Antimicrobial Resistance (AMR) Surveillance on Stool Culture Specimen in Public Hospitals and Clinics - Hospital Authority AMR Data (2020)

January 2022

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Background

Background

- The Hong Kong Strategy and Action Plan 2017-2022 was issued in July 2017

- Activity 1.2.1 suggests harmonising AMR surveillance reporting criteria with reference to the Global Antimicrobial Resistance Surveillance System (GLASS), developed by the World Health Organization (WHO)

- This presentation briefly accounts the surveillance findings of stool specimens from 2016 to 2020

Methodology

WHO GLASS Recommendations (1)

- Based on *WHO GLASS Manual for Early Implementation (2015):*
  - WHO Priority Organisms captured from stool:
    - *Salmonella* spp.
    - *Shigella* spp.
  - Organisms other than the above were grouped as "Other spp."
  - Location of onset
    - Community-onset - organisms isolated from stool specimen collected in non-inpatient settings or within 48 hours after hospital admission
    - Hospital-onset - organisms isolated from stool specimen collected more than 48 hours after hospital admission
    - Using 48 hours instead of 2 calendar days of WHO as agreed by HA

WHO GLASS Recommendations (2)

- Based on *WHO GLASS Manual for Early Implementation (2015):*
  - Removal of duplicate results (deduplication)
    - For each surveillance period (one calendar year), only the first result would be reported for each patient per specimen type per organism for the same location of onset
  - Antimicrobial susceptibility test (AST) result being "Intermediate" or "Resistant" was considered as "non-susceptible"
  - AST results derived from < 10 isolates per calendar year were excluded from analysis

Local Adaptation

- Taking local context into account, the following modifications were also agreed in consultation with HA experts in the Working Group:
    - To avoid misleading or interference by selection bias, percentages of non-susceptibility derived from less than 70% of total isolates were not reported, or remarked to remind readers to interpret with caution
    - Location of onset for *Salmonella* spp. and *Shigella* spp.
        - Location of onset would be collectively considered as "Community (undifferentiated)-onset" as a whole instead of adopting the definition by WHO as infections caused by these organisms are mostly community-associated and rarely are hospital-associated

Scope of Data

- The following information were collected from patients who had stool culture:
  - Demographic data
  - Microbiology data
    - Organisms cultured
    - AST results
      - Susceptible (sensitive)
      - Non-susceptible (intermediate or resistant)

Scope of Reporting

- Overview on patients with stool culture
  - Age distribution of patients with stool culture
  - Percentage of patients with positive stool culture
- Overview on WHO priority organisms isolated from stool
  - No. of patients with positive culture results by organisms and year
- AST results on WHO priority organisms
  - Number and % of patients with non-susceptibility results
  - Trend of antimicrobial non-susceptibility
    - 2019 vs 2020
    - 2016 - 2020 trend

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Statistical Analysis on AST Results

- % non-susceptibility (% NS) in 2019 vs 2020
  - Fisher's exact test or chi-squared test for comparison
  - P <0.05 was considered statistically significant

