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16. Abstract <p>The National Highway Traffic Safety Administration (NHTSA) began to evaluate its Federal Motor Vehicle Safety Standards (FMVSS) in 1975. By December 2004, NHTSA had evaluated the life-saving benefits as well as the consumer cost for a substantial "core" group of safety technologies for passenger cars and LTVs (pickup trucks, sport utility vehicles and vans).</p> <p>In 2002, these technologies added an estimated \$11,353,000,000 (in 2002 Dollars) to the cost of new cars and LTVs of that model year. They saved an estimated 20,851 lives in the cars and LTVs on the road during that calendar year. That amounts to \$544,482 per life saved in 2002.</p> <p>These technologies added a total of \$189,842,000,000 to the consumer cost of new cars and LTVs over model years 1968-2002. They saved 252,989 lives in model year 1968 and later vehicles during calendar years 1968-2002. That amounts to \$750,782 (in 2002 Dollars) per life saved in 1968-2002.</p>					
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***COST PER LIFE SAVED
BY THE FEDERAL MOTOR VEHICLE SAFETY STANDARDS***

Two reports summarize the benefits and costs of the Federal Motor Vehicle Safety Standards (FMVSS). The first report estimates that the FMVSS and other safety technologies saved 328,551 lives in calendar years 1960-2002, including 24,561 in 2002.¹ The second report estimates that the FMVSS added \$839 (in 2002 Dollars) to the cost of a car in model year 2001 and \$711 to the cost of an LTV², smaller amounts in earlier years.³ The results of the two reports are not directly comparable, primarily because the first report includes benefits of several voluntary, pre-FMVSS and/or no-cost technologies omitted from the cost study, whereas the second report included the cost of a side-impact standard for passenger cars for which benefits have not yet been evaluated.

Nevertheless, there is a substantial *core* group of safety technologies attributable to the FMVSS for which both benefits and costs have been estimated, and the cost per life saved can be computed. The computation is not based on a complex economic analysis, but on a direct comparison of consumer cost and lives saved. The purpose is to demonstrate, at an order-of-magnitude level, the heuristic cost effectiveness of the FMVSS, not to compute an exact, societal benefit-cost ratio.

In other words, this analysis does not include any:

- Valuation, in Dollars or equivalent fatality units, for the many nonfatal injuries or crash damages avoided by the FMVSS (it strictly compares lives saved to cost).
- Discounting or net-present-value calculations, either for costs or for the “value” of lives saved.
- Projection of future lives saved by vehicles currently on the road (the FMVSS have already been paid for but the benefits will still accrue for many years until those vehicles are retired).
- Value of the lifetime additional fuel consumption due to weight added by the FMVSS.

For example, the cost of the 8 million new cars and 7.9 million new LTVs sold in model year 2002 included \$11,353,000,000 for the vehicles to meet the core FMVSS (at \$710 per car, excluding the \$129 cost of the side impact standard, and \$711 per LTV). During calendar year 2002, the core FMVSS saved 20,851 lives, some in these model year 2002 vehicles, but most in earlier vehicles already on the road before 2002. Thus, in 2002 the payment per life saved was \$544,000.

¹ Kahane, C.J., *Lives Saved by the Federal Motor Vehicle Safety Standards and Other Vehicle Safety Technologies, 1960-2002 – Passenger Cars and Light Trucks*, NHTSA Technical Report No. DOT HS 809 833, Washington, 2004.

² Light truck or van, including pickup trucks, sport utility vehicles (SUVs), minivans and full-size vans.

³ Tarbet, M.J., *Cost and Weight Added by the Federal Motor Vehicle Safety Standards for Model Years 1968-2001 in Passenger Cars and Light Trucks*, NHTSA Technical Report No. DOT HS 809 834, Washington, 2004.

The *core* group of technologies cost an estimated \$544,000 (in 2002 Dollars) per life saved in 2002, and an average of \$751,000 (in 2002 Dollars) per life saved over the longer time period, 1968-2002. These numbers indicate the FMVSS are, on the whole, highly cost-effective, far below the \$3,000,000 per life saved that the Department of Transportation considers acceptable.

Exclusions from the “core” group of safety technologies

The core group of technologies includes all those associated with regulations of greater-than-zero cost, whose benefits and costs have both been evaluated and included in the summary reports, but limited to the model years where benefits and costs are both known. The core group is most easily defined by describing what is excluded.

