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

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Executive Summary

This report presents the findings of the second point prevalence survey (PPS) of hospital-acquired infections (HAI) and antimicrobial use (AMU) conducted in Ireland and the European Union (EU)/European Economic Area (EEA) using a common protocol.[1,] The first PPS was performed in 50 Irish hospitals in May 2012 and repeated in 60 hospitals in May 2017.[2,3] The number of patients included, along with the national HAI and AMU prevalence increased between the two surveys. For 49 hospitals that have participated in both PPS to date, increases in median patient age, the proportion of patients aged ≥65 years and the prevalence of vascular catheter use were observed.

The European Centre for Disease Prevention and Control (ECDC) has estimated that on any given day, there are 670 inpatients in Irish hospitals with a HAI, translating to almost 30,000 patients in Ireland affected by HAI annually.[4]

Hospital & Eligible Patient Characteristics

- In May 2017, 60 acute Irish hospitals (46 public and 14 private) participated in the voluntary European ECDC PPS of HAI and AMU. The breakdown of participating hospitals by type included: primary (n=9), secondary (n=17), tertiary (n=7), specialist public (n=13), specialist private (n=1) and private (n=13)
- The average number of acute beds in the 46 public hospitals ranged from 72 to 588, depending on the hospital type. The average proportion of single patient rooms was lowest in public primary (15%), secondary (20%), specialist (23%) and tertiary (29%) hospitals and was highest in private hospitals (52%)
- All hospitals reported having an infection prevention and control nurse (IPCN), 17 reported having no infection prevention and control doctor (IPCD) and 17 reported having no antimicrobial pharmacist (AMP)
- The resource of whole time equivalent (WTE) IPCN per 100 beds was similar for both public (0.8) and private hospitals (0.9). Private hospitals reported 0.24 IPCD per 100 beds, higher than that of public hospitals (0.17). Public hospitals reported 0.26 AMP per 100 beds, higher than that of private hospitals (0.14)
- Of 10,333 eligible patients, there was a slight female preponderance (52%), with 10% aged <10 and 54% aged ≥65 years
- Surgery since hospital admission was a risk factor for 18% of patients and 58% had at least one invasive device *in situ* (e.g., peripheral vascular catheter or urinary catheter)

Hospital-Acquired Infections (HAI)

- There were 678 active HAI identified in 633 patients. The overall HAI prevalence was 6.1%, an increase from 5.2% reported for the previous PPS in May 2012. The vast majority of HAI occurred in patients aged ≥15 years (96.5%) and 90% of HAI were attributable to the reporting hospital
- Ireland's HAI prevalence equalled that of Northern Ireland (6.1%), but was higher than that of Scotland (4.5%) and participating EU countries overall (5.5%)[4]
- Patients with HAI were more likely to have risk factors, such as surgery since hospital admission and invasive medical devices *in situ,* than the overall eligible population
- The overall HAI prevalence by hospital type was highest for tertiary (8.7%) and lowest for specialist hospitals (3.4%)
- The HAI prevalence was highest in adult intensive care units (24%) and surgical wards (9.1%). Obstetrics/gynaecology (1.8%) and psychiatry (1.6%) wards had the lowest HAI prevalence
- The top four HAI types were:
  - Pneumonia (PN) (196 cases; 28.9% of all HAI; prevalence = 1.9% of inpatients)
  - Surgical site infection (SSI) (122 cases; 18.1% of all HAI; prevalence = 1.2% of inpatients)
  - Urinary tract infection (UTI) (98 cases; 14.5% of all HAI; prevalence = 0.9% of inpatients)
  - Bloodstream infection (BSI) (64 cases; 9.9% of all HAI; prevalence = 0.6% of inpatients)

- A large increase in PN as a proportion of all HAI was observed in 2017 versus 2012 (28.9 versus 17%), with a doubling of prevalence (1.9 versus 1.0%) and for 49 hospitals that participated in both PPS, a 195% increase in the HAI categories pneumonia & lower respiratory tract infection was observed. Alteration in the PN surveillance case definition between the two PPS may have contributed to this increased prevalence
- Of the BSI, 16 (25%) were due to infection of an indwelling vascular catheter
- There were 30 patients with *Clostridium difficile* infection (CDI), accounting for 4.4% of all HAI
- The most common HAI causative pathogens were *Enterobacteriaceae* (37%) and of those, 14% were resistant to third generation cephalosporins (C3G). *Staphylococcus aureus* was the second commonest, 28% of which were flucloxacillin resistant (i.e., meticillin-resistant *S. aureus* or MRSA)

Antimicrobial Use (AMU)

- There were 4,105 patients who were prescribed 5,813 antimicrobials. The overall AMU prevalence was 39.7%, an increase from 34% reported in May 2012. The vast majority of AMU occurred in patients aged ≥15 years (94%)
- At 39.7%, Ireland's AMU prevalence was higher than that of neighbouring UK countries (Wales 34.2% - England 37.4%) and participating EU countries overall (30.5%)[5]
- The overall AMU prevalence, by hospital type was highest for private (45.4%) and lowest for specialist hospitals (26.5%)
- The AMU prevalence was highest in adult intensive care units (ICU) (70.4%) and lowest in psychiatry wards (7.8%)
- Most antimicrobials were administered via the parenteral or intravenous (IV) route (63%)
- For 91% of antimicrobial prescriptions, the indication was documented. Treatment of infection (78.8%), surgical antimicrobial prophylaxis (SAP) (9.5%) and medical prophylaxis (9.2%) were the commonest reasons:
    - Of prescriptions to treat infection, community infections represented the majority (72%), followed by hospital (24%) and long-term care facility infections (3%)
    - The commonest infection sites for treatment antimicrobials were; respiratory tract (36%), skin, soft tissue and surgical site (15%), urinary tract (11%) and intra-abdominal (10%)
- Of SAP prescriptions, the majority (69.4%) exceeded single-dose. Indeed, 36% exceeded 24 hours duration
- Compared with PPS 2012, only a slight reduction in the proportion of SAP exceeding single dose was observed (73% to 69.4%) and the duration in Ireland was double that in Scotland, with 69.4% of SAP continued beyond one dose versus 35.1%
- Twenty agents collectively accounted for 90% of prescribed antibacterials. Broad spectrum β lactam-β lactamase inhibitor combination antimicrobials (i.e., co-amoxiclav and piperacillin-tazobactam) together accounted for 36%. Meropenem ranked tenth (3%) and for 49 hospitals that participated in both PPS, while the meropenem ranking remained unchanged, an 8% increase in prescriptions was observed
- The HAI and AMU prevalence results of the 46 acute public hospitals are categorised by their respective hospital groups, with 14 private hospitals categorised separately. Owing to differences in hospital types and case mix, direct comparison of HAI and AMU prevalence is not recommended

Future Priorities

1. Ensure all acute hospital staff have been made aware of the local PPS results in 2017, along with observed changes since 2012, for the 49 hospitals that participated in both PPS to date

2. Provide ongoing education and training for healthcare workers, regarding the importance and impact of HAI and antimicrobial resistance and the need for antimicrobial stewardship

3. Minimise the risk of the most common HAI types;

    a. Develop and implement national evidence-based multi-modal preventative strategies for hospital acquired pneumonia

    b. Develop and implement national evidence-based multi-modal preventative strategies for surgical site infection, with particular emphasis on improving compliance with recommendations on duration of SAP

4. Monitor and measure the incidence of the most common HAI types, prioritising SSI and pneumonia, through the implementation of prospective surveillance programmes

5. Implement the core, high impact interventions to promote prudent antimicrobial prescribing

6. Ensure that frontline healthcare worker staffing levels reflect patient case mix and dependency levels

7. Ensure that infection prevention and control, antimicrobial stewardship and surveillance staffing levels reflect patient case mix and that such staff are not diverted to tasks outside their designated roles and that activities related to prevention of antimicrobial resistance and HAI are appropriately resourced

8. Ensure that future strategic developments in Irish healthcare includes infrastructure and information technology that support the prevention of HAI and antimicrobial resistance and the timely measurement and reporting of surveillance data

9. Plan for periodic repeat PPS, locally and nationally to monitor and measure improvements in HAI prevalence and antimicrobial prescribing practices. An annual PPS of AMU is already performed by most Irish hospitals

Plain Language Summary

Background

During May 2017, 60 Irish hospitals took part in a European hospital survey. The survey was coordinated in Ireland by the Health Protection Surveillance Centre (HPSC). The HPSC is the national centre for the surveillance of infections in Ireland. The survey was carried out in 28 European countries. This was the second European survey to be performed, with the first survey completed in 2012.

During April 2017, staff members from the 60 Irish hospitals went to a training day, where they were taught how to perform the survey. The survey was then carried out in each hospital by a team of the hospital's own staff, using the same set of instructions in each hospital across the country. Once the survey was completed, the results from each hospital were collected and checked at the HPSC. The results have been put together to produce this national report for Ireland. The results for every hospital that took part were returned to each individual hospital in February 2018, to be used to help the staff to make future plans to further improve patient care.

The survey was done for the following reasons:

1. To count the number of patients with an infection that may have occurred as a result of hospital contact. A so-called 'hospital-acquired infection' or HAI for short
2. To count the number of patients in the hospitals who were prescribed antibiotics
3. To provide the Irish Government, Department of Health, Health Service Executive (HSE), the managers, doctors and nurses in all of the hospitals that took part, with information about HAI and antibiotic prescribing in Irish hospitals in 2017 and for hospitals that took part in both surveys in 2012 and 2017, an opportunity to assess progress in the five-year interval between surveys. This information is important to plan future ways to reduce the numbers of patients who get HAI and to reduce the chance that antibiotics may be prescribed unnecessarily
4. To provide members of the public with more information about HAI in Ireland and which types of infections are most commonly seen in Irish hospitals

The count of the patients with a HAI and the patients prescribed antibiotics is called 'prevalence'. These results provide us with a picture or a snapshot of the number of patients who had a HAI and the number of patients who were prescribed antimicrobials in the 60 Irish hospitals that took part in the survey in May 2017.

Hospital-Acquired Infections (HAI)

During this survey, a HAI was defined as an infection that developed more than two days after a patient was admitted to a hospital, or an infection that developed because of a medical device being inserted or a wound infection that occurred within a defined time period after an operation. HAI are important because they can cause harm to patients. Not every HAI can be prevented from happening, but every opportunity should be taken to prevent HAI, whenever possible.