- 2016 – 2020 trend analysis
  - Year 2016 was chosen as the baseline for comparison as the Hong Kong Strategy and Action Plan on AMR was issued in 2017 and such decision was endorsed by the High Level Steering Committee
  - One-way Cochran-Armitage test was used to look for trend
  - P <0.05 was considered statistically significant
  - P <0.01 was considered statistically highly significant
  - For ease of presentation of trends with p < 0.05
    - Increasing trend of % NS – Red in colour
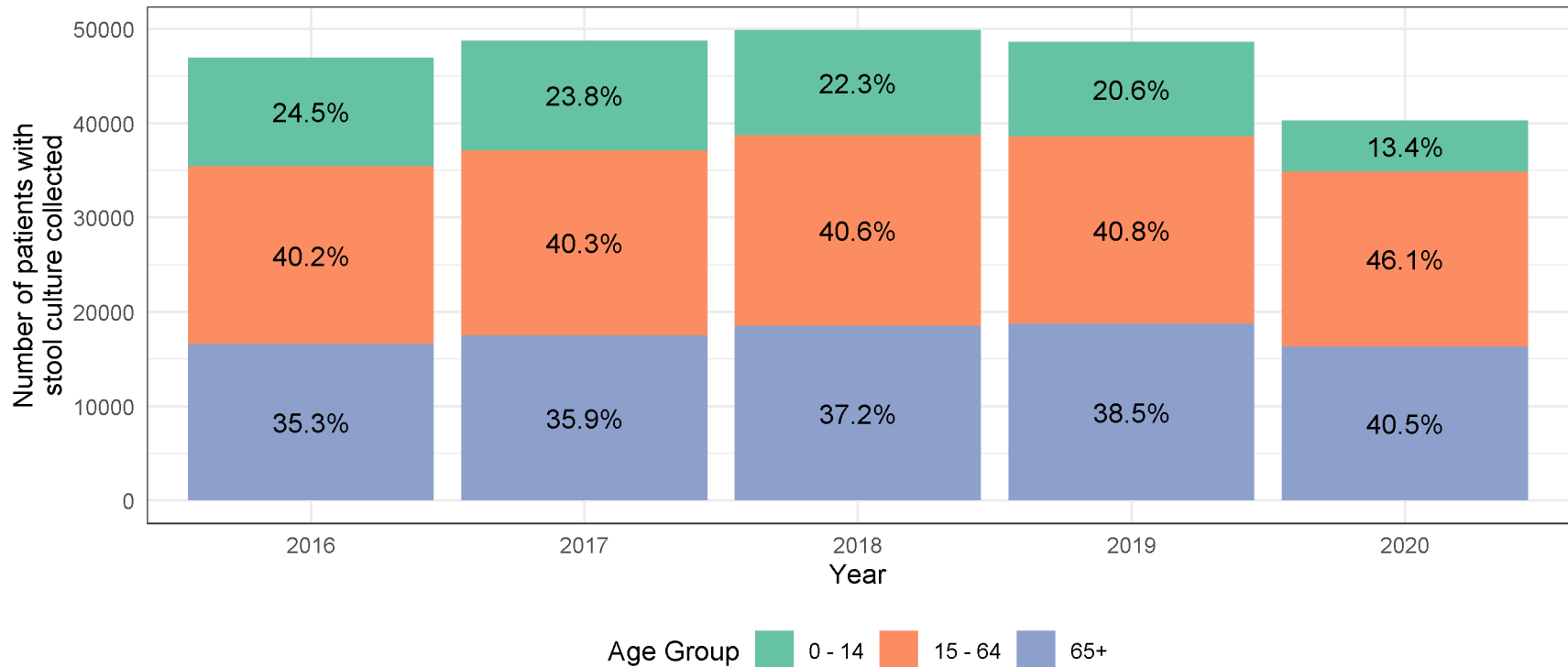   - Decreasing trend of % NS – Green in colour

