# "Imitation and Contagion Contributing to Suicide Clustering in Indigenous Communities: Time-Space-Method Cluster Analysis".

**LEONORE HANSSENS**

*PhD Candidate Adelaide University S.A.*

**Background**

Suicide rates in Indigenous communities of the Northern Territory are high and have increased dramatically in the past two decades. Hanssens & Hanssens identified evidence of clustering of suicides in a 2007 study but the initial analysis was flawed and required a robust analysis of the data.

**Aim**

To investigate whether imitation and contagion have contributed to the dramatic increase in Indigenous suicide rate. This will be achieved by determining if space-time and space-time-method clustering is occurring and by estimating the suicide imitation rate.

**Method**

After 230 Indigenous suicides were identified from Northern Territory Coroners Office and National Coroners Information System data (1996 – 2007) an analysis was conducted. Space-Time and the Space-Time-Method clustering were tested for separately. Dr Nigel McKenzie (UCL UK) analyzed the data using an enhanced Knox statistical test, designed to fit defined populations.

**Results**

Highly significant space-time and space-time-method clustering was found in 230 Indigenous suicides within a twelve-year period (1996-2007). Using space-time clustering analysis it suggests that imitation rises to about 12.5% with a time window of 360 days; and space-time-method clustering rises to about 21% with a time window of 360 days and still rising at 540 days. The result provides persuasive evidence of clustering and hence imitation.

**Conclusion and Recommendations**

This 2008 study supports a more conservative percentage of imitative suicide than the previous 2007 study. The current study provides indirect evidence of imitative suicide and clustering occurring among Indigenous people and may account for about 21% of suicides. Imitative suicide occurs well into the second year after the index suicide, and may be an indication of the cultural component of the study. A model of 'contact tracing' of close associates of the suicide victim to contain outbreaks is suggested, to be incorporated into a comprehensive postvention response.

## INTRODUCTION

Suicide does not have a preference for particular cultures but is found in all cultures across the world. [1, 2] In Australia suicide prevalence is ubiquitous but rates are higher in rural, regional and remote Australia, particularly for some age groups and for men. [3, 4] The majority of residents in these regional parts of Australia are Indigenous people with suicide being identified as the leading cause of alcohol attributable death, with a dramatic increase in suicide in the past two decades in Indigenous people of the Northern Territory. [5, 6, 7] Suicide is seen as a serious psychiatric emergency, is a major public health issue, has implications for primary care, and an indication that the social, spiritual, emotional wellbeing and resourcefulness of Indigenous people in these communities is failing and the suicide threshold reached. [8, 9, 10, 11, 12, 13]

Gibbons, Clark & Fawcett (1990) suggest that the absence of clear definitions and robust research into clustering of suicide can "hinder the development of appropriate public health responses to observed clusters" and obstruct the investigation of the "underlying contagious communication of suicidal behavior". [14] The research into clustering of suicides in Indigenous communities in the Northern Territory has been hindered by the difficulties of firstly, obtaining access to Indigenous suicide data, and secondly, accessing an appropriate program to analyse the data and provide evidence of the phenomenon. The former has been successfully negotiated with access to coronial data and the latter has been undertaken by Dr Nigel McKenzie, Royal Free University College, London UK. [12]

The antecedent issues of poverty and deprivation; transgenerational effects of trauma; unemployment and underemployment; lack of town and community infrastructure, poor roads and transport; poor education and career pathways, all impact on health, wellbeing, income earning capacity, standard of living are well documented and are ultimately a risk for suicide.[15, 16] To observe the grinding poverty, poor health, substance abuse, continuous cycles of violence and nepotism, puts the despair of those who take their own lives into perspective. In these vulnerable Indigenous people suicide and attempted suicide is often recidivist and contagious in nature, resulting in imitation and producing clusters or outbreaks of suicides. [17, 18, 19] Gould (1989) defines a cluster as an "excessive number of suicides which occur in close temporal and geographic proximity" and Joiner (1999) defines clusters as the "factual occurrence of two of more completed or attempted suicides that are 'nonrandomly bunched' in space or time". [20, 21]

