GIG CYMRU NHS WALES | Iechyd Cyhoeddus Cymru Public Health Wales

Carbapenemase-producing Organism (CPO) Surveillance

Wales 2023/24 Financial Year (FY) Report

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Mae'r ddogfen yma ar gael yn y Gymraeg/
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Contents

Report Summary

Wales is currently a relatively low prevalence area for Carbapenemase Producing Organisms (CPOs). Screening, detection of CPO and effective Infection Prevention and Control measures play a vital role in maintaining a low prevalence and combatting spread of antibiotic resistance.

A. Screening for CPO

- 13,865 screens for CPO were taken from 8,214 individuals in Wales in 2023/24, equating to a rate of 30 screens per 1,000 hospital admissions (Table & Figure 1.1.).
- 58% of individuals screened were male. The median age was 68 years (Figure 2.1.).
- 90% of screens were taken in a hospital inpatient (IP) location (Table 3.1.). 68% of first screens during a hospital IP stay were taken on admission (day 1 or 2) (Table 3.2.). Of these, 24% were admissions to critical care (CC); 3% admissions from a care home (CH); and <1% were patients who had a CPO detected in the previous 12 months (Table 3.3.). 15% of all patients admitted to CC were screened on the day of admission (Table 3.5.). Of the 1,326 CPO screens taken in the community or a non-IP hospital location, <1% were from CH residents and 2% prior to hospital admission (Table 3.4.).
- 264 of the 13,865 screens for CPO taken in Wales in 2023/24 identified at least one possible CPO. In 76 screens at least one possible CPO was confirmed as CPO. This equates to a rate of 19 possible and 5 confirmed CPO screens per 1,000 CPO screens taken (Table 4.1.).
- The number of screens for CPO, especially pre-admission screens, is low in some health boards and could improve in all health boards. Screening to detect and control the spread of CPO is an essential part of infection control measures.

B. Possible CPO

- 802 possible CPO were identified in Wales in 2023/24; 36% (289) from screening and 64% (513) clinical specimens (Table 5.1.). N.B. Multiple possible CPO were identified in 23 screening and 3 clinical specimens and counted as separate possible CPO.
- 54% of possible CPO were identified in specimens from males. The median age was 66 years (Figure 6.1.).
- *P. aeruginosa* was the most common species of possible CPO, accounting for 26% (Table 7.1.). Carbapenem resistance in *P. aeruginosa* is not uncommon, but it is mainly caused by the organism's native ampC beta-lactamase, permeability issues and efflux pumps. Grouped by genus, *Klebsiella spp*. and *Pseudomonas spp.* together accounted for 54% of all possible CPO (Figure 7.1.); *Klebsiella spp.* was more prevalent in screening specimens (50%) (Figure 7.2.) and *Pseudomonas spp.* in clinical (39%) (Figure 7.3.).
- 22% (175) of the 802 possible CPO identified in Wales in 2023/24 were confirmed as CPO. 37% of possible CPO identified in screening specimens were confirmed as CPO, compared to 13% from clinical specimens (Table 8.1.).

C. New CPO episodes

- In Wales in 2023/24, 139 new episodes of CPO were identified in 123 specimens from 102 individuals. 63% were from screening specimens (Table 9.1.). This equated to a rate of 0.30 new CPO episodes per 1,000 hospital admissions (Figure 9.4.). The highest monthly number of new CPO episodes were in specimens taken in July (15), September (18) and November (16) (Figure 9.3.).
- 56% of new CPO episodes were identified in specimens from males. The median age was 65 years (Figure 10.1.).
- 74% of new CPO episodes were identified in specimens taken in a hospital IP location (Table 11.1.), of which 54% were from specimens taken on admission (day 1 or 2) (Table 11.2.).
- For all new CPO episodes, 12 different species were identified; *E. coli* was the most common (39%), followed by K. pneumoniae (33%) (Table 12.1.). Grouped by genus, Escherichia spp. and *Klebsiella spp*. together accounted for 75% of new CPO episodes (Figure 12.1.). In screening specimens, the percentage of *Escherichia spp.* and *Klebsiella spp.* were similar (38%, 43% respectively) (Figure 12.2.), whereas *Escherichia spp.* was more common in clinical specimens (40%, 25%) (Figure 12.3.).
- OXA-48-like (53%) was the most common carbapenemase gene detected in new CPO episodes (Figure 13.1.). OXA-48-like and NDM type were the two most common genes detected in both screening and clinical specimens, however OXA-48-like accounted for 47% and NDM type 33% of screening specimens compared to 62% OXA-48-like and 17% NDM type in clinical specimens (Figure 13.2&3). The OXA-48-like carbapenemases have been the most common carbapenemases found in Wales since 2019. However, in 2023/24, the second most common carbapenemase gene detected was NDM type, compared with KPC type in 2019-2022.
- OXA-48-like *E. coli* was the most common gene/species combination found in new CPO episodes in Wales in 2023/24 (38 episodes), followed by OXA-48-like *K. pneumoniae* (22 episodes) (Table 14.1.). Grouped by genus OXA-48-like *Escherichia spp.* accounted for 27% of new CPO episodes and OXA-48-like *Klebsiella spp*. 17% (Table 14.2.). OXA-48-like in *Klebsiella spp.* or *Escherichia spp.* were the most common combinations found in screening specimens (23%, 20% respectively), whereas in clinical specimens there were 56% more OXA-48-like *Escherichia spp.* (18 episodes) than OXA-48-like *Klebsiella spp.* (8 episodes) (Figure 14.1&2.). Multiple new CPO episodes were identified in 15 of the 123 screening and clinical specimens; 13 with >1 gene type and 2 specimens where different species harboured the same carbapenemase gene (Figure 14.3.). This equated to 28 of the 102 individuals, 11 with multiple species containing the same carbapenemase gene, 12 with an isolate containing >1 gene type and 5 with both (Figure 14.4.). Among the 6 university health boards (UHBs), OXA-48-like *Escherichia spp*. was the most common combination in Betsi Cadwaladr and Hywel Dda UHBs and joint top with OXA-48-like *Klebsiella spp.* in Swansea Bay UHB. KPC type *Klebsiella spp.* was the most common in Aneurin Bevan UHB, NDM type *Escherichia spp*. and OXA-48-like *Klebsiella spp.* in Cardiff and Vale UHB and KPC type *Citrobacter spp*. in Cwm Taf Morgannwg UHB (Figure 14.5.).

The most common CPO gene/species isolated may be affected by outbreaks during the year. For 2023/24 there were no major CPO outbreaks in Wales.

The prevalence of the different CPO genes/species may change over time. Trends and comparisons with previous years will be added to subsequent reports.

Data sources

Carbapenemase-producing organism (CPO) screening data: Specimens submitted to a Welsh microbiology laboratory with CPO or CPE screen recorded as specimen type, extracted from LIMS via ICNet. Excludes MRSA screens and specimens not tested.

Possible carbapenemase-producing organism (CPO) data: Carbapenem resistant organisms detected in specimens submitted to a Welsh microbiology laboratory, extracted from the Welsh Laboratory Information Management System (LIMS) via ICNet.

New carbapenemase-producing organism (CPO) episode data: Specimens with a carbapenemase gene detected by multiplex PCR testing by the Specialist Antimicrobial Reference Unit (SACU), extracted from LIMS via ICNet or specimens with a carbapenemase gene detected by a rapid Cepheid test, extracted from LIMS via ICNet. Data deduplicated to exclude rapid result if a SACU result with the same organism and gene exists for that specimen.

Hospital admissions data: Admissions to hospitals in Wales extracted from patient administrative systems (PAS) via ICNet. Hospital admission defined as at least one overnight stay in hospital. Transfers to other hospitals within the same health board (HB) counted as one admission.

Care home (CH) resident data: Individuals resident in a care home at the time of specimen collection were identified using a trained random forest classifier model currently being developed in-house by the CDSC data science team. The automated tool predicts care home residency by checking available record address and postcode fields against multiple criteria and reference datasets, including a list of care homes registered with Care Inspectorate Wales (CIW).

Data definitions

UHB; THB; NHST: University Health Board; Teaching Health Board; National Health Service Trust.

Screening specimen: Specimen taken from an individual who had no evidence of infection but was identified as a potential carrier and tested for a carbapenemase-producing organism (CPO).

Clinical specimen: Specimen taken from an individual with signs and/or symptoms of an infection.

Possible carbapenemase-producing organism (CPO): Gram negative bacterium resistant to carbapenem antibiotics that could possibly be due to the presence of a carbapenemase gene. Includes all *Enterobacterales* resistant to ertapenem OR imipenem OR meropenem; all *Pseudomonas spp.* resistant to meropenem AND imipenem AND piperacillin-tazobactam; all *Acinetobacter spp.* resistant to imipenem OR meropenem. Excludes *Aeromonas spp.; Chryseobacteria spp.; Stenotrophomonas maltophilia; Providencia, Morganella* or *Proteus spp.* with resistance to imipenem, but susceptible to other carbapenems. N.B. More than one possible CPO can be isolated from a single specimen, e.g. *K. pneumoniae* and *E. coli* both isolated from the same specimen and both carbapenem resistant are counted as two possible CPO.

Carbapenemase gene: A transmissible gene that produces an enzyme which hydrolyses nearly all β-lactam antibiotics, including carbapenems.

Confirmed carbapenemase-producing organism (CPO): Carbapenem resistant organism

where resistance is due to the presence of a carbapenemase gene (rapid test and/or SACU confirmed). N.B. More than one CPO can be confirmed from a single specimen if multiple species and/or gene combinations are detected, e.g. carbapenem resistant *K. pneumoniae* and *E. coli* both isolated from the same specimen, OXA-48-like gene in both, count as two CPO; or *K. pneumoniae* containing both OXA-48-like and NDM-type genes, also count as two CPO.

New carbapenemase-producing organism (CPO) episode: Confirmed CPO with no prior confirmed CPO of the same species and carbapenemase gene from the same individual, within the last 52 weeks. e.g. *K. pneumoniae* and *E. coli* isolated from the same specimen, with OXA-48-like gene in both and no history of OXA-48-like *K. pneumoniae* or *E. coli* in the previous 52 weeks, count as two new CPO episodes; or *K. pneumoniae* containing both OXA-48-like and NDM-type genes and no OXA-48-like or NDM type *K. pneumoniae* in the previous 52 weeks, also count as two new CPO episodes. However, if the individual had a prior OXA-48-like *K. pneumoniae*, only the NDM-type *K. pneumoniae* combination counts as a new CPO episode.

