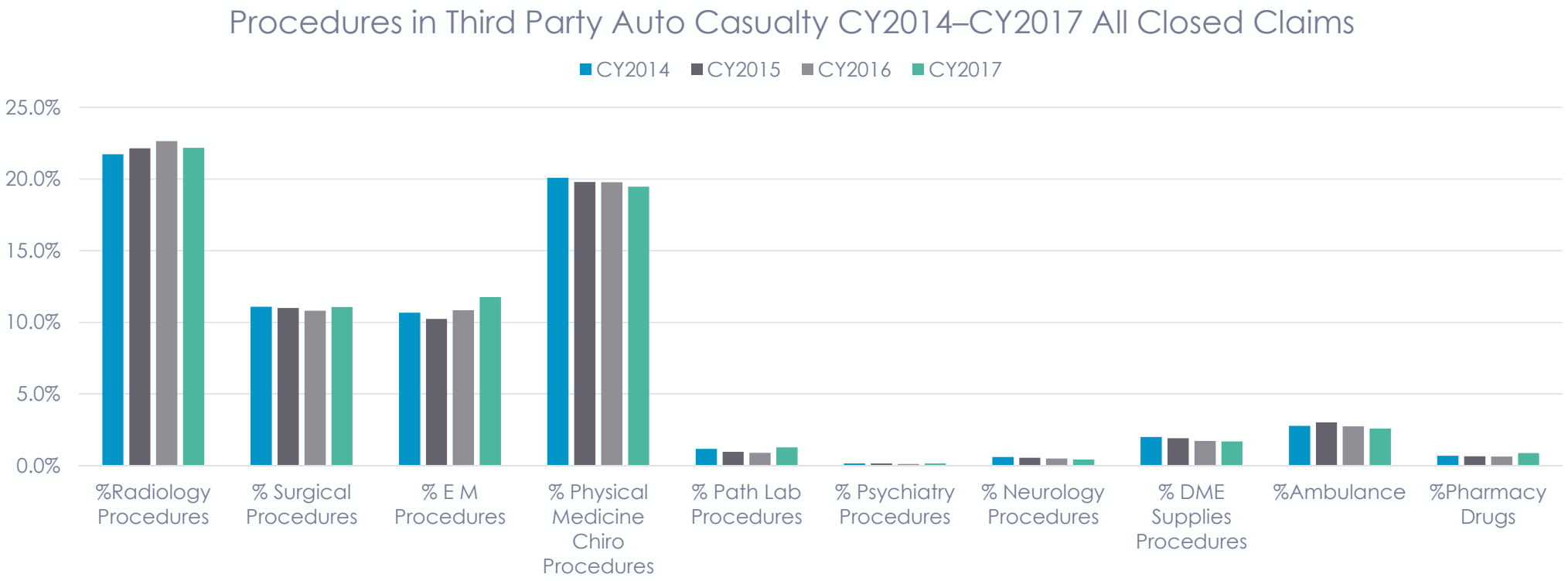
BI Claims Diagnosis Ranking Based on Dollars Charged				
	CY2014	CY2015	CY2016	CY2017
Cervicalgia	4	4	2	1
Low back pain			5	2
Sprain lig cerv spine initial enc			3	3
Sprain ligaments lumbar spn initial			7	4
Sprain ligaments t-spine initial			10	5
Strn musc fasc tendon neck levl int				6
Essential primary hypertension				7
Headache	6	7		8
Radiculopathy cervical region				9
Pain in thoracic spine				10
Neck sprain and strain	1	1	1	
Lumbar sprain and strain	2	2	6	
Thoracic sprain and strain	3	3	8	
Lumbago	5	5	9	
Spasm of muscle	7	6		
Unspecified essential hypertension	8	8		
Brachial neuritis/radiculitis nos	9	9		
Displcmt lumbar disc w/o myelopathy	10	10		
Source: Auto Injury Solutions (AIS), a CCC Company				

Top diagnoses for bodily injury claims in terms of overall dollars charged have remained consistent, with neck pain (Cervicalgia) and neck sprain and strain among the top one or two positions in the last four years

Source: Auto Injury Solutions (AIS), a CCC Company

BI Procedures Used Also See Little Change – Same for PIP/Medpay

Moderate changes in the number and share of procedures by category.

