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## The need to improve information on road user type in National Vital Statistics System mortality data

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### Abstract

**Objectives:** Both the National Vital Statistics System (NVSS) and the Fatality Analysis Reporting System (FARS) can be used to examine motor vehicle crash (MVC) deaths. These 2 data systems operate independently, using different methods to collect and code information about the type of vehicle (e.g., car, truck, bus) and road user (e.g., occupant, motorcyclist, pedestrian) involved in an MVC. A substantial proportion of MVC deaths in NVSS are coded as “unspecified” road user, which reduces the utility of the NVSS data for describing burden and identifying prevention measures. This study aimed to describe characteristics of unspecified road user deaths in NVSS to further our understanding of how these groups may be similar to occupant road user deaths.

**Methods:** Using data from 1999 to 2015, we compared NVSS and FARS MVC death counts by road user type, overall and by age group, gender, and year. In addition, we examined factors associated with the categorization of an MVC death as unspecified road user such as state of residence of decedent, type of medical death investigation system, and place of death.

**Results:** The number of MVC occupant deaths in NVSS was smaller than that in FARS in each year and the number of unspecified road user deaths in NVSS was greater than that in FARS. The sum of the number of occupant and unspecified road user deaths in NVSS, however, was approximately equal to the number of FARS occupant deaths. Age group and gender distributions were roughly equivalent for NVSS and FARS occupants and NVSS unspecified road users. Within NVSS, the number of MVC deaths listed as unspecified road user varied across states and over time. Other categories of road users (motorcyclists, pedal cyclists, and pedestrians) were consistent when comparing NVSS and FARS.

**Conclusions:** Our findings suggest that the unspecified road user MVC deaths in NVSS look similar to those of MVC occupants according to selected characteristics. Additional study is needed to identify documentation and reporting challenges in individual states and over time and to identify opportunities for improvement in the coding of road user type in NVSS.

## Keywords

Motor vehicle crash; fatality; vital statistics; WISQARS; FARS

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## Introduction

Motor vehicle crashes (MVCs) are a leading cause of death among those aged 1–54 years in the United States Centers for Disease Control and Prevention [CDC] 2016). Though the United States has made tremendous improvement in reducing MVC deaths in the 21st century, with a 31% decrease in the MVC death rate per 100,000 people between 2000 and 2013, the United States still has the highest rate compared to 19 other high-income countries (Sauber-Schatz et al. 2016). The number of MVC deaths was lowest in 2014 (32,744) but has increased in recent years; in 2016, 37,461 people died from MVC-related injuries, a 5.6% increase from 2015 (35,485; NHTSA 2015).

Surveillance plays an important role in understanding the burden of a problem and informing the implementation and development of appropriate and effective public health interventions. In the United States, 2 national data systems provide data for monitoring MVC deaths: the National Vital Statistics System (NVSS) and the National Highway Traffic Safety Administration (NHTSA) Fatality Analysis Reporting System (FARS). NVSS, coordinated and managed by the National Center for Health Statistics (NCHS), contains information from death certificates filed in all 50 states and the District of Columbia (NCHS 2017). FARS, which has provided national data on fatal crashes since 1975, captures detailed information on MVC deaths from a variety of sources, including death certificates, but also reports from police, coroners/medical examiners, hospitals, and emergency medical services. These 2 data systems operate independently, using different methods to collect and code data.

In both systems, MVC deaths are categorized based on the type of road user (e.g., motor vehicle [MV] occupant, motorcyclist, pedal cyclist [e.g., bicycle rider], or pedestrian) involved. These categories are critical for building targeted prevention programs. Due to differences in reporting and classification methodologies, however, the categorization of a death by road user type varies between NVSS and FARS. For example, compared to FARS, NVSS has a larger proportion of deaths categorized as “unspecified” road user. It is well known that most MVC deaths in the United States are MV occupants (i.e., drivers or passengers; Beck et al. 2007; NHTSA 2017). The NVSS data system has a lower count of MVC occupant deaths than would be expected when compared to other sources. Therefore, it may be that a majority of the unspecified road users are, in fact, MVC occupant deaths. This study seeks to describe the low count of MVC occupant deaths in NVSS. Further, it explores the unspecified road user deaths in NVSS by first comparing death counts between NVSS and FARS over a 17-year period. The study also examines the category of NVSS unspecified road users in detail to ascertain characteristics of the decedents (e.g., age, gender, state, location of death) and factors related to death investigation and certification (e.g., autopsy status, state medical death investigation system) that might be associated with the categorization of an MVC death to unspecified road user instead of to a specific road

user type (MV occupant, motorcyclist, pedal cyclist [e.g., bicycle rider], or pedestrian). Ascertaining the characteristics of the decedents and death investigation systems may indicate ways to improve the quality and completeness of the information provided on death certificates.