There were 10,333 patients counted during the survey across 60 Irish hospitals. Of those patients, 633 had a HAI at the time of the survey. This means that the prevalence of HAI across all of the hospitals in May 2017 was 6.1%. For individual hospitals, some had an infection prevalence that was higher and for others it was lower. This means that just over one-in-twenty patients admitted to Irish hospitals in May 2017 had a HAI, which equates to around 670 patients on one day or almost 30,000 patients in one year.[4] However, because different hospitals may admit different types of patients and have different types of medical and surgical specialists working within the hospital, it is not possible to directly compare the results of one hospital with those of another.

The commonest infection types found in the survey were:

1. Pneumonia, also known as a chest infection
2. Surgical site infection, also known as wound infection
3. Urinary tract infection, which may include infections of the bladder or kidneys
4. Bloodstream infection

In this survey, it was found that the patients who had a HAI were more likely to have some of the common 'risk factors' for developing a HAI, when they were compared with the patients who did not have a HAI. Well-known risk factors for developing HAI can include: having had an operation, having a drip or a urinary catheter, being in an intensive care unit, being older or very young in age and receiving antibiotics. Recent antibiotic use can also be a risk factor for developing *Clostridium difficile* infection. There were 30 patients being treated for *Clostridium difficile* infection during this survey.

Antibiotics are an extremely important resource for treatment of infections caused by bacteria. There is growing evidence worldwide that bacteria are becoming more and more resistant to antibiotics, so they no longer work to treat common infections. This problem is made worse by the fact that there have been very few new types of antibiotics developed to overcome this problem of resistance. It is very important that antibiotics are only used when they are absolutely necessary and that they are not used inappropriately, such as to try and treat infections caused by viruses. It is also very important that antibiotics are not used for too long and that the course of treatment is kept as short as possible. During this survey, 19 patients were reported to have infection caused by resistant *Enterobacteriaceae*, 14 by meticillin resistant *Staphylococcus aureus* (MRSA) and 14 by vancomycin resistant enterococci (VRE).

Antibiotic Use

This survey found that of 10,333 patients, 4,105 were prescribed antibiotics. This means that the prevalence of antibiotic use across all of the Irish hospitals was 39.7%. However, because different hospitals may admit different types of patients and have different types of medical and surgical specialists working within the hospital, it is not possible to directly compare the results of one hospital with those of another hospital.

About four-in-ten patients who were admitted to Irish hospitals in May 2017 were prescribed an antibiotic. This survey showed that antibiotic prescribing is very common in Irish hospitals. Many patients are admitted to hospital from home because they need to get antibiotic treatment for an infection. Patients who develop an infection while in hospital for other reasons (a so-called HAI) will often need antibiotic treatment. The results of the survey show that it is very important to make sure that antibiotic prescribing in hospitals is done properly and that antibiotics are prescribed appropriately. This in turn, will reduce the chances of antibiotic resistant bacteria emerging in our hospitals and preserve the use of antibiotics for treatment of patients in the future.

1.0 Introduction

This report outlines the findings of a national survey conducted in May 2017 to assess the prevalence of HAI and antimicrobial prescribing practices in Irish hospitals. The survey was first performed in Ireland in May 2012.[3]

HAI have the potential to cause harm to patients and in some cases, severe illness and death. The HAI types most likely to cause severe infection or patient mortality include; bloodstream infections (BSI) caused by infected vascular catheters and ventilator-associated pneumonia (VAP).[6] HAI are not an inevitable consequence of healthcare. It has been estimated that up to 70% of vascular catheter-related BSI and 55% of VAP and SSI cases may be reasonably prevented.[6]

Many HAI can be prevented, provided every healthcare worker applies simple measures, which include, but are not limited to: consistent compliance with the World Health Organisation (WHO) 'five moments for hand hygiene' to prevent cross-transmission of pathogens that cause HAI and the use of evidence-based interventions, such as care bundles or quality improvement tools, which may be applied to prevent device-related infections and SSI.[7,8,9,10] National Standards for the Prevention and Control of Healthcare-Associated Infections were published by the Health Information and Quality Authority (HIQA) in 2009 and were updated in 2017.[11,12] In 2012, HIQA published National Standards for Safer Better Healthcare, to describe how a service provides high quality, safe and reliable care through eight themes, relating to quality, safety, capacity and capability.[13]

National guidelines for antimicrobial stewardship were published in 2009, describing core high-impact interventions for antimicrobial stewardship.[14] Antimicrobial consumption is the major driver of antimicrobial resistance (AMR). HAI caused by antimicrobial resistant organisms (AMRO), also known as multi-drug resistant organisms (MDRO) [e.g., meticillin resistant *Staphylococcus aureus* (MRSA), vancomycin resistant enterococci (VRE), extended spectrum β lactamase (ESBLs) and carbapenem resistant or carbapenemase-producing *Enterobacteriaceae,* more recently termed *Enterobacterales* (CRE/CPE)] are associated with higher healthcare costs, increased length-of-stay and higher mortality than HAI that are caused by antimicrobial susceptible organisms.[15,16] A recent European study estimated that 33,000 people die in the EU annually from infections caused by AMRO and that in Ireland there are up to 5,000 infections and 200 deaths caused by AMRO annually.[17] Prior to the introduction of antimicrobials, infectious diseases were a leading cause of mortality. The 'antibiotic era' facilitated many advances in medicine, such as transplantation, chemotherapy and insertion of prosthetic devices. However, increased antimicrobial consumption, coupled with stagnation in discovery of novel antimicrobial agents has led to the emergence and worldwide dissemination of AMRO, which are well-described in Ireland and in some cases, are now endemic in Irish hospitals. In October 2017, Ireland's National Action Plan on Antimicrobial Resistance (2017–2020) was published and contemporaneously, the Minister for Health declared CPE as a national public health emergency, based on a rapidly increasing incidence and associated outbreaks in Irish hospitals.[18]

In Ireland, periodic incidence surveillance data on acute hospital hand hygiene compliance audit scores, CDI rates, antimicrobial consumption in acute hospitals and the community, antimicrobial resistance in key pathogens causing BSIs and monthly reporting on the incidence of CPE is produced by the HPSC, based on data submitted by hospitals participating in surveillance. Latest available surveillance data is available on the HPSC website, at the following link:

http://www.hpsc.ie/a-z/microbiologyantimicrobialresistance/infectioncontrolandhai/surveillance/

The results of this survey provide additional information, outlining the most prevalent HAI types and further details on antimicrobial prescribing practices in Irish hospitals in May 2017. This information should be used widely at hospital, hospital group and national levels to plan future improvement and preventative programmes.

2.0 Methods

The second national point prevalence survey (PPS) of HAI and antimicrobial use (AMU) took place in Ireland between May 1st and 31st 2017. Sixty acute hospitals volunteered to participate in this study, which was coordinated in Ireland by the HPSC. The survey was conducted across Europe using a standardised protocol devised by the European Centre for Disease Prevention and Control (ECDC) and HAI were defined using standardised European definitions of infection, where available:[1]

- ECDC intensive care unit (ICU) surveillance definitions for bloodstream infection (BSI), pneumonia (PN), vascular catheter-related infection (CRI) and urinary tract infection (UTI)
- ECDC surgical site infection (SSI) surveillance definitions for SSI
- ECDC *C. difficile* infection (CDI) surveillance definitions for CDI, adopted from the European Society for Clinical Microbiology and Infectious Diseases Study Group on *C. difficile* (ESCMID-ESGCD) definitions
- German HCAI surveillance network (KISS) definitions for neonatal infections
- US Centers for Disease Control and Prevention (CDC) definitions were used for other infections with no existing European definitions

In January 2017, a multi-disciplinary PPS steering group was convened under the Royal College of Physicians of Ireland (RCPI) Clinical Advisory Group (CAG) for Healthcare-Associated Infections (HCAI) and Antimicrobial Resistance (AMR) (Appendix A). The steering group held several teleconferences to plan for the PPS and had input into this report on the PPS findings.

Seven regional training days were organised for PPS data collectors to learn about the survey protocol and methodology. The schedule of presentations for each training day included; an introductory presentation describing content, completion instructions for the PPS data collection forms, presentations and practical case studies to enable trainees to practice completion of the PPS data collection forms (Appendix C). During April 2017, 251 data collectors attended a one-day training session, with positive feedback obtained and the majority of respondents indicated they felt prepared to undertake the PPS in their hospital. Many of those attending training in 2017 had also attended training and performed the PPS in 2012.

During the PPS, all eligible patients in each hospital were surveyed by a multi-disciplinary local PPS team for anonymous demographic details, risk factors, AMU and the presence of active HAI.

A dedicated PPS e-mail address was available at the HPSC to address any queries that arose before, during and after the PPS. A frequently-asked questions (FAQ) section was also maintained on the HPSC website to address the most commonly encountered queries during the training and PPS. PPS information leaflets were also prepared for patients and for healthcare workers.

All study documentation related to the PPS, including protocol and data collection forms were posted on a dedicated PPS section of the HPSC website:

www.hpsc.ie/a-z/microbiologyantimicrobialresistance/infectioncontrolandhai/surveillance/hospitalpointprevalencesurveys/2017/

Data Management & Analysis

Data were collected on paper forms (Appendix C) and subsequently entered electronically by hospital staff to an on-line data capture system (Formic Fusion Version 5.4.0). Each participating hospital was provided with password-protected secure remote access to this web-based system to allow electronic data submission.

Once submitted, data were cleaned and quality checks were performed. All hospitals received a summary of submitted data with any inconsistent, missing or potentially inaccurate data highlighted for correction. Example of such possible errors included invalid admission or survey dates and patient ages that did not correspond with the named ward specialty type.

Statistical analysis of the finalised data was performed using the free on-line tools from VassarStats http://www.vassarstats.net/ and OpenEpi https://www.openepi.com.

Data Validation

A validation study was conducted to assess the validity and consistency of applying the PPS protocol and definitions. The validation study performed in the first PPS in Ireland in May 2012 demonstrated excellent sensitivity and specificity for identification of patients on antimicrobials and lower sensitivity for identification of patients meeting a HAI case definition (false negatives or under-reporting). A five-year interval between national PPS and documented lower sensitivity for the HAI case definitions in the 2012 PPS supported a need to focus on HAI case definitions in the training for PPS 2017. Regrettably, some additional changes to the updated ECDC protocol added to the training needs of the data collectors, providing less time to expand on the opportunities to practice HAI case definitions within the confines of a training day timetable.

For PPS 2017, a simultaneous validation study was conducted to assess the validity and consistency of applying the PPS protocol and definitions. For this purpose, the national validation team (VT) comprised two members of the PPS national coordinating team, both of whom are based at HPSC. Both VT members had developed the PPS Protocol for Ireland, prepared the PPS training materials and delivered all seven PPS training dates during April 2017. The 2017 PPS national coordinator had previously performed the PPS validation study in May 2012.

