

Antimicrobial Resistance (AMR) Surveillance on Blood Culture Specimen in Public Hospitals and Clinics - Hospital Authority AMR Data (2021)

February 2023



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Background



Background

- The second Hong Kong Strategy and Action Plan 2023-2027 was issued in November 2022
- Activity 1.2.1 suggests continuing AMR surveillance based on the Global Antimicrobial Resistance Surveillance System (GLASS), developed by the World Health Organization (WHO)
- This presentation briefly accounts the surveillance findings of blood specimens from 2016 to 2021





Method



WHO GLASS Recommendations (1)

- Based on *WHO GLASS Manual for Early Implementation (2015)*:
 - WHO Priority Organisms captured:
 - *Escherichia coli*
 - *Klebsiella pneumoniae*
 - *Staphylococcus aureus*
 - *Salmonella* spp.
 - *Acinetobacter* spp.
 - *Streptococcus pneumoniae*
 - Organisms other than the above were grouped as “Other spp.”
 - Location of onset
 - Community-onset organisms isolated from blood specimen collected in non-inpatient settings or within 48 hours after hospital admission
 - Hospital-onset organisms isolated from blood 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)

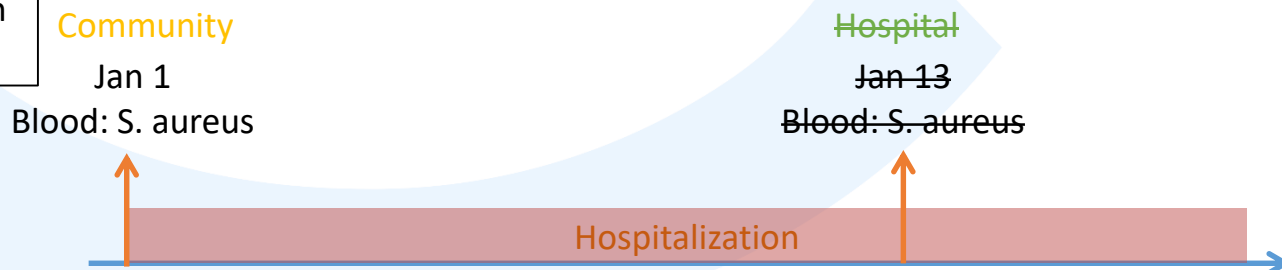
- Based on *WHO GLASS Manual for Early Implementation (2015)*:
 - Removal of duplicate results (deduplication)
 - For each surveillance period (one calendar year), only the first result would be reported for each patient per specimen type per organism for the same location of onset
 - Antimicrobial susceptibility 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 *Streptococcus pneumoniae*
 - Information on location of onset was not considered when analysing AST results, as they rarely cause hospital-associated infections
 - AST results were interpreted as “community (undifferentiated)-onset” as a whole
 - WHO’s definition of community- / hospital-onset still applies when presenting the organisms by location of onset
 - “Day-14” rule
 - Positive cultures for the same organism within a 14-day period from the same patient would be regarded as a single episode

Graphical Illustration
of “Day-14” rule



Scope of Data

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



Broad-spectrum Antimicrobials (Big Guns)

- Where appropriate, AST results of the following broad-spectrum antimicrobials identified by experts in HA were examined because of their importance on treating resistant infections
 - Piperacillin/tazobactam
 - Ceftazidime
 - Cefoperazone/sulbactam
 - Cefepime
 - Ceftaroline fosamil
 - Ceftolozane/tazobactam
 - Ceftazidime/avibactam
 - Meropenem
 - Ertapenem
 - Imipenem/cilastatin
 - Vancomycin
 - Linezolid
 - Daptomycin
 - Colistin
 - Teicoplanin



Scope of Reporting

- Overview on patients with blood culture
 - Number of patients from whom a blood culture was taken
- Overview on WHO priority organisms isolated from blood
 - Number of patients with positive and negative culture results
 - Distribution of organisms by location of onset
- AST results on WHO priority organisms
 - Number and % of patients with non-susceptibility results
 - Trend of antimicrobial non-susceptibility
 - 2016 - 2021 trend



Statistical Analysis on AST Results

- 2016 – 2021 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

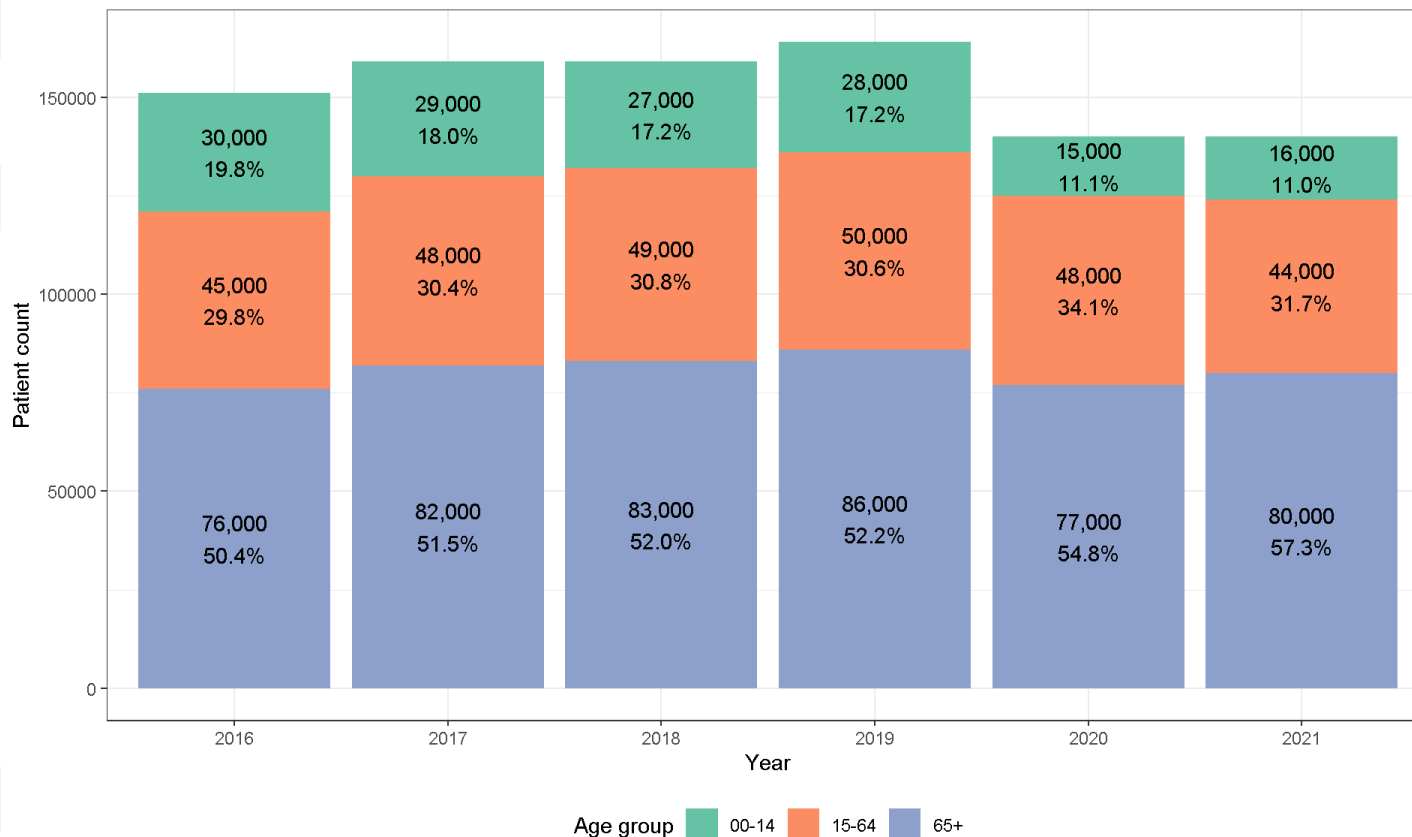


Results

1. Overview on patients with blood culture



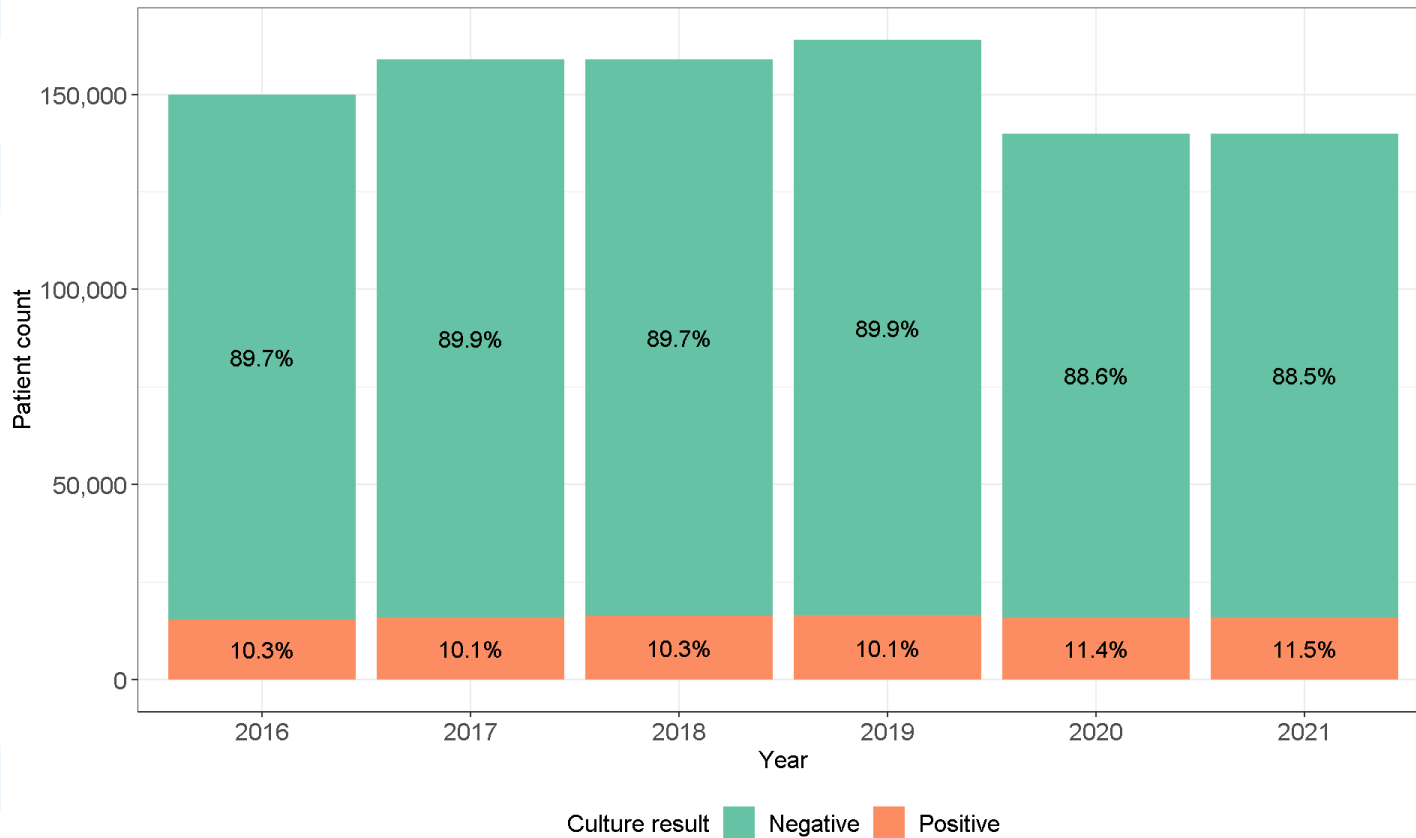
Age distribution of patients with blood culture



