INTRODUCTION

A cluster is the occurrence of a greater than expected number of cases of a particular disease within a group of people, a geographic area, or a period of time. Clusters frequently occur by chance. Real and apparent clusters cause much anxiety among those living in the area of concern. In this paper, the steps involved in the investigation of an alleged cancer cluster are documented.

In 1989, a 150 foot-high telecommunications mast was erected in a rural area of Northern Ireland as part of a radiocommunications network. In 2002, people living near the mast were reported to believe it to be responsible for an alleged cancer cluster of eleven cases in the immediate vicinity. Subsequently, in December 2002, the structure was felled (fig. 1). The story was covered extensively by the media.

The felling of this mast came after two similar incidents in England and preceded the felling of a second mast close to the location of the first. Dungannon District Council requested that the Northern Ireland Cancer Registry (NICR) conduct an investigation into cancer levels in the vicinity of the first felled telecommunications mast. The study aim was to determine whether or not cancer incidence and mortality rates in the area were higher than the Northern Ireland average.

METHODS

The procedures for cluster investigation, as outlined by the Ontario Cancer Treatment and Research Foundation, were followed. The fundamental steps involved in a cluster investigation are as follows;

(i) Preliminary assessment and communication
   - Literature review - to identify what is known already on the alleged cancer source
   - Validation of reported cases
   - Ascertainment of unreported cases
   - Analysis
   - Dissemination of results

Fig 1. Cranlome Telecommunications Mast: felled in December 2002.
existing research about cancers and telecommunications masts and about the importance of establishing whether a true cluster of clinical importance existed, i.e. the need to compare observed cases with what would be expected and then test for significance. It was stressed that, even if statistical significance is reached, e.g. at the 5% level, then, by chance, one in every twenty tests will yield a significant result. The geographical limits and diseases to be investigated were also agreed.

(ii) Literature review
To date, the most comprehensive review of the health effects associated with mobile phone communications, was the Stewart Report (2001), which failed to demonstrate any clear health effects caused by the use of mobile phones or being in proximity to base stations. More recently, similar findings were reported by an independent advisory group on non-ionizing radiation.

(iii) Validation of Reported Cases
Accurate information, including personal, identifiable data on all alleged cases of cancer reported in the area of interest, was requested from those alleging the cluster. Upon receipt, this information was checked against the NICR database, which holds information on all cancers diagnosed in the Northern Ireland population. Patient confidentiality was preserved at all times.

(iv) Ascertainment of Unreported Cases
Unreported cases occurring in the immediate vicinity of the Mast were identified using the NICR database, with the help of experts in Geographical Information Systems (GIS) from Ordnance Survey Northern Ireland (OSNI).

The OSNI Large Scale database consists of 1:1250 and 1:2500 scale vector mappings, a derived 1:10,000 scale Raster product, a COMPAS address database and a vegetation associated database. This database forms the basis on which spatial information in Northern Ireland is held, or is related to, either directly through a coordinated position on the Irish Grid, or indirectly through an address or administration area.

Upon our request, GIS experts at OSNI located the exact coordinates of the mast on the Irish Grid. Concentric circles, of radius 1km, 2km, 3km, 4km and 5km respectively were drawn around the mast and the COMPAS address database was used to highlight and list all addresses occurring within each of these ranges.

Various matching routines were then employed to match addresses in the area of the mast with addresses of cancer registrations on the NICR database.

(v) Analysis
a) Geographical Areas Studied
Analyses were conducted initially at the administrative area levels of local government district (LGD), electoral ward (EW) and census output area (COA), before turning to the non-administrative areas represented by concentric circles of radius 1, 2, …, 5 km from the mast. Population estimates at LGD level are available in the form of annual mid-year estimates from the Northern Ireland Statistics and Research Agency, whilst those for EW and COA level are available from Census 2001 output. Population estimates at smaller area level than COA are not available from the census office, so analysis at non-administrative area level required liaison with Central Services Agency (CSA), who matched a composite of address variables extracted from the OSNI database with their own system, to give estimates of population in these regions. Therefore, the areas studied for analysis were:

1. Dungannon Local Government District (population 47,849)
2. Ballygawley Electoral Ward (population 2,296)
3. COAs encompassing the area of interest – referred to as “Cranlome” (population 684)
4. Areas representing concentric circles of radius 1, 2, 3, 4 and 5km respectively from the mast site (population at 0-3km = 395; population at 3-5km = 1147)

b) Statistical Methods
Cancer cases in Cranlome/Ballygawley/Dungannon (and deaths in Dungannon) were compared with those experienced in the wider (reference) population of Northern Ireland, using indirect age-standardisation. Additionally, because of the rural nature of the Cranlome area, cancer incidence rates in Cranlome/Ballygawley were also compared with those occurring in the more rural (reference) population of Dungannon LGD.