The cost report begins with model year 1968, because the initial FMVSS went into effect on January 1, 1968. Therefore, any benefits in vehicles before model year 1968 are excluded from the core group, even though some of the technologies were implemented before 1968 and their benefits estimated, back to calendar year 1960, in the lives-saved report.

The cost report does not include any technologies introduced on a strictly voluntary basis, even if there is a tenuous subject-matter relationship with one of the FMVSS. The following voluntary technologies, whose benefits are included in the lives-saved report, are excluded from the core group:

- Improvements to mid- and lower instrument panels that were never actually required by FMVSS 201.
- Voluntary improvements to belts and other systems that improved performance on the frontal NCAP test.
- Structural improvements in 2-door cars that reduced TTI(d) in side impact tests, on a voluntary basis, well before the dynamic test was added to FMVSS 214.

Two FMVSS are excluded because they incorporate technologies that were implemented by the manufacturers well before any regulatory process by NHTSA or other government agencies, and are for that reason considered “no cost” in the summary report on costs:

- High-penetration resistant (HPR) windshields, on all vehicles by 1966, subsequently incorporated into FMVSS 205.
- Improvements to door locks, generally completed well before 1968, subsequently regulated by FMVSS 206.

Two safety technologies are excluded because they did not result in a cost increase, and possibly even saved money. In the spirit of the cost report, we will not attribute “credit” for the lives they saved to the associated FMVSS because, at zero or negative cost, these technologies would presumably have been implemented even in the absence of the FMVSS:

- Front disc brakes, a technology related to FMVSS 105.
- Adhesive windshield bonding, a technology related to FMVSS 212.

Two technologies are excluded because they do not add anything to the consumer cost of a new car or LTV:

- Conspicuity tape for heavy trailers (FMVSS 108): car and LTV occupants benefit from not hitting the trailers, but the cost accrues on the trailers.
- Child safety seats (FMVSS 213): they must be purchased separately and are not part of the cost of a new car or LTV.

In addition, we will limit benefits to those that accrue directly to car and LTV occupants, and not include the pedestrian, bicyclist and motorcyclist lives saved by dual master cylinders on cars and LTVs.

Finally, two recent technologies are excluded because they have not been fully evaluated:

- The dynamic side-impact test requirement of FMVSS 214: cost studies have been completed, but the estimation of benefits is still underway.
- 3-point belts for rear-center occupants: benefits are included in the lives-saved report, but cost has not yet been estimated.

The “core” group of safety technologies

Despite these exclusions, a large core group of technologies remains that can be associated with specific FMVSS, and for which both costs and benefits have been estimated starting in model year 1968 or later. The following technologies significantly reduced fatalities while adding cost to new cars and/or LTVs:

- Dual master cylinders (FMVSS 105)
- Energy-absorbing steering assemblies (FMVSS 203/204)
- Every type of safety belt at any seat position (FMVSS 208), except 3-point belts for rear-center occupants. Although it is true that lap belts were widely introduced before 1968, much of the impetus came from State laws or regulations. These State laws may be considered Government actions that are “predecessors” of the FMVSS. (But only the costs and benefits from 1968 onward will be included in the core group.) Of course, the FMVSS have played a direct role in many of the improvements to belt systems after 1968 that increased their effectiveness, use and consumer acceptance.
- Frontal air bags (FMVSS 208) and on-off switches for passenger air bags in pickup trucks.
- Side door beams, regulated by the static test requirement of FMVSS 214.
- Roof crush strength, passenger cars (FMVSS 216).

In addition, the following technologies were evaluated for cost and benefit. They added to the cost of a new vehicle, and although there was not a statistically significant reduction of fatalities, there were significant benefits of reducing injuries or avoiding crashes:

- Side marker lamps (FMVSS 108)

- Center High Mounted Stop Lamps (FMVSS 108)
- Head restraints (FMVSS 202)
- Fuel system integrity (FMVSS 301)

One technology added cost, but the statistical evaluation did not identify any significant benefit:

- Seat back locks in 2-door passenger cars (FMVSS 207)

Finally, four technologies were found to add cost. No evaluations of benefit have been performed, but none are planned because there is little hope of finding a statistically significant effect in the limited crash data that would be relevant to the analysis. We will assume, conservatively, zero lives saved for these technologies:

- Windshield washers, and upgraded wipers, for LTVs (FMVSS 104)
- Safety devices for power windows (FMVSS 118)
- Accelerator-pedal return systems (FMVSS 124)
- Seatback padding to provide head impact protection for rear-seat occupants (FMVSS 201)

In other words, the core group comprises all technologies included in the Executive Summary and summary tables of the cost report except those related to the dynamic test requirements of FMVSS 214 in passenger cars (whose benefits have not been evaluated).