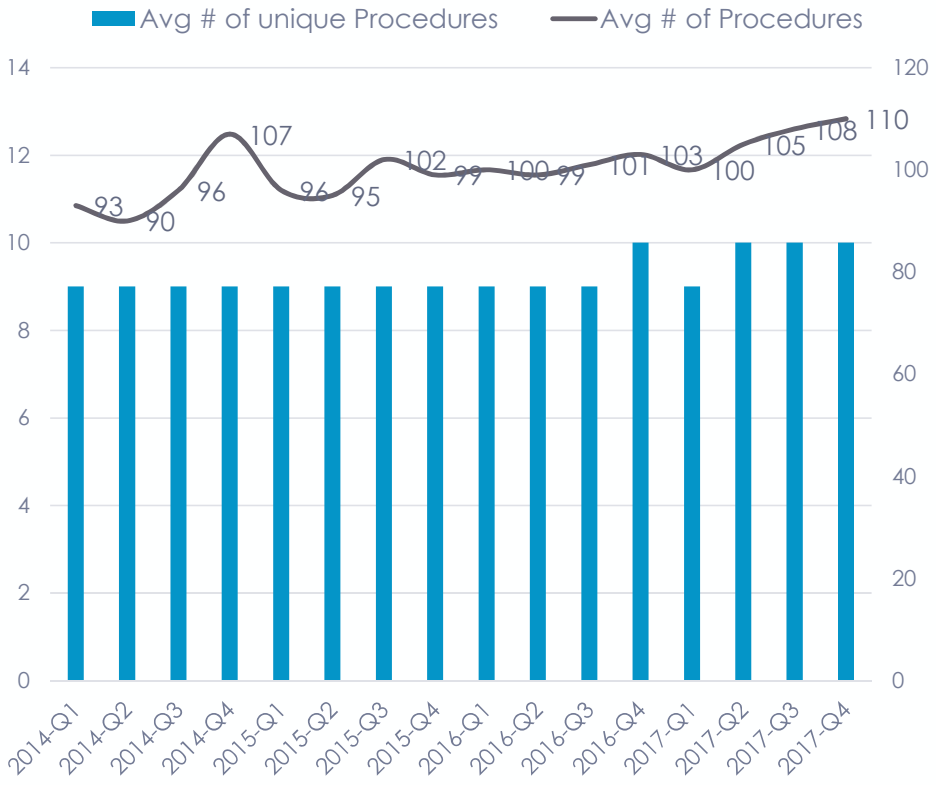


Note: Radiology procedures include CTs, MRIs and other diagnostic -xray studies.