Within the concentric circles around the mast, observed numbers of cases were assumed to have a Poisson distribution, as cases are relatively rare events, believed to occur at random. P-values were calculated based on Poisson probability and represent the probability of obtaining at least the observed number of cases by chance. In this study, a prior hypothesis existed (i.e. that numbers of cancers observed in the area of interest exceeded expected numbers) therefore a one-sided p-value was appropriate.

c) Cancers Monitored
The cancers analysed were;
1. All cancers
2. All cancers excluding non-melanoma skin cancer
   and for the larger areas of Dungannon and Ballygawley only:
3. The 3 most common cancers in males; lung, prostate, and colorectal cancer
4. The 3 most common cancers in females; breast, lung and colorectal cancer and
5. Cancers allegedly linked with electromagnetic radiation (brain, leukaemia, lymphoma and haematopoietic cancer).

all diagnosed during 2001 or 2002

(vi) Dissemination of results
A detailed report, chronicling the events leading to the enquiry, the parameters agreed, methods of analysis, results and conclusions, was compiled in a style which aimed to protect confidentiality. The study findings were presented
Addressing a community’s cancer cluster concerns

RESULTS

Despite our best efforts, of the eleven alleged cases, only six could be identified from contacts within the community. Two of the six which could be verified were not cancer and one was a non-malignant tumour. In addition to the three confirmed cancer cases, details of an additional seventeen cancer patients living within 5km of the Cranlome mast were identified by the NICR. The types of cancer occurring within 5km of the mast were as follows; six non-melanoma skin cancers, three each of breast and colon, two each of leukaemia (both in older people) and rectal cancer, and one each of lymphoma, bladder, ovarian and lung cancer.

The types of cancers diagnosed within the area of the mast were in accordance with what one might expect to be diagnosed in the general population, e.g. skin, lung, colorectal, breast, prostate, stomach, etc.

For all comparisons at Dungannon LGD level, there was either a lower than expected rate of cancer or no statistically significant difference between observed and expected rates (Table I).

Cancer incidence rates for all cancers diagnosed in the Ballygawley area (1993-2001) were lower than those experienced in both the whole of Northern Ireland and Dungannon LGD (Table II). Incidence rates for all cancers diagnosed in the Cranlome area, over the same period, were not significantly different from those encountered at Northern Ireland level or Dungannon LGD level (Table II).

DISCUSSION

Vigilant individuals will often be concerned that a population has a higher rate of cancer than they would expect. Part of this suspicion may reflect the increasing frequency with which cancer is diagnosed in our population. This increase has several causes:

at an open meeting of the local council and are available on the web.13

Table I

<table>
<thead>
<tr>
<th></th>
<th>All Cancers</th>
<th>All Cancers excluding NMS**</th>
<th>Lung</th>
<th>Breast</th>
<th>Colorectal</th>
<th>Prostate</th>
<th>Brain, lymphoma &amp; leukaemia</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Males</td>
<td>Females</td>
<td>Males</td>
<td>Females</td>
<td>Males</td>
<td>Females</td>
<td>Males</td>
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<tr>
<td>Standardised Incidence Ratio (SIR)</td>
<td>94 (88-99)</td>
<td>100 (94-106)</td>
<td>90 (83-97)</td>
<td>99 (92-106)</td>
<td>84 (69-99)</td>
<td>54 (38-70)</td>
<td>104 (90-118)</td>
</tr>
<tr>
<td></td>
<td>78 (62-94)</td>
<td>120 (99-141)</td>
<td>88 (71-105)</td>
<td>101 (79-124)</td>
<td>99 (74-124)</td>
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Table II

<table>
<thead>
<tr>
<th></th>
<th>Electoral Ward compared to Northern Ireland</th>
<th>Electoral Ward compared to LGD***</th>
<th>Cranlome compared to Northern Ireland</th>
<th>Cranlome compared to LGD***</th>
</tr>
</thead>
<tbody>
<tr>
<td>All cancers (SIR)</td>
<td>77 (60-93)</td>
<td>80 (62-97)</td>
<td>93 (61-126)</td>
<td>96 (63-130)</td>
</tr>
<tr>
<td>All cancers excluding NMS** (SIR)</td>
<td>76 (57-96)</td>
<td>81 (61-102)</td>
<td>94 (57-132)</td>
<td>101 (60-141)</td>
</tr>
</tbody>
</table>

* Results above are presented as standardised incidence and mortality ratios. Where SIR or SMR = observed/expected x 100. A result of less than 100 indicates lower than expected rates while rates over 100 indicates higher than expected rates. Confidence intervals which include 100 are not significant.

** NMS = Non-melanoma skin cancer

*** LGD = Local Government District (Dungannon)
• As people live longer, they are more likely to develop diseases of old age, including cancer
• Competing causes of death, such as infection, have been controlled
• Technological advances have improved the accuracy of diagnosis, so cancer is more likely to be diagnosed when it occurs
• Lifestyle changes including the use of tobacco, increased exposure to ultraviolet radiation, and a high fat, low fruit/vegetable diet, combined with increased alcohol consumption, reduced levels of exercise and increasing levels of obesity have all increased the risk of developing cancer
• Also, there is more openness regarding cancer in society today – people are more likely to discuss their cancer and so there is an increased awareness of cancer cases in the community.