A. Screening for CPO

1. Rate of screening for CPO

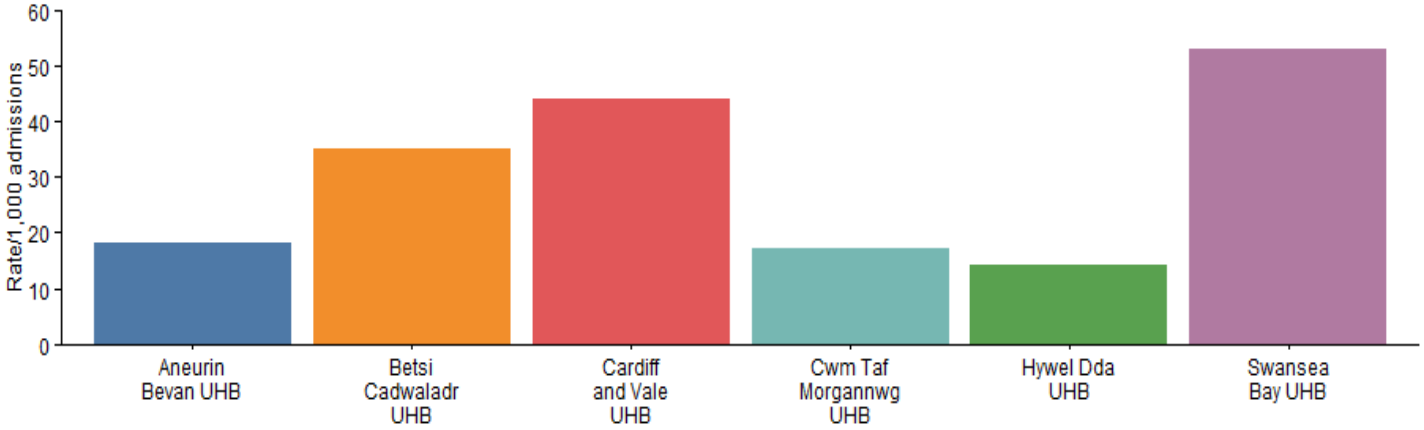
- 13,865 screens for CPO were taken from 8,214 individuals in Wales in 2023/24. This equates to a rate of 30 screens per 1,000 hospital admissions. Amongst the 6 UHBs, rates ranged from 14 in Hywel Dda UHB to 53 in Swansea Bay UHB (Table 1.1.).

Table 1.1. Count and rate of screening for CPO per 1,000 hospital admissions in each HB/NHS Trust, 2023/24 FY

HB/NHS trust	Count of screens for CPO taken	Rate of screening for CPO per 1,000 admissions
Aneurin Bevan UHB	1,903	18
Betsi Cadwaladr UHB	3,433	35
Cardiff and Vale UHB	2,976	44
Cwm Taf Morgannwg UHB	1,174	17
Hywel Dda UHB	722	14
Powys THB	6	5
Swansea Bay UHB	3,184	53
Velindre NHST	467	160
All Wales	**13,865**	**30**

Rate of screening for CPO per 1,000 hospital admissions: (Count of screens for CPO taken / Count of hospital admissions) x 1,000

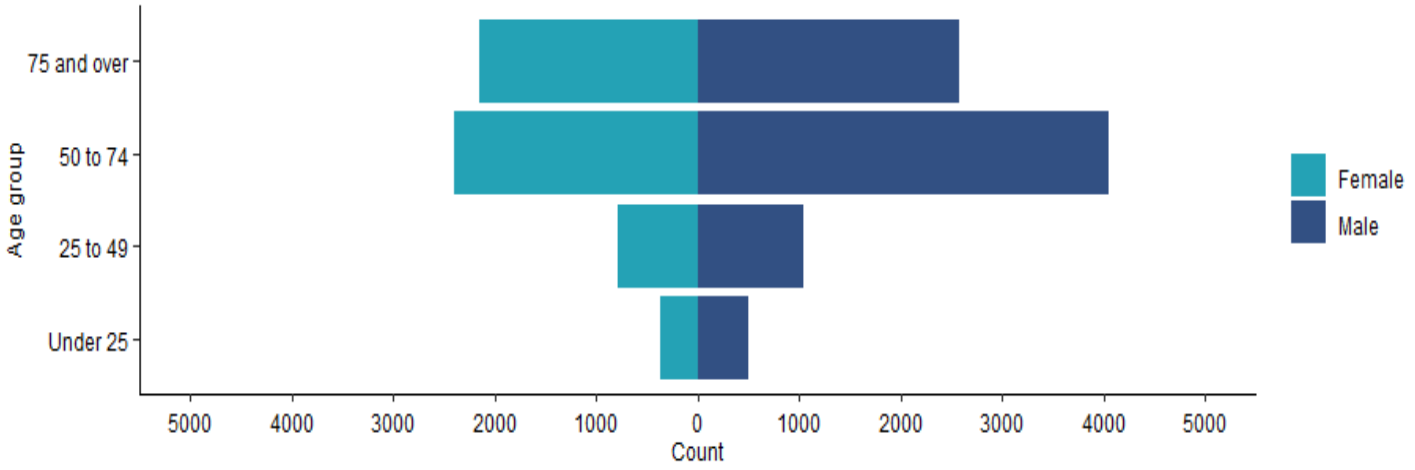
Figure 1.1. Rate of screening for CPO per 1,000 hospital admissions in each UHB, 2023/24 FY



2. Screening for CPO by demographics

- 56% of individuals screened were male. More males were screened than females across all age groups. The median CPO screening age was 68 years, with 47% aged between 50 and 74 years and just 6% under 25 years. Males between the age of 50 and 74 accounted for 29% of all CPO screens taken (Figure 2.1.).

Figure 2.1. Count of screens for CPO taken by age group and sex, 2023/24 FY



3. Screening for CPO by location

- 90% of CPO screens were taken in a hospital inpatient (IP) location. Aneurin Bevan and Swansea Bay UHBs had higher proportions of screening in non-inpatient (non-IP) hospital locations than the other UHBs (13% and 16%) (Table 3.1.).
- 68% of first screens taken during a hospital IP stay were on admission (day 1 or 2). Betsi Cadwaladr and Swansea Bay UHBs had a lower proportion of first screens on admission than other UHBs (54% and 63%) (Table 3.2.).
- 24% of first screens taken on admission to hospital were admissions to critical care (CC). Betsi Cadwaladr and Swansea Bay UHBs had higher proportions of first screens on admission to CC than other UHBs (41% and 43%). 3% of first screens on admission to hospital were care home (CH) residents. This was slightly higher in Aneurin Bevan and Betsi Cadwaladr UHBs (7% and 5%). Less than 1% of individuals screened had previously had a CPO detected within the last 12 months (Table 3.3.).
- Of the 1,326 CPO screens taken in the community or a non-IP hospital location, <1% were CH residents and 2% prior to hospital admission. Cwm Taf Morgannwg UHB had a higher proportion of screens prior to hospital admission, however numbers were low (10%, 2/21) (Table 3.4.).
- 15% of patients admitted to CC were screened on the day of admission. This ranged from 1% in Aneurin Bevan UHB to 36% in Swansea Bay UHB (Table 3.5.).

Table 3.1. Count and percentage (%) distribution of screens for CPO taken in each HB/NHS trust, by location type, 2023/24 FY

HB/NHS trust	Count (% of all CPO screens)		
	Hospital IP screens	Hospital non-IP screens	Community screens
Aneurin Bevan UHB	1551 (82%)	239 (13%)	113 (6%)
Betsi Cadwaladr UHB	3195 (93%)	236 (7%)	2 (<1%)
Cardiff and Vale UHB	2779 (93%)	36 (1%)	161 (5%)
Cwm Taf Morgannwg UHB	1153 (98%)	20 (2%)	1 (<1%)
Hywel Dda UHB	704 (98%)	17 (2%)	1 (<1%)
Powys THB	3 (50%)	0 (<1%)	3 (50%)
Swansea Bay UHB	2687 (84%)	496 (16%)	1 (<1%)
Velindre NHST	467 (100%)	0 (<1%)	0 (0%)
All Wales	**12539 (90%)**	**1044 (8%)**	**282 (2%)**

Hospital inpatient (IP) screen: Screen for CPO taken in a hospital location during an IP overnight stay.
Hospital non-inpatient (non-IP) screen: Screen for CPO taken in a hospital location with no overnight stay.
Community screen: Screen for CPO taken in a non-hospital location.

Table 3.2. Count and percentage (%) distribution of first screens for CPO taken in each HB/NHS trust during a hospital IP stay, by time from admission, 2023/24 FY

HB/NHS trust	Count of hospital IP stays with screen (N)	Count first screens (% of N)	
		On admission (day 1 or 2)	>2 days after admission
Aneurin Bevan UHB	630	470 (75%)	160 (25%)
Betsi Cadwaladr UHB	1,980	1078 (54%)	902 (46%)
Cardiff and Vale UHB	1,621	1356 (84%)	265 (16%)
Cwm Taf Morgannwg UHB	466	331 (71%)	135 (29%)
Hywel Dda UHB	625	442 (71%)	183 (29%)
Powys THB	1	1 (100%)	0 (0%)
Swansea Bay UHB	1,913	1212 (63%)	701 (37%)
Velindre NHST	410	280 (68%)	130 (32%)
All Wales	**7,646**	**5170 (68%)**	**2476 (32%)**

Hospital inpatient (IP) stays with screen: Hospital IP stays where the patient had at least one screen for CPO. N.B. IP stays are defined as an admission to hospital with at least one overnight stay. Transfers between hospitals in the same health board are counted as one IP stay.
On admission: First screen for CPO taken on day 1 or 2 of a hospital IP stay (where day 1 is the day of

admission).
>2 days after admission: First screen for CPO taken more than 2 days into a hospital IP stay (where day 1 is the day of admission).

