

The association of exposure to suicide-related Internet content and emergency department visits in children: A population-based time series analysis

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ABSTRACT

OBJECTIVES: Suicide-related emergency department (ED) visits by children are increasing in tandem with suicide-related Internet content. Following the announcement of Amanda Todd's suicide, her YouTube video received widespread views, providing an opportunity to explore this association.

METHODS: Our research question was: Among Ontario children age 11–17 years, was the release of Amanda Todd's YouTube video following her death announcement in October 2012 associated with an increase in average monthly ED visit rates for suicide-related diagnoses? We performed an interrupted time series analysis from April 2002 to December 2013, with the primary outcome as a composite of the average monthly rate of initial ED visits for suicidal ideation, intentional self-poisoning, and intentional self-harm. Secondary outcomes were average monthly rates of intensive care unit (ICU) admission and death resulting from the index visit.

RESULTS: There was a statistically significant increase in the monthly ED visit rate for the composite outcome ($p = 0.02$) and death or ICU admission ($p = 0.006$) from April 2002 to December 2013. There was no significant change in ED visit rate for the composite outcome before and after the announcement of Amanda Todd's death, overall (119.8 versus 219.2 respectively, $p = 0.5$), among females (167.4 versus 316.8 respectively, $p = 0.47$) or among males (74.7 versus 116.9 respectively, $p = 0.33$).

CONCLUSIONS: Ontario ED visits for suicide-related diagnoses in 11–17 year olds increased from 2002 to 2013. However, the increase from October 2012 to December 2013 could not be attributed to a highly publicized adolescent suicide. Our findings suggest that suicide-related Internet content is not associated with the increase in ED visits for suicidal behaviour.

KEY WORDS: Internet; suicidal behaviour; emergency department

La traduction du résumé se trouve à la fin de l'article.

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For Canadian adolescents (10–19 years), suicide is the second leading cause of death.¹ Since 1993, emergency department (ED) visits for suicide-related behaviour among 15–19 year olds have almost doubled (2.57 to 4.53 per 1000 United States population) and are continuing to increase.² The role of the Internet, particularly social media, on suicide-related behaviour is a topic of intense debate,³ and fueled in part by several highly publicized suicides involving social media.⁴ Several population-based studies support the theory that suicide contagion (exposure to a suicide influences suicidality in others)⁵ is a factor in adolescent suicides.⁶⁻⁸ Awareness of suicides from online discussion forums⁹ and television news¹⁰ have been linked to an increase in suicidal ideation (SI) among adolescents. YouTube, a US-based video-sharing social media platform, is a widely viewed source of Internet content among adolescents¹¹ and is now the top online video website in the US.¹² As of 2016, the site has over 800 million users per month,¹³ and 71% of Canadians visit YouTube every month.¹⁴ Using a keyword search in YouTube's search option, followed by a standardized approach to categorization and coding, Lewis et al. found that *YouTube* videos depicting self-injury may maintain this behaviour (through shared personal experiences) rather than encourage individuals to overcome it.¹⁵

To date however, no study has explored the association between suicide-related Internet content (defined as any web page or video depicting self-injury or self-harm¹⁶) on YouTube and ED visits for suicide-related diagnoses in children. Emergency physicians are often the initial providers of care for suicidal children, and it is hoped that the results of this study will inform resource allocation in this setting.

On September 7, 2012, Amanda Todd, a 15-year old Canadian, posted a nine-minute YouTube video entitled "*My Story: Struggling, bullying, suicide and self-harm*", which depicted a series of flashcards telling of her experiences being bullied.¹⁷ The video post received

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enormous publicity after her suicide on October 10, 2012, receiving over 1 600 000 views in three days,¹⁸ with news websites around the world providing a link to it. Given the purported links between the Internet and suicidal behaviour and the rise in suicide-related ED visits, our research question was: Among Ontario children age 11–17 years, was the release of Amanda Todd's YouTube video associated with an increase in average monthly ED visit rates for suicide-related diagnoses? Evidence supporting the Internet's role in suicide contagion may enable mental health clinicians to provide anticipatory guidance to children at risk of suicide. We hypothesized that the sudden surge in views of Amanda Todd's video was associated with an increase in average monthly ED visits for the composite outcome of SI, intentional self-poisoning and intentional self-harm in children.

