Point Prevalence Survey of Hospital-Acquired Infections & Antimicrobial Use in European Acute Care Hospitals: May 2017

INTENSIVE CARE UNIT REPORT: IRELAND – May 2019

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1.0 Executive Summary & Introduction

1.1 Executive Summary

This report presents the findings of the second point prevalence survey (PPS) of hospital-acquired infections (HAI) and antimicrobial use (AMU) in adult intensive care units (ICUs) in Ireland which was performed in May 2017. The first PPS was performed in May 2012, with inclusion of patients aged ≥16 years admitted to ICUs and high dependency units (HDU). A change in the European protocol for the second PPS resulted in HDUs being excluded from this analysis.

- In total, 10,333 patients in 60 acute hospitals were included in the PPS. Of those, 196 were ≥16 years old and admitted to 32 adult ICUs in 29 hospitals. There were 123 males (63%) and the median age was 65 years
- Ninety-eight percent (n=193) of ICU patients had at least one invasive device *in situ*
- There were 47 adult ICU patients (24%) who met the case definition for an active HAI, with 55 HAI identified, the majority of which were associated with the reporting hospital (93%)
- At 24%, the HAI prevalence in adult ICU patients was higher than in the overall population (6.1%)
- The majority of infections were deemed ICU-acquired (n=32; 58%), with 22 (40%) arising prior to or within the first two days of ICU admission. This data was not collected in PPS 2012
- The commonest infection type in ICU was pneumonia, accounting for 54.5% of infections and affecting 15.3% of ICU patients. Pneumonia in ICU was almost eight times more prevalent than in the overall population (1.9%). Of ICU patients with pneumonia, 57% were intubated
- Compared with 2012, the prevalence of pneumonia in ICU increased from 10.2% to 15.3%. While a change in the pneumonia case definition between the two PPS may have increased detection of pneumonia in patients outside of ICU, due to a softening of the radiological criteria, it might not have been expected to have impacted as much in the ICU, where radiological investigations are more frequently performed
- A causative pathogen was not identified for the majority of pneumonia cases (63%). Where a pathogen was reported, *Enterobacteriaceae* were the commonest (n=9), followed by *S. aureus*, all of which were meticillin susceptible (MSSA) (n=3)
- Carbapenemase producing *Enterobacteriaceae* (CPE) were not detected in HAI in ICU patients in 2017
- Despite the high prevalence of pneumonia in adult ICUs, availability and implementation of multi-modal strategies for prevention was not universal in May 2017, with guidelines available in 50%, a pneumonia prevention care bundle in use by 68% and 54% of ICUs providing staff education on pneumonia prevention. Just 32% of adult ICUs performed formal incidence surveillance of pneumonia
- Bloodstream infection (BSI) dropped both in rank (second to fifth) and prevalence (5.1% to 1.5%) when compared with 2012
- The AMU prevalence in adult ICU patients was 70.4% versus 39.7% for the overall population
- There were 263 antimicrobial prescriptions, the majority of which had a documented indication (92%) and were compliant with local guidelines (84%)
- As for the overall population, most antimicrobials prescribed in ICU were for treatment of infection (80.6%), with a higher proportion of those for treating hospital infection (45%) than the overall population (24%)
- Pneumonia was the commonest infection for which treatment antimicrobials were prescribed in ICU (39%), followed by intra-abdominal (15%) and clinical sepsis (10%)
- The top five antibacterials prescribed for ICU patients were piperacillin-tazobactam, vancomycin, meropenem, co-amoxiclav and metronidazole, which was essentially unchanged from 2012
- There were 26 antifungal prescriptions recorded in 2017, versus 28 in 2012

1.2 Introduction

A second national point prevalence survey (PPS) was conducted in May 2017 to assess the prevalence of hospital-acquired infections (HAI) and antimicrobial use (AMU) in Irish hospitals. Sixty acute hospitals participated, with 10,333 eligible patients surveyed. The PPS was coordinated in Ireland by the Health Protection Surveillance Centre (HPSC). The national PPS protocol and report may be accessed at the following link: http://www.hpsc.ie/a-z/microbiologyantimicrobialresistance/infectioncontrolandhai/surveillance/hospitalpointprevalencesurveys/2017/
This supplementary report provides analysis of data collected from eligible patients who were documented as being admitted to adult intensive care units (ICU).

The PPS was conducted across Europe using a standardised protocol devised by the European Centre for Disease Prevention and Control (ECDC) and HAI were categorised according to standardised European case definitions of infection, where available:

- ECDC HAI ICU definitions for bloodstream infection (BSI), pneumonia, catheter-related infection and urinary tract infection (UTI)
- ECDC HAI SSI definitions for surgical site infection (SSI)
- ECDC definitions for *C. difficile* infection (CDI)
- US Centers for Disease Control and Prevention (CDC) definitions were used for other infections with no existing European definitions

During the PPS, all eligible patients in each hospital were surveyed by a multi-disciplinary local PPS team for anonymous demographic details, risk factors, antimicrobial use and the presence of active HAI (**Appendix A:** PPS Patient Data Collection Form).

2.0 Participating Hospitals and Intensive Care Units

Of the 60 hospitals that participated in PPS 2017, 29 (48%) provided data from 32 adult ICUs, as displayed in Table 2.1.

Table 2.1. Participating hospitals by hospital group/ownership, hospital type and number of ICUs

Hospital Group or Ownership	Hospital	Hospital Type	ICU (N)
Dublin Midlands Hospital group	St James's Hospital	Tertiary	2
	Tallaght Hospital	Tertiary	1
	Midland Regional Hospital, Portlaoise	Secondary	1
	Midland Regional Hospital, Tullamore	Secondary	1
	Naas General Hospital	Secondary	1
Ireland East Hospital group	Mater Misericordiae University Hospital	Tertiary	1
	St Vincent's University Hospital	Tertiary	1
	Midland Regional Hospital, Mullingar	Secondary	1
	St Luke's General Hospital, Kilkenny	Secondary	1
	Wexford General Hospital	Secondary	1
RCSI Hospitals Group	Beaumont Hospital	Tertiary	2
	Cavan General Hospital	Secondary	1
	Connolly Hospital, Blanchardstown	Secondary	1
	Our Lady of Lourdes Hospital, Drogheda	Secondary	1
Saolta Hospital Group	Galway University Hospital	Tertiary	2
	Letterkenny University Hospital	Secondary	1
	Mayo University Hospital, Castlebar	Secondary	1
	Sligo University Hospital	Secondary	1
South/South-West Hospital Group	Mercy University Hospital	Secondary	1
	South Tipperary General Hospital, Clonmel	Secondary	1
	University Hospital Tralee, Tralee	Secondary	1
UL Hospitals Group	University Hospital Limerick	Tertiary	1
Private Hospitals	Beacon Hospital, Sandyford	Private	1
	Blackrock Clinic	Private	1
	Bon Secours Hospital, Cork	Private	1
	Bon Secours Hospital, Tralee	Private	1
	Galway Clinic	Private	1
	Hermitage Medical Clinic	Private	1
	Mater Private Hospital, Dublin	Private	1
Total		**29**	**32**

3.0 Results

3.1 Multi-modal strategies

Participating hospitals were asked to report on the availability of multi-modal strategies to prevent common HAI types (pneumonia, BSI and UTI) and to promote antimicrobial stewardship in the ICU (guidelines, care bundles, surveillance, staff education, checklists, audit and feedback), as displayed in Table 3.1. Availability of strategies to prevent pneumonia was generally lower than for the other HAI types (BSI and UTI), with pneumonia prevention guidelines in 50% of ICUs, a pneumonia prevention care bundle in use in 68% and staff education on pneumonia prevention provided in 54% of ICUs. While the majority of adult ICUs performed BSI surveillance (82%), UTI surveillance was performed by 36% and even fewer adult ICUs (n=9; 32%) performed pneumonia surveillance.

Table 3.1. Availability of ICU multi-modal strategies to prevent HAI and promote antimicrobial stewardship

	ICU-wide strategy*†			
	Pneumonia	Bloodstream infection	Urinary tract infection	Antimicrobial use
Guidelines	14 (50%)	15 (54%)	17 (61%)	28 (100%)
Care Bundles	19 (68%)	18 (64%)	21 (75%)	8 (29%)
Surveillance	9 (32%)	23 (82%)	10 (36%)	22 (79%)
Education	15 (54%)	17 (61%)	17 (61%)	22 (79%)
Checklist	14 (50%)	15 (54%)	12 (43%)	6 (21%)
Audit	11 (39%)	17 (61%)	13 (46%)	23 (82%)
Feedback	10 (36%)	23 (82%)	13 (46%)	25 (89%)

* If the participating hospital also had a neonatal and/or paediatric ICU, in addition to an adult ICU, availability of multi-modal strategies in those ICUs may have been reported as part of the hospital's ICU strategy

†28 of 29 hospitals participating with an adult ICU completed the hospital questionnaire

3.2 Eligible Patients

3.2.1 Patient Demographics

Of 10,333 patients included in the PPS performed in 60 Irish hospitals in May 2017, 196 (1.9%) aged ≥16 years were admitted to 32 adult ICUs in 29 hospitals. There were 123 males (63%) and the median age was 65 years (inter-quartile range [IQR] 51-73 years), with just over half (51.5%; n=101) aged ≥65 years. Table 3.2 and Figure 3.1 display the age and gender distribution of ICU patients aged ≥16 years.