Table 3.3. Count and percentage (%) of first screens for CPO taken on admission to each HB/NHS trust, by potential reasons for screening, 2023/24 FY

HB/NHS trust	Count of hospital IP stays with first screen on admission (N)	Count of first screens on admission (% of N)		
		CH resident	Previous CPO detected	On admission to CC
Aneurin Bevan UHB	470	32 (7%)	2 (<1%)	33 (7%)
Betsi Cadwaladr UHB	1,078	53 (5%)	1 (<1%)	441 (41%)
Cardiff and Vale UHB	1,356	10 (1%)	3 (<1%)	85 (6%)
Cwm Taf Morgannwg UHB	331	4 (1%)	0 (0%)	20 (6%)
Hywel Dda UHB	442	14 (3%)	1 (<1%)	144 (33%)
Powys THB	1	0 (0%)	0 (0%)	0 (0%)
Swansea Bay UHB	1,212	28 (2%)	1 (<1%)	518 (43%)
Velindre NHST	280	3 (1%)	1 (<1%)	0 (0%)
All Wales	**5,170**	**144 (3%)**	**9 (<1%)**	**1241 (24%)**

Hospital inpatient (IP) stays with first screen on admission: Hospital IP stays where the patient had their first screen for CPO (of current IP stay) on day 1 or 2 of the IP stay. N.B. IP stays are defined as an admission to hospital with at least one overnight stay. Transfers between hospitals in the same health board are counted as one IP stay.
Care home (CH) resident: First screen for CPO on admission taken from a patient whose residential address at the time of screening was a CH.
Previous CPO detected: First screen for CPO on admission taken from a patient who had a positive CPO test (rapid test and/or SACU confirmed) in the previous 12 months from a clinical or a screen specimen.
On admission to critical care (CC): First screen for CPO on admission taken on the same day the patient was admitted to a CC ward.
N.B. The above 3 categories are not mutually exclusive.

Table 3.4. Count and percentage (%) of CPO screens taken in each HB/NHS trust in non-IP hospital and community locations, by potential reasons for screening, 2023/24 FY

HB/NHS trust	Count of non-IP & community screens (N)	Count (% of N)	
		CH resident	Prior to hospital admission
Aneurin Bevan UHB	352	0 (0%)	5 (1%)
Betsi Cadwaladr UHB	238	3 (1%)	6 (3%)
Cardiff and Vale UHB	197	3 (2%)	0 (0%)
Cwm Taf Morgannwg UHB	21	0 (0%)	2 (10%)
Hywel Dda UHB	18	0 (0%)	0 (0%)
Powys THB	3	0 (0%)	0 (0%)
Swansea Bay UHB	497	0 (0%)	13 (3%)
Velindre NHST	0	0 (0%)	0 (0%)
All Wales	**1,326**	**6 (<1%)**	**26 (2%)**

Care home (CH) resident: CPO screen specimen taken from an individual whose residential address at the time of screening was a CH.
Prior to hospital admission: CPO screen specimen taken within 3 days prior to hospital admission. N.B. Only includes hospital admissions with an overnight stay.
N.B. The above 2 categories are not mutually exclusive.

Table 3.5. Count and percentage (%) of CC admissions screened for CPO in each UHB, 2023/24 FY

UHB	Count of CC admissions	Count of screens on admission to CC	% of CC admissions screened
Aneurin Bevan UHB	2,540	34	1%
Betsi Cadwaladr UHB	1,609	568	35%
Cardiff and Vale UHB	2,233	139	6%
Cwm Taf Morgannwg UHB	1,255	23	2%
Hywel Dda UHB	946	179	19%
Swansea Bay UHB	1,880	670	36%
All Wales	**10,463**	**1,613**	**15%**

Critical care (CC) admission: Admission to a CC ward that includes at least one overnight stay.
On admission to critical care (CC): Screen for CPO taken on day of admission to a CC ward.
% of critical care (CC) admissions screened: (Count of screens for CPO taken on admission to CC / Count of admissions to CC) *100.

4. Possible and confirmed CPO screens

- Of the 13,865 screens for CPO taken in Wales in 2023/24, 264 identified at least one possible CPO. In 76 screens at least one possible CPO was confirmed as CPO. This equates to a rate of 19 possible and 5 confirmed CPO screens per 1,000 screens for CPO taken. Of the 6 UHBs the rate of possible CPO screens ranged from 12 (Cwm Taf Morgannwg UHB) to 22 (Aneurin Bevan UHB) per 1,000 screens for CPO taken. Confirmed CPO screens ranged from 3 (Cwm Taf Morgannwg UHB) to 11 (Hywel Dda UHB) per 1,000 screens for CPO taken (Table 4.1.).

Table 4.1. Count and rate of possible and confirmed CPO screens per 1,000 CPO screens taken in each HB/NHS trust, 2023/24 FY

HB/NHS trust	Count of screens taken	Possible CPO screens		Confirmed CPO screens	
		Count	Rate per 1,000 screens taken	Count	Rate per 1,000 screens taken
Aneurin Bevan UHB	1,903	41	22	14	7
Betsi Cadwaladr UHB	3,433	59	17	15	4
Cardiff and Vale UHB	2,976	61	20	18	6
Cwm Taf Morgannwg UHB	1,174	14	12	3	3
Hywel Dda UHB	722	15	21	8	11
Powys THB	6	0	0	0	0
Swansea Bay UHB	3,184	67	21	16	5
Velindre NHST	467	7	15	2	4
All Wales	**13,865**	**264**	**19**	**76**	**5**

Possible CPO screen: Screening specimen with at least one possible CPO detected.
Confirmed CPO screen: Screening specimen with at least one confirmed CPO detected.
N.B. In table 4.1 and figures 4.1 and 4.2, specimens with more than one possible or confirmed CPO detected are still counted as one possible or confirmed CPO screen.

Figure 4.1. Rate of possible CPO screens per 1,000 CPO screens taken in each UHB (with 95% CI), 2023/24 FY

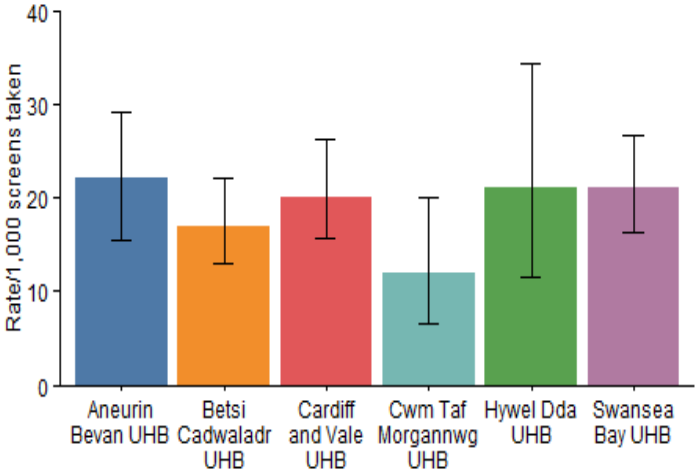
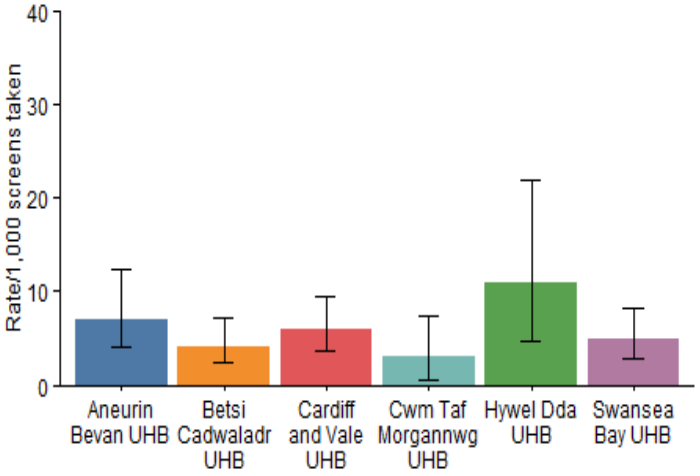


Figure 4.2. Rate of confirmed CPO screens per 1,000 CPO screens taken in each UHB (with 95% CI), 2023/24 FY



B. Possible CPO

5. Possible CPO by specimen type

- 802 possible CPO were identified in Wales in 2023/24; 36% (289) were from screening and 64% (513) clinical specimens. Among the 6 UHBs the proportion of possible CPO from screening ranged from 18% in Hywel Dda UHB to 52% in Swansea Bay UHB (Table 5.1.). N.B. Multiple possible CPO were detected in 23 screening and 3 clinical specimens and counted as separate possible CPO.

Table 5.1. Count and percentage (%) distribution of possible CPO identified in each HB/NHS trust, by specimen type, 2023/24 FY

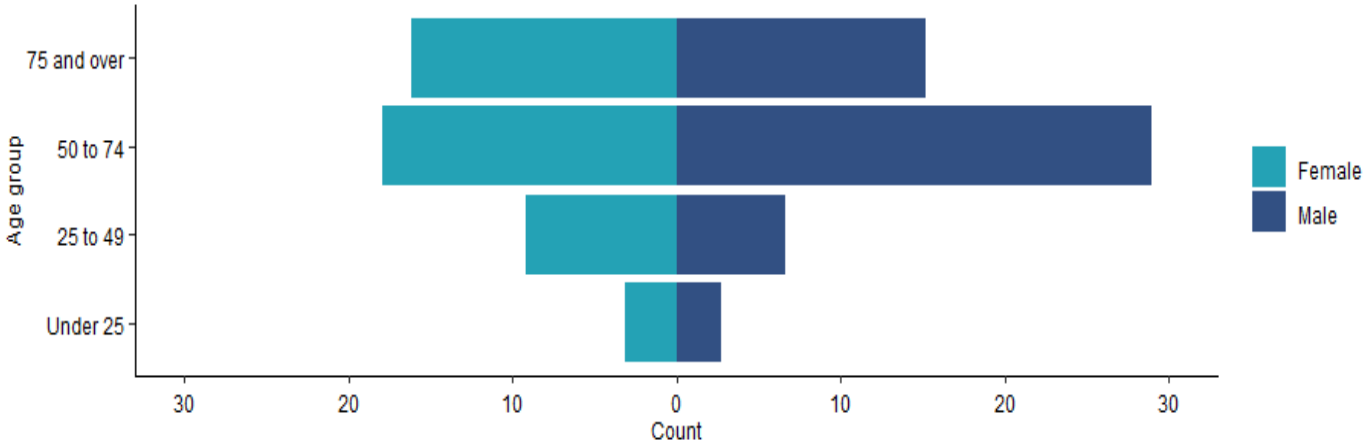
HB/NHS trust	Count of possible CPO (N)	Count of possible CPO (% of N)	
		Screening specimens	Clinical specimens
Aneurin Bevan UHB	115	42 (37%)	73 (63%)
Betsi Cadwaladr UHB	166	63 (38%)	103 (62%)
Cardiff and Vale UHB	163	64 (39%)	99 (61%)
Cwm Taf Morgannwg UHB	81	17 (21%)	64 (79%)
Hywel Dda UHB	113	20 (18%)	93 (82%)
Powys THB	11	0 (0%)	11 (100%)
Swansea Bay UHB	145	75 (52%)	70 (48%)
Velindre NHST	8	8 (100%)	0 (0%)
All Wales	**802**	**289 (36%)**	**513 (64%)**

Possible carbapenemase-producing organism (CPO): Gram negative bacterium resistant to carbapenem antibiotics that could possibly be due to the presence of a carbapenemase gene. Includes all Enterobacterales resistant to ertapenem OR imipenem OR meropenem; all *Pseudomonas spp*. resistant to meropenem AND imipenem AND piperacillin-tazobactam; all *Acinetobacter spp*. resistant to imipenem OR meropenem. Excludes *Aeromonas spp*.; *Chryseobacteria spp.; Stenotrophomonas maltophilia; Providencia, Morganella* or *Proteus spp*. with resistance to imipenem, but susceptible to other carbapenems. N.B. More than one possible CPO can be isolated from a single specimen, e.g. *K. pneumoniae* and *E. coli* both isolated from the same specimen and both carbapenem resistant are counted as two possible CPO.

