Report On The Management Of An Anthrax Incident In The Scottish Borders

July 2006 to May 2007

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Glossary:

AI	**Anderson Impactor plates**
CBRN	**Chemical, Biological, Radiation and Nuclear**
CfI	**Center for Infection (HPA)**
Cl02	**Chlorine Dioxide**
CMO	**Chief Medical Officer**
DFU	**Dry Filter Unit sampling**
DPH	**Director of Public Health**
FSML	**Food Safety Microbiology Laboratory (HPA)**
EIT	**Environmental Investigation Team (NHS Borders)**
GDS	**Government Decontamination Service**
HEPA	**High Efficiency Particulate Air (Filters)**
HPA	**Health Protection Agency**
HPA (Northeast)	**Health Protection Agency (Northeast)**
HPA (PD)	**Health Protection Agency (Porton Down)**
HPS	**Health Protection Scotland**
HSE	**Health & Safety Executive**
ICT	**Incident Control Team (NHS Borders)**
IMSG	**Incident Management Support Group (NHS Borders)**
MCE	**Mixed Cellulose Ester**
NRIE	**New Royal Infirmary Edinburgh**
NDPL	**Novel and Dangerous Pathogens Laboratory**
PCR	**Polymerase Chain Reaction**
RH	**Relative Humidity**
SABRE	**SABRE Technical Services Ltd.**
SBC	**Scottish Borders Council**
SEHD	**Scottish Executive Health Department**
SEPA	**Scottish Environmental Protection Agency**
SEERAD	**Scottish Executive Environment and Rural Affairs Dept.**
SVS	**State Veterinary Service**
VHP	**Vapourised Hydrogen Peroxide**

Acknowledgments

With the kind permission of his family, I would like to record that this professional report concerns the investigations into and the subsequent Public Health management and interventions undertaken after the untimely death from anthrax of a highly gifted local artist and resident of Scottish Borders, in July 2006.

I would like to take this opportunity to thank a number of people and organisations for their help and assistance during the management of this incident.

Firstly, I would like to thank all colleagues who have worked with us during the months of the this response, including members of the Incident Control Team, Environmental Investigation Team, Logistics Team, Clearance Committee and Incident Management Support Group.

Secondly, I would like to thank colleagues from a wide range of different organisations involved including:

- Health Protection Scotland
- Health Protection Agency
- Government Decontamination Service
- Scottish Executive (now Scottish Government)
- Health and Safety Executive
- Scottish Environmental Protection Agency
- Scottish Veterinary Service
- Lothian and Borders Police.
- The Procurator Fiscal.
- Scottish Borders Council.
- New Royal Infirmary at Edinburgh
- Center for Disease Control, Atlanta, USA

Thirdly, I would like to thank all my colleagues at NHS Borders including those at Borders General Hospital, who so ably and professionally supported the team during the many months of the investigation and response. A special mention is also due to colleagues at the Scottish Executive, (now Scottish Government) whose pragmatism, immediate and continuing support was instrumental in the effectiveness of our response.

Finally, it is always difficult to single out people, who deserve special mention, but my personal thanks go to the people mentioned on the page below; for without their support, the quality of the response achieved to this very rare and devastating infection would simply not have been possible.

Dr Colin Ramsay – Consultant Epidemiologist, Health Protection Scotland.
Mrs Sheila Patterson – Executive PA, NHS Borders
Ms Debbie Lawrie – PA, NHS Borders
Dr Sally Bennett – Consultant Microbiologist, NHS Borders
Mr Chris Faldon - Health Protection Nurse Specialist, NHS Borders
Mr Alex McSorley – Emergency Planning Officer, NHS Borders
Dr Alan Mordue – Consultant in Public Health Medicine, NHS Borders
Dr Tim Patterson – Consultant in Public Health Medicine, NHS Borders
Dr Sheena MacDonald – Chair Primary and Community Services Board
Mrs Alison Aitken - Consultant
Mr Graham Fraser – Procurator Fiscal

It has been my privilege to lead the Incident Control Team for NHS Borders during the management of this incident over such a long period of time since August 2006.

Dr Andrew Riley
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December 2007

1. Introduction

1.1. Following the sudden and unexpected death of a 50 year old Borders resident in July 2006, specialised microbiological investigations were undertaken by laboratories in Scotland and the Health Protection Agency (HPA) in England. The HPA confirmed that anthrax had been identified from a blood culture sample. NHS Borders was advised of this result on 10 August 2006 by the Local Consultant Microbiologist and by Health Protection Scotland (HPS).

1.2. The following morning, the first of a series of Incident Control Team meetings was held involving a wide range of agencies to assess the problem. The team has included NHS Borders, Health & Safety Executive (HSE), Health Protection Scotland (HPS), Scottish Borders Council (SBC), State Veterinary Service (SVS), the Government Decontamination Service (GDS) and the Health Protection Agency (HPA).

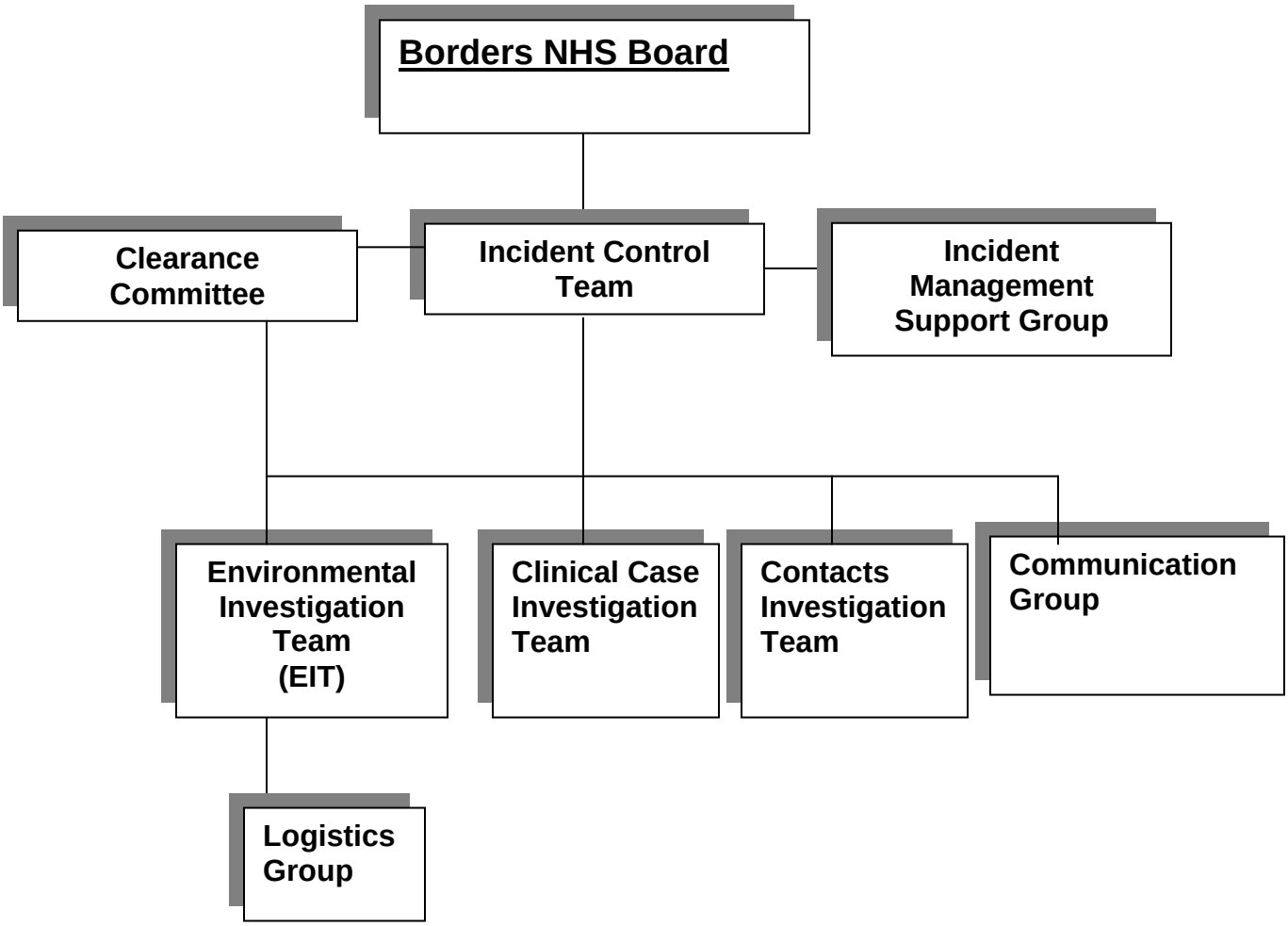
1.3. The work of the Incident Control Team has been informed throughout by national experts from the Health Protection Agency Novel and Dangerous Pathogens Laboratory (NDPL) at Porton Down and colleagues in the United States at the Center for Disease Control (CDC). The Incident Control Team continued to meet after that time and coordinated all further investigations and planning for the necessary actions to clarify the extent of contamination (if any) at Black Lodge, the home of the case and to determine what needed to be done by way of decontamination.

1.4. Immediate Control measures taken included: securing the site of possible exposure, namely the home of the case, to prevent any further exposure to any potential source of anthrax spores; obtaining expert guidance on the need for chemoprophylaxis and contact tracing for the group of contacts identified by the ICT as requiring chemoprophylaxis.

1.5. The NHS Borders Incident Control Team (ICT) managed this case in line with existing Scottish Executive Health Department guidance: "Managing Incidents Presenting Actual or Potential Risk to the Public Health" issued by the Chief Medical Officer (CMO) to the NHS with a CMO letter (SEHD/CMO (2003)2).The response to this incident was a multi-agency effort from the outset. The Incident management arrangements are graphically laid out in Figure 1 below.

1.6. As the incident evolved, aspects of the investigation led to the involvement of people and property in England. This led to the establishment of an Incident Control Team based in Northumberland which was led by colleagues from HPA Northeast and which cooperated with the Incident Control Team based in NHS Borders, Scotland.

Figure 1: Incident Organisational Response Arrangements



2. Background

2.1. Anthrax is a disease caused by the bacterium *Bacillus anthracis*. It is a disease of historical and current importance that is found throughout the world. The basis of its historical transmission is anecdotal and its true global population structure is largely unknown.

2.2. In a 2007 study[1], diverse *B. anthracis* strains were sequenced to identify genomic markers; these were used to subtype a collection of 1,033 *B. anthracis* isolates from 42 countries and to establish global patterns of diversity. The global population distribution of *B. anthracis* reflects colonial-era importation of specific genotypes from the Old World into the New World. Also, the repeated industrial importation of diverse genotypes into developed countries via spore-contaminated animal products. These findings indicate humans have played an important role in the evolution of anthrax by increasing the proliferation and dispersal of this now global disease although the actual incidence of anthrax spores in the normal environment is not known.

2.3. Local experience of anthrax Animal Health colleagues from the Scottish Veterinary Service (SVS) have given the following information. In the UK, the veterinary service is presented with approximately 11,000 cases annually to examine. In the Galashiels Division, SVS deal with approximately 430 cases each year. In the Borders Region alone, SVS deal with approximately 160 cases. In the UK annually, only 1 or 2 of those animals examined will be confirmed as positive. There have been very few cases of animal anthrax; the classical scenario being where ploughing takes place on an anthrax burial site undisturbed for years resulting in a case occurring. Ingestion is the most likely route of infection in animals, ingesting the spores from contaminated soil or herbage.

2.4. The last positive case in Galashiels Division was reported in 1997 at Strathaven and the last positive case in Borders Region was reported at St Boswells in 1984. There are no records of any positives in the Stobs, Hawick or Smailholm areas.[2]

2.5. Experience of Human Anthrax. Anthrax disease in humans is very rare in the UK and is associated with imported animal products and infected animals. Anthrax is known as Woolsorters' or Bradford disease due to its association with woollen mills in the north of England. Anthrax in textile workers was not known before 1837 when alpaca and mohair were imported into the UK. Despite the number of workers who had potentially been exposed, the level of inhalation anthrax was low. After 1904, all hides were disinfected using steam formaldehyde decontamination and this contributed to the drop in the number of reported cases. Vaccination of mill workers was introduced in the 1950's. The

[1] Van Ert MN, Easterday WR, Huynh LY, Okinaka RT, Hugh-Jones ME, et al (2007) Global Genetic Population Structure of Bacillus anthracis. PLoS ONE 2(5): e461. doi:10.1371/journal.pone.0000461

[2] Personal Communication: Mr Rob Smith, Scottish Veterinary Service, 2006.

last reported case of inhalation anthrax in the UK (before July 2006) was in 1904 although a fatal case of anthrax not thought to be inhalation anthrax was reported in England in 1976.

2.6. The last known case of human anthrax in Scotland was recorded in 1987 - a cutaneous anthrax leg lesion in a 3 year old girl in Tayside. She fully recovered and was presumed to have got it either through playing in the garden or through contact with sheep on farm land.[3]

2.7. Most worldwide cases of anthrax are cutaneous or gastro-intestinal due to handling and eating infected animals. It is not unusual for single spores of *B anthracis* to exist as natural contaminants in material fabrics of natural origins. Inhalation anthrax is rare, comprising less than 10% of clinical cases and is associated with handling infected hides, skin and hair. Nine cases of inhalation anthrax and 39 cases of cutaneous anthrax were reported in the US between 1950 and 2001. All the inhalation cases were linked to infected hides and wool.

2.8. Inhalation Anthrax is very difficult to treat when established with fever, severe breathlessness and shock with case fatality rates of 90% even with appropriate antibiotic therapy. In cutaneous anthrax, prompt antibiotic treatment usually results in full recovery although it can be fatal in between 5% and 20% of untreated cases for example if a septicaemic illness (blood borne infection) results.

2.9. Experiences from the former Soviet Union and other European countries. In 1979, an accidental release of anthrax spores at a Soviet military compound in Sverdlovsk (in former USSR) resulted in at least 66 deaths due to inhalation anthrax. The epidemiology of this inadvertent release was unusual and unexpected. None of the persons affected were children. Whether this is due to differences in susceptibility between children and adults or purely to epidemiologic factors (children may not have been outdoors at the time of release) is unclear.[4] Reports suggested that malnourished people were more susceptible to infection. After the Sverdlovsk incident, the USSR authorities decontaminated buildings by washing them with calcium hypochlorite to disinfect surfaces on the inside of buildings and formaldehyde was used for sensitive materials.

2.10. Germany has had similar experience to other European countries with cases of cutaneous and inhalation anthrax from handling animal hides, wool and infected carcasses. There was a large outbreak of anthrax in Switzerland from 1978-81 in which 24 textile workers developed cutaneous anthrax from handling infected goat hair imported from Pakistan.

[3] Personal Communication, Lynda Browning, Health Protection Scotland, 2007

[4] Clinical and EpidemiologicPrinciples of Anthrax. Cieslak TJ and Eitzen EM. Emerging Infectious Diseases Vol. 5, No. 4, 552- 555 Special Issue July-August 1999

2.11. Anthrax letters in the USA. In October 2001, letters filled with anthrax spores were sent to media and political figures in the US resulting in 22 cases of anthrax (11 inhalation and 11 cutaneous) which led to 5 deaths. The strain of anthrax used was a laboratory strain not naturally occurring anthrax. The anthrax was widely distributed throughout the US mail system. Two people were infected through receiving contaminated mail. An epidemiological investigation of a 94-year-old woman in Connecticut who died of inhalation anthrax showed that the mail sorter used for sorting mail to her address was contaminated.

2.12. Recent experience of anthrax associated with African drums. There have been three reported cases of anthrax infection associated with African style drums. One case of cutaneous infection was reported in a Florida man in 1974 who purchased a drum made with goat hair in Haiti. A Canadian woman acquired cutaneous anthrax from a drum made from goat skins imported from Africa in 2001. In January 2006, a man from New York was hospitalised with inhalation anthrax originating from goat hides that he had imported from the Ivory Coast in West Africa. He prepared drum skins by stretching, shaving and attaching them to finished drums. After a critical illness, he survived. No cases of inhalation anthrax have previously been reported due to the playing of African drums.

2.13. Infectious dose for anthrax. There are no accurate estimates of the infectious dose for inhalation anthrax. An estimate given from an outbreak of inhalation anthrax in a goat hair mill in 1957 gives an estimated dose required to cause deaths in 50% of those infected of between 2,500 and 55,000 spores. However, as it is known that some people can still get inhalation anthrax from a low exposure, it is thought that a proportion of the population are very susceptible to disease and that these people will succumb to disease when exposed to a very low dose of spores. There are two cases of inhalation anthrax from the 2001 bioterrorist attack in the US where the only route of infection was through contaminated mail. These two people are likely to have had a very low exposure to the spores and became infected.

2.14. Underlying health factors Health factors may play a large part in determining the susceptibility to inhalation anthrax after low dose exposure. Infection is a major complication of haematological or malignant disease relating to a combination of the disease itself and the immune suppression resulting from treatment of the condition. Also, the last victim of the 2001 US anthrax attacks was thought to have been exposed through contaminated mail. It is thought that her age and frailty contributed to her susceptibility.[5]

[5] Much of this background information resulted from a report from a workshop of experts in the anthrax field from throughout Europe which, was held on 21st November 2006. This was held at the HPA-NDPL Centre for Emergency Preparedness and Response, Porton Down, Salisbury, UK. The workshop concerned the risk assessment of *B.anthracis* discussing the risk of anthrax infection in humans in the UK. I am most grateful for colleagues sharing this report with the Incident Control Team in NHS Borders.

3. Timeline

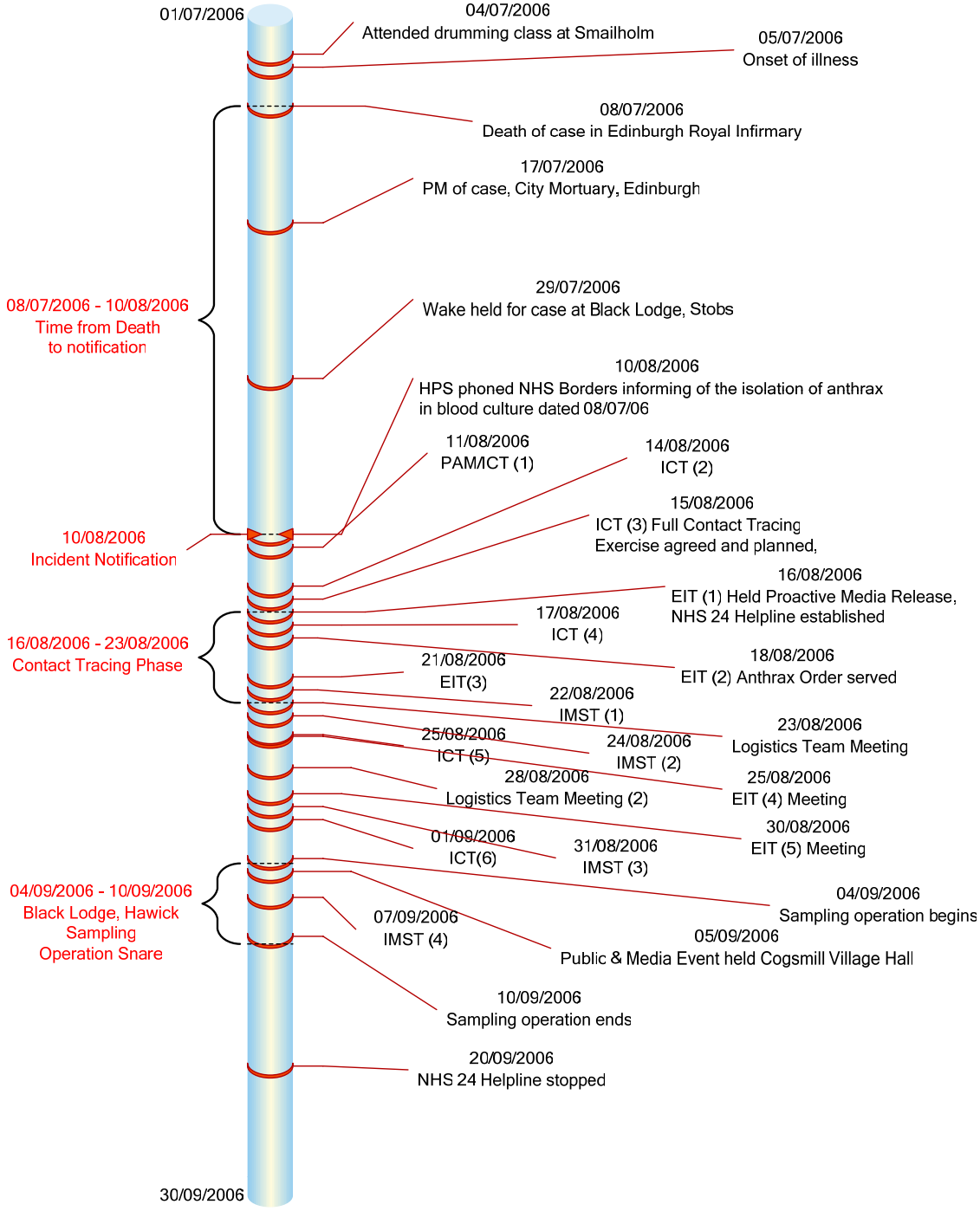
3.1. On 8th July 2006 a 50-year-old man from the Scottish Borders died from septicaemia due to inhalation anthrax infection. After notification, an investigation began to determine how the individual became infected. He was a highly skilled cabinet maker and artist who made musical instruments, including African style drums using skins obtained from imported African goat hides and skins recovered from local road-kill badgers. It was initially considered that the most likely route of infection was the handling or preparation of contaminated skins involved in the construction of drums, and that the source of contamination was likely to be animal skins possibly imported.

