

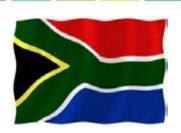
#### Listeria monocytogenes in South Africa



Juno Thomas
Centre for Enteric Diseases
National Institute for Communicable Diseases



Division of the National Health Laboratory Service



#### **South Africa**

- Upper Middle Income Country
- Population 56,52 million
  - > 51% (approximately 28,9 million) is female
  - Nine provinces
    - 25,3% live in Gauteng Province (approx. 14,3 million people)



#### **HIV in South Africa**

- In 2017:
  - overall HIV prevalence rate 12,6%
  - 7.9 million people living with HIV (PLHIV)
  - HIV prevalence in adults 15 49 years 20.6%
    - 26.3% in females, 14.8% in males
  - HIV prevalence in pregnant women 22%
  - Approximately 265 000 HIV-infected pregnant women in 2017







## Surveillance of foodborne disease and listeriosis in SA

- Foodborne disease outbreaks notifiable but historically poorly reported and investigated
  - No reliable surveillance or burden of disease data
- Prior to 15 December 2017, listeriosis not notifiable or under surveillance
- National legal framework for food safety encouraged self-regulation; no stipulated microbiological criteria for *L.monocytogenes* (Lm) in ready-to-eat foods

### July and August 2017: Gauteng Province

- Clinician at a Soweto hospital reports increase in neonatal listeriosis cases
- Microbiologist in Tshwane reports increase in listeriosis cases
- No historical data; prompted collection and analysis of laboratory-confirmed listeriosis cases

Free State

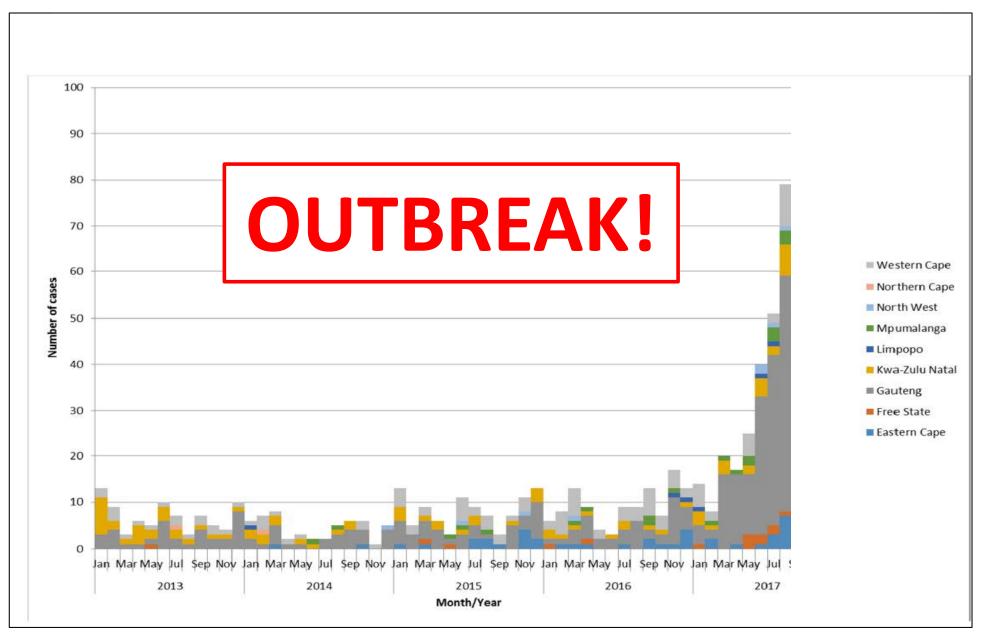


Figure 1. Epidemiologic curve of laboratory-confirmed listeriosis cases by date of sample collection and province, South Africa, 01 January 2013 to 15 August 2017

#### **Outbreak investigation**

#### Epidemiologic





 Clinical isolates: referred to reference laboratory (CED, NICD)



Case-patient interviews:food consumption history





#### Traceback

- Initial challenges:
  - Proportion of interviews with comprehensive food consumption history
  - Inspection and food/environmental testing already a major existing gap
  - No clear epidemiologic signal for likely food vehicles