Consumer cost vs. lives saved

Table 1 computes the annual and cumulative consumer cost of the core group of FMVSS for passenger cars, in model years 1968-2002, in 2002 Dollars. The first column of Table 1 indicates new-car sales by model year. It is based on Polk NVPP registrations, for that model year, as of July 1 of the next calendar year.⁴ New car sales have been in the 7-11 million range annually.

The next column, the cost of all FMVSS per passenger car, is copied from the cost report.⁵ Excluding the cost of the dynamic requirement for FMVSS 214 that phased in during 1994-97, the cost of the core FMVSS increased from \$169 in 1968 to almost \$710 in 1997-2002. The total consumer cost of the FMVSS in passenger cars increased from \$1,480,000,000 in 1968 to \$5,716,000,000 in model year 2002. It amounted to \$134,798,000,000 in model years 1968-2002.

⁴ For example, MY 2002 registrations as of July 1, 2003; by then nearly all MY 2002 cars have been sold and few retired. NHTSA only has Polk files back to calendar year 1975. The numbers for MY 1968-73 are from *MVMA Motor Vehicle Facts & Figures '77*, Motor Vehicle Manufacturers Association, Detroit, 1977, p. 34 (registrations in the calendar year following the model year). They are also derived from Polk data, but NHTSA's numbers for 1974 and 1975 are only 97.9% of MVMA's numbers; thus, the MVMA numbers for 1968-73 have also been multiplied by .979.

⁵ The cost for 2002 is assumed to be the same as in 2001 (the last year in the cost report), since there was little or no change in the specific FMVSS considered in the cost report.

TABLE 1 – PASSENGER CARS: COST OF THE FMVSS, MODEL YEARS 1968-2002
(in 2002 Dollars)

MODEL YEAR	NEW CAR SALES	FMVSS COST PER CAR			COST OF THE CORE FMVSS
		ALL	EXCLUDED	CORE	
1968	8,742,568	\$169.24	\$ 0.00	\$169.24	\$1,480,000,000
1969	9,106,883	216.05	0.00	216.05	\$1,968,000,000
1970	8,704,374	236.02	0.00	236.02	\$2,054,000,000
1971	8,730,816	241.47	0.00	241.47	\$2,108,000,000
1972	9,948,136	268.24	0.00	268.24	\$2,668,000,000
1973	11,036,182	291.23	0.00	291.23	\$3,214,000,000
1974	9,649,885	301.97	0.00	301.97	\$2,914,000,000
1975	7,611,961	299.54	0.00	299.54	\$2,280,000,000
1976	9,452,325	312.58	0.00	312.58	\$2,955,000,000
1977	10,267,394	306.66	0.00	306.66	\$3,149,000,000
1978	10,573,362	302.85	0.00	302.85	\$3,202,000,000
1979	10,277,491	299.58	0.00	299.58	\$3,079,000,000
1980	8,707,110	298.26	0.00	298.26	\$2,597,000,000
1981	8,127,671	297.87	0.00	297.87	\$2,421,000,000
1982	7,303,353	297.25	0.00	297.25	\$2,171,000,000
1983	7,657,122	297.61	0.00	297.61	\$2,279,000,000
1984	10,407,770	297.66	0.00	297.66	\$3,098,000,000
1985	10,531,723	298.29	0.00	298.29	\$3,142,000,000
1986	10,694,040	299.50	0.00	299.50	\$3,203,000,000
1987	10,380,058	338.32	0.00	338.32	\$3,512,000,000
1988	10,303,489	380.42	0.00	380.42	\$3,920,000,000
1989	9,728,781	421.31	0.00	421.31	\$4,099,000,000
1990	8,695,605	596.71	0.00	596.71	\$5,189,000,000
1991	8,100,316	593.10	0.00	593.10	\$4,804,000,000
1992	7,739,082	607.59	0.00	607.59	\$4,702,000,000
1993	8,201,002	650.01	0.00	650.01	\$5,331,000,000
1994	8,150,339	752.09	12.71	739.38	\$6,026,000,000
1995	9,178,951	777.93	31.94	745.99	\$6,847,000,000
1996	7,695,487	782.84	51.38	731.46	\$5,629,000,000
1997	8,049,242	838.81	128.94	709.87	\$5,714,000,000
1998	7,714,249	839.18	129.44	709.74	\$5,475,000,000
1999	8,177,224	839.16	129.41	709.75	\$5,804,000,000
2000	8,882,145	839.29	129.58	709.71	\$6,304,000,000
2001	8,092,939	839.13	129.35	709.78	\$5,744,000,000
2002	8,053,834	839.13	129.35	709.78	\$5,716,000,000
	=====				=====
	314,672,909				\$134,798,000,000

