The Listeria outbreak

9 May 2018

National Institute of Communicable Diseases
Outbreak Response Unit,
Kerrigan McCarthy
Overview

What is listeriosis and how does it present clinically?

How was the outbreak investigation conducted?

Evidence confirming the source of the outbreak
– In-depth food history interview findings
– Events linking the outbreak strain with clinical disease
– Factory inspections and findings

Going forward
– Monitoring for new cases
– Disposal of recalled product
– Communications and health awareness
Background
What is listeriosis?

Caused by the bacterium *Listeria monocytogenes*
- Gram-positive bacterium

Found in the environment, in soil and in gut of animals

Transmitted to humans through contaminated foods
- All animal produce are at risk of being contaminated with Listeria, but foods that are not cooked pose a risk to humans
- Dairy (milk/cheese), poultry, processed foods, ready-to-eat foods, fruit, vegetables.

Has a preference for cold environments (around 7°C)
- Able to live in the fridge
Background

How does listeriosis present clinically?

Four common clinical presentations, especially amongst persons at risk – pregnant women, the elderly and persons with weaker immune systems

Gastroenteritis

Meningitis

Pregnancy associated – illness (prem labour and neonatal sepsis/death)

Sepsis/bacteraemia

Usual incubation periods (=time from consuming contaminated food to development of disease)

– Gastroenteritis: 6-48 hours
– Bacteraemia: average 7 days
– Meningitis: average 10 days
– Pregnant women: 21 days (2-70 days)
Background

What foods have been implicated in Listeriosis outbreaks globally?

- Meats –
  - Cold
  - Processed/unprocessed
  - E.g. poultry, ham, polony

- Milk products
  - Milk
  - Cheese (soft and hard)
  - Yoghurts
  - Amasi / fermented milk

- Fruit
- Vegetables

How does food become contaminated with *Listeria*?

The Food Production Chain
How was the outbreak investigation conducted?

Principles of outbreak investigation were followed

- Verify the diagnosis
- Establish the existence of an outbreak
- Identify and count cases
- Describe the epidemiology
- Formulate and test hypothesis
- Assess local response capacity and address resource gaps
- Set up control measures
- Communicate findings
- Intensify surveillance
How was the outbreak investigation conducted?

Establishing the existence of the outbreak

Incidence of lab-confirmed cases of Listeriosis in Gauteng, August 2017 (data sources: NHLS, Ampath, Lancet, Pathcare, Vermaak)

Incidence rate per million population

Year

2013 2014 2015 2016 2017

Courtesy N Govender
How was the outbreak investigation conducted?

Principles of outbreak investigation were followed:

After we

- established the existence of the outbreak,
- did surveillance for cases and
- described the epidemiology (the distribution of cases by time, person and place)

we formulated a hypothesis and developed an investigative strategy
How was the outbreak investigation conducted?

The hypothesis:

The incidence of lab-confirmed listeria cases by district in South Africa, 2017

Distribution of cases by age group, Jan-October 2017

*Cases of listeriosis by month and sector origin in 2017 based on CDW and private sector data.*

 Courtesy J Khoza, S Candy
How was the outbreak investigation conducted?

- Whole genome sequencing and ‘DNA fingerprinting’ of listeria isolates
  - Listeria as 3 million base pairs in its DNA
  - Where DNA is identical or as <20 differences, these isolates come from the same source

- NICD established that 95% of isolates from patients were sequence type 6

- Therefore it was necessary to find ST-6 in food, or in a food factory to identify the source.

Courtesy A Smith, M Ali, A Ismail
How was the outbreak investigation conducted?

*The hypothesis:*

- The outbreak was caused by
  - A point source contamination of a widely distributed and consumed food product/s
  - Most likely due to a contaminated processing plant
  - The plant is located in or near Gauteng, or has easy access to Gauteng markets
  - Cases tended not to occur amongst the very poor, nor the very wealthy
How was the outbreak investigation conducted?

