



Original Article

Twelve-Year Temporal Trends in Ambulance Use for Patients Hospitalized With a Primary Diagnosis of Syncope in Canada

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ABSTRACT

Background: Ambulance use is a costly mode of transportation to the emergency department (ED). Syncope is a frequent presentation to the ED; however, no data exist regarding the proportion of hospitalized patients with syncope arriving by ambulance and their outcomes compared with self-presenters.

Methods: The Canadian Institute for Health Information database was used to identify patients aged > 20 years hospitalized with a primary diagnosis of syncope (International Classification of Diseases 10th Revision code R55) in Canada, except Quebec, between April 2004 and March 2016. Logistic regression models (odds ratio and 95% confidence interval) were used to identify demographics, clinical factors, and province associated with ambulance use and whether ambulance use was associated with in-hospital mortality.

Syncope is a common presentation to the emergency department (ED), accounting for 1.5%¹ of all visits and an estimated 10,000 hospitalizations per year.² Among syncope hospitalizations, patients are relatively healthy and in-hospital mortality rates are less than 1%.² Prior work among patients with cardiovascular conditions has shown ambulance use represents a sicker population with a poorer prognosis.³ However, for patients presenting with syncope, these data remain unknown. The objectives of this study were to describe the rate and predictors of ambulance use compared with self-presenters among patients hospitalized with a primary diagnosis of syncope and to examine the relationship between ambulance use and in-hospital mortality. These data

RÉSUMÉ

Contexte : L'ambulance est un moyen de transport coûteux pour se rendre à l'urgence. La syncope est un symptôme fréquent chez les patients se présentant à l'urgence; toutefois, on ignore quelle est la proportion des patients hospitalisés pour une syncope qui sont arrivés en ambulance et quelle est l'issue de leur séjour à l'hôpital par rapport à ceux qui sont arrivés à l'urgence par leurs propres moyens.

Méthodologie : Nous avons utilisé la base de données de l'Institut canadien d'information sur la santé pour recenser les patients âgés de plus de 20 ans hospitalisés avec un diagnostic primaire de syncope (Classification internationale des maladies, 10^e révision, code R55) au Canada, à l'exception du Québec, entre avril 2004 et mars 2016. Des modèles de régression logistique (rapport de cotes et intervalle de confiance à 95 %) ont été utilisés pour déterminer quelles

are needed to improve our understanding about appropriate ambulance use and if opportunities exist where transport may not be needed.

Methods

The data sources, data elements and variable definitions, and statistical analysis have been described.^{3,4} Briefly, this study included a total of 120,044 hospitalization episodes for 110,299 patients identified with a primary diagnosis of syncope between April 2004 and March 2016. Of these, exclusions occurred for the following reasons: (1) incomplete data (n = 692 from Manitoba between 2004 and 2006), (2) not residing in the province where care was provided (n = 1464), (3) transferred from day surgery (n = 41), (4) transferred from long-term care facilities (n = 8587), and (5) arriving via air or a combination of air/ground/water ambulance (n = 293). The final study cohort consisted of 108,967 syncope presentations for 100,644 patients (Fig. 1).

The primary outcomes were to determine the rate of ambulance use and trends over time, predictors of ambulance use, and the relationship between ambulance use and in-

Received for publication March 27, 2019. Accepted March 28, 2019.

Ethics Statement: This study was approved by the Research Ethics Board at the University of Alberta (Pro00072777).

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See page 146 for disclosure information.

Results: Among 108,967 syncope hospitalizations, 64% of patients arrived by ambulance, and use increased from 58.8% to 66.1% over 12 years (P for trend < 0.01). Significant variations existed in ambulance use across provinces ($P < 0.01$). Predictors associated with higher odds of ambulance use were increasing age, male sex, urban residence, residing in areas with lower annual household income, and higher comorbidity burden. In multivariable-adjusted analysis, ambulance use was associated with a 1.7-fold higher odds of in-hospital mortality.

Conclusions: Approximately two-thirds of patients hospitalized for syncope presented by ambulance, and use has increased over time. Hospitalized patients in syncope who are transported by ambulance have a worse prognosis. Further research on emergency medical services' risk stratification of patients who are transported by ambulance may help to identify a low-risk population who may obviate the need for transport.

hospital mortality among hospitalized patients with a primary diagnosis of syncope compared with self-presenters.