## Methods

### Data sources

NVSS data for MVC deaths for 1999–2015 were accessed by using WISQARS (CDC, National Center for Injury Prevention and Control 2017; age group, sex, and road user type) and WONDER (CDC 2017; place of death, autopsy status, state of residence of decedent, and road user type). FARS data for MVC deaths for 1999–2015 were accessed through data tables on the FARS website (NHTSA n.d.). NVSS has used the *International Classification of Diseases*, 10th revision (ICD-10) since 1999 to classify causes of death and the full listing of MVC-related codes is available (CDC, NCHS 2002). MVC deaths are identified and categorized as to road user type based on the underlying cause of death (CDC, NCHS 2002; Minino et al. 2006). NVSS road user types include MV occupant, motorcyclist, pedal cyclist, pedestrian, and unspecified. FARS includes categories for MV occupant, motorcyclist, pedal cyclist, pedestrian, and other/ unknown nonmotorist.

### Analyses

We compared the number of NVSS MVC deaths by road user type (MV occupant, motorcyclist, pedal cyclist, pedestrian, unspecified) with FARS counts and calculated the ratio of NVSS/FARS reported deaths. Frequency distributions by sex and age group are presented for NVSS occupants, NVSS unspecified road users, and FARS occupants. Within the NVSS data, to identify possible factors that might contribute to the assignment of an NVSS MVC death to the unspecified road user category, we compared the ratio of NVSS unspecified to NVSS occupant deaths by autopsy status (whether or not one was performed; available only from 2003 to 2015), place of death (at home; at a medical facility [medical facility–inpatient, medical facility–outpatient or emergency room, medical facility–dead on arrival, medical facility–status unknown, hospice facility, nursing home or long-term care facility]; or unknown/other place of death), and the type of death investigation system in the decedent’s state of residence (CDC 2015). State death investigation systems typically consist of either a coroner system, a medical examiner system, or a combination of the two. Coroners are usually elected and are not required to be physicians. Medical examiners are usually appointed and must be physicians. The systems can be centralized (a state medical examiner office that consolidates cases from the state); a county-based system with a mixture of medical examiner and coroner offices (counties in the state have either medical examiners or coroners); county- or district-based medical examiner offices (state uses medical examiners who are based in counties or districts); or county/district-based coroner offices (state uses coroners who are based in counties or districts). Different systems and staff investigating and certifying specific types of death may contribute to inconsistent reporting in the cause of death. To provide information about changes to the death certificate during the time period evaluated during this study, we indicated whether the death certificate process was revised during the study period for each state (Appendix, see online

supplement). We also examined the frequency of the ICD- 10 underlying cause-of-death codes for NVSS unspecified road users. MV occupant deaths were identified in WISQARS using ICD-10 codes V30-V39 (.4-.9), V40-V49 (.4-.9), V50-V59 (.4-.9), V60-V69 (.4-.9), V70-V79 (.4-.9), V83-V86 (.0-.3); MV unspecified road user deaths were identified using ICD-10 codes: V87 (.0-.8), V89.2.

To examine whether NVSS reporting of user type changed over time by state, we calculated the ratio of unspecified to occupant deaths for each state for three 3- year periods (1999–2001, 2006–2008, and 2013–2015). A ratio greater than 1 indicates more deaths assigned as unspecified road user than deaths assigned as MV occupant; a ratio less than 1 indicates more deaths assigned as MV occupant than deaths assigned as unspecified road user. Given that this analysis is largely descriptive and aims to show general differences or similarities in characteristics, statistical comparisons were not performed.

