When and Where: Understanding the Patterns of Emergency Service Calls in Toronto*

Exploring the Temporal and Spatial Dynamics of Reported Emergency Incidents

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This paper examines ten years of data on crisis service calls in Toronto, focusing on overdose, Person in Crisis, and suicide-related incidents. Our analysis reveals clear temporal patterns, with overdoses peaking at night and mental health crises spiking in the afternoon. Spatially, certain neighborhoods such as Moss Park and Downtown Yonge East consistently report higher numbers of crisis events. These findings highlight the importance of targeted mental health and substance abuse interventions, as well as resource allocation strategies tailored to specific times and locations.

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*Code and data are available at: https://github.com/xgao28/PICCFSA.

1 Introduction

The examination of crisis service calls is critical for enhancing public safety and effectively supporting vulnerable populations in urban environments. As mental health issues and substance use continue to rise, it is essential for emergency response services to understand the nature and patterns of crisis situations. Analyzing when and where these calls occur can inform strategic planning, resource allocation, and intervention methods for law enforcement and mental health services. By discovering on the dynamics of crisis response, we can better equip first responders to address the complex needs of individuals in distress, ultimately fostering safer and more resilient communities.

This study aims to analyze the temporal and spatial trends of crisis-related incidents in Toronto, as recorded in the Persons in Crisis Calls for Service dataset. The primary objectives are to:

- Identify the most common types of crisis events and their distribution across neighborhoods.
- Examine the temporal patterns of these events, including daily, weekly, seasonal and long-term trends.

The main sections are organized as follows: Section 2 provides a detailed description of the data and its sources, including the context, limitations and ethical considerations. Section 3 presents the analysis through a series of figures and tables, interpreting key patterns in the timing, location, and frequency of crisis-related incidents, and discussing their practical implications. Section 4 summarizes the findings, connects them with relevant literature on housing insecurity and mental health, and discusses how this analysis can inform future research and policy decisions for crisis management.

2 Data

2.1 Data Overview

The Persons in Crisis Calls for Service dataset offers a comprehensive view of crisis-related incidents attended by TPS. This dataset includes over 309,000 records from January 1, 2014, to June 30, 2024, focusing on significant event types such as Suicide, Person in Crisis, and

Overdose. The dataset captures incidents that required police intervention, excluding those handled by other TPS divisions, such as Parking and Marine. Additionally, the dataset does not contain sensitive information related to individuals in crisis, ensuring that no individual can be identified from the results.

The dataset consists of 10 primary variables after cleaning[1], focusing on unique identifiers and categorizing event types, along with associated spatial and temporal information.

2.2 Data Collection Process

Each entry in the dataset reflects a real-world crisis event attended by TPS officers. The data are based on police dispatch logs, meaning that a record is generated whenever officers respond to an event. The event types represent a wide range of crises, such as suicide attempts or overdose situations, and the TPS categorizes each event based on agency-specified fields.

The dataset is queried by the date the event was reported, not necessarily the date of occurrence, which may introduce a slight reporting delay for some incidents. Privacy considerations, particularly the offsetting of locations to the nearest road intersection node, limit geographic precision. While the dataset does include neighbourhood and police division information, these are approximate.

2.3 Practical Implications

Understanding the nature and patterns of crisis calls is foundational for several reasons. For public safety, identifying high-activity areas and time periods can help in deploying resources more effectively, ensuring quicker response times and better support for individuals in crisis.In terms of resource allocation, statistical results towards the demand for crisis services can inform budgeting and staffing decisions, ensuring that resources are allocated where they are most needed.For policy development, the findings can guide the development of policies and interventions aimed at reducing the incidence of crises and improving community well-being.

3 Results

Table 1: Summary Statistics of Crisis Events

Event Type	Total Count
Overdose	32494
Person in Crisis	172149

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[1]A comprehensive description of the data cleaning process, including the procedures, motivations, and variable definitions, can be found in Section 5.2.

Table 1: Summary Statistics of Crisis Events

Event Type	Total Count
Suicide-related	92762

3.1 Result Overview

Over the ten-year period, the dataset reveals the nature and frequency of three primary types of crisis events: Overdose, Person in Crisis, and Suicide-related, as summarized in Table 1. Among these, Person in Crisis events are by far the most frequent, comprising more than half of the total incidents.