In some communities in the Northern Territory a new phenomenon referred to as "echo clusters" has emerged, which are subsequent but distinct clusters of suicide occurring after the initial suicide cluster and is original research. It is a unique phenomenon that has been observed in Indigenous communities that are close-knit and proximate in geographic location. 10 Clusters or groupings of suicide have been reported in various Indigenous communities in Australia and in other countries, particularly fourth world populations in first world countries. [22] For example, both Tatz (1999) and Hunter et al (1999) have referred to the cluster phenomenon, in Yarrabah Queensland, where Hunter et al (1999) reported five suicides occurring within one family group over a two-year period and referred to "waves of suicide". [23, 24]

Baller and Richardson (2002) cite Coleman's (1987) account of one of the most dramatic stories of cluster suicides, which occurred in 1985 on a Native American reservation. At the Wind River Reservation in Wyoming, nine Native Americans completed suicide by hanging over a six-week period in the context of alcohol and unemployment, with imitation contributing to the deaths. [25, 26] Wissow et al (2001) and colleagues found that regional trends and clustering contributed to suicide attempts and deaths in a Southwestern American Indian Tribe of seven victims in forty days. [22] The "echo clusters" observed on the remote Tiwi Islands in the Northern Territory differ in one aspect in that each suicide cluster appears to stimulate another cluster, and another, which has produced the observed suicide 'echo cluster' phenomenon. It has resulted in forty (40) suicide deaths of Tiwi Islanders in just over a decade within a population of 2,300 people, with ten (10) deaths in one year alone, some of whom died in mainland communities. [27, 11] In total there have been 230 Indigenous suicide deaths in the study period from 1996 – 2007 within a population of approximately 60,000 Indigenous people in the Northern Territory. [28 29]

Marsden's (1998) research into social contagion suggests that there are two components operating and they are: emotional – where the mood is infectious; and behavioural – where the behaviour is contagious. In the case of suicide contagion he suggests that rates vary proportionally to the "extensity, intensity and content of exposure" to either an attempt or completed suicide in local communities or 'dispersed collectives' [30]. The suicide rate on the Tiwi Islands has been as high as 260 per 100,000 in one year of the study period and is evidence of point clustering. Behavioural contagion has been identified in recent research in the Northern Territory, with alcohol being involved in 77% of Indigenous suicides contributing to impulsiveness, 86% using hanging as a method, 82% being young adults, gender specific with 91% being male, and all factors contributing to lowering the suicide threshold. [10, 31, 12]

Social communication networks are suggested by Marsden (1998) to be supportive of contagion and in the case of Indigenous communities may also contribute to the frenzy of suicidal behaviour and recidivism as seen on the Tiwi Islands where suicide rates and suicide attempts have been observed at a phenomenal rate. [7, 32, 11] These social communication networks as seen in Indigenous communities facilitate the 'reach of news' and allow members of the community to become aware of, and enhance the impact of, a recent suicide, contributing to suicide recidivism, contagion and serve as a model of imitation. [12, 25] Therefore three factors are at play: recidivism, that is, a completed suicide preceded by attempted suicide; imitation, that is, a victim who copies the suicide of a previous suicide victim; and contagion, a process whereby exposure to suicidal behavior influences others to suicide. [33, 12, 21]