3.2. Environmental sampling of the case's house and workshop was undertaken. Further epidemiological investigation of the individual's movements prior to his death showed that he attended a village hall in Smailholm with a group to play African drums. The group was run by a couple originally resident in Scottish Borders but who moved to Northumberland at the end of July 2006. The couple provided drums for use within the group. Environmental testing of the drums and skins found at a house in Northumberland found positive samples by culture and PCR (Polymerase Chain Reaction). Further testing of the house and the Village Hall where he had attended drumming classes also found evidence of widespread contamination of the two sites, with some samples yielding colonies of *B. anthracis* and other sites giving positive results by PCR.

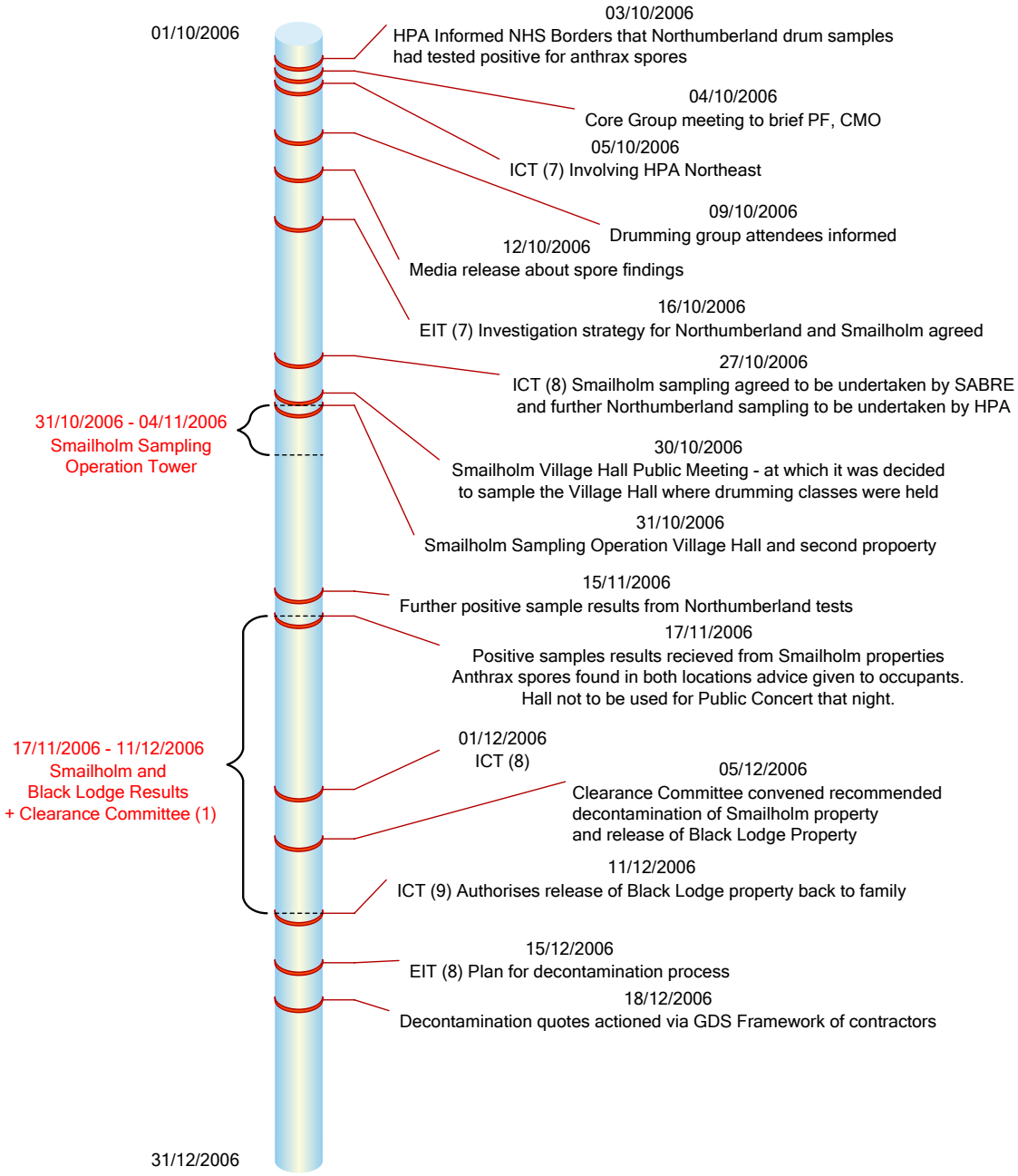
3.3. At the house in Northumberland, drums and skins were kept which, had been imported from West Africa during the course of the previous year.

3.4. The following diagrams summarise the time relationship of the complex series of events relating to the incident.

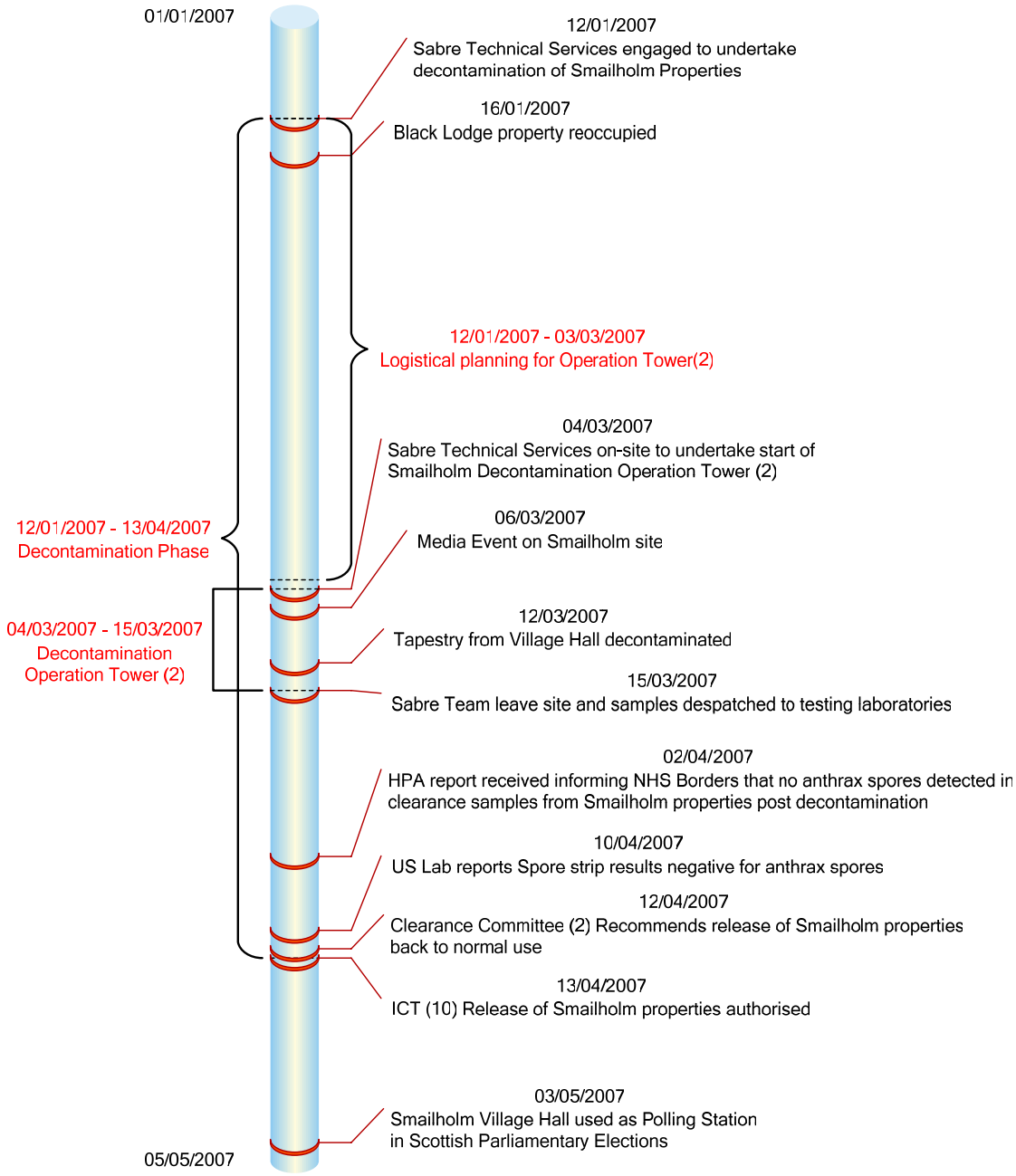
Anthrax Investigation Scottish Borders
July 2006 to September 2006



Anthrax Investigation Scottish Borders
October 2006 - December 2006



Anthrax Investigation Scottish Borders
January 2007 – May 2007



4. Initial Incident Investigations.

4.1. Introduction

The final illness and subsequent death of the case occurred at the beginning of July 2006. The date of death was 8th July 2006. See section 3 above for graphical representation of timeline recording key events and actions. The isolation of *B.anthracis* was reported on 10th August 2006 to NHS Borders. During the period of time taken for the anthrax isolation to be reported, a post mortem examination was carried out, followed by cremation and finally a wake with scattering of ashes.

This section outlines the initial microbiological investigations, an epidemiological clinical case report followed by a description of the environmental investigation undertaken, results obtained and interpretation of those results.

Microbiological Investigations JULY / AUGUST 2006

This section of the report details the initial microbiological investigations of the case prior to the case being reported to NHS Borders. The section outlines the steps each investigating laboratory took over the course of the month between the case occurring and the diagnosis being reported.

4.2. Borders General Hospital (BGH) Microbiology Department

4.2.1. Friday 7th July A blood culture was booked into the Laboratory system from a patient with a history of Acute Myeloid Leukaemia in remission. He was admitted with pyrexia, respiratory symptoms of pneumonia, and was investigated for possible meningitis and sepsis which required ITU support and ventilation.

4.2.2. Saturday 8th July A 'positive' blood culture was taken off the automated blood culture system and, as per protocol, sub cultured and Gram stained. It was noted to have a very unusual appearance. Standard procedure was followed and staff, after appropriate consultation between medical and scientific staff, decided to "wait and see" what grew. It was noted that a second gram stain was performed on the organism and it appeared morphologically to be a 'Bacillus' of unknown significance. A note is made in the laboratory request notes, that during the day, a member of staff from the New Royal Infirmary Edinburgh (NRIE) rang to inform the laboratory that the patient had been transferred but had died earlier that day.

4.2.3. Sunday 9th July All subculture plates from first blood culture were checked for growth and a Bacillus species was noted. A second blood culture was negative. As Bacillus species is a common environmental contaminant, and as the second blood culture was negative, further technical discussion was needed to determine any further action required. The isolate was further sub-cultured as per normal procedure for any blood culture isolated.

4.2.4. Monday 10th July Lack of definitive identification was noted; possible Bacillus species were considered and as the commonest interpretation would be of skin/environmental contamination, the report noted 'Contaminants only'.

A phone call was made by a neighbour of the case to the laboratory. The neighbour wanted advice regarding any possible contact with "meningitis". The caller was advised to speak to NHS Borders Public Health Department., the Director of Public Health then phoned the laboratory to determine the clinical aspects of the case. The Microbiology department advised that it had no evidence of organisms likely to have caused "meningitis". At that point reassurance concerning the possibility of meningococcal meningitis was given to the neighbour.

A phone call to the laboratory from a Specialist Registrar (SpR) in Microbiology NRIE was also received asking for any results on this patient. The SpR was informed of an isolate from one set of blood cultures and that the second set of blood cultures were negative. It was considered to be a Bacillus species and the interpretation was, of a probable skin/environmental contaminant and the then current routine practice would not attempt to further identify or perform sensitivities on the organism. The SpR asked if the BGH laboratory would send the organism to NRIE for interest, as no other Microbiology samples had been taken in the NRIE and no other organisms had been isolated.

4.2.5. Wednesday 12th July NHS Borders Consultant Microbiologist agreed to forward the isolate to NRIE Microbiology who wished to pursue its identity. Clinically, this is normal practice, in that on specific request from NRIE, any isolate in which they were interested or indeed one that had already been identified as significant to the on-going care of a patient transferred to the NRIE, would be sub-cultured and sent by courier to their laboratory.

4.2.6. Tuesday 8th August Consultant Microbiologist from Lothian e-mailed BGH laboratory to say Food Laboratory, HPA, Colindale had been in contact with NRIE requesting additional clinical details about the case.

4.2.7. Thursday 10th August Following a phone call from NRIE; the original isolate was identified not as a *Bacillus cereus* (an aerobic spore forming bacillus commonly associated with foodborne infections), but as *Bacillus anthracis*. The Consultant Microbiologist discussed this with Public Health colleagues and at the same time agreed with colleagues to start an audit trail for the specimen/culture and review leave charts to identify potentially "exposed" members of staff.

4.2.8. Friday 11th August The laboratory identified staff members who had been potentially exposed to any samples taken, i.e. present at the time the event occurred, or who remembered handling those samples. HPA advice was that after such a long time period had elapsed it was felt that any risks were very

small. This view was confirmed on Friday afternoon at a multi agency problem assessment teleconference as part of the initial incident response.

After this teleconference, and in discussion with laboratory management, all appropriate members of staff were informed of the background to the incident, the minimal risk that their "exposure" entailed and warned to be aware of the confidential nature and potential alarming response this information may have. All members of staff were advised that if any enquiries were made by outside agencies, especially the press, these should be directed to the Public Health Department.

At this first teleconference, the Microbiology department was advised to ensure the initial isolate stored was secured, and arrangements were made to facilitate transfer of the stored isolate for further testing to Porton Down, including the confirmation of initial findings.

4.3. Edinburgh Royal Infirmary

4.3.1. 10th July Information was requested regarding blood cultures passed to NRIE Microbiology Specialist Registrar (SpR) to follow up the identity of an isolate. A Biomedical Scientist (BMS) at Borders General Hospital (BGH) was contacted and it was noted that BGH presumed the blood culture growth was a contaminant but would send the culture.

The SpR spoke to the duty Consultant Microbiologist as the concern was that sepsis was cause of death. The consultant agreed that as the above blood culture was the only positive sample, further identification should be requested. The NRIE Consultant had initially planned to send the sample to the Food Lab at the Western General Hospital in Edinburgh, but subsequently reconsidered, that on reflection we could not identify all bacillus species with the tests available in the Edinburgh food laboratory, and so decided that the organism should be sent to the Colindale Food Reference Laboratory in London. That same day, the SpR was phoned by the Director of Public Health (DPH) at NHS Borders who was enquiring for any further information and was informed of a bacillus species but advised that it was unclear as to its significance and further identification had been requested.

4.3.2. 14th July The isolate arrived at NRIE and was sub cultured over the weekend and subsequently sent to HPA Colindale Food Safety Microbiology Laboratory on Wednesday 19th July arriving on Thursday 20th July.

4.3.3. 8th August HPA Food Safety Laboratory phoned in order to seek assistance with the identification of the organism in order to differentiate between *Bacillus cereus* and *Bacillus anthracis* based on sequencing. As the organism was penicillin sensitive, this is not typical for *Bacillus cereus*. The SpR spoke to HPA Food laboratory later that afternoon, informing them of the clinical

information known which was thought to be unusual for a case of *Bacillus cereus* as the patient had died of sepsis.

4.3.4. 10th August, the HPA Food Safety Lab informed RIE via the SpR that the isolate had been identified as *Bacillus anthracis.*

4.4. Health Protection Agency

4.4.1. 20th July At the, Centre for Infection, Colindale (CfI), a culture of *Bacillus* species, isolated from the blood of patient on 8th July was received at the Food Safety Microbiology Laboratory (FSML) from the New Royal Infirmary Edinburgh (NRIE). The original culture had been sent to NRIE from Borders General Hospital.

4.4.2. 21st July – 8th August. Various microbiological tests were performed within FSML in CfI to identify the culture, and these were performed in a containment level 2 laboratory. These included subculture on solid media, subculture on liquid media and DNA extraction.

4.4.3. 8th August. Review of phenotypic results showed that the culture was a *Bacillus* species which was non motile, non-haemolytic and sensitive to gamma phage and penicillin although it did not have a characteristic morphology of a *B. anthracis* culture. However, a biomedical scientist in FSML spoke to the microbiology registrar at NRIE, to obtain clinical information on the patient. It was reiterated that the bacillus species was originally perceived to be a contaminant of doubtful clinical significance.

4.4.4. 9th August. Director of FSML decided that a subculture of isolate should be sent to HPA Porton Down for identification as a suspect hazard (group 3) isolate which requires specific precautions for its handling.

4.4.5. 10th August. At 09.15 HPA Porton Down, informed Colindale Food Safety Laboratory that this was a presumptive *Bacillus anthracis.* This was confirmed as *Bacillus anthracis* at approximately 16.00 pm that afternoon. Health Protection Scotland and Edinburgh Royal Infirmary were also immediately informed.

<u>Initial Epidemiological Investigations</u>.

Investigations were complicated by the time lapse of one month between the case's illness and death and the microbiological confirmation of the cause. This meant that investigation relied heavily on the recall of family members, friends and acquaintances. The resulting information was sometimes conflicting; there was a lack of certainty on key facts and because of ongoing property risk assessments, access to some documentation and corroborating evidence was only possible much later in the investigation.

4.5. Initial investigations by NHS Borders established that the case lived in a rural location; was a Buddhist; was a vegetarian; that he was a musician and craftsman woodworker specialising in making stringed musical instruments including violins and guitars; was an active gardener, grew vegetables at home and worked part-time for an organic gardening co-operative; that he had sometime recently dug a new well for a private water supply at his home and that he had access to road kill badgers.

4.6. It was also reported that the case had taken up drumming early in 2006 and had attended West African drumming classes at one or more workshops run in the locality, where a variety of imported drums were available for use. He had made one or more drums himself, possibly using a badger or other animal skin for the drum head; that the skin of his first drum head had split and that he had, very recently, made a new drum head with an animal skin from an unknown source, either an imported goat skin, bought on the internet or from a tannery in England.

4.7. Based on these early investigation results, a number of plausible routes for exposure to *Bacillus anthracis* spores were identified associated with his home environment, his occupations and hobbies. In particular, the connections to musical instrument making, drums and animal skins, his contact with soil via gardening activities and recently digging a well were all considered significant as potential exposure risk factors.

