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Non-Fatal Work-Related Road Traffic Injuries During the Work Shift in Ecuador: A Descriptive Study of Social Security-Affiliated Workers

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ABSTRACT

Work-related road traffic injuries occurring during the work shift (in-mission injuries) represent an important but under-researched component of occupational health, particularly in middle-income settings. This study aimed to describe the frequency, relative severity, and epidemiological patterns of non-fatal in-mission occupational road traffic injuries among workers affiliated with the Ecuadorian Social Security system. A retrospective cross-sectional study was conducted using certified occupational accident records from the Ecuadorian Social Security Institute (IESS) for 2023–2024. The analysis included 2,363 certified non-fatal in-mission road traffic injuries. Three indicators were examined: absolute and relative frequencies for all certified cases, relative severity defined as the proportion of cases resulting in medically certified temporary disability, and incidence rates based on temporary-disability cases per 100,000 affiliated workers, using the mean affiliated population from the June 2023 and June 2024 registries as the denominator. A total of 2,363 cases were identified. Overall relative severity was 73.5%, and the pooled incidence rate of temporary-disability cases was 30.4 per 100,000 affiliates. Men accounted for 76.1% of cases and showed higher relative severity and incidence than women. Workers aged 25–34 years represented the largest proportion of cases and the highest incidence rate, whereas workers aged ≤24 years showed the highest relative severity. Guayas concentrated the largest share of cases, while Esmeraldas had the highest incidence rate and Imbabura the highest relative severity. Across economic activities, financial and insurance activities and real estate activities accounted for the largest proportions of cases, whereas the highest incidence rates were observed in real estate activities, electricity and gas, and financial and insurance activities. Among social security-affiliated workers in Ecuador, non-fatal in-mission road traffic injuries represent a relevant occupational health burden and support the more targeted integration of work-related road safety into occupational risk management.

1. INTRODUCTION

Occupational injuries remain a major public health concern and impose a substantial burden on social protection systems worldwide [1]. Within this context, road traffic injuries (RTIs) are especially relevant because they disproportionately affect the working-age population and remain a leading cause of premature mortality and disability, particularly in low- and middle-income countries [2, 3].

Work-related RTIs represent a specific and complex dimension of occupational morbidity. Unlike injuries occurring in stationary workplaces, these events arise from the interaction between road exposure and work organization [4]. Evidence indicates that factors such as time pressure, production demands, route-related hazards, and psychosocial stressors may increase crash risk in occupational settings [4, 5]. Accordingly, work-related RTIs should not be understood simply as random traffic events, but rather as outcomes potentially influenced by working conditions and organizational safety practices [4, 5].

From both epidemiological and preventive perspectives, it is important to distinguish between commuting crashes (in itinere) and those occurring during the work shift (in-mission) [6-9]. Commuting crashes occur during travel between the worker's residence and the workplace, whereas in-mission crashes take place during the performance of work-related tasks [7, 9]. This distinction is not merely terminological, as in-mission events are more directly linked to work activity and to preventive measures that may fall within the employer's sphere of responsibility [4, 7, 8]. For this reason, in-mission RTIs may be more amenable to occupational safety and health (OSH) interventions, including route planning, workload management, and work organization measures [4, 5].

In Ecuador, available studies have mainly addressed fatal work-related events, selected economic sectors, age-related patterns in occupational injuries, or the lethality of commuting

accidents [9-12]. By contrast, epidemiological evidence specifically addressing non-fatal road traffic injuries occurring during the work shift remains limited.

This gap restricts the identification of priority groups, high-burden provinces, and economic activities in which work-related mobility may represent a relevant but under-recognized source of occupational injury burden [1, 4, 13, 14]. To address this gap, the present study aimed to describe the frequency, relative severity, and incidence patterns of non-fatal in-mission occupational road traffic injuries among workers affiliated with the Ecuadorian Social Security system during 2023–2024, according to demographic, occupational, geographic, and temporal characteristics.

2. METHODS

2.1 Study design and data source

A retrospective, nationwide, registry-based cross-sectional study was conducted using certified occupational accident records from Ecuador. The reporting of the study followed the STROBE statement [15] and the RECORD extension for studies based on routinely collected health data [16]. Data were obtained from an anonymized administrative database provided by the General Directorate of Occupational Risks (GDOR) of the Ecuadorian Social Security Institute (IESS). The database included all certified occupational accidents recorded between January 1, 2023, and December 31, 2024, and validated in accordance with national social security regulations [13].