Joiner (1999) argues that both 'contagion effect' and 'point clustering' may be operating simultaneously. Contagion effect is the social, interpersonal transmission of suicidality

from one person to another, and 'point-clustering' is where victims, who may be a 'preexisting socially contiguous group' of people, such as those living in a close-knit Indigenous community, are having frequent social contact with those who complete suicide, which lowers the threshold at which a person becomes suicidal. Therefore he suggests that people who are vulnerable and have similar psychopathology may well cluster before the introduction of a suicidal stimulus. He also suggests that negative life events added to the suicidal behaviour of others in the group increases the risk for suicide. [21] Indigenous Elders in the Northern Territory verify this behaviour in their accounts of events leading up to completed suicides in their communities. [27] The finding of "echo clusters" witnessed by the Tiwi Islanders as a lived experienced in the past decade impacts on the post event consequences and unique postvention responses necessary after a completed suicide or a cluster of suicides in Indigenous communities. [27, 4, 10] The interface between substance abuse, violence, intolerable anguish, spiritual and emotional bankruptcy, and inadequate bereavement support conspire to increase the vulnerability of the individual and the collective community after a completed suicide. [11, 13]

The clear vulnerability of Indigenous people has been persuasively demonstrated by the previous analysis of Australian Bureau of Statistics (ABS) - Confidentialized Unit Record File data (1997 – 2005) and Coronial data (1996 – 2006) obtained from the National Coroners Information System (NCIS) and the Northern Territory Coroners Office. [4, 10, 11] Other studies using data from ABS and NCIS suggest that injury surveillance is necessary and that suicide is a major cause of potentially preventable death in Australia. [34, 35] The guiding principle behind the use of statistical data, to identify outbreaks or clusters of disease, has been to use the results not as definitive but as a persuasive argument and supported by other evidence, that clustering occurs. [36] Therefore, discourse analysis of coronial narratives and focus group interviews with Indigenous Elders will be undertaken to provide supporting evidence of clustering and will be reported on in future discussion papers. [37, 38]

# METHOD

### Closeness in Space and Time

Data collected from the Northern Territory Coroners Office (NTCO) and the National Coroners Information System (NCIS) 1996 – 2007 were used to detect clustering of suicides in space and time and to detect clustering in relation to method of completion among Indigenous suicides. [39] McKenzie (2005) used a technique to analyze the data, which was initially developed by epidemiologists Knox (1964) and Mantel (1967) to look for clustering in infectious communicable diseases. [12, 40, 41] McKenzie (2005) enhanced the technique so that it could be used for defined populations, for example prison populations, and thereby making it also transferable to the defined populations of Indigenous communities in the Northern Territory. [12] McKenzie (2007) used the Mantel (1967) or "Pairs Method" making it possible to derive the distribution of "excess pairs" corresponding to imitative suicides, then identified whether the 'pairs' or clusters of suicide occurred more frequently in a given population than would be expected by chance. [17, 41] McKenzie (2007) suggests that this excess pairs percentage gives a measure of the true percentage of suicides that are imitative in a given time window, that is, the amount of time from an index suicide during which you allow subsequent suicides to be considered as possibly imitative in nature. The method assumes that the base population in each area is either constant or changing at the same rate in all locations during the twelve-year period of the study. It also assumed that populations in each of the locations were in touch with each other so that members of each community or location would hear about the index suicide and subsequent suicides. [17]

McKenzie (2007) investigated clustering by considering all possible pairs of suicides and following the Knox (1964) procedure, took the number of pairs "close in space and time" as the test statistic. It required the selection of criteria for 'closeness in space', 'closeness in time' and included all 'methods of completion'. These were employed in the analysis of space-time, and space-time-method clustering. 'Closeness in space' relied upon a communication unit or 'reach of news' of the index suicide. 'Closeness in time' was calculated from a range of plausible thresholds from 30 to 360 days. 'Closeness in method' was defined as any method that fell into one of the broad category of methods of completion. McKenzie (2007) suggests that although the index suicide case should be reasonably close in time to have an influence on a subsequent suicide victim, there is no clear time limit for the influence to occur. [17, 40, 25, 11, 12]

### Analysis of Data

The data was de-identified and each suicide was given a case identification number, and the location of suicide given a case identification number. The data list was then sorted alphabetically by location. The data list also included the date of death and the method of completion to look for clustering in space (location), time and by method. All suicides in each location over the study period from 1996 - 2007 were included and it was important to adopt a consistent statistical approach to all cases in the data set. Two hundred and thirty cases (n=230) were considered a large enough number of suicides for clustering to find a significant level of probability of 95%.