4.8. Review of the recent literature on anthrax cases identified a (non-fatal) case of inhalation anthrax reported earlier in 2006 from the USA, involving a male in New York thought to have been exposed to *Bacillus anthracis* spores when making a drumhead for a West African Djembe drum. He had shaved and prepared a goatskin, brought into the USA after a trip to Côte d'Ivoire to make the drumhead and this was thought to have released *Bacillus anthracis* spores into the air, which he then inhaled. Contamination with *Bacillus anthracis* spores was confirmed in his workplace, his home and a vehicle he used. This report was the first case of naturally acquired inhalation anthrax recorded in the USA since 1976. Decontamination of the contaminated property was carried out.[6]

4.9. In addition to the New York case, there were several other reports of human anthrax infection, reportedly associated with contact or use of drums using goatskin hides for the drumheads from West Africa or other sources.

4.10. The initial information on this case's risk factors as well as case reports from elsewhere provided the basis for generating the initial hypotheses on the source and route of infection and was the basis for planning the subsequent environmental and epidemiological investigations.

[6] Morbidity and Mortality Weekly Report. CDC. MMWR March 17, 2006 / 55(10);280-282

Clinical Case Report

4.11. The clinical picture, presenting symptoms and signs were reviewed by a clinical review group of medical and microbiological specialists at a case review on September 7th 2006. All clinical records, summaries, investigations, scans and X-rays were examined together with autopsy reports. Subsequently, a second review was sought from a US specialist Infectious Diseases Physician from Emory University School of Medicine, Georgia, USA, facilitated for the ICT by the Center for Disease Control (CDC) in Atlanta, USA. These elements are considered together with a detailed immunohistochemistry report from the Infectious Diseases Pathology branch at (CDC) Atlanta.

4.12. In summary, the case had a history of being treated for Acute Myeloid Leukaemia diagnosed in 2002. In June 2006, he was reviewed at Borders General Hospital and no specific problems were noted. He was considered to be in remission from this condition. One friend noted a black and red lesion on one hand, this was felt to be a chronic lesion that was getting better.

4.13. The case attended a drumming group on 4th July and started to feel unwell with high fever and shivering on the 5th July. Feeling better the next day, he continued to work on his own drum but reported a cough, some shortness of breath and chest discomfort. On the 7th July, his condition deteriorated and he was admitted via his general practitioner to Borders General Hospital. Investigations showed chest X-ray changes and over the course of the next 12 hours, his clinical condition deteriorated quickly, even with active and intense treatment. In view of the clinical deterioration, he was transferred to NRIE Intensive Care, treatment including a range of antibiotic therapy was administered, but in spite of all treatment, he died on 8th July 2006.

4.14. Post mortem examinations of the body, blood and tissue samples, subsequently revealed that the case died from systemic *B.anthracis* complicated by a haemorrhagic septicaemia (blood borne infection). The rapid downhill course is characteristic of other cases in the medical literature including those from the 2001 deliberate release of anthrax in the USA. The reported skin lesion was thought highly unlikely to be cutaneous anthrax and was not recorded at either hospital admission where careful examination of the skin was made due to the possibility of meningitis infection where skin signs are a key feature of such disease. No sign of anthrax type skin lesions were noted at autopsy.

4.15. The recorded features of this case were not typical of cutaneous anthrax; however neither did the presentation exhibit all typical features of inhalation anthrax. On balance, taking into account both local and international expert case review processes, this case shared many features of a case of inhalation anthrax recorded during the 2001 US anthrax attack and is regarded as an atypical (unusual or not typical) case of inhalation anthrax.

4.16. This opinion is supported by immunohistochemistry results from the Infectious Diseases Pathology branch at CDC, Atlanta. Examination provided positive immunohistochemical evidence of *Bacillus anthracis* infection in multiple organ sites. The evidence to support a possible diagnosis inhalation anthrax is the presence of *Bacillus anthracis* antigen on the surface of focal bronchiolar epithelial cells and in adjacent macrophages. Without an obvious cutaneous lesion, it is very unlikely that this case contracted anthrax via cutaneous exposure. The fatality rate of cutaneous anthrax used to be 20~25% without effective antibiotic treatment. None of the patients died during the 2001 cutaneous anthrax outbreak in New York City. The findings indicate systemic sepsis and the pathologic evaluation and test results are compatible with inhalation anthrax.

Incident Control Team

4.17. The Incident Control Team was chaired eight times by the Director of Public Health, NHS Borders and on two occasions by a Consultant Epidemiologist from Health Protection Scotland. An Incident Control Team was established and met for the first time on 11 August 2006 in order to formally assess the problem. In all the ICT met 10 times with a similar number of Environmental Investigation team meetings between those. The meetings were held in NHS Borders and involved a mixture of actual and teleconference attendees. It included representatives from NHS Borders, Health & Safety Executive, Scottish Borders Council, State Veterinary Service, and the Health Protection Agency. The work of the Incident Control Team was informed by national experts from the Health Protection Agency Novel and Dangerous Pathogens Laboratory at Porton Down (NDPL) and colleagues in the United States at the Center for Disease Control (CDC). The Incident Control Team remit was to:

- co-ordinate all investigations and planning for any necessary public health actions including contact tracing and the provision of public health advice to any affected population;
- clarify the extent of any contamination with anthrax at Black Lodge or any other properties highlighted during the course of the investigation;
- determine any decontamination requirements;
- take any necessary steps to protect the health of the public including managing the process of decontamination.

4.18. Incident Management Support Group (IMSG)

An Incident Management Team Support Group was established, chaired initially by the Chief Executive of NHS Borders and subsequently by the Director of Public Health. It involved lead officers from key local agencies, including NHS Borders, Health Protection Scotland, Scottish Borders Council and Lothian and Borders Police. This Group, on behalf of NHS Borders, took a strategic oversight of the operations which supported the function of the ICT. It met a total of four times and its members were instrumental in clarifying issues such as funding streams for the necessary public health interventions arising from the incident

4.19. Environmental Investigation Team (EIT)
An Environmental Investigation Team (EIT) was set up as a sub-group of the Incident Control Team (ICT) to coordinate the epidemiological investigation into possible sources of the anthrax which resulted in the case's illness and death. The EIT was chaired by a Consultant Epidemiologist from HPS. This Team included representatives from NHS Borders, Health & Safety Executive, State Veterinary Service, the Government Decontamination Service, Scottish Environmental Protection Agency and the Health Protection Agency. This Team led the design of the sampling and decontamination plans for the property. The role of EIT was to:

- consider possible sources for *B. Anthracis*
- assess potential continuing risks to public health
- advise ICT on appropriate measures to control any potential continuing risk
- investigate potential sources and potentially contaminated locations
- determine policy on decontamination of any identified sources or contaminated property
- determine standards for final clearance of contaminated property

4.20. A **Logistics Sub-Group** of the EIT was established and responsibility was delegated to it for the planning and delivery of the investigation and decontamination operations. The Logistics group was chaired by the Health Emergency Planning Officer of NHS Borders and coordinated the logistic and operational support to the implementation of plans. Including those for sampling of all properties investigated in Scottish Borders and the subsequent decontamination required.

4.21.A **Clearance Committee** was later established chaired by the Procurator Fiscal and to this group was delegated the task of approving decontamination clearance standards and agreeing recommendations to the ICT on the final clearance of contaminated property. The memberships of the EIT, Logistics Sub-Group and Clearance Committee are listed in **Appendix 1**.

4.22. Initial Assessment of exposure hazards and actions taken to manage continuing health risks

Based on the early investigation results, the primary hypothesis was that the case had been exposed to anthrax spores as a result of activities at his home location (Black Lodge) associated with the handling of animal skins, with drum making, or with contact with potentially contaminated soil. The Black Lodge property consists of a detached house, a large separate multi-roomed wood workshop/wood store and large separate garage/metal workshop, with surrounding garden land. The property was bounded by free-standing walls on two sides, a fence and a stream. In view of the uncertainties regarding contamination at Black Lodge, the family was asked to vacate the property.

4.23. In order to ensure that all appropriate precautions were taken, initial assessment by the ICT accepted specialist advice from HPA and HPS and immediately traced all people who had been present in Black Lodge in the seven days prior to notification of the diagnosis. On the grounds that 7 days was recognised as the usual incubation period for anthrax and no other cases had been reported in the month after the case's death. This was done and 11 direct contacts were interviewed and 7 prescribed antibiotic chemoprophylaxis in accordance with guidance from the HPA.[7]

4.24. At the next ICT, after detailed discussion and review of known cases in the medical literature, expert advice indicated that the contact tracing period should be extended to people who had been in contact with the suspected site within a period of 30 days prior to notification of the diagnosis. Evidence was collected on the very few similar incidents in the USA, namely the deliberate release in the US Post Office and a single case of inhalation anthrax in a man in New York who was a drum maker. It was suggested that the contact tracing exercise for this incident may be extended backwards in time to cover a possible extended incubation period of disease of 30 days. This meant tracing people who had been in the house and workshop between the time of the case's death and notification.

4.25. This period was chosen because expert opinion agreed that 30 days was the most likely period within which anyone inadvertently exposed to anthrax spores would have been likely to show signs of having contracted the illness. Although accepted advice is that the normal incubation period for anthrax is seven days, cases have been recorded as having been exposed to spores more than seven days before onset of illness. The group potentially exposed now included at least 50 people who had attended the wake and scattering of ashes at the home of the case. Subsequently a number of people who attended the wake were advised to take antibiotic prophylaxis as a result of a full risk assessment.

4.26. As a result, an extensive contact tracing exercise was planned organised and undertaken. NHS Borders traced the case's relatives and other individuals known to have had access to the building during a period of 30 days prior to notification of the case. With the help of HPS, a protocol for a case by case risk assessment was developed for the contact tracing exercise. This resulted in the production of a risk matrix (**Table 1**) to decide who should be recommended to take antibiotic chemoprophylaxis.

[7] Interim Guidelines for action in the event of a Deliberate release of Anthrax Version 5.5 November 2005).

Table 1. Risk Matrix

Level of potential exposure	Less than 1 hour	More than an hour, but not overnight	Overnight
Low	Info & Advice	Info & Advice	Prophylaxis
Medium	Info & Advice	Prophylaxis	Prophylaxis
High	Prophylaxis	Prophylaxis	Prophylaxis

Examples of levels of potential exposure:

Low: Entered garden
Medium: Entered the house or outbuildings other than workshop
High: Entered the workshop
or handled hides, or dead animals, or drums

The contact was allocated to one of three groups, and action recommended Accordingly either:

- Immediate referral to A&E if medical concerns apparent.
- referral for antibiotic prophylaxis, information and advice
- or information and advice only.

4.27. The contact tracing exercise was undertaken with immense support from the Primary & Community Services Board of NHS Borders, Borders Emergency Care Service and a group of volunteer contact tracers. NHS 24 hosted a helpline where calls were sifted and contacts passed to NHS Borders. As a result, a total of 167 people were contacted and 73 people commenced a course of antibiotic prophylaxis. The resulting health impact of the contact tracing and antibiotic prophylaxis is summarized later in the document [**Section 8.8, 8.9**]

4.28. The contact tracing exercise was planned and undertaken within a 24 hour period by the **Contacts Investigation Team** chaired by an NHS Borders Consultant in Public Health Medicine. Media releases were used to help trace all people who had spent time at Black Lodge in the month after the case died.

Investigation of Black Lodge

4.29. At the same time, (August 11th) Black Lodge itself was physically isolated with fencing round the property and a 24 hour police presence was put in place. No further access was permitted pending a full environmental investigation. Having secured the property, a detailed plan for the investigation of Black Lodge was then developed and carried out. In addition investigators continued to develop a detailed history in the period prior to the case's fatal illness and to corroborate information supplied in the early investigation phase. This detailed investigation identified additional potential sources of exposure. A **Communications Group** had oversight of the media and press relations, as well as communications with other key stakeholders.

4.29.1. Securing the site - Legal Issues*.* The EIT sought advice on legal measures to secure the property and prevent access. This proved problematic. Advice was sought from the Scottish Executive on what legislation might be appropriate. Existing Public Health legislation did not appear to offer a solution in this situation. A definitive answer on what legislation could be used proved elusive. It was noted at this stage that Black Lodge had a large bat colony living in the house attic. There had been reports of significant numbers of dead bats found after the death of the case. The cause of death was unknown at that time. Given the uncertainty over the origin of the *B. anthracis* spores, the Anthrax Order 1991[8] was used initially to issue an exclusion order on the property, which was duly posted.

4.29.2. The EIT were subsequently advised that the use of the Anthrax Order, while not "inappropriate" in this situation was considered "undesirable" by SEERAD. The exclusion order was therefore withdrawn. As Black Lodge was used as a place of business, HSE representatives on the EIT were of the view that the general provisions of the Health and Safety at Work Act[9] would be appropriate. HSE helpfully facilitated the process and a 'Notice to Leave Undisturbed' was issued on 25th August 2006 and was posted on the site and lifted on 21st December 2006.

4.29.3. Other legislation was discussed during the course of the incident and could possibly have been used. This relates to the nuisance provisions of the Environment Protection Act 1990. In Scotland this legislation also involves the provisions of the Environment Act 1995 (c. 25).

4.29.4. Environmental Investigation (Operation Snare)

Sampling at Black Lodge lasted for a week from the 4th September 2006 to 10th September 2006 and involved a major logistics effort. The Logistics Sub-Group of the EIT undertook the detailed planning of Operation Snare involving support from NHS Borders, Scottish Borders Council, Lothian & Borders Police, Lothian & Borders Fire and Rescue Service, the Scottish Ambulance Service (SAS), GDS, HPA, HSE, HPS, SEPA and SW.

The inability to obtain permission to use private land immediately adjacent to Black Lodge required an alternative organisational order and plan to be developed. The plan involved the daytime closure, for the duration of the sampling programme, of the main road (B6399) in order to ensure the safety of operations. The lack of legal rights to secure access to the property via a third party's land, was identified as an issue.

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[8] Statutory Instrument 1991 No. 2814 The Anthrax Order 1991 and Statutory Instrument 1996 No. 1855 The Anthrax (Amendment) Order 1996

[9] Section 20(2)(e) of the Health & Safety at Work etc. Act 1974

4.29.5. Microbiological sampling of property.

Sampling of the Black Lodge property was carried out in two phases using different procedures, methodologies and teams.

A team from the Health Protection Agency (HPA) Novel and Dangerous Pathogens Laboratory (NDPL), Porton Down, was commissioned to carry out the first sampling exercise. Prior to sampling, a small team carried out a video reconnaissance of the property. In view of the legal status of the enquiries (technically under the direction of the Procurator Fiscal) the video was then reviewed in the presence of Lothian & Borders Police, to decide on materials to be removed for further examination.

In the course of the house investigation, two completed Djembe drums were found, neither of which had an intact drumhead. Intact spare skins were located in the main bedroom and completed drumheads were found elsewhere in the property. Equipment was found on a workbench, strongly suggesting that the house had been the site where the case shaved and prepared animal skins for use in making drumheads, consistent with the process used in the New York drummer case (in February 2006).

Testing was conducted either using wet swabs or sponges to wipe surfaces or using a vacuum-cleaner fitted with HEPA (High Efficiency Particulate Air) filters from which the material is extracted. Any material from the swabs/sponges or the HEPA filters were extracted for direct isolation onto agar plates and by PCR. Material was then placed into enrichment broth and the broth incubated for 24-48 hours to allow growth. The broth was then plated out for colony isolation or subjected to PCR. PCR was conducted on all bacterial colonies that were suspected to be *Bacillus anthracis*.

Given the history of a newly dug well, samples of kitchen tap water were taken. Animal hides found in the property, together with equipment including hair trimmers, completed drumheads found in the garage/metal workshop and remnants of dried skins found in the wood workshop were all removed for testing, as were the contents of a large vacuum cleaner found in the wood workshop.

All samples were packaged to Police evidential standards and a chain of custody procedure was adopted to ensure traceability at all stages of sample handling. The samples were transported to HPA-NDPL at Porton Down. Analysis was carried out over the following weeks using standard HPA-NDPL protocols where possible. Samples of animal skins and drumheads were tested to destruction to maximise the chances of detecting any spores present.

4.29.6. The Government Decontamination Service (GDS)

The Government Decontamination Service (GDS) is an executive Agency of the Department for Environment Food and Rural Affairs. It operates on a UK wide and cross departmental basis. Its remit is to advise on the decontamination of buildings, other infrastructure, transport assets and the open environment following a CBRN[10] or significant HazMat[11] incident. GDS works to assess the ability of companies in the private sector to carry out decontamination operations, and to ensure that responsible authorities have ready access to services, through a pre-negotiated framework agreement, if the need arises.

GDS is a key element of the Government resources which helps the country prepare for a CBRN or significant HazMat incident, and minimises its impact on people, society, the economy and the environment. It supports the wider UK decontamination capability.

In August 2006, the UK Government Decontamination Service (GDS) was made aware of the death in the Scottish Borders resulting from anthrax. GDS responded to the notification of the anthrax case in Borders by:

- assigning a case officer who was dispatched to the Scottish Borders to work and establish liaison with Health Protection Scotland and NHS Borders.
- offering and facilitating full use of GDS resources, including links with experts in the USA and the GDS Specialist Supplier Framework.
- facilitating the use of the Specialist Supplier Framework to choose a method and supplier to decontaminate the affected properties.
- forming part of the decision making committee to sign off the properties as cleared, following fumigation by Chlorine Dioxide gas.

4.29.7. GDS commissioned a second sampling team from SABRE Technical Services of the USA to test the practicality of existing arrangements for support in the event of such an incident. This exercise consisted of deploying the contractor to the UK and conducting sampling to clearance standards in the suspect property at Black Lodge.

SABRE carried out characterisation sampling to the standard used in investigations of deliberate anthrax contamination in the US, using wet wipes, HEPA filter vacuuming and total volumetric air sampling following air agitation to detect any airborne BA spores. The contents of the domestic house vacuum cleaner were found and taken, as was a dead bat found in an upstairs room, together with samples of bat guano from the attic although the sampling team experienced great difficulties in accessing the attic.

[10] CBRN – a chemical, biological , radiological or nuclear event caused by terrorist activity.
[11] HazMat – an incident resulting from the accidental discharge or hazardous materials whether chemical, biological or radiological.

The samples collected by SABRE were sent to the Veterinary Laboratory Services (VLA) Laboratory, Weybridge in Surrey with whom a separate contract was negotiated. Analysis at VLA was carried out using a set of modified US protocols by agreement with the US CDC/EPA, consistent with methods developed following experience gained from investigations of the deliberate release anthrax incidents in the USA in 2001.

Investigation of other potential sources of anthrax.

4.30. In parallel with the investigation of the Black Lodge site, exhaustive enquiries continued to identify other possible sources of exposure to *B.anthracis* spores, in particular, contact with animal skins and West African sourced drums. As a result secondary hypotheses for possible routes of infection were examined including

- Exposure via environmental contamination
  - gardening/composting animal contact/rescues
  - contaminated private water supply as the case had recently dug new domestic drinking-water well
- Exposure via contact with other drums & hides used for drums
  - contact with other drums at local drumming classes
  - contact with drums and spare goat hides brought to UK from West Africa.

4.30.1. the case was known to have taken up African style drumming early in 2006. He joined a class run by a local West African drumming school and attended classes regularly up until he developed his illness. His last class was the day before he became ill. He also attended two workshops organised by the drumming school, one in March 2006 and a second in July immediately before his illness. He may also have attended other drumming events in Scotland.

4.30.2. Although the case used the first Djembe drum that he had made himself, The case also used other drums at the drumming school at classes and at the workshops. These drums had been imported by the drumming school from sources including Guinea, West Africa over a period from 2005 onwards. Completed Djembe drums (with shaved goat skin drum heads) and larger Dun Dun drums (with unshaved cow-hide drum heads) were imported together with spare goatskins for use in making new drum heads. The drums and skins were imported in accordance with existing DEFRA regulations via UK airports.

4.30.3. There was uncertainty as to where the case had sourced animal skins used for making drum heads. Reports from contacts suggested that he had acquired one or more goatskins from unknown sources. However, there was no evidence that he had acquired an unprepared goatskin from the West African drumming school owners, nor any evidence that he had any direct contact with spare skins belonging to the school. He did however request advice from the drumming teacher on how to process a new goatskin.

4.31. Cumbria link

During interviews with the drumming school owners, it was established that the case had not been in contact with spare goatskins brought from West Africa by the drumming school owners. However, it was reported that one skin had been sold on to another participant at the workshop held in March 2006. This raised immediate concerns and the individual was eventually traced to Cumbria where the skin had been used to make a drumhead.