- No. of patient with blood culture remained similar in 2020 (140,000) and 2021 (140,000)
- > 50% patients aged 65 years or above from 2016 to 2021



Percentage of Patients with Positive Blood Culture



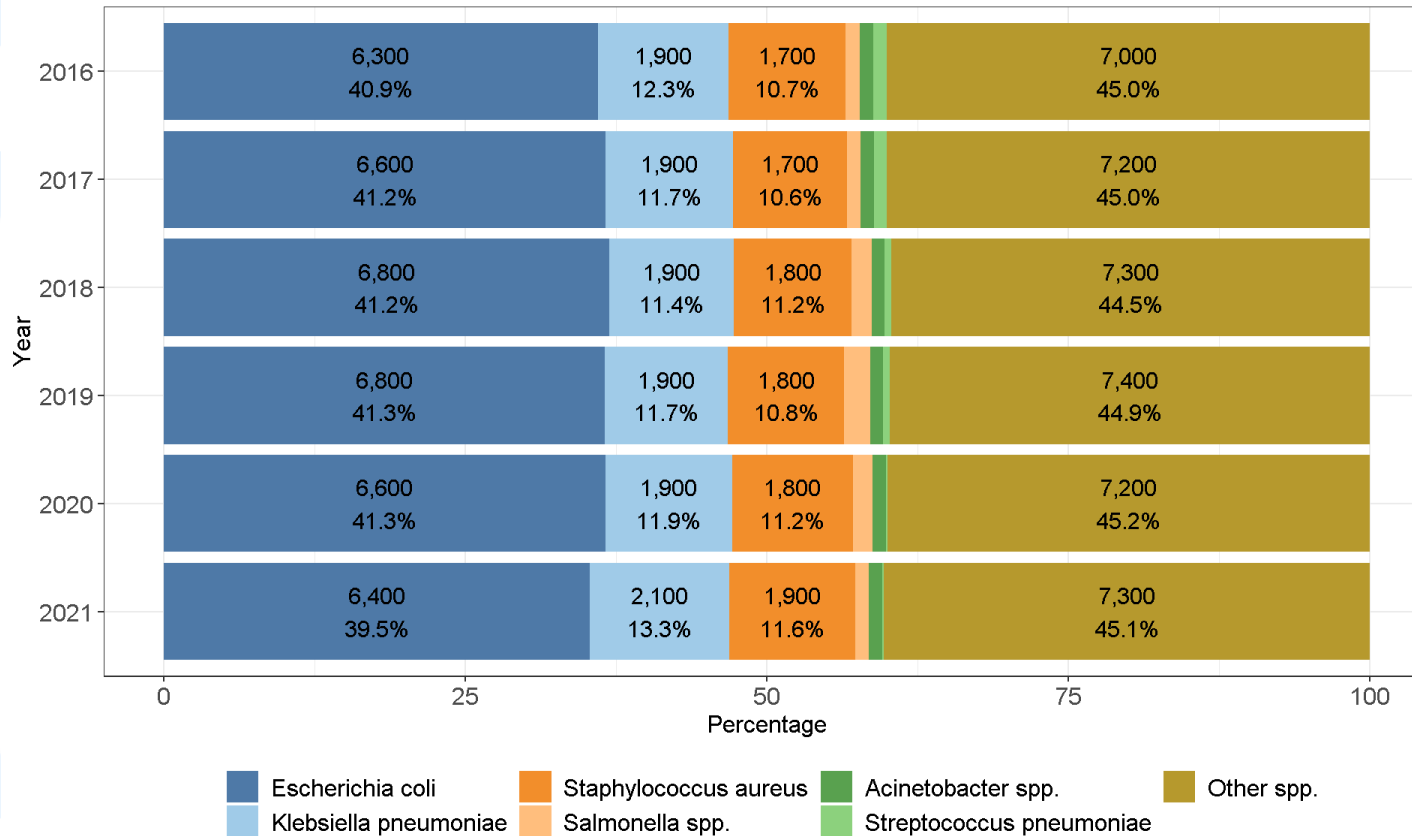
- % patients with positive blood culture remained stable over the past years at around 10 – 11%

Results

2. Overview on WHO priority organisms isolated from blood

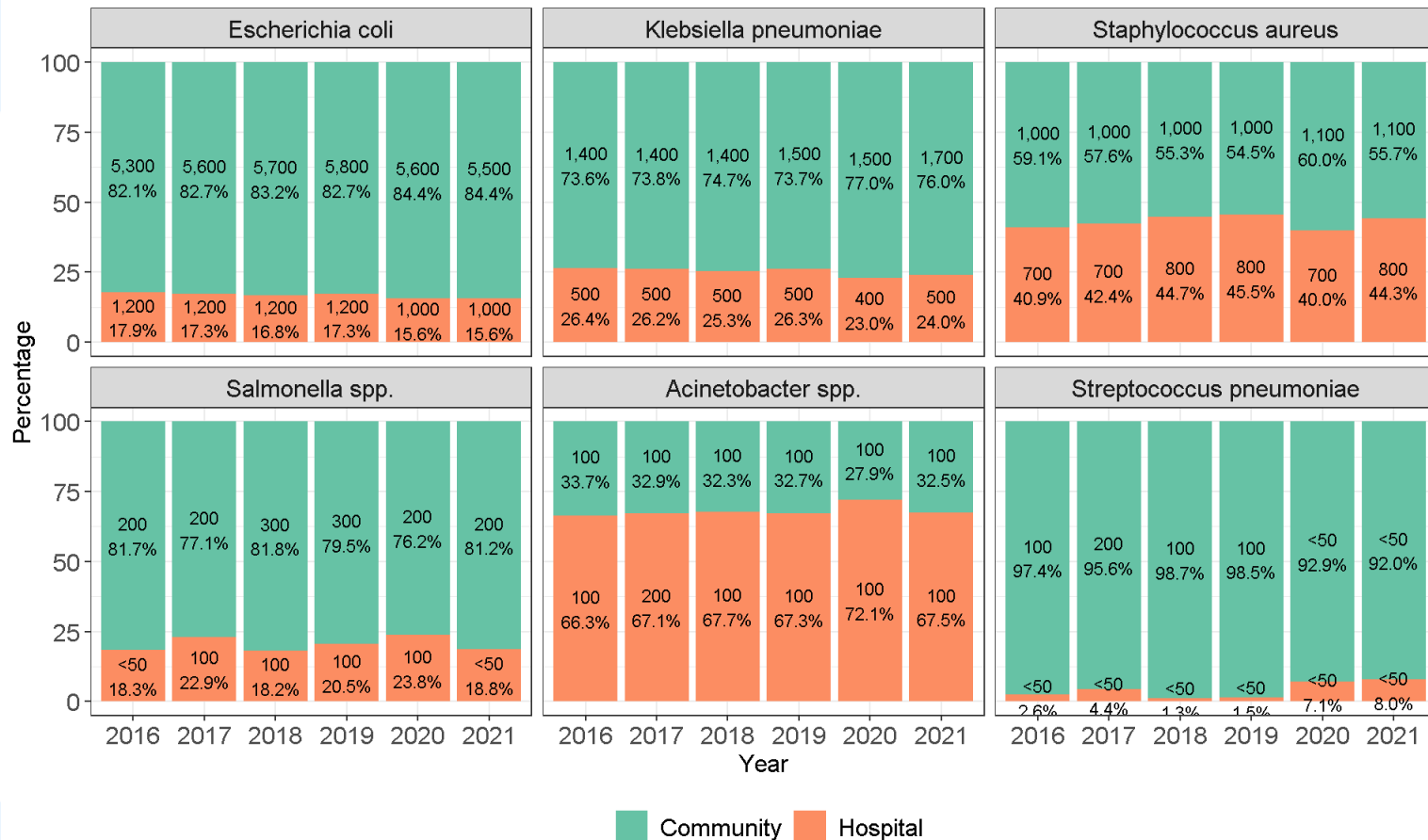


Distribution of Organisms by Year



- The three most common WHO priority organisms cultured from blood remained to be *E. coli*, *K. pneumoniae* and *S. aureus* from 2016 to 2021
- *Salmonella* spp. case count dropped (300 → 200)
- *S. pneumoniae* (<50 cases) and *Acinetobacter* spp. (200 cases) case count remained low and stable

