Integrated Foodborne Disease Surveillance and Antimicrobial Resistance

Dr Lisa Indar
Program coordinator: Tourism and Health program
Responsible for Foodborne Disease surveillance

Preventing disease, promoting and protecting health
Global situation

- Foodborne diseases (FBD): major cause of morbidity, mortality and economic burden worldwide
- Food safety: important component of IHR
  - WHO: 1.8 million people died worldwide from diarrheal illness; 70% of diarrheal illness is foodborne, 3000 deaths/day to FBD
  - Leading causes of illness & death in less developed countries, causing 2.2 million deaths/yr, 1.9 million of whom are children
  - Norovirus, *Salmonella*, *Clostridium* and *Campylobacter*: leading causes of FBD
  - WHO identified the surveillance, prevention and control of FBD a priority in 2002 and 2010 (WHA resolutions).
- Increasing number of large, multi-jurisdictional outbreaks, new agents causing illness, and the globalisation of trade and travel.
- Integrated FBD surveillance is essential to reducing FBD
Increasing risk of FBD transmission due to:
- Global distribution of food has increased: demand, globalization
- Food production is no longer restricted to one country or continent
- Microbial & chemical contamination of food: food safety concern
- New & emerging pathogens and AMR - developing in one country and rapidly spreading globally: *FBD has no boundaries*
- Increasing international Trade and Travel
- Societal factors (poverty, pop. migration)
- Regional integration initiative
- Inadequate surveillance of diseases

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FBD surveillance & food monitoring essential to characterize the epidemiological dynamics of FBD and to direct prevention & control strategies

Preventing disease, promoting and protecting health
CAREC (and now CARPHA)
Regional Strategy for FBD surveillance & Food Safety

Objective: to promote and strengthen integrated FBD surveillance to reduce FBD incidence and outbreaks and improve food safety

• 2004-2012 (CAREC) and continues under CARPHA
• Multidisciplinary, integrated farm to table approach to FBD surveillance and food safety
• Interdepartmental approach at CAREC, now CARPHA
• Interagency collaboration and Partnerships
  – PAHO partners (PAHO FOS, CPC, CFNI, CEHI)
  – regional agencies: CARICOM, CTO, CHTA, FAO
  – international agencies: WHO, PHAC, FDA, GFN, INFAL, PulseNet
  – WHO-GFN regional center of excellence
• Intersectoral approach at country level
  – integrating epidemiological, laboratory, environment and veterinary health aspects of FBD surveillance along the farm to table continuum
  – Linking MOH and MOA

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Caribbean Situation

Surveillance of foodborne diseases in the Caribbean

- Syndromic surveillance – reported weekly (alerts & early warning)
- Laboratory Based/disease specific surveillance (monthly)
  - *Salmonella, Shigella, Cholera, Campylobacter, pathogenic E coli, S aureus, Vibrio, Norovirus, Rotavirus*
  - *Serotypes, phage types for discrimination and trace back*
- Outbreak surveillance- immediate reporting
- Integrated FBD surveillance: Salmonella
  - clinical, food and animal data for some CMCs

Data shows

- Food safety is one of top 3-priorities of most Caribbean countries (PAHO survey)
- Foodborne Diseases: continues to increase, major cause of morbidity and burden
  - Increasing cases of gastroenteritis (AGE) and increasing in reported pathogens
  - Frequent FBD outbreaks, many involving tourists
- Changing epidemiology of FBD-: instructive for prevention and control
- FBD directly affects IHR, tourism and trade since the Caribbean comprise of tourism-dependant economies
Reported cases of Foodborne Pathogens, 2005-2012

FBD increased 31% from 2005-2012

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Priority Pathogens/ Focal Areas

- **Salmonella**
  - *Remains most common reported FBD*
  - Reported from 13-16 countries: >50% of reported pathogens
  - Requires integrated farm to table approach to trace to source
  - Different serotypes: different countries/ different food sources
  - **Serotype specific interventions** (e.g. *Enteritidis in eggs & poultry, Typhimurium in pigs, Mississippi in bird and wildlife*)

- **Norovirus**
  - *Emerging pathogen of grave concern; 70% increase since 2005*
  - Main cause of FBD outbreaks; outbreaks involving tourists, cruiseship outbreaks
  - Reported from 11 CMCs: outbreaks, many involved cruise ships
  - Deep cleaning: hence closure of premise/disembarking of ship

- **Ciguatera (fish toxin) poisoning (specific countries)**
  - Training in case-identification, specific prevention measures

- **Campylobacter**
  - Incomplete cooking of poultry and cross contamination
Priority FBDs
Changes (%) in Reported FBD infections (2005 compared to 2012)

- Norovirus: -90%
- Campylobacter: -80%
- Salmonella: -70%
- Shigella: -60%
- Ciguatera: -50%
- Typhi: 10%

Percent Increase of Decrease (2005-2012)
Salmonella serotypes by country

- serotyping: essential to distinguish epidemiology
  - different serotypes - different sources, different prevention measures
Caribbean Situation