The Investigative strategy

Key requirements
1. Listeria isolates from patients and food.
2. Molecular fingerprinting of strains

In depth food history from persons with lab-confirmed listeriosis to identify commonly consumed foods

Surveillance for cases of lab-confirmed listeriosis

Testing food samples from the fridges of persons with lab-confirmed listeriosis to find the outbreak strain

Targeted investigations of food factories
Evidence confirming the source of the outbreak

In depth food history from persons with lab-confirmed listeriosis to identify commonly consumed foods

Testing food samples from the fridges of persons with lab-confirmed listeriosis to find the outbreak strain

Targeted investigations of food factories
In-depth food histories

Did the patient consume the following food items a month ago?

- Unpasteurised milk
- Root vegetables
- Processed meat (biltong, sausage)
- Meat spreads (preserves)
- Ready-to-eat meals
- Ready-to-eat-sliced meat
- Soft cheeses (cream cheese)
- Hard cheeses
- Cream/Ice cream
- Eggs
- Cured/smoked

FOOD GROUPS

Cold meats

<table>
<thead>
<tr>
<th>Any cold meats?</th>
<th>Answer (YN/NE/Not asked)</th>
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<tbody>
<tr>
<td>Ham</td>
<td></td>
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<tr>
<td>Pate</td>
<td></td>
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<tr>
<td>Patey flavour</td>
<td></td>
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<tr>
<td>Patey brand</td>
<td></td>
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<tr>
<td>Salami</td>
<td></td>
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<tr>
<td>Chicken loaf</td>
<td></td>
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<tr>
<td>Pre-sliced/packed cold meats (state which)</td>
<td></td>
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<tr>
<td>Roll/Dei/not asked</td>
<td></td>
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<tr>
<td>Other</td>
<td></td>
</tr>
<tr>
<td>Brand</td>
<td></td>
</tr>
<tr>
<td>Quantity Purchased</td>
<td></td>
</tr>
<tr>
<td>Shop purchased from</td>
<td></td>
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<tr>
<td>COMMENT:</td>
<td></td>
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</table>

Sausages

<table>
<thead>
<tr>
<th>Any sausages?</th>
<th></th>
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<tbody>
<tr>
<td>Red viennas</td>
<td></td>
</tr>
<tr>
<td>Smoked viennas</td>
<td></td>
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<tr>
<td>Chicken viennas</td>
<td></td>
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<tr>
<td>Bratwurst</td>
<td></td>
</tr>
<tr>
<td>Frankenfurters</td>
<td></td>
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<tr>
<td>Cheesepies</td>
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<tr>
<td>Cocktail sausages</td>
<td></td>
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<tr>
<td>Smoked/uncured</td>
<td></td>
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<tr>
<td>Brand</td>
<td></td>
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<tr>
<td>Quantity Purchased</td>
<td></td>
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<tr>
<td>Shop purchased from</td>
<td></td>
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<tr>
<td>COMMENT:</td>
<td></td>
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Fresh Chicken

<table>
<thead>
<tr>
<th>Any fresh chicken?</th>
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<tbody>
<tr>
<td>Fresh Whole bird (with giblets)</td>
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</table>
Evidence confirming the source of the outbreak

Food history interviews from patients

- A total of 106 in-depth interviews done amongst persons with laboratory-confirmed listeriosis by a dedicated team of interviewers using a standardised food history questionnaire
- Several ‘signals’ emerged

Courtesy T Doyle, P Sekwadi, K Calver, N Abraham, M Sikhosana, P Bapela
Evidence confirming the source of the outbreak

*Food history interviews from patients*

- A ‘case-case’ analysis was done using persons with
  - ST-6 LM as ‘cases’
  - Non-ST-6 LM as ‘controls’

- Risk of developing listeriosis due to ST6 strain after polony exposure
  - OR=21 (95% CI=1.5-310)

<table>
<thead>
<tr>
<th>Consumption of polony</th>
<th>ST6</th>
<th>Non-ST6</th>
</tr>
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<tbody>
<tr>
<td>Yes</td>
<td>32</td>
<td>3</td>
</tr>
<tr>
<td>No</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

Courtesy T Doyle, P Sekwadi, K Calver, N Abraham, M Sikhosana, P Bapela
Evidence confirming the source of the outbreak