Results

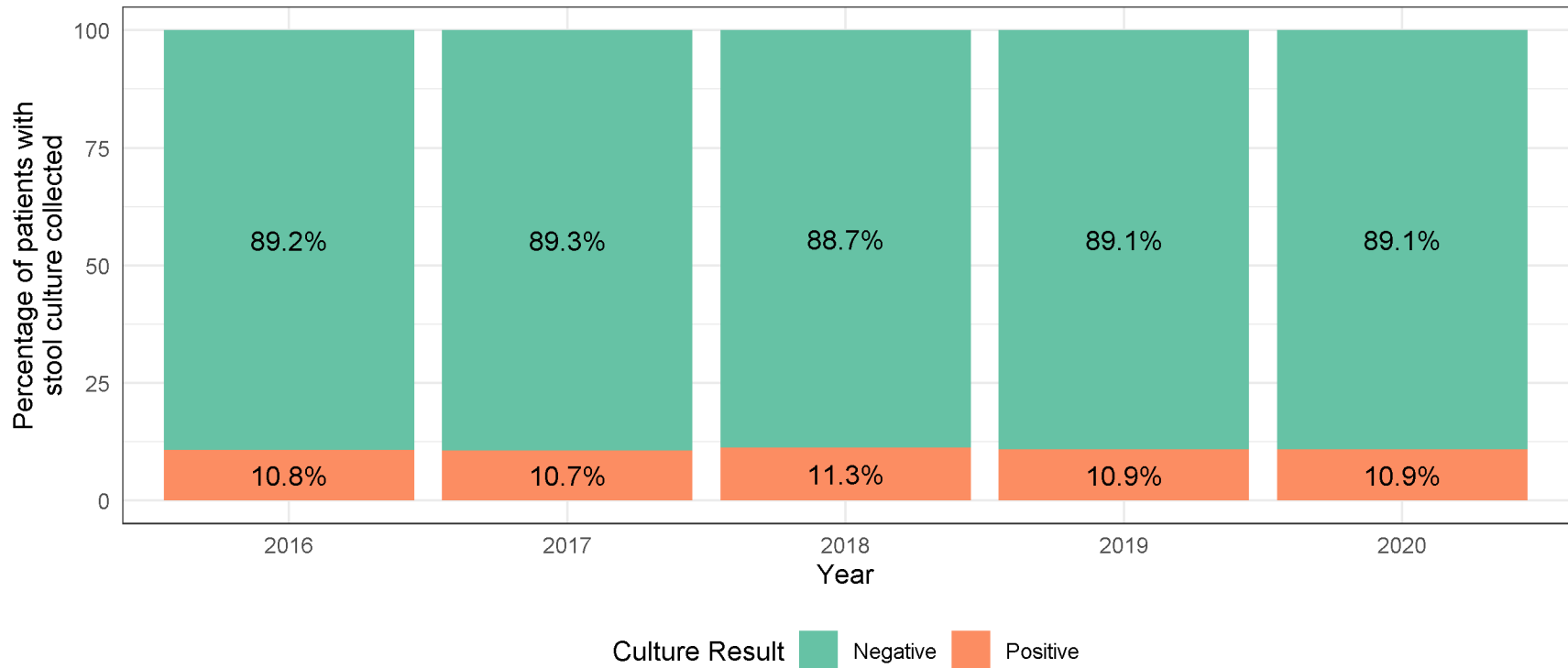1. Overview on patients with stool culture

Age distribution of patients with stool culture

- ⇧ No. of patients with stool culture from 2016 to 2019
  (~47,000 in 2016 to ~50,000 in 2018-2019)
- No. of patients with stool culture significantly dropped in 2020 (~40,000)
- Majority of the patients with stool culture were in the age groups
  15-64 (40.2% - 46.1%) and aged 65+ (35.3% - 40.5%)

Percentage of Patients with positive Stool Culture

- % patients with positive stool culture remained stable over the past years at around 11%

Results

2. Overview on WHO priority organisms isolated from stool

Distribution of Organisms by Year

Organism	No. of patients with positive stool culture by organisms and year (%)				
	2016	2017	2018	2019	2020
Salmonella spp.	2,925 (57.6%)	2,806 (53.7%)	3,038 (53.9%)	2,732 (51.7%)	2,332 (53.2%)
Shigella spp.	33 (0.6%)	24 (0.5%)	25 (0.4%)	25 (0.5%)	15 (0.3%)
Other spp.	2,224 (43.8%)	2,508 (48.0%)	2,703 (48.0%)	2,642 (50.0%)	2,127 (48.5%)
Total no. of patients	5,080	5,222	5,635	5,288	4,385