#### Food and environmental testing

- Sampling of food from case-patients' homes
- Limited, ad-hoc inspection and sampling of food production facilities, retailers and restaurants
- Food industry and retailers use private sector laboratories. Lm data requested from industry stakeholders and laboratories; most refused to cooperate



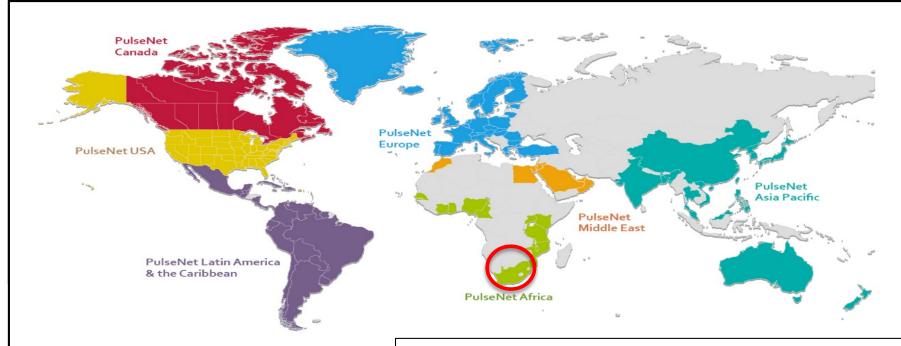


#### Eurosurveillance, Volume 22, Issue 23, 08 June 2017

#### Review

#### PULSENET INTERNATIONAL: VISION FOR THE IMPLEMENTATION OF WHOLE GENOME SEQUENCING (WGS) FOR GLOBAL FOOD-BORNE DISEASE SURVEILLANCE

C Nadon <sup>12</sup>, I Van Walle <sup>23</sup>, P Gerner-Smidt <sup>4</sup>, J Campos <sup>5</sup>, I Chinen <sup>5</sup>, J Concepcion-Acevedo <sup>4</sup>, B Gilpin <sup>6</sup>, AM Smith <sup>7</sup>, KM Kam <sup>8</sup>, E Perez <sup>9</sup>, E Trees <sup>4</sup>, K Kubota <sup>10</sup>, J Takkinen <sup>3</sup>, EM Nielsen <sup>11</sup>, H Carleton <sup>4</sup>, FWD-NEXT Expert Panel <sup>12</sup>

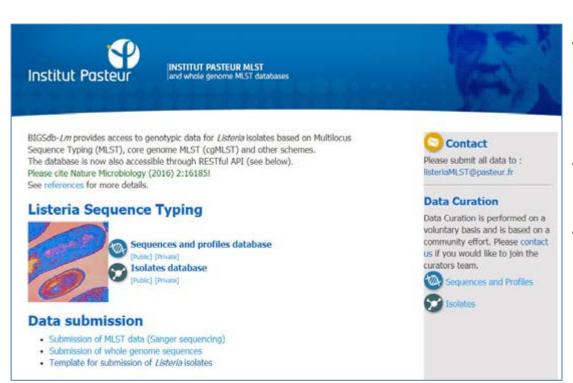


- Global laboratory network dedicated to food- & waterborne disease surveillance
- Early warning system for outbreaks
- Molecular subtyping network standardized methodology
- 7 regional networks

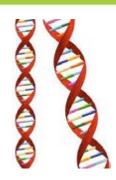
#### Whole genome sequencing (WGS)

NICD Sequencing Core Facility

- All clinical isolates referred to NICD
- From mid-November 2017: food & environmental isolates



- analysis of sequences at the Bacterial Isolate Genome Sequence Database (BIGSdb) hosted by Institut Pasteur
- analysis of the nucleotide sequence of <u>seven</u> housekeeping genes
- allele numbers & sequence types (STs) assigned to isolates



#### Listeriosis now a notifiable disease, as death toll rises to 61

2018-01-08 10:57

Alex Mitchley

#### news24

Pretoria - The listeriosis death toll has risen to 61 since the outbreak was announced in early December last year, Health Minister Dr Aaron Motsoaledi said on Monday.

Motsoaledi also said genome sequencing was being carried out to shed light on the source of the outbreak.

Gauteng still has the most cases of listeriosis, with 442 out of the 727 confirmed cases. The Western Cape was second with 92 confirmed cases.