In preparation for the PPS validation study, both VT members individually reviewed ten different case studies each during April 2017, returning answers to ECDC for analysis.

Of the 60 participating hospitals, five were selected at random for inclusion in the validation study (acute public tertiary = 1, acute public secondary = 3, acute private = 1). In 2012, 10 hospitals were included in the validation study and the VT comprised five members. It was not possible to perform validation in more than five hospitals in 2017, because there were only two VT members available.

In Ireland, the PPS validation study was performed according to the ECDC validation protocol (December 2015). The validation study in each hospital was performed at the same time as the primary PPS, with both VT and primary PPS team blinded to the data collected by the other team. The wards included in the validation study were selected randomly, representing the wards that had been already scheduled by the local PPS coordinators for inclusion on the PPS date. In total, 282 patients were included in the validation study in Ireland.

The sensitivity, specificity and kappa statistic for HAI and antimicrobial identification are presented in Table 2.1. The sensitivity and specificity for 'patient on antimicrobials' were excellent, signifying that the hospital PPS teams were able to correctly identify whether or not a patient was receiving antimicrobials. The kappa value (0.84) indicates a high level of agreement between the VT team and the hospital PPS teams.

The specificity for 'patient has active HAI' was also excellent, meaning hospital PPS teams were able to correctly identify when a patient did not have a HAI. The sensitivity for 'patient has active HAI' was lower, indicating that hospital PPS teams were less likely to correctly apply the case definition when identifying a patient with a HAI.

Table 2.1. Validation results for HAI and antimicrobial identification

PPS Data Collection Form Question	Sensitivity	Specificity	Kappa value
Patients has active HAI	0.556	0.969	0.55
Patient on antimicrobials	0.876	0.959	0.84

3.0 Participating Hospitals

The 60 participating hospitals, classified by hospital group or ownership are presented in Table 3.1. In Ireland, 46 acute public and 14 private hospitals participated. For the purposes of data analysis and reporting by hospital type, 14 specialist hospitals (13 public and one private) have been included together. The single specialist private hospital has not been included in the analysis of the other private hospitals, owing to the difference in case mix.

Table 3.1. Participating hospitals categorised by hospital group or ownership (continued overleaf)

Hospital Group or Affiliation	Hospital name	Hospital type
Children's Hospital group	Children's University Hospital, Temple Street	Specialist
	Our Lady's Children's Hospital, Crumlin	Specialist
	Tallaght Children's Hospital	Specialist
Percentage of acute hospitals in Children's Hospital group participating in PPS		*100%*
Dublin Midlands	St James's Hospital	Tertiary
	Tallaght Hospital	Tertiary
	Midland Regional Hospital, Portlaoise	Secondary
	Midland Regional Hospital, Tullamore	Secondary
	Naas General Hospital	Secondary
	Coombe Women and Infant's University Hospital	Specialist
Percentage of acute hospitals in Dublin Midlands group participating in PPS		*100%*
Ireland East	Mater Misericordiae University Hospital	Tertiary
	St Vincent's University Hospital	Tertiary
	Midland Regional Hospital, Mullingar	Secondary
	St Luke's General Hospital, Kilkenny	Secondary
	Wexford General Hospital	Secondary
	Our Lady's Hospital, Navan	Primary
	St Columcille's Hospital, Loughlinstown	Primary
	St Michael's Hospital, Dun Laoghaire	Primary
	Cappagh National Orthopaedic Hospital	Specialist
	National Maternity Hospital, Holles Street	Specialist
	Royal Victoria Eye and Eye Hospital	Specialist
Percentage of acute hospitals in Ireland East group participating in PPS		*100%*
RCSI group	Beaumont Hospital	Tertiary
	Cavan General Hospital	Secondary
	Connolly Hospital, Blanchardstown	Secondary
	Our Lady of Lourdes Hospital, Drogheda	Secondary
	Louth County Hospital	Primary
	Rotunda Hospital	Specialist
	St Luke's Hospital, Rathgar	Specialist
Percentage of acute hospitals in RCSI group participating in PPS		*100%*

Table 3.1 continued. Participating hospitals categorised by hospital group or ownership

Hospital Group or Affiliation	Hospital name	Hospital type
Saolta group	Galway University Hospital	Tertiary
	Letterkenny University Hospital	Secondary
	Mayo University Hospital, Castlebar	Secondary
	Portiuncula University Hospital, Ballinasloe	Secondary
	Sligo University Hospital	Secondary
	Roscommon County Hospital	Primary
Percentage of acute hospitals in Saolta group participating in PPS		*100%*
South/ South-West group	Mercy University Hospital	Secondary
	South Infirmary/Victoria University Hospital	Secondary
	South Tipperary General Hospital, Clonmel	Secondary
	University Hospital Tralee, Tralee	Secondary
	Bantry General Hospital	Primary
	Kilcreene Regional Orthopaedic Hospital, Kilkenny	Specialist
Percentage of acute hospitals in South/ South-West group participating in PPS		*67%*
UL group	University Hospital Limerick	Tertiary
	St John's Hospital Limerick	Primary
	University Hospital Ennis	Primary
	University Hospital Nenagh	Primary
	Croom Orthopaedic Hospital	Specialist
	University Maternity Hospital, Limerick	Specialist
Percentage of acute hospitals in UL group participating in PPS		*100%*
Private	Aut Even Hospital, Kilkenny	Private
	Beacon Hospital, Sandyford	Private
	Blackrock Clinic	Private
	Bon Secours Hospital, Limerick at Barringtons	Private
	Bon Secours Hospital, Cork	Private
	Bon Secours Hospital, Galway	Private
	Bon Secours Hospital, Glasnevin	Private
	Bon Secours Hospital, Tralee	Private
	Galway Clinic	Private
	Hermitage Medical Clinic	Private
	Mater Private Hospital, Cork	Private
	Mater Private Hospital, Dublin	Private
	St Vincent's Private Hospital	Private
	Sports Surgery Clinic, Santry	Specialist
Percentage of private hospitals participating in PPS		*100%*
Percentage of all acute hospitals participating in PPS		***95%***
Other	National Rehabilitation Hospital, Dun Laoghaire	Specialist
TOTAL NUMBER OF PARTICIPATING HOSPITALS		**60** *

For the purpose of data analysis, Santry Sports Surgery Clinic is included in the specialist hospital category, along with the public specialist hospitals

4.0 Results

4.1 Characteristics of Participating Hospitals

4.1.1 Hospital Characteristics

Sixty acute hospitals (46 public and 14 private) participated in the PPS in May 2017. The 46 acute public hospitals were categorised as primary (n=9), secondary (n=17), tertiary (n=7) and specialist (n=13). For the purposes of data analysis, the specialist category included 13 public hospitals and one private hospital (n=14), with the following hospital types: maternity (n=4), orthopaedic (n=4), paediatric (n=3), oncology (n=1), combined ophthalmology and otorhinolaryngology (n=1) and rehabilitation (n=1).

Each participating hospital's PPS team leader provided additional demographic and activity data by completion of the Hospital Form (Form B) [Appendix C] Tables 4.1 to 4.4 present additional data provided by participating hospitals. Data on admissions, patient days and average length-of-stay (LOS) were reported based on data from the latest complete calendar year (2016).

A total of 10,333 patients on 599 wards in 60 acute hospitals were included in the 2017 PPS. Public hospitals accounted for 8,989 patients (87%) and private hospitals for 1,344 patients (13%).

Table 4.1. Demographic and activity data, by ownership

Hospitals	Number	Average number of acute beds	Average number of admissions	Average number of patient days	Average length of stay	Number of wards surveyed	Number of patients surveyed
Public	46	218	16,710	74,802	4.5	520	8,989
Private	14	124	8,846	31,328	3.5	79	1,344
Overall	**60**	**196**	**14,875**	**64,658**	**4.3**	**599**	**10,333**

Table 4.2. Demographic and activity data, by hospital type

Hospital type	Number	Average number of acute beds	Average number of admissions	Average number of patient days	Average length of stay	Number of wards surveyed	Number of patients surveyed
Primary	9	72	2,991	21,973	6.6	33	577
Secondary	17	238	19,271	75,765	3.9	222	3,514
Tertiary	7	588	40,462	224,696	5.6	191	3,700
Specialist*	14	111	9,705	28,345	2.9	76	1,229
Private†	13	128	9,143	32,616	3.6	77	1,313

* includes one private hospital providing specialist services and one non-acute hospital providing rehabilitation services; † excludes one private hospital providing specialist services

Primary = general hospital, secondary = regional hospital

For the purpose of data analysis by hospital type, one private specialist hospital has been included in the specialist hospital category along with 13 public specialist hospitals and has not been included in the private hospital category.

For the purpose of this survey, a bay with six beds could be defined as one patient room. Thus, the number of patient rooms does not equate to the number of acute beds. A single patient room is defined a room with one bed. Taking the average number of acute hospital beds and the average number of single rooms, by hospital type, the average proportion of single rooms was lowest in primary hospitals (15%), followed by secondary (20%), specialist (23%) and tertiary hospitals (29%). Private hospitals (52%) had the highest proportion of single rooms.

Forty-nine hospitals (82%) participated in both PPS (2012 and 2017), with the following observations in 2017:

- A reduction in mean acute beds: 196 versus 217 (2012)
- An increase in the percentage of beds in single rooms: 28% versus 22% (2012)
- A shorter average LOS: 4.3 versus 6.1 days (2012)

In 2017, 76% of single rooms were reported to have *en suite* facilities and there were 1.8 airborne isolation rooms per 100 beds, information which was not sought in 2012. The vast majority of participating hospitals reported having an annual infection prevention and control report and plan (n=59; 97%).

Overall, there was 0.83 whole time equivalent (WTE) infection prevention and control nurse (IPCN) per 100 beds reported (public; 0.8, private; 0.9), an increase from 0.7 WTE/100 beds in 2012.

An infection prevention and control doctor (IPCD) may be defined as a nominated doctor with specialist training and contractual responsibility for infection prevention and control tasks, work planning and surveillance systems. Seventeen Irish hospitals (31%) reported having no nominated IPCD. Overall, there was just 0.18 WTE IPCD per 100 beds reported (public; 0.17, private; 0.24), unchanged from 0.19 WTE/100 beds reported in 2012.

In 2017, participating hospitals were also asked for the first time to provide information on the antimicrobial pharmacist (AMP) resource. Seventeen Irish hospitals (31%) reported having no nominated AMP. Overall, there was 0.24 WTE AMP per 100 beds reported (public; 0.26, private; 0.14).