Distribution of Organisms by Location of Onset



- *Escherichia coli*, *Klebsiella pneumoniae*, *Salmonella* spp. and *Streptococcus pneumoniae* were predominantly community-onset from 2016 to 2021
- *Acinetobacter* spp. was predominantly hospital-onset

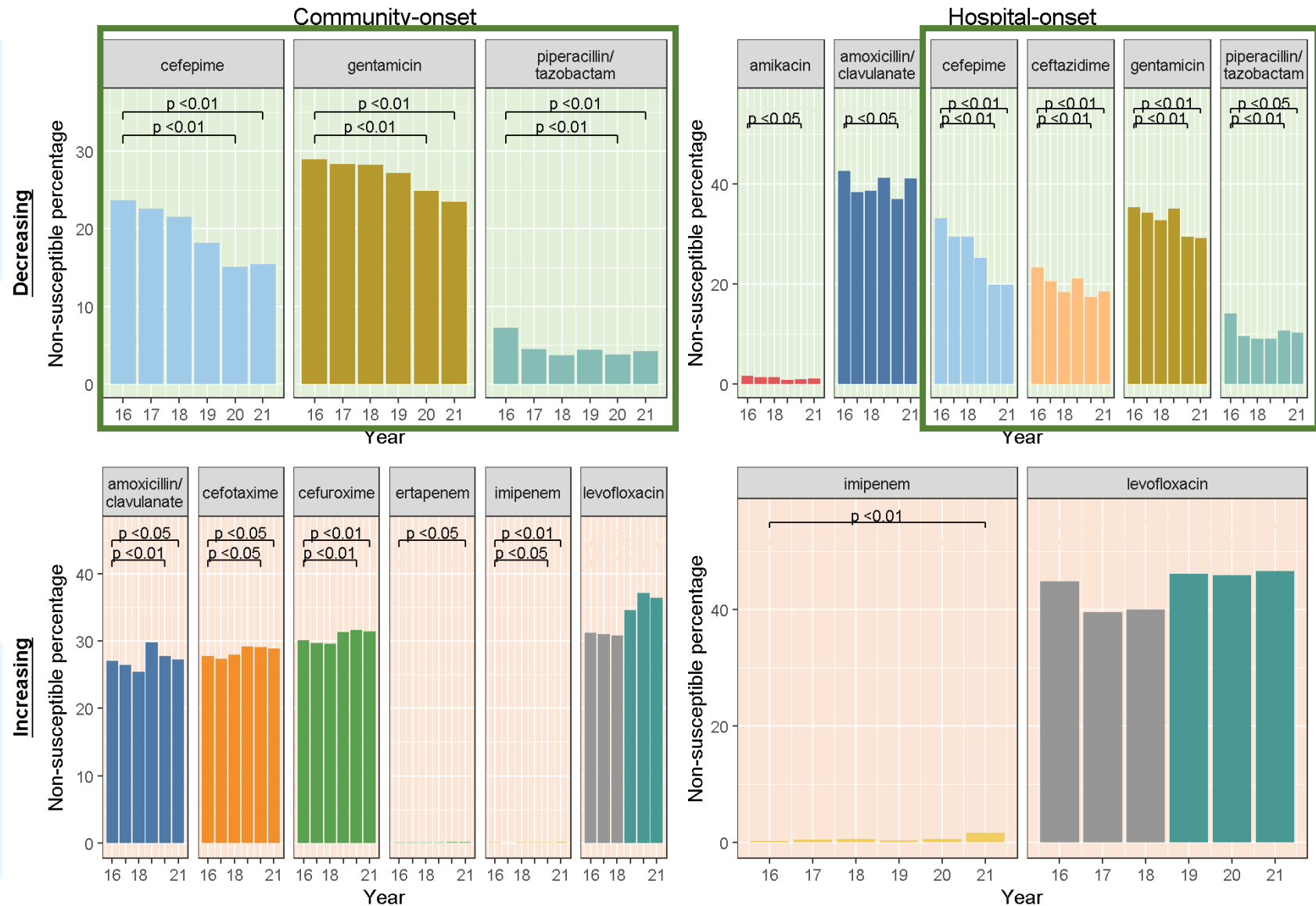


Results

3. AST results for WHO priority organisms isolated from blood



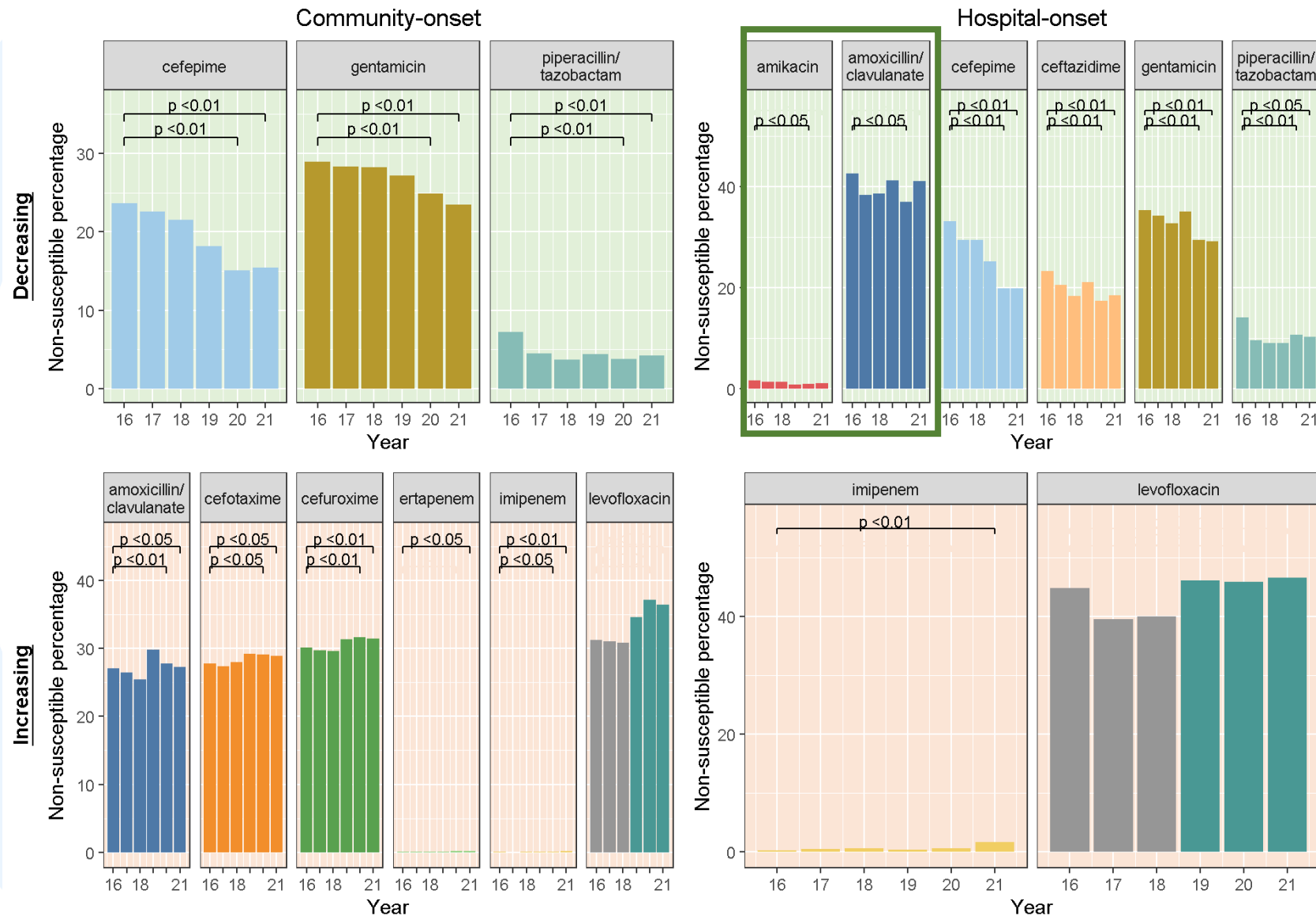
Significant change in trend for *E. coli* (16 to 21)



‡ Revised fluoroquinolones interpretive criteria for Enterobacteriaceae (except *Salmonella* spp.) was released by CLSI in 2019. The increase in 2019 and thereafter compared with 2018 and before may be contributed by a change in CLSI criteria.

1. Continuous downward trends were observed for piperacillin/ tazobactam (community & hospital), ceftazidime (hospital), cefepime (community & hospital) and gentamicin (community & hospital) for 16-20 and 16-21