The Department of Health has amended the list of notifiable diseases to now include listeriosis. Prior to this outbreak, it was not on the list

Listeriosis is a bacterium found in soil, water and vegetation, which contaminates food sources, such as animal products and fresh produce.

- Health24: What you should know about listeriosis outbreak













Health Minister Aaron Motsoaledi. (Netwerk24)

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#### **11 January 2018**

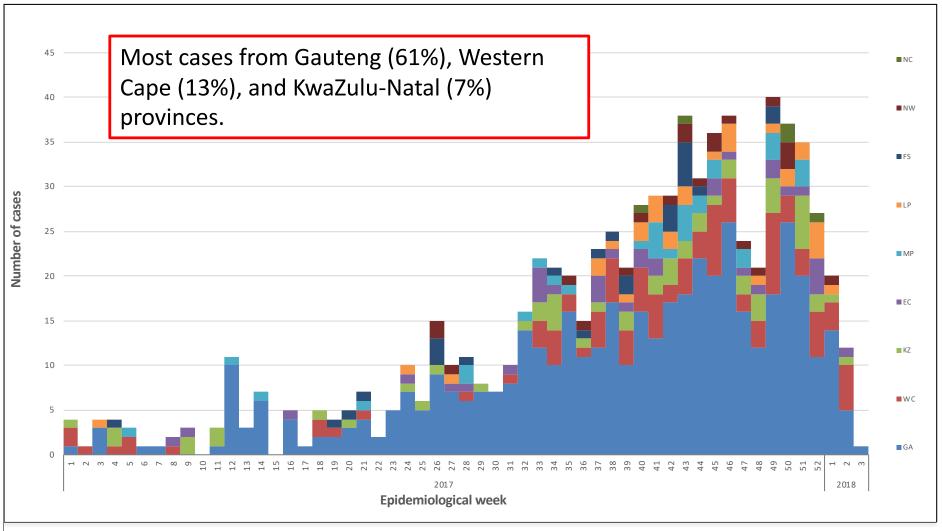
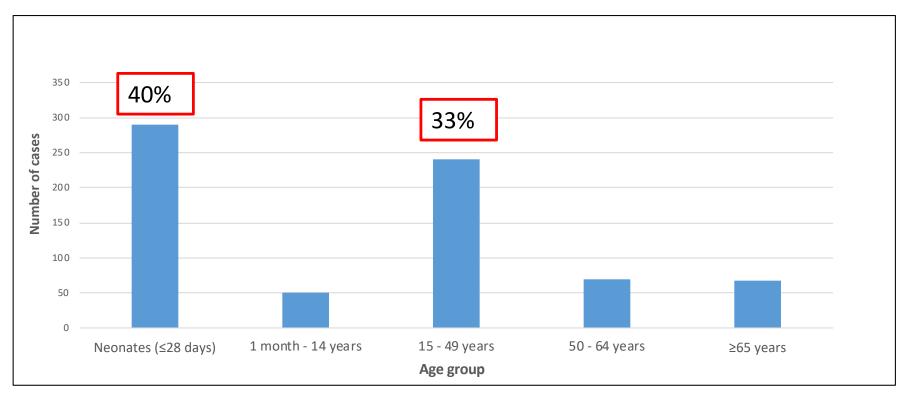


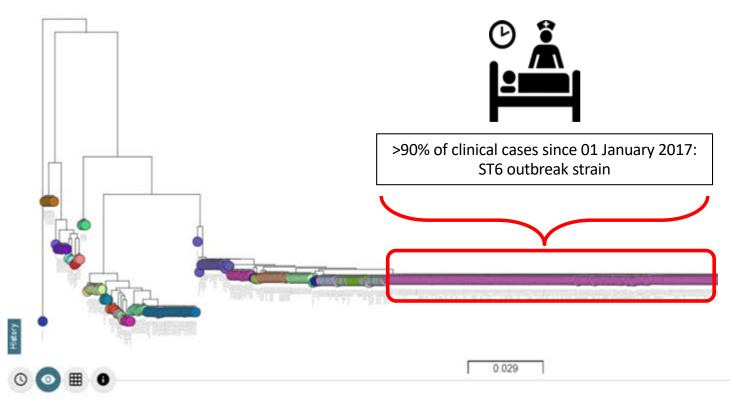
Figure 2. Laboratory-confirmed listeriosis cases by date of sample collection and province, South Africa, 01 January 2017 to 11 January 2018 (n=741)