2.2 Identification and selection of work-related travel accidents

The analysis was restricted to certified occupational accidents classified in the GDOR-IESS registry as occurring during the work shift (in-mission), while commuting accidents (in itinere) were excluded. Within this subset of certified in-mission occupational accidents, road traffic injuries were identified using ICD-10 external cause codes V01–V99 [17]. Thus, the classification of an event as in-mission was based on the occupational accident certification process recorded in the administrative database, whereas ICD-10 coding was used to identify the road traffic nature of the injury. The database did not allow further disaggregation into specific crash subtypes, such as pedestrians, motorcyclists, or vehicle occupants. However, it did include information on the nature and anatomical location of injuries, which enabled clinical characterization of the cases. The final analytic dataset comprised 2,363 certified non-fatal in-mission occupational road traffic injuries.

2.3 Study population

The study population comprised workers affiliated with the GDOR of the IESS. By the end of 2024, this population included approximately 3.29 million workers, representing 38.7% of the Economically Active Population (EAP) in Ecuador [18]. The affiliated population was predominantly male (57.8%) and geographically concentrated in the provinces of Pichincha (28.8%) and Guayas (25.4%). By economic activity, the services sector accounted for the largest proportion of affiliates (49.5%).

2.4 Variables and indicators

The primary unit of analysis was the certified non-fatal in-mission occupational road traffic injury. The following variables were examined: year of occurrence, sex, age group (≤24, 25–34, 35–44, 45–64, and ≥65 years), province of occurrence, and economic activity. Temporal characteristics included month, day of the week, and hour of occurrence.

Temporary disability (TD), defined as medically certified work absence of at least one day, was used as a proxy indicator of relative severity.

Three complementary indicators were calculated. First, frequency was described using absolute and relative distributions of all certified cases. Second, relative severity was defined as the proportion of cases resulting in temporary disability. Third, incidence was estimated as a population-burden indicator based on temporary-disability cases, using the following formula: IR = (number of in-mission road traffic injuries with temporary disability during 2023–2024 / mean affiliated population in June 2023 and June 2024) × 100,000. For sex-, age-, province-, and economic activity-specific incidence rates, the same approach was applied using the corresponding stratum-specific numerators and denominators. Because the available denominator reflects affiliated population counts rather than direct measures of road exposure or person-time at risk, these incidence rates should be interpreted as indicators of burden within the affiliated workforce rather than as direct estimates of individual crash risk.

2.5 Statistical analysis

Data cleaning and consistency checks were performed before analysis to ensure internal coherence and dataset integrity. A descriptive analysis was conducted for the overall 2023–2024 period. In accordance with the descriptive aim of the study, no causal modeling or multivariable inferential analysis was performed. All analyses were conducted using Microsoft Excel (version 16.78).

2.6 Bias and limitations

The study has several limitations inherent to the use of administrative records. First, the database did not include individual-level measures of road exposure, such as mileage, travel duration, or frequency of work-related travel. Accordingly, the incidence rates should be interpreted as indicators of population burden rather than as direct estimates of individual risk. Second, the use of routinely collected administrative data may involve variability in data quality, incomplete recording, or underreporting. Third, the findings reflect only workers affiliated with the IESS and therefore cannot be extrapolated to the entire Economically Active Population of Ecuador, particularly to workers in informal employment.

2.7 Ethical considerations

This study was based on a secondary anonymized administrative database. In accordance with the Organic Law on Personal Data Protection [19] and international ethical principles for research involving human data [20], no direct identification of individuals was possible. Administrative authorization for the use of the database and implementation

of the study was formally granted by the GDOR-IESS. Given the use of anonymized secondary data and the absence of direct participant involvement, formal ethics committee review was not required under the applicable institutional and regulatory framework.

3. RESULTS

Table 1 presents the distribution, relative severity, and incidence rates of non-fatal in-mission road traffic injuries (RTIs) in Ecuador during 2023–2024. A total of 2,363 cases were recorded, with an overall relative severity of 73.5% and an incidence rate of 30.4 per 100,000 affiliates. The annual distribution was similar, with 1,213 cases (51.3%) in 2023 and 1,150 (48.7%) in 2024. Relative severity remained stable over years (73.2% in 2023 vs. 73.6% in 2024), whereas the incidence rate showed a slight decline from 31.2 to 29.6 per 100,000 affiliates.