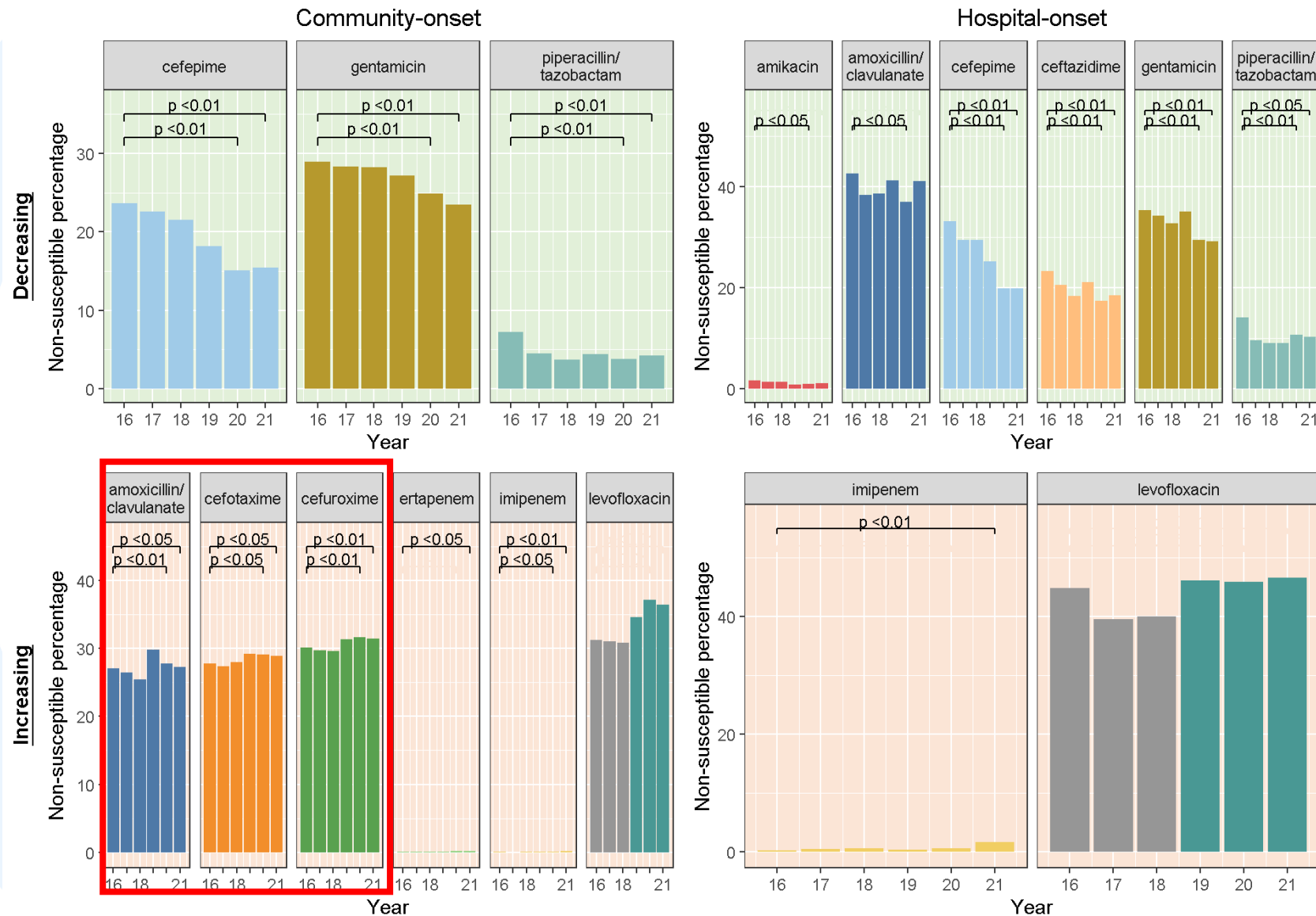
Significant change in trend for *E. coli* (16 to 21)



‡ Revised fluoroquinolones interpretive criteria for Enterobacteriaceae (except *Salmonella* spp.) was released by CLSI in 2019. The increase in 2019 and thereafter compared with 2018 and before may be contributed by a change in CLSI criteria.

2. NS% for amoxicillin/ clavulanate and amikacin (hospital-onset) fluctuated

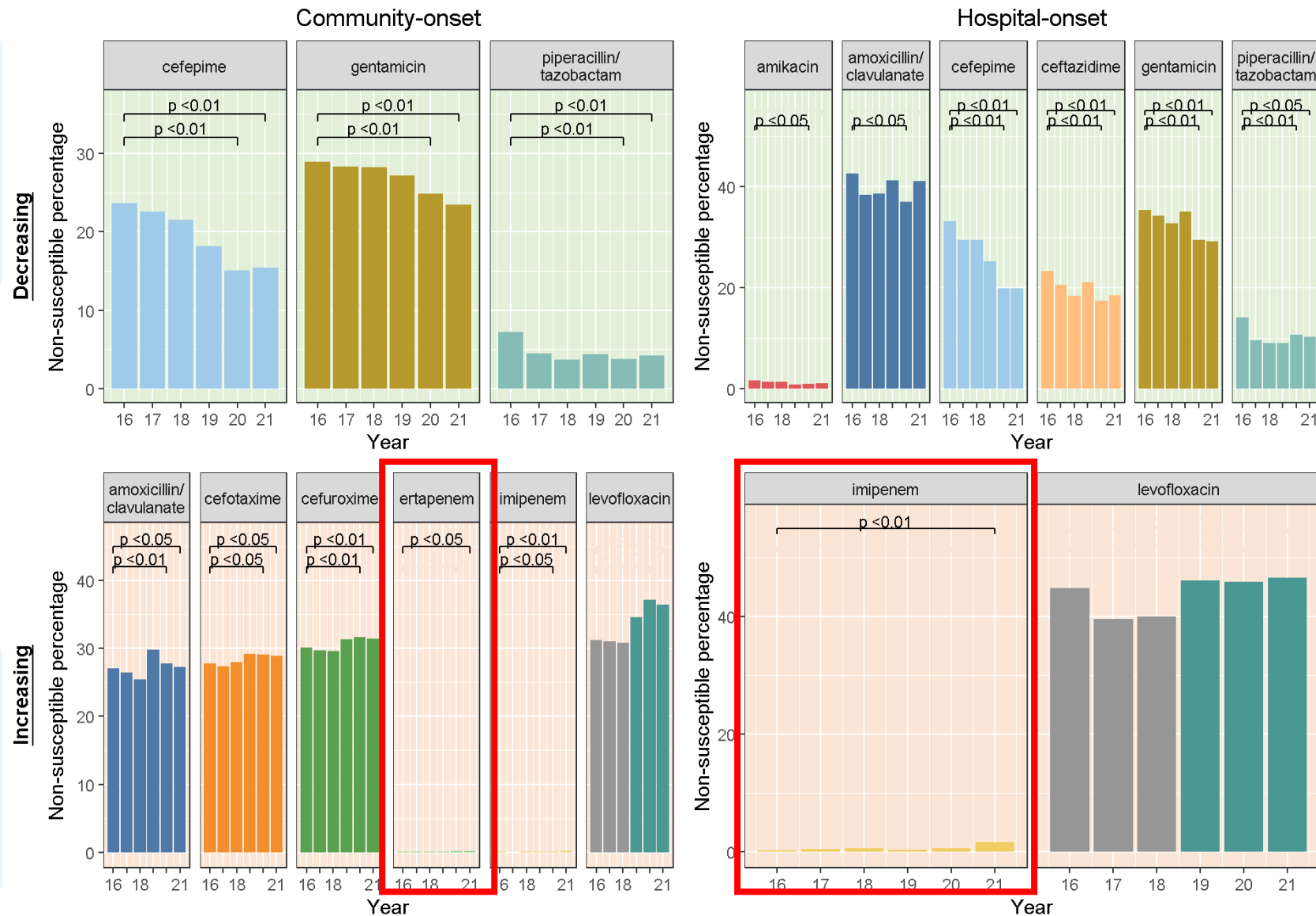
Significant change in trend for *E. coli* (16 to 21)



‡ Revised fluoroquinolones interpretive criteria for Enterobacteriaceae (except *Salmonella* spp.) was released by CLSI in 2019. The increase in 2019 and thereafter compared with 2018 and before may be contributed by a change in CLSI criteria.

4. For community-onset *E. coli* bacteraemia, although an increasing trend was still seen for amoxicillin/ clavulanate, cefotaxime, cefuroxime, mild reduction was also observed.

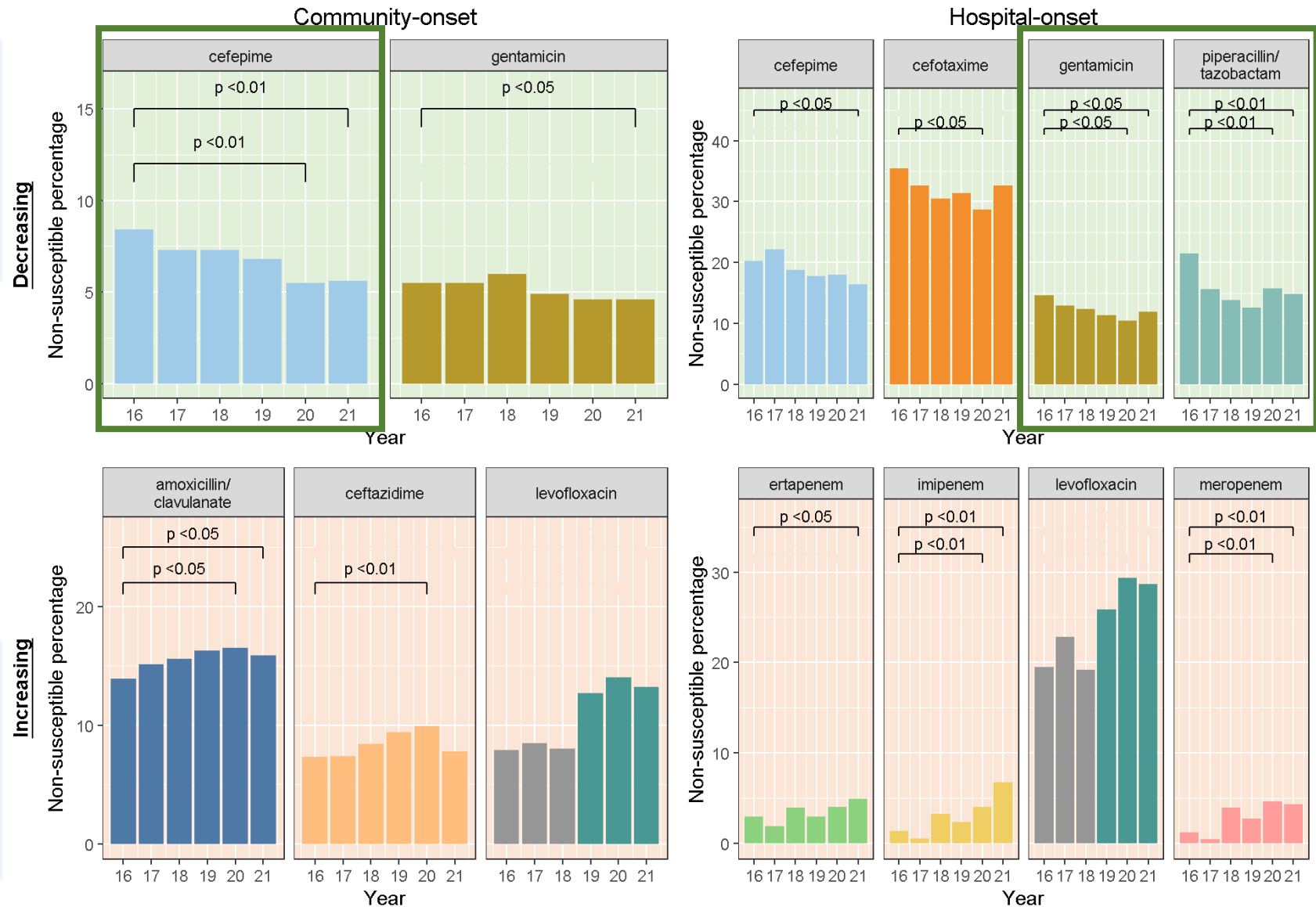
Significant change in trend for *E. coli* (16 to 21)



‡ Revised fluoroquinolones interpretive criteria for Enterobacteriaceae (except Salmonella spp.) was released by CLSI in 2019. The increase in 2019 and thereafter compared with 2018 and before may be contributed by a change in CLSI criteria.