Table 3.2. Distribution of ICU patients, by age group and gender

Age Group (years)	Male		Female		Total	
	N	%	N	%	N	%
16-29	8	6.5	5	6.8	13	6.6
30-49	17	13.8	14	19.2	31	15.8
50-64	31	25.2	20	27.4	51	26.0
65-79	50	40.7	29	39.7	79	40.3
80+	17	13.8	5	6.8	22	11.2
Total	**123**	**100**	**73**	**100**	**196**	**100**

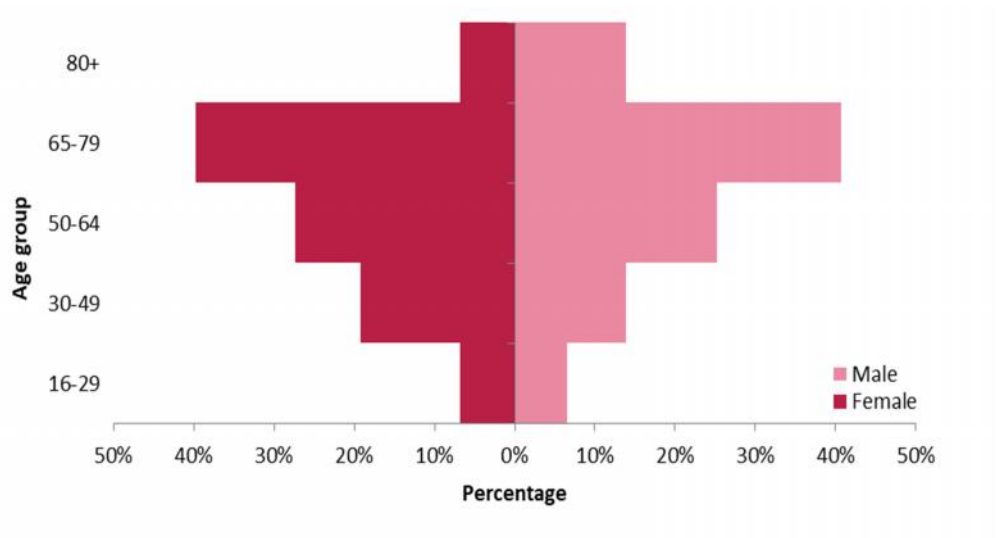


Figure 3.1. Population pyramid: Percentage of ICU patients, by age group and gender

3.2.2 Patient Risk Factors for HAI

Figure 3.2 displays the risk factors for HAI for all 10,333 eligible patients and the 196 ICU patients, with a significantly higher prevalence across all risk factors evident for ICU patients (p<0.001). Ninety-eight percent (n=193) of ICU patients had at least one invasive device *in situ* at the time of the PPS.

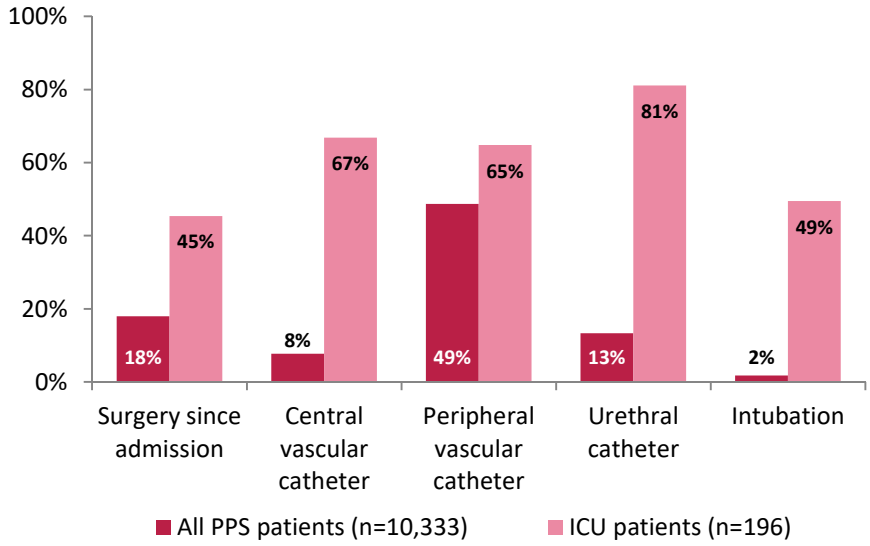


Figure 3.2. Prevalence of HAI risk factors for all PPS patients and patients aged ≥16 years admitted to an ICU

The McCabe score is a subjective categorisation of underlying illness severity that was utilised in the PPS protocol.[1] Table 3.3 displays the distribution of the McCabe score for the overall patient cohort and the ICU patients, whereby ICU patients were more likely to have an 'end-of-life' and 'life-limiting' prognosis than the overall patient cohort: 5.1% versus 3.9% and 26% versus 18.1%, respectively.

Table 3.3. Distribution of McCabe Score: All PPS patients and ICU patients

Disease prognosis	All PPS Patients N	All PPS Patients %	ICU Patients N	ICU Patients %
None/non-fatal	7,933	76.8	133	67.9
Life-limiting	1,875	18.1	51	26.0
End-of-life	406	3.9	10	5.1
Not known	119	1.2	2	1.0
Total	**10,333**	**100.0**	**196**	**100.0**

3.3 Hospital-Acquired Infections (HAI)

The PPS HAI results should be reviewed and interpreted in conjunction with the HAI definitions used in this survey. These are available in the PPS All Ireland Protocol Version 1.0 [Appendix B pages 67 – 87], which may be accessed on the HPSC website:
http://www.hpsc.ie/a-z/microbiologyantimicrobialresistance/infectioncontrolandhai/surveillance/hospitalpointprevalencesurveys/2017/protocol/

3.3.1 HAI Prevalence

Of 10,333 eligible patients, 633 (6.1%; 95% CI:5.7-6.6) met a case definition for an active HAI. In total, 678 HAI were identified, which equates to 1.07 HAI per infected patient.
Of 196 ICU patients, 47 (24.0%; 95% CI:18.5-30.4) met a case definition for an active HAI. In total, 55 HAI were identified, which equates to 1.17 HAI per infected ICU patient (Table 3.4).

Table 3.4. Number of HAI per patient for all PPS patients and ICU patients

Number of HAI reported per patient	All PPS Patients N	All PPS Patients %	ICU Patients N	ICU Patients %
0	9,700	93.9	149	76.0
1	592	5.7	40	20.4
2	37	0.4	6	3.1
3	4	0.0	1	0.5
Total	**10,333**	**100.0**	**196**	**100.0**

3.3.2 HAI Prevalence, by Admitting Consultant Specialty

Of 196 ICU patients aged ≥16 years, 95 (48%) were admitted under the care of a surgical consultant, 75 (38%) under a medical consultant and 21 (11%) under a consultant in intensive care medicine. Table 3.5 displays HAI prevalence by admitting consultant specialty.

Table 3.5. HAI prevalence in ICU, by admitting consultant specialty

Consultant specialty	Total patients	Patients with HAI	HAI prevalence (%)	95%CI	
				Lower	Upper
Surgery	95	22	23.2	15.8	32.6
Medicine	75	14	18.7	11.5	28.9
Intensive Care Medicine	21	7	33.3	17.2	54.6
Geriatrics	4	3	75.0	30.1	95.4
Obstetrics/Gynaecology	1	1	100.0	20.7	100.0
Total	**196**	**47**	**24.0**	**18.5**	**30.4**

3.3.3 Onset and Origin of HAI

Figure 3.3 displays the location of HAI onset, with the majority of HAI arising after hospital admission (n=46; 84%). For the nine HAI that were evident on admission to hospital, five originated in the current hospital (i.e. infection related to a prior admission to the current hospital) and four (7% of the 55 HAI in ICU) had origin in another acute hospital, as shown in Figure 3.4.