Table 4.3. Infection prevention and control (IPC) and antimicrobial stewardship resources, by ownership

Hospitals	Average number of patient rooms	Average number of single rooms	Average number of WTE IPCN	Number of WTE IPCN per 100 inpatient beds	Average number of WTE IPCD	Number of WTE IPCD per 100 inpatient beds	Average number of WTE AMP	Number of WTE AMP per 100 inpatient beds
Public	88	53	1.8	0.81	0.4	0.17	0.6	0.26
Private	85	62	1.1	0.9	0.3	0.24	0.2	0.14
Overall	**87**	**55**	**1.6**	**0.83**	**0.4**	**0.18**	**0.5**	**0.24**

WTE: Whole time equivalent; IPCN: Infection prevention and control nurse; IPCD: Infection prevention and control doctor; AMP: antimicrobial pharmacist

Table 4.4. IPC and antimicrobial stewardship resources, by hospital type

Hospital type	Average number of patient rooms	Average number of single rooms	Average number of WTE IPCN	Number of WTE IPCN per 100 inpatient beds	Average number of WTE IPCD	Number of WTE IPCD per 100 inpatient beds	Average number of WTE AMP	Number of WTE AMP per 100 inpatient beds
Primary	24	11	0.8	1.06	0.05	0.06	0.1	0.14
Secondary	87	47	1.9	0.81	0.4	0.18	0.8	0.34
Tertiary	257	171	4.6	0.83	1.0	0.18	1.2	0.22
Specialist*	43	26	1.1	1.02	0.3	0.25	0.3	0.28
Private†	89	66	1.3	0.98	0.3	0.26	0.2	0.16

* includes one private hospital providing specialist services and one non-acute hospital providing rehabilitation services; † excludes one private hospital providing specialist services

Primary = general hospital, secondary = regional hospital

For the purpose of data analysis by hospital type, one private specialist hospital has been included in the specialist hospital category along with 13 public specialist hospitals and has not been included in the private hospital category.

Table 4.5 displays the reported weekend availability of microbiology laboratory services. A service for processing of clinical specimens (e.g., specimens taken from patients with suspected infection) was reported to be unavailable in 25% of hospitals on Saturdays and 40% on Sundays, with the weekend service further reduced for screening specimens (e.g., screening swab for carriage of CPE) unavailable in 40% of hospitals on Saturdays and 67% on Sundays.

Table 4.5. Microbiology laboratory resources

Indicator		PPS 2017	Data from
Availability of microbiology laboratory weekend service	Clinical specimens:		
	Saturday	75%	All hospitals
	Sunday	60%	All hospitals
	Screening specimens:		
	Saturday	52%	All hospitals
	Sunday	33%	All hospitals
Rate of blood culture sets tested per 1000 patient days		52.5	59 hospitals
Rate of faeces specimens tested for *C. difficile* per 1000 patient days		12.0	54 hospitals

4.1.2 Multi-Modal Strategies

Participating hospitals were asked to report on the availability of multi-modal strategies to prevent HAI and promote antimicrobial stewardship, for the hospital overall and the ICU in particular. Strategies to prevent pneumonia, including availability of guidelines, care bundles, surveillance, staff education, checklists, audit and feedback, were more commonly available in ICU than the hospital overall.

Table 4.6. Hospital-wide multi-modal strategies to prevent HAI and promote antimicrobial stewardship

	Hospital-wide stategy (excluding ICU)*				
	Pneumonia	Bloodstream infection	Surgical site infection	Urinary tract infection	Antimicrobial use
Guidelines	13 (23%)	30 (53%)	27 (47%)	38 (67%)	57 (100%)
Care Bundles	3 (5%)	25 (44%)	17 (30%)	39 (68%)	15 (26%)
Surveillance	3 (5%)	44 (77%)	31 (54%)	22 (39%)	42 (74%)
Education	3 (5%)	27 (47%)	17 (30%)	28 (49%)	42 (74%)
Checklist	2 (4%)	17 (30%)	13 (23%)	19 (33%)	9 (16%)
Audit	3 (5%)	28 (49%)	18 (32%)	23 (40%)	48 (84%)
Feedback	5 (9%)	40 (70%)	31 (54%)	25 (44%)	49 (86%)

*57 of 60 hospitals completed the hospital questionnaire

Table 4.7. ICU multi-modal strategies to prevent HAI and promote antimicrobial stewardship

	ICU-wide strategy*			
	Pneumonia	Bloodstream infection	Urinary tract infection	Antimicrobial use
Guidelines	19 (53%)	19 (53%)	22 (61%)	36 (100%)
Care Bundles	22 (61%)	23 (64%)	25 (69%)	10 (28%)
Surveillance	13 (36%)	30 (83%)	13 (36%)	29 (81%)
Education	18 (50%)	22 (61%)	20 (56%)	27 (75%)
Checklist	16 (44%)	18 (50%)	14 (39%)	7 (19%)
Audit	14 (39%)	22 (61%)	15 (42%)	28 (78%)
Feedback	14 (39%)	29 (81%)	17 (47%)	32 (89%)

*36 of 37 hospitals with an ICU completed the hospital questionnaire

4.1.3. Ward Characteristics

Table 4.8 describes the number of wards surveyed, categorised by ward specialty. General medical wards accounted for 202 (33.7%) and general surgical for 120 (20%) wards. Compared with PPS 2012, there were some changes in categorisation of ward specialties, as a previous category 'Augmented Care' had included: adult, paediatric, neonatal ICU and high dependency units (HDU). In 2017, adult ICU was categorised separately and HDU was categorised either as a medical or surgical ward, with paediatric and neonatal ICU categorised as paediatric and neonatal wards, respectively.

Table 4.8. Number of surveyed wards by ward specialty

	Wards	
Ward specialty	**N**	**%**
Medicine	202	33.7
Surgery	120	20.0
Other*	61	10.2
Mixed†	46	7.7
Obstetrics/gynaecology	42	7.0
Paediatrics	41	6.8
Adult Intensive Care	32	5.3
Neonatal	19	3.2
Rehabilitation	17	2.8
Geriatrics	14	2.3
Psychiatry	5	0.8
Total	**599**	**100.0**

* Other ward specialty: <80% of patients belong to a single speciality, with mixed medical and surgical patients. Emergency Department (ED) was categorised as 'Other' ward specialty for the purposes of capturing admitted patients who remained in ED at the time of PPS

† Mixed ward specialty: Only two specialties on a ward, with one speciality accounting for <80% of patients

4.2 Characteristics of the Patient Population

4.2.1 Patient Demographics

Data was gathered on 10,333 eligible patients, with 52% female and a mean age of 59 years (range: 0 - 102). Patient age and gender distribution is presented as a population pyramid in Figure 4.1. Compared with PPS 2012, an increase in both the mean age (59 versus 54 years) and the proportion of the population aged ≥65 years was observed (54% versus 48%). Ten percent of the inpatient population was aged <10 years in 2017.

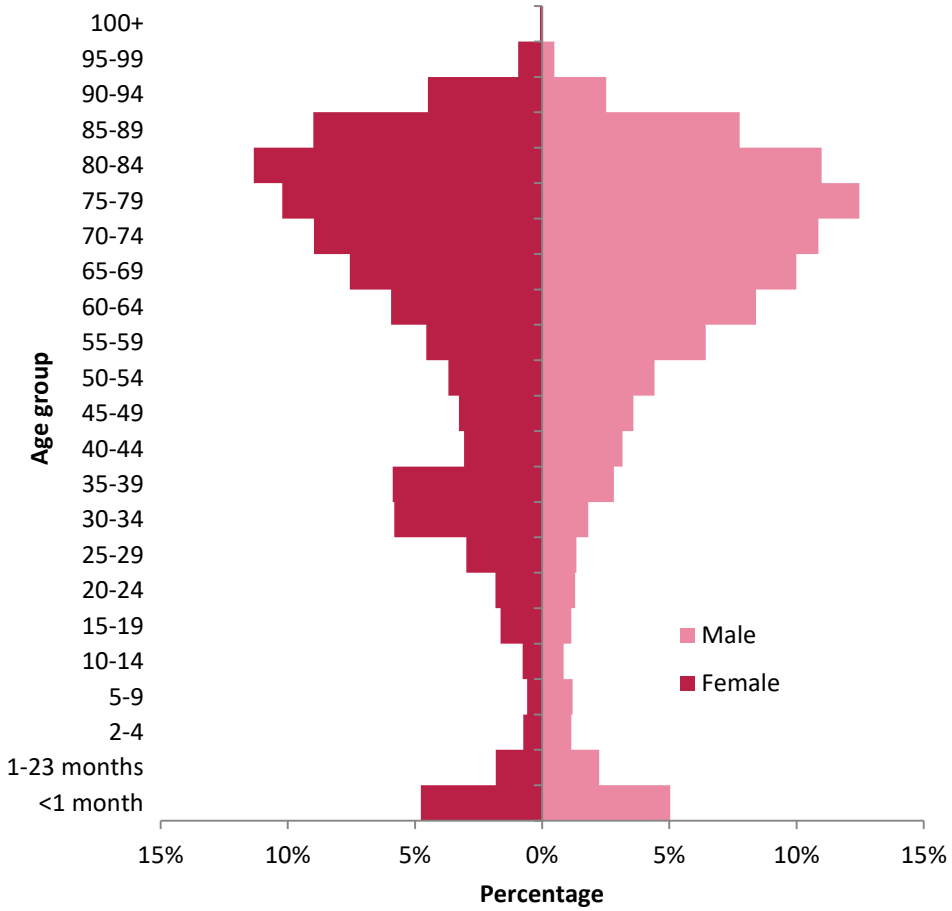


Figure 4.1. Population pyramid: Percentage of patients by age and gender

4.2.2 Patient Location by Ward & Admitting Consultant Specialty

Over half of the eligible patient population (n=6,125; 59%) was admitted to either a medical or surgical ward (Table 4.9).

Table 4.9. Number of patients surveyed by ward specialty

Ward specialty	Patients	
	N	%
Medicine	3,866	37.4
Surgery	2,259	21.9
Obstetrics/gynaecology	959	9.3
Mixed*	923	8.9
Other†	854	8.3
Paediatrics	451	4.4
Geriatrics	320	3.1
Rehabilitation	245	2.4
Adult Intensive Care	196	1.9
Neonatal	196	1.9
Psychiatry	64	0.6
Total	**10,333**	**100.0**

*Mixed ward specialty: Only two specialties on a ward, with one speciality accounting for <80% of patients

†Other ward specialty: <80% of patients belong to a single speciality, with mixed medical and surgical patients. Emergency Department (ED) was categorised as 'Other' ward specialty for the purposes of capturing admitted patients who remained in ED at the time of PPS

Table 4.10 describes the number of patients by admitting consultant specialty. Just over half of all patients were under the care of a medical consultant (51.2%) and just over one quarter under the care of a surgical consultant (25.8%).