For a suicide to be considered imitative in nature, the current suicide victim must have heard about the index suicide in his community or family group. An assumption is made from local knowledge of Indigenous communities that this information travels quickly from family to family within the community, and then from community to community within regions. The information about the suicide death and the impact of the suicide also remains in the corporate memory of the Indigenous family, community and region longer than would be expected in a non-Indigenous community. [27, 42] McKenzie (2007) supports this notion when he suggests that imitation might occur if a member of the community experiences a low mood, combined with suicidal ideation, a memory or a story of a loved one lost to suicide, and the previous suicide offers a way out of an intolerable situation. [17]

## RESULTS

### Original Analysis 2007

The original analysis of suicide data from the study in 2007 used the "Cell Method" developed by Ederer, Myers & Mantel (1967) cited in Gould, Wallenstin and Davidson (1989) and was crudely adapted to provide an initial estimate of cluster suicides.[4] The data (n=180) from NTCO & NCIS 1996 – 2005 was used within a basic Excel database and a minimum of two suicides per cluster were identified which gave rise to a higher than expected 77% clustering percentage and was flawed. The analysis was based on the observed link from the index suicide to another completed suicide, in a particular geographic location. Two different thresholds for closeness in time were used and because the time window was not fixed for all cluster observations resulted in a flaw in the analysis. In smaller communities (<500 people) a six-month time window was used and in larger communities (>1000 people) an eighteen months time window was used. The data was sorted by determining the imitation variables: location and date of death; then the index suicide which initiated the cluster; then the subsequent suicide that followed; and were then manually assigned as 'pairs' to within a time window. Each community was observed for imitation at a six-month window and up to an eighteen-month window. These cluster groups (pairs) once identified were then analyzed to find a percentage using Excel analysis tool. Therefore the analysis, though flawed from a scientific perspective, was informed by and reflected the "on the ground" reality of imitative suicides and cluster formation. It also identified the unique 'echo clusters' phenomenon in Northern Territory Indigenous communities, particularly the Tiwi Islands.[4, 10, 11]

### Recent Analysis 2008

The recent analysis of suicide data in 2008 with the refined and extended data from 1996 – 2007 was undertaken by McKenzie (2005) & (2007).[12, 17] The first run through the analysis program, of the data from NTCO & NCIS 1996 – 2006 (n=204) in November 2007, used the space-time-clustering analysis, and suggested that imitation rises to about 14% of suicides using a time window of 30 to 360 days. The data was refined and checked for any space, that is, geographical errors and each geographical location was coded again. The second run of the data from NTCO & NCIS 1996 – 2007 (n=230) in January 2008 used the space-time-clustering analysis and shows a gradual increasing percentage with the increasing time window (See table "Excess pairs as a percentage of the number of suicides" line). This increase persisted, giving rise to 12.5% imitation rate at 360 days and 15.5% at 540 days and 14.5% at 600 days gradually dropping off to 5.5% at 720 days using a time window of 30 to 720 days.

When the second analysis included the method of completed suicide, the space-time-method clustering analysis gave rise to an even higher percentage since a large majority of suicides were by hanging. The time-space-method analysis within a 30 – 720 day time window showed clustering as a percentage at about 21% at 360 days and continues to rise to 27% at 540 days and 25% at 600 days but returning at 21% at 720 days. Therefore, the time-space clustering imitation rate is at 12.5% (CI 2.7 – 15.5) with a time window of 360 days; and the space-time-method clustering is at 21% (CI 2.8 – 27.4) with a time window of 360 days and still rising at 540 days.