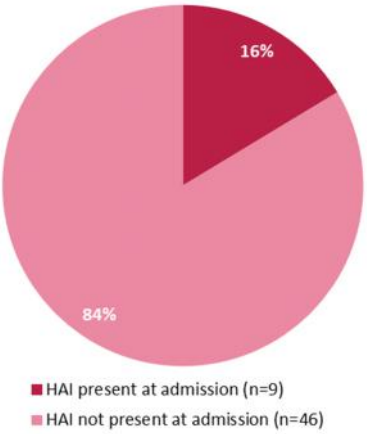


Figure 3.3. Location of HAI onset

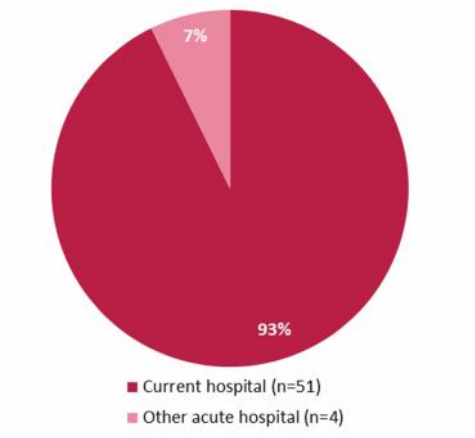


Figure 3.4. HAI origin

A new question was added to the PPS protocol in 2017 to determine the proportion of HAI that were acquired in the ICU, based on HAI onset three or more days following ICU admission. Unit-acquired infections accounted for the majority of HAI in ICU (n=32; 58%), with 22 HAI (40%) arising prior to or within the first two days of ICU admission (Figure 3.5). The indication for ICU transfer was not captured in the PPS. Therefore, the proportion of the HAI acquired outside of ICU resulting in a need for escalation to ICU care is not known.

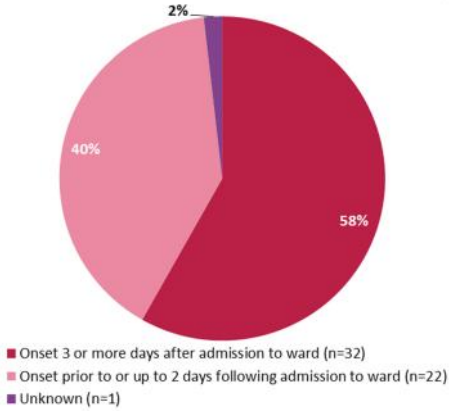


Figure 3.5. HAI distribution in ICU based on date of onset

3.3.4 Distribution of HAI, by Type

Table 3.6 displays the rank order of the 55 HAI, with pneumonia the commonest HAI in ICU, accounting for 54.5% of infections and affecting 15.3% of ICU patients.

Table 3.6. Rank order of HAI in ICU

Rank order	HAI Type	HAI N	HAI %	HAI Prevalence (%)
1	Pneumonia	30	54.5	15.3
2	Systemic infection	7	12.7	3.6
3	Surgical site infection	6	10.9	3.1
4	Urinary tract infection	4	7.3	2.0
5	Bloodstream infection	3	5.5	1.5
5	Gastrointestinal infection	3	5.5	1.5
6	Eye, ear, nose, throat or mouth infection	1	1.8	0.5
6	Catheter-related infection	1	1.8	0.5
	Total	**55**	**100**	

Figure 3.6 compares the prevalence of the commonest HAI in ICU patients versus the overall patient cohort.

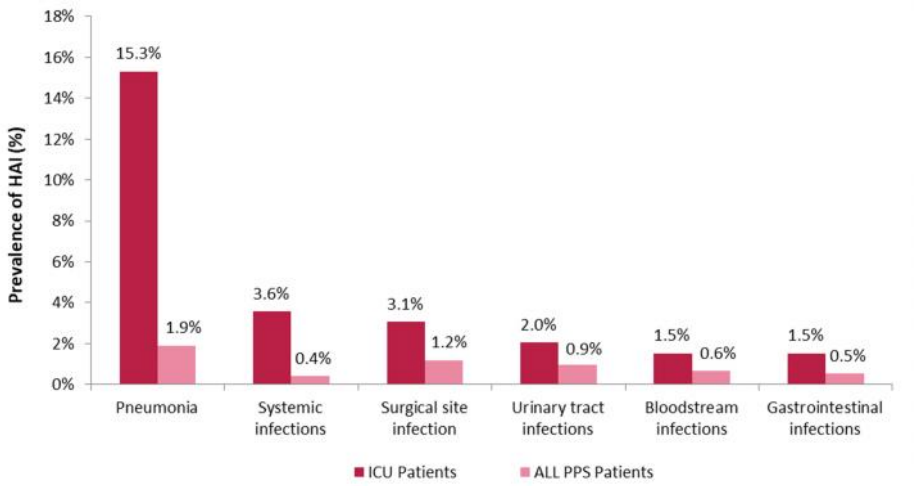


Figure 3.6. Prevalence of commonest HAI in ICU patients versus overall patient cohort

Table 3.7. Number and percentage of device-associated HAI in ICU patients

	HAI	
HAI type	**N**	**%**
Pneumonia		
Intubation present	17	57%
Intubation absent	13	43%
Total	30	
Urinary tract infection		
Urinary catheter present	3	75%
Urinary catheter absent	1	25%
Total	4	
Bloodstream infections		
Vascular catheter present	1	33%
Vascular catheter absent	2	67%
Total	3	

Pneumonia (PN)

As seen in the overall patient cohort, pneumonia was the commonest HAI (54.5%), with 30 cases reported in ICU patients, equating to a prevalence of 15.3%, almost eight times that of the overall patient cohort (1.9%). The prevalence of pneumonia in ICU increased from 10.2% in PPS 2012. Intubation of the respiratory tract was present for 17 ICU patients with pneumonia (57%), as shown in Table 3.7. The majority of cases (63%) were not microbiologically-confirmed (PN5), although this was lower than in the overall population (84% PN5) (Figure 3.7 & See **Appendix B** for pneumonia case definition).

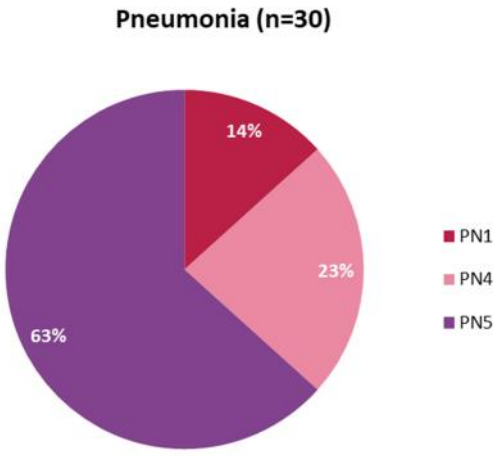


Figure 3.7. Distribution of pneumonia cases in ICU based on level of microbiological evidence (See **Appendix B**)
PN1: Protected sample + quantitative culture; PN2: Non-protected sample + quantitative sample; PN3: Alternative microbiological criteria; PN4: Sputum bacteriology or non-quantitative ETA; PN5: No microbiology

Systemic Infection (SYS-CSEP)

Clinical sepsis was the second commonest HAI in ICU (12.7%), with a prevalence of 3.6% in ICU patients, almost ten times higher than the overall patient cohort (0.4%) and higher than that observed in 2012 (1.4%).

The clinical sepsis case definition in the PPS protocol is a patient with at least one of: fever (temperature >38^{0}C), hypotension (systolic blood pressure <90mmHg) or oliguria (urine output <20mL per hour)

and blood culture not done or no micro-organisms detected in blood

and no apparent infection at another site

and clinician institutes treatment for sepsis

Surgical Site Infection (SSI)

SSI was the third commonest HAI in ICU patients (10.9%), with a prevalence of 3.1%, over twice that of the overall patient cohort (1.2%) (See **Appendix B**). All six SSI in ICU patients were classified as organ/space SSI. The prevalence of SSI was stable versus 2012 (3.3%)

Urinary Tract Infection (UTI)

UTI was the fourth commonest HAI in ICU patients (7.2%), with a prevalence of 2%, twice that of the overall patient cohort (0.9%) and higher than that observed in 2012 (0.9%). A urinary catheter was present in 75% of UTI in ICU, as shown in Table 3.7. Half of the UTIs were microbiologically-confirmed (Figure 3.8 and see **Appendix B** for UTI case definition), a lower proportion than the overall patient cohort (63.3%).

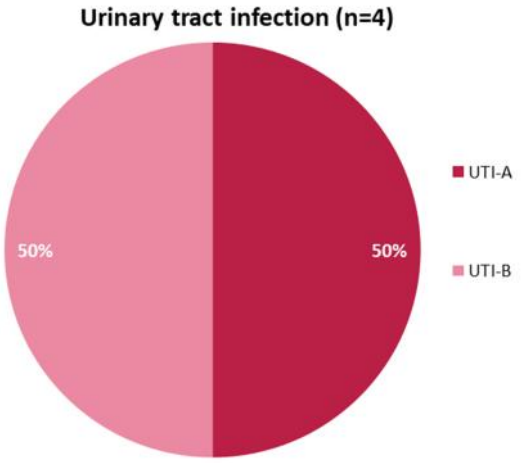


Figure 3.8. Distribution of UTI cases in ICU based on microbiological evidence (See **Appendix B**)
UTI-A = Microbiologically-confirmed & UTI-B = Not microbiologically-confirmed

3.4 Microbiology & Key Antimicrobial Resistance Markers

The PPS microbiology and antimicrobial resistance results should be reviewed and interpreted in conjunction with the definitions used in this survey. These are available in the PPS All Ireland Protocol Version 1.0 [Appendix A – Tables 8 & 9 (pages 62 – 66)], which may be accessed on the HPSC website: http://www.hpsc.ie/a-z/microbiologyantimicrobialresistance/infectioncontrolandhai/surveillance/hospitalpointprevalencesurveys/2017/protocol/

3.4.1 Microbiology and Antimicrobial Resistance Data

Of the 678 HAI identified in the overall patient cohort, positive microbiology results were available for 309 (46%), with a total of 386 microorganisms isolated from relevant specimens.