- Ages range from birth to 93 years (median 26 years).
- 96% neonates had early-onset disease (birth to ≤6 days).
- Females account for 56% of cases



Laboratory-confirmed listeriosis cases by age group, South Africa, 01 January 2017 to 11 January 2018 (n=717)

# Phylogenetic tree of WGS: 11 January 2018

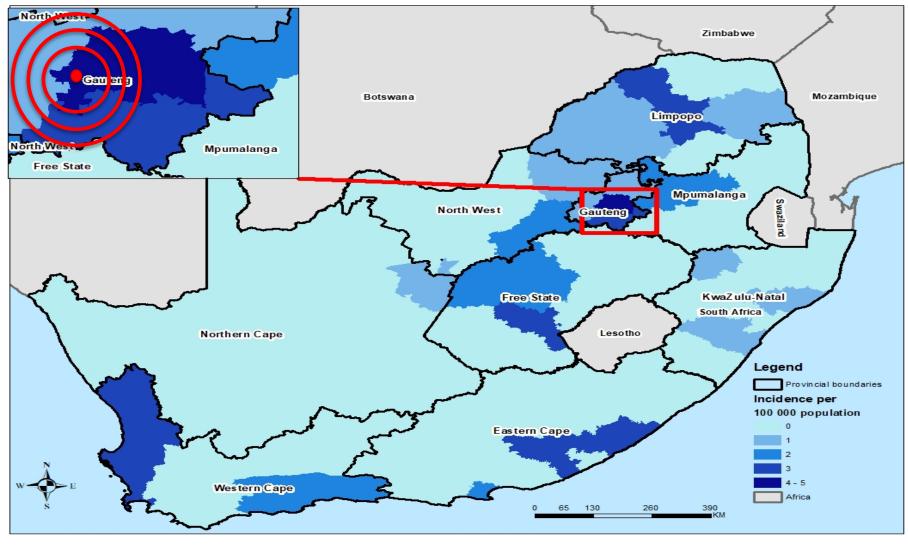


Developed at Imperial College London

#### **Case-control study**

- 106 case-patients interviewed
  - ST6: n=39, 8 were non-ST6: n=8, sequence data not available: n=59.
  - Polony consumed by 89 (84%).
  - Food items significantly associated with Lm ST6:
    - polony (OR=9.2, 95% CI:1.7-48.9)
    - apples (OR=8.3, 95% CI:1.5-46.6)
    - frozen chicken (OR=5.9, 95% CI:1.1-31.3).

# 12 January 2018: the 'Soweto crèche' investigation



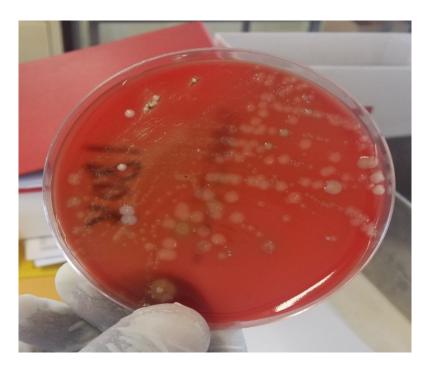


The 'Soweto crèche' (Klipspruit West Child Care and Orientation Centre). Photo courtesy K. McCarthy, NICD.

- 9 children from a crèche presented to a Soweto hospital with febrile gastroenteritis
- Stool and CSF samples collected from several children
- Food samples collected from crèche refrigerator

- Lm isolated from one stool sample (3-year-old child)
- Lm isolated in RTE processed meat samples collected from crèche refrigerator: Bokkie® French polony (an Enterprise® Foods brand)
- Clinical isolate and food sample isolates: Lm ST6 outbreak strain





*L. monocytogenes* isolated from stool sample of 3-year-old child, CHBAH NHLS.

Photo courtesy K. McCarthy, NICD.