## Results

The number of MVC deaths by road user type as reported in NVSS and FARS for 1999–2015 is shown in Table 1. Overall, the ratio of MVC deaths reported in NVSS to MVC deaths reported in FARS was 1.02, with NVSS reporting 10,822 more MVC deaths during the study period than FARS. For deaths involving pedestrians and motorcyclists, the overall 1999–2015 numbers were similar between NVSS and FARS (ratio of NVSS to FARS counts of 1.02 and 0.93, respectively). The NVSS/FARS ratio for pedal cyclists was 0.85 and the ratio for occupants was 0.52.

For each year from 1999 through 2015, the number of MVC occupant deaths identified in FARS was greater than the number identified in NVSS (Table 2). The number of MVC occupant deaths in FARS approximated the sum of occupant and unspecified road user deaths in NVSS. For example, in 1999, there were 33,392 occupant deaths in FARS and 33,542 occupant plus unspecified road user deaths in NVSS, for a difference of 150 deaths. The number of NVSS deaths coded as unspecified road user remained relatively constant through 2014 and peaked in 2015. NVSS deaths coded as occupants declined from a peak of 21,344 deaths in 2002 to 8,313 deaths in 2015.

The distribution of deaths across age groups and gender was similar between NVSS occupants, NVSS unspecified road users, and FARS occupants (Table 3). Approximately two thirds of the NVSS occupants, NVSS unspecified, and FARS occupants decedents were male.

Within NVSS, the ratio of unspecified to occupant deaths was higher if the death occurred in a medical facility or at home than at “other” locations (1.08, 1.10, and 0.90, respectively; Table 4). The ratio of unspecified to occupant deaths was higher in states with a county/district coroner system (1.21) and lower in states with a county/district medical examiner system (0.78) and higher for deaths that did not have an autopsy (1.15) than for deaths that had an autopsy (1.00).

There was variation in the ratio of NVSS MVC unspecified to occupant deaths between states and over time (Table 5). In 2013–2015, states with the lowest ratios (<0.4) included

Idaho, Maine, South Dakota, Vermont, Washington, and Wisconsin and states with the highest ratios (>4.0) included Arizona, Connecticut, Louisiana, Massachusetts, Pennsylvania, South Carolina, and Tennessee. Forty-five states saw an increase in the ratio (indicating more deaths classified as unspecified) from the first (1999–2001) to the third (2013–2015) time period; 6 states saw a decrease (Alaska, District of Columbia, Idaho, New Hampshire, Oregon, and Vermont).

We examined the frequency of the ICD-10 underlying cause of death codes for the 17,008 NVSS unspecified road user deaths in 2015. Two codes accounted for 98% of the deaths. Nearly 70% (11,813 deaths) of the MVC unspecified road user deaths in 2015 were coded as V89.2 (“Person injured in unspecified motor vehicle accident, traffic”), and more than a quarter (4,768 deaths, 28%) were assigned an underlying cause of death code of V87.7 (“Person injured in collision between other specified motor vehicles [traffic]”). The percentage of deaths assigned an underlying cause code of V87.7 or V89.2 varied by state. In 2013–2015, nearly one quarter of all MVC deaths in Arkansas (22.4%) and Missouri (22.3%) were assigned an underlying cause code of V87.7. Approximately half or more of the MVC deaths in Alabama (48.5%), Connecticut (52.9%), Kansas (48.2%), Montana (48.1%), Oklahoma (48%), Tennessee (55.1%), and Wyoming (52.1%) were assigned an underlying cause code of V89.2.

## Discussion

We found that NVSS had a higher number of MVC deaths in which the road user type was listed as unspecified and a lower than expected count of MVC occupant deaths (i.e., lower than expected from FARS data). However, the sum of occupant and unspecified death counts in NVSS for each year from 1999 to 2015 approximates the number of MVC occupant deaths counted in FARS. The number of deaths for other categories of road users (motorcyclists, pedal cyclists, and pedestrians) was consistent when comparing NVSS and FARS. The number of MVC deaths in which the road user type was listed as unspecified varied by state and over time.