6. Possible CPO by demographics

- 54% of possible CPO were identified in specimens from males, although more were found in females across all age groups except those aged 50 to 74 where males accounted for 62%. The median age was 66 years, with 47% aged between 50 and 74 years and just 6% aged under 25. Males between the ages of 50 and 74 accounted for 29% of all possible CPO (Figure 6.1.).

Figure 6.1. Count of possible CPO by age group and sex, 2023/24 FY



7. Possible CPO by species

- P. aeruginosa was the most common species of possible CPO identified in Wales in 2023/24, accounting for 26% of all possible CPO. (Table 7.1.).
- Grouped by genus, *Klebsiella spp*. and *Pseudomonas spp*. together accounted for 54% of all possible CPO (Figure 7.1.). *Klebsiella spp*. was more prevalent in screening specimens (50%) (Figure 7.2.) and *Pseudomonas spp.* in clinical specimens (39%) (Figure 7.3.).

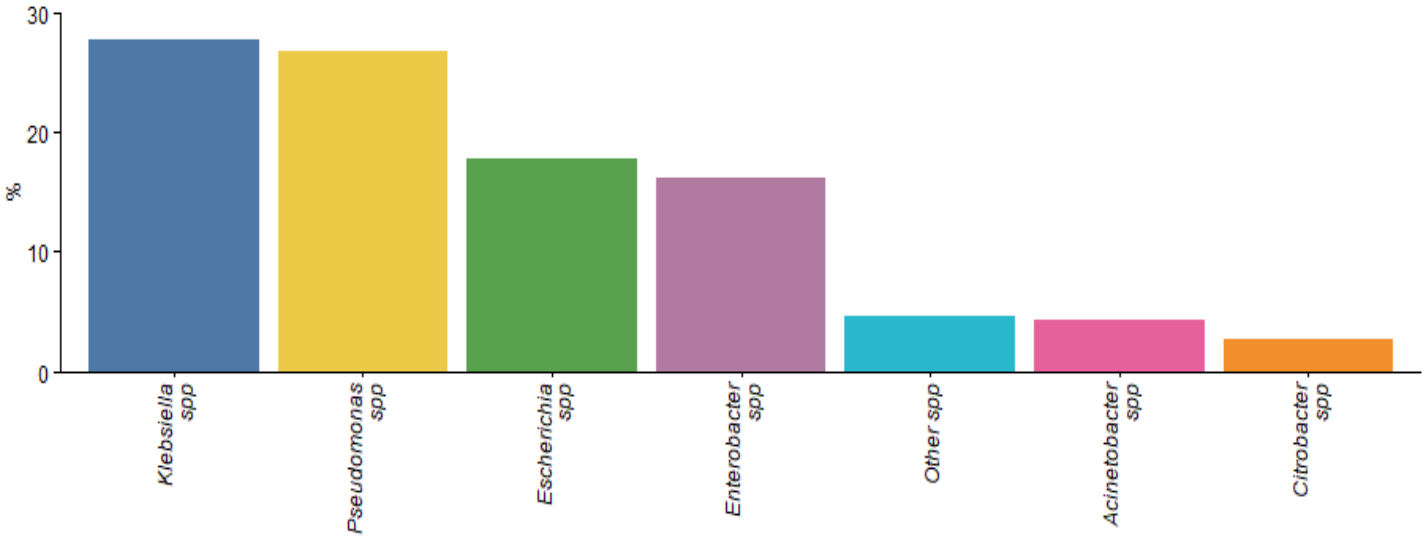
Table 7.1. Count and percentage (%) distribution of most common species of possible CPO, 2023/24 FY

Organism species	Count of possible CPO	% of possible CPO
Pseudomonas aeruginosa	212	26%
Klebsiella pneumoniae	196	24%
Escherichia coli	143	18%
Enterobacter cloacae complex	130	16%
Acinetobacter baumannii	18	2%
Citrobacter freundii	18	2%
Klebsiella aerogenes	15	2%
Other	70	9%

Most common species of possible CPO: Organism species that individually account for more than 1% of all possible CPO. Species that account for 1% or less are grouped as 'Other' (*Achromobacter denitrificans, Achromobacter sp., Achromobacter xylosoxidans, Acinetobacter baumanii, Acinetobacter calcoaceticus, Acinetobacter lwoffii, Acinetobacter nosocomialis, Acinetobacter radioresistans, Acinetobacter schindleri, Acinetobacter sp., Acinetobacter ursingii, Acinetobacter venetianaus, Alcaligenes faecalis, Burkholderia cepacia, Burkholderia gladioli, Citrobacter amalonaticus, Citrobacter braakii, Citrobacter koseri, Comamonas aquatica, Comamonas testosteroni, Delftia acidovorans*, Gram negative

bacillus, Hafnia alvei, Klebsiella oxytoca, Klebsiella variicola, Pantoea agglomerans, Pantoea septica, Proteus mirabilis, Proteus sp., Pseudomonas fluorescens, Pseudomonas putida, Pseudoxanthomonas mexicana, Raoultella ornithinolytica, Roseomonas gilardii, Serratia marcescens).

Figure 7.1. Percentage (%) distribution of most common genus of possible CPO, 2023/24 FY



Most common genus of possible CPO: Organism genus that individually account for more than 1% of all possible CPO. Genus that account for 1% or less grouped as 'Other' (*Achromobacter spp., Alcaligenes spp., Bacillus spp., Burkholderia spp., Comamonas spp., Delftia spp., Hafnia spp., Pantoea spp., Proteus spp., Pseudoxanthomonas spp., Raoultella spp., Roseomonas spp., Serratia spp.*).

Figure 7.2. Percentage (%) distribution of top 5 genus of possible CPO from screening specimens, 2023/24 FY

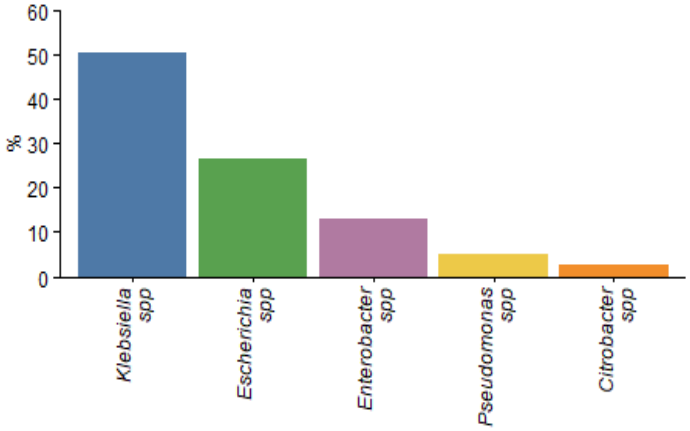
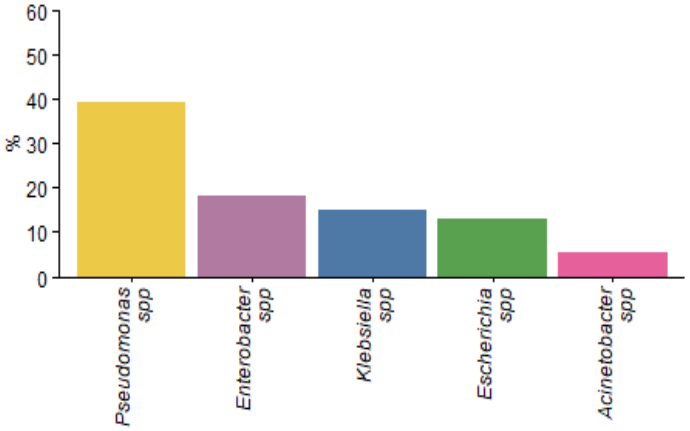


Figure 7.3. Percentage (%) distribution of top 5 genus of possible CPO from clinical specimens, 2023/24 FY



8. Possible CPO confirmed

- Of the 802 possible CPO identified in Wales in 2023/24, 22% (175) were confirmed as CPO. Across the UHBs the percentage of possible CPO confirmed ranged from 16% in Betsi Cadwaladr UHB and Cwm Taf Morgannwg UHB to 34% in Swansea Bay UHB. A higher proportion of possible CPO were confirmed from screening (37%) compared to 13% in clinical specimens (Table 8.1.).

Table 8.1. Count and percentage (%) of possible CPO identified in each HB/NHS trust that were confirmed, by specimen type, 2023/24 FY

HB/NHS trust	All specimens		Screening specimens		Clinical specimens	
	Count of possible CPO (N)	Count of possible CPO confirmed (% of N)	Count of possible CPO (N)	Count of possible CPO confirmed (% of N)	Count of possible CPO (N)	Count of possible CPO confirmed (% of N)
Aneurin Bevan UHB	115	21 (18%)	42	17 (40%)	73	4 (5%)
Betsi Cadwaladr UHB	166	27 (16%)	63	20 (32%)	103	7 (7%)
Cardiff and Vale UHB	163	40 (25%)	64	26 (41%)	99	14 (14%)
Cwm Taf Morgannwg UHB	81	13 (16%)	17	5 (29%)	64	8 (12%)
Hywel Dda UHB	113	22 (19%)	20	8 (40%)	93	14 (15%)
Powys THB	11	1 (9%)	0	0 (0%)	11	1 (9%)
Swansea Bay UHB	145	49 (34%)	75	29 (39%)	70	20 (29%)
Velindre NHST	8	2 (25%)	8	2 (25%)	0	0 (0%)
All Wales	**802**	**175 (22%)**	**289**	**107 (37%)**	**513**	**68 (13%)**

Confirmed CPO: Possible CPO where the resistance is confirmed (by a positive rapid test and/or SACU) to be due to the presence of a carbapenemase gene.

N.B. In table 8.1. and Figure 8.1&2., possible CPO confirmed by the presence of more than one type of carbapenemase gene are counted as one possible CPO confirmed.