#### **Polony**



- Also called 'French polony' in SA
- Ready-to-eat processed meat product similar to bologna.
   Best-by date 5 months after production.
- Low-cost, readily available value added meat product; popular across many socio-economic groups
- Essential ingredient in a street food called kota, very popular in Gauteng Province











- Visit to Enterprise® Foods' production facility in Polokwane on 02 February 2018
  - Environmental risk assessment and sampling (n=343)
  - Lm isolated from 104/343 samples (30%)
     throughout facility; 28 samples yielded ST6
     outbreak strain

## Distribution of Lm ST6 outbreak strain isolates – Enterprise® Foods' Polokwane Production Facility (n=28)

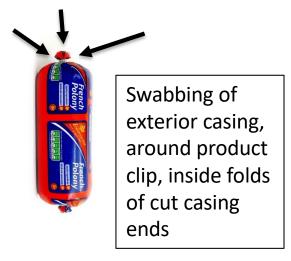
 Vienna production area: n=3

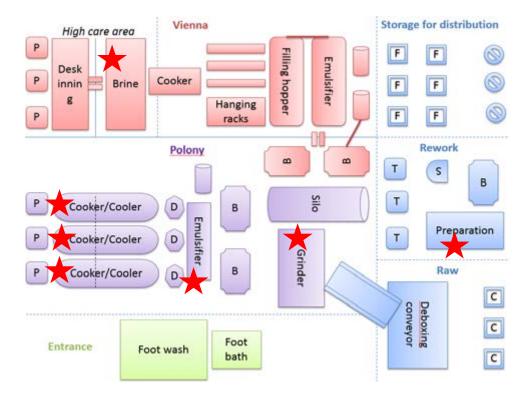
Polony production

area: n=20

Raw area: n=3

Finished product: n=2



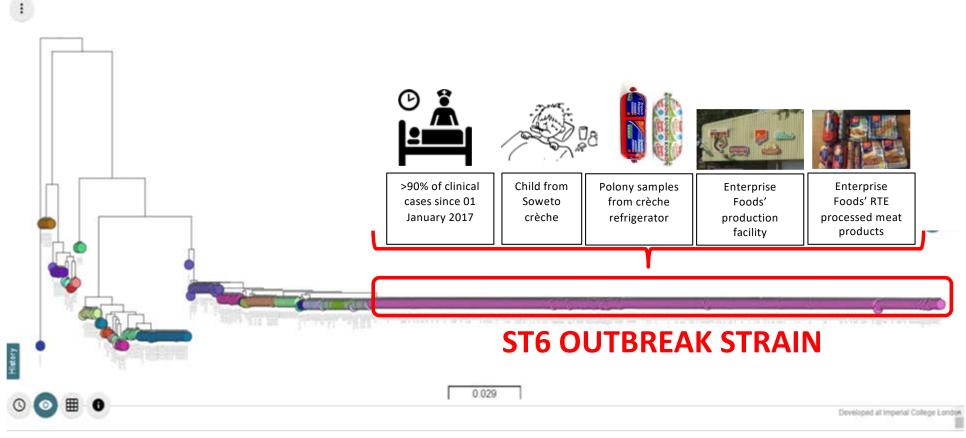


= Production areas where ST6 was isolated

### The polony brine chiller: ST6 soup?



#### WGS phylogenetic tree: 03 March 2018



Distance and topology calculated by RaXML. Courtesy M. Allam, NICD

#### 04 March 2018: Ministerial media briefing



- Source of outbreak: RTE processed meats manufactured at Enterprise Foods' Polokwane facility
- Recall of implicated products and closure of facility