The percentage of road user types that are unspecified has previously been noted when examining mortality surveillance across countries (Bhalla et al. 2010; Lu et al. 2007). In both studies, the overall proportion of unspecified unintentional injuries was low in the United States, though the proportion of unspecified transport and road injuries was significantly higher than would be expected. A case study of the coding of MVC deaths in New York also found a substantial proportion of unspecified road users (Thihalolipavan et al. 2011).

The NVSS data file used for statistical analysis is based on information gathered from death certificates. Most MVC deaths are investigated by a coroner or medical examiner, who then completes and submits the death certificate to the state vital registrar. States provide death certificate information to NCHS, where coding software and trained nosologists assign the ICD-10 codes for underlying and contributory causes of death based on the literal text and other information provided on the death certificate (CDC, NCHS 2003). The death investigation and certification process can vary substantially within and between states

because some states have a centralized death investigation system, whereas other states have a county- or district-level system. Moreover, some states use medical examiners, who are often physicians trained in forensic pathology, whereas other states use coroners, who are typically elected officials and often are not physicians. Variation also exists in state training requirements; some states have no training requirements, whereas other states require coroners to be physicians (Hanzlick 2007, 2014). Our study examined the differences between these systems and found that there appeared to be a difference in reporting of occupant versus unspecified based on the type of death investigation system. The ratio of NVSS unspecified to occupant deaths was high in the group of states with a county/district-based coroner (1.21) and low in the group of states with a county/district-based medical examiner (0.78).

The literal text on the death certificate, particularly the descriptions of the causes of death and how the injury occurred, determine the coding of the underlying and multiple causes of death. Three key pieces of information are required to assign a completely specified MVC ICD-10 code to the death: (1) The decedent's mode of transportation (e.g., car, truck, motorcycle, bicycle, pedestrian), (2) the type of crash or second object involved in the crash (e.g., car, fixed object, noncollision), and (3) the role or position of the decedent (e.g., driver, passenger, on the outside of the vehicle, boarding/alighting, or unspecified occupant; CDC, NCHS 2003). For the crash to receive an occupant code, the decedent must be defined as an occupant ("unspecified occupant" is sufficient) and the mode of transportation must be specified ("unspecified motor vehicle" is not sufficient). Coding rules require that if a vehicle type (e.g., car, truck, van) is not specified in the literal text, then the death is assigned one of the V87 codes (traffic accident of specified type but victim's mode of transport unknown) or to V89.2 (person injured in unspecified motor vehicle accident, traffic). The V87 and V89.2 codes do not have subsets that would allow subsequent identification of the road user type (e.g., driver, passenger, occupant), even if that information is available in the literal text of the death certificate. Efforts are needed to inform medical examiners, coroners, and other death certifiers on the importance of the specificity regarding the type of vehicle (e.g., car, truck) and the decedent's role (e.g., driver, passenger, occupant) in MVC deaths on the death certificate.

We found that the assignment of unspecified codes varied substantially by state and the lack of specificity appeared to increase over time. Users of the NVSS data should be aware of these differences when conducting state-to-state comparisons. Additional study is needed to identify documentation and reporting challenges in individual states and over time and to identify opportunities for improvement in the coding of road user type in the NVSS. The NVSS is a fundamental source of cause-of-death information and is widely used to estimate the burden of injuries in the United States. As such, enhancing specificity is critical to inform evidence-based motor vehicle crash prevention programs.

## Limitations

We did not directly link FARS and NVSS MVC deaths. Though this additional step would have confirmed whether deaths with no road user type specified in NVSS were categorized as occupants in FARS, linking the publicly available data sets is not possible because



decedents in both data sets were de-identified. WISQARS and WONDER systems report deaths according to the decedent's legal residence at the time of death, and we categorized the state system based on this assignment, but the person could have died in another state. FARS captures deaths within 30 days of a crash. NVSS does not impose a time limit on the days between crash and death; therefore, NVSS may code more deaths than FARS as MVC related.

## Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

## Acknowledgments

Disclaimer

The findings and conclusions in this article are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

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**Table 1.**

Type of road user in MVC deaths, NVSS and FARS, United States, 1999–2015.