Of the 55 HAI identified in ICU patients, 22 (40%) were associated with positive microbiology, with a total of 30 microorganisms isolated from relevant specimens. Figure 3.9 displays the distribution of microorganisms detected from ICU patients with HAI. As for the overall patient cohort, *Enterobacteriaceae* were the most frequently isolated pathogens (n=14; 47%), with *E. coli* accounting for 50% (n=7). *Candida spp.* ranked second commonest pathogen, accounting for 20% of isolates from patients with HAI in ICU versus 6% of all patients with HAI (ranked sixth). Enterococci were not reported as causing HAI in ICU in 2017, having ranked third in 2012, accounting for 15% of isolates.

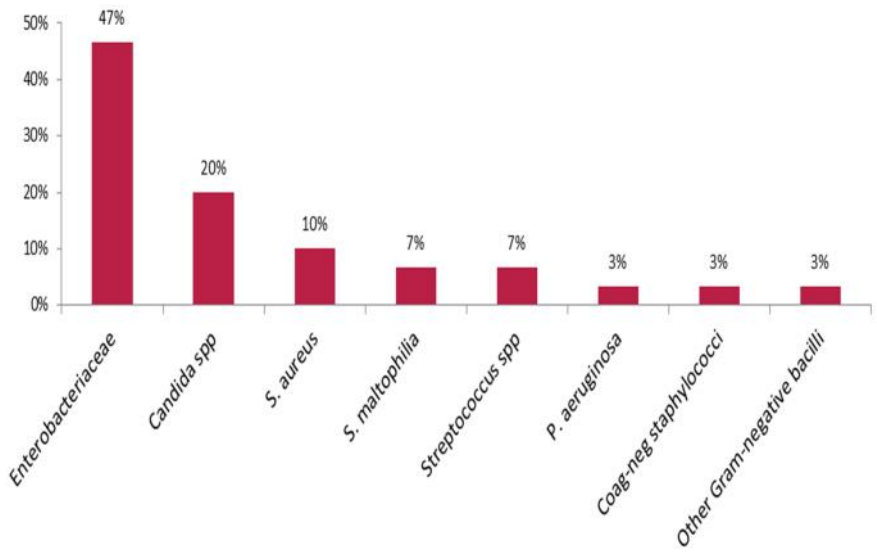


Figure 3.9. Distribution of microorganisms detected from ICU patients with HAI

- Of the *Enterobacteriaceae*, resistance to third-generation cephalosporins (C3G) was reported for four isolates (29%) and carbapenem resistance was not reported for any of the *Enterobacteriaceae*
- There were three *Staphylococcus aureus* isolates (10%), all susceptible to flucloxacillin (MSSA) and glycopeptide resistance (e.g., vancomycin) was not reported for any *S. aureus* isolate (Table 3.8)

Table 3.8. Key antimicrobial resistance markers in selected microorganisms

Microorganism	Antimicrobial Susceptibility Results	Number	%
Enterobacteriaceae	C3G resistant & carbapenem resistant	0	0
	C3G resistant & carbapenem susceptible	4	29
	C3G susceptible & carbapenem susceptible	8	57
	Unknown susceptibility results	2	14
S. aureus	Flucloxacillin resistant (MRSA)	0	0
	Flucloxacillin susceptible (MSSA)	3	100
P. aeruginosa	Carbapenem resistant	1	100
	Carbapenem susceptible	0	0
Total		**18**	**100**

3.4.2 Causative Pathogens of the Most Common HAI Types in ICU

- **Pneumonia:** Of the 30 cases of pneumonia in ICU, 11 (37%) were associated with positive microbiology results, with 17 pathogens isolated, as shown in Table 3.9. The detection of *Candida spp.* from ICU patients with pneumonia is of doubtful significance and more likely to reflect colonising flora.

Table 3.9. Microorganisms isolated from ICU patients with pneumonia

Microorganism	Number	%
*Enterobacteriaceae**	9	53
Staphylococcus aureus	3	17
Candida spp.	2	12
Gram-neg bacilli (not specified)	1	6
P. aeruginosa	1	6
S. maltophilia	1	6
Total	**17**	**100**

**E. coli* (n=5), *E. aerogenes, K. pneumoniae, P. mirabilis & S. marcescens* (n=1 each)

- **SSI:** Four of six ICU patients with SSI had positive microbiology results (67%): *E. coli* (n=2), *C. albicans* (n=1) and *Streptococcus spp.* (n=1)
- **UTI:** Two of four patients with UTI had positive microbiology results (50%): *K. pneumoniae* (n=1) and *C. albicans* (n=1)
- **Clinical Sepsis:** As per the case definition, organisms were not detected from any of the seven ICU patients

3.5 Antimicrobial Use (AMU)

The PPS AMU results should be reviewed and interpreted in conjunction with the AMU definitions used in this survey. These are available in the PPS All Ireland Protocol Version 1.0 [Section 5.6.5 (pages 41 – 47) and Appendix A: Tables 4 & 5 (pages 54 – 58)], which may be accessed on the HPSC website: http://www.hpsc.ie/a-z/microbiologyantimicrobialresistance/infectioncontrolandhai/surveillance/hospitalpointprevalencesurveys/2017/protocol/

3.5.1 AMU Prevalence

Of the 10,333 eligible patients in the overall patient cohort, 4,105 (39.7%; 95% CI: 38.8-40.7) were prescribed 5,809 systemic antimicrobials, which equates to 0.56 antimicrobials per patient. At 70.4% (95% CI: 63.7-76.4), the AMU prevalence for 196 ICU patients was much higher, with 138 ICU patients prescribed 263 antimicrobials, equating to 1.34 antimicrobials per patient (Table 3.10).

Table 3.10. Number of antimicrobials prescribed per patient

Number of antimicrobials prescribed per patient	All PPS patients		ICU patients	
	N	%	N	%
0	6,228	60.3	58	29.6
1	2,771	26.8	60	30.6
2	1,058	10.2	48	24.5
3	205	2.0	22	11.2
4	51	0.5	4	2.0
5+	20	0.2	4	2.0
Total	**10,333**	**100.0**	**196**	**100.0**

3.5.2 AMU Prevalence, by Admitting Consultant Specialty

Of 196 ICU patients aged ≥16 years, 95 (48%) were admitted under the care of a surgical consultant, 75 (38%) under a medical consultant and 21 (11%) under a consultant in intensive care medicine. Table 3.11 displays AMU prevalence, by admitting consultant specialty.

Table 3.11. AMU prevalence in ICU, by admitting consultant specialty

Consultant speciality	Total N patients	N patients with AMU	AMU prevalence (%)	95% CI	
				Lower	Upper
Surgical	95	63	66.3	56.3	75.0
Medical	75	51	68.0	56.8	77.5
Intensive care	21	19	90.5	71.1	97.4
Geriatrics/care of the elderly	4	4	100.0	51.0	100.0
Obstetrics /gynaecology	1	1	100.0	20.7	100.0
Total	**196**	**138**	**70.4**	**63.7**	**76.4**

3.5.3 Documentation of Indication and Compliance with Local Guidelines

The indication was documented for the majority of the 263 antimicrobials prescribed for ICU patients (n=241; (92%), as shown in Figure 3.10. The majority of prescriptions were assessable against a local prescribing guideline (n=238; 90.5%) and 16% (n=38) of those were deemed to be non-compliant, as shown in Figure 3.11.