Figure 8.1. Percentage (%) of possible CPO from screening specimens in each UHB that were confirmed, 2023/24 FY

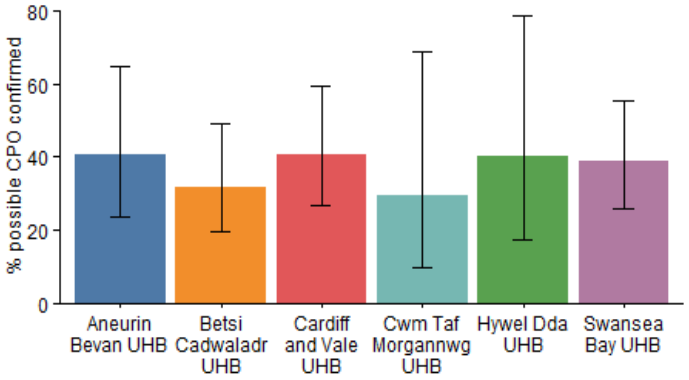
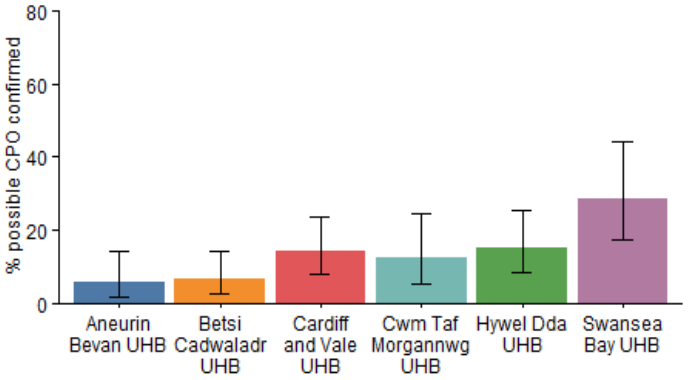


Figure 8.2. Percentage (%) of possible CPO from clinical specimens in each UHB that were confirmed, 2023/24 FY



C. New CPO episodes

9. New CPO episodes by specimen type

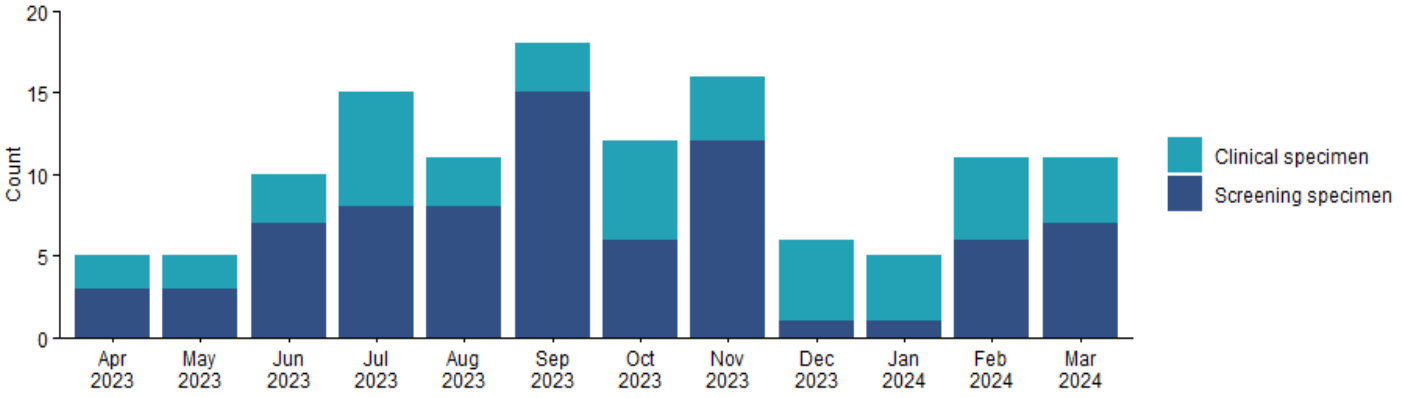
- 139 new episodes of CPO were identified in 123 specimens from 102 individuals. 63% (87) of new episodes were isolated from screening specimens, although in Cwm Taf Morgannwg and Hywel Dda UHBs more new CPO episodes were found in clinical specimens (Table 9.1.).
- The highest monthly number of new CPO episodes were identified in specimens taken in July (15), September (18) and November (16) (Figure 9.3.).
- The rate of new CPO episodes in Wales in 2023/24 was 0.30 per 1,000 hospital admissions. Rates per 1,000 hospital admissions ranged from 0.13 in Cwm Taf Morgannwg UHB to 0.57 in Swansea Bay UHB (Figure 9.4.).

Table 9.1. Count and percentage (%) distribution of new CPO episodes identified in each HB/NHS trust, by specimen type, 2023/24 FY

HB/NHS trust	Count of new CPO episodes (N)	Count (% of N)	
		Screening specimens	Clinical specimens
Aneurin Bevan UHB	22	18 (82%)	4 (18%)
Betsi Cadwaladr UHB	23	16 (70%)	7 (30%)
Cardiff and Vale UHB	31	21 (68%)	10 (32%)
Cwm Taf Morgannwg UHB	9	4 (44%)	5 (56%)
Hywel Dda UHB	18	8 (44%)	10 (56%)
Powys THB	1	0 (0%)	1 (100%)
Swansea Bay UHB	33	18 (55%)	15 (45%)
Velindre NHST	2	2 (100%)	0 (0%)
All Wales	**139**	**87 (63%)**	**52 (37%)**

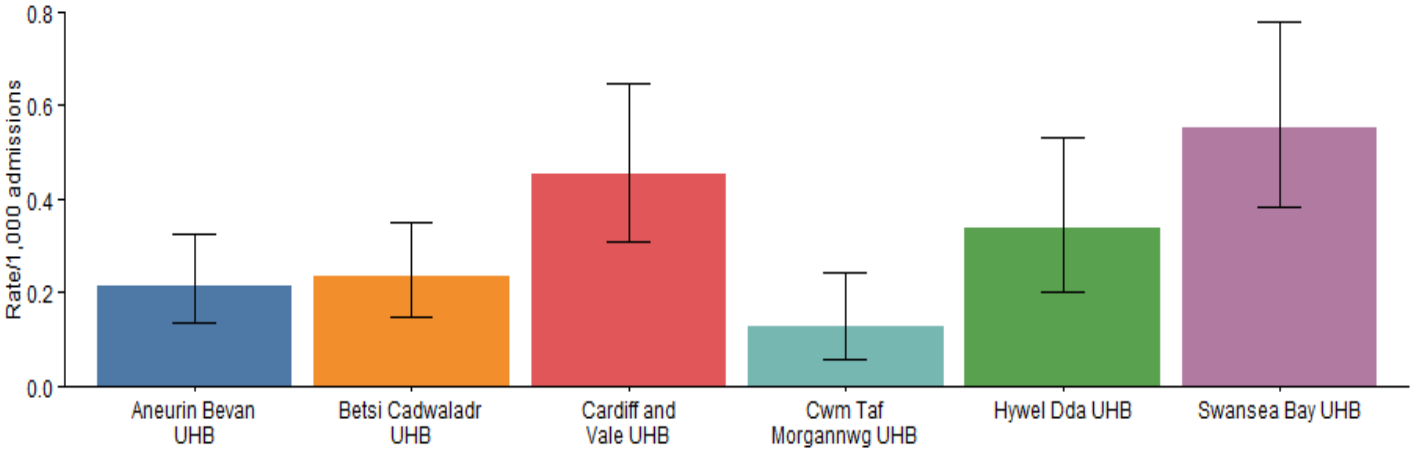
New CPO episode: Carbapenem resistant organism where the resistance is due to the presence of a carbapenemase gene (positive rapid test and/or SACU confirmed). Excludes repeat episodes within 52 weeks of the same species and carbapenemase gene, from the same individual. N.B. More than one new CPO episode can be confirmed from a single specimen if multiple species and/or gene combinations are detected, e.g. carbapenem resistant K. pneumoniae and *E. coli* both isolated from the same specimen, OXA-48-like gene in both and no history of *K. pneumoniae* or *E. coli* with an OXA-48-like gene in the previous 52 weeks, count as two new CPO episodes; or *K. pneumoniae* containing both OXA-48-like and NDM-type genes and no *K. pneumoniae* with OXA-48-like or NDM type genes in the previous 52 weeks, also count as two new CPO episodes. However, if the individual did have a prior OXA-48-like *K. pneumoniae*, only the NDM-type *K. pneumoniae* combination counts as a new CPO episode.

Figure 9.3. Monthly count of new CPO episodes, by specimen type, 2023/24 FY



Monthly count: Based on month a screening or clinical specimen was taken that identified a new CPO episode.

Figure 9.4. Rate of new CPO episodes per 1,000 hospital admissions identified in each HB/NHS trust (with 95% CI), 2023/24 FY

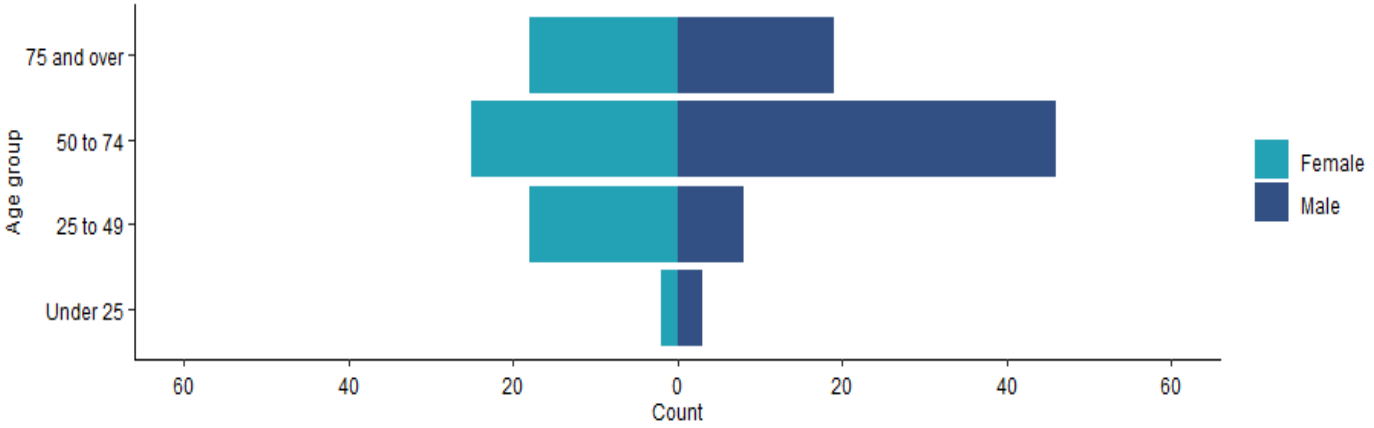


Rate per 1,000 hospital admissions: (Count new CPO episodes / Count of hospital admissions) x 1,000. With 95% confidence intervals (CI).