Table 2 estimates the lives of passenger car occupants saved by the core group of FMVSS. The first column of Table 2, copied from Table 2-4 of the lives-saved report, estimates that 232,255 lives were saved in calendar years 1960-2002 by all of the safety technologies considered in that report, in cars of any model year. Two steps reduce those numbers to the benefits of just the core FMVSS. The middle column shows lives saved by all of the technologies, but only in cars of model year 1968 and later. The same model as in Part 2 of the lives-saved report, but with the data limited to model year 1968 and later, generates those estimates.⁶ In the early years, a substantial proportion of the lives saved are in pre-1968 cars, but by the 1980's the first two columns are quite similar, because most of the pre-1968 cars have been retired. The lives saved by the core group of FMVSS, shown in the last column, is obtained by deducting that model's estimates for the voluntary, pre-FMVSS, no-cost and other safety technologies excluded from the core group. In 2002, 11,851 of the total 14,175 lives saved are included in the core group of FMVSS; altogether, 176,614 of 232,255 lives saved are in the core group.

Tables 3 and 4 compute the costs and benefits of the core FMVSS in LTVs. The first column of Table 3 indicates that new-LTV sales increased from 1.5 million in 1968 to nearly 8 million in 2002.⁷ All of the LTV FMVSS in the cost report are included in the core group; the cost of the core FMVSS per LTV is copied from the cost report.⁸ The consumer cost of the FMVSS in LTVs increased from \$158,000,000 in 1968 to \$5,637,000,000 in model year 2002, adding up to \$55,044,000,000 in model years 1968-2002.

The first column of Table 4, copied from Table 2-4 of the lives-saved report, estimates that 94,117 lives were saved in LTVs during calendar years 1960-2002 by all of the safety technologies in all model years. When the analysis is limited to LTVs of model years 1968+, the estimate drops to 93,296. The core group of FMVSS saved 76,245 of these lives in 1968-2002. In 2002 alone, 9,000 of the total 10,331 lives saved are included in the core group.

⁶ The 252 lives saved in 1968 include 12 lives saved during CY 1967 in MY 1968 cars sold before January 1, 1968. These 12 were added to the 240 lives actually saved in calendar year 1968 for more direct comparability with the cost estimate (cost of the FMVSS for MY 1968 cars).

⁷ Estimates for MY 1974-2002 are based on Polk NVPP registrations, for that model year, as of July 1 of the next calendar year. The numbers for MY 1968-73 are from *MVMA Motor Vehicle Facts & Figures '77*, p. 35. The MVMA numbers include heavy trucks as well as LTVs; they are multiplied by .938 to make them comparable to subsequent NVPP numbers for LTVs only. Furthermore, the NVPP file for LTV registrations on July 1, 1977 is not available to NHTSA. We used the registrations of MY 1976 LTVs on July 1, 1978, multiplied by 1.0027 (the inverse of the average attrition of MY 1974 and 1977 LTVs from the first to the second calendar year after the model year).

⁸ The cost for 2002 is assumed to be the same as in 2001, since there was little or no change in the specific FMVSS considered in the cost report.