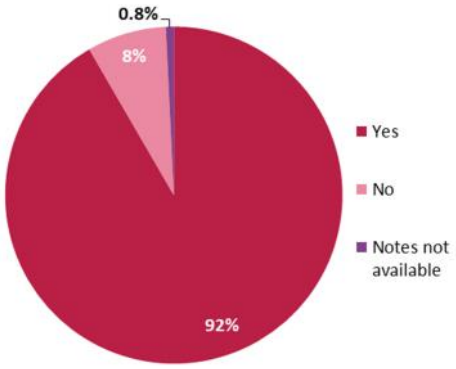


Figure 3.10. Documented indication

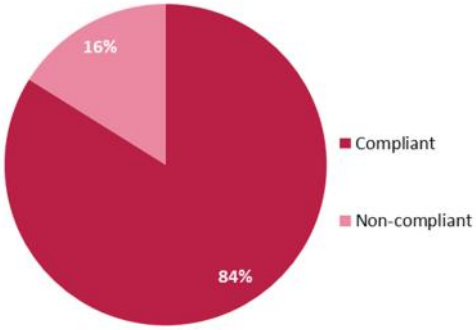


Figure 3.11. Compliance with local guidelines (n=238)

3.5.4 Description of Prescribed Antibacterials

Table 3.12 displays the breakdown of the 237 prescribed antibacterials. Piperacillin-tazobactam was the commonest agent (n=44, 18.6%), prescribed to 22.4% of ICU patients. The distribution of the top five agents was essentially unchanged compared with PPS 2012.

Table 3.12. Number, percentage and prevalence of prescribed antibacterials in ICU patients

Rank order	Antibacterials	N	%	Prevalence (%)
1	Piperacillin-tazobactam	44	18.6	22.4
2	Vancomycin (parenteral – IV)	23	9.7	11.7
3	Meropenem	22	9.3	11.2
4	Co-amoxiclav	19	8.0	9.7
5	Metronidazole (parenteral – IV)	17	7.2	8.7
6	Ceftriaxone	15	6.3	7.7
7	Linezolid	13	5.5	6.6
8	Co-trimoxazole	11	4.6	5.6
9	Cefuroxime	9	3.8	4.6
10	Ciprofloxacin	8	3.4	4.1
10	Clarithromycin	8	3.4	4.1
11	Gentamicin	7	3.0	3.6
12	Ceftazidime	4	1.7	2.0
13	Cefotaxime	3	1.3	1.5
13	Clindamycin	3	1.3	1.5
13	Daptomycin	3	1.3	1.5
13	Erythromycin	3	1.3	1.5
13	Flucloxacillin	3	1.3	1.5
13	Metronidazole (enteral – PO)	3	1.3	1.5
13	Rifaximin	3	1.3	1.5
	Others	16	6.8	
	Total	**237**	**100.0**	

3.5.5 Description of Prescribed Antifungals

Table 3.13 displays the breakdown of the 26 prescribed antifungals. Anidulafungin was the commonest agent (n=8, 30.8%), prescribed to 4.1% of ICU patients. In 2012, 28 antifungals prescriptions were recorded.

Table 3.13. Number, percentage and prevalence of prescribed antifungals in ICU patients

Rank order	Antifungals	N	%	Prevalence (%)
1	Anidulafungin	8	30.8	4.1
2	Fluconazole	7	26.9	3.6
3	Caspofungin	5	19.2	2.6
4	Amphotericin B (parenteral)	3	11.5	1.5
5	Nystatin	1	3.8	0.5
6	Posaconazole	1	3.8	0.5
7	Flucytosine	1	3.8	0.5
	Total	**26**	**100.0**	

3.5.6 Indication for Antimicrobial Prescribing

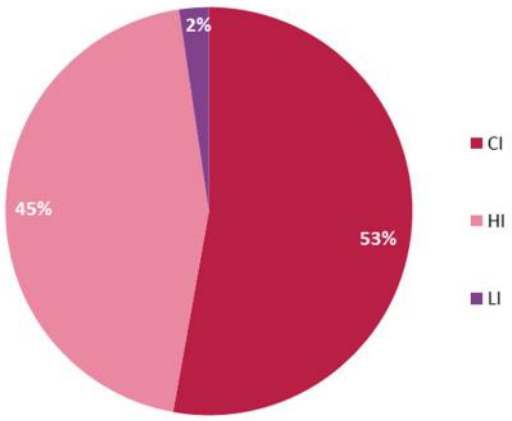
Table 3.14 displays the prescriber's indication for the antimicrobial, for the overall PPS patient cohort and ICU patients.

Table 3.14. Number and percentage of antimicrobials by prescriber's indication

Prescriber's indication	Antimicrobials prescribed in			
	All PPS patients		ICU patients	
	N	%	N	%
Treatment of infection	**4,579**	**78.8**	**212**	**80.6**
community infection (CI)	3,311	72.3	112	53
hospital infection (HI)	1,111	24.3	95	45
long-term care infection (LI)	157	3.4	5	2
Surgical prophylaxis	**552**	**9.5**	**28**	**10.6**
single dose (SP1)	169	30.6	4	14.3
one day (SP2)	185	33.5	13	46.4
> 1 day (SP3)	198	35.9	11	39.3
Medical prophylaxis	**537**	**9.2**	**16**	**6.1**
Other	**42**	**0.7**	**3**	**1.1**
Unknown	**103**	**1.8**	**4**	**1.5**
Total	**5,813**	**100%**	**263**	**100%**

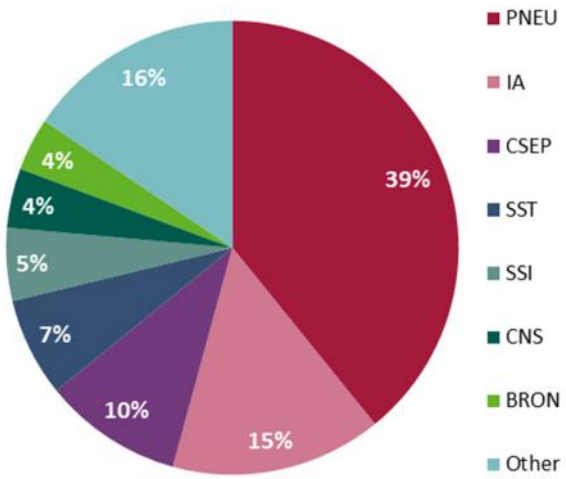
3.5.7 Antimicrobials Prescribed for the Treatment of Infection

Treatment of infection accounted for 80.6% of antimicrobials in ICU (n=212). Of treatment antimicrobials, 53% (n=112) were for community infection, 45% (n=95) for hospital infection and 2% (n=5) for long-term care infection, as shown in Figure 3.12. Treatment of pneumonia accounted for most antimicrobials (39%; n=95), as shown in Figure 3.13.



CI: Community-infection; **HI**: Hospital-infection; **LI**: Long-term care infection

Figure 3.12. Breakdown of treatment antimicrobials, by origin of infection (n=212)



PNEU: Pneumonia; **IA:** Intrabdominal infection; **CSEP:** Clinical Sepsis; **SST:** Skin and soft tissue infection; **SSI**: Surgical site infection; **CNS:** Infections of the Central Nervous System; **BRON**: Acute bronchitis or exacerbations of chronic bronchitis

Figure 3.13. Breakdown of treatment antimicrobials, by site of infection (n=212)

3.6 Key findings for ICUs that participated in both PPS 2012 & PPS 2017

There were 25 hospitals, and 28 adult ICUs (>90% national coverage), that performed both PPS (2012; n=153 patients and 2017; n=162). Table 3.15 displays the participating hospitals (tertiary = 6; 24%, secondary = 14; 56% and private = 5; 20%).

Table 3.15. Participating hospitals by hospital group/ownership, hospital type and ICU patients in PPS 2012 and 2017

Hospital Group or Ownership	Hospital name	Hospital Type	ICU patients 2012 N	ICU patients 2017 N
Dublin Midlands Hospital group	St James's Hospital	Tertiary	22	18
	Tallaght Hospital	Tertiary	9	11
	Midland Regional Hospital, Portlaoise	Secondary	2	2
	Midland Regional Hospital, Tullamore	Secondary	4	3
	Naas General Hospital	Secondary	4	3
Ireland East Hospital group	St Vincent's University Hospital	Tertiary	8	12
	Midland Regional Hospital, Mullingar	Secondary	4	5
	St Luke's General Hospital, Kilkenny	Secondary	3	4
	Wexford General Hospital	Secondary	4	4
RCSI Hospitals Group	Beaumont Hospital	Tertiary	16	14
	Cavan General Hospital	Secondary	3	2
	Our Lady of Lourdes Hospital, Drogheda	Secondary	5	4
	Connolly Hospital, Blanchardstown	Secondary	4	4
Saolta Hospital Group	Galway University Hospital	Tertiary	8	13
	Letterkenny University Hospital	Secondary	4	3
	Sligo University Hospital	Secondary	4	4
South/South-West Hospital Group	University Hospital Kerry, Tralee	Secondary	4	5
	South Tipperary General Hospital, Clonmel	Secondary	4	4
	Mercy University Hospital	Secondary	4	5
UL Hospitals Group	University Hospital Limerick	Tertiary	6	8
Private Hospitals	Galway Clinic	Private	7	7
	Beacon Hospital, Sandyford	Private	2	6
	Bon Secours Hospital, Tralee	Private	6	6
	Bon Secours Hospital, Cork	Private	7	6
	Mater Private Hospital, Dublin	Private	9	9
Total			**153**	**162**

Median age, gender distribution and risk factor prevalence were similar between PPS, with ICU patients in 2012 more likely to have an 'end-of-life' and 'life-limiting' prognosis than those in 2017 (48% versus 36%), as shown in table 3.16.