Note:
• Percentages were rounded to one decimal place
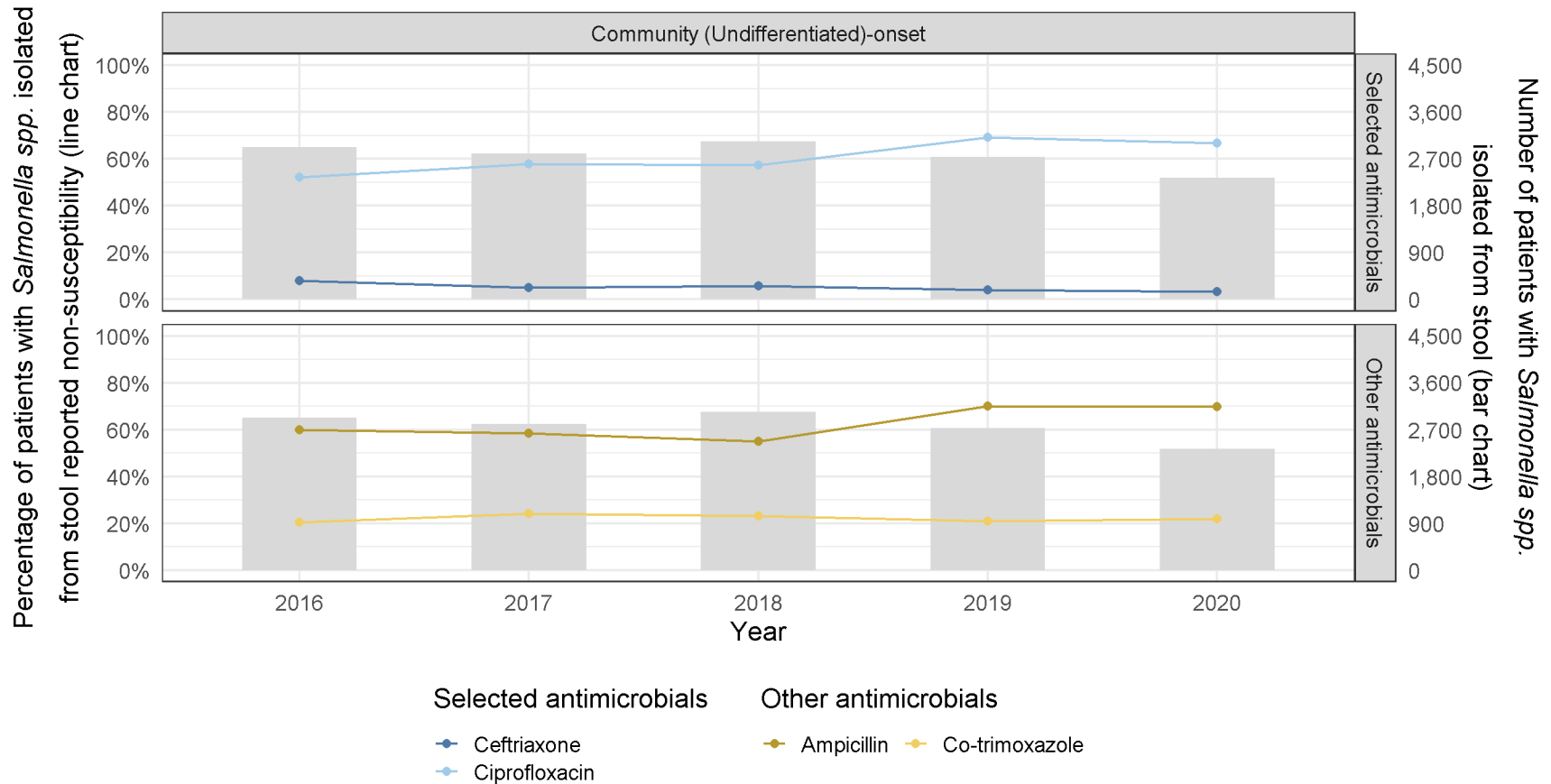• A patient might have stool culture(s) with growth of multiple organisms