METHODS

Design

We conducted a population-based, time-series analysis using the National Ambulatory Care Reporting System (NACRS) database from the Canadian Institute for Health Information (CIHI) during the period from April 2002 to December 2013. NACRS involves a standard data collection and reporting tool to capture data for ambulatory care visits, including EDs. A time series analysis is a statistical method for analyzing data that is accrued in time order that accounts for an internal structure such as seasonal variation. Using aggregate data, we identified all patients age 11–17 years who presented to Ontario EDs using *International Classification of Disease and Health Related Problems, Tenth Revision, Canada* (ICD-10-CA) codes for suicidal ideation (R45.851), intentional self-poisoning (X60-X69) and intentional self-harm (X70-X84). These discharge diagnoses were used previously to explore the impact of media coverage on adolescent suicidal behaviour^{4,19,20} and were chosen because we felt they comprehensively encompassed the range of suicide-related behaviour. Self-harm encompasses suicidal attempts²⁰ and is a major risk factor for suicide.¹⁹ Individuals in the NACRS database could only have one diagnostic code assigned and we excluded repeat visits by the same individual over the study period to avoid inflating point estimates. The age range was chosen to reflect the demographic with the highest risk of suicidal behaviour.¹ The study was approved by Western University's Health Sciences Research Ethics Board.

Exposure of interest

The exposure of interest was October 2012, the month that Amanda Todd's suicide was announced, as this coincided with the widespread viewing of her YouTube video in the three days that followed. To our knowledge, this represented the most highly publicized adolescent suicide featured on this social medium. We acquired data for a prolonged duration of time before the event in order to procure a more valid estimate of baseline trends in ED visit rates.

Measures of suicide-related behaviour

We divided the study period into monthly intervals giving a total of 140 consecutive data points, 15 of which followed the announcement of Amanda Todd's suicide, which in turn prompted the sudden surge in views of her YouTube video. For

each period, we collected the total number of ED visits, final discharge diagnosis (SI, self-poisoning and intentional self-harm), age range, year and month of presentation, death and intensive care unit (ICU) admission rates resulting from the index ED visit.

Statistical analysis

Demographic variables were summarized using absolute values and percentages. The primary outcome was an addition of the average monthly rate of ED visits for the three ICD-10-CA diagnoses and expressed as the number of visits per 10 000 total ED visits as a single composite variable. Secondary outcomes were the number of ICU admissions and deaths resulting from the ED visit and the overall change in ED visit rates for the entire study period. We limited the sample to older children given the higher prevalence of suicidal behaviour in this demographic.^{2,20} An a priori decision was made to stratify data by sex based on the higher prevalence of suicidal behaviour in females.^{19,20} We applied an interrupted time series analysis using autoregressive integrated moving-average (ARIMA) models to examine the impact of Amanda Todd's death announcement in October 2012 on the average monthly rates of ED visits for the composite outcome. The ARIMA model uses a *t*-ratio to test the significance of the difference between the regression model's slope before and after October 2012. We also modeled the overall trend for the composite outcome across the entire study period. We expressed the results of inferential testing using *p*-values. We accounted for heteroscedasticity and used correlograms depicting autocorrelation, partial autocorrelation and inverse autocorrelation functions to guide initial model selection and account for seasonality and cyclic changes. The presence of white noise was evaluated by examining the autocorrelations at various lags using the Ljung–Box chi-square statistic. Stationarity was assessed using the augmented Dickey–Fuller test. The date of Amanda Todd's suicide and surge in views of her YouTube video was reflected as a ramp function in the regression model. All *p*-values were two-sided and a value of <0.05 was interpreted as significant. Data were analyzed using SAS version 9.3 (Cary, NC).

RESULTS

Of a total of 4 775 658 ED visits over the study period, there were 36 854 visits for SI, 17 130 visits for intentional self-poisoning, and 8074 visits for intentional self-harm in children 11–17 years. Of these visits, 457 resulted in death or admission to the ICU (Table 1). There was a statistically significant increase in the overall average monthly ED visit rate for the composite outcome ($p = 0.02$) and death or ICU admission ($p = 0.006$) from April 2002 to December 2013 (Table 2).