In depth food history from persons with lab-confirmed listeriosis to identify commonly consumed foods

Targeted investigations of food factories

Testing food samples from the fridges of persons with lab-confirmed listeriosis to find the outbreak strain
Evidence confirming the source of the outbreak

Testing of food samples from patients fridges

- Environmental health practitioners took food from patient fridges and retail/processing environments.
- When *Listeria* is cultured, the isolate is sent to the NICD for whole genome sequencing.
- Only 79 foodstuffs tested positive for LM
  - None were positive for ST-6

# food samples submitted by Environmental Health and tested for Listeria by NHLS infection control laboratory, Nov 2017-23 Feb 2018

<table>
<thead>
<tr>
<th>Province</th>
<th>Negative</th>
<th>Positive</th>
<th>Rejected</th>
<th>Total</th>
</tr>
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<tbody>
<tr>
<td>EC</td>
<td>68</td>
<td>8</td>
<td>0</td>
<td>76</td>
</tr>
<tr>
<td>GA</td>
<td>744</td>
<td>152</td>
<td>340</td>
<td>1236</td>
</tr>
<tr>
<td>KZN</td>
<td>129</td>
<td>22</td>
<td>0</td>
<td>151</td>
</tr>
<tr>
<td>LM</td>
<td>8</td>
<td>0</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td>LP</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>MP</td>
<td>13</td>
<td>1</td>
<td>1</td>
<td>15</td>
</tr>
<tr>
<td>NC</td>
<td>9</td>
<td>0</td>
<td>0</td>
<td>9</td>
</tr>
<tr>
<td>WC</td>
<td>75</td>
<td>12</td>
<td>9</td>
<td>96</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1047</strong></td>
<td><strong>195</strong></td>
<td><strong>352</strong></td>
<td><strong>1594</strong></td>
</tr>
</tbody>
</table>
Evidence confirming the source of the outbreak

**Testing of food from patient fridges**

A cluster of cases of febrile gastro-enteritis – 13 January 2017

- 10 children hospitalised at CHBara for febrile gastro-enteritis.
- The attending clinician, Dr V and suspected listeriosis, and sent off every culture possible.
- Stool culture from one boy grew LM.
- Food history interviews were conducted by an investigative team.
- Food specimens were taken for culture – Enterprise polony, Rainbow polony and margarine grew LM.

Whole genome sequencing = THE OUTBREAK STRAIN!!!

Courtesy P Vallabh, Jeanette Wadula, CHB NHLS Micro laboratory, NICD Interview team, CoJ CDC and EHPs, NICD CED, ORU and Core Sequencing Facility
Evidence confirming the source of the outbreak

- In depth food history from persons with lab-confirmed listeriosis to identify commonly consumed foods
- Testing food samples from the fridges of persons with lab-confirmed listeriosis to find the outbreak strain
- Targeted investigations of food factories
Evidence confirming the source of the outbreak

Processing plant inspections

Visit to Enterprise (Polokwane, 2 Feb 2018) and Rainbow (Wolwehoek, 13 Feb 2018) with Veterinary public health, environmental health practitioners from district

- Review of quality testing results
- Overview of factory layout
- Extensive sampling of all machinery, drains, floors and products for listeria culture

‘Swabathon’ was conducted

- 324 specimens from Enterprise
  - 26/104 listeria isolates were ST6
- 260 from Rainbow
  - No ST 6, but other strains implicated in clinical cases

Photos from Enterprise facility, courtesy D Mahoney, WHO Consultant
Distribution of *L. monocytogenes* ST6 isolates – Enterprise Foods’ Polokwane Production Facility

- Vienna production area: n=3
- Polony production area: n=20
- Raw area: n=3
- Finished product: n=2

Swabbing of exterior casing, around product clip, inside folds of cut casing ends

★ = Production areas where ST6 was isolated

Courtesy N Govender, NICD sequencing facility
Public health interventions

- Announcement by Minister of Health, 5 March 2018
- Recall of all Tiger Brands (Enterprise) products made at Polokwane and Germiston Factories, and RCL (Rainbow) polony products made at Wolwehoek production facility
Dealing with the aftermath