Results

3.1 AST results for *Salmonella* spp.

AST results for *Salmonella* spp. - Overview

- % NS to ampicillin and ciprofloxacin among *Salmonella* spp. isolates remained >50% during 2016 to 2020

AST results for *Salmonella* spp. - 2019 vs 2020

Antimicrobial group	Antimicrobial	Community (Undifferentiated)-onset		
		% NS		p-value[†]
		2019	2020	(19 vs 20)
Penicillins with extended spectrum	Ampicillin	70.1%	69.7%	-
Third-generation cephalosporins	Ceftriaxone	4.1%	3.2%	-
Combinations of sulfonamides and trimethoprim, incl. derivatives	Co-trimoxazole	20.8%	22.0%	-
Fluoroquinolones	Ciprofloxacin	69.3%	66.7%	-

[†]P-value was calculated using chi-squared test or Fisher's exact test, whether appropriate

- No statistically significant results related to the commonly used antimicrobials between 2019 to 2020

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AST results for *Salmonella* spp.
Trend 2016-2020

| Antimicrobial group | Antimicrobial | Community (Undifferentiated)-onset | | | | | |
| | | % NS | | | | | p-value[†] |
		2016	2017	2018	2019	2020	16 - 20
Penicillins with extended spectrum	Ampicillin	59.9%	58.4%	54.9%	70.1%	69.7%	↗ p <0.01
Third-generation cephalosporins	Ceftriaxone	7.9%	5.0%	5.7%	4.1%	3.2%	↘ p <0.01
Combinations of sulfonamides and trimethoprim, incl. derivatives	Co-trimoxazole	20.4%	24.2%	23.1%	20.8%	22.0%	-
Fluoroquinolones	Ciprofloxacin	52.1%	57.7%	57.4%	69.3%	66.7%	↗ p <0.01

Legend: ↗ Increasing trend; ↘ Decreasing trend
[†]P-value reports the statistical significance of trend observed during the captioned time period, it was calculated using Cochran-Armitage test , only trends with statistical significance (i.e. p<0.05) and high statistical significance (p<0.01) were reported

- Statistically significant ⇑ trends of % NS towards ampicillin and ciprofloxacin were observed from 2016 to 2020