A logistic regression model was constructed to identify factors associated with ambulance use adjusting for the following variables: age, sex, residence, 2010 annual household income, Charlson comorbidity score without age, and province.

Results

Over the study period, 64.0% ($n = 69,655$) of 108,967 hospitalizations for a primary diagnosis of syncope were of patients who arrived via ambulance. Overall, ambulance use significantly increased from 58.8% in 2004/2005 to 66.1% in 2015/2016 fiscal year ($P < 0.01$). A significant increasing trend of ambulance use was observed across all provinces except Manitoba and the Northwest Territories/Nunavut/Yukon, which had a significant decrease trend in ambulance use, and for Newfoundland and Labrador, Prince Edward Island, New Brunswick, and British Columbia, there was no significant change in ambulance use over time (Fig. 2).

Baseline demographics according to mode of arrival are shown in Table 1. Compared with self-presenters, hospitalized patients with syncope arriving by ambulance tended to be older (mean age 73.2 vs 67.0 years, $P < 0.001$), to reside in an urban area (82.4% vs 77.7%, $P < 0.001$), to reside in areas with lower 2010 annual household income, and to have a higher comorbidity burden ($P < 0.001$).

After multivariable adjustment, factors associated with increased likelihood of ambulance use were increasing age ($P < 0.001$), male sex (odds ratio [OR], 1.08; confidence interval [CI], 1.05-1.11; $P < 0.01$), urban residence (OR, 1.21; CI, 1.17-1.25; $P < 0.01$), residing in areas with lower 2010 annual household income ($P < 0.01$), higher Charlson

caractéristiques démographiques, quels facteurs cliniques et quelles provinces sont associés au recours à l'ambulance et s'il existe une association entre ce moyen de transport et la mortalité en cours d'hospitalisation.

Résultats : Sur 108 967 hospitalisations pour une syncope, 64 % des patients étaient arrivés en ambulance, et le recours à ce moyen de transport a augmenté de 58,8 % à 66,1 % sur une période de 12 ans (p pour la tendance $< 0,01$). Des variations importantes concernant le recours à l'ambulance ont été observées d'une province à l'autre ($p < 0,01$). Les facteurs prédictifs associés à une probabilité plus élevée d'utilisation de l'ambulance étaient l'augmentation de l'âge, le sexe masculin, la résidence en zone urbaine, la résidence dans une région où le revenu annuel moyen des ménages est plus bas, ainsi qu'un fardeau de comorbidité plus lourd. Une analyse après ajustement multivarié a mis en évidence une multiplication par 1,7 de la probabilité de décès à l'hôpital associée au recours à l'ambulance.

Conclusions : Environ deux tiers des patients hospitalisés pour une syncope sont arrivés à l'hôpital en ambulance, et le recours à ce moyen de transport a augmenté au fil du temps. Le pronostic est plus défavorable chez les patients hospitalisés en état de syncope qui ont été transportés en ambulance. Des recherches plus poussées sur la stratification des risques liés aux services médicaux d'urgence pour les patients transportés en ambulance pourraient aider à repérer les individus à faible risque n'ayant pas besoin d'un tel transport.

comorbidity score ($P < 0.01$), and residing in the province of British Columbia ($P < 0.01$). (Fig. 3). Compared with Ontario residents, British Columbia residents were more likely to present via ambulance (OR, 1.13; CI, 1.09-1.17; $P < 0.01$), whereas residents of all other provinces were less likely to present via ambulance. Specifically, the residents of Prince Edward Island (OR, 0.63; CI, 0.54-0.74; $P < 0.01$), Manitoba (OR, 0.54; CI, 0.50-0.59; $P < 0.01$), and Saskatchewan (OR, 0.56; CI, 0.52-0.59; $P < 0.01$) had the lowest likelihood of presenting via ambulance. An additional logistic regression model using the Charlson comorbidity score as a continuous variable showed an increase in the OR of ambulance activation by 1.05 (CI, 1.04-1.07) for every 1 point in the Charlson comorbidity score.