A suspected cancer cluster is more likely to be a true cluster if it involves:

i. a specific geographical area
ii. a large number of cases of one type of cancer, rather than several different types
iii. a rare type of cancer, rather than common types
iv. a number of cases of a certain type of cancer in age-groups not usually affected by that type of cancer.

It should be noted that the occurrence of several types of cancer in a group of people or a geographic area generally does not constitute a cancer cluster.

The pattern of cancers found in the vicinity of the Cranlome mast represents that which would be expected in the general population and not that of a cluster. In many cluster investigations, an initial conclusion such as this would be sufficient to halt the study, since it does not warrant further investigation. Nevertheless we felt that, in order to satisfy the intense public and media interest surrounding this issue, it was necessary to proceed to a comparison of rates between various geographical areas.

The inability of the local community to identify all alleged cases is a common finding in alleged clusters. This often results from inadvertent double counting by well meaning concerned groups. We, and the local community, were surprised to discover a total of 20 cancer cases in this small rural area (17 unknown to residents group). The data analysis, however, indicated that this was not significantly different from the expected level, based on rates at that time. This identification of all cases demonstrated the value of a complete, accurate cancer registration system. It also enhanced the credibility of the investigation with the local population.

Currently in Northern Ireland, the vast majority of cancer registrations are made within two years of diagnosis, although information on pathologically diagnosed tumours is available with only one month delay. Although very timely for a cancer registry, this lag in registration means that area investigations into recently diagnosed cases are limited.

Of particular concern to some, living in the vicinity of the Cranlome mobile phone mast, was the question of whether low level radiofrequency (RF) exposure might increase their risk of cancer. However, this study investigated the levels of cancer in an area, but not any of the alleged putative causes of the alleged cluster. It is important when investigating an alleged cluster to firstly identify whether a cluster actually exists before setting out to determine any likely causal factors.

There was extensive media coverage of the alleged cluster and the felling of the mast. There was also excited anticipation among the media for the results of this study. However, the negative findings of the study received only local media coverage and, even then, with headlines such as “Public sceptical over mast cancer findings” (Tyrone Times, May 14th 2004) and “Residents oppose mast re-erection” (Dungannon Observer, May 14th 2004).

The preparatory work involving the setting of limits for the study and including the agreement of the terms of reference, diseases and areas to be studied, is of vital importance when investigating alleged clusters. Also, because the circumstances surrounding many cluster problems are emotive, everything relating to the cluster investigation should be documented. A carefully written record of events (telephone conversations, etc.) will help to avoid disputes among the many people involved and also enables a comprehensive report to be compiled at the end of the investigation.

The results of this study were presented to an open meeting, attended by those active in raising the issue of the alleged cluster, as well as elected representatives. Official and unofficial discussions at the meeting indicated a degree of satisfaction with the study and the clarity of the presentation of its findings. A full report is available.

ACKNOWLEDGEMENTS

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The authors have no conflict of interest

REFERENCES
2. BBC News 2002 Dec 16.


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**A patient that changed my practice…**

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**Careful History Taking**

I work in Craigavon Area Hospital Accident and emergency (A&E) department, which is supposed to be one of the busiest A&E’s in Northern Ireland. The pressure of work most of the times is immense and you’ve to be very quick and at the same time very precise to take right decisions.

I came across a young lady who presented with right sided upper quadrant pain for 5 days. Co-incidentally I had seen her some months ago with exactly the same type of pain. On further inquiry and obtaining the old notes I came to know that she had been investigated for gallstones with no success and the symptoms were attributed to bile duct stones. This seemed a straightforward surgical case as the patient was very dehydrated and fairly jaundiced. What else can you dream about as an A&E Senior house officer when you get a straight forward case! I rushed into the routine things and ignored the fact that patient mentioned something about 20 paracetamol tablets that she claimed to have taken in last 5 days to help pain and she vaguely mentioned her concern about the same.

The investigations came back quickly with just liver function tests (LFT) to come. Somehow I started feeling uncomfortable about the whole situation, albeit the surgical admission was already organised and patient wasn’t technically mine anymore. I went back and told her I would like to know more about the details of the pain. This time I was more focussed on spending some time with the patient and getting the right history. It was only then she asked me, “Doctor, am I going to die” and I was quite surprised…. She later admitted taking 50 paracetamol tablets due to depression as she had an argument with her boyfriend. Her LFT’s arrived back - grossly deranged with ALT and AST in the range of 16,000 and 14,000 respectively. The patient had to be eventually transferred to a specialist unit and she survived.

It was a good lesson for me and probably for any other doctor to make sure that quality of patient-care is not compromised for quantity.

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