Table 3.16. ICU patient characteristics in PPS 2012 and 2017

Patient Characteristics	2012		2017	
	N	%	N	%
Median age (years)	**68**		**66**	
Age groups (years)				
17-64	71	46	77	48
65-79	60	39	63	39
80+	22	14	22	14
Male gender	88	58	104	64
Surgery since admission (yes)	70	46	74	46
Central vascular catheter yes)	99	65	105	65
Peripheral vascular catheter (yes)	95	62	103	64
Urinary catheter (yes)	124	81	133	82
Intubation (yes)	73	48	79	49
McCabe score				
None/non-fatal	79	52	102	63
Life-limiting	53	35	48	30
End-of-life	20	13	10	6
Not known	1	1	2	1

HAI

While the HAI prevalence was slightly lower in 2017 (n=40; 24.7%; 95%CI:18.7-31.9) than 2012 (n=41; 26.8%; 95%CI:20.4-34.3), the difference was not significant after adjusting for differences in patient case mix. In total, 48 HAIs were identified in each survey, equating to 1.17 HAI (2012) and 1.20 HAI (2017) per infected ICU patient. Table 3.17 displays the 48 HAI in each PPS, with pneumonia the commonest HAI in ICU, accounting for 42% and 52% of infections in 2012 and 2017, respectively. Systemic infection jumped rank from sixth to second, SSI dropped from second to third and BSI dropped from third to joint fifth in 2017.

Table 3.17. Rank order of HAI in ICU: 2012 – 2017

HAI Type	2012				2017			
	Rank order	N	%	Prevalence (%)	Rank order	N	%	Prevalence (%)
Pneumonia	1	20	42	13.1	1	25	52	15.4
Surgical site infection	2	7	15	4.6	3	5	10	3.1
Bloodstream infection	3	6	13	3.9	5	3	6	1.9
Gastrointestinal infection	4	5	10	3.3	5	3	6	1.9
Catheter-related infection	5	4	8	2.6	6	1	2	0.6
Systemic infection	6	3	6	2.0	2	6	13	3.7
Urinary tract infection	7	2	4	1.3	4	4	8	2.5
EENT* or mouth infection	8	1	2	0.7	6	1	2	0.6
Total		**48**	**100**			**48**	**100**	

*EENT = Eyes, ear, nose and throat

AMU

While the AMU prevalence in ICUs was lower in 2017 (n=109; 67.3%; 95%CI: 59.4-74.0) than 2012 (n=116; 75.8%; 95%CI: 68.4-81.9), the difference was not significant after adjusting for differences in patient case mix. Treatment of infection was the commonest indication for AMU in both PPS (Table 3.18).

Table 3.18. Number (%) of antimicrobials, by prescriber's indication: PPS 2012 & 2017.

Indication	2012		2017	
	N	%	N	%
Community infection (CI)	82	37	91	45
Hospital infection (HI)	93	42	71	35
Long-term care infection (LI)	0	0	5	2
Medical prophylaxis	9	4	10	5
Surgical prophylaxis	23	10	19	9
Other	8	4	3	1
Unknown indication	9	4	2	1
Total	**224**	**100**	**201**	**100**

There was no major change in the proportion of antimicrobial prescriptions that were for broad spectrum agents between the two surveys (53% versus 56%). For the ICUs that participated in both PPS, improvements were noted in documentation of the indication (from 77% to 95%) and compliance with local antimicrobial guidelines, where assessable (from 80% to 86%).

4.0 Discussion

There was excellent participation in the 2017 point prevalence survey (PPS), with 32 ICUs in 29 hospitals (22 public and seven private) submitting anonymous data on hospital-acquired infections (HAI) and antimicrobial use (AMU) from 196 patients aged over 16 years. Of these, 28 ICUs of 25 hospitals also participated in PPS 2012. In 2017, males predominated in ICU (63%), while accounting for 48% of the overall population. Patients admitted to high dependency units (HDU) were not included in 2017, unlike 2012, due to an update to the PPS protocol.

ICU patients had a higher prevalence across all risk factors for HAI, including surgery in the current admission and use of invasive medical devices, which were present in 98% of patients; peripheral and central vascular catheters, urethral catheters and intubation of the respiratory tract. Additionally, a higher proportion of ICU patients had more severe underlying illness in comparison with the overall patient cohort, as measured by the McCabe score. An ICU-specific illness severity score (e.g., SOFA/APACHE II) was not captured in the PPS and should be considered for inclusion in future surveys.

The prevalence of HAI in ICU was 24%, very similar to that observed in 2012 (23.3%) and four times higher than that of the overall population (6.1%). Additionally, the percentage of patients with more than one active HAI type at the time of survey was higher in ICU (3.6%) than the overall population (0.4%). The majority of HAI were attributable to the reporting hospital (93%) and unlike PPS 2012, where ICU admission date was not recorded, it was possible to further stratify HAI in ICU into unit-acquired (onset day three onwards after ICU admission) infections which accounted for 58% versus hospital-acquired but not unit-acquired (40%) infections. For those ICU patients with HAI evident on or within two days of ICU admission, information as to whether ICU admission was deemed to be related to the HAI was not collected.

Similar to the overall hospital population, pneumonia was the commonest HAI in ICU, accounting for 54.5% of infections. However, the prevalence of pneumonia was almost eight times higher in ICU patients. Additionally, pneumonia prevalence increased compared with 2012 (10.2% to 15.3%). While a change in the pneumonia case definition between 2012 and 2017, which softened the radiological criteria for pneumonia and may have contributed to the increased prevalence of pneumonia in the overall population, it might have been expected to have less of an impact on the prevalence of pneumonia in ICU, where radiological investigations are more frequently performed. As the commonest ICU infection which is increasing in prevalence, incidence surveillance of pneumonia should be initiated in ICUs in Ireland, particularly as just 32% of ICUs reported performing surveillance in 2017. Bloodstream infection (BSI) dropped in rank from second to fifth commonest HAI in ICU and in prevalence from 5.1% to 1.5% between the two PPS.

Positive microbiology results were available for 46% of HAI in ICU, with *Enterobacteriaceae* most commonly isolated, followed by *Candida spp,* similar to that observed in 2012. Having ranked third in 2012, there were no enterococci reported from HAI in 2017. There were no HAI reported due to MRSA, VRE, CPE or *C. difficile* infection in adult ICU patients on the date of the Irish PPS 2017.

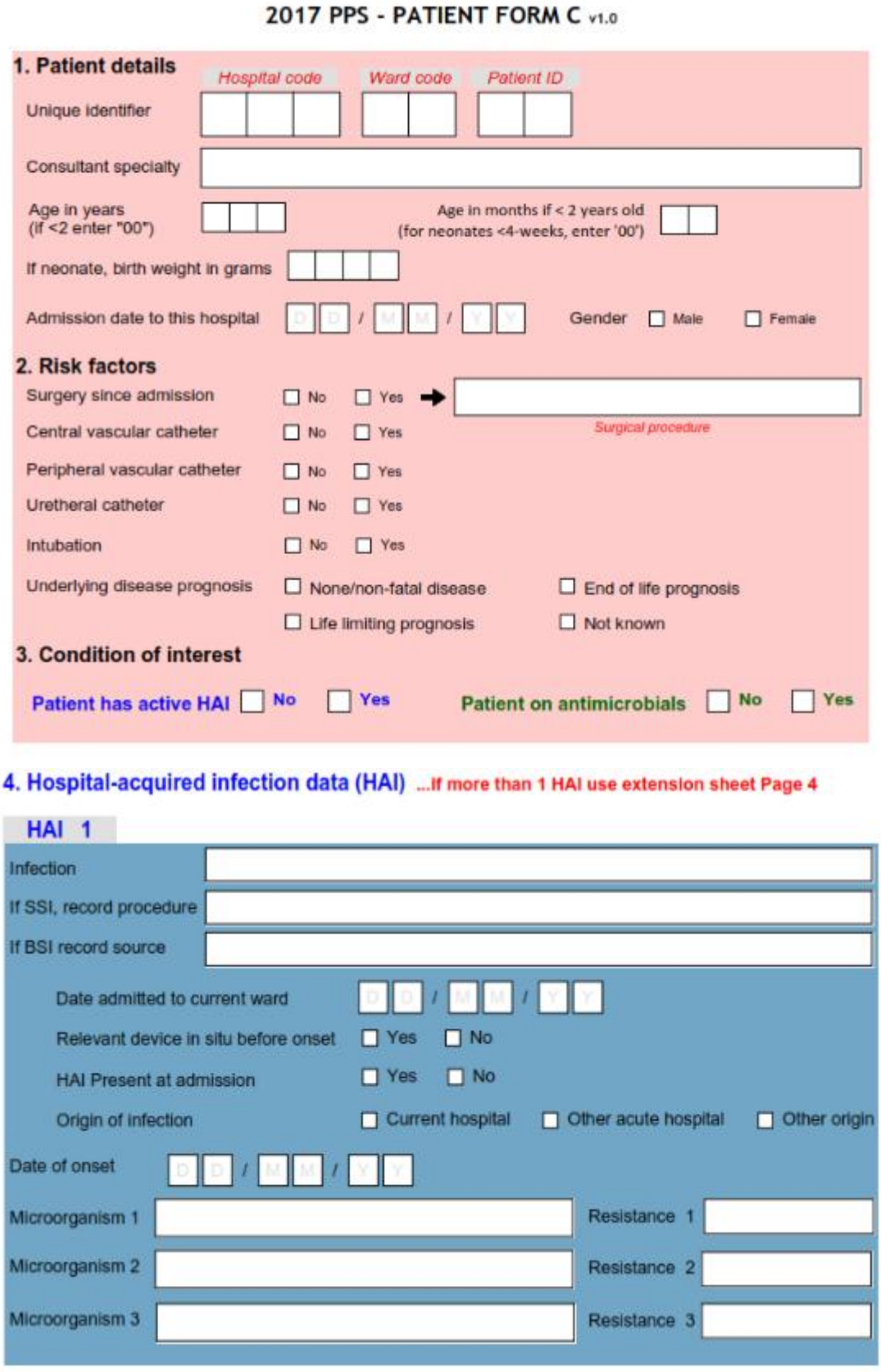
The AMU prevalence in ICU was 70.4%, slightly less than that observed in 2012 (74.4%), but much higher than the overall population (39.7%). The percentage of patients on more than one antimicrobial was higher; 2% of ICU patients were prescribed five separate antimicrobials versus 0.2% in the overall population. The rank order of the top five antibacterials in ICU was essentially unchanged from 2012, with piperacillin-tazobactam ranking first and meropenem third.