5. NS% for ertapenem (community-onset) and imipenem (hospital-onset) showed increasing trend for the first time since the beginning of surveillance (16-21)

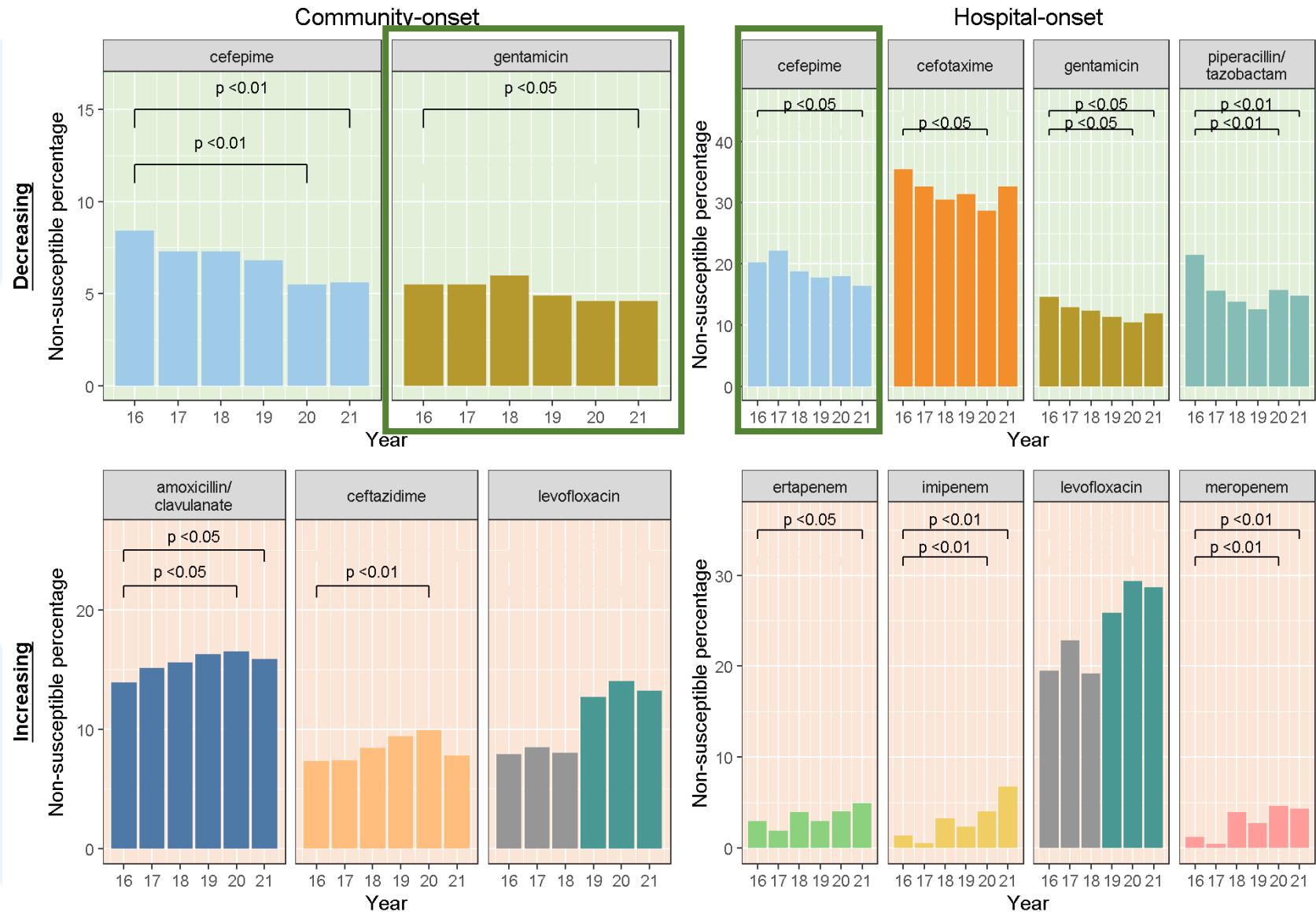
Significant change in trend for *K. pneumoniae* (16 to 21)



‡ Revised fluoroquinolones interpretive criteria for Enterobacteriaceae (except *Salmonella* spp.) was released by CLSI in 2019. The increase in 2019 and thereafter compared with 2018 and before may be contributed by a change in CLSI criteria.

1. A decreasing trend for cefepime (community-onset), gentamicin and piperacillin/ tazobactam (hospital-onset) were observed in 16-20 and 16-21

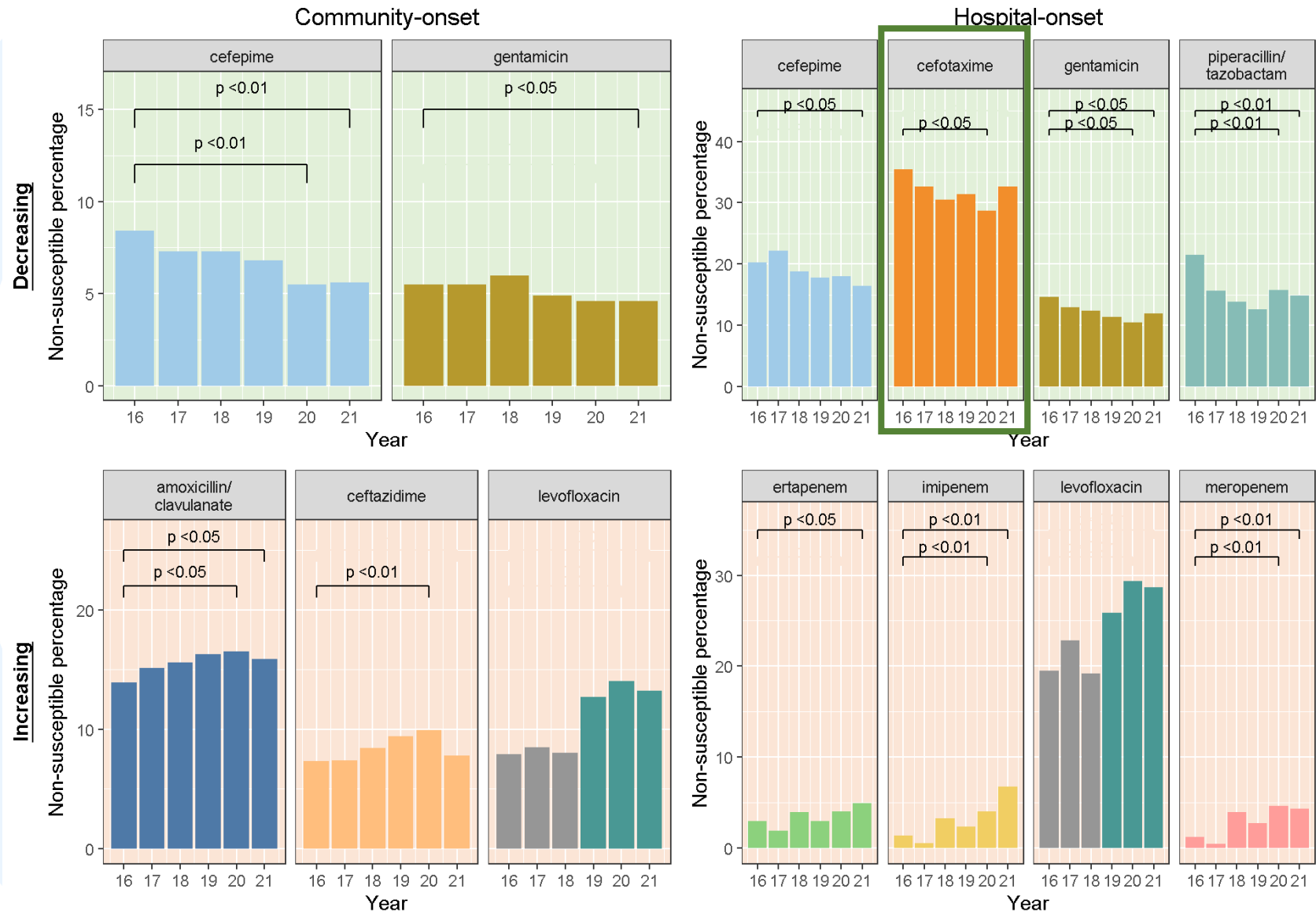
Significant change in trend for *K. pneumoniae* (16 to 21)



‡ Revised fluoroquinolones interpretive criteria for Enterobacteriaceae (except *Salmonella* spp.) was released by CLSI in 2019. The increase in 2019 and thereafter compared with 2018 and before may be contributed by a change in CLSI criteria.