The completed drum with drumhead and the remains of the skin were taken to HPA-NDPL, Porton Down for analysis. Testing of this drum and the skin remnants did not identify any evidence of contamination with anthrax.

4.32. Cross Border Investigation

At this time, the investigation involved England so the HPA established its own Incident Control Team mechanisms to coordinate the agencies in England. Leadership was from HPA Northeast. There was effective cross representation between the Scottish and English groups and very close liaison was maintained to coordinate the investigations and communications.

4.33. Investigation of a West African Drumming School link.

Although the case had not obtained a skin through the drumming school connection, there remained the possibility that the case's anthrax exposure was associated with the drums used at the drumming classes. The drums from the school were themselves investigated. The drumming school had in excess of 20 drums, which were used by clients at classes and workshops. Some drums were sold on and replaced by newer drums and some drums were imported specifically for sale.

4.34. Prior to August 2006, the drums were stored at a property in Smailholm Village in the Scottish Borders. These drums were transported to Smailholm Village Hall for weekly drumming classes and on occasion to other locations for classes or workshops. The case attended classes predominantly at Smailholm Village Hall but did not attend the domestic properties involved.

4.35. After July 2006, the majority of the drums were moved and then stored at a property in Northumberland, England, where the drumming school owners had relocated. Some drums were also stored in a garage at the original property in Smailholm Village and from time to time in the Village Hall.

4.36. A team from HPA-NDPL was commissioned to visit both Smailholm and Northumberland to collect the drums for return to Porton Down for sampling. The majority of drums were stored in a bedroom in the Northumberland property stacked on top of each other. These were removed at that first visit, although subsequently further drums were recovered from a cupboard in the Northumberland property.

4.37. In addition to the Djembe and Dun Dun drums, a number of animal skins were also recovered from the Northumberland property and removed. These were spare goatskins imported for use in making replacement drum heads. Also, limited sampling was carried out in rooms at the Northumberland property consisting of swabs from surfaces in the room where the drums were stored and flooring under a rug on which some of the drums had stood.

4.38. A number of drums were also removed from the garage at the Smailholm property. Limited sampling was also carried out at the garage consisting of vacuuming of the garage floor and swabbing of surfaces. These samples were all transported to HPA-NDPL for analysis.

Results from sampling at Black Lodge, Smailholm and Northumberland.

4.39. Black Lodge Investigation Results All 51 samples collected by the HPA and 113 samples collected by the US SABRE team from Black Lodge, were found to be negative for anthrax spores using culture techniques and negative for anthrax DNA using PCR tests.

The exhaustive investigation of the Black Lodge site therefore failed to find any evidence of *B.anthracis* spores and effectively ruled out the initial Primary hypothesis that the case had been exposed during his work at home with animal skins. There was no evidence to support his exposure to spores, via his shaving and preparing an animal skin to produce a drumhead, as in the New York drummer case of February 2006.

4.40. On the basis that there was no microbiological evidence of contamination with *B.anthracis* or spore DNA material at Black Lodge, the Clearance Committee recommended no decontamination and the return of the property to the owners for normal use on the 11th December 2006.

4.41. Results from the initial sampling at Northumberland and Smailholm. The initial tests on these samples were expected to be negative. However, subsequent PCR and culture testing identified a number of positive isolates from the Northumberland site. Results from the samples tested, using both a vacuum sampling methodology, where a gelatine membrane was used on a dedicated sampling head to vacuum the drum surface, plus any fur edging and a sponge sampling methodology where sponge wipes were used to remove any material from the drum skin. From these drums, *B. anthracis* was isolated from one drum (genotype reported as the same strain as the case) and presumptive positives were obtained by PCR assay from a further two drums.

4.42. A number of unprocessed skins, plus 2 drum skins removed from drums were removed from the house at the time of sampling the drums. When these skins were analysed, *B. anthracis* was isolated from one of the drum skins but not from the unprocessed skins. The genotype of this isolate was found to be

different from the profile of the case strain.[12] The implication was that low levels of spores were present.

4.43. This prompted a re-assessment of the investigation strategy and a revision of the hypotheses for the case's exposure to anthrax. It was decided that although the samples from Black Lodge were still being processed, the possibility that the case had been exposed via contact with drums belonging to the drumming school could not be discounted and would need to be fully investigated.

4.44. Second sampling at Northumberland and Smailholm.

HPA – NDPL staff were commissioned by HPA Northeast to revisit the Northumberland property and secure the remaining drums for return to Porton Down. A suite of samples were taken from the property, including HEPA vacuum samples, swabs and wipe samples within the property and from the vehicle used to transport the drums.

4.45. It was also decided to resample the original property at Smailholm as it was reported that the drums had previously been stored in the garage and house at this address; therefore the entire house was included in the second sampling visit. It was further reported that the drum school teacher had shaved goatskins in preparation for making drumheads at this property though not inside the house.

4.46. In addition to the domestic property used to store the drums, the Village Hall at Smailholm had been a regular venue for the drumming classes and a workshop. The case had attended classes predominantly at the village hall, and in fact, had attended a class there the day before he first became unwell. It was therefore decided with the full agreement of the local community, that for maximum reassurance, the hall itself should also be sampled to eliminate the possibility of it being contaminated.

4.47. SABRE Technical Services of the US were commissioned by NHS Borders to conduct sampling at Smailholm. This sampling operation, code named Operation Tower was conducted following an intensive planning exercise by the local logistics sub group. The sampling took place between the 31st October and 4th November 2006. Once again, all samples were packaged and labeled to Police evidential standards and a strict chain of custody procedure was adopted to ensure traceability at all stages of sample handling. The resulting samples taken, were sent to HPA-NDPL for processing and analysis.

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[12] Report prepared for NHS Borders & Health Protection Scotland by Graham Lloyd, Nigel Silman, Allan Bennett, Tim Brooks, Novel and Dangerous Pathogens Centre for Emergency Preparedness and Response Health Protection Agency.

4.48. Summary of Second Smailholm Sampling Results (Operation Tower). In respect of the Village Hall, evidence of viable spores of *B. anthracis* from positive cultures was obtained from HEPA vacuum samples of cushioned chairs in the smaller room. Evidence of viable spores of *B. anthracis* from positive cultures were obtained from HEPA vacuum samples of main hall floor, broom cupboard floor and brooms (combined sample). Evidence of *B. anthracis* DNA was present on surfaces throughout the hall complex. Positive PCR results were obtained from wipes and HEPA vacuum samples and bulk dust from the domestic hall vacuum cleaner. There was no evidence of airborne spore or spore DNA contamination – all air samples were negative.

4.49. In order to consider these results a clearance committee was established. There was evidence of contamination with viable *B. anthracis* spores in the main hall and on chair furniture in the small room, with widespread evidence of contamination with spore DNA. As a result, the ICT recommended that decontamination of the hall complex was carried out.

4.50. In respect of the domestic property in Smailholm, there was no evidence of contamination in a small garage. However there was evidence of viable *B.anthracis* spores on the garage floor and evidence of *B.anthracis* DNA on surfaces within a larger garage where the drums had been stored. The conclusions reached by the Clearance Committee were that decontamination was not required for the smaller garage but was required for the larger garage.

Clearance Committee

4.51. Throughout this report reference is made to a Clearance Committee which was established to assist the management of this incident. As part of this investigation, a number of properties were sampled for anthrax spores. It was agreed by the NHS Borders Incident Control Team (ICT) to set up a "Clearance Committee". The role, remit and operating procedures for this committee are described below. Members of all committees are listed in **Appendix 1**.

4.52. The membership included all relevant agencies with an interest in this aspect of the investigation. The Chair of the committee was selected to be independent of NHS Borders and to represent the "public" interest. The Procurator Fiscal for the Scottish Borders very kindly agreed to accept this role.

4.53. Involved agencies provided membership of the committee and were asked to present evidence to the committee. This raised the possibility of a degree of conflict of interest in aspects of the committee's role. The status of members representing agencies was discussed and agreed at the initial meeting of the committee. The role and remit of the Clearance Committee was: to review the results of samples taken from investigated properties; to assess the significance of the results and to make any recommendations on further action to the ICT.

The following operating procedures were used: The Clearance Committee was presented with the results of environmental sampling and microbiological analysis carried out on relevant properties; the Clearance Committee considered the results and the implications of the findings in terms of criteria agreed for investigation and clearance by the NHS Borders ICT and recommended:

either *the property and its contents had been investigated to an appropriate standard and that the clearance standard in relation to the presence/absence of anthrax spores had been met and such a property would be safe for normal use without restriction;*

or *that the investigation and clearance criteria have not been satisfied and that decontamination of the property was required with further verification sampling.*

As a result, a decontamination plan was required for that property and the results of post-decontamination sampling were to be submitted to the Clearance Committee when available. The Clearance Committee met twice and reported its conclusions and recommendations to the ICT.

5. Decontamination Process.

5.1. Introduction Following the detection of anthrax spores at some of the properties, decontamination of certain properties was recommended by the Incident Control Team (ICT). The findings of the investigations were assessed by a Clearance Committee, chaired by the Procurator Fiscal. This process was delegated to and coordinated by the Environmental Investigation Team and involved representatives from many different agencies including NHS Borders, Health Protection Scotland (HPS), Health Protection Agency (Porton Down), Health and Safety Executive (HSE), Scottish Environmental Protection Agency (SEPA) and the Government Decontamination Service (GDS).

5.2. Two methods for decontamination of properties were identified and the GDS was asked to obtain quotations from its Framework of Contractors to undertake this work. The two methods involved treatment of the properties with either gaseous Chlorine Dioxide or vapourised Hydrogen Peroxide as the active agent.

5.3. Decontamination Process An expert working group was convened comprising world wide decontamination experience with representatives from:

- HPA – Novel and Dangerous Pathogens Laboratory
- GDS – Government Decontamination Service
- German Bundeswehr Inst Mikro Bio Leitung
- US EPA – Environmental Protection Agency

5.4. The US-EPA provided generic advice and questions were posed to the experts relating to each contaminated property specifically, “to what extent should each property be designated as contaminated?” “What would be the preferred decontamination methods and preferred agents?” It should be noted that cost issues were not addressed when seeking expert views on the best decontamination methods. Opinions were sought on the efficacy of treatment options not on their comparative cost, although cost was taken into account when the final choice of method was made.

5.5. The environmental investigation of Smailholm Village Hall confirmed the presence of viable *Bacillus anthracis* spores from the main hall flooring, the broom cupboard floor and the brooms and from the cushioned chairs in a smaller room where drumming classes were held. In addition to positive evidence of viable spores, there was widespread evidence of spore DNA from positive PCR tests of samples from surfaces within the hall complex including the kitchen, toilets, main hall and other rooms.

5.6. Extent of contamination The panel was asked to comment on the extent of contamination of the hall complex. There were differing views from panel members ranging from only the specific sites sampled and found to be positive should be considered as the contaminated areas, to the entire hall complex should be considered as contaminated.

5.7. The US EPA provided generic criteria for categorising contamination. Using these criteria, the property would be considered as having "surface contamination" only, due to the absence of confirmed positive air samples. There was no direct evidence of airborne contamination in the hall from air sampling carried out at the time of investigation. However, a number of additional issues, relating to the possibility of airborne contamination, were considered:

- environmental sampling efficiency is less than 100% and it is possible that the actual level of contamination were higher than the detected level
- Evidence from other episodes in the US confirms that spores can travel extensively even in low concentrations scenarios
- The positive PCR tests in the Hall indicate evidence for the spread of spore DNA throughout the Hall complex including the kitchen and toilet areas, which may have been spread via airborne contamination.
- The evidence suggests that the case may have acquired infection following exposure to airborne spores at a drumming class within the Hall.
- Experiments since carried out by HPA have verified that it is technically possible to liberate spores from a contaminated drum surface and for these to become airborne for a period

5.8. For the reasons given above, there was a reasonable case for accepting the advice that the entire Hall complex and all its contents were considered as contaminated. Expert panel members were asked to advise on their preferred decontamination methods and preferred agents. Responses from the panel on the preferred decontamination options advised were similar. Respondents generally differentiated between materials described as "porous" or non-porous" e.g. soft furnishings and fabrics or hard surfaces respectively, methods for decontamination were:

Porous materials

- Destroy porous materials by incineration.
- Remove porous items for separate decontamination by a suitable method
- As above but with final disinfection by vapourised sporicide

Non-porous materials

- Spray or wipe down with liquid sporicide
- as above but with HEPA vacuuming
- as above but with final disinfection by fumigation using vapourised sporicide

5.9. There was no single consensus view on the preferred method or agent. The advice included the removal of porous items (e.g. the contaminated chairs from the small room) for separate decontamination or destruction and use of liquid sporicide for surfaces, plus or minus additional measures including a final disinfection step using vapourised fumigation. The US-EPA cites fumigation as an option normally used when there is confirmed evidence of airborne spore contamination. As a result of deliberations, two decontamination options were identified.

5.10. Option 1 was a combination of removal and off-site decontamination or destruction of porous materials and decontamination in-situ of non-porous surfaces with liquid sporicide. This had certain advantages namely a potentially less disruptive and potentially cheaper option. The disadvantages included: practical and logistical difficulties of removing furniture for separate decontamination or incineration; identifying contractors willing to undertake removal and decontamination or destruction to a required standard; no guarantee that a single use of liquid sporicide will be sufficient, as repeat treatments were required with a similar case in New York in 2006. There was also the practical difficulty of ensuring liquid sporicide wetting of vertical surfaces for required contact times and issues about compensation for property damaged or destroyed in the process.

5.11. Option 2 involved fumigation with contents in place (with removal of high value items only). Advantages included: Single use process incorporating verification using surrogate spore strips; depending on the agent used there may be no need to remove furniture for separate treatment; evidence for efficacy confirmed in various settings especially for chlorine dioxide and hydrogen peroxide. The disadvantages included: potential disruption for a short period during the exercise; potentially greater cost; and depending on the agent used this might still require the removal of some porous materials for separate treatment.

5.12. Two methods for decontamination of properties were identified and the GDS was asked to obtain quotations from its Framework of Contractors to undertake this work. The two methods involved treatment of the properties with either gaseous Chlorine Dioxide (Cl02) or vapourised Hydrogen Peroxide (VHP) as the active agent.

5.13.Smailholm Village Hall using an approach of HEPA vacuum and subsequent removal of a large and expensive wall hanging followed by fumigation of the entire Hall complex with either gaseous Chlorine Dioxide or vapourised hydrogen peroxide as the active agent.

5.14. Private Garage, Smailholm. The recommended option was to decontaminate the floor and contents with a sporicide and sample to ensure clearance.

5.15. Three quotations were obtained by way of the tendering process undertaken, from two companies using vapourised Hydrogen Peroxide (VHP) and one company using gaseous Chlorine Dioxide (ClO_2). The quotations are summarised in (**Table 2**) below to illustrate comparability.

Table 2: Decontamination Quotations

Company	**1**	**2**	**3**
Decontaminant suggested	VHP	VHP	ClO_2
Final Clearance Resampling Included	No but available at extra cost	No	Yes
Biological Indicators included	Yes	Yes	Yes
Wallhanging to be HEPA vacuumed, removed and replaced if found clear	Yes	Yes	Yes
Porous Soft Furnishings to be removed, bagged and disposed of at extra cost (GDS verbal estimate quote for removal and disposal) (A)	Yes total estimated ≈ £40,000	Yes total estimated ≈ £40,000	No
Soft Furnishings to be replaced (B)	Yes	Yes	No
HPA Sampling Costs to be included (C)	Yes	Yes	No
HPA Laboratory Testing Costs to be included (D)	Yes ≈ £28,000	Yes ≈ £28,000	Yes £28,000
Personal decontamination Equipment required (SAS)	Yes	Yes	No
Sub–total of cost (E)	£65,800	£53,285	£112,000
Sub-total including Lab Testing (D+E)	£93,800	£81,285	£140,000
Total including Resampling costs, Lab testing costs, Soft Furnishing Disposal costs, (A+B+C+D+E)	£133,800 +B+C	£121,285 +B+C	£140,000

Additional factors were also considered in the final decision which was made at a meeting between representatives of NHS Borders, HPS and GDS which considered the tenders on the 11th January 2007:

- The Hall, on balance of probabilities, may be the site at which the case acquired his fatal exposure to anthrax spores.
- The Hall is a public facility where more vulnerable individuals in the community (the very young, the elderly, the immune suppressed) may be exposed to anthrax, should any contamination remain.
- There was a need to provide the highest degree of public assurance that there is no possibility of residual contamination with a known source of anthrax spores.

- The risk of airborne contamination occurring during the removal of any contaminated furniture, or airborne spores generated by decontamination processes could not be ruled out completely using one of the methods (VHP method).
- The logistics of any approach which requires removal and disposal of soft furnishings are more complex and would take considerably more time and effort to organise. They are also dependent on identifying facilities willing to receive and destroy contaminated items with attendant specialised transportation issues and associated hazards as well as additional costs.
- Local public concerns and expectations of eliminating any residual hazard necessitated a highly precautionary approach.

5.16. Given the additional factors and the overriding need to reassure the public that any remaining hazards have been eliminated as far as possible, the final choice of decontamination agent was guided by best evidence in similar situations. The US National Academy of Sciences report by its expert group on "Reopening Public Facilities after a Biological Attack" specifically recommends the use of gaseous chlorine dioxide[13].

5.17. Experience in the United States of decontamination of buildings has resulted in Chlorine Dioxide gas being used in hundreds of buildings both for anthrax and other contaminants. The main practical alternative would be to use vapourised hydrogen peroxide, experience of this method for decontaminating anthrax contaminated buildings is more limited. Neither method has been used to decontaminate natural anthrax contamination in the UK.

5.18. Discussion centered on the real need to take a highly precautionary approach to the decontamination of a public facility such as that in Smailholm. Whilst both VHP and CLO_2 might be competent decontaminants they have very different working parameters for example the VHP requiring additional logistical support had to be taken into account when making the final decision about choice of method.

5.19. The evidence base is limited but as well as the NAS report referred to above, a recent decontamination workshop in the USA considered the choice of decontamination methods.[14] Part of this report cites a decontamination of a large facility and evaluated four separate technologies for conducting decontamination in a single property: formaldehyde gas, VHP, chlorine dioxide gas, and manual wiping with a high-level disinfectant. Formaldehyde gas is inexpensive and effective, but leaves a residue that must be manually cleaned and the EPA

[13] Reopening Public Facilities after a Biological Attack: a Decision-Making Framework.(2005) National Research Council of the National Academies. Committee on standards and policies for decontaminating public facilities affected by exposure to harmful biological agents: how clean is safe? Washington. The National Academies Press.

[14] Report on 2006 NHSRC Decontamination Workshop . 2006 Workshop on Decontamination, Cleanup, and Associated Issues for Sites Contaminated with Chemical, Biological, or Radiological Materials. U.S. Environmental Protection Agency Office of Research and Development, National Homeland Security Research Center, Cincinnati, OH 45268. Personal Contribution: M Czarneski, ChlorDiSys Solutions, Inc. EPA/600/R-06/121 January 2007

considers formaldehyde a carcinogen. VHP is also effective, but condensation can be difficult to control and an even distribution can be difficult to achieve. The facility might need to be divided into smaller sections for VHP decontamination. Manual wiping was impractical because of the need to decontaminate many surfaces and types of material. The facility owners in the US eventually selected chlorine dioxide gas decontamination because of the effective penetration of the gas, even distributions, and lack of residues to clean.

5.20. The methods using VHP would require more destruction of property and did not include sampling costs which were previously very expensive (>£50,000), The VHP costs outlined were regarded as significantly underestimated.

5.21. In summary, a decision was made taking into account advice and support from all agencies involved, best evidence from around the world, the reasons outlined above, and the relative experience of the three companies in decontaminating anthrax contaminated properties. It was decided to engage a US company SABRE Technical Services to use the Chlorine Dioxide gaseous method for decontamination of the anthrax contaminated properties in Scottish Borders. This decision was discussed with the Scottish Executive and the decision was supported by NHS Borders Board. The remit for the detailed planning of the decontamination was passed to the Logistics sub-group.