Road user type	NVSS	FARS	Difference (NVSS – FARS)	Ratio NVSS/FARS
Motorcyclists	67,432	72,353	-4,921	0.93
Pedestrians	82,271	80,454	1,817	1.02
Pedal cyclists	10,291	12,140	-1,849	0.85
Occupants	254,387	485,511	-231,124	0.52
Other	184	—	—	—
Other/unknown nonmotorist	—	2,898	—	—
Unspecified	249,612	—	—	—
Total	664,177	653,355	10,822	1.02

**Table 2.** Number of MVC occupant and unspecified road user deaths, NVSS and FARS, United States, 1999–2015.

Year	NVSS MVC occupant	NVSS MVC unspecified	NVSS MVC occupant and unspecified combined	FARS MVC occupant	Difference (NVSS MVC combined – FARS MVC occupant)	Ratio of NVSS MVC combined/FARS MVC occupant
1999	18,326	15,216	33,542	33,392	150	1.00
2000	18,649	15,459	34,108	33,451	657	1.02
2001	19,270	14,775	34,045	33,243	802	1.02
2002	21,344	13,961	35,305	34,105	1,200	1.04
2003	20,720	13,476	34,196	33,627	569	1.02
2004	19,965	14,040	34,005	33,276	729	1.02
2005	19,125	14,617	33,742	33,070	672	1.02
2006	18,277	14,962	33,239	32,119	1,120	1.03
2007	16,560	15,178	31,738	30,527	1,211	1.04
2008	13,677	14,192	27,869	26,791	1,078	1.04
2009	12,349	13,273	25,622	24,526	1,096	1.04
2010	10,246	14,320	24,566	23,371	1,195	1.05
2011	10,891	13,288	24,179	22,510	1,669	1.07
2012	9,948	14,715	24,663	23,017	1,646	1.07
2013	8,629	15,388	24,017	22,483	1,533	1.07
2014	8,098	15,744	23,842	22,307	1,535	1.07
2015	8,313	17,008	25,321	23,695	1,626	1.07

**Table 3.**

Percentage distribution of MVC occupant and unspecified road user deaths by sex and age group, NVSS and FARS, United States, 1999–2015.

	NVSS MVC occupants ( <i>n</i> = 254,387)	NVSS MVC unspecified ( <i>n</i> = 249,612)	FARS MVC occupants ( <i>n</i> = 485,511)
<b>Sex</b>			
Males	66.2	66.7	66.1
Females	33.8	33.3	33.9
<b>Total</b>	100.0	100.0	100.0
<b>Age group (years)</b>			
00–04	1.4	1.3	1.4
05–09	1.2	1.1	1.2
10–15	2.7	2.2	2.5
16–20	14.8	13.6	14.7
21–24	10.8	10.5	11.0
25–34	16.3	16.3	16.6
35–44	13.8	13.7	13.8
45–54	12.5	12.7	12.5
55–64	9.1	9.7	9.3
65–74	7.2	7.6	7.1
>74	10.2	11.3	9.7
Unknown age	0	0	0.2
<b>Total</b>	100.0	100.0	100.0

**Table 4.**

Ratio of unspecified road user type to occupant, NVSS, United States, 1999–2015.

<b>Place of death</b>	<b>NVSS MVC occupants</b>	<b>NVSS MVC unspecified</b>	<b>Ratio NVSS unspecified/NVSS occupant</b>
Medical facility	104,440	113,118	1.08
Decedent's home	2,110	2,314	1.10
Other	146,483	132,157	0.90
Unknown	1,354	2,023	1.49
<b>State death investigation system</b>			
Centralized state medical examiner	39,540	42,121	1.06
County-based mixture of medical examiner and coroner	124,989	119,836	0.96
County/district-based coroner	40,863	49,381	1.21
County/district-based medical examiner	48,995	38,274	0.78
<b>State medical examiner</b>			
Yes	84,751	86,214	1.02
No	169,636	163,398	0.96
<b>Autopsy status (2003–2015)</b>			
Not performed	84,291	96,878	1.15
Performed	80,288	80,145	1.00
Unknown	12,219	13,178	1.08

Table 5.