Caribbean Burden of Diseases
www.jhpn.net/index.php/jhpn/article/download/2303/977

- The burden of AGE, FBD and economic impact in the Caribbean: much larger than reported by statutory notifications & reports
- **Highest burden: Norovirus, Salmonella, Campylobacter, Guardia**
- Degree of underreporting for AGE: 64%-99%
- Estimated economic costs for AGE in countries: US $ 1.3 to 40 M
- Under-diagnosis of FBD etiology in Caribbean, esp viral etiology
- **Etiology of FBD: vary/differ from that reported by countries**
Importance of AMR to Integrated FBD surveillance

- Antimicrobial agents used for food animals: same or belong to the same classes as those used in human medicine
- Resistant bacteria that develop: carried in food animals to people
  - Mainly via foods (inadequately cooked food), but can also occur in hospitalized patients via the same route
  - Also by environmental spread and via direct animal contact
  - *Escherichia coli, Salmonella, Enterococcus, Clostridium difficile* and *Staphylococcus aureus*
- Studies: use of antimicrobial agents in food animals favours AMR among non-typhoid *Salmonella* and *Campylobacter*;
- Use of antimicrobial agents in food animals also selects for standalone and transferable resistance genes.
  - These resistant genes can be transferred from animals to humans via non-pathogenic bacteria in food products and then be transferred to bacterial pathogens in the human gastro-intestinal tract.
Antimicrobial resistance and zoonosis

- Methicillin-resistant *Staphylococcus aureus* (MRSA) spread to the community and since 2003: a new variant of MRSA (CC398) has emerged & spreads among food animals, primarily swine.

- *C. difficile* colonise many food animals and also causes disease in some food animals with an associated high mortality (e.g. piglets). There are new data on the etiology of and potential risk factors for CDI; controversial issues include specific antimicrobial agents, gastric acid suppressants, potential animal and food sources of *C. difficile*.

- Recent studies: major component of the antimicrobial-resistant *E. coli* causing extra-bowel infections in humans, may have originated in food animals, especially poultry.
Antimicrobial use monitoring in FBD surveillance

Needed to:

- Track use, overuse and misuse of antimicrobials
- Provide insights to assess the public health consequences
- Detect resistant strains of public health importance
- Support prompt notification and investigation of outbreaks
- Inform clinical treatment decisions
- Guide policy recommendations
- Monitor efficacy of interventions

(incl. infection control measures)
Integrated food-chain surveillance

- Analysis of data from across the food chain to identify sources and evaluate interventions
  - Human
  - Food
  - Animal
## Integrated food-chain surveillance

### Requirements
- Availability and comparison of data from animals, food and humans
- Lab-based
- Often uses active surveillance and sentinel sites

### Benefits
- Can detect outbreaks and identify source
- Can identify links between human disease and food/animal sources
- Can assess effectiveness of food safety policies
- Can estimate burden of foodborne disease by food/animal category
Advantages of integrated AMR surveillance

- Tracing sources of infection
- Linking human cases to animal/food sources
- Evaluate trends in sources of human illness

Identify and prioritise food safety interventions
Status of AMR activities in Caribbean (up to 2012)

- CAREC, Hospital and Public health laboratories in many countries conduct AMR testing on ad hoc basis:
  - Hospitals: mainly non-enterics
  - Public Health Laboratories: mainly enterics (Salmonella & Shigella)
  - Disk Diffusion method (some automated)
- No established AMR surveillance system
- No routine data collection, reporting & analyses
- AMR training done via the WHO_GSS/GFN activities
- CAREC joined the PAHO-AMR program in July 2009
- Train the trainer AMR workshop: Sept 28-Oct 2, 2009
  - Methods and QC
  - WHONet system for data entry and analysis
- Country commitment for AMR surveillance: 2010: 10th meeting of national epidemiologists and Laboratory Directors
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PAHO AMR Monitoring/Surveillance Network

2000
- BOLIVIA
- ECUADOR
- PERÚ
- EL SALVADOR
- NICARAGUA
- GUATEMALA
- PARAGUAY

2002
- COSTA RICA
- HONDURAS
- PANAMÁ
- REPÚBLICA DOMINICANA

2003
- VENEZUELA
- URUGUAY
- CHILE
- MEXICO
- COLOMBIA
- BRAZIL
- CUBA

2009: CAREC: Caribbean

Preventing disease, promoting and protecting health
• All 21 CMCs: hospital labs do AMR testing

• 13 CMCs conduct ad hoc AMR testing for Salmonella and Shigella
  - Bahamas
  - Barbados  
  - Belize  
  - Dominica  
  - Guyana  
  - Grenada  
  - Jamaica
  - St. Lucia  
  - St Kitts/ Nevis  
  - St. Vincent & the Grenadines  
  - Suriname  
  - Trinidad & Tobago  
  - Turks & Caicos Islands

- **Data on Salmonella AMR** in the Caribbean
- **2798** Salmonella isolates for the period 1996-2003 were tested from **11 countries**:
  - Anguilla, Antigua,
  - Barbados, Bahamas, Jamaica,
  - St. Kitts, St. Lucia, St. Vincent, Suriname
  - Turks & Caicos, Trinidad & Tobago
- **Tested and collated by Michele Nurse-Lucas**
ANTIBIOTICS