- Concern (bordering on panic) amongst general population
- Serious economic loss
  - Enterprise
  - RCL
- International concern
The Incident Management Team

- Incident Management Team
  - Multiple stakeholders
    - NDoH (EH, Food Safety, CDC), DAFF, NICD, DTI, NCC, SAMHS
  - WHO technical experts

- Incident Response plan
  - Designed using WHO Emergency Response Framework
  - A flexible, scaleable approach that can be adapted for any
Aim and objectives

**Aim:** To control and end the current listeriosis outbreak and to strengthen systems to prevent future outbreaks

<table>
<thead>
<tr>
<th>#</th>
<th>Objective</th>
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<tbody>
<tr>
<td></td>
<td><strong>Objective supporting the overall goal of the response</strong></td>
</tr>
<tr>
<td>1</td>
<td>Strengthen Multi-sector Coordination, under one structure, working as one team</td>
</tr>
<tr>
<td>2</td>
<td>Strengthen Listeriosis surveillance to ensure timely detection and response to clusters and outbreaks</td>
</tr>
<tr>
<td>3</td>
<td>Strengthen lab capacity to support food and environmental testing, including enumeration of the levels in food</td>
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<tr>
<td>4</td>
<td>Strengthen food safety monitoring programs in food production facilities and monitor the recall of implicated foodstuffs</td>
</tr>
<tr>
<td>5</td>
<td>Review and enhance existing legislation relating to food safety, enforcement and outbreak response</td>
</tr>
<tr>
<td>6</td>
<td>To continuously inform stakeholders and public in an accurate, timely, consistent, transparent and comprehensive way on the response to Listeriosis outbreak in SA.</td>
</tr>
</tbody>
</table>

Add Contingency of 30% *(due to increased need for specimen testing, logistics and human resources)*

TOTAL COST
DRAFT Joint Incident Management Team (IMT) organogram

**Communications**
(with MoH, NICD, media, public)

**EOC Management**

**Incident Managers**
Overall co-ordination, planning and implementation

**Partner co-ordination**
Communication, and co-ordination with stakeholders not represented in IMT but who have important interests or contributions to make to the outbreak

**Information and planning**

**Information**
1. Surveillance for listeriosis cases
2. Monitoring & evaluation of response (by tracking decline in cases, patient interviews etc)
3. Production of situation report and other technical reports for stakeholders

**Planning**
Development of initial incident response plan with ongoing adaptations/revisions

**Health Operations and Technical expertise**

**Prevention and control measures**
1. Monitoring of recall of affected foodstuffs
2. Strengthen food safety monitoring programs in food production facilities

**Risk communications and community engagement**
Improve and enhance dissemination of information on food safety guidelines by the public

**Food safety legislation review**
Review and enhance existing legislation

**Food and environmental laboratory testing**
To strengthen food and environmental lab testing services

**Training**
To co-ordinate and conduct training where appropriate

**Operations Support and logistics**

**Finance and administration**

- Financial management and budget
- Procurement
- Human resources

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Surveillance for listeriosis cases
Monitoring & evaluation of response (by tracking decline in cases, patient interviews etc)
Production of situation report and other technical reports for stakeholders
Development of initial incident response plan with ongoing adaptations/revisions
Monitoring of recall of affected foodstuffs
Strengthen food safety monitoring programs in food production facilities
Review and enhance existing legislation
To strengthen food and environmental lab testing services
To co-ordinate and conduct training where appropriate
Improve and enhance dissemination of information on food safety guidelines by the public
Review and enhance existing legislation
To strengthen food and environmental lab testing services
To co-ordinate and conduct training where appropriate
Improve and enhance dissemination of information on food safety guidelines by the public

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World Health Organization
HEALTH EMERGENCIES programme
NATIONAL INSTITUTE FOR COMMUNICABLE DISEASES
Division of the National Health Laboratory Service
Department of Health
REPUBLIC OF SOUTH AFRICA
Emergency response plan to address Listeria