At the provincial level, ambulance use was not correlated with in-hospital mortality (Pearson correlation coefficient = -0.16 ; 95% CI, -0.74 to 0.57 ; $P = 0.70$) (Fig. 4). In multivariable logistic regression using patient-level data, ambulance use had a 1.7 odds higher risk for

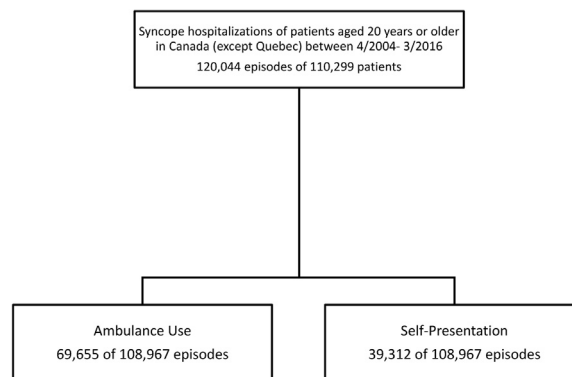


Figure 1. Patient selection.

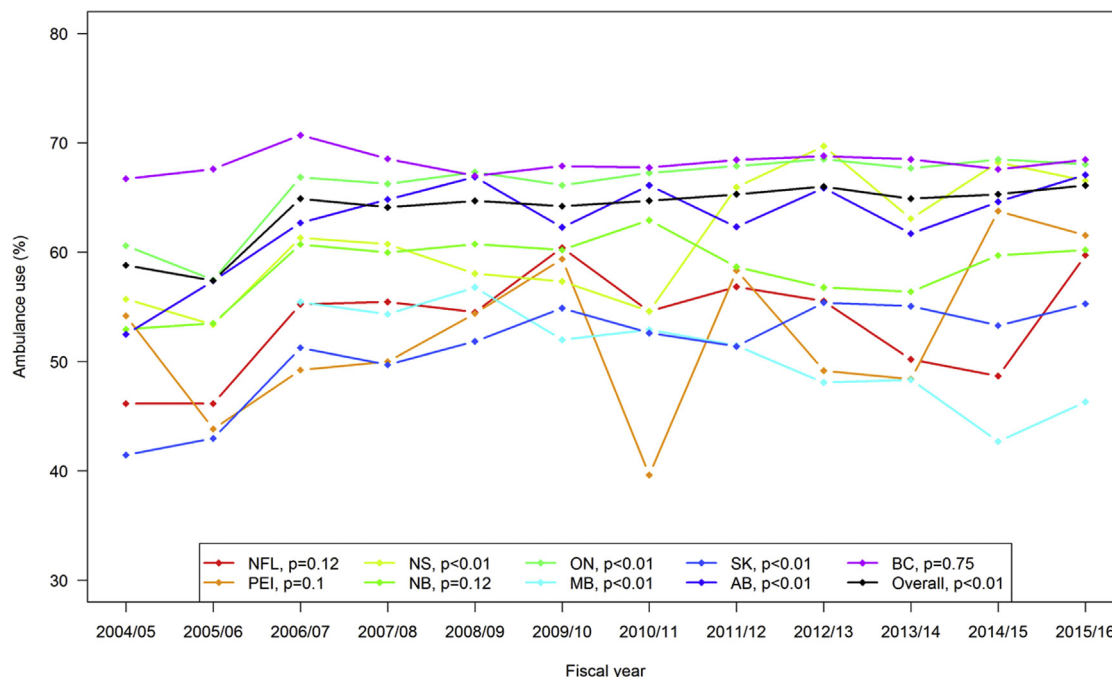


Figure 2. Rates of ambulance use among patients hospitalized with syncope according to year and province. AB, Alberta; BC, British Columbia; MB, Manitoba; NB, New Brunswick; NFL, Newfoundland; NS, Nova Scotia; ON, Ontario; PEI, Prince Edward Island; SK, Saskatchewan.

in-hospital mortality (OR, 1.72; CI, 1.41-2.11; $P < 0.0001$) (Table 2).

Discussion

In this large population-based analysis of national syncope hospitalizations and outcomes based on method of presentation (ambulance vs self-presenter), we found that approximately two-thirds of patients arrived by ambulance and that there was an absolute increase of 7.3% over the study period. Factors associated with ambulance use were increasing age, male sex, urban residence, residing in areas with lower annual household income, and higher comorbidity burden. Although provincial-level analysis did not demonstrate a correlation between ambulance use and mortality, we found a 1.7-fold higher odds of in-hospital mortality for patients arriving by ambulance after adjusting for confounders.