There was no significant change in the average monthly ED visit rate for the composite outcome before and after the announcement of Amanda Todd's death in October 2012 among all children (119.8 versus 219.2 respectively, $p = 0.5$) (Table 3), among females (167.4 versus 316.8 respectively, $p = 0.47$) (Table 2; Figure 1) or among males (74.7 versus 116.9 respectively, $p = 0.33$) (Table 3; Figure 2). Directionally similar results were seen for all component ICD-10 CA diagnoses of SI, self-poisoning and self-harm (Table 3).

There was no significant change in the average monthly rate of ED visits leading to death and ICU stay before and after the announcement of Amanda Todd's death in October 2012 among all children, among males or among females (Table 3).

Table 1. Number of ED visits (% of total ED visits) by sex from April 2002 to December 2013

	Composite	Suicidal ideation	Intentional self-poisoning	Intentional self-harm	Death or ICU admission	Total number of ED visits
Male	19 252 (0.8)	13 304 (0.5)	3599 (0.2)	2349 (0.1)	34 (0.001)	2 441 836
Female	42 806 (1.8)	23 550 (1.0)	13 531 (0.6)	5725 (0.3)	423 (0.02)	2 333 822
Total	62 058 (1.3)	36 854 (0.8)	17 130 (0.4)	8074 (0.2)	457 (0.01)	4 775 658

Table 2. Average monthly rate* (and number[†]) of ED visits for suicide-related outcomes before and after the announcement of Amanda Todd’s death in October 2012

	April 2002 to September 2012	October 2012 to December 2013	p value [‡]
<i>Primary outcomes</i>			
<i>Composite</i>			
Male	74.7 (16 460)	116.9 (2792)	0.33
Female	167.4 (34 876)	316.8 (7930)	0.47
Total	119.8 (51 336)	219.2 (10 722)	0.5
<i>Suicidal ideation</i>			
Male	50.7 (11 169)	89.4 (2135)	0.28
Female	89.1 (18 555)	199.6 (4995)	0.3
Total	69.3 (29 724)	145.8 (7130)	0.33
<i>Intentional self-poisoning</i>			
Male	14.5 (3195)	16.9 (404)	0.66
Female	33.6 (11 515)	80.5 (2016)	0.8
Total	34.3 (14 710)	49.5 (2420)	0.61
<i>Intentional self-harm</i>			
Male	9.5 (2096)	10.6 (253)	0.75
Female	23.1 (4806)	36.7 (919)	0.61
Total	16.1 (6902)	24 (1172)	0.4
<i>Secondary outcomes</i>			
<i>Death or ICU admission</i>			
Male	0.2 (34)	0 (0)	0.94
Female	1.9 (392)	1.2 (31)	0.9
Total	1 (426)	0.6 (31)	0.71
<i>Number of ED visits</i>			
Male	2 203 021	238 815	
Female	2 083 519	250 303	
Total	4 286 540	489 118	

* Average monthly rate expressed as number of ED visits for a given ICD-10 CA diagnosis per 10 000 ED visits.

† Data in parentheses represent the total number of ED visits for a given ICD-10 CA diagnosis.

‡ p values are for the trend difference in average monthly ED visit rate before and after October 2012.

DISCUSSION

In this population-based study of ED visits across Ontario, we found that ED visit rates for SI, self-harm and self-poisoning increased among children from 2002 to 2013. However, there was

no evidence that this increase was related to the release of Amanda Todd’s widely viewed YouTube video that detailed the events leading up to her suicide. Our results have important implications for caregivers and mental health clinicians and provide contrary evidence to the notion that increased ED visits for suicidal behaviour in children can be attributed to suicide-related Internet content.