TABLE 2 – PASSENGER CARS: LIVES SAVED BY SAFETY TECHNOLOGIES,
CALENDAR YEARS 1960-2002

CALENDAR YEAR	LIVES SAVED BY SAFETY TECHNOLOGIES		
	ALL	ALL (MY 68+)	CORE FMVSS
1960	92	0	0
1961	95	0	0
1962	110	0	0
1963	131	0	0
1964	168	0	0
1965	211	0	0
1966	288	0	0
1967	444	0	0
1968	719	252	169
1969	1,042	586	395
1970	1,279	867	585
1971	1,574	1,180	793
1972	1,984	1,591	1,073
1973	2,282	1,921	1,303
1974	2,220	1,958	1,356
1975	2,723	2,492	1,786
1976	2,852	2,659	1,880
1977	3,190	3,015	2,065
1978	3,501	3,360	2,285
1979	3,657	3,546	2,337
1980	3,848	3,764	2,445
1981	3,758	3,697	2,374
1982	3,394	3,337	2,173
1983	3,534	3,494	2,286
1984	3,943	3,909	2,634
1985	5,196	5,160	3,767
1986	6,827	6,786	5,167
1987	7,783	7,751	5,975
1988	8,733	8,702	6,759
1989	8,677	8,652	6,763
1990	8,684	8,666	6,789
1991	8,943	8,926	7,074
1992	9,007	8,994	7,146
1993	9,916	9,903	7,982
1994	10,626	10,612	8,578
1995	11,115	11,108	8,957
1996	12,076	12,068	9,785
1997	12,146	12,138	9,866
1998	12,325	12,319	10,128
1999	12,401	12,393	10,140
2000	13,052	13,044	10,689
2001	13,532	13,526	11,258
2002	14,175	14,168	11,851
	=====	=====	=====
	232,255	226,543	176,614

TABLE 3 – LTVs: COST OF THE FMVSS, MODEL YEARS 1968-2002
(in 2002 Dollars)

MODEL YEAR	NEW LTV SALES	CORE (ALL) FMVSS COST PER LTV	COST OF THE CORE FMVSS
1968	1,483,642	\$106.58	\$158,000,000
1969	1,765,168	106.64	\$188,000,000
1970	1,629,097	115.95	\$189,000,000
1971	1,674,141	116.24	\$195,000,000
1972	2,238,132	142.26	\$318,000,000
1973	2,654,790	154.61	\$410,000,000
1974	2,573,930	160.79	\$414,000,000
1975	2,012,141	160.87	\$324,000,000
1976	2,688,814	162.27	\$436,000,000
1977	3,170,915	173.14	\$549,000,000
1978	3,463,941	189.14	\$655,000,000
1979	3,701,137	191.06	\$707,000,000
1980	2,167,721	195.96	\$425,000,000
1981	1,861,330	196.63	\$366,000,000
1982	1,996,118	206.92	\$413,000,000
1983	2,339,221	212.12	\$496,000,000
1984	3,557,322	214.28	\$762,000,000
1985	3,943,446	216.33	\$853,000,000
1986	4,488,215	216.81	\$973,000,000
1987	4,162,249	233.52	\$972,000,000
1988	4,598,016	232.58	\$1,069,000,000
1989	4,525,434	232.42	\$1,052,000,000
1990	3,869,770	236.15	\$914,000,000
1991	3,977,269	250.26	\$995,000,000
1992	4,077,077	294.29	\$1,200,000,000
1993	4,861,491	308.55	\$1,500,000,000
1994	5,677,239	389.49	\$2,211,000,000
1995	5,934,273	547.71	\$3,250,000,000
1996	5,407,762	612.52	\$3,312,000,000
1997	6,125,244	658.58	\$4,034,000,000
1998	6,331,463	705.27	\$4,465,000,000
1999	7,189,531	708.22	\$5,092,000,000
2000	7,410,544	709.39	\$5,257,000,000
2001	7,389,764	710.86	\$5,253,000,000
2002	7,929,365	710.86	\$5,637,000,000
=====			=====
	138,875,712		\$55,044,000,000