There are several possible explanations for the increase in ambulance use over the study period. First, patients with syncope are older and have a higher comorbidity burden, which may lead them to be concerned about a serious cause for syncope for which they want prompt evaluation. As in our study, increased ambulance use has also increased for other cardiac conditions, in particular, ST-elevation myocardial infarction.³ For chest pain, patients are encouraged to activate ambulance services for early diagnosis and treatment; however, no clear recommendations exist for patients with syncope. Second, patients with syncope who are transported by ambulance may not have access to other means of transportation. These findings are

not entirely surprising; older patients may not have access to a vehicle or someone who can drive them to the hospital, and therefore they may need to rely on ambulance transportation. These factors were also shown to be associated with increased ambulance use in patients with ST-elevation myocardial infarction.³ In addition to a syncope population who are older (65% of the studied patients were aged > 70 years), previous national data² found that there was an increase in the severity of comorbidity burden over this study period. An older and sicker population may contribute to increased ambulance use. Other possible explanations may include increased availability and public awareness, but these need to be further substantiated. Third, urban residence was found to be an independent predictor of presentation via ambulance. When looking at Canadian Census data,⁵ the proportion of urban-dwelling Canadians has consistently increased over the past 150 years. Urban dwellers likely have shorter wait times for ambulance arrival compared with rural dwellers, which may be why they arrive by ambulance more often, resulting in an overall increase in ambulance use. Further research is needed to better understand reasons for ambulance use from a patient's perspective. This information may help to develop targeted interventions.

Our study is also novel because we demonstrate that hospitalized patients with syncope who arrive by ambulance have a 1.7-fold higher risk of in-hospital death after adjusting for confounders. Older age and higher comorbidity burden were among the factors associated with ambulance use, suggesting a high-risk population. These data suggest high-risk patients are self-identifying and calling the ambulance. Even

Table 1. Baseline characteristics among patients hospitalized with syncope according to mode of arrival

Variables	Ambulance use	Self-presentation	<i>P</i> value
N episodes	69,615	39,312	
N patients	65,470	37,804	
Demographic characteristics			
Age, y median (IQR)	77.0 (65.0-84.0)	71.0 (56.0-80.0)	< 0.0001
Age group, n (%)			< 0.0001
< 40 y	2461 (3.5)	3248 (8.3)	
40-49 y	3084 (4.4)	3150 (8.0)	
50-59 y	6583 (9.5)	5219 (13.3)	
60-69 y	10,411 (14.9)	7027 (17.9)	
70-79 y	18,258 (26.2)	9943 (25.3)	
≥ 80 y	28,858 (41.4)	10,725 (27.3)	
Male, n (%)	36,501 (52.4)	20,561 (52.3)	0.75
Urban residence, n (%)	57,256 (82.4)	30,354 (77.7)	< 0.0001
2010 annual household income, CAD, n (%)			
< 40,000	1812 (2.6)	976 (2.5)	< 0.0001
40,000-60,000	32,343 (46.4)	18,170 (46.2)	
60,000-80,000	23,379 (33.6)	13,446 (34.2)	
80,000-100,000	9429 (13.5)	4976 (12.7)	
≥ 100,000	2403 (3.4)	1460 (3.7)	
Missing	289 (0.4)	284 (0.7)	
Comorbidities, n (%)			
Myocardial infarct	2359 (3.4)	1088 (2.8)	< 0.0001
Congestive heart failure	3201 (4.6)	1459 (3.7)	< 0.0001
Peripheral vascular disease	937 (1.3)	455 (1.2)	0.008
Cerebrovascular disease	2673 (3.8)	1072 (2.7)	< 0.0001
Dementia	3709 (5.3)	960 (2.4)	< 0.0001
Chronic pulmonary disease	3192 (4.6)	1473 (3.7)	< 0.0001
Renal disease	2910 (4.2)	1327 (3.4)	< 0.0001
Liver disease	390 (0.6)	178 (0.5)	0.0184
Diabetes	13,540 (19.4)	6675 (17.0)	< 0.0001
Cancer	2197 (3.2)	1194 (3.0)	0.286
Charlson score, n (%)			
0	42,622 (61.2)	26,750 (68.0)	< 0.0001
1-2	21,438 (30.8)	10,096 (25.7)	
3-4	4363 (6.3)	1870 (4.8)	
≥ 5	1232 (1.8)	596 (1.5)	
Median length of stay	3.0 (1.0-5.0)	2.0 (1.0-4.0)	< 0.0001