- Overdose: There were a total of 32,494 overdose incidents recorded over the decade. This category includes all cases where an individual required police intervention due to drug or alcohol overdose. The number of overdose incidents highlights the ongoing public health challenge related to substance abuse in the community.

- Person in Crisis: With 172,149 incidents, Person in Crisis is the most frequently reported type of event. These incidents involve individuals who are experiencing mental health crises or other forms of distress that necessitate police involvement. The high count underscores the critical need for mental health support and resources within the community.

- Suicide-related: A total of 92,762 suicide-related incidents were documented. This includes both attempts and situations where there was a risk of suicide, requiring immediate police response. The prevalence of such incidents emphasizes the importance of suicide prevention efforts and access to mental health services.

3.2 Temporal Analysis

Figure 1 shows the distribution of event types across the hours of the day. This plot helps identify any daily patterns in the occurrence of crisis events. Overdose incidents, represented in red, peak at night, highlighting the potential need for heightened availability of medical and police services during these hours. Person in Crisis events, shown in green, are most frequent in the afternoon and steadily decline toward evening, suggesting that mental health resources may need to be more accessible during business hours. Suicide-related events, depicted in blue, follow a trend similar to Overdose events but with lower overall counts, peaking in the late afternoon and early evening hours.

Figure 2 illustrates the distribution of event types across the days of the week, showing that Person in Crisis events (green bars) consistently dominate the count across all days. Thursdays have the highest count of all events, while weekends see a marked drop. This could reflect
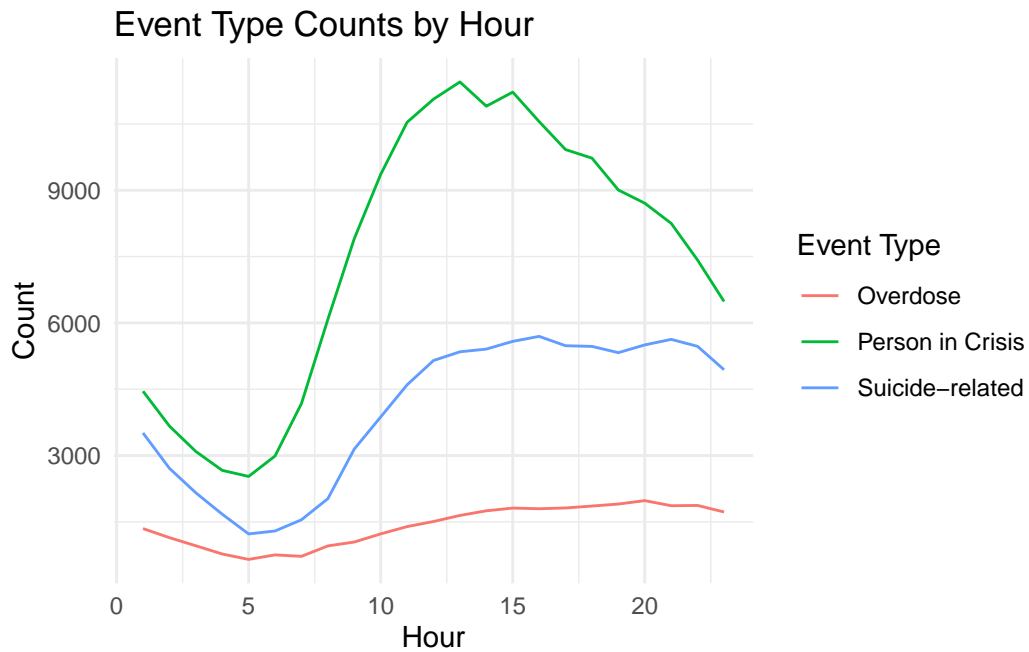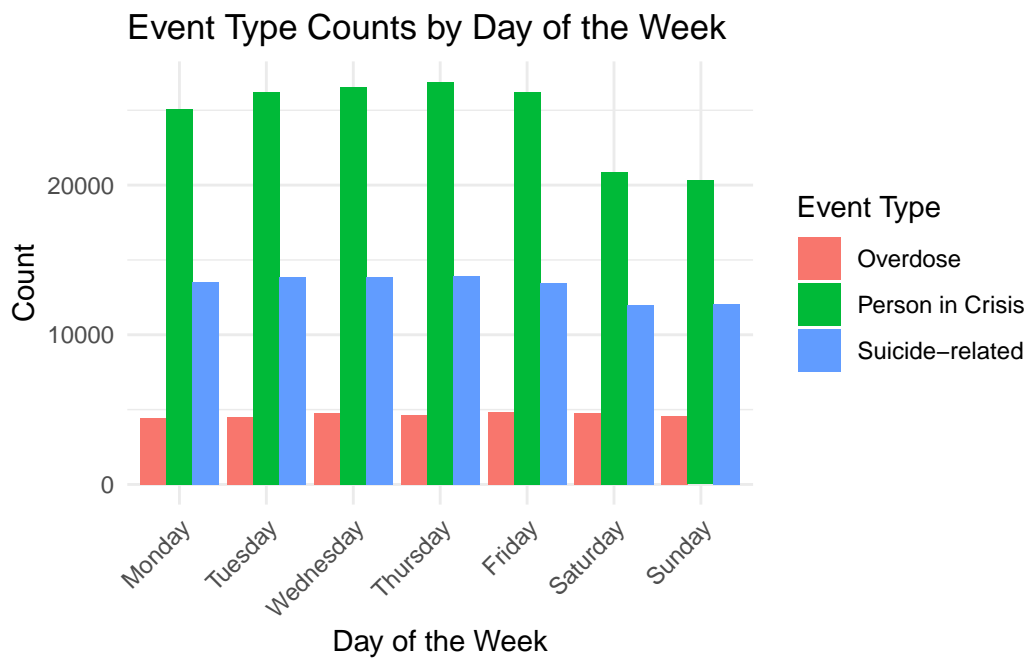
Figure 1: Event Type Counts by Hour of the Day