#### International travellers...

## Enterprise® Foods RTE processed meats exported to:

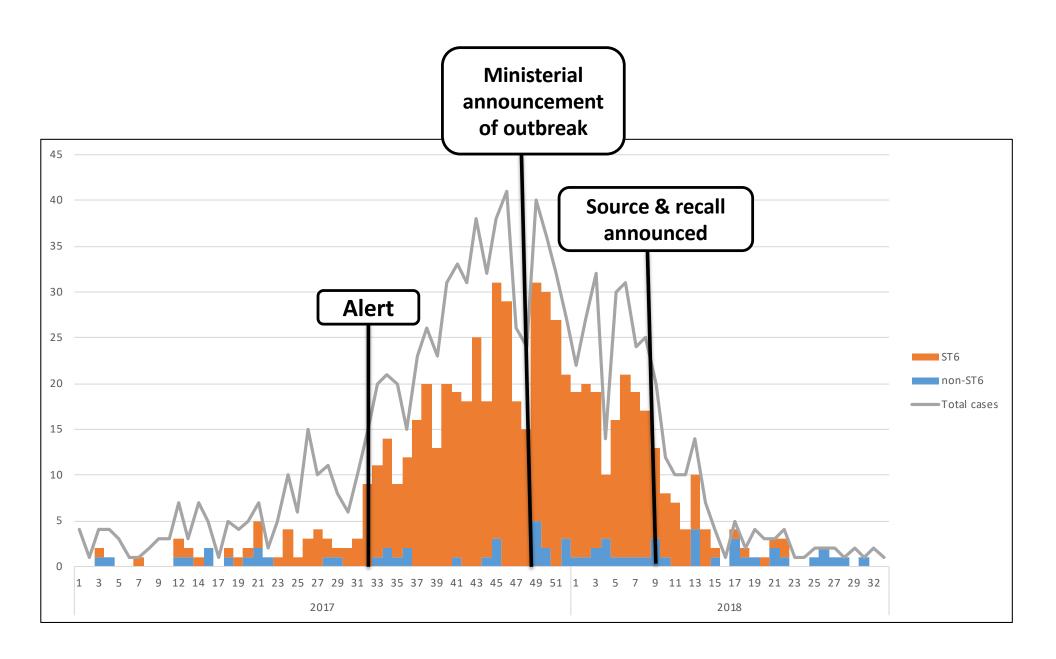
- Angola
- Botswana
- DRC
- Ghana
- Lesotho
- Madagascar
- Malawi
- Mauritius
- Mozambique
- Namibia
- Nigeria
- Swaziland
- Uganda
- Zambia
- Zimbabwe