Table 1. Distribution (n, %), relative severity (%TD), and incidence rates (IR) of non-fatal in-mission by demographic and geographic characteristics in Ecuador (2023–2024)

Sociodemographic Characteristics	n (%)	%TD[a]	IR[b]
Overall	2363 (100)	73.5	30.4
Years			
2023	1213 (51.3)	73.2	31.2
2024	1150 (48.7)	73.6	29.6
Sex			
Men	1798 (76.1)	77.4	40.3
Women	565 (23.9)	69.5	16.1
Age group (years)			
≤ 24	127 (5.4)	78.9	18.1
25–34	934 (39.5)	77.9	39.1
35–44	721 (30.5)	65.1	33.3
45–64	560 (23.7)	69.8	24.3
≥ 65	21 (0.9)	75.9	13.3
Educational level			
No formal education	20 (0.8)	75.4	—
Lower secondary	180 (7.6)	79.8	—
Upper secondary	1533 (64.9)	77.3	—
Post-secondary	550 (23.3)	65.4	—
Undergraduate	80 (3.4)	69.6	—
Nationality			
Ecuadorian	2361 (99.9)	73.8	—
Other nationalities	2 (0.08)	72.9	—
Marital status			
Single	1146 (48.5)	74.3	—
Married	959 (40.6)	69.1	—
Cohabiting	22 (0.9)	74.2	—
Divorced	220 (9.3)	77.2	—
Widowed	16 (0.7)	73.1	—
Provinces			
Azuay	134 (5.7)	74.3	29.0
Esmeraldas	74 (3.1)	60.1	55.0
Guayas	912 (38.6)	80.1	44.4
Imbabura	60 (2.5)	89.1	44.5
Los Ríos	70 (3.0)	80.6	42.8
Manabí	110 (4.7)	58.5	18.7
Pichincha	606 (25.6)	70.6	22.1
Other provinces (< 50 cases)	397 (16.8)	73.3	34.1

Notes: absolute (n) and relative (%n) frequency; [a] Relative severity: proportion of accidents resulting in medically certified temporary disability (≥ 1 day); [b] Incidence rate temporary disability per 100,000 affiliates. Dashes (—) indicate IR was not calculated due to the absence of a reliable population denominator.

Men accounted for most cases (76.1%) and showed both higher relative severity (77.4%) and a higher incidence rate (40.3 per 100,000 affiliates) than women (23.9%, 69.5%, and 16.05 per 100,000 affiliates, respectively). By age group, the largest proportion of cases occurred among workers aged 25–34 years (39.5%), followed by those aged 35–44 years (30.5%) and 45–64 years (23.7%). The highest incidence rate was also observed in the 25–34-year group (39.05 per 100,000 affiliates), followed by the 35–44-year (33.3) and 45–64-year (24.25) groups. In contrast, the highest relative severity was observed among workers aged ≤24 years (78.9%), despite this group representing only 5.4% of all cases.

Regarding educational level, most cases occurred among workers with upper secondary education (64.9%), followed by those with post-secondary education (23.3%). Relative severity was highest among workers with lower secondary education (79.8%) and upper secondary education (77.3%). Nearly all cases involved Ecuadorian nationals (99.9%). By marital status, the highest proportions were observed among single (48.5%) and married (40.6%) workers, whereas the highest relative severity was recorded among divorced workers (77.2%).

At the provincial level, Guayas accounted for the largest share of cases (38.6%), followed by Pichincha (25.6%) and the group of other provinces with fewer than 50 cases (16.8%). However, the highest incidence rate was observed in Esmeraldas (55.0 per 100,000 affiliates), followed by Imbabura (44.5) and Guayas (44.4). The highest relative severity was recorded in Imbabura (89.1%), followed by Los Ríos (80.6%) and Guayas (80.1%). Although Pichincha contributed one-quarter of all cases, it showed a comparatively lower incidence rate (22.1 per 100,000 affiliates) and a relative severity of 70.6%.