Figure 2: Event Type Counts by Day of the Week

workplace or social stress accumulating during the week, leading to crises toward the week's end. The reduction during weekends may point to fewer reports or different response patterns, offering an opportunity for further investigation.
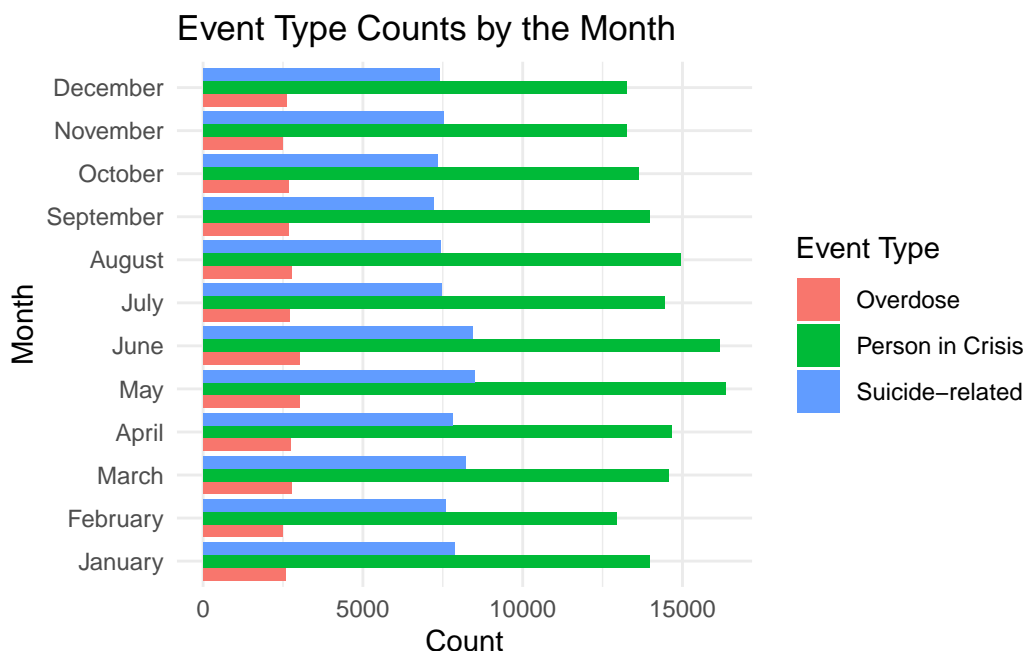

Figure 3: Event Type Counts by the Month

Figure 3 displays the distribution of event types across the months of the year, revealing seasonal trends. Person in Crisis events (green bars) consistently have the highest counts throughout the year, followed by Suicide-related events (blue bars). Overdose events (red bars) are the least frequent. May and June see the highest number of events across all categories, while February has the lowest, potentially due to fewer outdoor activities during colder months. These trends may reflect how seasonal factors and societal conditions influence crisis situations.