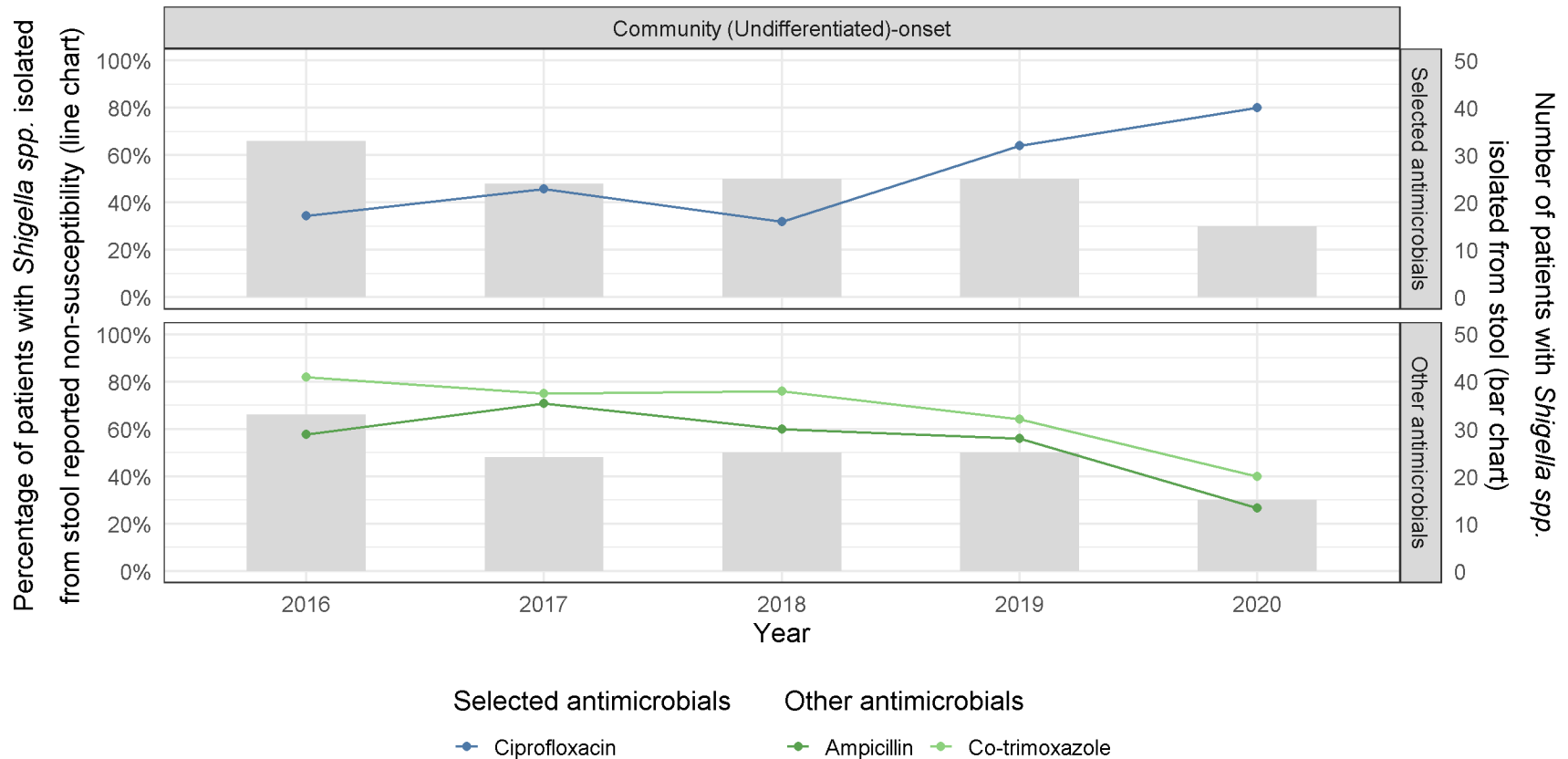- Statistically significant ⇓ trend of % NS towards ceftriaxone was observed from 2016 to 2020

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Results

3.2 AST results for *Shigella* spp.

AST results for *Shigella* spp.^ - Overview

^The results of *Shigella* spp. were derived from less than 50 specimens annually and should be interpreted with caution

AST results for *Shigella* spp.^ - 2019 vs 2020

Antimicrobial group	Antimicrobial	Community (Undifferentiated)-onset		
		% NS		p-value[†]
		2019	2020	(19 vs 20)
Penicillins with extended spectrum	Ampicillin	56.0%	26.7%	-
Third-generation cephalosporins	Ceftriaxone	50.0%	0%	<0.05
Combinations of sulfonamides and trimethoprim, incl. derivatives	Co-trimoxazole	64.0%	40.0%	-
Fluoroquinolones	Ciprofloxacin[‡]	64.0%	80.0%	-

^The results of Shigella spp. were derived from less than 50 specimens annually and should be interpreted with caution

[†]P-value was calculated using chi-squared test or Fisher's exact test, whether appropriate

[‡]Revised ciprofloxacin interpretive criteria for Enterobacteriaceae (except *Salmonella* spp.) was released by CLSI in 2019.

The increase in 2019 may be contributed by a change in CLSI criteria.