Table 4.10. Number of patients surveyed by admitting consultant specialty

Consultant specialty	Patients	
	Number	%
Medical	5,292	51.2
Surgical	2,664	25.8
Obstetrics/gynaecology	803	7.8
Geriatrics/care of the elderly	556	5.4
Neonatolaogy	380	3.7
Paediatrics	361	3.5
Rehabilitation	172	1.7
Psychiatry	64	0.6
Other specialty	41	0.4
Total	**10,333**	**100.0**

4.2.3 Risk Factors for Hospital-Acquired Infection in the Study Population

Risk factors for HAI in the eligible patient population are described in Figure 4.2. Of the 10,333 eligible patients, 1,853 (18.0%) had a history of a surgical procedure since admission to the participating hospital and 6,001 patients (58.1%) had at least one invasive device *in situ*. The number and percentage prevalence of invasive devices was: peripheral vascular catheter (PVC) 5,032 patients (prevalence 49%); central vascular catheter (CVC) 794 patients (prevalence 8%); urethral catheter 1,376 patients (prevalence 13%). The prevalence of urethral catheters was higher in males (15%) than females (11.5%) and by location was highest in ICU (81%) followed by surgical (17%) and care of the elderly wards (14%). Intubation of the respiratory tract (endotracheal tube or tracheostomy), with or without mechanical ventilation, was recorded for 176 patients [prevalence 2%]. Within ICU, 49.5% of patients were intubated versus 0.8% of patients admitted to all other ward specialties.

When compared with PPS 2012, an increased prevalence of vascular catheter use was observed in 2017, for both PVC (49% versus 41%) and CVC (8% versus 6%).

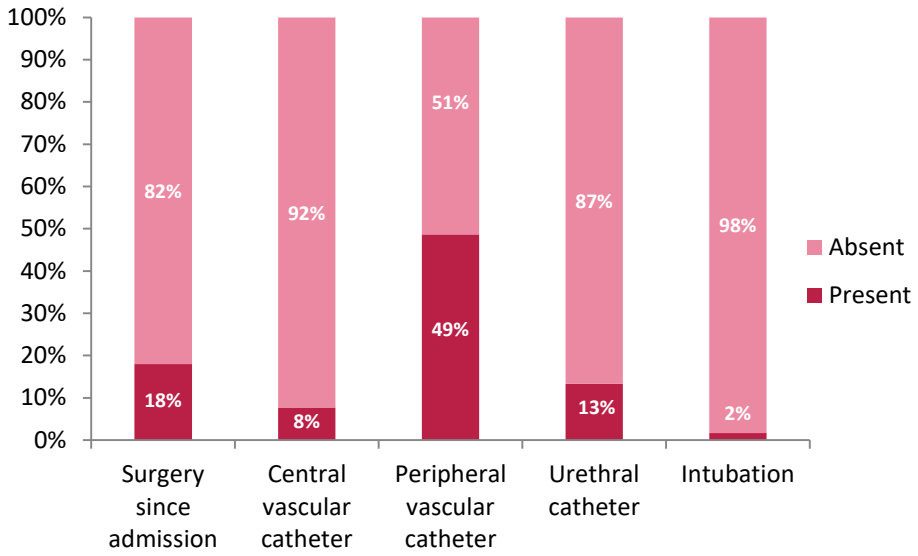


Figure 4.2. Percentage of patients surveyed by history of surgery since admission and device utilisation

Eligible patients were categorised using the McCabe Score, a subjective patient score assigned on severity of the underlying medical condition(s), as displayed in Table 4.11.[19] The majority (76.8%) had a 'non-fatal prognosis' (life expectancy greater than five years), 18.1% had a 'life-limiting prognosis' (life expectancy between one and four years) and 3.9% had a 'rapidly fatal or end-of-life prognosis' (life expectancy less than one year).

Table 4.11. Number of patients surveyed by McCabe Score

	Patients	
Disease prognosis	**N**	**%**
None/non fatal	7,933	76.8
Life limiting prognosis	1,875	18.1
End of life prognosis	406	3.9
Not known	119	1.2
Total	**10,333**	**100.0**

4.3 Hospital-Acquired Infections (HAI)

The PPS HAI results should be reviewed and interpreted in conjunction with the HAI definitions used in this survey. They are available in the PPS All Ireland Protocol Version 1.0 [Appendix B pages 67 – 88], which may be accessed on the HPSC website: http://www.hpsc.ie/a-z/microbiologyantimicrobialresistance/infectioncontrolandhai/surveillance/hospitalpointprevalencesurveys/2017/protocol/

4.3.1 Overall Prevalence of HAI

Of the 10,333 eligible patients, 633 met a surveillance case definition for an active HAI, resulting in a HAI prevalence of 6.1% (95% CI 5.7 – 6.6), an increase on the national HAI prevalence of 5.2% in PPS 2012. Overall, 678 active HAI were identified, with 37 patients who had two active HAI and four who had three active HAI (Table 4.12).

Table 4.12. Number of HAI per patient

Number of HAI reported per patient	Patients	
	N	%
0	9,700	93.9
1	592	5.7
2	37	0.4
3	4	0.0
Total	**10,333**	**100.0**

4.3.2 HAI Patient Risk Factors

A greater proportion of the 633 patients with active HAI had a history of surgery since admission to the participating hospital in comparison with the overall cohort of 10,333 eligible patients (34% versus 18%). The prevalence of invasive device utilisation was also higher for all devices across the HAI than overall patient cohort [PVC: 62 versus 49%, CVC: 26 versus 8%, urethral catheterisation 26% versus 13% and respiratory tract intubation 7 versus 2%].

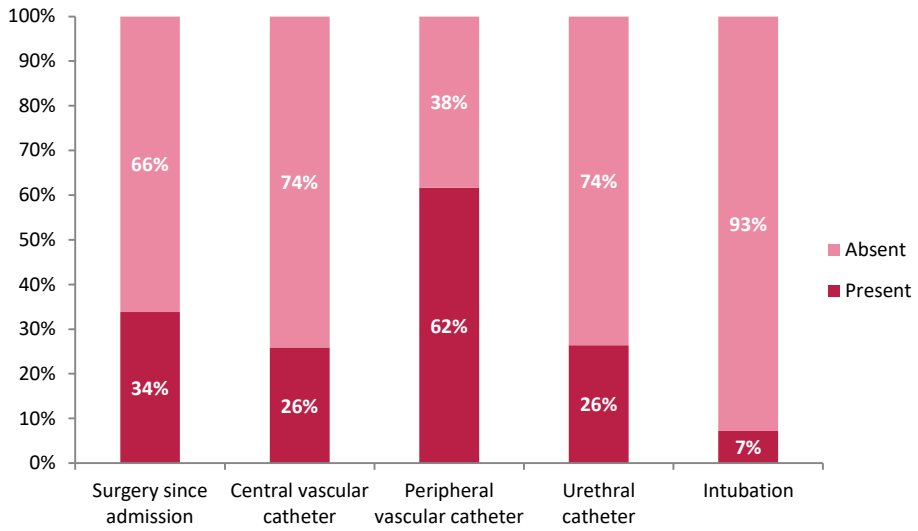


Figure 4.3. Prevalence of HAI risk factors in patients with HAI

4.3.3 HAI Prevalence by Gender, Age, McCabe Score & Birth Weight

The prevalence of HAI by gender, age and McCabe score, with univariate odds ratio (OR) analysis is presented in Table 4.13. Of the 633 patients with HAI, males accounted for 334 (53%). However, the HAI prevalence was significantly higher in males (6.7%) than females (5.6%) (OR=1.22, 95% CI: 1.04-1.43; p=0.02).

The vast majority of patients with HAI (96.5%; n=611) were aged ≥15 years. The remaining 22 patients (3.5%) were aged 0 to 14 years. The highest HAI prevalence arose in patients aged 50 to 64 (8%) and 65 to 79 years (6.9%), respectively. A significant association between patient age and HAI prevalence was observed, with HAI prevalence significantly lower in the <1 month, 2 to 14 years and 15 to 29 years age groups when compared with the 80+ years age group. There were no significant differences in HAI prevalence between the 1 to 23 months, 30 to 49 years, 50 to 64 years and 65 to 79 years age groups, when compared with the 80+ age group.

The underlying disease prognosis, as measured by the McCabe score, was also significantly associated with HAI prevalence (p<0.001). The odds ratio increased with the severity of the McCabe score. The highest HAI prevalence was reported for patients with 'end of life prognosis' McCabe score (10.3%; 95% CI: 7.6-13.7).

Table 4.13. HAI prevalence by gender, age and McCabe score

Risk factor	Category	N patients	N patients with HAI	HAI prevalence (%)	HAI Prevalence 95% CI		Odds Ratio	Odds Ratio 95% CI		P-value
					Lower	Upper		Lower	Upper	
Gender	Female*	5,371	299	5.6	5.0	6.2	-	-	-	-
	Male	4,962	334	6.7	6.0	7.4	1.22	1.04	1.43	**0.02**
Age group	<1 month	506	9	1.8	0.8	3.3	0.27	0.13	0.52	**<.0001**
	1-23 months	209	9	4.3	2.0	8.0	0.66	0.33	1.31	0.23
	2-14	271	4	1.5	0.4	3.7	0.22	0.08	0.60	**0.001**
	15-29	535	19	3.6	2.2	5.5	0.53	0.32	0.88	**0.01**
	30-49	1,534	84	5.5	4.4	6.7	0.85	0.65	1.11	0.23
	50-64	1,717	137	8.0	6.7	9.4	1.27	1.00	1.61	0.05
	65-79	3,091	213	6.9	6.0	7.8	1.08	0.87	1.33	0.49
	80+ years*	2,470	158	6.4	5.5	7.4	-	-	-	-
McCabe score	None/non fatal*	7,933	394	5.0	4.5	5.5	-	-	-	-
	Life limiting prognosis	1,875	185	9.9	8.6	11.3	2.10	1.75	2.52	**<.0001**
	End of life prognosis	406	42	10.3	7.6	13.7	2.21	1.58	3.10	**<.0001**
	Not known	119	12	10.1	5.3	17.0	2.15	1.17	3.94	**0.01**

* Reference group for odds ratio calculation; significant P-values are highlighted in bold

The birth weight of neonates represented a new question in PPS 2017. Of 506 neonates, birth weight was normal (2.5–4.0 kg) for 298 (59%), high (>4.0 kg) for 67 (13%) and low (<2.5 kg) for 131 (26%). The HAI prevalence was significantly higher for low birth weight neonates (3.8%); (OR 5.9; 95% CI: 1.3–8.7), as displayed in Table 4.14.