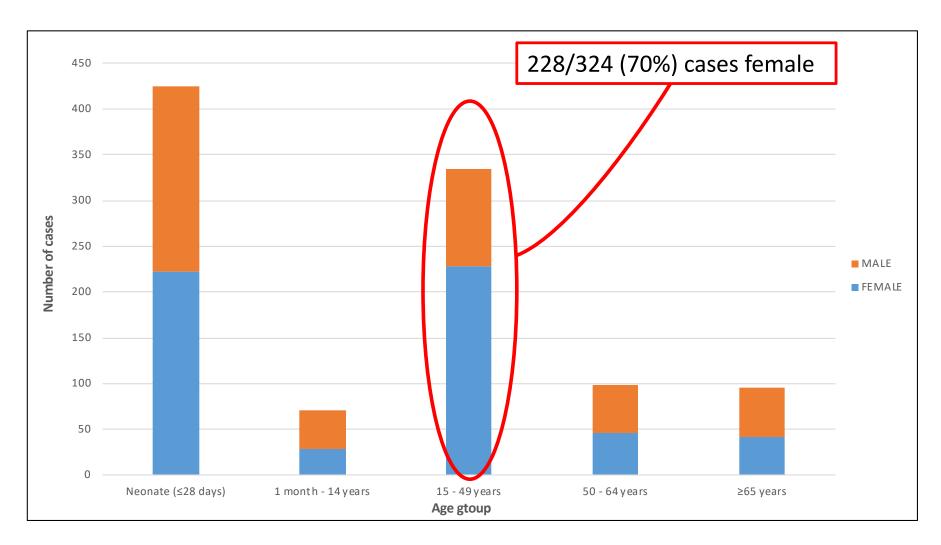
Since recall: only 1 Lm case reported

Namibia; non-ST6

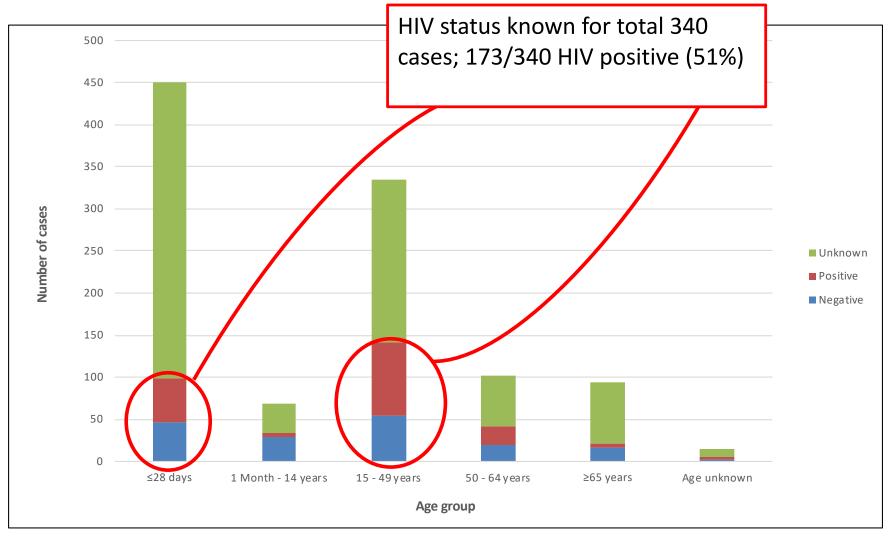




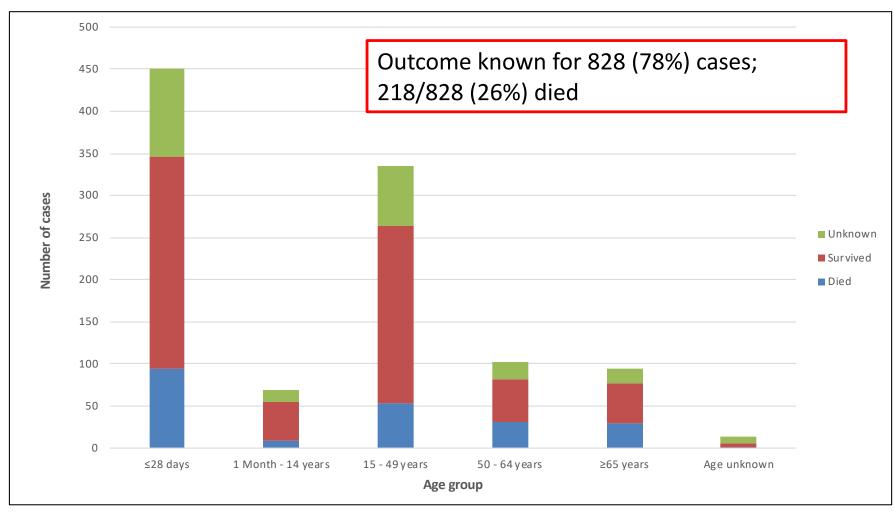




Laboratory-confirmed listeriosis cases by age group, South Africa, 01 January 2017 to 14 August 2018 (n=1 023 where age known)

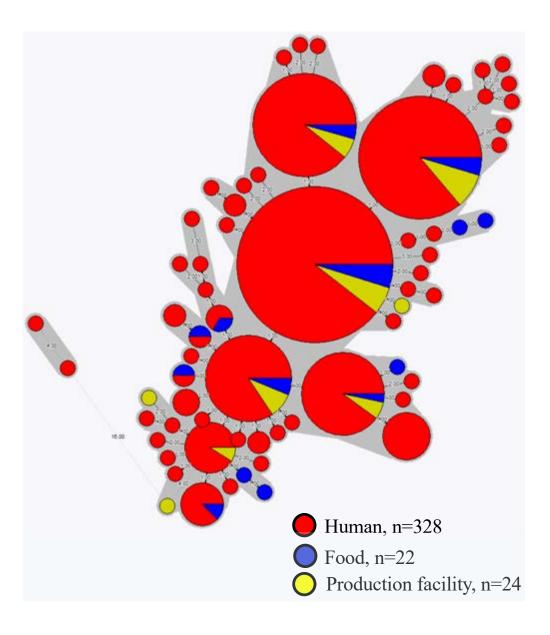


HIV status of laboratory-confirmed listeriosis cases by age group, South Africa, 01 January 2017 to 14 August 2018 (n=1 064)



Outcome of laboratory-confirmed listeriosis cases by age group, South Africa, 01 January 2017 to 14 August 2018 (n=1 064)