- Statistically significant result related to ceftriaxone between 2019 to 2020 was observed

- Readers should note only a small number (<50) of *Shigella* spp. isolates were cultured during the surveillance period, thus the results should be interpreted with caution

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AST results for *Shigella* spp.^
Trend 2016-2020

Antimicrobial group	Antimicrobial	Community (Undifferentiated)-onset					
		% NS					p-value†
		2016	2017	2018	2019	2020	16 - 20
Penicillins with extended spectrum	Ampicillin	57.6%	70.8%	60.0%	56.0%	26.7%	↘ p <0.05
Third-generation cephalosporins	Ceftriaxone	22.7%*	62.5%*	26.7%*	50.0%	0%	-
Combinations of sulfonamides and trimethoprim, incl. derivatives	Co-trimoxazole	81.8%	75.0%	76.0%	64.0%	40.0%	↘ p <0.01
Fluoroquinolones	Ciprofloxacin‡	34.5%	45.8%	32.0%	64.0%	80.0%	↗ p <0.01

^The results of *Shigella* spp. were derived from less than 50 specimens annually and should be interpreted with caution

Legend: ↗ Increasing trend; ↘ Decreasing trend

* Non-susceptibility percentage should be interpreted with caution as the figure is derived from less than 70% of total isolates for surveillance. The figure may be affected by selection bias.

†P-value reports the statistical significance of trend observed during the captioned time period, it was calculated using Cochran-Armitage test , only trends with statistical significance (i.e. $p < 0.05$) and high statistical significance ($p < 0.01$) were reported

‡Revised ciprofloxacin interpretive criteria for Enterobacteriaceae (except *Salmonella* spp.) was released by CLSI in 2019. The increase in 2019 may be contributed by a change in CLSI criteria.

- Statistically significant ⇓ trend towards ampicillin and co-trimoxazole while statistically significant ⇧ trend towards ciprofloxacin was observed from 2016 to 2020

- Readers should note only a small number of *Shigella* spp. isolates were cultured during the surveillance period, thus the results should be interpreted with caution

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Change in HA service volume in 2020

Annual attendance count for HA non-inpatient service

	2016*	2017*	2018*	2019*	2020*	20 over 19†
Accident & Emergency	4,519,000	4,393,000	4,291,000	4,394,000	3,285,000	-25.2%
Primary Care (GOPC)	12,719,000	12,800,000	12,802,000	12,669,000	11,492,000	-9.3%
Specialist Out-patient (Clinical)	14,952,000	15,390,000	15,739,000	16,003,000	14,300,000	-10.6%
Total	**32,191,000**	**32,584,000**	**32,832,000**	**33,067,000**	**29,077,000**	**-12.1%**

*Rounded to nearest thousand
†Rounded to one decimal places

Annual patient-days for HA inpatient service

	2016*	2017*	2018*	2019*	2020*	20 over 19†
Medicine	6,617,000	6,928,000	7,121,000	7,399,000	6,771,000	-8.5%
Surgery	1,831,000	1,924,000	1,984,000	2,014,000	1,705,000	-15.3%
Orthopaedics & Traumatology	1,571,000	1,625,000	1,711,000	1,732,000	1,321,000	-23.7%
ICU/ HDU	141,000	140,000	143,000	142,000	134,000	-5.8%
Others	3,773,000	3,809,000	3,820,000	3,828,000	3,154,000	-17.6%
Total	**13,933,000**	**14,428,000**	**14,779,000**	**15,115,000**	**13,084,000**	**-13.4%**

*Rounded to nearest thousand
†Rounded to one decimal places

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Age distribution of patients with stool culture in 2020