- NS% for gentamicin (community-onset) and cefepime (hospital-onset) showed decreasing trend for the first time since the beginning of surveillance (16-21)

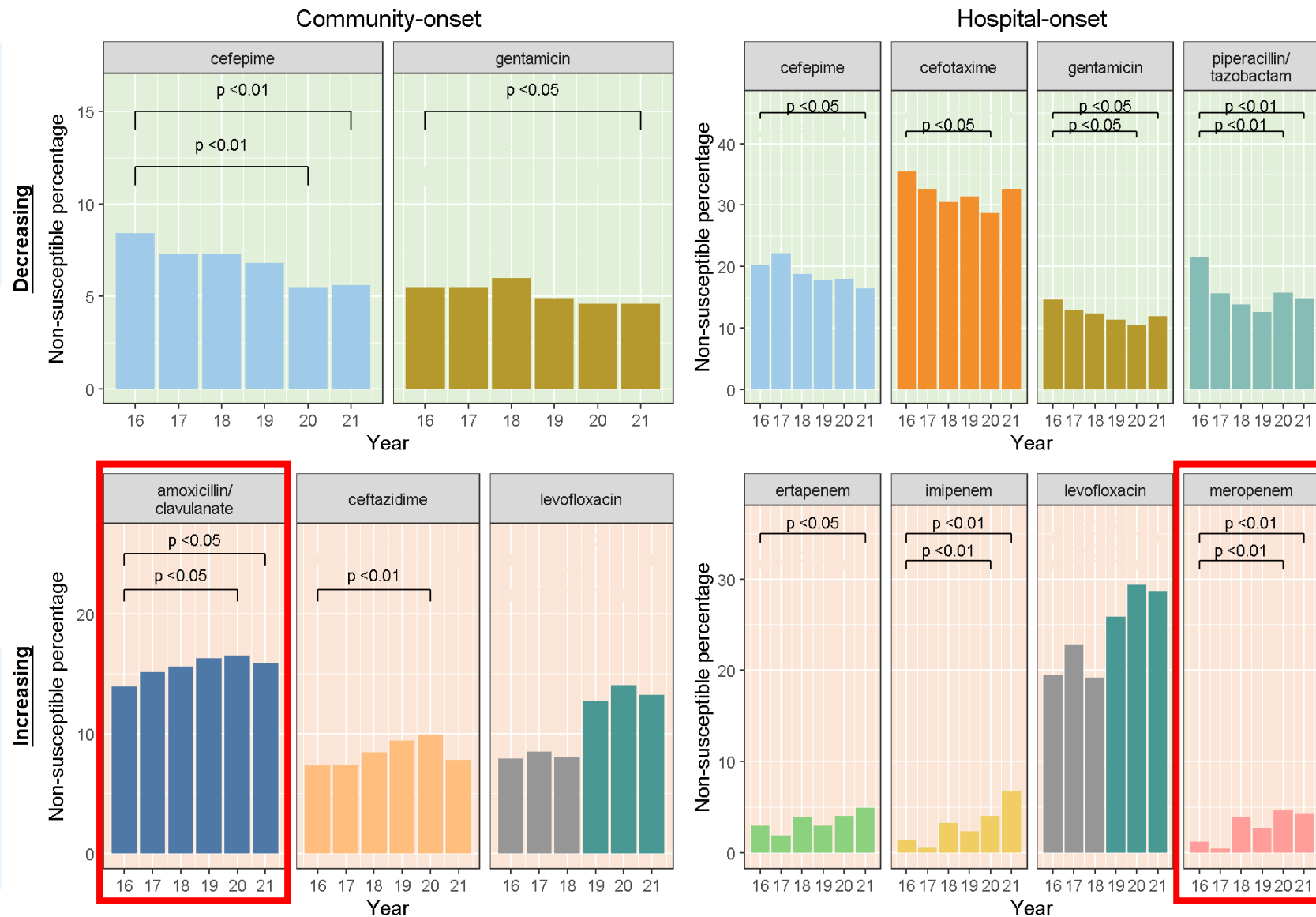
Significant change in trend for *K. pneumoniae* (16 to 21)



‡ Revised fluoroquinolones interpretive criteria for Enterobacteriaceae (except *Salmonella* spp.) was released by CLSI in 2019. The increase in 2019 and thereafter compared with 2018 and before may be contributed by a change in CLSI criteria.

3. NS% for cefotaxime (hospital-onset) fluctuated

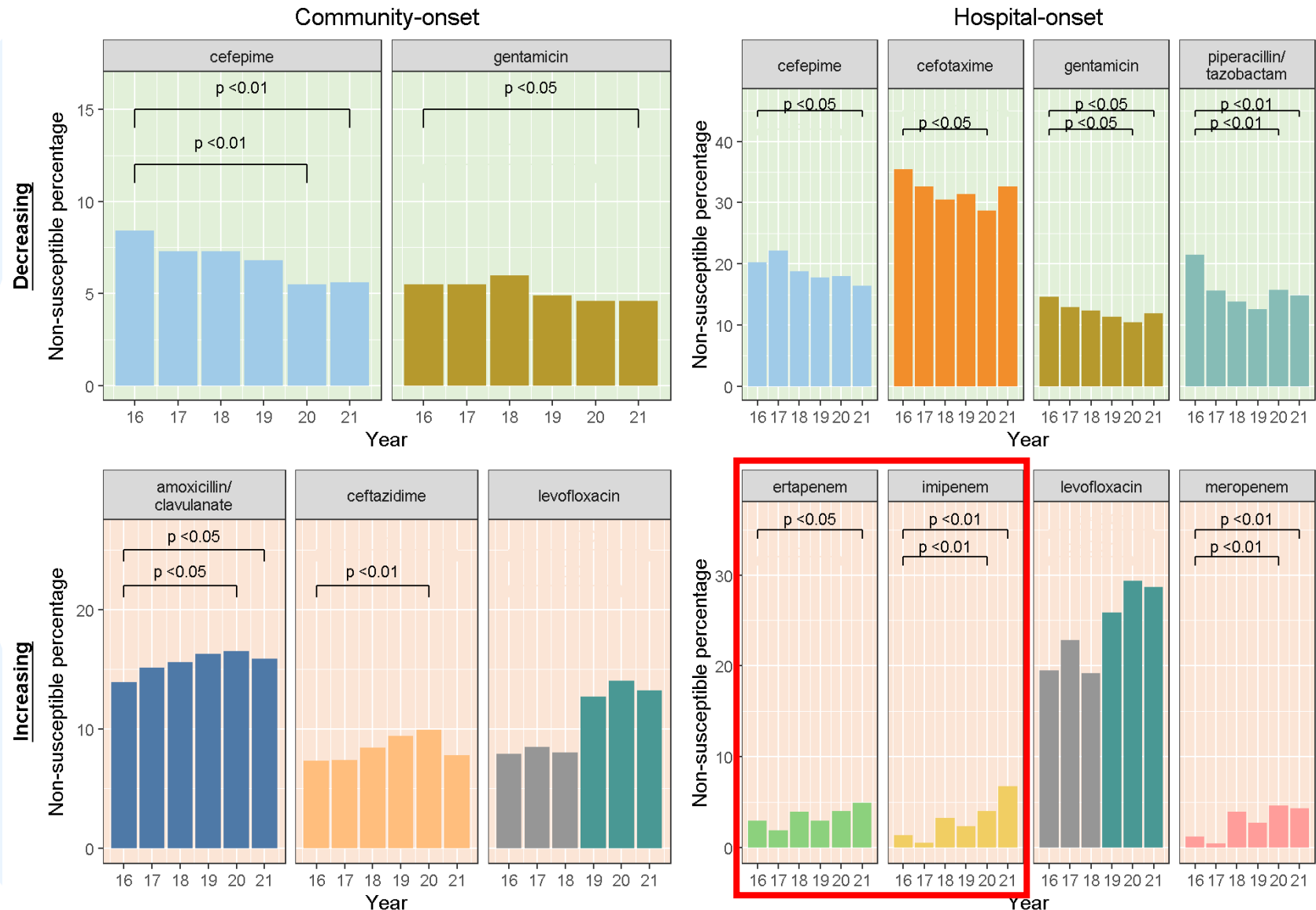
Significant change in trend for *K. pneumoniae* (16 to 21)



‡ Revised fluoroquinolones interpretive criteria for Enterobacteriaceae (except *Salmonella* spp.) was released by CLSI in 2019. The increase in 2019 and thereafter compared with 2018 and before may be contributed by a change in CLSI criteria.

4. Although an increasing trend was still seen for amoxicillin/ clavulanate (community), and meropenem (hospital), mild reduction was also observed.