Figure 4 presents the temporal trends of crisis calls over the entire period. Overall, the chart indicates a general upward trend in the number of crisis events, with a significant peak during the pandemic years of 2021 and 2022, coinciding with lockdowns and restrictions. This surge likely reflects the psychological toll of isolation and economic stress, contributing to more frequent mental health crises and overdoses. Another noticeable increase is seen in 2024. These patterns underscore the importance of mental health and substance abuse support during times of social upheaval.
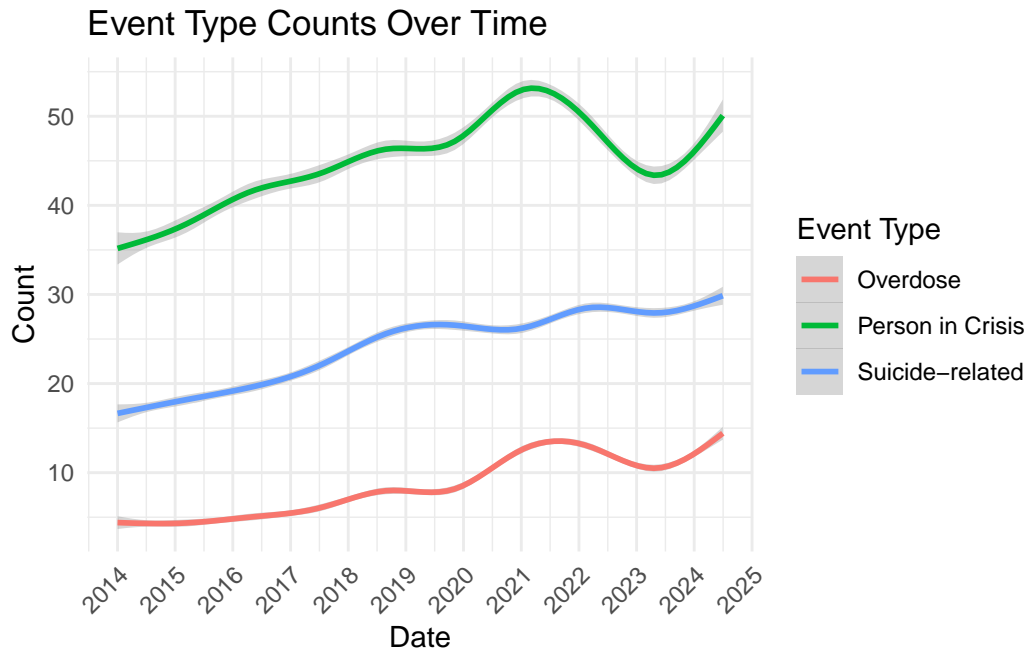
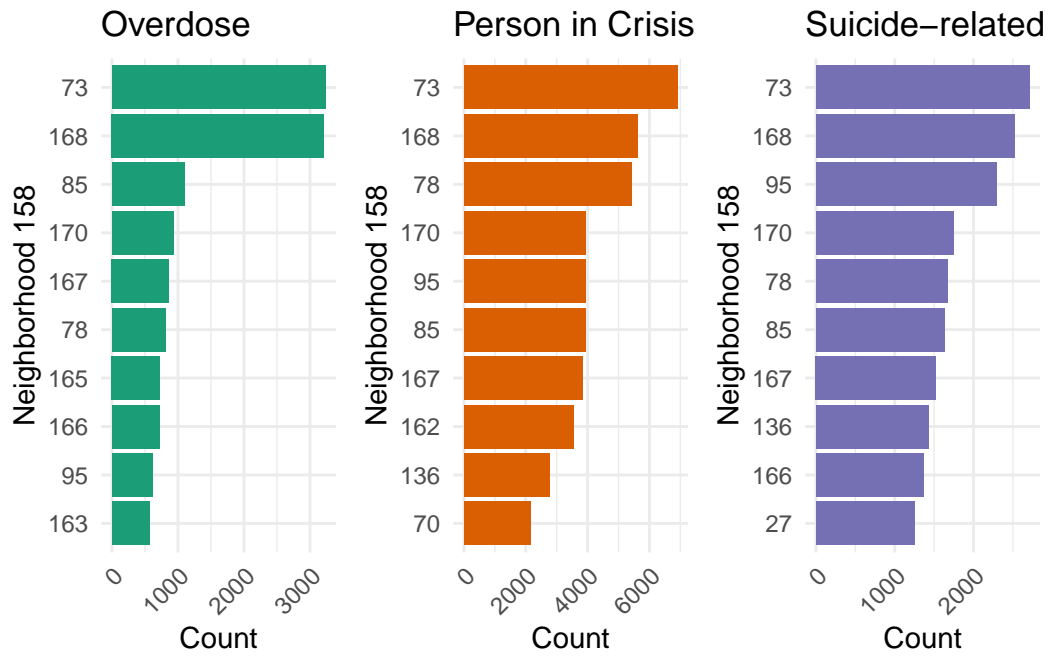## 3.3 Spatial analysis