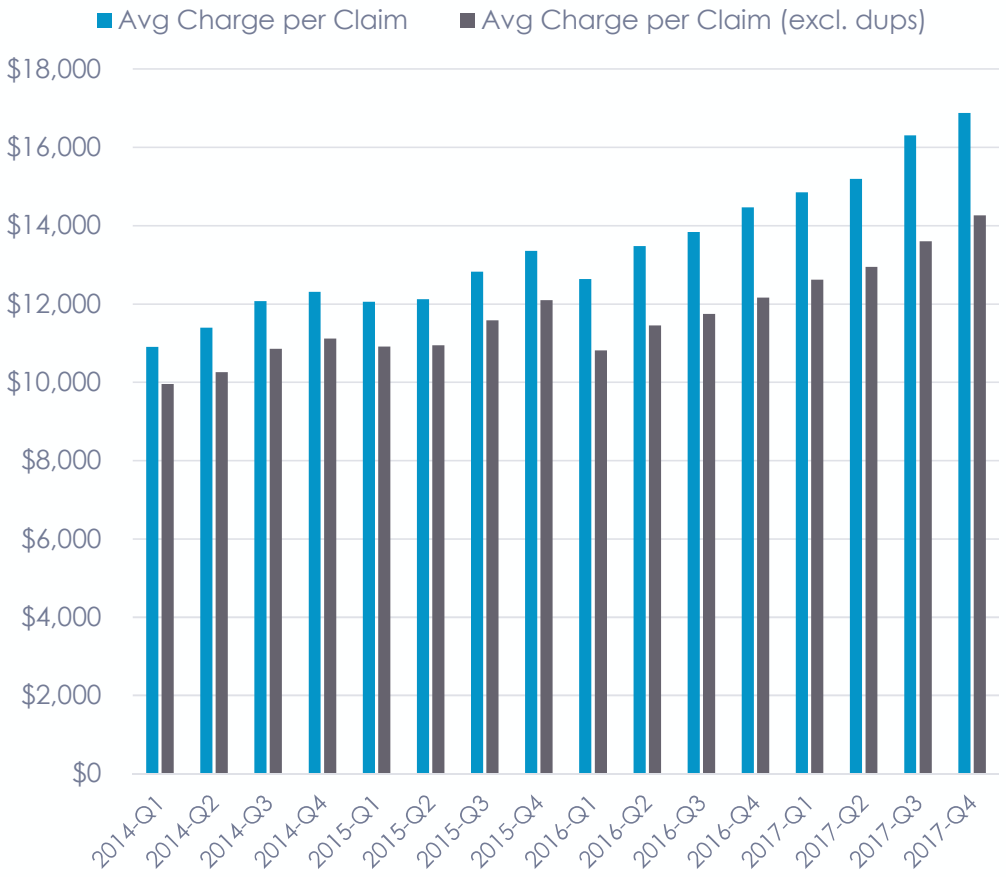
Source: Auto Injury Solutions (AIS), a CCC Company

Procedures and Fees Increasing

First Party Casualty - Average Total Number of Procedures Increasing While Average Number of Unique Procedures Remains Flat All Closed Claims CY2014-CY2017



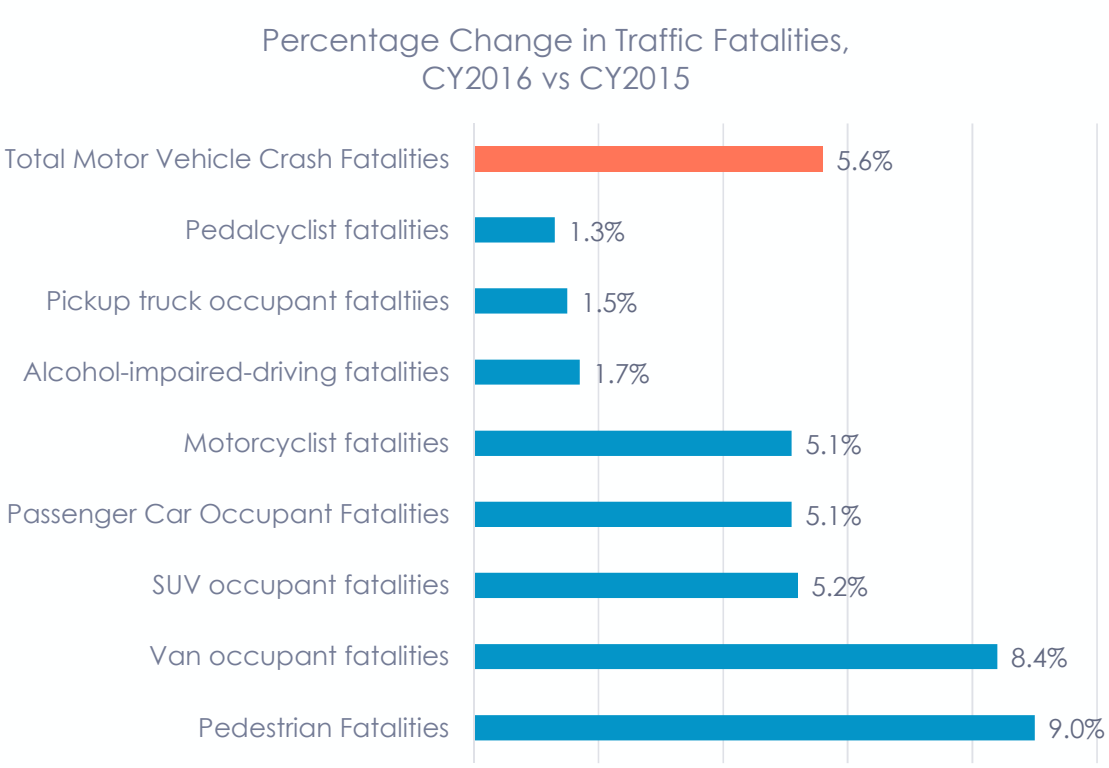
PIP/Medpay Increasing Average Charges per Claim CY2014-CY2017