Community (undifferentiated) onset	Patient with positive stool culture/ Patient with any stool culture (positive %)					Patients with any stool culture
	2016*	2017*	2018*	2019*	2020*	20 over 19†
0 - 14	2,240/11,500 (19.4%)	2,180/11,620 (18.8%)	2,190/11,100 (19.8%)	1,930/10,030 (19.2%)	1,520/5,400 (28.2%)	-47.4%
15 - 64	1,720/18,890 (9.1%)	1,750/19,630 (8.9%)	1,980/20,220 (9.8%)	1,910/19,840 (9.6%)	1,860/18,540 (10.1%)	-7.4%
65+	1,130/16,550 (6.8%)	1,290/17,510 (7.4%)	1,460/18,520 (7.9%)	1,460/18,730 (7.8%)	1,000/16,320 (6.1%)	-15.7%
Total	**5,080/46,940 (10.8%)**	**5,220/48,760 (10.7%)**	**5,640/49,840 (11.3%)**	**5,290/48,600 (10.9%)**	**4,380/40,250 (10.9%)**	**-20.1%**

*Rounded to nearest ten
†Rounded to one decimal places

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Remarks on Interpretation of Results

- Readers are reminded that over 10% reduction in HA service volume in 2020 was observed which might have affected the overall number of culture specimens collected

- As only a small number (<50) of *Shigella* spp. isolates were cultured during the surveillance period, related results should be interpreted with caution

- CLSI guidelines for sensitivity testing involving fluoroquinolones (including ciprofloxacin) interpretive criteria for Enterobacteriaceae (except *Salmonella* spp.) has been updated in 2019. For laboratories that chose to apply the new criteria for reporting in 2019, some *Shigella* spp. isolates previously categorised as susceptible to ciprofloxacin would be categorised as non-susceptible using the updated zone size requirement under the 2019 criteria

- Laboratories of different hospitals might use different panels for AST. This could result in bias of results toward those laboratories performing a major proportion of a particular AST especially if number of isolates tested is small
  - In the report, the issue of small number of isolates is partially addressed, in accordance of recommendation by WHO GLASS, that non-susceptibility results derived from <10 isolates were not included for analysis.

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Summary Table of Key Findings

WHO priority organism	Proportion of isolates being non-susceptible to antimicrobials, 2016 vs 2020
	Community (Undifferentiated)-onset
Salmonella spp.	⇓ Ceftriaxone (7.9% → 3.2%)
	⇑ Ampicillin (59.9% → 69.7%) ⇑ Ciprofloxacin (52.1% → 66.7%)
Shigella spp.^	⇓ Ampicillin (57.6% → 26.7%) ⇓ Co-trimoxazole (81.8% → 40.0%)
	⇑ Ciprofloxacin (34.5% → 80.0%)

^The results of *Shigella* spp. were derived from less than 50 specimens annually and should be interpreted with caution

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Summary

- In general, non-susceptibility for the two WHO GLASS priority pathogens in stool towards ampicillin and ciprofloxacin remains high

- A statistically significant increasing trend of %NS from 2016 to 2020 for the *Salmonella* spp. towards ampicillin and ciprofloxacin was observed (from 59.9% to 69.7% and 52.1% to 66.7% respectively)

- A statistically significant decreasing trend of %NS from 2016 to 2020 for *Salmonella* spp. towards ceftriaxone was observed (from 7.9% in 2016 to 3.2% in 2020)

- A statistically significant increasing trend of %NS from 2016 to 2020 for *Shigella* spp.^ towards ciprofloxacin was also observed (from 34.5% to 80.0%), the increasing trend is particularly evident among male patients aged 15-64

- A statistically significant decreasing trend of %NS from 2016 to 2020 for *Shigella* spp.^ towards ampicillin and co-trimoxazole was observed (from 57.6% to 26.7% and 81.8% to 40% respectively from 2016 to 2020)

^The results of *Shigella* spp. were derived from less than 50 specimens annually and should be interpreted with caution

Recommendations

- In view of increasing trend of non-susceptibility of the following antimicrobial-organism combinations, further monitoring of the phenomenon may be warranted:
    - Ciprofloxacin for *Salmonella* spp.
    - Ciprofloxacin for *Shigella* spp.
- To alert working partners of HA about increasing trend of non-susceptibility of the aforesaid antimicrobial – organism combinations for their further investigation and management as appropriate

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THE END

Thank you