Although absolute increases were seen in ED visit rates for the composite outcome following the announcement of Amanda Todd’s death, these differences did not reach statistical significance compared to the overall increase in ED visit rates from 2002 onwards. Our finding that ED visits for suicide-related diagnoses increased from 2002 to 2013 among older children is consistent with that described by Ting et al., who found more than a 100% increase in the number of ED visits in the US for attempted suicide and self-harm from 1993 to 2008. The largest increase was seen in adolescents age 15–19 years.² Canadian data from 1980 to 2008 also suggest an increase in suicide rates among female children and adolescents.¹ Multiple theories have been put forward, including an increase in treatment-seeking behaviour²¹ and decreased rates of prescribing antidepressants to children following the Food and Drug Administration’s (FDA) black box warning.²² Health Canada issued a similar warning in 2004. Gibbons et al. postulated that the FDA’s black box warning may have led to a decrease in the number of children diagnosed and pharmacologically treated for depression,²³ however, no studies have explored this in a Canadian population.

Our findings stood in contrast with much of the evidence supporting a link between suicide-related Internet content and self-harm behaviour.^{9,24,25} One possible explanation is that our outcome of interest was ED visits for suicide-related behaviour, rather than passive contemplation of self-harm, as the latter may not have been captured by the clinician’s final diagnosis. Suicide-related Internet use has been correlated with an increased risk of self-harm and depression.²⁵ Our results countermand this notion but raise the possibility that ED visits may not be a promising indicator to assess the effect of the circumstances surrounding a

Table 3. Average monthly rate* (and number[†]) of ED visits for suicide-related outcomes by sex from April 2002 to December 2013

	Composite	Suicidal ideation	Intentional self-poisoning	Intentional self-harm	Death or ICU admission	Total number of ED visits
Male	78.8 (19 252) (p = 0.02) [‡]	54.5 (13 304) (p = 0.009)	14.7 (3599) (p = 0.55)	9.6 (2349) (p = 0.17)	13.9 (34) (p = 0.008)	2 441 836
Female	183.4 (42 806) (p = 0.02)	100.9 (23 550) (p = 0.003)	58 (13 531) (p = 0.66)	24.5 (5725) (p = 0.2)	1.8 (423) (p = 0.03)	2 333 822
Total	129.9 (62 058) (p = 0.02)	77.2 (36 854) (p = 0.003)	35.9 (17 130) (p = 0.68)	16.9 (8074) (p = 0.37)	1 (457) (p = 0.006)	4 775 658

* Average monthly rate expressed as number of ED visits for a given ICD-10 CA diagnosis per 10 000 ED visits.

† Data in parentheses represent the total number of ED visits for a given ICD-10 CA diagnosis.

‡ p values are for the overall trend in average monthly ED visit rates from April 2002 to December 2013.

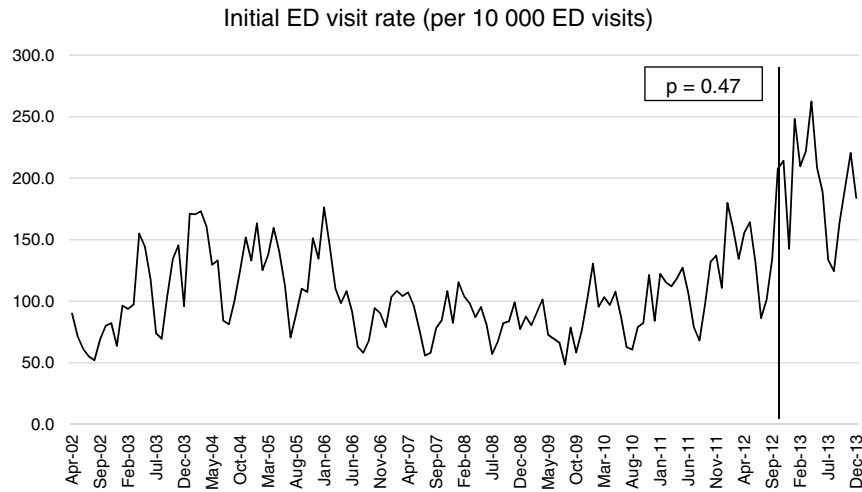


Figure 1. Average monthly initial ED visit rate for the composite outcome for females before and after October 2012 (vertical line). The solid line represents point estimates from the interrupted time-series analysis. The p value is for the trend difference in average monthly ED visit rates before and after the announcement of Amanda Todd's death in October 2012