5.22. Northumberland property. Throughout the process, HPA Northeast was included in the approach that was being followed by NHS Borders towards decontamination. This was because HPA Northeast was leading the management of the process for the investigation and impending decontamination of the Northumberland property. Further investigations of the Northumberland property had revealed positive samples by culture and PCR methods in various rooms plus on two further drums stored in the house. There was no evidence of contamination in any other properties.

5.23. As at the 31st of October 2007, information was shared that the Northumberland property has been decontaminated as evidenced by the certificate of bio-decontamination. The certificate states that successful area bio-decontamination using Vapourised Hydrogen Peroxide VHP® technology, as verified by the successful kill of biological indictors of *Bacillus Stearothermophilus* 106, has taken place within the property. Also, post decontamination samples were taken from the property and also found to be negative for anthrax spores. One issue of note is that different methods of decontamination were used in the properties treated in both Scotland and Northumberland.

5.24. Village Hall and Garage Decontamination Smailholm March 2007 Sabre Technical Services, LLC (Sabre) was retained by NHS Borders to develop and implement a plan to decontaminate a village hall and domestic garage in Smailholm, contaminated with *Bacillus anthracis* spores. The results of environmental sampling performed by Sabre during October 2006, showed the presence of viable spores inside both structures as detailed in **Table 3**.

Table 3. Sample Results from Smailholm

Structure	Results
Village Hall	Six positive cultures for *B. anthracis*, obtained from two samples: • Small room cushioned chairs – High efficiency particulate air (HEPA) vacuum sample • Main hall floor, broom closet floor and brooms in the closet – HEPA vacuum sample Ten positive samples via Polymerase Chain Reaction (PCR) (enrichment broth): • Six positive samples from culture positives (confirmed positives) Four positive samples by PCR only (no culture positives) • One HEPA vacuum sample from small room surfaces – wooden chair and cabinet • Three wet wipe surface samples in small room, kitchen, windowsills, bathrooms and main hall.
Garage	One positive culture for *B. anthracis*, obtained from one HEPA vacuum sample from floor, confirmed on PCR One positive sample via PCR (enrichment broth) from wet wipe sample of table and boat in garage

5.25. Both Smailholm properties were decontaminated by Sabre using chlorine dioxide (ClO_2) gas in accordance with criteria proven effective in eradicating structural *B. anthracis* spore contamination. The Village Hall was fumigated on March 9, 2007 and the garage was fumigated on March 13, 2007. Fragile cloth tapestries present on walls in the Village Hall were removed prior to fumigation and autoclaved at a local NHS hospital facility.

5.26. Decontamination Process

Site of Village Hall Decontamination

Construction of Tent for Village Hall Fumigation.

5.27. The technical description of the decontamination method used at Smailholm is detailed in **Appendix 2**. This contains information on the systems and monitoring employed. The elements described include: tent construction; gaseous treatment; temperature control; fumigation monitoring; post decontamination sampling and quality assurance methods.

5.28. Environmental Sampling. As directed by NHS Borders, post-treatment environmental sampling was performed in both the Village Hall and garage structures in an essentially identical fashion to the pre-treatment sampling that originally identified the presence of *B. anthracis* spores. Surface sampling was first performed using a combination of HEPA vacuuming and wet wiping techniques. Following the completion of surface sampling, a leaf-blower was used to agitate the air near surfaces where any surviving spores might conceivably have settled following the fumigation. Air sampling was then conducted using a variety of techniques including Dry Filter Unit (DFU) sampling, Mixed Cellulose Ester (MCE) filter sampling and Anderson Impaction sampling.

5.29. Results The BI spore strip results for the 34 locations monitored within the Village Hall, 6 locations monitored within the garage and three samples tested following autoclave of the Tapestry were all reported as negative. Whilst results for the positive control spore strips submitted for analysis along with the actual samples were all reported as positive (ie non-fumigated spore strips held viable spores). The environmental surface and air samples were analyzed by HPA using appropriate analytical methods. HPA has reported that all post fumigation sample results were all negative for *B anthracis*.

6. Post Decontamination Process

6.1. Decontamination of the Borders properties took place in March 2007 over a 10 day period and despite poor weather conditions of intense cold and high winds which made the tent construction extremely difficult, the properties were successfully decontaminated. Surrogate spore strips were placed and post decontamination samples were taken and following decontamination, the samples and spore strips were tested at approved laboratories and reports obtained.

6.2. The post decontamination reports were circulated to a second meeting of the Clearance Committee on the 12th April 2007. This meeting, also chaired by the Procurator Fiscal, considered evidence and reports from Sabre Technical Services dated 11 April 2007 which provided written confirmation of results. The conclusion from the reports was that there was no evidence of persisting viable *B.anthracis* spores following decontamination of the properties in Smailholm.

6.3. The release of the properties and tapestry was confirmed at an Incident Control Team held on 13 April 2007 and the committee agreed that the Borders properties could be returned to normal use. The properties were handed back for normal use at a meeting on Wednesday 18th April. A very expensive wall hanging tapestry initially created by the people of Smailholm was successfully treated and handed back to Smailholm Village Hall Committee. Subsequently the hall was used as a Polling Station for the village at the Scottish Parliamentary elections of the 3rd May 2007.

Use of the Village Hall as a polling station after Fumigation (May 2007)

7. Communications

7.1. Throughout the incident, communications with involved families, the public, the media, local & national partner agencies and politicians were specifically considered at each Incident Control Team meeting. Effective communication with the public and between agencies is necessary to avoid any widespread public anxiety which can be a result of outbreaks and incidents. NHS Boards must ensure that the public are kept fully and appropriately informed about public health incidents. Boards must co-ordinate the reporting of incidents to a network of local professionals and national agencies and ensure effective media involvement.

7.2. Initial investigation phase Specific efforts were made to liaise closely with family members directly involved. Channels of direct communication were opened and continuity of contact was considered important with rapport established and maintained whenever possible. Relatives clearly needed to be informed of all investigations and control measures necessary on site. Prior to release of information to the public, family members were briefed. Relevant clinical staff were also briefed with appropriate advice and clinical information within Borders and asked to be aware of the possibility of other clinical cases of anthrax. The Public Health Department and laboratory received no other reports of actual or probable cases during the course of this incident.

7.3. The need for a general media release was considered necessary in the light of expert advice to extend the contact tracing screening period to 30 days from time of diagnosis. A pro-active press release was issued in order to ensure that full contact tracing for all contacts (formal and informal) of a possibly contaminated property could be identified. A draft press release was produced by HPS and initially a lead press agency (that of HPS) was identified to handle the anticipated media work. Local media interest was anticipated by NHS Borders and the need for careful coordination to ensure consistency of media message was clearly stated. Initially, it was agreed that the press agency for HPS would field all calls and would liaise with other organisations. Close coordination with media contacts of all involved agencies was agreed and all press releases were agreed collectively before release.

7.4. As the initial media release was aimed to inform and to assist in contact tracing, arrangements for calls to come through to a helpline were established. A contact number was provided and a two stage helpline process was put in place. Firstly, calls from the public were sifted via unique helpline number staffed by experienced NHS 24 call handlers. General enquires were directed towards specialist sources of advice and anyone who considered themselves a contact as defined by the ICT were passed to a local helpline staffed by NHS staff from both Primary Care and Public Health. Arrangements for this complex contact tracing exercise were put in place within a 48 hour period of intense activity.

7.5. The potential difficulties of identifying all contacts particularly of those who attended a funeral event at the case's home was highlighted and the possibility that some may live outside the area and even from abroad.

7.6. Clear answers on the sources of the anthrax were needed as it was anticipated that this would be something the media would ask. Concerns including any potential bio-terrorist threat and implications for wildlife were considered as the case was known to have used badger skins in the construction of his drums. Information on the importation of hides to the UK was obtained and shared. As outlined in **Table 4** at the end of this section, a series of communication materials were developed throughout the incident including relevant Q&A sheets.

7.7. The issue of information for staff, particularly those who cared for the patient was also considered. The timing of release of information to such staff was extremely important and it was agreed that wherever possible, it should precede any press release.

7.8. Throughout the course of the incident, regular and reactive briefing of the Scottish Executive (now the Scottish Government) took place. The local communications group ensured that all press releases were coordinated through NHS Borders and shared with key stakeholders in order that each agency could brief their key contacts appropriately.

7.9. No communication was issued without the support of the ICT who confirmed key findings and developments. As the investigation developed and involved property in Northumberland, media coordination was immediately extended to include press officers from HPA Northeast and other HPA divisions as required although media coverage for this aspect of the investigation proved more limited than that for NHS Borders.

7.10. At each major development, the Communications Group worked with members of the ICT to proactively develop any briefing materials and frequently asked question lists (FAQs). As media queries were received reactive responses were then developed and released.

7.11. Key Communication Milestones Throughout the incident, effective working relations were established with the families involved. Specific liaison officers for the families were established. Press releases and significant developments were shared with the families. A key principle of the communications strategy was to agree that all information to be released should be channeled through one central point and to achieve this, a communications group was established, with representation from all key agencies involved.

7.12. 15th August 2006 At the second ICT, the need for a general contact tracing media release was agreed. As a result, an immense amount of work was

required over a period of 48 hours to put all arrangements in place such as helpline facilities, staffing, briefing and developing information packs. Also communications with politicians and other agencies was coordinated through the local communications group

7.13. 17th August 2006 A general media release took place on the morning of 17th August. There were large numbers of media enquiries, initially through the agreed press agency. However, it rapidly became apparent that most of the media call burden was falling on the local press team at NHS Borders. An identified spokesperson gave numerous interviews throughout the day and media calls were handled by the local team. Public risk enquiries were dealt with rapidly, but the majority of questions centered on environmental risk.

7.14. It became clear on the first day of the proactive media release, that the major media burden was falling locally, as a result, it was quickly decided that NHS Borders would take over the leadership of communications strategies for the incident. This involved the issuing, preparation and coordination of all press releases and the development of any required responses on this incident. This led to an immense amount of work for the local media team which was not initially fully anticipated but was in fact managed very effectively.

7.15. 27th October 2006 Similar communication methods to those used in the Black Lodge investigation were used when briefing the local community at Smailholm. This was necessary, after it became apparent that further investigation of properties in the village was required as part of the overall anthrax investigation.

7.16. 11th December The findings from the follow up investigation of the Smailholm and Northumberland properties became available as well as news of clearance of the Black Lodge property. In order to manage the issues that the results would cause particular efforts were made to communicate personally with the involved families before any public media release took place regarding the particular findings. Lines of communication were re-opened with all the families involved and the teams shared lines of communication to ensure consistency of message. It was also decided that further direct communication was needed with the Smailholm community and the Village Hall Committee.

7.17. In order to manage the number of media and personal approaches regarding people who were on the contact database (167 people on the database including those started on chemoprophylaxis), NHS Borders sent letters and advice information to update this group of the main findings on Black Lodge and give them the necessary reassurance. The letter also advised the contacts that NHS Borders intended to follow-up contacts with regard to their health experience since going onto this database, in particular, looking to explore the experience of taking chemoprophylaxis. NHS Borders developed this study with approval from the Local Research Ethics Committee.

7.18. 14th February 2007 The next major development was the decontamination of the Smailholm properties and in order to manage this, a communication strategy was put in place. After liaison with the Village Hall Committee, it was decided that local members of the community preferred to be informed via the committee rather than by direct mail drop from NHS Borders. These wishes were respected and direct liaison with the Village Hall Committee was established for the remainder of the incident. Local elected members were briefed of decisions taken. NHS Borders Communications Group continued to communicate with the press and others. A Press Conference was held at NHS Borders Headquarters and a photo opportunity at the site was arranged. The media was briefed a week before the commencement date which also gave time to develop a communication strategy.

7.19. This approach was agreed with the decontamination contractors SABRE. It was highlighted to the press release that this was intended to be a one-off opportunity for photographs or interviews. The press contact was managed off-site. The recognised and tested system remained in place for informing elected members and the local NHS Board.

7.20. 13th April 2007 The clearance of the Smailholm properties was communicated to the Community via the Village Hall Committee and a snagging visit to the hall was arranged to find out what damage has been caused to the contents. The Hall Committee was asked what communications they would wish with the public in terms of media to announce the re-opening of the Hall. It was decided to issue a pro-active release as an advert for the Hall reopening and act as a positive exercise of reassurance for the community.

7.21.Summary: Throughout the whole incident the Incident Control Team considered communications as a key priority for the incident response. Efforts were made to take a flexible approach to communications both internal and external. Key stakeholders were involved and considered at all stages and materials planned and released as required. Public interest and concerns remained the highest priority.

7.22. The communications response was characterized by a flexible and adaptable approach which involved teams from all agencies involved. Levels of cooperation remained high throughout and the high quality of the majority of media reports throughout the course of this relatively long incident response is a testimony to the professionalism of all those involved.

7.23.Table 4. Summary listing of key communications materials produced during the anthrax incident.

Date	Title	Target Audience
11th August 2006	What is anthrax: Q&A	General public and contacts. Sent to GP's as a resource for patients/contacts as well as directly to some contacts
11th August 2006	Prophylactic treatment for persons exposed to anthrax spores	GP's
14th August 2006	What is anthrax: Q&A for Health Professionals	GP's. More detailed anthrax info (including images)
15th August 2006	Anthrax incident: Briefing	NHS24 staff
16th August 2006	FAQ sheet	NHS24 staff
16th August 2006	Press Statement	Media
16th August 2006	Briefing letter	NHS Borders staff
17th August 2006	Patient Information Sheet: Ciprofloxacin	To GP's for their patients
17th August 2006	What is anthrax: Q&A for media	Media
17th August 2006	Press update	Media
19th August 2006	Contact questionnaire	For Belgian doctor asked to risk assess several Belgian contacts
22nd August 2006	Press update	Media
24th August 2006	Press update	Media
25th August 2006	Press update	Media
1st September 2006	Operation Snare: Agency Briefing	Briefing for key agencies involved in Sampling operation
1st September 2006	Operation Snare: Media Briefing	Briefing for media
1st September 2006	Operational Order	To agencies involved in Sampling at Black Lodge
11th September 2006	Briefing post sampling	Letter to Stobs residents
11th September 2006	Press update	Media
9th October 2006	Anthrax incident: Briefing	NHS24 staff
9th October 2006	Q & A: Anthrax and Animal Hides	Drummers attending specifically identified workshops and classes
9th October 2006	Letter	Drumming contacts
9th October 2006	Briefing	Contacts GP's
9th October 2006	Briefing	Borders GP's
11th October 2006	Update on Anthrax investigation	All contacts who had been offered antibiotic prophylaxis
20th October 2006	Anthrax vaccine information	To specific contacts
27th October 2006	Pre-community briefing information	All Smailholm village residents
27th October 2006	Press Statement	Media
2nd November 2006	Operational Order	To agencies involved in Sampling at Smailholm
7th November 2006	Drum Letter	Drum purchasers living overseas
7th November 2006	Drum email	Drum purchasers - local
7th November 2006	Drum letter	Drum purchasers - local
17th November 2006	Anthrax sampling update	Smailholm village residents
17th November 2006	Anthrax incident: Briefing	NHS24 staff
17th November 2006	Primary Care briefing	GP's
12th December 2006	Anthrax update	All contacts
14th December 2006	Anthrax update	Smailholm Village Hall Committee
14th December 2006	Press release	Media
31st January 2007	Study Information sheet	All contacts and their GP's
31st January 2007	Letter re study	All contacts
31st January 2007	Letter re study exclusion	Contacts Border GP's
31st January 2007	Letter re study exclusion	Contacts non-Border GP's
6th March 2007	Press release	Media

8. Lessons Learned through Debrief process

8.1. This incident was managed according to the principles outlined in "Managing incidents presenting actual or potential risks to the public health: guidance on the roles and responsibilities of incident control teams" (A Consultation Document).[15] This overall Scottish Executive guidance, applicable to all types of public health incidents, was requested by the Ad-Hoc Group of Ministers on Health and the Public Water Supply. In addition to the issues raised in the incidents involving cryptosporidium and the public water supply to Edinburgh and Glasgow in August 2002, it takes into consideration the generic organisational arrangements and main functions involved in handling incidents or outbreaks involving actual or potential exposures to a range of hazards, and in particular the roles and responsibilities of incident control teams (ICTs). The statutory responsibilities of the relevant agencies are given, as well as the key functions of incident management. These are:

- Surveillance and reporting
- Identification and initial investigation
- Investigation
- Risk assessment
- Control measures
- Communications

8.2. Those charged with managing incidents should prepare a report on progress to the agencies to which they are accountable. In order to learn from the incident management experience, those involved in managing incidents should evaluate and report on the efficiency and effectiveness of their efforts. Information on public health incidents should then be disseminated to interested parties, so that the whole service can learn from the experience of others. The debriefing process for the ICT was put in place to collect lessons learned about managing the incident and to identify any further preventive action required. This section of the ICT report identifies key lessons learnt from the incident and procedures to improve the handling of further outbreaks and incidents. The response to this incident also includes research into the effectiveness of incident management arrangements in protecting the public health.

8.3. In summary, this section highlights lessons learned and includes recommendations based on evidence collected during the incident and the ICT debriefing and also includes feedback from members of the public involved in this incident. Recommendations are targeted at organisations with specific responsibility for taking action on the recommendation. ICTs both during and in the debriefing following an incident should assess and report on their own performance in managing the incident and the appropriateness of current plans. Recommendations on how these can be improved are included in the ICT report.

[15] Scottish Executive Health Department. 2003

8.4. This section includes feedback from both the public and professionals involved in the incident response. It provides an overall view of lessons learned related to the anthrax incident which may be of value to other incidents of a similar nature for participating agencies, local, Scotland wide and agencies elsewhere in the UK. This recent incident therefore represented a valuable opportunity to review existing guidance and practice to identify areas that can be improved further.

Public Debrief and Follow up Study

8.5. An extensive contact tracing exercise was instituted in the very early stages of the incident. Anthrax is extremely rare, and therefore experience in managing the ramifications of a case is also limited. A total of 167 contacts were identified. A risk assessment was developed through discussion and agreement with key members of the incident control team and a total of 73 (43.7%) of these contacts were, as a result, advised to take precautionary antibiotics for a prolonged period of time (60 days).

8.6. Due to the unique nature of this incident and the relative rarity of anthrax in the UK, the study sought to investigate the health experience of contacts involved in this incident, including their experience of the recommended chemoprophylaxis regime, and highlight areas where existing guidance and practice could be improved. A unique opportunity was therefore presented to conduct a study with the primary objective of describing the health impact on the contacts during the anthrax incident. Approval was granted by Borders Local Research Ethics Committee (LREC) to proceed.

8.7. The overall objectives of the study were to:

- assess compliance with the recommended antibiotic chemoprophylaxis in contacts identified following potential exposure to *Bacillus anthracis* in the recent anthrax incident in the Borders.
- assess the health impact of the incident on all contacts, both the group taking chemoprophylaxis and the group of contacts who were not recommended to take chemoprophylaxis.
- identify other issues from the perspective of contacts in relation to the management of the incident
- discuss the findings in relation to existing guidance, good practice and the published literature and make recommendations for improvement

8.8. One hundred and nine contacts (65.3%) completed a telephone survey, conducted by nurse interviewers, which yielded a mixture of qualitative and quantitative data. Some preliminary results of interest include the following:

- 45% of the study population were recommended to take antibiotics but 1 in 5 of this group decided not to start the antibiotics.

- Of those who did respond and were recommended to take antibiotic chemoprophylaxis only 2 out of 5 completed the full 60 days course.

- 85% of those on antibiotics reported a range of health problems and 9 out of 10 felt that the medication may have been responsible for their symptoms

- 41% of those on antibiotics reported their overall health to be worse since the incident in comparison to 7.5% who did not take antibiotics

8.9. Respondents were invited to comment on their personal views of how the incident affected them and offer any suggestions as to how the incident management could be improved upon. This qualitative aspect to the study provided valuable insight into the human impact of the incident on the lives of ordinary people. It provided an opportunity for contacts to 'de-brief' and obtain a degree of closure. Comments include:

"…. a whole community had suffered, not just individuals"

"I am glad you have asked me these (survey) questions as I can now draw a line under this chapter of my life."