Compared with 2012, the proportion of antimicrobials for which there was no documented indication fell from 23.4% to 8% and the percentage of antimicrobials compliant with local guidelines increased from 75.8 to 84%. Both of these are positive findings of good antimicrobial stewardship programmes in a high prevalence area.

5.0 Recommendations

- Ensure that the local and national results of the 2017 PPS have been shared with ICU staff
- Multi-modal strategies for prevention of the commonest HAI in ICU should be universally implemented, especially pneumonia and device-related infections: device maintenance care bundles, device insertion checklists, with induction and periodic staff education, availability of local guidelines and policies, supported by a programme of audit and surveillance
- As an area of high antimicrobial use prevalence, ensure that antimicrobial stewardship resources are available and utilised in ICU
- Ensure that frontline healthcare worker staffing levels reflect patient case mix and dependency levels.
- While the national PPS of HAI and AMU is repeated every five years, this measures prevalence and is not sufficiently frequent for evaluation of the impact of multi-modal preventative strategies, performance of individual ICUs over time, nor can it be used to benchmark ICUs caring for a similar patient case mix. Consideration should be given to including an ICU-specific illness severity score (e.g. SOFA, APACHE II) to the protocol for the next PPS
- A national ICU prospective incidence infection surveillance programme should be developed, resourced and implemented, with primary focus on the most prevalent infection types, pneumonia, with bloodstream infection and central line related infections also prioritized
- Ensure that any ICU information technology (IT) plans incorporate modern technology such as; electronic prescribing with prescriber decision support and capacity to support stewardship interventions in a timely way, electronic patient records and laboratory information systems. Such developments have enormous potential to positively impact on suboptimal prescribing practices, medication errors, improve documentation, manage demand on resources and to reduce waste

Appendix A: PPS Patient Data Collection Form



2017 PPS - PATIENT FORM C v1.0

1. Patient details

Hospital code | Ward code | Patient ID

Unique identifier

Consultant specialty

Age in years (if <2 enter "00")

Age in months if < 2 years old (for neonates <4-weeks, enter '00')

If neonate, birth weight in grams

Admission date to this hospital D D / M M / Y Y

Gender ☐ Male ☐ Female

2. Risk factors

Surgery since admission ☐ No ☐ Yes → Surgical procedure

Central vascular catheter ☐ No ☐ Yes

Peripheral vascular catheter ☐ No ☐ Yes

Uretheral catheter ☐ No ☐ Yes

Intubation ☐ No ☐ Yes

Underlying disease prognosis ☐ None/non-fatal disease ☐ End of life prognosis ☐ Life limiting prognosis ☐ Not known

3. Condition of interest

Patient has active HAI ☐ No ☐ Yes

Patient on antimicrobials ☐ No ☐ Yes

4. Hospital-acquired infection data (HAI) ...If more than 1 HAI use extension sheet Page 4

HAI 1

Infection

If SSI, record procedure

If BSI record source

Date admitted to current ward D D / M M / Y Y

Relevant device in situ before onset ☐ Yes ☐ No

HAI Present at admission ☐ Yes ☐ No

Origin of infection ☐ Current hospital ☐ Other acute hospital ☐ Other origin

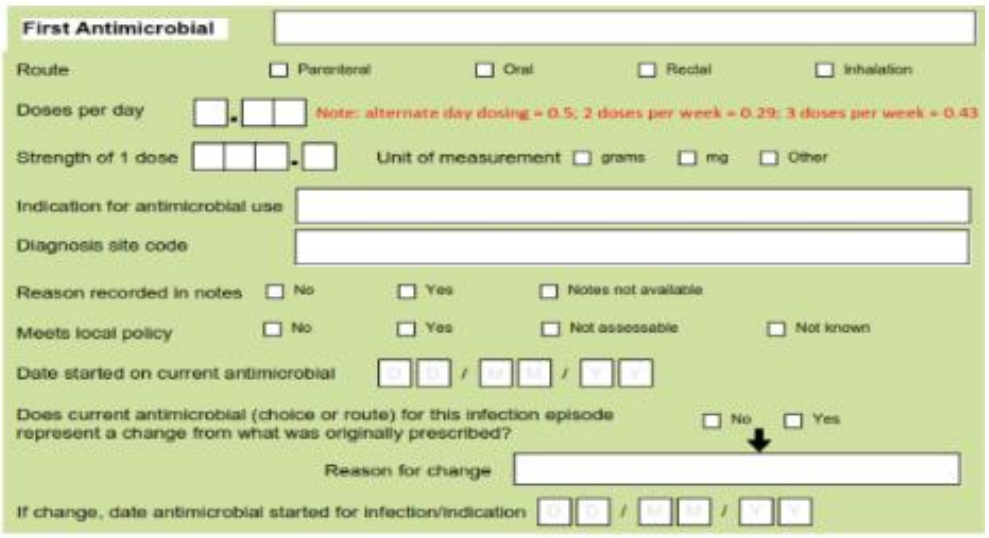
Date of onset D D / M M / Y Y

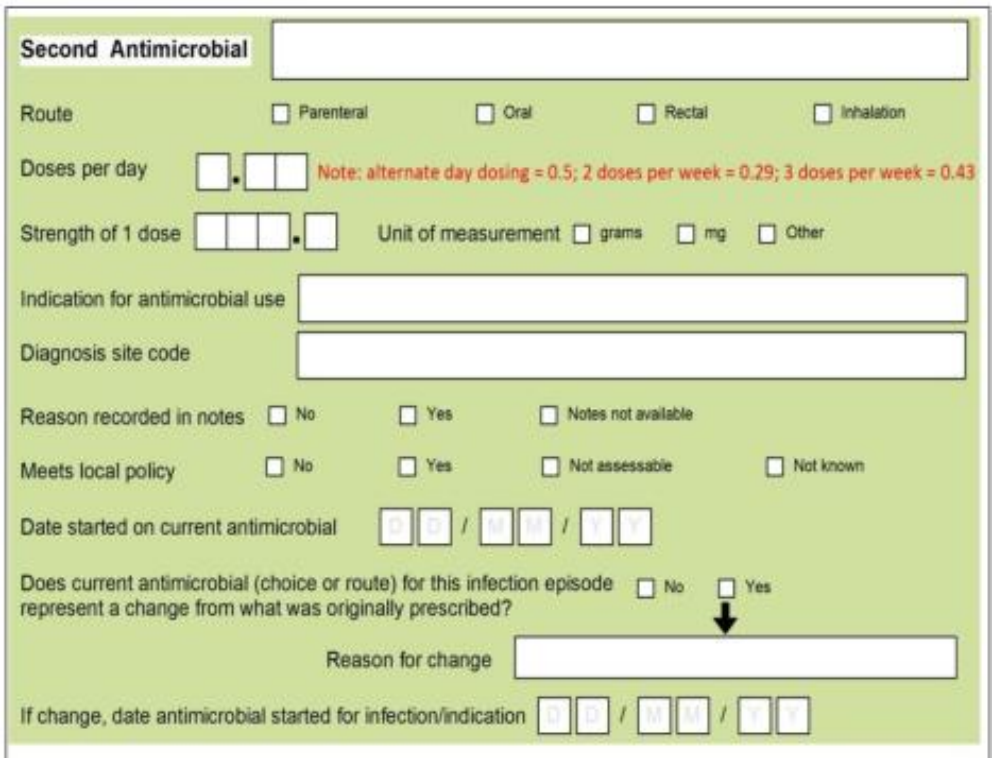
Microorganism 1 | Resistance 1

Microorganism 2 | Resistance 2

Microorganism 3 | Resistance 3

5. Antimicrobial use ... if more than 2 antimicrobials use extension sheet Page 3





Appendix B: Case Definitions for the Most Common HAI Reported in ICU Patients

1.1 PN: PNEUMONIA

Rx

Two or more serial chest X-rays or CT-scans of lungs with suggestive image of pneumonia for patients with underlying cardiac or pulmonary disease*. In patients without underlying cardiac or pulmonary disease, one definitive chest X-ray or CT-scan is sufficient.