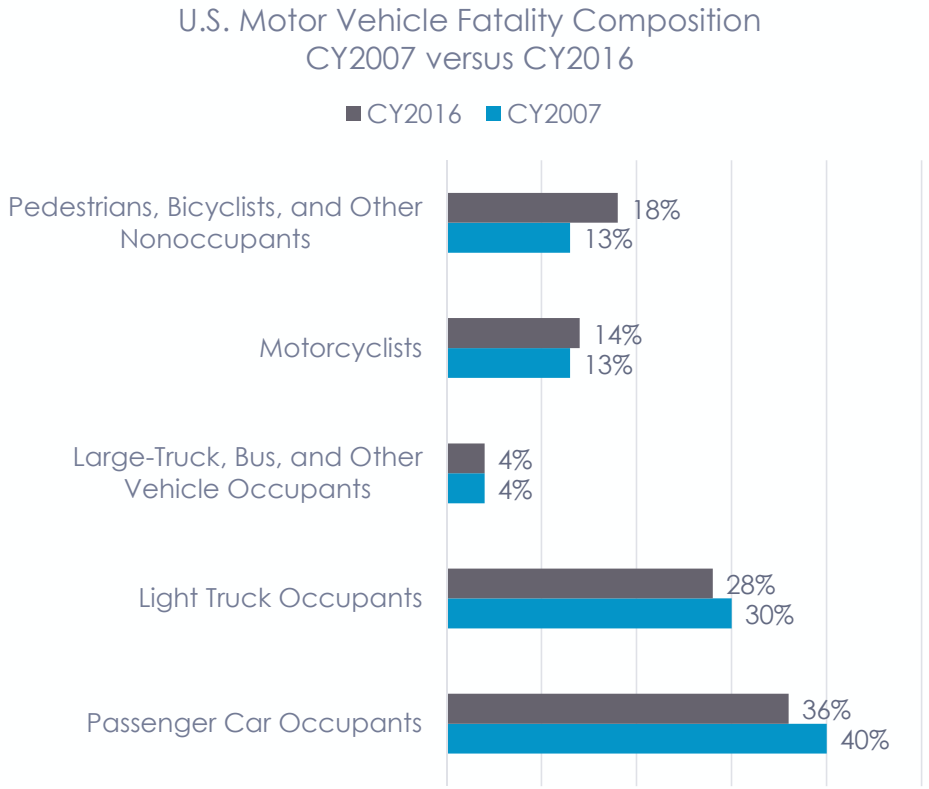


Source: Auto Injury Solutions (AIS), a CCC Company

Motor Vehicle Fatalities Outside the Vehicle Increase Most

In 2016, over 37,000 people were killed in crashes on U.S. roadways. The largest increases occurred among pedestrians and cyclists