Table 4.14. HAI prevalence by birth weight

Birth weight category	Total N patients	HAI		HAI Prevalence 95% CI		Odds Ratio	Odds Ratio (95% CI)		P-value
		N	%	Lower	Upper		Lower	Upper	
Normal*	298	2	0.7	0.1	2.4	-	-	-	-
Low birth weight	131	5	3.8	1.3	8.7	5.9	1.1	30.7	**0.03**
High birth weight	67	2	3.0	0.4	10.4	4.6	0.6	32.9	0.16
Unknown	10	0	0.0	-	-	-	-	-	-

4.3.4 HAI Prevalence by Ward Specialty & Admitting Consultant Specialty

The prevalence of HAI by ward specialty is shown in Table 4.15. HAI prevalence was highest in adult ICUs (24.0%), followed by surgical wards (9.1%). Psychiatry (1.6%) and obstetrics and gynaecology wards (1.8%) had the lowest HAI prevalence.

Table 4.15. HAI prevalence by ward specialty

Ward specialty	Total N patients	N patients with HAI	HAI prevalence (%)	95% CI Lower	95% CI Upper
Medicine	3,866	205	5.3	4.6	6.1
Surgery	2,258	206	9.1	8.0	10.4
Obstetrics/gynaecology	959	17	1.8	1.0	2.8
Mixed*	923	70	7.6	6.0	9.5
Other†	854	37	4.3	3.1	5.9
Paediatrics	451	9	2.0	0.9	3.8
Geriatrics	320	13	4.1	2.2	6.8
Rehabilitation	245	17	6.9	4.1	10.9
Neonatal	197	11	5.6	2.8	9.8
Adult Intensive Care	196	47	24.0	18.2	30.6
Psychiatry	64	1	1.6	0.0	8.4
Total	**10,333**	**633**	**6.1**	**5.7**	**6.6**

*Mixed ward specialty: Only two specialties on a ward, with one speciality accounting for <80% of patients

†Other ward specialty: <80% of patients belong to a single speciality, with mixed medical and surgical patients. Emergency Department (ED) was categorised as 'Other' ward specialty for the purposes of capturing admitted patients who remained in ED at the time of PPS

The prevalence of HAI by admitting consultant specialty is shown in Table 4.16.

Table 4.16. HAI prevalence by admitting consultant specialty

Consultant specialty	Total N patients	N patients with HAI	HAI prevalence (%)	9% CI Lower	9% CI Upper
Medical	4,798	279	5.8	6.0	9.5
Surgical	3,158	273	8.6	4.1	10.9
Obstetrics /gynaecology	803	22	2.7	2.8	9.8
Geriatrics/care of the elderly	556	25	4.5	4.6	6.1
Neonatal	380	11	2.9	3.1	5.9
Paediatrics	361	4	1.1	2.2	6.8
Rehabilitation	172	10	5.8	1.0	2.8
Psychiatry	64	1	1.6	0.0	8.4
Other specialty	41	8	19.5	0.9	3.8
Total	**10,333**	**633**	**6.1**	**5.7**	**6.6**

While the highest HAI prevalence (19.5%) was recorded for the category 'other specialty' (n=41 patients), 23 of those patients were recorded as being admitted under the care of a consultant in intensive care medicine and 18 were admitted under the category of 'other consultants – not specified'. In Ireland, the majority of paediatric and adult patients admitted to ICU tend not to be admitted under the care of a named consultant in intensive care medicine. Rather, such patients tend to be admitted under the care of a medical or surgical consultant.

4.3.5 HAI Prevalence by Surgery and Length-of-Admission Prior to HAI Onset

Of the 10,333 eligible patients, 1,853 (18%) were documented as having a history of surgery since admission to the participating hospital. During the PPS, surgical procedures could be classified into two categories:

1. **National Healthcare Safety Network (NHSN) Operative Procedures:** Classified by the US Centers for Disease Control & Prevention (CDC).[20] A NHSN procedure takes place during a single trip to the operating room, where a surgeon makes at least one incision through the skin or mucous membrane, including laparoscopic approach, and closes the incision before the patient leaves the operating room.
2. **Non-NHSN Operative Procedures:** Operative procedures which do not meet the definition of an NHSN procedure. For example, transurethral resection of the prostate, operation where wound healing is by secondary intention, external ventricular drain or hysteroscopic removal of fibroids.

The HAI prevalence and OR of HAI was significantly higher for patients who had undergone either NHSN (11.7%) or non-NHSN operative procedures (9.5%) than for patients who had no surgery performed (5%), as shown in Table 4.17.

Table 4.17. HAI prevalence by history of surgery since admission

Risk factor	Category	N patients	N patients with HAI	HAI prevalence (%)	HAI Prevalence 95% CI		Odds Ratio	Odds Ratio 95% CI		P-value
					Lower	Upper		Lower	Upper	
Surgery since admission	No surgery*	8,476	420	5.0	4.5	5.4	-	-	-	-
	NHSN surgery	1,601	188	11.7	10.2	13.4	2.6	2.1	3.1	**<.0001**
	Non-NHSN surgery	252	24	9.5	6.2	13.8	2.0	1.3	3.1	**0.001**
	Unknown	4	0	0.0	-	-	-	-	-	-

* Reference group for odds ratio calculation; significant P-values are highlighted in bold

The length-of-admission was also significantly associated with HAI prevalence (p<0.001). Patients admitted longer than four days by the time of survey or HAI onset date had a higher HAI prevalence than those admitted three days or less. The highest HAI prevalence (9.7%) and significantly higher OR for HAI (5.2) was observed in patients admitted more than 22 days before PPS or HAI onset date (Table 4.18).

Table 4.18. HAI prevalence by length-of-admission prior to PPS or HAI onset date

Risk factor	Category	N patients	N patients with HAI	HAI prevalence (%)	HAI Prevalence 95% CI		Odds ratio	Odds Ratio 95% CI		P-value
					Lower	Upper		Lower	Upper	
Length-of-admission (prior to date of survey or HAI onset)	1-3 days*	3,314	67	2.0	1.6	2.6	-	-	-	-
	4-7 days	2,494	144	5.8	4.9	6.8	3.0	2.2	4.0	**<.0001**
	8-14 days	1,775	142	8.0	6.8	9.4	4.1	3.1	5.6	**<.0001**
	15-21 days	757	62	8.2	6.3	10.4	4.3	3.0	6.2	**<.0001**
	22+ days	1,938	188	9.7	8.4	11.1	5.2	3.9	6.9	**<.0001**
	Undetermined	55	30	54.5	-	-	-	-	-	-

* Reference group for odds ratio calculation; significant P-values are highlighted in bold

4.3.6 HAI Onset & Origin

Table 4.19 and Figure 4.4 display the patient's location when the signs or symptoms of the HAI began (onset). Table 4.19 and Figure 4.5 display the location where the patient acquired the HAI (origin). Of the 678 active HAI, 156 (23%) were already evident upon admission of the patient to the current hospital (i.e. HAI onset prior to current hospital admission). Of the 156 HAI with onset prior to admission to the current hospital, 85 (54%) had origin in the current hospital (i.e. HAI related to a prior admission to the current hospital, which developed subsequent to discharge from the current hospital) and 71 (46%) had origin in another facility [acute hospital; 54, non-acute hospital; 11, other origin; 6], (i.e., HAI related to a prior admission to another hospital, which developed either in or subsequent to discharge from that hospital). Of the 678 active HAI, 89% were acquired in the current hospital, with 11% attributable to another hospital.

Table 4.19. Number and percentage of HAI by onset and origin

	HAI present at admission				Total	
Origin of HAI	Yes	%Yes	No	%No	N	%
Current hospital	85	14	521	86	606	89
Other acute hospital	54	98	1	2	55	8
Other non-acute hospital	11	100	0	0	11	2
Other origin	6	100	0	0	6	1
Total	**156**	**23**	**522**	**77**	**678**	**100**

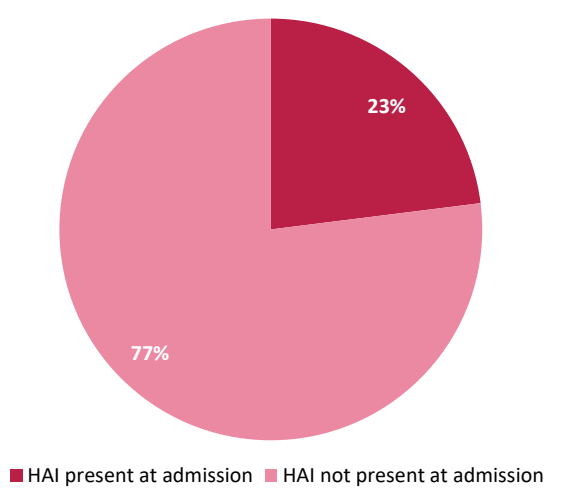


Figure 4.4. HAI onset

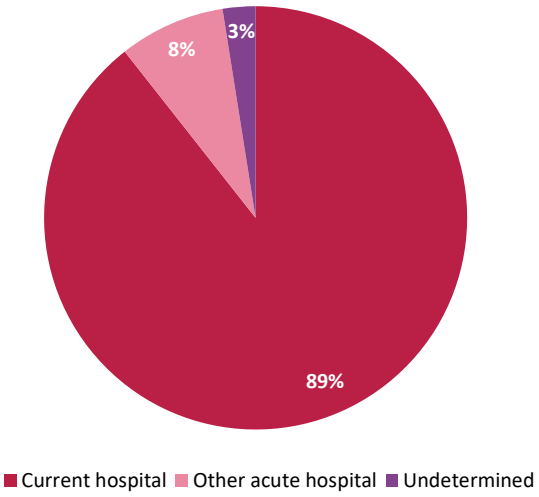


Figure 4.5. HAI origin

In PPS 2017, a new question was added to determine the association between the HAI and the ward to which the patient was admitted on the PPS date, as shown in Figure 4.6. The majority of HAI had onset three or more days after admission to the current ward (n=415; 61%), thus categorised as acquired on the current ward, with the remainder categorised as acquired on a ward other than the current ward (n=261; 39%).

Figure 4.7 displays the association between HAI and the ICU. The majority of HAI had onset three or more days after admission to the ICU (n=38; 56%), thus categorised as unit-acquired infections. In 43% of cases (n=29), the HAI had onset before or on day one or two after admission to the ICU and were not unit-acquired infections.