CAD, Canadian dollar; IQR, interquartile range.

among the ambulance users, it remains unclear whether the distribution of risk (low, intermediate, or high) and if applying a tool such as the Canadian Syncope Risk Score⁶ may identify the proportion of very low-risk and low-risk patients who do not need to be transported to the ED. In addition, increased public awareness about when to activate emergency medical services and availability of syncope care pathways by health-line personnel may reduce unnecessary ED presentations. Patient outcomes along with cost-effectiveness evaluations are needed for any initiatives that are implemented.

We found significant differences across provinces in ambulance use for patients hospitalized with syncope. Interprovincial variations may be a result of several factors, including differences in populations living in urban compared with rural locations, availability, response time of emergency medical services, ambulance cost, healthcare insurance, and public awareness of ambulance services. These explanations require further investigation. Finally, patient motivation to activate ambulance services may differ from province to province, further contributing to these differences.

There were also significant interprovincial variations observed for in-hospital mortality after multivariable

adjustment. We were not able to ascertain whether provincial differences in triage mechanisms used by emergency medical services account for vastly different patients presenting with syncope and brought to the hospital.

Study limitations

This study has several limitations. The data in this study were obtained from an administrative dataset and therefore are subject to unmeasured confounders and misclassification. Furthermore, data from the province of Quebec and 2 years of data from Manitoba are missing. Also, data regarding patients with syncope presenting by ambulance who were not admitted to the hospital (and their subsequent outcomes) were not available and therefore were not assessed in this study. Last, although we used statistical methods to adjust for potential confounders, they may not fully address residual confounding and selection bias among ambulance users.

Conclusion

Hospitalizations for patients with syncope presenting by ambulance significantly increased over a 12-year period in Canada, and interprovincial variations exist. Presentation by