## DISCUSSION

The persistence of imitation still rising beyond one year may provide evidence of "echo clusters" (See table). It also implies that some people are imitating a suicide that occurred more than one year earlier and suggests a strong contagion element, possibly cultural, which is contributing to these echo clusters. The results, though high, are plausible since Indigenous suicide in the Northern Territory is seen in the younger age groups with 82% aged 15 – 34 years, and clustering is known to be 2 – 4 times higher in adolescents and young adults compared with older people.[4, 43] Similarly, in McKenzie's (2007) prison study, hanging was the main method used by 85% of inmates, and in this study 86% of Indigenous suicide victims used hanging as a method of completion. Other methods used were firearms 5%, cutting 3%, fall from a height 2% and "other causes" 4%, with all methods of completion included in the study. 10 Given the fairly small sample size of 230 suicides (n=230) there is persuasive evidence of imitation and hence clustering, given assumptions about the data being consistent.[17]

### Limitations of Study

Inconsistencies in the data can result from the population in one location suddenly doubling or dropping dramatically. Another reason could be gaps in data, which are missing over a period of months due to inconsistent data collection; both these examples can appear as clustering. Other factors such as the change in suicide rate in one area only and not in other areas can give rise to apparent clustering. A weakness in most clustering studies is that evidence for imitative suicide is indirect and other explanations for observed clustering can not be excluded.[12, 17]

### Strengths of Study

Reliable data collection and identification of Indigenous status in the Northern Territory makes the study accurate and consistent and 95% of deaths are coded by the NCIS.[28, 29, 39] Another strength of this type of study suggested by McKenzie (2007) is that the methodology detects only a space-time interaction and is not confounded by temporal clustering such as seasonal variations. McKenzie's (2005) analysis program is empirically sound, peer reviewed and used on similar defined populations.[12, 17]

### Comparative Studies

Other studies by Gould, Wallenstein & Davidson (1989) and Gould et al (1990) have found youth suicide to be clustering at 1 – 5% and Johansson, Linqvist & Erikson (2006) found evidence that youth suicide clustered at 1 – 13%.[20, 44, 9] McKenzie (2007) found prisoners clustering at 6%; and again McKenzie (2005) found patients in contact with mental health services clustering at 10%.[17, 12] Wissow (2001) found in a Native American population clustering at 16% and all these

populations have some remarkable similarities to Indigenous people in this study, in that they have higher than average mental and behavioural disorders and substance abuse disorders generally (see Hanssens 2007). [22, 11] Therefore the finding of 12% imitative suicide rate contributing to clustering in space-time and 21% in space-time-method is high but comparable with other studies from around the world. This result also supports a suicide contagion effect operating, as imitation is only one of the factors contributing to contagion, along with factors of behavioral and familial links between suicide victims. [12, 17]

Baller & Richardson (2002) suggest that the temporal design is ideal for picking up on celebrity or elite suicides because there is an index suicide at a fixed point in time, but spatial or geographic effect is better suited to studying imitative suicides. They cite both the founding fathers of suicide research Durkheim (1897) and Tarde (1903) who agree that imitation, if present, manifests itself in geographic patterning of suicide. [25] Baller & Richardson (2002) go on to suggest that, "suicides of non-elites may produce local or geographically bounded imitation not detectable in a national time-series analysis". Therefore the analysis technique developed by McKenzie (2005 and 2007) is a more accurate and reliable approach to use when identifying imitation and clustering in defined populations within specific locations. [12, 17]

Indigenous people are bound by spiritual ties to the land, thus the geography of their community is important, even if a town or community is an artifact of culture which is alien to their Indigenous culture. [27] The "reach of news" about each suicide is an important variable in the spatial interaction and geographic communication of the suicide event that promotes imitation in close-knit Indigenous communities. [25] Hence the necessity for carefully targeted post suicide interventions and comprehensive postvention responses in the Northern Territory. [13] Coleman (2008) commenting on the recent cluster of suicides in Wales, UK reminds us that "suicide is about pain" and "it is about escaping from pain" and not about "ending one's life". He also points out that hanging is a "method that takes some thought and it's a very painful" way to die and it's used "almost certainly because they heard about it and chose it in a deliberate fashion". It is the method used by most Indigenous suicide victims, which says much about the level of pain in these Indigenous communities in the NT. [45, 10]