- Ampicillin (AMP)
- Chloramphenicol (C)
- Cefotaxime (CTX)
- Gentamicin (GM)
- Ciprofloxacin (CIP)
- Trimethoprim/sulfamethoxazole (SXT)
# AMR Salmonella isolates 1996-2003

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**Total Number of Isolates Tested:**
- 1996: 471
- 1997: 375
- 1998: 528
- 1999: 428
- 2000: 271
- 2001: 238
- 2002: 207
- 2003: 280

Preventing disease, promoting and protecting health
% Resistant Salmonella by Antibiotic

- Ampicillin (AMP) - 8.5% (239)
- Chloramphenicol (C) - 5.7% (160)
- Gentamicin (GM) - 2.6% (75)
- Trimethoprim/sulfamethoxazole (SXT) - 2.2% (61)
- Cefotaxime (CTX) - 0.4% (10)
- Ciprofloxacin (CIP) - 0.04% (1)
## Specific AMR Patterns and Associated Serotypes

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5 Most Resistant Serotypes

- S. Typhimurium (there is also DT104)
- S. Enteritidis
- S. Heidelberg
- S. Saint-Paul
- S. Muenster
Resistant Serotypes
(continued)

AMR of enteric pathogens: *Salmonella* 2008

- 222 *Salmonella* isolates from 10 CMCs tested: 10 antibiotics
- Barbados (34%), Trinidad (34%), St. Lucia (15%), Suriname (10%)
- 74.3% (165) were Susceptible to all ten antimicrobial agents
- 5.4% (12) was Resistant to one antimicrobial agent
- 2.7% (6) and 3.6% (8) antimicrobial to 2 & ≥3 antibiotics
- Typhimurium, Kentucky and Uganda: Resistant to ≥3 antibiotics
- Majority of the isolates were resistant to streptomycin 34.5% (20)
- Tetracycline and Ampicillin resistance were 15.5% (12) and 16%
AMR (%) of Salmonella (n=58)
# AMR patterns by Salmonella serotypes, 2008

## 2008 Salmonella serotypes

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<th>Nº</th>
<th>CIP 5µg</th>
<th>NAL 30µg</th>
<th>AMP 10µg</th>
<th>AMC 20/10µg</th>
<th>CTX 30µg</th>
<th>CAZ 30µg</th>
<th>FOS 50µg</th>
<th>CHL 30µg</th>
<th>SXT 1.25/23.75µg</th>
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AMR of enteric pathogens: *Shigella* 2008

- 17 *Shigella* isolates tested with 10 antibiotics
- 56.3 % (9): Resistance to one or more antibiotics
- 100 % (4) *Shigella flexneri* type 2a: Resistant to 3 antibiotics

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<th>C</th>
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## AMR patterns by Shigella serotypes, 2008

<table>
<thead>
<tr>
<th>Especie</th>
<th>Nº</th>
<th>CIP 5µg</th>
<th>NAL 30µg</th>
<th>AMP 10µg</th>
<th>AMC 20/10µg</th>
<th>CTX 30µg</th>
<th>CAZ 30µg</th>
<th>FOS 50µg</th>
<th>CHL 30µg</th>
<th>SXT 1.25/23.75µg</th>
<th>NIT 300µg</th>
<th>TET 30µg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shigella Sonnei</td>
<td>2</td>
<td>I</td>
<td>R</td>
<td>I</td>
<td>R</td>
<td>I</td>
<td>I*</td>
<td>R</td>
<td>I</td>
<td>R</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Shigella Flexneri Type 2a</td>
<td>4 3 1</td>
<td>I</td>
<td>R</td>
<td>I</td>
<td>R</td>
<td>I*</td>
<td>R</td>
<td>I</td>
<td>I</td>
<td>3</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>
Next steps (2010-2011)

- **8 countries**: agreed to participate in AMR assessments and subsequent country-specific capacity building activities
  - Trinidad and Tobago
  - Barbados
  - Jamaica
  - Grenada
  - Guyana
  - Dominica
  - St Lucia
  - St Vincent

- Country commitment for AMR surveillance
- CAREC and PAHO to coordinate with other partners to conduct in-country AMR assessments
  - Using the PAHO model AMR standard written questionnaire
  - Followed by in country training (standardization, and WHONet)

- Establish AMR surveillance at CAREC, and seek AMR data from countries as part of overall reporting
Proposed role of CARPHA as Regional coordinating Center

- Organize and coordinate the program with external partners
- Serves as a referral institution supporting the laboratory activities of the participating institutions
- Standardize diagnostic techniques, serotyping, antimicrobial susceptibility testing and quality management
- Training the professionals of the institutions participating in the network
- Organize and maintain an AMR database and bank of strains
- Consolidate, analyze and disseminate the information provided by the national coordinating institutions
Proposed Integrated AMR surveillance

Preventing disease, promoting and protecting health