8.10. The proportions of people who were given antibiotics or advice in the survey population matched the proportions in the whole group. Therefore, the study population could be considered reasonably representative of the contact population. It is important to note that 23 people (32%) of those who were recommended to take antibiotics did not respond to the survey; therefore comment on their health experience cannot be made. The findings are currently being prepared for publication in a peer reviewed medical journal and when published will go into the reasons for these important findings in more detail.

8.11. The qualitative data has been analysed and consistent themes have been identified. This has been used to identify lessons learned and recommendations for further action. Qualitative analysis of the responses was made using a simple process of grouping under themes which emerged using a grounded theory approach.[16]

[16] The qualitative approach was used for this part of the study in order to aid in identifying both the positive and negative outcomes from the human perspective. It aids in identifying themes and issues which underlie them. The qualitative data complements the quantitative which is described in another paper. The approach was intended to try and ensure the participants' perspective would remain intact giving a more rich and detailed account.
The interviews were structured using open ended questions enabling respondents to talk around their views, feeling and attitudes as well as to make proposals of how they thought things could have been done differently or better. The records from the interviews recorded key phrases spoken by participants. By analysing the phrases the study findings emerged into themes. Content analysis was used which highlighted themes of interest.

8.12. Table 5 Includes direct comments made by members of the public who gave their opinions as part of the debrief process.
It summarises the main learning points, under theme headings of

- Communications
- Information
- Contact tracing
- Organisations handling of Incident
- Effects on the population

Table 5. Direct comments and learning points from members of Public involved in the anthrax incident and subsequent debrief.

Comments made on what went well	Comments made on what did not go so well	Learning Point
Communications		
Information and help line was up and running quickly.		• Incident responses need to have people available and knowledgeable who can be deployed flexibly to cover essential roles.
Written letters and follow up letters were helpful.		• Have a standard database programme with core dataset already available which can be activated quickly. • Ensure there is adequate Administrative support to type up letters and to maintain an up to date, accurate database. • Ensure Mail merge capability available and staff members are trained to use it and when software is updated.
Helpful to have face to face contact		• Need to balance priorities and availability of personnel to do this.
Being able to speak to someone over the phone		
The response to and from the media was seen as being helpful	The media response was seen as being intrusive and scaremongering.	• The value of effective lines of communication between the media and the Incident Control function is essential to the smooth running of any incident
Putting the contact phone number on the radio is important		• It is important to ensure that the contact phone number is put on the radio and needs to be repeatedly publicized.
	GPs required better information.	• Explore with GPs future information requirements when dealing with complex infection control issues.

Comments made on what went well	Comments made on what did not go so well	Learning Point
Information		
There were wide ranging views including too much information	There was too little information.	• Communications with the public needs to strike a balance between realism and alarmism in explaining possible impacts.
More information on the effects of the antibiotics was requested.		• Specific briefing materials are required for complex Public Health interventions such as the provision of chemoprophylaxis
	Better use of the website with up to date information was also suggested.	• Inform NHS Borders web design team
More information was needed in simple terms about anthrax.		• A library of information in easy read format which can be accessed electronically to cover as wide a range of possible hazards is required.
Organisations involved in the handling of Incident		
More involvement of the Scottish Executive would have helped in providing support to the NHS board and the public health department in particular when dealing with the press.		• This contribution illustrates a public perception that more involvement and information was required from the Scottish Executive as some of the issues were thought to require more national guidance as this was a unique situation for the NHS in the UK, considering the high profile impact.
Have a designated press officer.		• An experienced press officer assists in freeing up personnel involved in the direct incident response. Such a post ensures that a single message goes out and helps provide continuity for individuals and the organisation.
	Statutory services appeared to err on the side of caution	• Need to ensure a balance between realism and alarmism in explaining impacts.
	Staff across the NHS needs to be aware of the required procedures.	• Continue emergency planning exercises and table top events. Use Intranet to alert staff to incidents.
Rapid response was appreciated		
The fact that public health was always contactable when advice was needed.		
Good quality of customer care.		
Initial impressive response from public health.	Then a perception that the response became less personal, which was perceived as being a	• This incident took place over a long period and dealt with potentially high risks. • Need to take account of the

Comments made on what went well	Comments made on what did not go so well	Learning Point
	reduction in the caring attitude	emotional impact on staff who are dealing with incidents at close quarters for prolonged periods of time where there may be potential for burn out.
	Communication within the organisation seemed to be slow. One person described how information was not passed on quickly or easily.	• Consider importance of internal communications as well as external
Contact tracing		
The caller's manner was rated as being important.	People felt they needed more reassurance and more honesty.	• Consider these points in briefing materials for future incidents.
For those contacts who were advised to take prophylactic antibiotics there were a number of issues which contacts would have benefited from reassurance.	• Worries that taking antibiotics has weakened immune system and led to time off sick from work • The need to have the information and time to be able to make an informed choice • Follow up would have been valued once started on the course of treatment	• Consider these points in briefing materials for future incidents. • This reinforced the need for risk assessment before being advised to take the antibiotics • Concerns about longer term health effects from the antibiotics
As contacts lived not only in the Borders but also in the rest of the UK and overseas, contacts from a distance very much appreciated the efforts that went into getting in touch with them.		• How to ensure continuity and quality of contact between authorities in different countries
Effects on the population		
Themes which came through showed that there was an impact from the individual point of view; family members of the deceased; communities- in particular Smailholm and the drumming group.		• Consider the need for family or contact liaison early on in any complex incident
	Mental Health issues could have benefited from more P.R	• Consider psychological impacts and mechanisms for intervention if needed for individuals and populations
One contact said 'I am glad you have asked me these [survey] questions as I can now draw a line under this chapter in my life.'	From another 'I hope I never have an experience like this ever again'	• Debrief process which involves members of the public can assist in closure of incident impact

Comments made on what went well	Comments made on what did not go so well	Learning Point
	There were feelings that a whole community had suffered not just individuals.	• Community impact is very important an incident is not simply an unconnected series of impacts on individuals
The impact of having to take antibiotics and the fear of the unknown was mentioned by many contacts	Some people felt isolated, that the whole process was intrusive and some felt pushed to take antibiotics.	• Chemoprophylaxis has wide ranging health impacts including physical, social and psychological.
	The decontamination of the hall took too long.	

Anthrax Incident - Professionals debrief.

8.13. This section of the report summarises the outcomes of the anthrax incident in the Scottish Borders from August 2006 to April 2007 from the perspective of the professionals who were involved. This group was contacted in May 2007 and asked to complete a questionnaire. This reflected the same questions asked of members of the public who were contacts. The number of professionals and organisations involved was large and there were 20 returns from individuals and organisations involved in the incident response. Data collected was of a qualitative nature. It was analysed as above taking common themes.

8.14.Table 6 below includes direct comments made by professionals who gave their opinions as part of the debrief process.

It summarises the main lessons learned and recommendations for action, from a range of individual opinions expressed by debrief respondents under theme headings of:

- Multi-organisational, multi-national team interagency working
- Communications
- Operational Plans
- Administration
- Media
- Incident management
- Financial decisions
- Leadership

Table 6: Lessons learned from direct comments taken from the debrief of Professionals involved in the anthrax incident.

What went well?	What did not go so well?	Learning points
Multi-organisational , multi-national team interagency working		
1. Good interagency working as part of a large multi-organisational team Being a part of such a diverse group of people all working together to achieve a common goal 2. Team working/spirit of co-operation 3. Recognising the need to involve SEPA in most of the groups 4. There was excellent cross-border communication and working – from the weekend when involved as part of the North East (England) response onwards.	1. Not understanding the individual roles of all the organisations involved and the authority they had to act. 2. Confused lines of responsibility and accountability in relation to the initial handling of the incident. 3. It would have been nice to have some smooth process where the various stages of the investigation and management happened in unison – but realise that this is probably an unrealistic dream! 4. Some of the contributors from the affiliated Agencies were long-winded. 5. Not being more involved or being asked to help more.	• At the earliest ICT meetings, clarify and agree roles and remits, ensure all agencies understand lines of accountability and mechanisms of incident response. • Centralised resources in incident management – this has taken up an inordinately large amount of time for relatively small teams (NHS Borders, HPA-NE and the Novel & Dangerous Pathogens team). This might make decision making easier and more consistent.
5. There was always good communication etc between PH colleagues on both sides of the border. 6. Participating in a project that evolved into an international, multi-agency multiprofessional organisational response to an incident. 7. Feeling part of a team who were all under pressure together and supporting each other. 8. There was excellent team work within the public health department and good working relationships were enhanced with other agencies and each other. 9. Team work and response by all staff to support crisis. 10. HPA involvement 11. It was good to liaise with and develop a rapport with Medical	6. Being unable to contact relevant people at DEFRA. 7. Complete focus on the anthrax at expense of other things. 8. The meeting rooms used for initial meetings were not suitable for the numbers attending. 9. Consideration should be given to ensuring that: • rooms are capable of taking the number of attendees • secure teleconference systems are used to ensure that only "authorised" personnel can hear and participate. 10. Notification of the incident to the GDS did not follow the route agreed and included in a guidance document drafted by the Scottish Executive. The notification process should be revisited. 11. The ICT could have considered the establishment of a Strategic Co-ordinating Group (SCG) with Health in	• More room. NHS Borders should identify an incident control room for any future incidents. • Repeatedly consider if the response is outstripping capacity to respond and requires a major incident formal response.

What went well?	What did not go so well?	Learning points
colleagues – good experience to enable developing plans for major Zoonotic incidents e.g. Pandemic 'flu' assoc with Bird 'flu'. 12. The major players' contributions were brief, relevant and to-the-point. 13. Staff 'can-do' attitude. 14. Being involved in a busy, needs-led and vital piece of action. Sharing our (rapidly) growing knowledge – and being able to "bounce ideas" off each other in terms of how to manage the pragmatic public health aspects of the response.	the Chair. The calling together of this group may have: a) ensured that all necessary responder organisations were represented. b) led to early identification of which organisation was best placed to lead, and which organisation had statutory responsibility for legislation in relation to the management of the site etc c) ensure that supportive activities of all agencies involved were fully recognised and that agencies have input to and agreement of press releases d) ensured that each responding organisation was fully aware of the remit of all other responding agencies	
Theme: Communications		
1. Good Communication 2. Being able to give factual information on the phone. 3. Sharing our (rapidly) growing knowledge – and being able to "bounce ideas" off each other in terms of how to manage the pragmatic public health aspects of the response	1. Lack of communication from NHS Borders – simple things like not being copied into press releases and having to deal with press enquiries blind. 2. Poor communication methods of some people involved in incident. 3. Not being able to get a reply on phone 4. Having wrong numbers. 5. Not being totally sure that the advice I was giving was acceptable	• Ensure crisis communication teams are well established in advance and that everyone is clear on what is expected from them. • Consider regular media training for key spokespeople to try and ensure consistency of response. • Communications plans to extend to staff within departments or organisation impacted by events. • Consider the management of the "the day job" outside the incident. Have a clear local leader for the logistical management of this type of incident response.
Theme: Operational Plans		
1. Operational Plan. 2. The ability to plan the response. 3. Speed of initial response and implementation of plan to respond.	1. Lack of strategic steer and application of our own Agency procedures when on the ground doing the decontamination work led to wasted time. 2. Resource planning was very slow. 3. Certain GDS protocols are now subject to our own lessons learnt procedures.	• Regularly consider what additional personnel can contribute to an incident response. • Regularly check opinion on progress in an ongoing incident response

What went well?	What did not go so well?	Learning points
4. Putting into practice our own agency's (GDS) protocols and proving they do work. 5. Clarity of Actions 6. The response was excellent and the incident was dealt with promptly and efficiently in spite of the lack of precedents. 7. "Thank you" Social event was appreciated	4. Not being involved or being asked to help more	• Consider how to respond to incident team members through the course of an incident and after the incident response is complete.
Theme: Administration		
1. Circulation of notes of meetings and photographs etc. 2. Kept up to date at all times 3. Having access to further advice. 4. E mail use kept us informed/	1. Information was not always shared openly across all the partner agencies. 2. Pieces of paper going missing. 3. The initial logistics of where the first phone calls from the public contacts should take place. 4. The work being guided by advice that changed, this made the phone calls to the public to try and trace contacts difficult as the rules of engagement changed. 5. The staffing of the phone lines was adhoc, calling around to see who was free. 6. IT pressures, lack of template data base, log-ons for new team members, actual work stations. 7. Initial accommodation. 8. Release of staff to support crisis	• Use of read receipts to ensure communications reach every member of incident team. • Have staff pre-identified on a list who would be willing to work extra hours on this type of situations. • Have systems available to record staff used and the hours they worked etc. • A log of events actions and responses should be kept with every issue, large or small, being noted as and when they happen. • The log should be kept by a delegated person within the department with log sheets being issued by other members with daily events. • Consider bringing in additional administrative staff to help manage the incident. • NHS Borders should have an incident control room for any future incidents. • HPS to assist in the development of data base templates. • Record the names of those who helped and thank them.
Theme: Media		
1. NHS Borders showed flexibility of response in assuming control of media communications once the press became directly involved in the incident.	1. Initially, there was an expectation by NHS Borders and HPS that a media agency identified by HPS would handle and lead on any media enquiries at the outset of the incident.	• Ensure crisis communication teams are established well in advance and that everyone is clear on what is expected from them. • Consider refresher media training for key spokespeople. • Try to model for a full range of media responses from limited or no attention to full multimedia coverage.

What went well?	What did not go so well?	Learning points
2. The NHS Borders media response team performed extremely well in demanding circumstances 3. Initial information given from HPS allowed greater control of press enquiries at beginning of incident.	2. By the time that the press statement was issued on 16 August 2007, it was clear that all agencies had not anticipated the full intensity of the media interest. 3. The media agency had not devised a comprehensive media strategy or contingency arrangements. 4. Within an extremely short space of time on 16 August 2007, it was evident that the agency was not prepared to handle all media calls, which were in effect re-directed to NHS Borders. 5. Over reaction of local press and certain politicians. 6. Management of press issues and press getting hold of second hand information that was not relevant to the case.	
Theme: Incident management		
1. Professional approach to incident management 2. Borders NHS Logistics arrangements, including innovative use of General Hospital facilities and NHS HQ facilities. 3. The latter allowed us to continue to conduct routine business as far as possible. 4. Use of the Geographical Information Service (GIS) 5. It was very thorough. 6. Receiving the management advice in a timely manner. 7. NHS 24 help line. 8. Speaking to the public and sometimes being able to reassure them. 9. I thought the response was excellent and the incident was dealt with promptly and efficiently.	1. Water supply at Black Lodge. 2. Logistics and Communications at Black Lodge. 3. There seemed to be an element of "secrecy" rather than openness. For example the story has still not been publicised in a way that would help others to understand and respond appropriately to what happened. 4. The fact that the condition is so rare and the public became so anxious	• Logistics Planning is of immense value including the production of operational orders and a clear and single route for coordination e.g. ordering of equipment and supplies.

What went well?	What did not go so well?	Learning points
Theme: Financial decisions		
1. Robust financial decisions taken at an early stage. 2. The whole management of the incident. 3. By having Scottish Executive's backing it was refreshing to know that money was not the most important issue in this investigation. 4. This also allowed Public Health to organise and lead on behalf of the Multiagency Incident Team, the decontamination of the relevant properties. 5. Having the reassurance that everything had been done.	1. The different approaches taken by partner organisations with regard to the funding. 2. The fact that the funding for the Scottish side of the investigation and decontamination was agreed at the outset compared to the NE was frustrating for us, and meant that we weren't seen as dealing with this incident in as coordinated way as possible.	• Agreement at Government Department level about funding of investigation and decontamination – for exceptional incidents like this would be one of the first issues to sort out.
Theme: Disease and diagnosis		
1. Follow up after initial diagnosis of case 2. Early recognition of the potential environmental impact. 3. The environmental investigation and unique opportunity to be involved in responding to an extremely rare condition. 4. The successful decontamination of the buildings and preservation of precious artifacts. 5. Rapidity, magnitude and stamina of response by NHS Borders on receiving details of the case. 6. Identification of environmental isolates	1. The changing "interpretation" of results for and the appearance of positive results after we had initially been told that they were "all negative". 2. The interpretation of the significance of pcr results. 3. Later stages of investigation. 4. Not being able to relay that the case was not responsible for the Anthrax. 5. The lack of sympathy and respect for the hard work that was done from a minority of the public, some residents of Smailholm and a minority of NHS staff. 6. A lot of people forgot the fact that someone had lost their life and Public Health was out there to help and avoid any more cases and was not deliberately hindering them from their everyday activities.	• Anticipate the improbable • The suggestion that human patients presenting with unusual nasal/buccal haemorrhage have a direct smear taken from the discharge and for this to be examined forthwith. Veterinary experience is such that prepared smears stained with McFadyen's stain may give a rapid indication of presence of B.anthracis. • Ensure all Medical colleagues are fully aware of and conversant with Zoonoses.

What went well?	What did not go so well?	Learning points
Theme: Leadership		
1. The role of the Procurator Fiscal which provided the project with direction and consistency. 2. Clear lead by NHS Borders	1. Being under the "jurisdiction" of the PF was a new experience in the northeast of England and was a new set of circumstances we had to take into consideration when handling information. 2. Press releases. Communications with partner organisations. 3. For a month or more the initial Incident Commander (chair of ICT) was working long hours under severe pressure.	• Clear business continuity at HQ level to ensure appropriate senior staff are freed up to manage such a crisis over short, medium and long term. • Staff should be able to / encouraged to take breaks.
Theme: Legal issues		
1. Assistance from HSE and veterinary colleagues helped in initial response management and protection of "high risk" site.	1. Health and safety requirements were seen as a constraint. 2. Some of the legal issues eg who has the authority to serve notices on the property seemed unclear. Animal Health Legislation used was an effective and adequate stop-gap and fitted the bill temporarily. 3. Lack of clarity around legislation	• Supporting the review of Public Health Legislation in Scotland is important to ensure that appropriate legislation is on hand to protect the public.

8.15. The recommendations for action from debrief of members of the Public and Professionals involved in the anthrax incident are included together with a summary of all recommendations in **Chapter 10**.

9. Discussion

9.1. Introduction The management of this incident was the result of the first fatal case of naturally occurring inhalation anthrax in the UK in over 30 years. The incident has been managed by a multi-agency team led by NHS Borders. The incident response has included the first successful property decontamination for anthrax using Chlorine Dioxide in the UK.

9.2. The case had a history of Acute Myeloid Leukaemia (AML), although at the time of infection, the AML was considered to be in remission. It is possible that this previous medical history contributed to his susceptibility to infection. It is also likely that the case was exposed to a low dose of anthrax spores, as no other associated cases of either inhalation or cutaneous anthrax have been reported connected with this case.

9.3. Interpretation of initial results from this investigation. A month after the death of the case, anthrax spores were isolated from blood cultures taken from him during his final illness. Initially the history and investigations indicated that the case's highest risk of contracting anthrax was most likely to be associated with his work constructing African style Djembe drums and the preparation of animal hides in his own home and workshop in the days and weeks prior to infection. Immense efforts were undertaken to find a source of spores. Anthrax spores were not found in the home and workshop of the case after very extensive and systematic investigation**.** Investigation results indicated that there was no evidence that the case contracted anthrax through his work or at his home.

9.4. Time between death and diagnosis. Death occurred before diagnosis and after a short final illness lasting a period of hours. In view of the rapid clinical deterioration, the case was transferred for Intensive Care treatment and a range of appropriate antibiotic therapy was administered, but in spite of all treatment, he died on 8th July 2006. Confirmation of the diagnosis would in all likelihood not have occurred before death and in view of the appropriate antibiotic therapy and Intensive Therapy received would, on balance of probabilities, not have materially changed the final outcome. In the opinion of one author in the Oxford Textbook of Medicine, almost all cases of inhalation anthrax and anthrax meningitis are fatal.[17]

9.5. Anthrax was diagnosed by the use of specialised microbiology investigations. During any initial investigation, the microbiology department relies heavily on the clinical details supplied with a request/sample and on continual communication with the managing clinical team in order to interpret the relevance of organisms isolated. The role of the medical microbiologist facilitates this process. The clinical context is used to identify any appropriate characterization/identification tests for an isolate, the antibiotics against which

[17] Sirisanthana T, Oxford Textbook of Medicine, Section 7.52, 4th Edition OUP

sensitivity testing should be performed, the urgency of referral to a reference centre when required and the need for inter-laboratory communication to facilitate these systems.