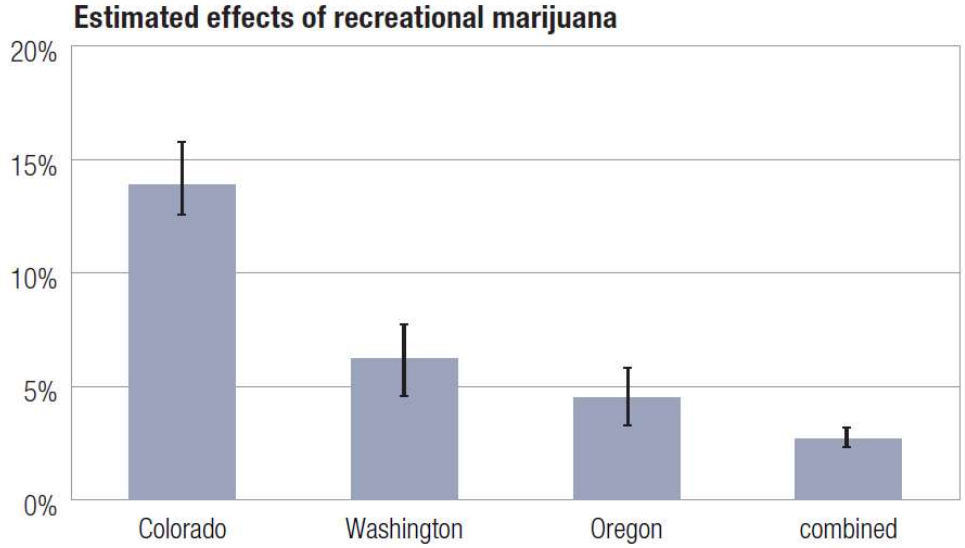




Source: US DOT NHTSA, "2016 Fatal Motor Vehicle Crashes: Overview" October 2017

Marijuana and Opiods Drive Higher Frequencies and Fatalities

- IIHS/HLDI study found collision claim frequencies higher in states with legal recreational use of marijuana than in neighboring states
- Modern marijuana contains THC levels three to four times levels in the 1980s and 90s
- The prevalence of THC metabolites detected in the blood or oral fluids of weekend nighttime drivers participating in the National Roadside Survey rose from 8.6 percent in 2007 to 12.6 percent in 2013–2014
- The percentage of fatally injured drivers who tested positive for prescription opioids rose sevenfold from 1 percent in 1995 to over 7 percent in 2015.



Sources: HLDI Bulletin Vol. 34, No. 14, April 2017. "Recreational Marijuana and collision claim frequencies. "The Health Effects of Cannabis and Cannabinoids." http://www.nap.edu/24625

The Road Ahead

- Strong new vehicle sales drive more costly complex vehicles into the VIO
  - Technology in vehicles points to longer term fewer but more expensive repairs
  - Fuel economy standards continue to drive light-weighting of vehicles and proliferation of materials
- Vehicle repair costs will increase 2-3% annually
  - Growth in volume share of newer MY vehicles where repair costs are accelerating fastest
  - Inflation in part costs and labor
- Total Loss frequency to remain elevated
  - Low scrappage rates and hangover of older vehicle fleet
  - Prices of older units remain strong, while newer unit prices have started to decline
- New crash avoidance technology slowly entering vehicle fleet
  - Questions re: liability will grow
  - Human interaction with ADAS and the how the various OEM's ADAS systems work may lead to different types of accidents
- Casualty Costs to see further increases
  - Uninsured rate has increased in U.S. for first time in a decade
  - Tax code revisions will add pressure to cut from other programs such as Medicare and Medicaid
  - Legalization of marijuana has led to higher frequency and pedestrian injury/fatalities