10. New CPO episodes by demographics

- 56% of new CPO episodes were identified in specimens from males. Males accounted for 65% of those aged 50 to 74 years and females 69% of the 25 to 49 age group. The median age was 65 years, with 51% aged between 50 and 74 and 4% aged under 25. Males between the age of 50 and 74 years accounted for 33% of all new CPO episodes (Figure 10.1.).

Figure 10.1. Count of new CPO episodes by age group and sex, 2023/24 FY



11. New CPO episodes by location

- 74% of new CPO episodes were identified in specimens taken in a hospital IP location. Of the 6 UHBs, Aneurin Bevan and Cardiff and Vale UHBs had a higher proportion of new CPO identified in community and hospital non-IP locations than the other HBs (37% and 32%) (Table 11.1.).
- 54% of new CPO episodes identified during a hospital IP stay were from specimens taken on admission (day 1 or 2). Swansea Bay UHB had a lower proportion of new CPO episodes identified on admission than the other HBs (29%) (Table 11.2.).

Table 11.1. Count and percentage (%) distribution of new CPO episodes identified in each HB/NHS trust, by location type, 2023/24 FY

HB/NHS trust	Count (% of all new confirmed CPO)		
	Hospital IP new CPO episodes	Hospital non-IP new CPO episodes	Community new CPO episodes
Aneurin Bevan UHB	14 (64%)	4 (18%)	4 (18%)
Betsi Cadwaladr UHB	16 (70%)	1 (4%)	6 (26%)
Cardiff and Vale UHB	21 (68%)	5 (16%)	5 (16%)
Cwm Taf Morgannwg UHB	8 (89%)	1 (11%)	0 (0%)
Hywel Dda UHB	14 (78%)	0 (0%)	4 (22%)
Powys THB	0 (0%)	0 (0%)	1 (100%)
Swansea Bay UHB	28 (85%)	0 (0%)	5 (15%)
Velindre NHST	2 (100%)	0 (0%)	0 (0%)
All Wales	**103 (74%)**	**11 (8%)**	**25 (18%)**

Hospital inpatient (IP): Screening or clinical specimen taken in a hospital location during an IP overnight stay.
Hospital non-inpatient (non-IP): Screening or clinical specimen taken in a hospital location with no overnight stay.
Community: Screening or clinical specimen taken in a non-hospital location.

Table 11.2. Count and percentage (%) distribution of new CPO episodes identified in each HB/NHS trust during a hospital IP stay, by time from admission, 2023/24 FY

HB/NHS trust	Count of hospital IP new CPO episodes (N)	Count (% of N)	
		On admission (day 1 or 2)	>2 days after admission
Aneurin Bevan UHB	14	8 (57%)	6 (43%)
Betsi Cadwaladr UHB	16	8 (50%)	8 (50%)
Cardiff and Vale UHB	21	15 (71%)	6 (29%)
Cwm Taf Morgannwg UHB	8	7 (88%)	1 (12%)
Hywel Dda UHB	14	8 (57%)	6 (43%)
Powys THB	0	0 (0%)	0 (0%)
Swansea Bay UHB	28	8 (29%)	20 (71%)
Velindre NHST	2	2 (100%)	0 (0%)
All Wales	**103**	**56 (54%)**	**47 (46%)**

On admission: Screening or clinical specimen taken on day 1 or 2 of a hospital IP stay (where day 1 is the day of admission).
>2 days after admission: Screening or clinical specimen taken more than 2 days into a hospital IP stay (where day 1 is the day of admission).

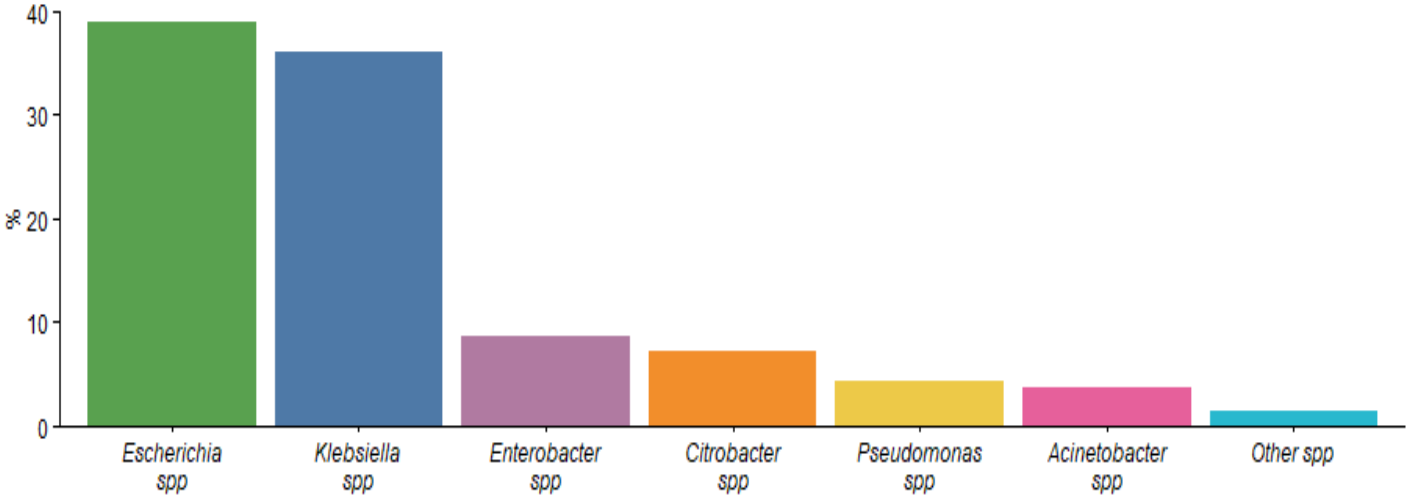
12. New CPO episodes by species

- 12 different species were identified in new episodes of CPO in Wales in 2023/24. *E. coli* accounted for 39%, followed by *K. pneumoniae* with 33% (Table 12.1.).
- Grouped by genus, *Escherichia* and *Klebsiella spp*. together accounted for 75% of episodes. Other genus that accounted for more than 1% of new CPO episodes were *Enterobacter, Citrobacter, Pseudomonas* and *Acinetobacter spp.* (Figure 12.1.).
- In screening specimens, the percentage of *Escherichia spp*. and *Klebsiella spp*. were similar (38%, 43% respectively) (Figure 12.2.), whereas *Escherichia spp*. was more common in clinical specimens (40%, 25%) (Figure 12.3.) The 6 *Pseudomonas spp*. episodes were all identified in clinical specimens.
- Among the 6 UHBs, *Escherichia spp*. was the most common genus of new CPO episodes in Betsi Cadwaladr, Cardiff and Vale and Hywel Dda UHBs. *Klebsiella spp*. was most common in Aneurin Bevan and Swansea Bay UHBs. *Citrobacter spp*. was most common in Cwm Taf UHB although the number of new CPO episodes in that UHB was small (Figure 12.4.).

Table 12.1. Count and percentage (%) distribution of species of new CPO episodes, 2023/24 FY

Organism species	Count of new CPO episodes	% of new CPO episodes
Escherichia coli	54	39%
Klebsiella pneumoniae	46	33%
Enterobacter cloacae complex	12	9%
Citrobacter freundii	8	6%
Pseudomonas aeruginosa	6	4%
Acinetobacter baumannii	4	3%
Klebsiella oxytoca	4	3%
Acinetobacter radioresistans	1	1%
Citrobacter amalonaticus	1	1%
Citrobacter koseri	1	1%
Raoultella ornithinolytica	1	1%
Serratia marcescens	1	1%

Figure 12.1. Percentage (%) distribution of most common genus of new CPO episodes, 2023/24 FY



Most common new CPO episode genus: Organism genus that individually account for more than 1% of new CPO episodes. Genus that account for 1% or less grouped as 'Other'. N.B. Multiple species identified in the same specimen are counted as separate CPO.

Figure 12.2. Percentage (%) distribution of top 5 genus of new CPO episodes from screening specimens, 2023/24 FY

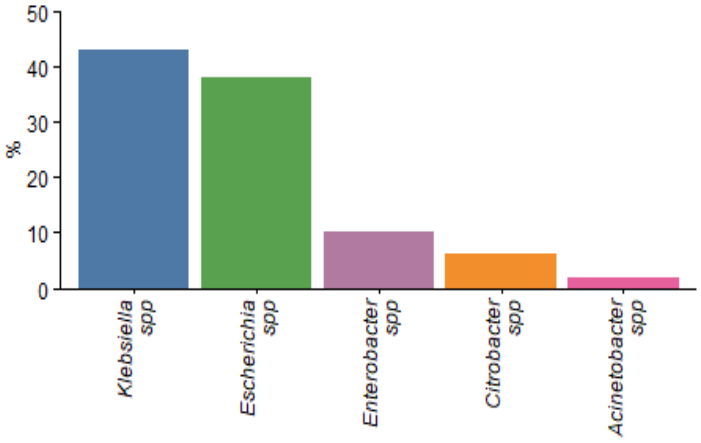


Figure 12.3. Percentage (%) distribution of top 5 genus of new CPO episodes from clinical specimens, 2023/24 FY