9.6. The time line discussed for the isolate from the case is consistent with 'routine' standard operating procedures and with current best practice in place at the time the case was diagnosed. This case reflects good inter-laboratory communication that occurs between Microbiology laboratories both general and specialist when patients or samples are transferred between facilities.

9.7. Any diagnosis of anthrax in the UK requires the confirmation of the single civilian laboratory in the UK authorized to undertake such work. Any suspected anthrax isolates have to be sent to the Novel and Dangerous Pathogens Laboratory at Porton Down for final confirmation. NADPL is the only recognised (non-military) laboratory in the UK capable of confirming *Bacillus anthracis* to the agreed international standards. Any isolate identified by any other laboratory would be regarded as "provisional" until confirmed by NADPL. This is what happened in this case.

9.8. The time taken to diagnose the infection reflects the absolute rarity in the UK of illness caused by this bacillus. It is important to note that until this case, no UK microbiology laboratories have seen or diagnosed any cases of naturally occurring anthrax originating in the UK in last 30 years. This incident, the first of its kind in the UK for over 30 years, highlighted a collective lack of national experience in dealing with naturally occurring clinical anthrax; although UK organisations have exercised for deliberate release incidents.

9.9. Parallel investigations continued, relating to other exposures of the case potentially associated with drumming. These included attendance at a drumming workshop in the week before his final illness. Environmental investigations of drums and property where those drums were used, played or stored were undertaken. These investigations resulted in Anthrax spores being detected in three properties.

1) A property in Northumberland where drums which were played at the workshop attended by the case in the week before his death, were stored and worked on at various times.

2) A domestic garage in Smailholm, where these drums were also stored and worked on prior to the drumming workshop.

3) A Village Hall in Smailholm, Scottish Borders, which was the venue for the drumming workshop, a site where drums used in the workshop were stored. It is a multipurpose community venue used by the local population.

9.10. The significance of these investigation findings is that anthrax spores were isolated from the patient, from two domestic properties which he had not visited and from a Village Hall where he had attended a drumming event in the week before he became ill. This is consistent with the usual incubation period of this type of anthrax being from 1 to 7 days. Crucially after very extensive investigation of his home and workshop involving expert sampling teams from the Health Protection Agency and from a highly experienced team from the USA, no evidence of anthrax spores was detected at his home. This indicates that on the balance of probabilities, the case was not exposed to anthrax spores as a result of activities he undertook in his own home or workshop therefore came into contact with anthrax spores outwith his home.

9.11. Expert opinion on the interpretation of microbiological investigation results. According to reports from the Health Protection Agency, Novel and Dangerous Pathogens unit at Porton Down, the interpretation of DNA analysis and typing investigations is that anthrax spores of the same type/strain were isolated from the case and all three properties. It must be noted that the case visited only the Village Hall not the Northumberland property or the domestic garage. Indeed the Northumberland property was only occupied by the residents after the case had died.

9.12. Genotyping of *Bacillus anthracis* is based upon the analysis of 8 loci on the chromosome and virulence plasmids of the bacteria. Strains of bacteria can exhibit variability because of the small differences in sizes of the fragments. In the opinion of HPA-NDPL, it is likely that all three strains isolated from the case are to all intents and purposes identical, as would be expected. In addition, the spores recovered from the drum, vacuum sample, Northumberland property, Smailholm Village Hall and the garage are on balance of probabilities, the same strain. It is not, however, possible to state categorically that these are identical isolates because of the observed variability (heterogeneity) in 4 of the 8 loci examined. Additionally, two other genotypes were found which were unrelated to the case strain or to each other.[18]

9.13. Also, investigations of the property in Northumberland, revealed anthrax spores of three different strains, one of which was the same type as that isolated from the Blood cultures of the case. This evidence taken together with the negative results from the home and workshop of the case indicates that on balance of probabilities the case contracted the illness after playing, handling or being close to drums as they were being played, drums which were later found to be contaminated with the same strain of anthrax spores. There is no evidence to indicate that the case contaminated the drums when he played them as no evidence of contamination was found in his home to which he returned after the drumming classes.

[18] Personal Communication 7th December 2007. Dr G.Lloyd, HPA Novel and Dangerous Pathogens, Porton Down.

9.14. Specialist interpretation of the species of anthrax isolated revealed that the species isolated from the patient and which was also found in three other properties has been characterized by HPA as a species previously unrecognized in the UK. Further assays have been run by specialist Laboratories in Northern Arizona University and the samples from this case belong to a group identified as the A.Br.008/009 group. [19]

9.15. In Europe, isolates from A.Br.008/009 sub-group are dominant. A relatively common sub type of anthrax, it is widely distributed in the world being found as the predominant strain in southern Europe and Asia, it is also found in Africa and the Americas. Isolates in the A lineage are widely dispersed globally, whereas the B and C lineages are distributed less widely.

9.16. There are several possible explanations for the differences in global distribution observed among the major lineages of B. anthracis. One explanation is genetic differences that affect survival and propagation in either the environment or hosts. A comparison of A vs. B isolates from South Africa indicated that A strains (as found in this case) are adapted to more diverse environments than B strains, which were restricted to more narrow environmental conditions. This trend is also reflected on a global scale and the highly-stable *B.anthracis* spore plays an important role in the importation of diverse genotypes into industrialized countries via transport and trade of contaminated commodities across large distances.

9.17. This information is based on a study of a global collection of 1,033 *B. anthracis* isolates.[20] These isolates were obtained from known anthrax cases, environmental sources, or other materials associated with the disease. The isolate collection is biased toward anthrax outbreaks that occurred in the last several decades (the latest isolate from the UK was 1996). It is also biased towards countries actively engaged in the international exchange of scientific material. Although strains from South Africa were included in the study no strains from other Sub-Saharan or West Africa countries were examined. This means we have no direct information on what strains are present in these countries.

9.18.Interpretation of risk following anthrax investigation results.

Due to the inherent inefficiencies of any sampling process, it can be assumed that the areas where anthrax colonies were isolated were more heavily contaminated than areas which were PCR positive but no colonies were isolated (the level of contamination in these areas is likely to be below the level of detection).

[19] Personal Communication from Drs Leo Kenfics and Dr Paul Keim at Northern Arizona University. November 2007

[20] Van Ert MN, Easterday WR, Huynh LY, Okinaka RT, Hugh-Jones ME, et al (2007) Global Genetic Population Structure of Bacillus anthracis. PLoS ONE 2(5): e461. doi:10.1371/journal.pone.0000461

9.19. Commentary on the likely numbers of spores present and the risk posed by that number: Calculations of the numbers of spores present within for example the vacuum cleaner sample indicated that approximately 1000 spores were recovered from a rug at the Northumberland property. Because the efficiency of spore recovery is unknown, it is not possible to estimate what the actual level of contamination of the rug might have been. The data that HPA-NDPL has shared indicates that with a clean preparation of spores, the nucleic acid extraction efficiency is approximately 10% and recovery of spores from samples with a high dust or dirt content is, at best, 50%. If these caveats are applied to the samples from the rug, then the spore numbers present may have been as high as 20,000. The distribution was unknown. The risk presented by these spores for developing inhalational anthrax is very small, as they would have to be aerosolised by some event which created sufficient energy to do this, and then breathed in. It is possible that contact with spores directly could cause infection through skin abrasions, although the chance of this is small given the location and numbers of spores involved.

9.20. Although the risk of inhalation anthrax from the contamination is small due to the low amount of contamination (at the limit of detection), it is still possible that a susceptible person may be infected by this route, especially if they have exposure over a long time period. The risk of cutaneous infection is greater. These risks were considered high enough to require decontamination in Smailholm Village Hall, which is a multi-user facility and thus susceptible people are likely to be at risk of exposure.

9.21. A commentary on the numbers of spores present at Smailholm Village Hall and the likely risk: It is not possible to calculate the actual numbers of spores present and, significant aerosolisation and inhalation of spores would be required to cause disease, the risk was, therefore, relatively low for persons entering the building and undertaking “normal” activities. However, the possibility with multiple users, including children and others who might touch contaminated surfaces, that someone would eventually contact spores and develop a cutaneous or other infection remained unless decontamination was performed.

9.22.Decontamination and fumigation. All sampling data collected both during and after the fumigation process demonstrate that potential *B. anthracis* spore contamination present in the Village Hall and garage structures, as well as the wall tapestry, was effectively decontaminated. With respect to fumigation process variables, temperature and humidity levels were maintained within their desired ranges throughout both fumigation operations. In addition, the ClO_2 concentration level reached a minimum of 500 ppm_v quickly in both the Village Hall and garage fumigation operations and was held at or above that level until both three hours of building exposure had occurred and 9,000 ppm_v-hours of CT credit or more had accumulated. This combination of exposure conditions is known to bring about the eradication of all forms of microbial life, including *B. anthracis* spores.

9.23. The spore strip results verified that effective treatment conditions were indeed achieved during the Village Hall and garage fumigations as well as during the tapestry autoclaving process. All surrogate marker *B. atrophaeus* spore strips placed within each structure and inside the autoclave were found to be negative for surrogate test organism growth following fumigation. In addition, the positive control spore strips submitted for analysis along with the actual samples were found to be positive for growth, thereby indicating that the spore strips were of good product quality and the analytical laboratory maintained quality standards to test organism growth.

9.24. Making drums, Playing drums, Handling drums. Animal hides pose a low risk of cutaneous (skin) anthrax, and an extremely low risk of inhalation anthrax. Animal hides imported from a range of countries may pose a higher risk for exposure than domestic origin hides. The risk of contracting *B. anthracis* from handling individual hides is believed to be very low; however, the industrial processing of hides or hair has historically been associated with increased risk of anthrax. Such industrial handling of large numbers of hides or hair from multiple animals results in prolonged direct contact with contaminated materials, often in enclosed or poorly ventilated settings. Among the 236 cases of anthrax reported to CDC in the USA from 1955 to 1999, 153 (65%) were associated with industrial handling of animal hide or hair. Only 6% of cases associated with handling of hair or hides were inhalation anthrax.

9.25. At the time of writing this report (November 2007) two further cases of cutaneous anthrax have been reported in Connecticut, USA.[21] One was the director of an African drumming program who worked with hides and constructed drums and the other was a relative. Animal hides from Africa used to make drums are known to have been the source of anthrax that infected a New York City drum maker in February 2006 last year.

9.26. Anthrax cases associated with handling drums are extremely rare and are more commonly associated with cutaneous anthrax. The February 2006 case in New York was the first inhalation anthrax case recorded as associated with the preparing of animal hides used in the construction of African Drums.

9.27. If this case was not exposed from the act of preparing animal hides at his own home, which is highly unlikely since the hides and surfaces at his home were all found to be negative for any evidence of anthrax spores, this case is the first case of inhalation anthrax that, on balance of probabilities, was contracted after playing or handling drums. This is supported by: drums used at the drumming workshop; the Village Hall; and other properties where the drums were stored or played; all subsequently found to be contaminated with anthrax spores of the same strain as those isolated from the case.

[21] New York Times, September 7th 2007

9.28. Does drumming activity add to the risk of anthrax infection to the general public?

From the documented cases, it appears that there is a risk (although a very rare and difficult to quantify) from working with untreated hides and from handling or playing drums made from untreated hides. It should be noted that although these cases are very rare, over the last two years there have been four cases (3 in the USA and this case), associated in some way with drumming or preparation of drums with untreated imported hides.

9.29. The likely route of exposure of animal hides is environmental contamination. However, there are no available data on the levels of contamination of anthrax spores in the environment. It is thought that when importing hides, one hide in the consignment may be heavily contaminated and contaminated other hides in the consignment. In this case, either the drum or the hide presumably had levels of contamination sufficient to enable numbers of spores to be inhaled by the case in order for the infection to develop. 27 drums were tested, 2 anthrax colonies were isolated from 1 drum, 2 adjacent drums were positive by PCR. At least 2 other hides had evidence of contamination with other anthrax strains.

9.30. There are probably low levels of anthrax spores coming into the UK on untreated or untanned hide skins and drums. The skins taken from the case's home were negative, suggesting that the source of contamination was hides and skins used or stored in Northumberland or Smailholm or drums which were played at the drumming class at the Village Hall during the week prior to the illness developing.

9.31. Drum making therefore appears to be a potentially hazardous process. Playing drums should also now be considered to be a potentially hazardous activity particularly if drums with untreated skins are played by or next to people with predisposing health conditions or compromised immune systems. The mechanism may be that the sound waves and vibrations produced by playing may cause aerosolisation, releasing spores from the surface of the drum skin.

9.32. Decontamination Criteria The US Environmental Protection Agency guideline on decontamination states that there must be no growth of *B. anthracis* by detectable limits. Detection now is better than 10 years ago and techniques used are much more sensitive. The contamination levels in this case are at the limits of sampling and detection, how much is not being detected? The risk of infection is very small, but there is still a risk and a possibility of an individual with high susceptibility (i.e. requiring contact with relatively few spores to contract the illness) coming into contact with anthrax spores, although this is low. The decontamination criterion in Scotland was "no detectable spores", therefore the Incident Control Team decided, there was a need to decontaminate the two premises as viable spores were found on both premises.

9.33. The risk of exposure through drumming appears to be very low however experience in this case and from the three cases noted in the USA within the last two years would appear to indicate that this risk is increasing and further steps may be required to safeguard drums or drum skins imported into the UK.

9.34. The Incident Control felt there was little justification for widespread testing of other premises where drumming takes place, or has in the past taken place. Any risk is thought to be extremely small, and any extended testing may cause unnecessary public anxiety and would be immensely difficult to define and to specify.

10. Conclusions

10.1. In July 2006, a 50 year old man died as a result of contracting anthrax. His short illness was characterized by an atypical presentation of what world experts considered to be inhalation anthrax. This was the first case of human anthrax infection in the UK in 30 years. The speed of the illness and resulting sudden death serve to illustrate the potential devastating impact of an organism thought to have been controlled in this country.

10.2. The result of the investigation was that on the balance of probabilities the case became infected as a result of using or handling one or more West African style drums contaminated with viable anthrax spores, at drumming classes or workshops. This is supported by the finding of spores, which were, on balance of probabilities, the same strain of *Bacillus anthracis* that was isolated from a blood culture taken from the case, on drums; on an animal skin; and in three properties where the drums had been stored or used.

10.3. It is not possible to be more precise as to which particular exposure episode was the one which resulted in his fatal illness. However it was known that he attended drumming sessions on two separate occasions, days before becoming ill. It is possible although not certain, that the case's previous medical condition did make him more susceptible to inhalation anthrax infection. What is clear is that no other cases of infection occurred at the same period despite the probability that other individuals attending the drumming sessions had also been exposed to viable anthrax spores.

10.4. While there have been cases of anthrax elsewhere in the world associated with contact with West African sourced drums, there have been no cases associated with contact with West African drums in the UK before this case or since. It would therefore be reasonable to conclude that while a risk of infection clearly does exist, the level of risk would have to be considered as relatively low.

10.5. However, further research is needed to try to quantify the level of risk associated with such drums and imported animal skins more accurately and to determine if more specific risk avoidance measures are necessary. In the meantime, it would be reasonable for general advice to be given to the public about the potential risks of anthrax infection associated with imported animal skins and West African drums.

10.6. This tragic and premature death was the result of an extremely rare disease which was diagnosed post mortem. As a result, a large scale public health incident response was put in place. An Incident Control Team was established under the leadership of NHS Borders. The team involved specialist input and expert advice from many agencies around the world and listed elsewhere in this document. This unique incident demanded a long-term, flexible and adaptable approach be taken and resulted in an effective team response.

The key stages of the incident response involved:

- An initial problem and risk assessment meeting.
- A large series of Incident Control Team and Environmental Investigation Team meetings held with the extensive use of teleconferencing allowing input from many different agencies and different countries.
- An extensive contact tracing exercise and telephone helpline for people identified as high potential risk of exposure to anthrax identified over 165 contacts from Scotland, other parts of the UK and Europe.
- The urgent provision of chemoprophylaxis to over 70 contacts assessed as being at high risk of potential exposure to anthrax
- A public information campaign reactive to the various stages of the incident response and the various groups of families and communities involved.
- A managed media communication programme.
- Investigation of numerous potential sources of anthrax spores.
- The identification of three properties contaminated with anthrax spores.
- The successful decontamination of two properties contaminated with anthrax spores in Scottish Borders.
- The restoration to a community of a valuable community hall and the preservation and successful decontamination of a very costly and highly valued tapestry.
- Important ethically approved research was undertaken into the health impacts of the incident and in particular the health impact of the prescribing of long term antibiotic chemoprophylaxis.

10.7. This incident response took over eight months with huge consumption of time and person hours only part of which can be accurately estimated. Overall expenditure on this anthrax response is estimated in the region of £466,186. A summary cost breakdown is given in **Appendix 3**. These summary costs of the incident response are necessarily an underestimate of the true costs. The costs do not take into account the huge number of additional hours put in by staff from a range of different agencies who gave their time willingly.

The main impact on NHS Borders and other agencies involved in the response is that of the opportunity cost of being unable to undertake work that would otherwise have been possible. However these costs are balanced by the successful and unique response that was possible only through the selfless work of a large number of people. Many valuable lessons have been learned which will aid other agencies throughout this country and elsewhere in planning and if necessary, undertaking similar work.

It is important to recognise that this report and subsequent publications are used to learn, to record and to share the valuable lessons that have been possible, only as a direct result of the untimely death of a very gifted and creative man.

Dr Andrew Riley December 2007

11. Recommendations

This chapter including **Table 7** and **Table 8** summarises the recommendations from members of the public consulted and professionals involved in the management of this incident.

These tables are followed by a summary of recommendations from the ICT which are aimed at various interested organisations. These summary recommendations cover incident management procedures in general and the investigation and management of anthrax specific incidents.

It is intended that the findings of this investigation and more detailed work involved will be published in peer reviewed journals in order to ensure that the value of these experiences can be widely shared and inform the preparations and responses of other organisations to any similar public health or health protection incidents.

Table 7.
Recommendations arising from consultation with members of the public involved.

Communications
1) Identify key tasks and staff roles in incident response. 2) Identify registers of volunteer staff to fill incident response roles 3) Identify and share basic skills and knowledge/requirements for key roles 4) Exercise use of 'volunteers' in key roles. 5) Prepare template database in a format adaptable to a variety of incident responses 6) Ensure Mail Merge capability available and staff are trained to use it and retrained when software versions are updated. 7) Communications with the public needs to balance the need to inform with the potential for causing alarm. 8) Build ongoing relationships with regular media contacts
Information
9) Communication with the public needs to strike a balance between realism and alarmism in explaining impact on themselves. 10) A library of information in easy read format is required which can be accessed electronically to cover as wide a range of possible hazards is required.
Organisations involved in the handling of the incident
11) Scottish Government to consider how (upon request), media expertise can assist and play into complex significant events which are associated with a high degree of public anxiety 12) Identify a designated publicity/ press officer. Consider outsourcing when major incidents occur and if required, request access to Scottish Executive press resource. 13) Consider access to expert advice as part of every incident management agenda 14) Ensure that support, relief and 'time out' for staff is available. Provide staff with training and/or support with coping strategies. 15) Organisation requires regular review of response if incident management is likely to be prolonged
Contact tracing
16) Use of continuing or prolonged courses of antibiotic prophylaxis needs health concerns to be addressed, in particular information needs and follow up during therapy 17) Overseas follow up of contacts to be made a responsibility of HPS to ensure continuity and quality of contact between authorities in different countries

Effects on the population
18) Family Liaison function to be explicitly identified early on and if required to be communicated to all concerned parties 19) Consider formal debrief for members of the public involved in any significant incident. 20) Regular media and communication training for professionals is important , also exercising any helpline function to be used

Table 8.
Recommendations from consultation with professionals involved in the incident response.