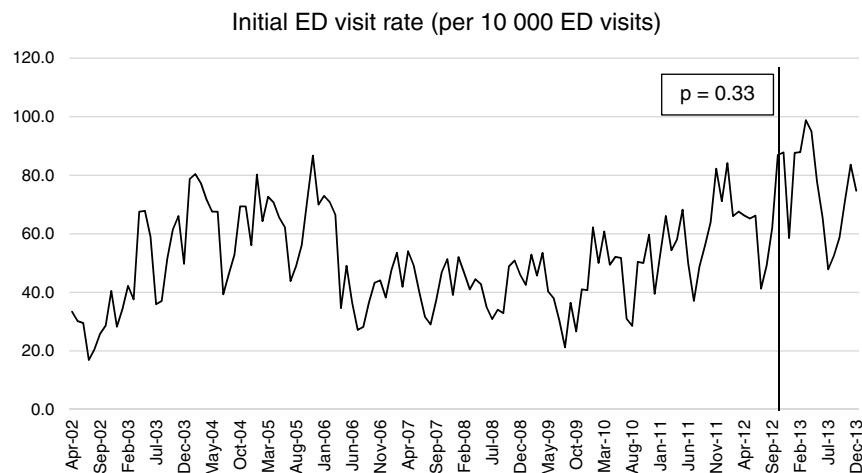


Figure 2. Average monthly initial ED visit rate for the composite outcome for males before and after October 2012 (vertical line). The solid line represents point estimates from the interrupted time-series analysis. The p value is for the trend difference in average monthly ED visit rates before and after the announcement of Amanda Todd's death in October 2012

suicide publicized on social media on subsequent suicide behaviour. An alternative explanation is the possibility that Amanda Todd's video may have provided an opportunity for children at risk of suicide to realize that their peers face similar challenges, thereby ameliorating feelings of isolation and promoting online communication with friends and family. The latter has been associated with a decline in depressive symptoms and the resulting support network has shown beneficial effects on mental well-being.²⁶

Only one study to date has explored the relationship between ED visits for mental health concerns and highly publicized suicides of two local teenagers in the media. Among children age 12–18 years, the authors found a significant increase in ED presentations for mental illness, substance misuse or abuse, and intentional self-harm, but no significant effect on suicidal status (ideation, plan,

gesture or attempt) or psychiatric hospitalization rate.⁴ Their findings were somewhat contradictory to ours and may be due to differences in the sampling frame. Leon et al. studied ED visits at a single Canadian academic centre within a narrow geographic region of Ontario, in contrast to our sample which included all Ontario EDs, possibly making an association easier to observe. Differences in ED visits for mental health concerns such as self-harm vary across the urban to rural spectrum²⁰ and higher suicide rates have been described in rural areas.²⁷ In addition, the two teenage victims resided in the same region as the ED under study. Local awareness and subsequent imitative behaviour may have led to increased ED visits within that geographic region. Two incidents of suicide contagion in Massachusetts²⁸ and New Zealand²⁹ support the notion that geographic proximity may play a role in suicide contagion. We did not explore suicide-related diagnoses in

EDs proximate to the city in which Amanda Todd lived, primarily because we were interested in whether Internet exposure could influence children with no personal or socio-cultural affinity to her community. Near-universal access to the Internet and the vast number of views her video received suggested that the audience comprised a large proportion of individuals outside her community. Social media can also be a key resource and a powerful communication tool for understanding and psychologically supporting potentially suicidal individuals.³⁰ There is evidence that access to social media may exert a protective effect on adolescent well-being. The social networking site Facebook was reported to help post-secondary students at risk of suicide obtain online social support.³¹ At a policy level, social media may be a feasible and effective way to educate high-risk populations with limited access to face-to-face care. A social media campaign designed to reach youth through Internet-based, social networking sites, including Facebook and Twitter, has been shown to improve adolescent attitudes towards mental health, personal stigma, and social distance up to one year following its launch.³² Future research should explore how social media sites such as YouTube may be used as a platform to implement initiatives such as a national suicide prevention strategy, an initiative that is currently lacking in Canada.³³