TABLE 4 – LTVs: LIVES SAVED BY SAFETY TECHNOLOGIES,
CALENDAR YEARS 1960-2002

CALENDAR YEAR	LIVES SAVED BY SAFETY TECHNOLOGIES		
	ALL	ALL (MY 68+)	CORE FMVSS
1960	22	0	0
1961	22	0	0
1962	25	0	0
1963	28	0	0
1964	34	0	0
1965	38	0	0
1966	46	0	0
1967	55	0	0
1968	80	22	16
1969	114	60	43
1970	136	92	63
1971	161	124	81
1972	194	161	100
1973	238	208	128
1974	244	222	138
1975	272	251	162
1976	324	306	188
1977	409	395	238
1978	462	448	260
1979	561	549	304
1980	608	596	300
1981	614	602	318
1982	585	576	304
1983	641	635	353
1984	815	804	483
1985	1, 118	1, 107	749
1986	1, 620	1, 606	1, 174
1987	2, 115	2, 105	1, 576
1988	2, 457	2, 439	1, 865
1989	2, 741	2, 733	2, 132
1990	2, 957	2, 948	2, 317
1991	3, 188	3, 180	2, 530
1992	3, 417	3, 408	2, 763
1993	3, 818	3, 813	3, 139
1994	4, 469	4, 462	3, 698
1995	4, 942	4, 931	4, 096
1996	5, 679	5, 673	4, 754
1997	6, 356	6, 350	5, 362
1998	6, 998	6, 988	5, 938
1999	7, 486	7, 480	6, 365
2000	8, 682	8, 676	7, 479
2001	9, 016	9, 012	7, 830
2002	10, 331	10, 330	9, 000
	=====	=====	=====
	94, 117	93, 296	76, 245

Finally, Table 5 compares the consumer cost and lives saved by the core group of FMVSS for cars and LTVs, combined. Adding the right columns of Tables 1 and 3, the first column of Table 5 shows the core FMVSS added a total of \$189,842,000,000 to the consumer cost of new cars and LTVs in model years 1968-2002. They saved 252,989 lives in model year 1968+ cars during calendar years 1968-2002 (sum of 176,614 from Table 2 and 76,245 from Table 4). That averages out to a cost of \$750,782 per life saved in 1968-2002.

In 2002 alone, the core FMVSS added \$11,353,000,000 to the cost of new cars and LTVs of that model year. They saved 20,851 lives in the cars and LTVs on the road during that calendar year. They cost \$544,482 per life saved. The cost per life saved generally decreased from year to year during 1968-2002, primarily because belt use increased: the more people buckle up, the more benefit the public will obtain from equipment they have already paid for whether they use it or not.

TABLE 5 – CONSUMER COST AND LIVES SAVED BY THE CORE FMVSS,
 CARS + LTVs, 1968-2002
 (in 2002 Dollars)

YEAR	COST OF THE CORE FMVSS	LIVES SAVED	
1968	\$1,638,000,000	185	
1969	\$2,156,000,000	438	
1970	\$2,243,000,000	648	
1971	\$2,303,000,000	874	
1972	\$2,986,000,000	1,173	
1973	\$3,624,000,000	1,431	
1974	\$3,328,000,000	1,494	
1975	\$2,604,000,000	1,948	
1976	\$3,391,000,000	2,068	
1977	\$3,698,000,000	2,303	
1978	\$3,857,000,000	2,545	
1979	\$3,786,000,000	2,641	
1980	\$3,022,000,000	2,745	
1981	\$2,787,000,000	2,692	
1982	\$2,584,000,000	2,477	
1983	\$2,775,000,000	2,639	
1984	\$3,860,000,000	3,117	
1985	\$3,995,000,000	4,516	
1986	\$4,176,000,000	6,341	
1987	\$4,484,000,000	7,551	
1988	\$4,989,000,000	8,624	
1989	\$5,151,000,000	8,895	
1990	\$6,103,000,000	9,106	
1991	\$5,799,000,000	9,604	
1992	\$5,902,000,000	9,909	
1993	\$6,831,000,000	11,121	
1994	\$8,237,000,000	12,276	
1995	\$10,097,000,000	13,053	
1996	\$8,941,000,000	14,539	
1997	\$9,748,000,000	15,228	
1998	\$9,940,000,000	16,066	
1999	\$10,896,000,000	16,505	
2000	\$11,561,000,000	18,168	
2001	\$10,997,000,000	19,088	
2002	\$11,353,000,000	20,851	\$544,482 per life saved in 2002
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	\$189,842,000,000	252,859	\$750,782 per life saved in 1968-2002