Table 2. Distribution (n, %), relative severity (%TD), and incidence rates (IR) of non-fatal in-mission by economic activities in Ecuador (2023–2024)

Economic Activities (ISIC/Ecuador)	n (%)	%TD[a]	IR[b]
Agriculture, forestry, and fishing	47 (2.0)	71.5	7.3
Mining and quarrying	20 (0.8)	97.0	32.3
Manufacturing	30 (1.3)	24.0	1.0
Electricity, gas	159 (6.7)	79.5	296.7
Water supply	39 (1.7)	79.5	60.1
Construction	18 (0.8)	72.5	7.3
Wholesale and retail trade	343 (14.5)	77.5	25.2
Transportation and storage	92 (3.9)	78.0	25.5
Accommodation and food	257 (10.9)	72.5	85.2
Information and communication	160 (6.8)	76.0	103.2
Financial and insurance activities	430 (18.2)	80.0	223.0
Real estate activities	388 (16.4)	68.5	375.8
Professional, scientific	28 (1.2)	67.5	6.8
Administrative and support	127 (5.4)	66.5	24.3
Public administration	155 (6.6)	69.0	14.6
Human health and social	1 (0.04)	–	–
Arts, entertainment	15 (0.6)	80.5	33.0
Other service activities	54 (2.3)	56.5	23.2

Notes: absolute (n) and relative (%n) frequency; a Relative severity: proportion of accidents resulting in medically certified temporary disability (≥1 day); b Incidence rate of temporary-disability cases per 100,000 affiliates. Dashes (–) indicate IR was not calculated due to the absence of a reliable population denominator. Very high IR values in some activities should be interpreted cautiously because small affiliated populations may inflate stratum-specific rates.

Table 2 reveals substantial variation in non-fatal in-mission RTIs across economic activities. The highest proportions of cases were observed in financial and insurance activities (18.2%), real estate activities (16.4%), and wholesale and retail trade (14.5%). Relative severity was highest in mining and quarrying (97.0%), followed by arts, entertainment, and recreation (80.5%) and financial and insurance activities (80.0%). The highest incidence rates were recorded in real estate activities (375.8 per 100,000 affiliates), electricity and gas (296.7), and financial and insurance activities (223.0), whereas the lowest were observed in manufacturing (1.0), professional and scientific activities (6.8), and agriculture and construction (7.3 each). These unusually high rates in some strata should be interpreted cautiously, as they may reflect the combination of relatively few temporary-disability cases with comparatively small affiliated populations in those economic activities.

Figure 1 illustrates the temporal distribution of non-fatal in-mission RTIs in Ecuador during 2023–2024. Monthly frequencies were broadly stable, suggesting no marked seasonal concentration of events, while relative severity varied only modestly across the year. By day of the week, the burden was concentrated on weekdays, with the highest frequencies observed on Tuesday and Thursday, whereas weekend frequencies were substantially lower. Across the day, cases clustered within standard working hours, rising from the early morning and reaching their highest levels between late morning and mid-afternoon before declining in the evening. Relative severity was comparatively stable across weekdays and daytime hours but showed greater fluctuation during low-frequency nighttime periods.

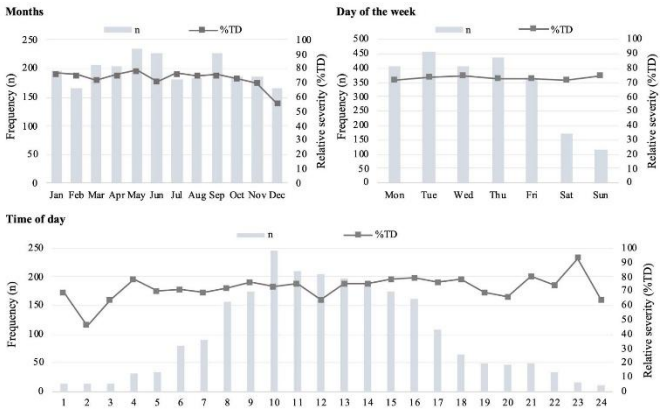

Figure 1. Distribution (n) and relative severity (%TD) of non-fatal in-mission according to month, day of the week, and time of occurrence in Ecuador (2023–2024)

Notes: Bars indicate absolute frequency (n), and the line indicates relative severity (%TD), defined as the percentage of cases resulting in medically certified temporary disability (≥1 day).