## Recommendations and Conclusion

Epidemiologists who have identified outbreaks of contagious communicable disease have undertaken much of the cluster research. Suicide clusters have been identified but without the same public health response that, for example, an outbreak of measles demands. A proposed model of response to a serious suicide attempt or a completed suicide is a comprehensive 'contact tracing' of the victim's family, friends and cluster group members. It is suggested that after a serious suicide attempt or completed suicide is identified within a defined population, a comprehensive follow-up of those at risk of imitation is undertaken within the social network but in a culturally appropriate way. [46] The proposed model will be explored further in future discussion papers. Anecdotal evidence from Indigenous people suggests that the contagion effect and clustering of suicide is still a current issue in Indigenous settings in the Northern Territory.

The Tiwi Islands were the first to manifest the phenomenon of 'echo clusters' a decade ago in the context of rapid social change resulting in increased suicides, especially in males. Concurrently, Alice Springs produced another phenomenon of intergenerational and familial contagion and Coleman (1987) reports that some families are particularly vulnerable. [4, 26] Petzchkovsky et al (2007), Stockhard & O'Brien (2002) and Palmer et al (2007) suggest nurturing, strengthening and supporting families and children moderates this tendency. [47, 48, 42] Current clusters of suicide are appearing in rural and urban setting types, and some are in the grip of 'echo clusters' since late 2006 and 2007. Both regional urban, and rural Indigenous suicide deaths have the same antecedents as suicides in other settings but require a comprehensive postvention response and support mechanisms to contain the outbreak as suggested in the proposed model. [13]

Tracking the discourse on Indigenous suicide in the Northern Territory has been particularly difficult since the information available is so sensitive to families of loved ones lost to suicide and also politically volatile. If suicide clusters and imitative behaviour are causal factors in the dramatic increase in Indigenous suicide contributing to more than a fifth of completed suicides, then there is an urgency to implement the changes necessary to eradicate the antecedents to suicide in Indigenous communities. It is also essential to develop new models that are culturally appropriate ways to reduce Indigenous suicide in the Northern Territory.