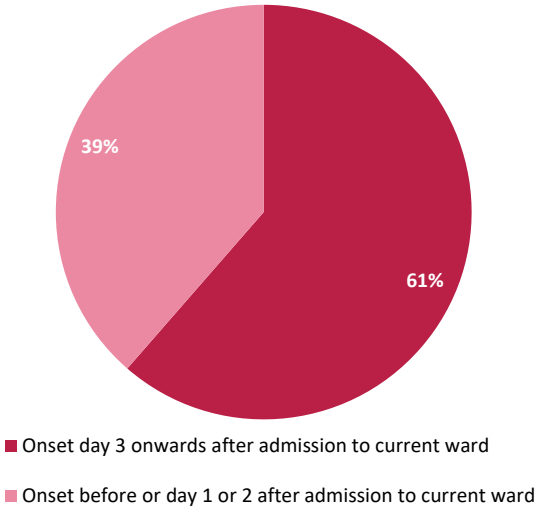


Figure 4.6. HAI association with current ward

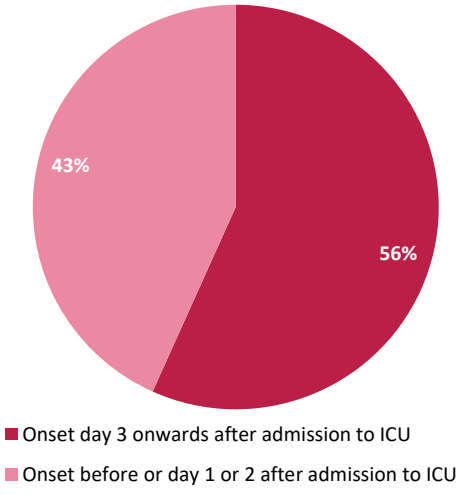


Figure 4.7. HAI association with ICU

4.3.7 Distribution of HAI by Type

Table 4.20 and Figure 4.8 display the distribution of the 678 active HAI. The most common HAI types were pneumonia and surgical site infection.

Table 4.20. Number, percentage and prevalence of HAI by type

Rank order	Infection type	HAI N	HAI %	HAI Prevalence (%)
1	Pneumonia	196	28.9	1.9
2	Surgical site infection	122	18.0	1.2
3	Urinary tract infection	98	14.5	0.9
4	Bloodstream infection	67	9.9	0.6
5	Systemic infection	42	6.2	0.4
6	*C. difficile* infection (CDI)	30	4.4	0.3
7	Skin and soft tissue infection	26	3.8	0.3
8	Eye, ear, nose, throat or mouth infection	24	3.5	0.2
9	Gastrointestinal infection (other than CDI)	24	3.5	0.2
10	Lower respiratory tract infection	16	2.4	0.2
11	Bone and joint infection	9	1.3	0.1
12	Neonatal specific infection	8	1.2	1.6*
12	Cardiovascular infection	7	1.0	0.1
13	Central nervous system infection	3	0.4	0.0
14	Reproductive tract infection	3	0.4	0.0
15	Catheter-related infection	2	0.3	0.0
16	Unknown	1	0.1	0.0
	Total	**678**	**100.0**	**6.6**

*Prevalence of neonatal specific infection in the 506 neonates

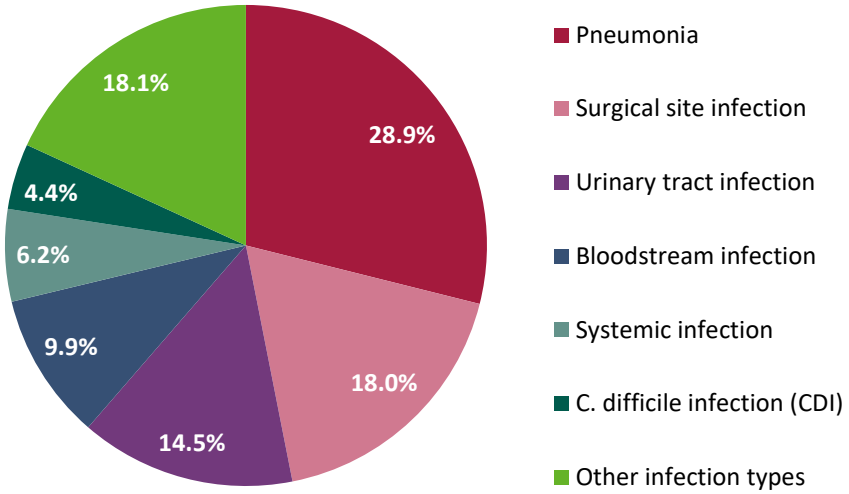


Figure 4.8. Percentage of HAI by type

Pneumonia (PN)

Pneumonia (PN) was the commonest HAI (n=196), accounting for 28.9% of all HAI and affecting 1.9% of inpatients. While patients were required to meet strict radiological and clinical criteria, in accordance with the case definition, 84% of hospital-acquired pneumonia cases were not microbiologically-confirmed (PN5 category). Of the 196 pneumonia cases, 32 (16%) were associated with intubation of the respiratory tract. Figure 4.9 displays the classification of PN types, based on microbiological findings. Table 4.21 displays the percentage of PN cases associated with intubation.

When compared with PPS 2012, a large increase in PN as a proportion of HAI was observed (28.9% versus 17%), along with a doubling of the prevalence of PN (1.9% versus 1.0%). PN rose from second to first ranked HAI in PPS 2017.

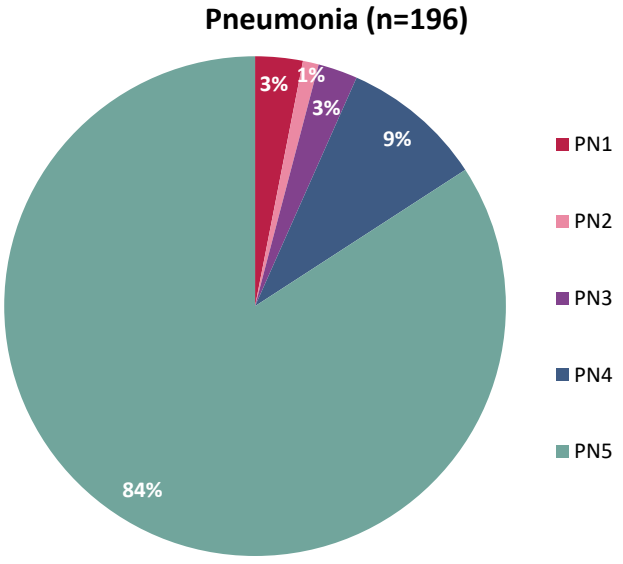


Figure 4.9. Percentage of pneumonia by type

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

Surgical Site Infection (SSI)

Surgical site infection (SSI) was the second commonest HAI (n=122), accounting for 18.1% of all HAI and affecting 1.2% of inpatients. Of the SSI, 33% were classified as superficial incisional and 67% were classified as either deep incisional or organ/space SSI (Figure 4.10).

When compared with PPS 2012, SSI dropped from first to second in rank, although as a proportion of HAI, SSI remained stable at 18%. An increase in the percentage of SSI categorised as deep incisional or organ/space was observed between the two PPS (from 56% to 67%).

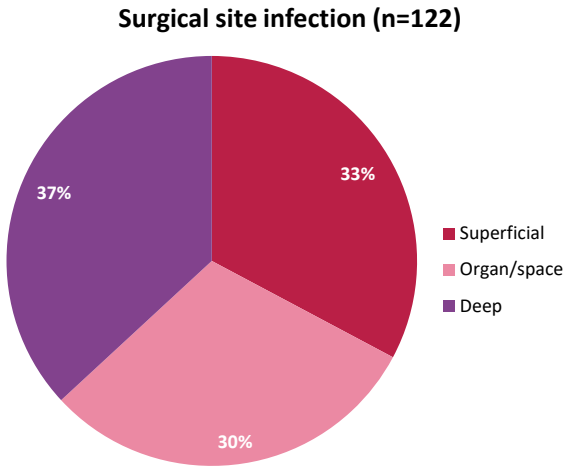


Figure 4.10. Percentage of SSI by type

Urinary Tract Infection (UTI)

Urinary tract infection (UTI) was the third commonest HAI, with 98 cases (14.5%) reported and affecting 0.9% of inpatients. Over half of the UTI (63%) were microbiologically-confirmed. Of the 98 UTI cases, 38 (39%) were associated with the presence of a urinary catheter (Table 4.21). Figure 4.11 displays categorisation by microbiologically-confirmed (UTI-A) and non-microbiologically-confirmed (UTI-B). When compared with PPS 2012, the rank and proportion of UTI remained stable in 2017.

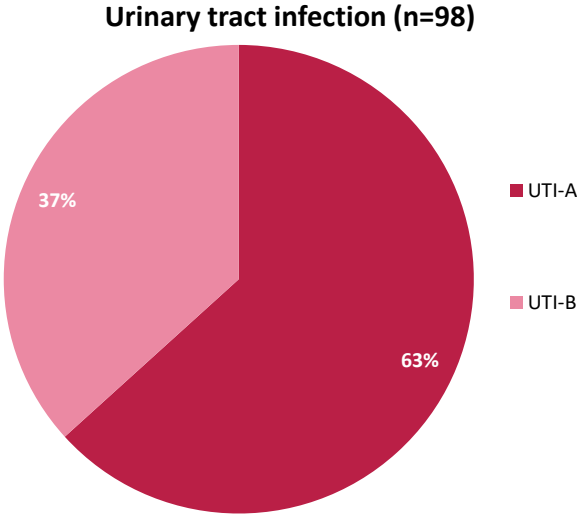


Figure 4.11. Percentage of UTI by type
UTI-A: microbiologically-confirmed UTI; UTI-B: non-microbiologically-confirmed UTI

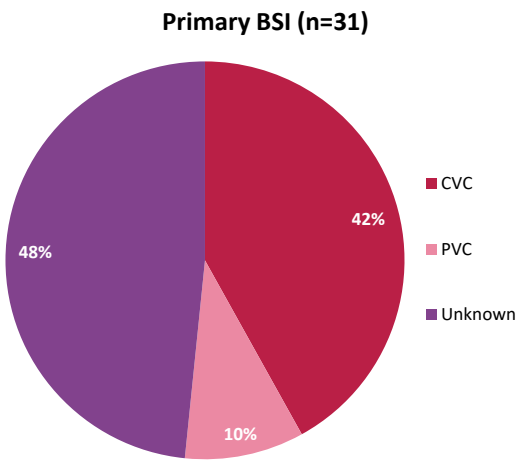
Bloodstream Infection (BSI)

Bloodstream infection (BSI) was the fourth commonest HAI, with 67 cases reported (9.9%) and affecting 0.6% of inpatients. BSI may be categorised as primary (which may be due to an infected vascular catheter or of unknown origin, where no source is identifiable) or as secondary, which may be further differentiated based on the underlying infection site. Of 67 BSI, 34 (51%) were classified as primary, with 33 (49%) secondary to infection elsewhere in the body.