Figure 4: Event Type Counts Over Time

Figure 5: Event Counts in Neighbourhood by Event Type

Table 2: Hood Number and Name Reference

hood number	hood name
27	York University Heights (27)
70	South Riverdale (70)
73	Moss Park (73)
78	Kensington-Chinatown (78)
85	South Parkdale (85)
95	Annex (95)
136	West Hill (136)
162	West Queen West (162)
163	Fort York-Liberty Village (163)
165	Harbourfront-CityPlace (165)
166	St Lawrence-East Bayfront-The Islands
167	Church-Wellesley (167)
168	Downtown Yonge East (168)
170	Yonge-Bay Corridor (170)

Figure 5 showcases the top 10 neighborhoods with the highest counts for each event type. Moreover, Table 2 provides a lookup table for the neighborhood numbers and their corresponding names, which can be used to interpret the neighborhood codes in the previous plots. To illustrate, Moss Park and Downtown Yonge East have the most reported cases for all three event types, with Overdose incidents dominating other neighborhoods. The high counts in these areas may be linked to population density, socioeconomic challenges, or proximity to services like shelters and social support networks. Kensington-Chinatown ranks third for Person in Crisis events, while Annex ranks third for Suicide-related events. These findings suggest that certain neighborhoods may require targeted interventions based on the specific crisis patterns observed.

4 Conclusion

The analysis of the Persons in Crisis Calls for Service dataset shows notable patterns in the timing and location of crisis-related incidents in Toronto over the past decade. Overdose, Person in Crisis, and Suicide-related events each follow distinct daily, weekly, and seasonal cycles. Overdoses tend to occur most frequently at night, Person in Crisis calls are most common in the afternoon, and Suicide-related incidents maintain a steady rate during late afternoon and early evening. Thursdays experience the highest volume of crisis calls across all types, while weekends typically have fewer incidents. These time-based trends help guide the allocation of resources and the adjustment of response plans to align with periods of greatest demand.

In terms of location, areas like Moss Park and Downtown Yonge East consistently report high numbers of crisis calls, particularly for overdoses. These findings suggest the need for focused interventions in these neighborhoods, potentially influenced by socioeconomic conditions or population density. Notably, Moss Park is one of Toronto's main encampment sites, and the research on pandemic encampments by Edhi (2022) provides a complementary perspective on the broader social context within which these crises occur. The study highlights that the City of Toronto has been experiencing one of its deepest housing crises, with homeless encampments serving as sites of resistance against systemic violence and insufficient interventions. The displacement and criminalization of unhoused residents during the pandemic underscore the intersectionality of housing insecurity and mental health crises. As such, addressing the root causes of homelessness, including the lack of affordable housing and supportive services, could contribute to reducing the frequency of crisis calls, especially in areas with high concentrations of vulnerable populations. Integrating a human rights-based approach to housing and crisis management, as advocated by Edhi, can provide a more holistic framework for responding to and preventing these emergencies, thereby fostering a more equitable and resilient urban environment.