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| 19-Nov-07<br>**Test for Space-Time clustering based on the location variable ID, DAYS, LOCN_ID, METHOD_ID FROM DATA1 WHERE LOCN_ID>0** | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Time window | 31 | 61 | 91 | 121 | 151 | 181 | 211 | 241 | 271 | 301 |
| Number of permutations | 999 | 999 | 999 | 999 | 999 | 999 | 999 | 999 | 999 | 999 |
| Number of suicides | 204 | 204 | 204 | 204 | 204 | 204 | 204 | 204 | 204 | 204 |
| Number of suicide pairs | 20706 | 20706 | 20706 | 20706 | 20706 | 20706 | 20706 | 20706 | 20706 | 20706 |
| Observed number of close pairs | 20 | 33 | 51 | 71 | 88 | 103 | 119 | 135 | 142 | 155 |
| Expected number of close pairs = mean of permutated values | 13.66 | 26.31 | 40.41 | 53.28 | 67.00 | 79.49 | 91.76 | 102.88 | 115.89 | 128.98 |
| SD of mean | 3.60 | 5.18 | 6.43 | 7.29 | 8.12 | 8.77 | 9.41 | 9.98 | 10.87 | 11.20 |
| Excess pairs = observed – expected | 6.34 | 6.69 | 10.59 | 17.72 | 21.00 | 23.51 | 27.24 | 32.12 | 26.11 | 26.02 |
| Excess pairs as % of no. of suicides | 3.11 | 3.28 | 5.19 | 8.69 | 10.30 | 11.52 | 13.35 | 15.75 | 12.80 | 12.75 |
| p-value (one-sided) | 0.066 | 0.114 | 0.066 | 0.018 | 0.015 | 0.016 | 0.007 | 0.004 | 0.021 | 0.021 |
| p-value (two-sided) | 0.132 | 0.228 | 0.132 | 0.036 | 0.03 | 0.032 | 0.014 | 0.008 | 0.042 | 0.042 |
| 16-Jan-08<br>**Test for Space-Time clustering based on the location variable ID2, DAYS2, LOCN_ID2, METHOD_ID2** | | | | | | | | | | |
| Time window | 31 | 61 | 91 | 121 | 151 | 181 | 211 | 241 | 271 | 301 |
| Number of permutations | 99 | 99 | 99 | 99 | 99 | 99 | 99 | 99 | 99 | 99 |
| Number of suicides | 230 | 230 | 230 | 230 | 230 | 230 | 230 | 230 | 230 | 230 |
| Number of suicide pairs | 26335 | 26335 | 26335 | 26335 | 26335 | 26335 | 26335 | 26335 | 26335 | 26335 |
| Observed number of close pairs | 23 | 37 | 59 | 79 | 98 | 112 | 131 | 148 | 160 | 175 |
| Expected number of close pairs = mean of permutated values | 16.78 | 31.70 | 49.04 | 64.48 | 80.14 | 92.93 | 107.75 | 120.92 | 138.33 | 154.84 |
| SD of mean | 3.50 | 5.62 | 7.49 | 8.80 | 9.65 | 10.29 | 10.72 | 11.57 | 12.35 | 12.98 |
| Excess pairs = observed – expected | 6.22 | 5.30 | 9.96 | 14.52 | 17.86 | 19.07 | 23.25 | 27.08 | 21.67 | 20.16 |
| Excess pairs as % of no. of suicides | 2.71 | 2.31 | 4.33 | 6.31 | 7.76 | 8.29 | 10.11 | 11.77 | 9.42 | 8.77 |
| p-value (one-sided) | 0.07 | 0.17 | 0.12 | 0.08 | 0.07 | 0.04 | 0.03 | 0.04 | 0.06 | 0.1 |
| 16-Jan-08<br>**Test for Space-Time-Method clustering based on the location variable ID2, DAYS2, LOCN_ID2, METHOD_ID2** | | | | | | | | | | |
| Time window | 31 | 61 | 91 | 121 | 151 | 181 | 211 | 241 | 271 | 301 |
| Number of permutations | 99 | 99 | 99 | 99 | 99 | 99 | 99 | 99 | 99 | 99 |
| Number of suicides | 230 | 230 | 230 | 230 | 230 | 230 | 230 | 230 | 230 | 230 |
| Number of suicide pairs | 26335 | 26335 | 26335 | 26335 | 26335 | 26335 | 26335 | 26335 | 26335 | 26335 |
| Observed number of close pairs | 18 | 31 | 51 | 68 | 80 | 91 | 106 | 120 | 132 | 146 |
| Expected number of close pairs = mean of permutated values | 11.54 | 22.19 | 35.22 | 46.18 | 55.47 | 66.54 | 75.47 | 86.68 | 98.22 | 108.75 |
| SD of mean | 3.40 | 4.88 | 6.33 | 8.93 | 9.21 | 8.94 | 10.19 | 11.78 | 11.79 | 12.68 |
| Excess pairs = observed – expected | 6.46 | 8.81 | 15.78 | 21.82 | 24.53 | 24.46 | 30.53 | 33.32 | 33.78 | 37.25 |
| Excess pairs as % of no. of suicides | 2.81 | 3.83 | 6.86 | 9.49 | 10.66 | 10.64 | 13.27 | 14.49 | 14.69 | 16.20 |
| p-value (one-sided) | 0.05 | 0.05 | 0.02 | 0.04 | 0.02 | 0.02 | 0.02 | 0.01 | 0.01 | 0.01 |