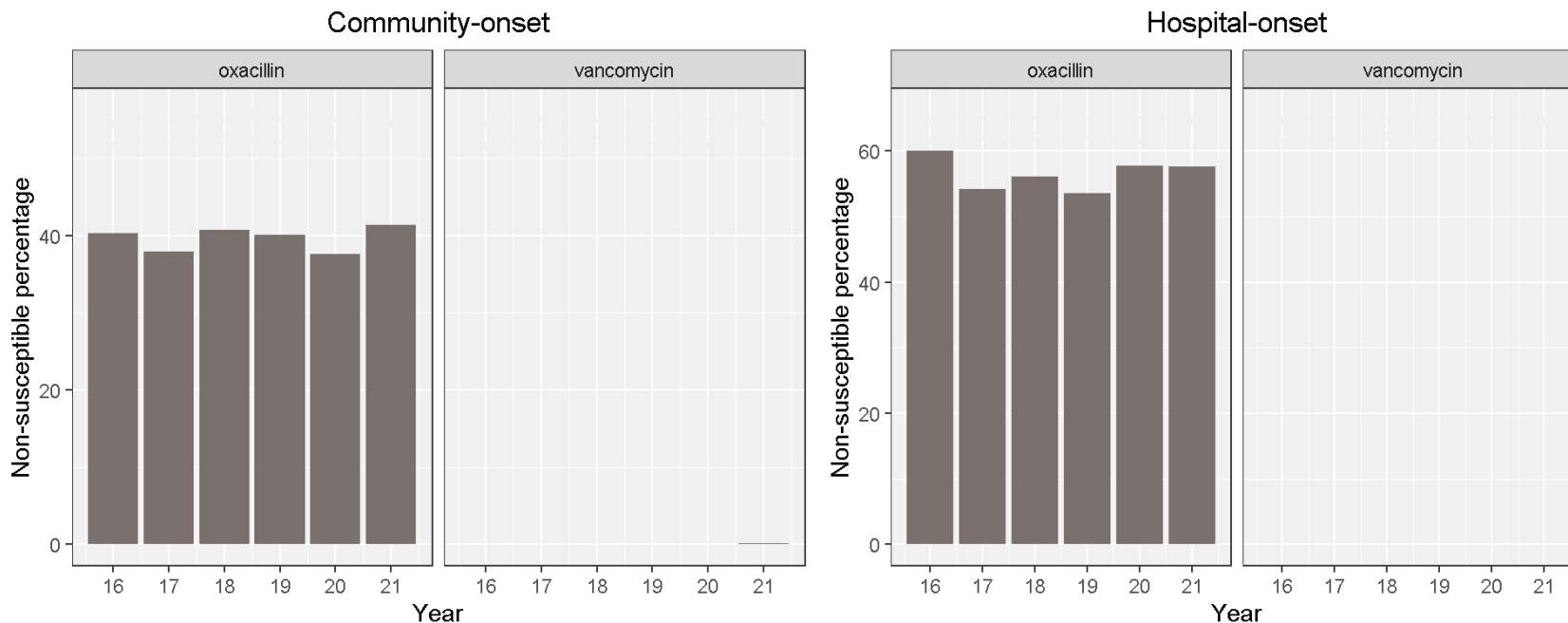
Significant change in trend for *K. pneumoniae* (16 to 21)



‡ Revised fluoroquinolones interpretive criteria for Enterobacteriaceae (except *Salmonella* spp.) was released by CLSI in 2019. The increase in 2019 and thereafter compared with 2018 and before may be contributed by a change in CLSI criteria.

5. NS% for ertapenem and imipenem (hospital-onset) showed increasing trend, of which increasing trend for ertapenem was firstly seen since the beginning of surveillance of surveillance (16-21).

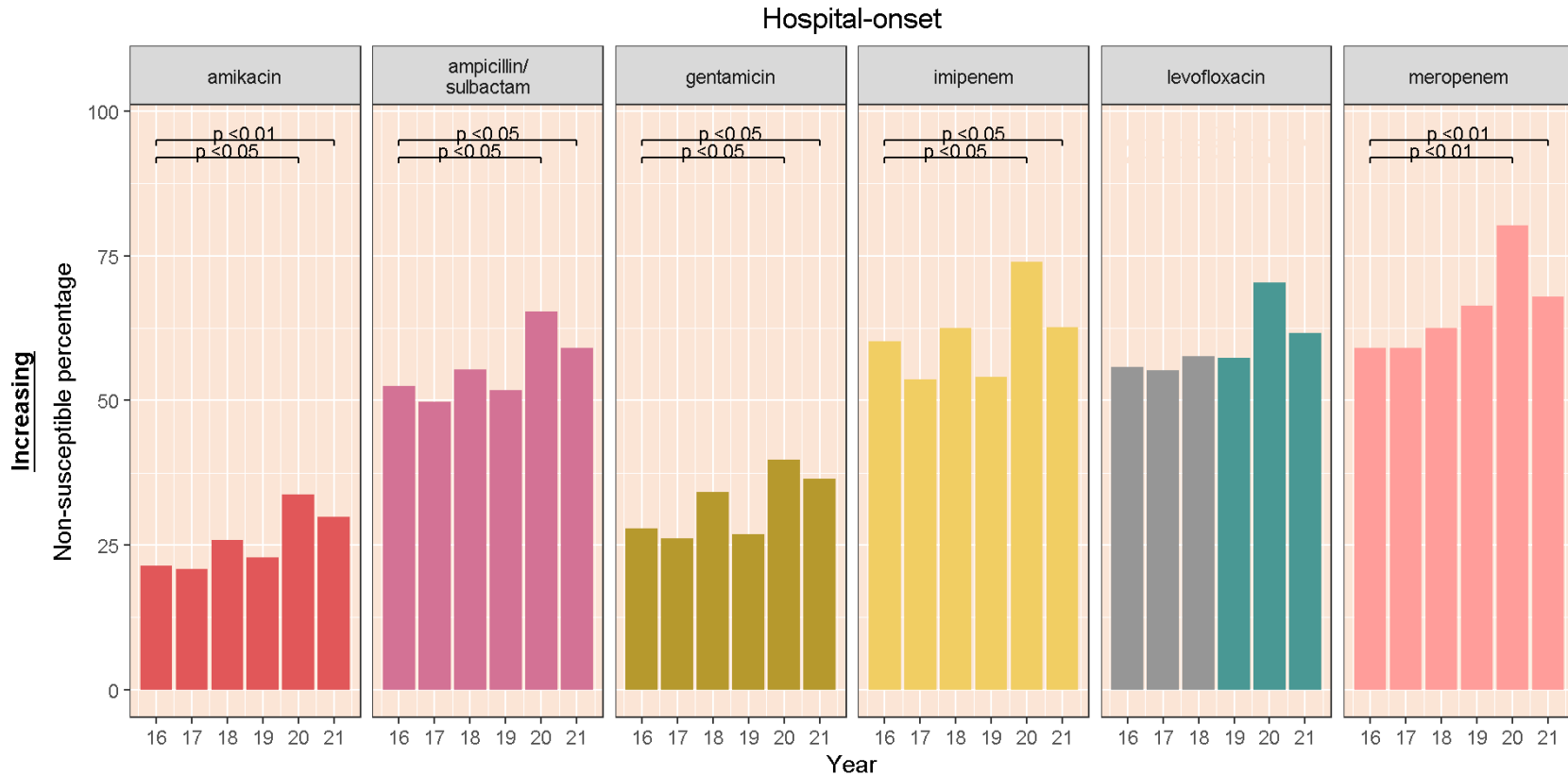
Non-susceptibility trend for *S. aureus* (16 to 21)



- No change in significant trend were observed
- NS% for oxacillin remains at 40% for community-onset isolates and 60% for hospital-onset isolates from 2016 to 2021



Significant change in trend for *Acinetobacter* spp. (16 to 21)

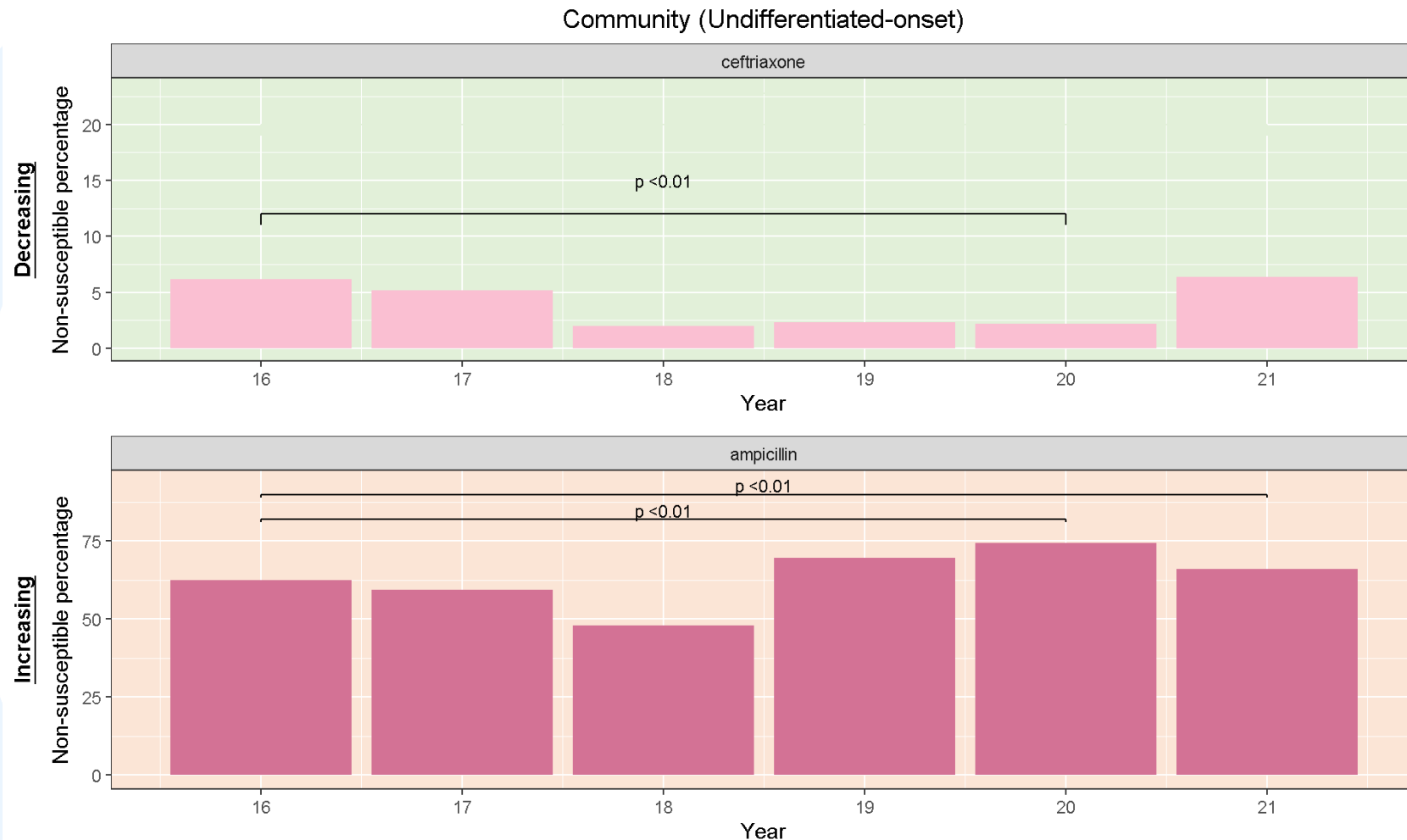


‡ Revised fluoroquinolones interpretive criteria for Enterobacteriaceae (except *Salmonella* spp.) was released by CLSI in 2019. The increase in 2019 and thereafter compared with 2018 and before may be contributed by a change in CLSI criteria.