Ratio of MVC unspecified to occupant deaths, by state, NVSS, United States, 1999–2015.<sup>a</sup>

State	1999–2001		2006–2008		2013–2015		2015 Percentage of MVC deaths coded:	
	Ratio: Unspecified road user to occupant		Ratio: Unspecified road user to occupant		Ratio: Unspecified road user to occupant		UCOD V87.7 <sup>b</sup>	UCOD V89.2 <sup>c</sup>
Alabama	2.77	2.12	3.16	13.3	48.5			
Alaska	3.24	3.05	3.03	16.9	23.7			
Arizona	4.27	5.63	6.56	9.6	47.6			
Arkansas	0.85	1.24	2.91	22.4	36.7			
California	0.75	1.08	1.50	12.0	21.6			
Colorado	1.52	1.93	3.23	14.5	34.4			
Connecticut	6.23	7.98	15.00	6.2	52.9			
Delaware	1.23	0.91	2.37	17.5	25.4			
District of Columbia	1.43	0.69	1.23	*	*			
Florida	0.42	0.13	2.18	10.0	28.9			
Georgia	1.89	2.03	2.39	14.6	39.1			
Hawaii	0.88	1.43	1.80	0.0	19.2			
Idaho	0.30	0.10	0.27	10.0	12.8			
Illinois	0.64	0.92	1.75	14.0	29.6			
Indiana	0.84	1.53	2.13	9.2	42.6			
Iowa	0.15	0.07	0.88	16.8	30.6			
Kansas	0.39	0.14	0.98	13.7	48.2			
Kentucky	1.26	1.74	2.60	16.3	40.0			
Louisiana	3.73	3.53	4.05	15.0	42.7			
Maine	0.20	0.11	0.38	*	11.1			
Maryland	1.01	0.42	1.12	3.7	29.4			
Massachusetts	2.82	3.40	4.57	13.6	36.3			
Michigan	0.78	1.66	2.52	16.5	30.2			
Minnesota	0.39	0.18	1.24	13.5	22.8			
Mississippi	0.11	0.13	0.59	8.8	24.5			
Missouri	1.47	0.31	3.32	22.3	39.3			

State	2015 Percentage of MVC deaths coded:				
	1999–2001	2006–2008	2013–2015	UCOD V87.7 <sup>b</sup>	UCOD V89.2 <sup>c</sup>
Montana	0.22	0.12	1.45	12.6	48.1
Nebraska	0.13	0.15	1.09	17.6	24.5
Nevada	1.25	1.49	2.59	10.8	31.7
New Hampshire	1.51	0.59	1.36	11.5	26.9
New Jersey	1.31	2.01	1.98	11.4	26.6
New Mexico	0.17	0.18	0.45	7.5	18.1
New York	0.84	0.99	1.37	11.9	20.9
North Carolina	0.22	0.46	3.67	14.5	41.1
North Dakota	0.46	0.63	2.36	21.8	37.8
Ohio	1.35	1.99	1.56	12.9	27.4
Oklahoma	1.69	6.04	2.08	2.6	48.0
Oregon	0.77	0.36	0.41	4.4	9.8
Pennsylvania	2.28	2.79	4.23	18.6	43.2
Rhode Island	0.28	0.83	1.54	0.0	30.8
South Carolina	1.03	2.60	5.43	19.6	40.5
South Dakota	0.09	0.07	0.14	*	*
Tennessee	0.20	0.37	4.77	9.5	55.1
Texas	0.83	0.98	2.26	18.5	30.5
Utah	1.59	1.27	2.35	16.7	31.6
Vermont	1.17	0.48	0.38	*	*
Virginia	0.80	1.66	2.11	8.9	41.5
Washington	0.06	0.09	0.37	13.1	15.6
West Virginia	2.08	2.21	2.44	18.5	41.5
Wisconsin	0.11	0.06	0.14	1.9	4.7
Wyoming	0.60	1.24	2.26	14.9	52.1

<sup>a</sup>UCOD = Underlying cause of death. A ratio greater than 1 indicates more deaths assigned as unspecified road user than deaths assigned as MV occupant. A ratio less than 1 indicates more deaths assigned as MV occupant than deaths assigned as unspecified road user.

<sup>b</sup>V87.7 = Person injured in collision between other specified motor vehicles (traffic).

<sup>c</sup>V89.2 = Person injured in unspecified motor vehicle accident, traffic.

\* Cases assigned V89.2 or V87.7 codes were <20.

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