Figure 2 shows that the neck was the most frequently affected anatomical region (776 cases; 32.8%), followed by the knees and legs (389; 16.5%), ankles and feet (310; 13.1%), and head (215; 9.1%). The remaining regions each accounted for less than 10% of cases. Relative severity varied across anatomical regions. The highest %TD values were observed in the elbows and forearms (82.9%), knees and legs (82.0%), and wrists and hands (79.1%), whereas the neck showed a lower relative severity (65.1%) despite concentrating the largest share of injuries. Overall, the anatomical distribution was dominated by cervical and lower-limb injuries, while the highest relative severity was observed in upper- and lower-limb regions.

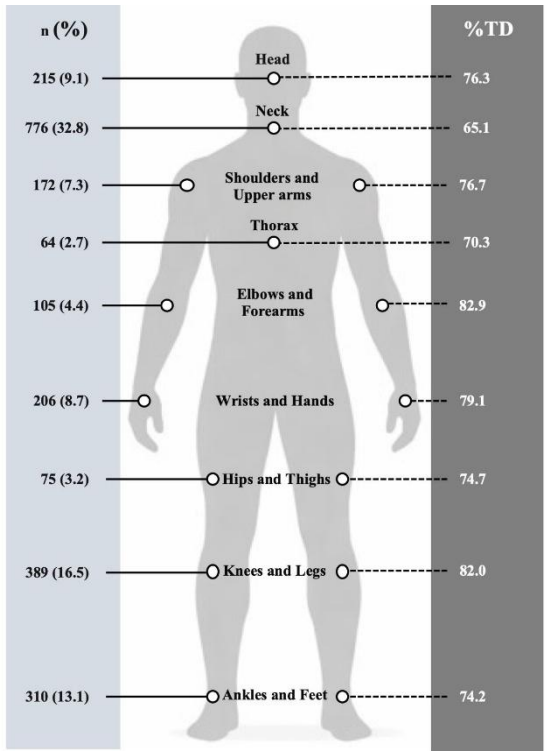

Figure 2. Distribution (n, %), and relative severity (%TD) of non-fatal in-mission by anatomical region in Ecuador (2023–2024)

Note: values are presented as n (%). %TD indicates the percentage of cases with temporary disability leave. Abdomen, lumbosacral area, and pelvis accounted for 51 cases (2.2%), of which 68.6% involved temporary disability leave.

4. DISCUSSION

This study provides a descriptive characterization of work-related road traffic injuries occurring during the work shift (in-mission) among social security-affiliated workers in Ecuador and shows that these events constitute a relevant component of the occupational injury burden. Rather than representing isolated incidents, the observed pattern suggests that in-mission road traffic injuries should be understood within the intersection between occupational exposure to mobility demands and the broader road environment, in line with previous literature [4, 5].

In terms of magnitude, the findings are broadly consistent with international evidence identifying road traffic injuries as an important source of injury and disability among the working-age population [1-3]. Within the Ecuadorian Social Security system, the incidence reported in Table 1 supports the interpretation that these events represent a non-negligible occupational health problem. In this regard, the present study extends the national literature by addressing non-fatal in-mission events, whereas prior research in Ecuador has largely concentrated on fatal outcomes or selected economic sectors [9-12]. This additional evidence contributes to a more comprehensive epidemiological description of work-related road traffic injuries in the country.

The sex distribution, with a higher proportion of cases among men, is consistent with previous studies [6, 8]. A plausible explanation is the greater concentration of men in

occupations involving work-related travel or higher occupational mobility. However, the participation of women should not be overlooked, particularly given that severe outcomes were also observed in this group. Although this pattern may reflect changes in labor market participation and mobility profiles, such an interpretation cannot be confirmed with the available data and therefore requires specific empirical support.

The concentration of cases in the 25–44-year age group is also epidemiologically plausible, as this age range corresponds to a large share of the economically active population [2, 3, 10]. This distribution may be associated with greater occupational exposure to travel demands during the most productive stages of working life. By contrast, the observation that younger workers appear to experience more severe outcomes warrants cautious interpretation. Although lower driving experience has been proposed as a possible explanatory factor in previous research [4], the present study does not directly assess this mechanism. Accordingly, this explanation should be considered hypothesis-generating rather than conclusive.