and at least ONE of the following

Symptoms

- Fever > 38 °C with no other cause
- Leukopenia (<4000 WBC/mm^3) or leucocytosis (≥ 12 000 WBC/mm^3)

and at least ONE of the following
(or at least TWO if clinical pneumonia only = PN 4 and PN 5)

- New onset of purulent sputum, or change in character of sputum (colour, odour, quantity, consistency)
- Cough or dyspnoea or tachypnoea
- Suggestive auscultation (rales or bronchial breath sounds), rhonchi, wheezing
- Worsening gas exchange (e.g., O_2 desaturation or increased oxygen requirements or increased ventilation demand)

and according to the used diagnostic method

Microbiology

a – Bacteriologic diagnostic performed by:

Positive quantitative culture from minimally contaminated lower respiratory tract (LRT) specimen **(PN 1)**

- Bronchoalveolar lavage (BAL) with a threshold of ≥ 10^4 colony-forming units (CFU)/ml or ≥ 5 % of BAL obtained cells contain intracellular bacteria on direct microscopic exam (classified on the diagnostic category BAL).
- Protected brush (PB Wimberley) with a threshold of ≥10^3 CFU/ml
- Distal protected aspirate (DPA) with a threshold of ≥ 10^3 CFU/ml

Positive quantitative culture from possibly contaminated LRT specimen **(PN 2)**

- Quantitative culture of LRT specimen (e.g. endotracheal aspirate) with a threshold of 10^6 CFU/ml

b – Alternative microbiology methods **(PN 3)**

- Positive blood culture not related to another source of infection
- Positive growth in culture of pleural fluid
- Pleural or pulmonary abscess with positive needle aspiration
- Histologic pulmonary exam shows evidence of pneumonia
- Positive exams for pneumonia with virus or particular microorganism detected: *Legionella spp., Aspergillus spp.*, mycobacteria, *Mycoplasma spp., Pneumocystis spp.*)
    - Positive detection of viral antigen or antibody from respiratory secretions (e.g., EIA, FAMA, shell vial assay, PCR)
    - Positive direct exam or positive culture from bronchial secretions or tissue
    - Seroconversion
    - Detection of antigens in urine (*Legionella pneumophila, Streptococcus pneumoniae)*

c – Others

- Positive **sputum** culture **or non-quantitative LRT specimen** culture **(PN 4)**
- **No positive microbiology** **(PN 5)**

1.14 SYS: SYSTEMIC INFECTION

SYS-DI: Disseminated infection

Disseminated infection is infection involving multiple organs or systems, without an apparent single site of infection, usually of viral origin, and with signs or symptoms with no other recognised cause and compatible with infectious involvement of multiple organs or systems.

SYS-DI reporting instructions:

- Use this code (SYS-DI) for viral infections involving multiple organ systems (e.g., varicella, measles, rubella, mumps, erythema infectiosum/parvovirus B19). These infections often can be identified by clinical criteria alone
- Do not use this code for HAI with multiple metastatic sites, such as bacterial endocarditis with embolic infection to other sites. Only the primary site of such disseminated HAI should be reported
- Do not report fever/pyrexia of unknown origin (FUO/PUO) as SYS-DI
- Report viral exanthems or rash illness as SYS-DI

SYS-CSEP: Clinical sepsis in adults and children

Patient has at least **ONE** of the following clinical signs or symptoms with no other recognised cause: Fever (>38° C), hypotension (systolic blood pressure <90 mmHg) or oliguria (urine output <20 ml/hr)

- **and** blood culture not done or no micro-organisms or antigen detected in blood
- **and** no apparent infection at another site
- **and** clinician institutes treatment for sepsis

SYS-CSEP reporting instructions:

- Do not use this code unless there is absolutely no other potential focus for HAI (last resort definition)
- For CSEP in neonates, use NEO-CSEP case definition (see below)

1.3 UTI: URINARY TRACT INFECTION

UTI-A: microbiologically confirmed symptomatic UTI

Patient has at least **ONE** of the following signs of symptoms with no other recognised cause: fever (>38°C), urgency, frequency, dysuria, or suprapubic tenderness **and** patient has a positive urine microbiology culture report. That is, ≥ 10^5 microorganisms per ml of urine with no more than two species of microorganisms detected in the same urine sample.

UTI-B: not microbiologically confirmed symptomatic UTI

Patient has at least **TWO** of the following with no other recognised cause: fever (>38°C), urgency, frequency, dysuria, or suprapubic tenderness **and** at least **ONE** of the following:

a. Positive dipstick for leukocyte esterase and/or nitrite
b. Pyuria – White blood cells (WBC) or pus cells seen on urine specimen microscopy with ≥10 WBC/ml or ≥ 3 WBC/high-power field of unspun urine
c. Organisms seen on Gram stain of unspun urine
d. At least <u>two</u> urine cultures with repeated isolation of the same uropathogen (Gram-negative bacteria or *Staphylococcus saprophyticus*) with ≥ 10^2 colonies/ml urine in non-voided specimens
e. ≤10^5 colonies/ml of a single uropathogen (Gram-negative bacteria or *S. saprophyticus*) in a patient being treated with effective antimicrobial agent for a urinary infection
f. Clinician clinical diagnosis of a urinary tract infection
g. Clinician institutes appropriate therapy for a urinary infection

UTI reporting instruction:

For urinary tract infection, only fill in one subcategory (where more than one UTI definition is met by the patient, prioritise urinary tract infection as UTI-A>UTI-B).

1.5 SSI: SURGICAL SITE INFECTION

Superficial incisional (SSI-S)

Infection occurs within 30 days after the operation **and** infection involves only skin and subcutaneous tissue of the incision **and** at least **ONE** of the following is present:

1. Purulent drainage with or without laboratory confirmation, from the superficial incision
2. Organisms isolated from an aseptically obtained culture of fluid or tissue from the superficial incision
3. At least **ONE** of the following signs or symptoms of infection: pain or tenderness, localised swelling, redness, or heat **and** superficial incision is deliberately opened by surgeon, **unless** incision is culture-negative
4. Clinical diagnosis of superficial incisional SSI made by consultant clinician

Deep incisional (SSI-D)

Infection occurs within 30 days after the operation if no implant is left in place or within 90 days if implant is in place **and** the infection appears to be related to the operation **and** infection involves deep soft tissue (e.g., fascia, muscle) of the incision **and** at least **ONE** of the following:

1. Purulent drainage from the deep incision but not from the organ/space component of the surgical site
2. A deep incision spontaneously dehisces or is deliberately opened by a surgeon when the patient has at least **ONE** of the following signs or symptoms: fever (>38º C), localised pain or tenderness, unless incision is culture-negative
3. An abscess or other evidence of infection involving the deep incision is found on direct examination, during reoperation or by histopathologic or radiologic examination
4. Diagnosis of deep incisional SSI made by consultant clinician

Organ/Space (SSI-O)

Infection occurs within 30 days after the operation if no implant is left in place or within 90 days if implant is in place **and** the infection appears to be related to the operation **and** infection involves any part of the anatomy (e.g., organs and spaces) other than the incision which was opened or manipulated during an operation **and** at least **ONE** of the following:

1. Purulent drainage from a drain that is placed through a stab wound into the organ/space
2. Organisms isolated from an aseptically-obtained microbiological culture of fluid or tissue in the organ/space
3. An abscess or other evidence of infection involving the organ/space that is found on direct examination, during reoperation, or by histopathologic or radiologic examination
4. Diagnosis of organ/space SSI made by consultant clinician

SSI reporting instruction:

Report vaginal cuff infections as SSI-O if diagnosed within 30 days of hysterectomy. See section on REPR: Reproductive tract infection