There are a number of limitations to our work. Inherent to the observational and retrospective nature of the data are threats to internal validity. We could not verify the accuracy of the discharge diagnoses and this, together with misclassification of diagnoses, may have led to under-reporting of suicide-related concerns. In contrast, although we selected ICD-10-CA codes that we assumed would comprehensively encompass suicidal behaviour, we could not verify suicidal intent. This may have led to over-reporting of suicide-related concerns. However, we believe that the large sample size and inclusion of data from across the range of urban to rural and academic and non-academic EDs enhance the generalizability of our results. We also did not collect data on completed suicides unrelated to the index visit. In addition, the use of aggregate data precluded our ability to identify other important risk factors for suicidal behaviour, such as co-morbid psychiatric illness, family history, and urban versus rural settings. Finally, similarly to Leon et al., our approach did not allow us to confirm that the patients comprising the data set were actually exposed to video and the details surrounding the highly profiled suicide of Amanda Todd on YouTube, and therefore, our results may be susceptible to ecological fallacy. By the same rationale, we could not account for other, potentially protective Internet content that may have been viewed at the same time. While it is safe to assume that most youth are highly connected to social media and possibly our exposure of interest, future work should involve a large longitudinal cohort of at-risk individuals, a valid method of documenting social media exposure, and comprehensive follow-up using validated tools to assess suicidality.

CONCLUSION

This population-based study found ED visit rates for suicide-related diagnoses increased among male and female children in Ontario age 11–17 years from 2002 to 2013. However, the increase from October 2012 to December 2013 was not associated with a highly publicized YouTube video depicting the events surrounding an

adolescent suicide. Given the widespread popularity of social media among adolescents, future studies should explore whether and how these media can identify and support children at risk of suicide.

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RÉSUMÉ

OBJECTIFS : Les visites d'enfants aux services d'urgence (SU) qui sont liées au suicide augmentent de pair avec les contenus liés au suicide sur Internet. Après l'annonce du suicide d'Amanda Todd, sa vidéo sur YouTube a été

largement visionnée, ce qui nous a donné l'occasion d'explorer cette association.

MÉTHODE : Notre question de recherche était la suivante : Chez les enfants de 11 à 17 ans en Ontario, la diffusion de la vidéo d'Amanda Todd sur YouTube après l'annonce de sa mort en octobre 2012 a-t-elle été associée à une augmentation des taux de visites mensuelles moyennes aux SU pour des diagnostics liés au suicide? Nous avons effectué une analyse des séries chronologiques interrompues d'avril 2002 à décembre 2013, le résultat principal englobant les taux mensuels moyens des visites initiales aux SU dues à l'idéation suicidaire, à l'auto-empoisonnement intentionnel et à l'automutilation intentionnelle. Les résultats secondaires étaient les taux mensuels moyens d'admission aux unités de soins intensifs (USI) et de décès résultant de la visite primaire.

RÉSULTATS : Il y a eu une augmentation significative du taux mensuel des visites aux SU pour le résultat composite ($p = 0,02$) et pour les décès ou les admissions aux USI ($p = 0,006$) entre avril 2002 et décembre 2013. Il n'y a eu aucun changement significatif dans les taux de visites aux SU pour le résultat composite avant et après l'annonce de la mort d'Amanda Todd, ni dans l'ensemble (119,8 contre 219,2 respectivement, $p = 0,5$), ni chez les filles (167,4 contre 316,8 respectivement, $p = 0,47$), ni chez les garçons (74,7 contre 116,9 respectivement, $p = 0,33$).

CONCLUSIONS : Les visites aux SU pour des diagnostics liés au suicide chez les enfants de 11 à 17 ans ont augmenté de 2002 à 2013 en Ontario. Toutefois, l'augmentation d'octobre 2012 à décembre 2013 n'a pas pu être imputée au suicide hautement médiatisé d'une adolescente. Nos constatations indiquent que les contenus liés au suicide trouvés sur Internet ne sont pas associés à l'augmentation des visites aux SU dues aux comportements suicidaires.

MOTS CLÉS : Internet; comportement suicidaire; service d'urgence