# Space-Time and Space-Time-Method Clustering Based on 230 Northern Territory Indigenous Suicides 1996 – 2007

| | |
|---|---|
| 331 | 361 |
| 999 | 999 |
| 204 | 204 |
| 20706 | 20706 |
| 168 | 182 |
| 139.25 | 153.10 |
| 11.22 | 12.48 |
| 28.75 | 28.90 |
| 14.09 | **14.17** |
| 0.021 | 0.02 |
| 0.042 | 0.04 |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 331 | 361 | 391 | 421 | 451 | 481 | 511 | 541 | 571 | 601 | 631 | 661 | 691 | 721 |
| 99 | 99 | 99 | 99 | 99 | 99 | 99 | 99 | 99 | 99 | 99 | 99 | 99 | 99 |
| 230 | 230 | 230 | 230 | 230 | 230 | 230 | 230 | 230 | 230 | 230 | 230 | 230 | 230 |
| 26335 | 26335 | 26335 | 26335 | 26335 | 26335 | 26335 | 26335 | 26335 | 26335 | 26335 | 26335 | 26335 | 26335 |
| 190 | 211 | 223 | 240 | 257 | 269 | 283 | 300 | 312 | 324 | 329 | 339 | 346 | 360 |
| 168.87 | 182.07 | 197.82 | 211.81 | 224.39 | 237.86 | 255.14 | 264.24 | 277.00 | 290.22 | 303.41 | 317.40 | 325.05 | 347.03 |
| 15.63 | 15.20 | 14.10 | 16.41 | 14.86 | 15.09 | 16.67 | 16.27 | 17.84 | 22.26 | 20.86 | 23.18 | 17.89 | 23.18 |
| 21.13 | 28.93 | 25.18 | 28.19 | 32.61 | 31.14 | 27.86 | 35.76 | 35.00 | 33.78 | 25.59 | 21.60 | 20.95 | 12.97 |
| 9.19 | **12.58** | 10.95 | 12.26 | 14.18 | 13.54 | 12.11 | **15.55** | 15.22 | 14.69 | 11.12 | 9.39 | 9.11 | 5.64 |
| 0.09 | 0.02 | 0.07 | 0.07 | 0.03 | 0.04 | 0.06 | 0.05 | 0.05 | 0.08 | 0.14 | 0.2 | 0.15 | 0.33 |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 331 | 361 | 391 | 421 | 451 | 481 | 511 | 541 | 571 | 601 | 631 | 661 | 691 | 721 |
| 99 | 99 | 99 | 99 | 99 | 99 | 99 | 99 | 99 | 99 | 99 | 99 | 99 | 99 |
| 230 | 230 | 230 | 230 | 230 | 230 | 230 | 230 | 230 | 230 | 230 | 230 | 230 | 230 |
| 26335 | 26335 | 26335 | 26335 | 26335 | 26335 | 26335 | 26335 | 26335 | 26335 | 26335 | 26335 | 26335 | 26335 |
| 159 | 178 | 186 | 199 | 212 | 221 | 233 | 247 | 256 | 262 | 266 | 273 | 279 | 288 |
| 121.41 | 130.54 | 139.78 | 146.46 | 161.05 | 167.93 | 176.08 | 184.05 | 194.71 | 203.78 | 213.99 | 222.88 | 230.14 | 239.68 |
| 14.63 | 14.82 | 16.98 | 15.92 | 19.13 | 17.62 | 18.56 | 19.10 | 17.25 | 22.26 | 25.04 | 23.51 | 23.43 | 22.66 |
| 37.59 | 47.46 | 46.22 | 52.54 | 50.95 | 53.07 | 56.92 | 62.95 | 61.29 | 58.22 | 52.01 | 50.12 | 48.86 | 48.32 |
| 16.34 | **20.64** | 20.10 | 22.84 | 22.15 | 23.07 | 24.75 | **27.37** | 26.65 | 25.31 | 22.61 | 21.79 | 21.24 | 21.01 |
| 0.02 | 0.01 | 0.02 | 0.01 | 0.02 | 0.01 | 0.01 | 0.01 | 0.01 | 0.03 | 0.01 | 0.02 | 0.04 | 0.02 |