Knowing when and where these incidents are most likely to happen is vital for planning emergency response efforts and distributing resources effectively. By identifying neighborhoods and time periods with higher incident rates, this analysis offers practical guidance for policymakers and service providers to improve crisis management, ultimately contributing to public safety and community well-being.

In terms of future work, the dataset also includes additional information that could deepen the analysis, such as police division details, whether an official occurrence was logged, and whether a Mental Health Act (MHA) apprehension occurred. Future studies could examine how these elements influence crisis resolution. Moreover, although this dataset focuses on three crisis types, incorporating a broader range of emergency call categories could provide a more detailed understanding of Toronto's crisis response landscape.

5 Appendix

5.1 Acknowledgements

We would like to express our gratitude to the developers and contributors of R (R Core Team 2023) as well as several R packages that were essential for the analysis and visualization of the data in this report. The following R packages provided indispensable tools and functionalities:

- `tidyverse` (Wickham et al. 2019): A collection of R packages designed for data science, including dplyr, ggplot2, readr, purrr, and others, which greatly facilitated data manipulation, analysis, and visualization.

- `ggplot2` (Wickham 2016): An implementation of the Grammar of Graphics, which allowed us to create complex and aesthetically pleasing visualizations with ease.

- `cowplot` (Wilke 2024): The package enabled us to combine multiple plots into a single figure, enhancing the presentation of our results.

- `lubridate` (Grolemund and Wickham 2011): This package facilitates the work with date and time data, simplifying the process of manipulating and analyzing temporal information.

- `knitr` (Xie 2023): This package enabled us to perform data demonstration with tables.

- `janitor` (Firke 2023): This package provided helpful tools for data cleaning. Its functionalities greatly enhanced the efficiency and accuracy of our data preparation process.

- `styler` (Müller and Walthert 2023): This package is helpful for styling the code.

Additionally, we are grateful to the City of Toronto and the Open Data Portal for providing access to the dataset through the opendatatoronto package (Gelfand 2022). The availability of such high-quality, open-source data is vital for conducting meaningful and impactful research.

Finally, we would like to thank all those who contributed to the development and maintenance of the R programming language and its ecosystem, as well as the broader open-source community, whose efforts make such research possible.

5.2 Data Cleaning

In the data cleaning process, the raw dataset was first read from a CSV file and irrelevant variables, were removed. The janitor package was used to clean the column names for consistency. Instances of the value "NSA" in character columns were replaced with NA, and any rows containing NA values were subsequently dropped. To ensure proper ordering in visualizations, the day of the week and month were converted to factors with defined levels. Finally, the cleaned dataset was saved as a new CSV file for further analysis. The cleaned dataset contains over 297,000 observations of 10 variables:

- `objectid`: A unique identifier for each record.
- `event_id`: A numeric identifier for the event, distinct from the object ID.
- `event_date`: The exact date when the event occurred, used for time-based analysis.
- `event_year`: The year in which the event occurred, facilitating yearly trend analysis.
- `event_month`: The month of the event, converted into an ordered factor for proper ordering in visualizations.
- `event_dow`: The day of the week on which the event occurred, also converted to an ordered factor.

- `event_hour`: The hour the call was received, for discovering time-of-day patterns for crisis incidents.
- `event_type`: A field that categorizes the event, with possible values including Suicide-related, Person in Crisis, and Overdose.
- `hood_158`: The identifier of the neighbourhood using the City of Toronto's new 158-neighbourhood structure.
- `neighbourhood_158`: The name of the neighbourhood, corresponding to the new 158-neighbourhood structure.

In terms of unnecessary columns, the raw dataset contains several additional variables, including `DIVISION`, `OCCURRENCE_CREATED`, `APPREHENSION_MADE`, `HOOD_140`, and `NEIGHBOURHOOD_140`, which were not the focus of our research. Our analysis centers specifically on the temporal and spatial patterns of crisis incidents rather than the effects of intervention by TPS. Consequently, we chose to remove these columns to streamline our dataset and concentrate on the variables most relevant to our research objectives. Specifically, we opted to exclude `HOOD_140` and `NEIGHBOURHOOD_140` in favor of the newer 158-neighbourhood labeling system to ensure our analysis reflects the most current geographic designations.

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