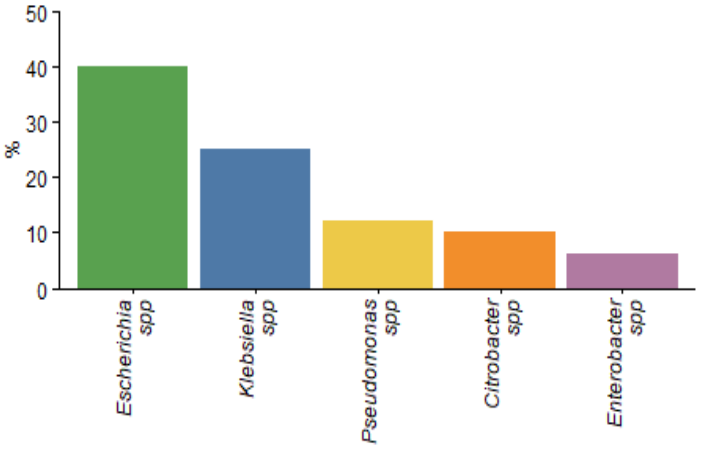
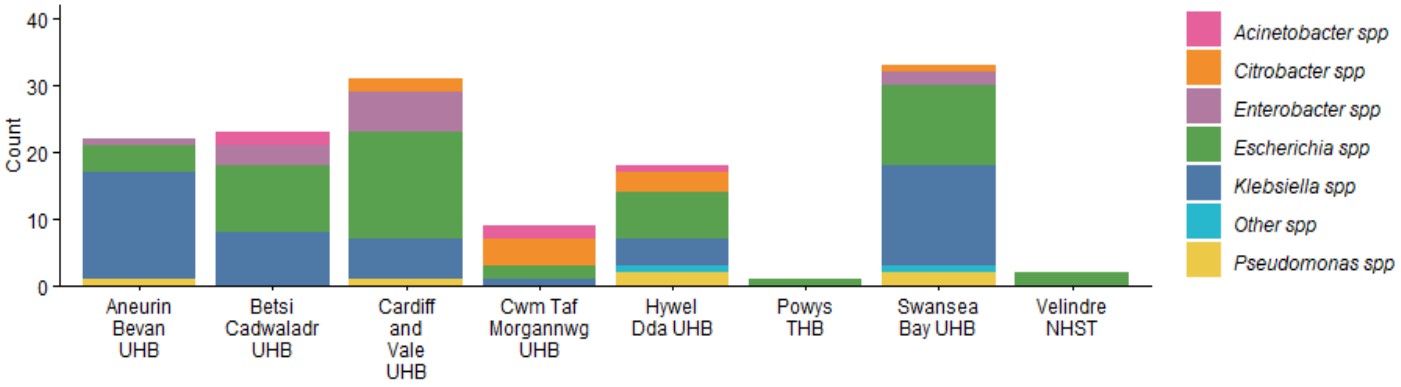


Figure 12.4. Count of genus of new CPO episodes for each HB/NHS trust, 2023/24 FY



13. New CPO episodes by gene

- 53% of carbapenemase genes in new CPO episodes in Wales in 2023/24 were OXA-48-like (Figure 13.1.).
- OXA-48-like and NDM type were the most common carbapenemase gene types found in isolates from screening and clinical specimens, however 47% of screening specimens were OXA-48-like and 33% NDM type compared to 62% OXA-48-like and 17% NDM type in clinical specimens (Figure 13.2&3.).
- OXA-48-like was the most common carbapenemase gene in new CPO episodes in Betsi Cadwaladr, Cardiff and Vale, Hywel Dda and Swansea Bay UHBs. NDM type was most common in Aneurin Bevan UHB and KPC type in Cwm Taf Morgannwg UHB (Figure 13.4.).

Figure 13.1. Count and percentage (%) of new CPO episodes by specimen type, genus and carbapenemase gene, 2023/24 FY

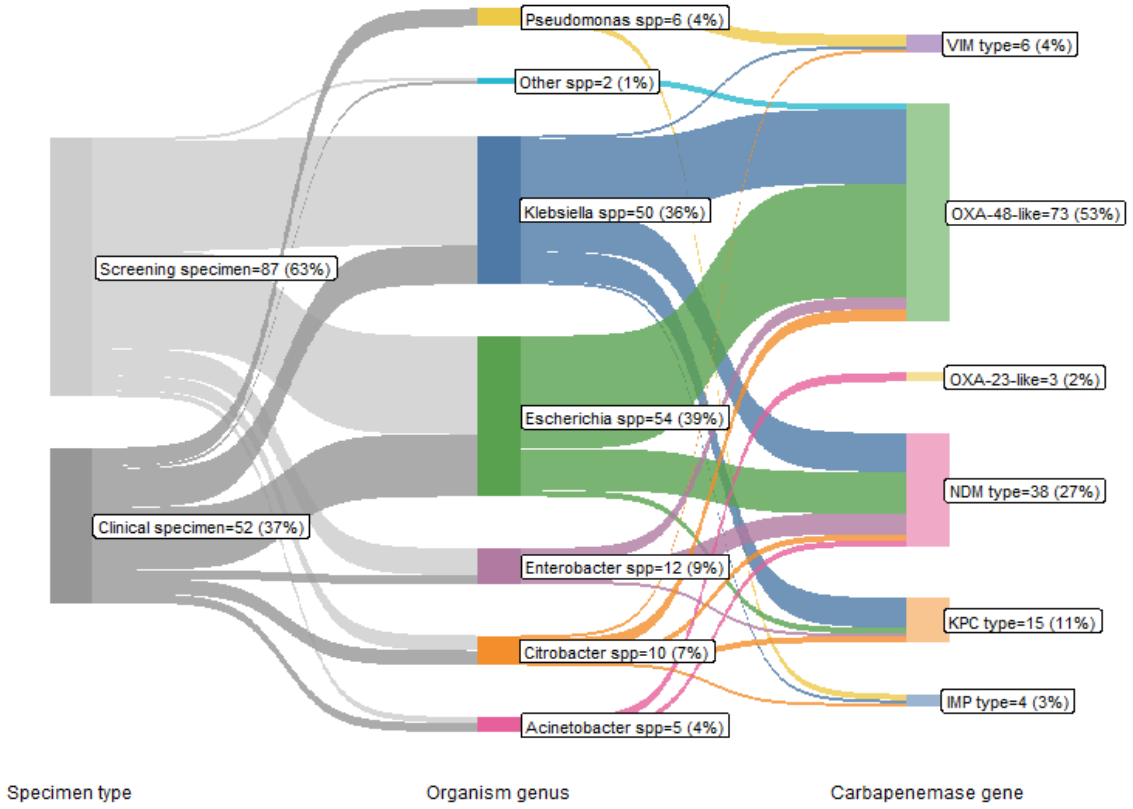


Figure 13.2. Percentage (%) distribution of carbapenemase genes in new CPO episodes from screening specimens, 2023/24 FY

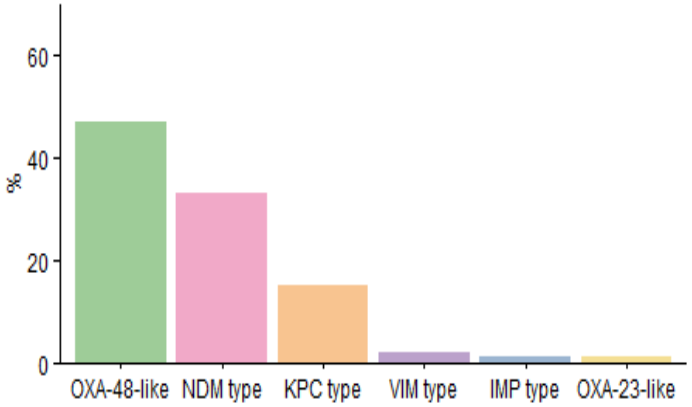


Figure 13.3. Percentage (%) distribution of carbapenemase genes in new CPO episodes from clinical specimens, 2023/24 FY

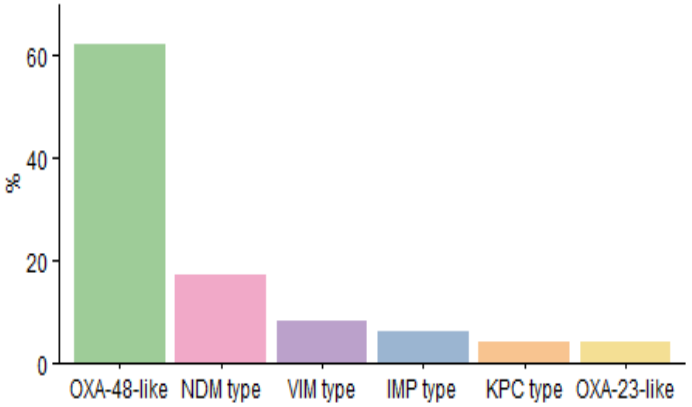
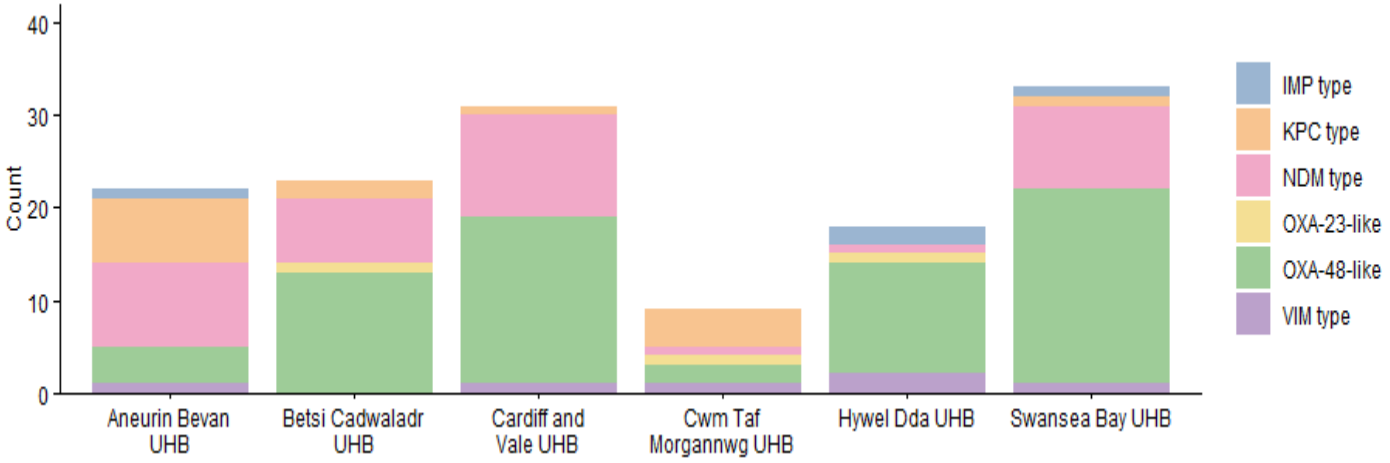


Figure 13.4. Count of carbapenemase gene in new CPO episodes for each UHB, 2023/24 FY



14. New CPO episodes by gene/species combination

- OXA-48-like *E. coli* was the most common species and carbapenemase gene combination found in new CPO episodes in Wales in 2023/24 (38 episodes), followed by OXA-48-like *K. pneumoniae* (22 episodes) (Table 14.1.).
- Grouped by genus OXA-48-like *Escherichia spp.* accounted for 27% of new CPO episodes and OXA-48-like *Klebsiella spp*. 18% (Table 14.2.).
- OXA-48-like *Klebsiella* and *Escherichia spp*. were the most common genus/gene combinations found in screening specimens (23%, 20%), whereas in clinical specimens the proportions were 35% OXA-48-like *Escherichia spp*. (18 episodes) and 15% OXA-48-like *Klebsiella spp*. (8 episodes) (Figure 14.1&2.).
- Multiple new CPO episodes were identified in 15 of the 123 screening and clinical specimens. 2 had multiple species containing the same carbapenemase gene and 13 had one species with multiple gene types (Figure 14.3.).
- Multiple new CPO episodes were identified in 28 of the 102 individuals. 11 had multiple species (in ≥1 specimen) containing the same carbapenemase gene. 12 had one species with multiple gene types. 5 had multiple species and multiple gene types (in ≥1 specimen) (Figure 14.4.).
- OXA-48-like *Escherichia spp*. was the most common genus/gene combination of new CPO episodes in Betsi Cadwaladr and Hywel Dda UHBs and joint top with OXA-48-like *Klebsiella spp*. in Swansea Bay UHB. KPC type *Klebsiella spp*. was the most common in Aneurin Bevan UHB, NDM type *Escherichia spp*. and OXA-48-like *Klebsiella spp*. in Cardiff and Vale UHB and KPC type *Citrobacter spp*. in Cwm Taf Morgannwg UHB (Figure 14.5.).