Theme: Multi-organisational , multi-national team interagency working
1. At the earliest incident control meetings, clarify and agree roles and remits to ensure all agencies understand lines of accountability and mechanisms of incident response. 2. Consider the need for centralised resources in incident management – this incident consumed an inordinately large amount of time for relatively small teams (NHS Borders, HPA-NE and HPA-NDPL. This might make decision making easier and more consistent. 3. NHS Borders and other organisations should identify an incident control room for any future incidents. 4. Organisations should regularly consider if the response is outstripping capacity to respond and therefore requires a major incident formal response.
Theme: Operational Plans
5. Regularly consider if additional personnel are required to contribute to an incident response. 6. Regularly check opinion on progress with colleagues in an ongoing incident response 7. Consider how the organisation monitors the effects of response on incident team members throughout the course of an incident and after the incident response is complete. 8. Develop operational orders for any discrete, complex logistical elements of an incident response. 9. Have a clear local lead for the logistical management of this type incident response.
Theme: Administration
10. Consider the use of read receipts to ensure communications reach every member of incident team. 11. Regularly update e-mail and phone records. 12. Have staff pre-identified on a list willing to work extra hours on this type of incident response. 13. Have systems available to centrally record staff hours worked, resources required. 14. A log of events actions and responses should be kept with every issue, being noted. 15. The log should be kept by a delegated person(s) within the department with log sheets being completed by other members with daily events. 16. Consider bringing in additional administrative staff to assist with incident management and to manage on-going normal daily tasks that may be given a lower priority. 17. NHS Borders should identify an incident control room for any future incidents. 18. HPS to assist in the development of data base templates available to use at short notice in an incident response. 19. Record who helped and remember to thank them after the response.
Theme: Media
20. Ensure crisis communication teams are established well in advance and that everyone is clear on what is expected from them. 21. Consider refresher media training for key spokespeople. 22. Try to model for a full range of media responses from limited or no attention to full multimedia coverage. 23. Consider at regular stages of any incident response, the contingency arrangements for media when assessing capacity to respond and ongoing media demands. Service continuity arrangements for communications teams would be a valuable resource. Communications plans should be extended to staff within departments or organisation impacted by events.

Theme: Incident management
24. Logistics Planning is of immense value including the production of operational orders and a clear and single route for coordination e.g. ordering of equipment and supplies. 25. Consider the management of the "the day job" outside the incident depending on the duration of the incident response.
Theme: Financial decisions
26. Agreement at Government Department level about funding of investigation and decontamination would be one of the first issues to sort out for exceptional incidents like this, where high costs might be anticipated. 27. Consider possible financial impacts of incident responses at an early stage of any incident and establish contingency arrangements so as not to risk any delay to response.
Theme: Disease and diagnosis
28. Anticipate the improbable 29. The suggestion that human patients presenting with unusual nasal/buccal haemorrhage have a direct smear taken from the discharge and for this to be examined forthwith. Veterinary experience is such that prepared smears stained with McFadyen's stain may give a rapid indication of presence of B.anthracis. Medical colleagues should consider extending use of such rapid diagnostic tests if validated for human use. 30. Ensure all Medical colleagues are fully aware of and conversant with Zoonoses. 31. Microbiology laboratories (both NHS and Private) to agree and review in the light of this incident the 'best practice' when general Bacillus spp. isolates are obtained from sterile site or blood culture specimens.
Theme: Leadership
32. Clear business continuity plans should be in place to ensure appropriate staffing is available to mange incidents over short, medium and long term. 33. Formally assess at an early stage of incident response if management of the incident should be reallocated if other Health Boards or health protection services in other UK countries are involved. Consideration could be given to leadership by Health Protection Scotland for nationally significant incidents.
Theme: Legal issues
34. Support the review of Public Health Legislation in Scotland presently before the Scottish Parliament to ensure that appropriate legislation is in place to protect the public.

Recommendations arising from the management of this case:

Incident Management Procedures

11.1. NHS Borders Health Board should designate an Incident Control Room for future similar large scale or long term incidents.

11.2. All Incident Control Teams should keep a continuous log of information, actions and resulting reactions, preferably kept by administrative staff dedicated to the task.

11.3. National agencies including HPS, HPA and Police should undertake work to identify and disseminate the best methods of evidence collection and data recording during incident investigation which ensures any chain of evidence is demonstrable.

11.4. National agencies including HPS, HPA, with the involvement of the Scottish Government and Department of Health should review the contracts and service level agreements between England and other home nations in order to establish a framework of working in health protection which enables the management of 'cross border' incidents to take place without the need to negotiate new contracts.

11.5. HPS to be asked to develop template databases accessible to all Incident Control Teams in a format which will allow the collection of incident data and the import and export of data for subsequent statistical analysis.

Investigation and Management of Anthrax Specific Incidents

11.6. The clearance criterion of "no detectable viable spores" adopted in the Borders incident proved to be practical and attainable. It is recommended that this criterion should be adopted in any future human anthrax related incidents where environmental decontamination is required. (Action by HPA, HPS)

11.7. Relevant government departments in the UK including devolved administrations should review the current methods in place to prevent the importation of potentially anthrax contaminated material. In particular, untreated or minimally treated animal hides. This should extend to products incorporating such hides such as West African drums. Additional protective measures should be considered including measures in use for other products in the UK and elsewhere in the world e.g. irradiation. (Action by DEFRA and HM Customs)

11.8. Due to the lack of information and knowledge of the extent of environmental contamination with *Bacillus anthracis* spores, the Incident Control Team recommends research is funded and undertaken to determine the background levels of anthrax in the general environment of the UK. (Action by DEFRA, HPA and HPS)

11.9. The lack of knowledge on the prevalence of past exposure to *Bacillus anthracis* in the UK population requires research into the prevalence of antibodies to *Bacillus anthracis* in the human population. This could be funded by UK Government departments. (Action by DoH, SGHD)

11.10. The Incident Control Team recommends research to determine the extent of contamination of animal hides with *Bacillus anthracis* spores imported from countries where anthrax is endemic. Countries of sub-Saharan Africa identified by this and other similar investigations as producing hides which might be a source of *Bacillus anthracis* spores with the potential to cause human infection.

11.11. National agencies including HPS, HPA should note the relatively low levels of compliance with chemoprophylaxis advice during this incident. This has significant implications in terms of existing guidance on the administration of contact tracing and chemoprophylaxis for future incidents involving human exposure to anthrax spores.

11.12. Early recognition of potential anthrax infection is important to enable early public health investigations and intervention, especially to identify any possible deliberate release of anthrax spores in a CBRN context. The incident highlighted limited experience in dealing with clinical anthrax. Opportunities to raise awareness of anthrax as a possible cause of unexplained septicaemia should be taken, particularly among clinical microbiologists, intensive care physicians and others [Action by SGHD].

11.13. It is recommended that where there is a clinical case history or findings which suggest the possibility of anthrax infection, then samples or isolates should be sent to HPA NADPL as a matter of urgency, especially if any *Bacillus species* is identified even if it is thought to be a contaminant. (Action by SGHD)

11.14. Awareness of the signs and symptoms of anthrax infection and other CBRN agents should be raised within the NHS both in Scotland and the UK as a whole, to increase the potential that such a case would be recognised earlier. The recent Glasgow airport incident clearly demonstrated that Scotland could be a target for a CBRN attack. (Action for SGHD)

11.15. Problems were encountered during the incident in identifying which legislation could be used to assist the investigation and management of the incident. In particular the issues of isolating potentially contaminated property and gaining access to properties involved via third party owned land were problematic. A review of legislative options to cover these aspects is recommended, to ensure that such scenarios are adequately addressed in the revision of public health legislation being put before the Scottish Parliament [Action for SGHD].

11.16. A continuous process of risk communication with the public is recommended. Advice should be updated and made available to anyone engaged in drumming activity or in the making of drums using imported animal skins, especially drums or skins form West Africa. The advice should include the potential risk of anthrax infection, the signs and symptoms of infection and action to take if infection is suspected. Advice should be given to hide importers and drum manufacturers. (DEFRA, HPA, HPS)

Appendix 1. Memberships of the Incident Control Team, Environmental Investigation Team, Logistics Sub-Group and Clearance Committee.

Agency	Personnel	Group
DEFRA	Rob Smith	Incident Control Team Environmental Investigation Team
Government Decontamination Service	Stephen Varley	Incident Control Team Environmental Investigation Team Logistics Group
Government Decontamination Service	Robert Bettley-Smith	Clearance Committee
Government Decontamination Service	Sara Casey	Clearance Committee
Health & Safety Executive	Sandy Ritchie	Incident Control Team Environmental Investigation Team Clearance Committee
Health and Safety Executive	Susan Donnelly	Environmental Incident Team
Health and Safety Executive	Nancy Hamilton	Incident Control Team Environmental Investigation Team Logistics Group Clearance Committee
Health Protection Agency	Alan Bennett	Environmental Incident Team Clearance Committee
Health Protection Agency	Dr N J Silman	Environmental Incident Team Clearance Committee
Health Protection Agency	Dr Dilys Morgan	Incident Control Team
Health Protection Agency	Dr Graham Lloyd	Incident Control Team Environmental Investigation Team Logistics Group Clearance Committee
Health Protection Agency	Dr Kirsty Foster	Incident Control Team Environmental Incident Team Clearance Committee
Health Protection Agency	Roger Cook	Incident Control Team
Health Protection Agency	Dr Tim Brooks	Incident Control Team Environmental Investigation Team Clearance Committee
Health Protection Scotland	Dr John Cowden	Incident Control Team
Health Protection Scotland	Dr Steve Hankin	Incident Control Team Environmental Investigation Team Logistics Group
Health Protection Scotland	Carole McRae	Environmental Investigation Team
Health Protection Scotland	Dr Colin Ramsay	Incident Control Team Environmental Investigation Team Logistics Group Clearance Committee
Lothian & Borders Fire Brigade	John Mallin	Environmental Investigation Team Logistics Group
Lothian & Borders Police	Paula Clark	Logistics Group
Lothian & Borders Police	Charlie Common	Clearance Committee
Lothian Health Board	Carol Fraser	Incident Control Team
Lothian Health Board	Dr Lorna Willocks	Incident Control Team
Lothian Health Board	Susan Lloyd	Incident Control Team
NHS Borders	Deborah Adams	Incident Control Team

Agency	Personnel	Group
NHS Borders	Dr Sally Bennett	Incident Control Team Clearance Committee
NHS Borders	Christopher Faldon	Incident Control Team
NHS Borders	Debbie Lawrie	Environmental Investigation Team
NHS Borders	Alex McSorley	Incident Control Team Environmental Investigation Team Chair of the Logistics Group Clearance Committee
NHS Borders	Dr Alan Mordue	Incident Control Team
NHS Borders	Lorna Paterson	Incident Control Team Environmental Investigation Team Clearance Committee
NHS Borders	Sheila Patterson	Incident Control Team
NHS Borders	Dr Tim Patterson	Incident Control Team Environmental Investigation Team
NHS Borders	Robbie Pearson	Incident Control Team Environmental Investigation Team Clearance Committee
NHS Borders	Dr Chris Richard	Incident Control Team
NHS Borders	Dr Andrew Riley	Incident Control Team Environmental Investigation Team Clearance Committee
Procurator Fiscal	Graham Fraser	Incident Control Team Clearance Committee
Royal Infirmary of Edinburgh	Dr Alan (Paddy) Gibb	Incident Control Team
Royal Infirmary of Edinburgh	Dr Ian Laurenson	Incident Control Team
Royal Infirmary of Edinburgh	Graham Paxton	Incident Control Team
Sabre Technical Services	Brian Hendron	Logistics Group
Scottish Ambulance	Neil Gillies	Environmental Investigation Team Logistics Group
Scottish Ambulance	Paul Gowens	Environmental Investigation Team
Scottish Borders Council	Ken Jones	Incident Control Team Environmental Investigation Team Clearance Committee
Scottish Borders Council	Ron Swinton	Incident Control Team Environmental Investigation Team
Scottish Borders Council	Ian Hogarth	Environmental Investigation Team Logistics Group
Scottish Executive	Dr Arthur Johnston	Incident Control Team Environmental Investigation Team
Scottish Executive	Dr Elizabeth Stewart	Incident Control Team
Scottish Executive	Dr Peter Christie	Incident Control Team
Scottish Executive	Prof. George Morris	Incident Control Team Environmental Investigation Team
Scottish Executive	Susan Roberts	Environmental Investigation Team
Scottish Executive	Professor Maggie Gill	Clearance Committee
SEPA	Allan Virtue	Environmental Investigation Team Logistics Group Clearance Committee
SEPA	Bill Lyons	Environmental Investigation Team
SEPA	Colin Bayes	Environmental Investigation Team
SEPA	John Dalgleish	Environmental Investigation Team

Appendix 2: Decontamination method used at Smailholm

The Village Hall and garage were both encapsulated prior to fumigation with a layer of tenting material proven to be impervious to ClO_2 gas. The tent fabric was sealed to the ground using sand "snakes" and the seams were sealed with metal clamps to prevent leakage of ClO_2 gas during the fumigation process.

Negative Pressure System. Containment of the ClO_2 gas was assured through installation of a negative air pressure system to maintain a slight negative pressure on the internal walls and ceiling of the tent. The negative air system was visually inspected before introduction of ClO_2 into the tent.

Emission Control. Because air was removed from the tent during fumigation to create negative pressure, a treatment process was necessary to remove ClO_2 gas prior to exhausting the discharge air to the surrounding environment. To accomplish this, the negative air system was equipped with a gas scrubbing treatment process that consisted of: an induced draft fan; and two vapour phase carbon cells. The treated air leaving the carbon cells was monitored continuously to identify potential breakthrough of ClO_2 gas to the ambient environment.

ClO_2 Generation System A Sabre three-chemical system was used to generate the ClO_2 used during both fumigation operations. The Sabre system uses 15% hydrochloric acid, 12.5% sodium hypochlorite and 25% sodium chlorite solutions to generate high purity ClO_2 gas in an aqueous solution with a concentration of approximately 2,000 to 5,000 parts per million (ppm).

ClO_2 Distribution System The liquid ClO_2 solution was pumped from the generator to a single gas "emitter" located immediately outside the fumigation tent. The ClO_2 gas was then “stripped” out of the water solution by the emitter and introduced into the building. The depleted solution flowed back to the generator in a process flow loop where it was “recharged” to its initial concentration and used again. Supplemental ClO_2 gas was added until the concentration present in air throughout the building undergoing treatment was in the desired range.

Temperature Control System The building was brought to the minimum desired initial temperature level of 70^{o} Fahrenheit (F) before ClO_2 gas was introduced. Due to the low ambient temperatures, portable heaters were used to increase the internal temperature to this level.

Relative Humidity Control System The building was brought to the minimum desired initial relative humidity (RH) level of 70% before ClO_2 gas was introduced. The RH was increased to this level using steam introduced through

the emitter. Humidity was monitored and adjusted throughout the fumigation process as required by selectively adding steam to the emitter.

Gas Neutralization System At the end of fumigation, residual ClO_2 gas remaining inside the building was neutralized by the addition of hydrogen peroxide solution to the liquid flow loop. The solution was then circulated to the emitter where it removed ClO_2 gas from the building as air was drawn through the emitter. Removal of ClO_2 gas from the building and fumigation tent continued until concentration levels within the structure fell to a level below 0.1 parts per million by volume (ppm_v), a level generally recognized as being safe for re-entry by normal healthy workers without a need for personal protective equipment.

Fumigation Monitoring. The ClO_2 application parameters known to be effective against B. anthracis spores were monitored throughout both the Village Hall and garage fumigation events. These parameters included temperature, RH, ClO_2 concentration and fumigant dose, which is expressed in terms of " (CT) credits (concentration x time of exposure). The operational objective of the fumigation process was to achieve or exceed the following criteria within the treated buildings:

- Temperature at or above 65 ^{o}F
- RH at or above 65 percent
- ClO_2 concentration of 500 ppm_v or higher
- CT dose duration of 9,000 ppm_v- hours or more (i.e. 3,000 ppm_v for 3 hours)

Temperature and Relative Humidity levels were monitored through use of HOBO® Model U12-011 TEMP/RH Data Loggers and were logged at 5-minute intervals throughout the fumigation process.

Chlorine Dioxide Concentration levels were monitored by means of a composite sample collection system constructed of ¼-in inside diameter high-density polyethylene (HDPE) tubing. HDPE tubing has been shown not to react with ClO_2. The tubing was run from inside the treated buildings to a sampling manifold located outside the fumigation tent in a mobile laboratory facility. Samples were collected and analyzed by trained technicians. Air flowed continuously to the sampling manifold so that samples represented existing conditions within the buildings at the time they were taken. A vacuum pump was placed on the downstream side of the sampling manifold to move air through the system and return it to the structures on a continuous basis throughout the fumigation process. Samples were collected at a frequency of one air sample from each sampling location every 15 minutes throughout the fumigation period.

CT Credits The fumigation CT "clock" was started when a minimum ClO_2 concentration level of at least 500 parts per million by volume (ppm_v) was measured at all sampling locations within the building. This was continued until all areas had received at least three hours of exposure time and accumulated a minimum 9,000 ppm_v-hour CT clock value, at which time the fumigation was deemed complete. The basis of the target "dose" of 9,000 ppm_v-hours is a series of studies that showed ClO_2 is efficacious at this dose against various species of Bacillus spores, including B. anthracis, widely known as the most difficult biological agents to inactivate.

Bacterial Indicator (BI) Spore Strips. Spore strips containing Bacillus atrophaeus (*B. atrophaeus*) (formerly known as *B. subtilis, var. niger*) spores were placed throughout the contaminated structures prior to decontamination to verify that effective treatment conditions were indeed achieved during the two fumigation events. BI spore strips were also placed in the autoclave along with the fragile wall tapestries during their treatment. The *B. atrophaeus* strain is commonly used in medical applications to demonstrate successful ethylene oxide sterilization, as well as in the pharmaceutical industry to document the effectiveness of small-scale ClO_2 treatment.

B. atrophaeus was also used as an indicator organism during all of the large-scale ClO_2 anthrax fumigations performed by Sabre following the bio-weapon attacks that occurred in the US during autumn 2001. Single log 10^6 (2.2×10^6 spores per strip) spore strips were placed in both representative locations and the most challenging locations for gas distribution that could be identified in advance of the fumigations at a density of at least one spore strip per 100 square feet of building floor space. A total of 34 spore strips were placed within the town hall and six spore strips were placed in the garage. The specific placement locations for each spore strip in the town hall and garage are recorded. Three spore strips were also placed in the autoclave inside a surrogate bundle of cloth items designed to be of equivalent size to the tapestries during treatment to document autoclave process efficacy.

Spore strips were removed from the treated structures as soon as possible following fumigation and shipped, along with strips from the tapestry autoclaving process, to Nelson Laboratories, Incorporated (Nelson) in Salt Lake City, Utah (US) for analysis. The Nelson facility is Food and Drug Administration (FDA) registered, ISO 9001-certified and ISO 17025-accredited. Spore strips were shipped to Nelson in accordance with US Department of Transportation standards for potentially hazardous biological agents.

Quality Control. Positive control BI spore strips were submitted for analysis along with treated strips from the two structures in a ratio of at least one positive control for every six treated samples. Six positive control spore strips were submitted for the town hall fumigation and two for the garage fumigation. Positive controls are untreated (i.e. not fumigated) spore strips of identical composition that are submitted "blind" to the laboratory along with exposed spore strips. Positive controls provide evidence of spore strip product quality as well as evidence that conditions for surrogate organism growth during analytical incubation are conducive. The positive controls were handled, packaged and shipped in the same manner as the actual samples, except that the positive controls were not subjected to the fumigant gas.

Appendix 3: Summary of Costs Incurred in Management of the Anthrax Incident during 2006/2007.

Description	Amount (£)
1. Salaries for additional staff hours worked.	£7,960.85
2. Emergency Response Vehicle.	£7,575.00
3. Maintenance and Equipment	£4,512.16
4. Hire charges	£7500.51
5. Consultancy fees	£2,000.00
6. L&B Police fees	£22,970.52
7. Medical fees	£225.05
8. Specialist contractor fees (HPA, SABRE and specialist waste disposal service)	£227,291.93
9. HPA costs	
a. Hawick	£119,902.87
b. Smailholm	£27,785.00
10. Incident costs general	£37,129
Total	**£466,186.60**