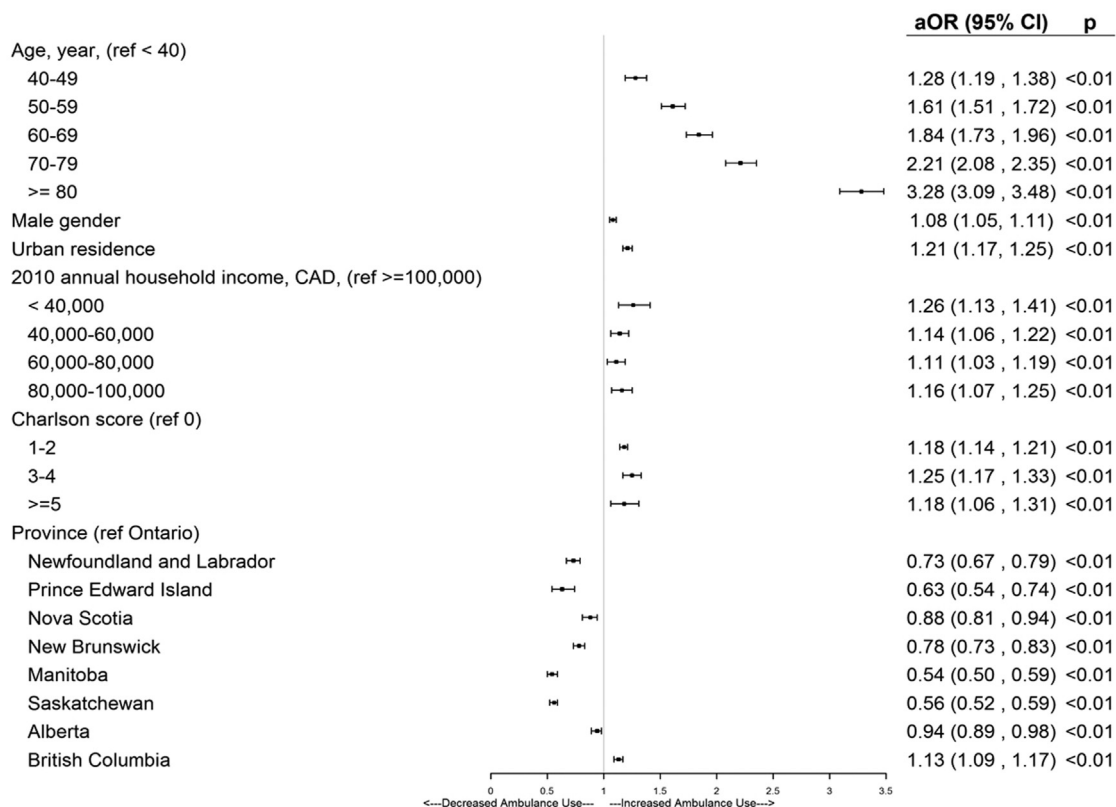


Figure 3. Multivariable odds ratio (OR) (95% confidence interval [CI]) for predictors associated with ambulance use.

ambulance appears to be associated with increased mortality; therefore, further educational and systemic opportunities exist to identify high-risk patients while potentially reducing unnecessary ambulance use and ED visits for low-risk individuals.

Funding Sources

University Hospital Foundation of the University of Alberta and Cardiac Arrhythmia Network of Canada.

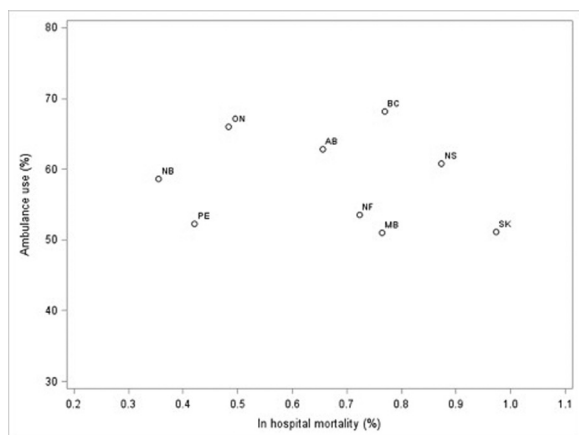


Figure 4. Correlation between ambulance use and in-hospital mortality across Canada. AB, Alberta; BC, British Columbia; MB, Manitoba; NB, New Brunswick; NF, Newfoundland; NS, Nova Scotia; ON, Ontario; PEI, Prince Edward Island; SK, Saskatchewan.

Table 2. Multivariable OR (95% CI) for predictors of in-hospital mortality

Variables	Adjusted OR (95% CI)	P value
Ambulance use	1.72 (1.41-2.11)	< 0.0001
Age group, ref < 40 y		
40-49 y	1.81 (0.49-6.71)	0.38
50-59 y	2.12 (0.64-7.03)	0.22
60-69 y	2.18 (0.68-7.01)	0.19
70-79 y	3.84 (1.22-12.10)	0.0218
≥ 80 y	7.29 (2.33-22.84)	0.0007
Male, n (%)	1.27 (1.07-1.51)	0.0051
Urban residence, n (%)	0.76 (0.62-0.93)	0.0082
2010 annual household income, CAD, ref ≥ 100,000		
< 40,000	1.30 (0.70-2.39)	0.41
40,000-60,000	0.81 (0.51-1.28)	0.37
60,000-80,000	0.88 (0.56-1.40)	0.59
80,000-100,000	0.92 (0.56-1.52)	0.75
Charlson score, ref 0		
1-2	4.31 (3.45-5.39)	< 0.0001
3-4	10.35 (7.96-13.45)	< 0.0001
≥ 5	36.00 (27.39-47.31)	< 0.0001
Province, ref Ontario		
Newfoundland and Labrador	1.99 (1.19-3.32)	0.0083
Prince Edward Island	1.19 (0.37-3.76)	0.77
Nova Scotia	1.78 (1.17-2.70)	0.0071
New Brunswick	1.17 (0.73-1.89)	0.51
Manitoba	1.49 (0.92-2.42)	0.1
Saskatchewan	2.16 (1.59-2.94)	< 0.0001
Alberta	1.12 (0.83-1.52)	0.46
British Columbia	1.90 (1.54-2.35)	< 0.0001

CAD, Canadian dollar; CI, confidence interval; OR, odds ratio.

Disclosures

The authors have no conflicts of interest to disclose.

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