**Phase 1**
9 April – 26 April

- **Stakeholder communications** (keeping all stakeholders informed)
- **Information**
- **Legislation review**

**Risk assessment**
- Lists of food production facilities + metadata
- Identification of facilities to inspect

**Risk communications**
- Preparation of material
- Training

**P&C-Inspection team (n=10-15)**
- Assembling of team
- Preparation of checklists, SOPs
- Training

**P&C-Recall**
- Collection of data

**NHLS food lab**
- Optimisation of SOPs, database infrastructure, DNA extraction etc

**Info**
- Detection and investigation of clinical cases

**Funding**
- Life Esidimeni residual

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**Phase 2**
26 April – [20 July]

- **Risk assessment**
  - Review of findings

- **Information (sequencing)**
  - Sequencing of all isolates

- **NHLS food lab**
  - Testing of facility samples

- **P&C-Inspection team (n=10-15)**
  - Inspection and follow up of all identified facilities

**Recommendations**

**Information**
- Production of information products (sitreps, reports etc)

**Risk communications**
- Preparation of material
- Training

**P&C-Tiger Brands & RCL**
- Expert review group to advise + action

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**Phase 3**
[20 July – 31 Aug]

- **Stakeholder communications**
- **Information**
- **Recommendations**

**Funding**
- WHO/Donor
- RSA NDoH/Province/District

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**Funding: Life Esidimeni residual**

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**Funding: WHO/Donor**

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**Funding: RSA NDoH/Province/District**

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**National Institute for Communicable Diseases**

Division of the National Health Laboratory Service
Ongoing epidemiological investigations and case monitoring
Ongoing epidemiological investigations and case monitoring

![Bar chart showing the number of cases by age group and outcome (OUTCOME PENDING, DISCHARGED, DIED).](chart)

- **≤28 days**: [Number of cases]
- **1Month - 14 years**: [Number of cases]
- **15 - 49 years**: [Number of cases]
- **50 - 64 years**: [Number of cases]
- **≥65 years**: [Number of cases]
- **Age Unknown**: [Number of cases]
Ongoing epidemiological investigations and case monitoring

- Monitoring for new cases
  - Notification via NMC, completion of Case investigation forms (everyone – IPC nurses in facilities)
  - Publication of Sitrep and Line lists (NICD)
  - Verification of line lists (Provinces)
  - Interviews of new patients to determine exposure to polony/processed meat (NICD interview team together with provincial teams)
  - Acting on findings from individual cases
    - Recall from retail if it is discovered that this person obtained food from retail (EHPs)
    - Family needs to remove all polony/viennas/enterprise product and decontaminate kitchen (EHPs)
    - Education of families (EHPs)
Monitoring the recall of affected products

- Recall of affected food products is monitored by NCC (National Consumer Council)
- NCC have assembled info from all exporters
- Info shared with WHO, and yourselves
Risk communications

• Communications and health awareness (Health Promotion)
  – Key messages
    • Avoid processed meat if pregnant
    • Return Enterprise, Rainbow products
    • Observe WHO 5 keys to safer food
Risk communications

• Resources on NICD website [www.nicd.ac.za](http://www.nicd.ac.za)
  – NMC material and notification forms –
    • Send notification forms to NMC email as per usual procedures)
  – Case Investigation form –
    • new form to be released within the next month;
    • Send forms to NMC email or ‘outbreak@nicd.ac.za’
  – Clinical guidelines for diagnosis and treatment
  – FAQs
    • Clinical management following exposure to processed meat products
    • How to disinfect kitchens
Acknowledgements

- NICD
  - Lynn Morris, Lucille Blumberg, Juno Thomas, Nevashan Govender
  - Centre for Enteric Diseases
  - Division of Public Health Surveillance and Response

- NDoH
  - Communicable Diseases Cluster
  - Environmental Health
  - Food Safety

- DAFF
  - Veterinary public health

- DTi

- Provinces
  - CDCCs
  - Environmental health
  - Hospital services
  - Veterinary Public Health

- WHO
  - Dr Chatora and country office
  - INFOSAN
  - GOARN

- CDC Atlanta USA, Tim Doyle