- Increasing trends observed in 16-20 for amikacin, ampicillin/sulbactam, gentamicin, imipenem and meropenem remained in 16-21
- Non-susceptibility % in 2021 of these drugs were lower than that of 2020



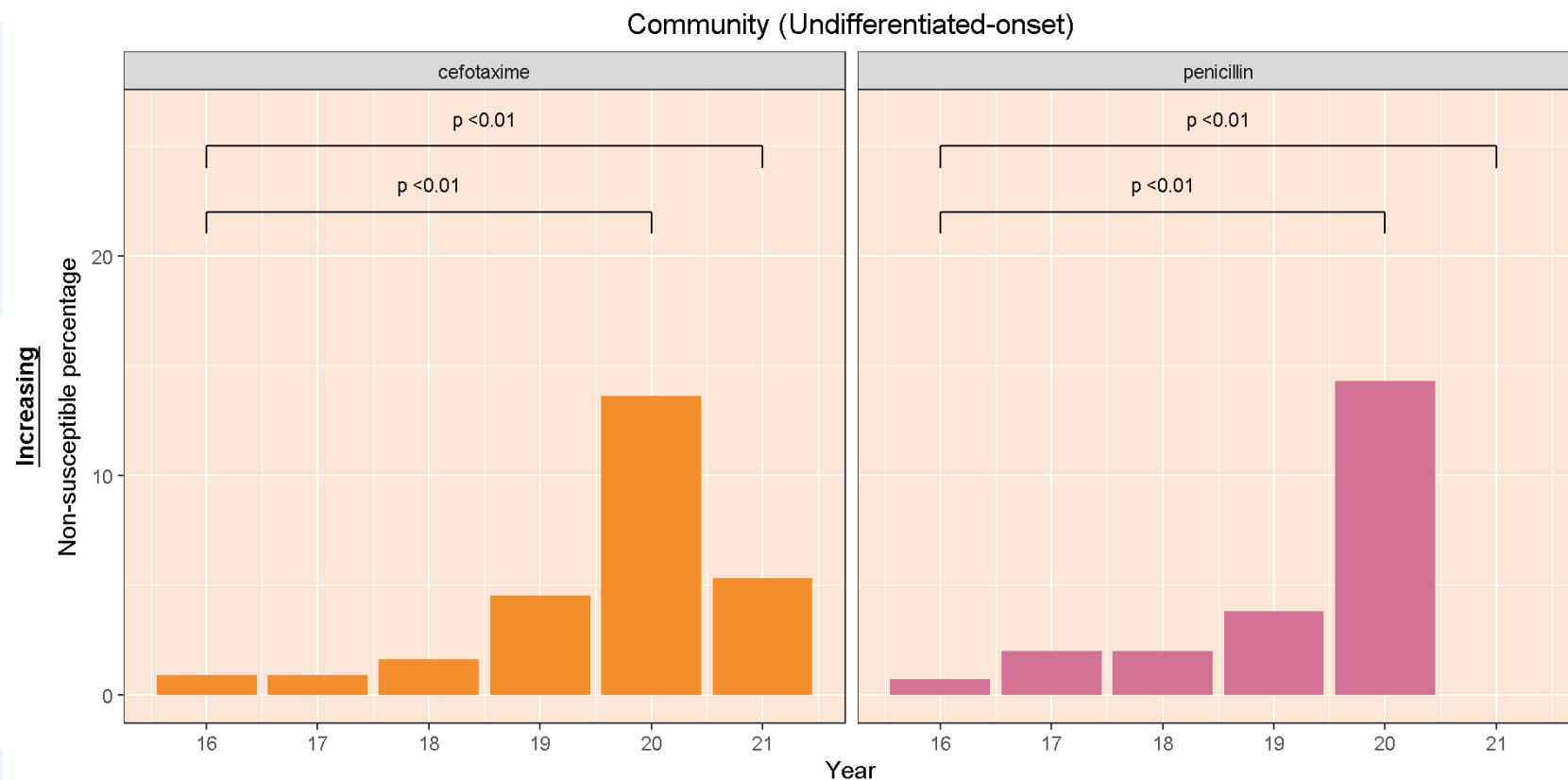
Significant change in trend for *Salmonella* spp. (16 to 21)



- Although an increasing trend was still seen for ampicillin, mild reduction was also observed.
- Non-susceptibility % of ceftriaxone increased in 2021



Significant change in trend for *S. pneumoniae* (16 to 21)



- Continuous upward trends were observed for cefotaxime and penicillin for 16-20 and 16-21
- Trend should be interpreted with caution due to small sample size



Remarks on Interpretation of Results

- Differentiation of location of onset of patients with bloodstream infections for surveillance purposes depends on the operational definition (hospital-onset for organism isolated from blood specimen collected > 48 hours after hospital admission):
 - Factors affecting differentiation of location of onset:
 - Timing of blood specimen taken
 - Rate of disease progression
- CLSI guidelines for sensitivity testing involving levofloxacin interpretive criteria for Enterobacteriaceae (except *Salmonella* spp.) has been updated in 2019. In case laboratories in HA chose to apply the criteria for reporting in 2019, some *E. coli* and *K. pneumoniae* isolates previously categorised as sensitive to levofloxacin / ciprofloxacin using the old criteria would become non-susceptible following a change in 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.



Summary Table on Key Findings (Blood)

WHO priority organism	Proportion of isolates being non-susceptible to antimicrobials, 2016 vs 2021	
	Community-onset	Hospital-onset
<i>E. coli</i>	↓ Piperacillin/tazobactam (7.2% → 4.2%) ↓ Cefepime (23.6% → 15.4%) ↓ Gentamicin (28.9% → 23.5%)	↓ Piperacillin/tazobactam (14.1% → 10.3%) ↓ Ceftazidime (23.2% → 18.4%) ↓ Cefepime (33.1% → 19.8%) ↓ Gentamicin (35.3% → 29.2%)
	↑ Amoxicillin/clavulanate (27.1% → 27.3%) ↑ Cefuroxime (30.1% → 31.4%) ↑ Cefotaxime (27.8% → 28.9%) ↑ Ertapenem (0.1% → 0.2%) ↑ Imipenem (<0.05% → 0.2%)	↑ Imipenem (0.2% → 1.6%)
<i>K. pneumoniae</i>	↓ Cefepime (8.4% → 5.6%) ↓ Gentamicin (5.5% → 4.6%)	↓ Piperacillin/tazobactam (21.5% → 14.9%) ↓ Cefepime (20.3% → 16.4%) ↓ Gentamicin (14.6% → 11.9%)
	↑ Amoxicillin/clavulanate (13.9% → 15.9%)	↑ Meropenem (1.2% → 4.3%) ↑ Imipenem (1.3% → 6.7%) ↑ Ertapenem (2.9% → 4.9%)
<i>S. aureus</i>	Oxacillin (40.3% → 41.4%)	Oxacillin (60.0% → 57.6%)
<i>Acinetobacter</i> spp.	None observed	↑ Ampicillin/sulbactam (52.5% → 59.1%) ↑ Meropenem (59.0% → 67.9%) ↑ Imipenem (60.2% → 62.6%) ↑ Gentamicin (27.9% → 36.5%) ↑ Amikacin (21.5% → 29.9%)



Summary Table on Key Findings (Blood)

WHO priority organism	Proportion of isolates being non-susceptible to antimicrobials, 2016 vs 2021
	Community (Undifferentiated)-onset
<i>Salmonella spp.</i>	⬆ Ampicillin (62.4% → 66.0%)
<i>S. pneumoniae</i>	⬆ Penicillin (0.7% → 0%)* ⬆ Cefotaxime (0.9% → 5.3%) * <50 <i>S. pneumoniae</i> isolated and non tested NS to penicillin



Summary



Summary

- 👍 Downward trends of non-susceptibility (NS) continued in 16-20 and 16-21:
E. coli – cefepime, gentamicin, piperacillin/ tazobactam, ceftazidime
K. pneumoniae – cefepime, gentamicin, piperacillin/ tazobactam

- 👍 New downward trend of NS observed in 16-21:
K. pneumoniae – cefepime, gentamicin

- 👍 Upward trend of NS continued in 16-21 but showed sign of decrease:
E. coli – amoxicillin/ clavulanate, cefotaxime, cefuroxime
K. pneumoniae – amoxicillin/ clavulanate, meropenem
Acinetobacter spp. – amikacin, ampicillin/ sulbactam, gentamicin, imipenem, meropenem
Salmonella spp. – ampicillin

- 👍 New upward trend of NS observed in 16-21:
E. coli & *K. pneumoniae* – ertapenem, imipenem



Recommendations

- Continue ASP in public hospitals
 - NS% on selected antimicrobials for *Acinetobacter* spp. started to decrease in 2021
 - NS% on some drug-bug combinations were peaked in 2020 and reduced in 2021 (e.g. *E. coli* & *K. pneumoniae* – amoxicillin/clavulanate (Blood, Community-onset))
- Attention needed on emerging drug-bug combinations shows increasing resistance, e.g.
 - *E. coli* – ertapenem (Community-onset) & imipenem (Hospital-onset) (Blood)
 - *K. pneumoniae* – ertapenem (Blood, Hospital-onset)
 - Attention on these drug-bug combinations for ASP is warranted