Table 14.1. Count of species and carbapenemase gene combinations of new CPO episodes, 2023/24 FY

Organism species	IMP type	KPC type	NDM type	OXA-23-like	OXA-48-like	VIM type
Acinetobacter baumannii			1	3		
Acinetobacter radioresistans			1			
Citrobacter amalonaticus			1			
Citrobacter freundii	1	2	1		3	1
Citrobacter koseri					1	
Enterobacter cloacae complex		1	7		4	
Escherichia coli		2	14		38	
Klebsiella oxytoca	1				3	
Klebsiella pneumoniae		10	13		22	1
Pseudomonas aeruginosa	2					4
Raoultella ornithinolytica					1	
Serratia marcescens					1	

Table 14.2. Count and percentage (%) distribution of top 5 genus and carbapenemase gene combinations of new CPO episodes, 2023/24 FY

Gene/genus combination	Count of new CPO episodes	% of new CPO episodes
OXA-48-like *Escherichia spp.*	38	27%
OXA-48-like *Klebsiella spp.*	25	18%
NDM type *Escherichia spp.*	14	10%
NDM type *Klebsiella spp.*	13	9%
KPC type *Klebsiella spp.*	10	7%
Other combinations	39	28%

Figure 14.1. Percentage (%) distribution of genus and gene combinations of new CPO episodes from screening specimens, 2023/24 FY

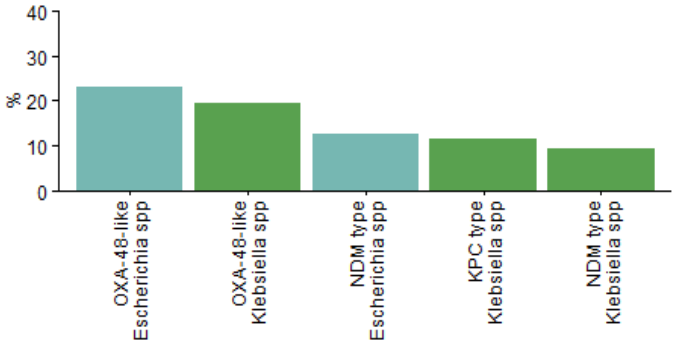


Figure 14.2. Percentage (%) distribution of genus and gene combinations of new CPO episodes from clinical specimens, 2023/24 FY

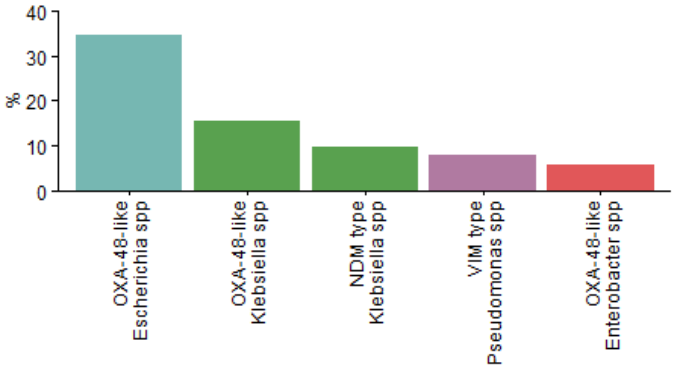
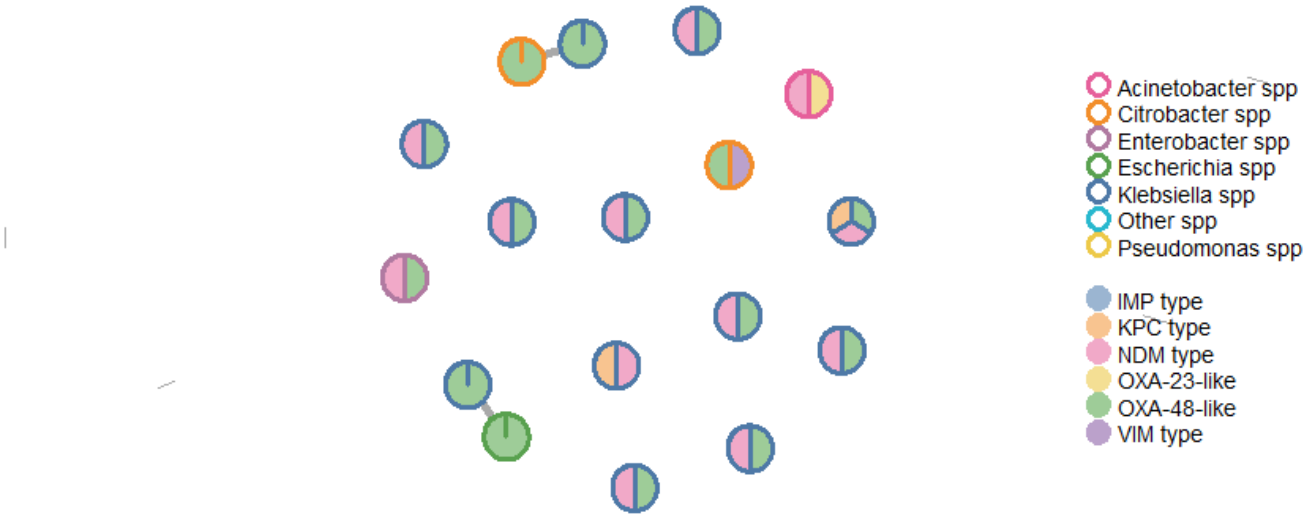


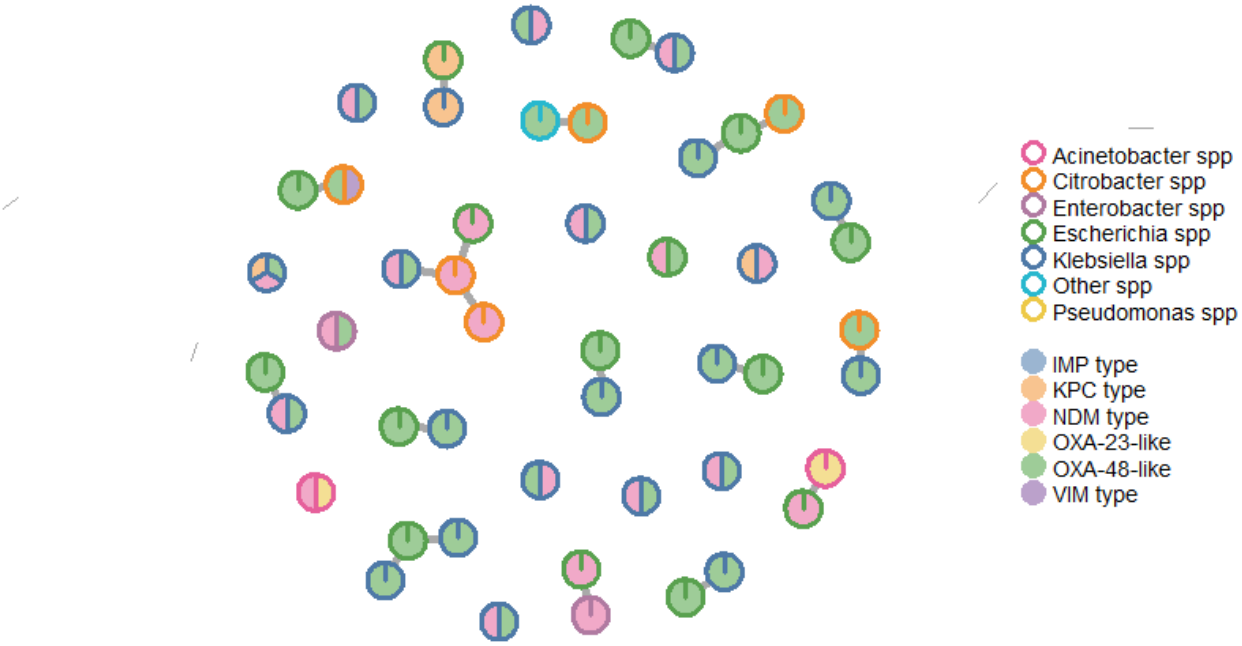
Figure 14.3. Organism species and carbapenemase gene combinations in specimens that contained multiple new CPO episodes, 2023/24 FY



In figure 14.3., each circle represents one carbapenem resistant isolate. Circles linked by a line are isolates from the same specimen. The outer colour of the circle represents the organism genus and the inner colour(s) the carbapenemase gene type(s). N.B. Where linked circles are identical in colour, the organism species differ.

Carbapenemase gene: Gene that produces an enzyme which hydrolyses carbapenemase rendering the organism resistant to carbapenem antibiotics. N.B. Multiple gene types which exist in the same isolate from a single specimen are counted as separate CPO episodes.
Specimens with multiple new CPO episodes: More than one carbapenem resistant organism species isolated in the same specimen with the same or different carbapenemase gene type(s); or one species in the same specimen with multiple carbapenemase gene types.

Figure 14.4. Organism species and carbapenemase gene combinations in individuals with multiple new CPO episodes, 2023/24 FY



In figure 14.4., each circle represents one carbapenem resistant isolate. Circles linked by a line are isolates from the same individual (from one or more specimen). The outer colour of the circle represents the organism genus and the inner colour(s) the carbapenemase gene type(s). N.B. Where linked circles are identical in colour, the organism species differ.

Individuals with multiple new CPO episodes: More than one carbapenem resistant organism species (in one or more specimen) from one individual with the same or different carbapenemase gene type(s); or one species with more than one carbapenemase gene type.

Figure 14.5. Count of genus and carbapenemase gene combinations of new CPO episodes for each HB/NHS trust, 2023/24 FY

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