At the territorial level, the greater absolute number of cases in provinces such as Guayas and Pichincha is consistent with their higher concentration of economic activity and affiliated workers [18]. However, the presence of elevated incidence rates in smaller provinces suggests that the distribution of risk cannot be explained solely by workforce size. Contextual determinants, including road infrastructure, traffic enforcement, commuting patterns, or regional organization of work, may also contribute to these differences. Since these factors were not directly evaluated in the present analysis, their role should be interpreted cautiously and regarded as a priority for future research. Nevertheless, the findings indicate that geographic heterogeneity is a relevant feature of the burden of in-mission road traffic injuries in Ecuador.

The sectoral analysis further indicates that occupational road risk is not confined to transport-related activities. The high values observed in sectors such as finance, real estate, and services suggest that road exposure may be embedded in a wide range of jobs beyond professional driving. This interpretation is consistent with previous research showing that work organization factors, including time pressure, task demands, and workload, may shape occupational road risk [5]. From an occupational health perspective, this finding is important because it broadens the scope of prevention beyond traditionally recognized high-risk sectors. At the same time, the very high incidence rates observed in some activities should be interpreted cautiously because small affiliated populations may amplify stratum-specific rates.

The higher severity observed in sectors such as mining also deserves attention. One possible interpretation is that these sectors combine road traffic exposure with more complex occupational settings or multiple concurrent hazards [5, 9]. However, because the present analysis does not include detailed information on work processes, exposure profiles, or crash circumstances, this explanation remains tentative and requires further empirical or bibliographic support. Even so, the findings underscore that the burden of in-mission road traffic injuries should be evaluated not only in terms of frequency but also in terms of severity and functional consequences.

With respect to injury patterns, cervical injuries and lower-limb injuries accounted for the largest share of cases, with the neck being the single most frequently affected anatomical region. By contrast, abdomen, lumbosacral area, and pelvis represented only a small proportion of injuries. This pattern suggests that the burden of non-fatal in-mission road traffic injuries in this population is concentrated in body regions that may substantially affect short-term functional capacity and work performance. However, the anatomical distribution should be interpreted descriptively, as the database does not include detailed crash mechanics, vehicle type, or collision circumstances.

A key analytical contribution of the study lies in distinguishing in-mission from commuting road traffic accidents. This distinction is important because in-mission events are more directly linked to work activity, work organization, and employer-related preventive opportunities [4-6, 8]. Consequently, these events may be more amenable to intervention through occupational safety and health policies, organizational controls, and mobility management strategies. Framing in-mission road traffic injuries as an occupational risk rather than solely as a transport issue may therefore improve prevention planning and institutional response.

These findings should nevertheless be interpreted considering the study limitations. The use of administrative records may entail underreporting, classification errors, and inconsistencies in case registration [16]. In addition, the available database does not permit direct evaluation of potentially relevant explanatory variables such as road exposure, type of vehicle, occupational task, driving experience, organizational pressures, or road environment. As a result, several interpretations proposed in this discussion should be understood as plausible but not demonstrable with the present data. This limitation does not invalidate the descriptive value of the findings, but it does constrain causal interpretation and highlights the need for more analytically detailed studies.

5. CONCLUSIONS

In conclusion, non-fatal work-related road traffic injuries occurring during the work shift (in-mission) represent a relevant component of the occupational injury burden among social security-affiliated workers in Ecuador. The findings indicate that these events occur predominantly among men and working-age adults, and that their distribution varies across economic activities and geographic areas.

The high proportion of cases resulting in temporary disability underscores their relevance not only for affected workers, but also for the social security system. In this regard, in-mission RTIs should be understood not solely as traffic events, but also as occupational events shaped by work-related mobility demands.

This study provides new evidence on a topic that has received limited attention in Ecuador. Although the descriptive design does not allow causal inference, the findings help identify priority areas for prevention. From an occupational safety and health perspective, attention should be directed to economic activities with the highest incidence rates, to provinces showing high burden relative to their affiliated workforce, and to the concentration of events during standard daytime working hours on weekdays. These patterns support the integration of work-related road safety into occupational risk assessment, travel management, and sector-specific surveillance within the social security-covered workforce.

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