#### One tree says it all



## Minimum spanning tree of cgMLST allelic profiles, ST6 isolates (n=374)

- Raw sequencing data was submitted to the BIGSdb-Im hosted by Institut Pasteur
- Core genome MLST: analysis of sequencing data for 1 748 genes
- Size of nodes corresponds to number of isolates
- Grey shading links isolates showing ≤7 allele differences
- Indicative of highly related isolates
  - ⇒ epidemiological relatedness

#### **Conclusions**

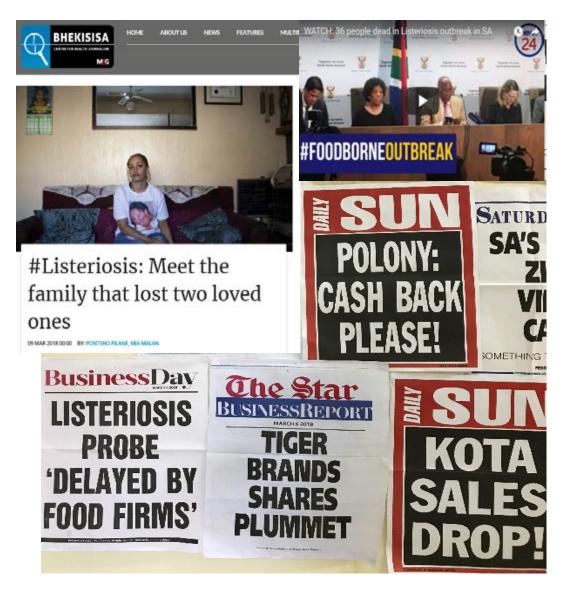
- A nationally noteworthy outbreak
  - First Lm outbreak with a proven source in SA
  - Risk factors: pregnancy, HIV
  - Perfect storm
    - No surveillance
    - Food safety legislation not addressing Lm in RTE products
    - Self-regulating food industry; weak monitoring and enforcement
    - RTE processed meat product with long refrigeration shelf-life
    - Huge production facility, multiple brands
    - Products available nationwide, cheap, popular
    - Large vulnerable population

#### A globally noteworthy outbreak

- 1064 cases and at least 223 deaths: largest ever described
- First on the African continent definitively linked to a food vehicle and resulting in a large scale international food recall
- Risk factors for disease (HIV, pregnancy) prevalent in populations elsewhere
- No outbreak cases identified in the other 15 African countries importing product
  - No established surveillance
  - Cases missed
    - Non-specific clinical presentations; many other common infectious diseases
    - Limited clinical sample collection for investigation; syndromic management
    - Limited laboratory diagnostic/molecular capacity

## Life after 'killer polony'





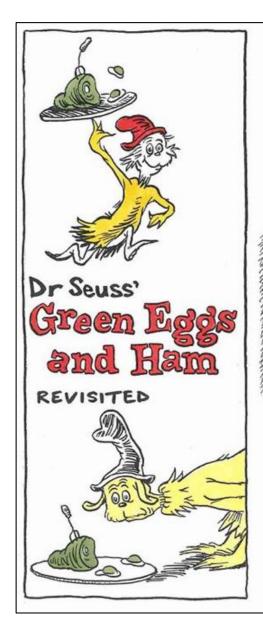
- Listeriosis: notifiable disease, routine surveillance
- Routine WGS of all clinical isolates
- Revision of food safety legislation
  - HACCP for RTE meat published
  - Lm limits in RTE foods: pending
- Food safety awareness
  - Food industry
  - Civil society
- Class action law suit
  - Pending...

#### **ACKNOWLEDGEMENTS**

- NICD: CED, EOC & ORU, SCF, CRDM, CEZPD
- NHLS laboratories; private sector laboratories
- SA Government departments: Health; Agriculture, Forestry and Fisheries; Trade and Industry
- Private pathology laboratories
- Private healthcare sector
- WHO (country office, GOARN)
- Institut Pasteur
- US CDC: DGHP (South Africa), DFWED
- PulseNet



Division of the National Health Laboratory Service



Remember me? I'm Sam-I-am! I made him eat green eggs and ham unaware that Tiger Brands' testing process was a sham! New labelling (this is not hysteria): PROCESSED MEAT - CONTAINS LISTERIA