Figure 4.12 displays the source of primary BSI and Table 4.21 displays the percentage of primary BSI reported in the presence of an indwelling vascular catheter. Of the 31 vascular catheter-related primary BSI, 23 (74%) occurred in the presence of an indwelling vascular catheter, with the vascular catheter implicated as the BSI source in 16 cases. Overall, 52% of primary BSI were vascular catheter-associated; CVC (n=13; 42%) and PVC (n=3; 10%). For the remaining 15 primary BSI (48%), an underlying source was not identified upon review of the patient's healthcare record and relevant microbiology results. While seven of those patients had documentation of an indwelling vascular catheter, there was no clinical or microbiological evidence linking the vascular catheter to the BSI.

When compared with PPS 2012, a welcome reduction in the proportion of primary BSI due to CVC infection (42% versus 57%), despite a slight increase in the overall prevalence of CVC use (8% versus 6%) was observed. An increase in the proportion of primary BSI due to PVC infection (10% versus 7%) and the overall prevalence of PVC use (49% versus 41%) was observed between PPS.

Figure 4.13 illustrates the breakdown of 33 secondary BSI. The urinary (33%) and digestive (24%) tracts were the most common sources, followed by SSI (12%) and non-surgical wound/soft tissue infection (12%).



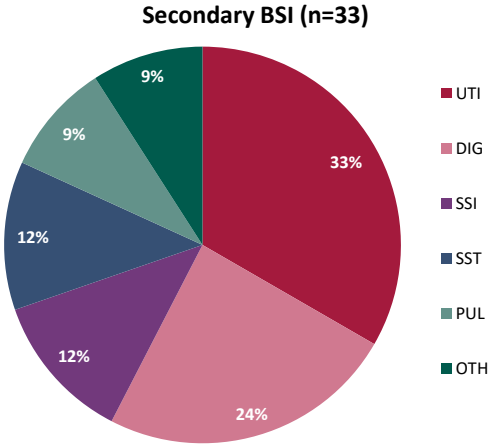


Figure 4.12. Percentage of primary BSI by origin **Figure 4.13.** Percentage of secondary BSI by origin

CVC: central vascular catheter; PVC: peripheral vascular catheter; UTI: urinary tract infection; DIG:digestive tract infection; SSI:surgical site infection; SST: skin/soft tissue infection; PUL: pulmonary infection; OTH: other infection site

Table 4.21. Number and percentage of device-associated HAI

	HAI	
HAI type	**N**	**%**
Pneumonia		
Intubation present	32	16
Intubation absent	164	84
Total	**196**	
Urinary tract infection		
Urinary catheter present	38	39
Urinary catheter absent	60	61
Total	**98**	
Primary BSI		
Vascular catheter present*	23	74
Vascular catheter absent	8	26
Total	**31**	

* A vascular catheter documented as underlying source for 16 of the primary BSI. For the remaining seven cases the vascular catheter was not the underlying source

Gastrointestinal Infections

The category of gastrointestinal (GI) infections combined represented the fifth most common HAI type, with 54 cases (8%) reported and affecting 0.5% of inpatients. Of those, CDI accounted for the majority, with 30 cases (56%) reported and affecting 0.3% of inpatients. In Table 4.20, CDI and GI infections (other than CDI) are presented separately.

CDI accounted for 4.4% of HAI in 2017 versus 5.7% in PPS 2012 (n=29). Figure 4.14 displays the breakdown of GI infection types.

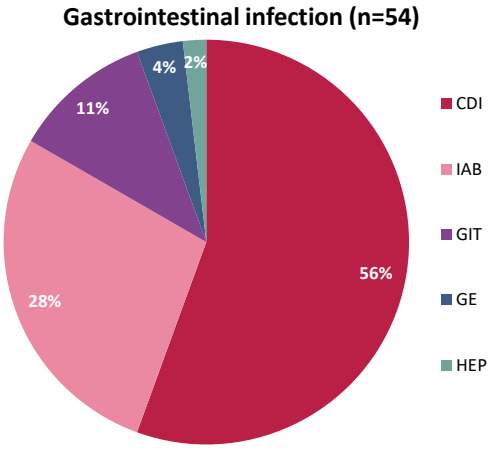


Figure 4.14. Percentage of gastrointestinal infections by type

CDI: *Clostridium difficile* infection; IAB: intraabdominal; GIT: gastrointestinal tract; GE: gastroenteritis; HEP: hepatitis

4.4 Microbiology & Antimicrobial Resistance Markers

The PPS microbiology and antimicrobial resistance results should be reviewed and interpreted in conjunction with the definitions used in this survey. They 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/

4.4.1 Microbiology & Antimicrobial Resistance Data

Figure 4.15 displays the reported microbiology data on the 678 HAI, with positive microbiology results available for 309 (46%) and a total of 386 microorganisms identified from relevant specimens sent to the microbiology laboratory.

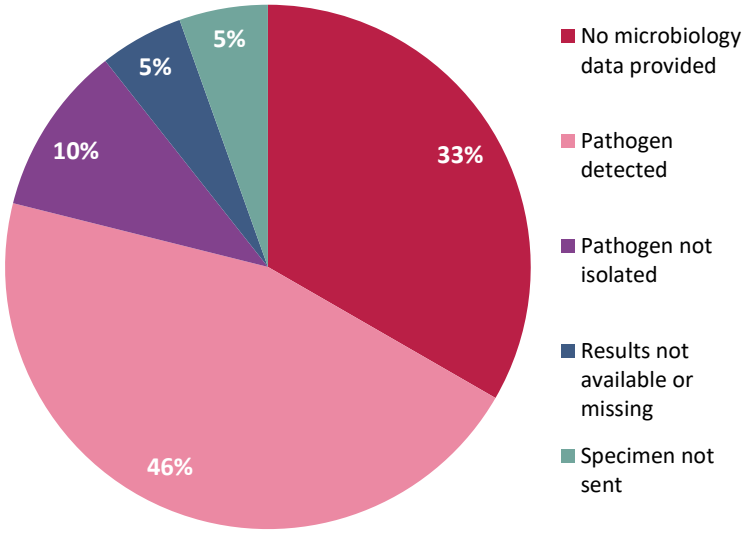


Figure 4.15. Microbiology data for HAI

Figure 4.16 displays the distribution of the 386 microorganisms detected. *Enterobacteriaceae* were the most frequently detected (n=142; 37%). *Enterobacteriaceae** is the term used to describe groups of Gram-negative bacilli, which are associated with the gastrointestinal tract of humans and animals and related bacteria that occur in the environment. Of the *Enterobacteriaceae*, *Escherichia coli* (n=91; 64%), *Klebsiella pneumoniae* (n=16; 11%), *Enterobacter spp*. (n=12; 8%) and *Proteus spp.* (n=11; 8%) were most commonly isolated (Figure 4.17). *Staphylococcus aureus* (n=57; 15%) and enterococci (n=36; 9%) ranked second and third most commonly detected pathogens from patients with HAI. *Clostridium difficile* accounted for 28 (7%) detections.

*In 2018, *Enterobacteriaceae* were renamed as *Enterobacterales*.

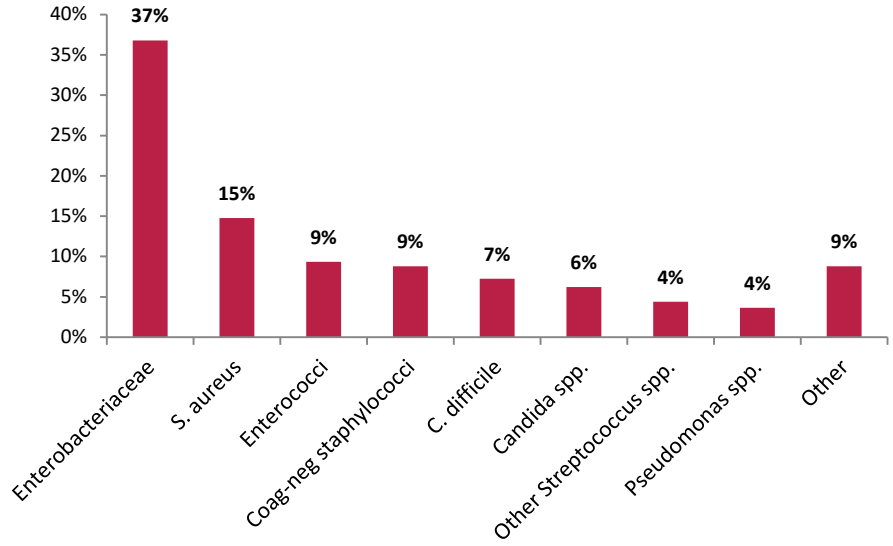


Figure 4.16. Distribution of microorganisms detected in patients with HAI

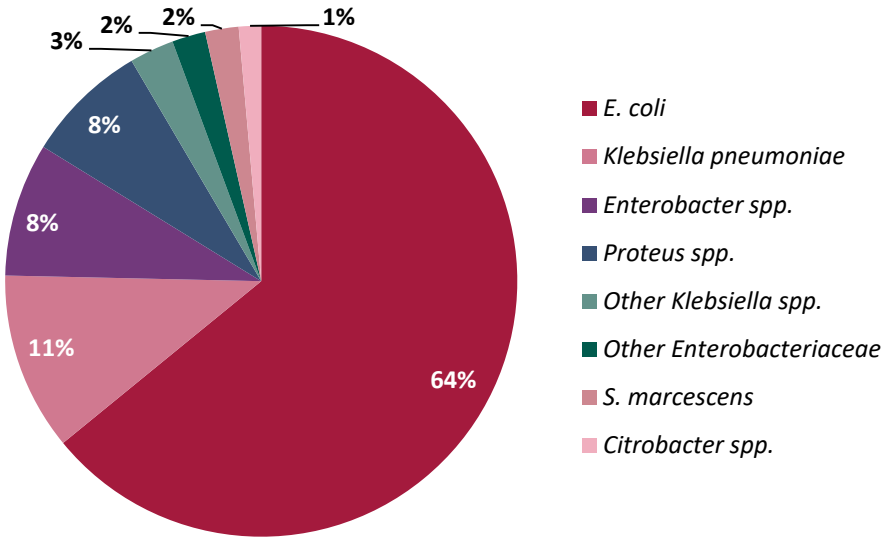


Figure 4.17. Percentage of *Enterobacteriaceae* isolates by species (n=142)

- Figure 4.18 displays breakdown of selected microorganisms by key antimicrobial resistance markers: The majority of *Enterobacteriaceae* (61%) retained susceptibility to third generation cephalosporins (C3G) and carbapenems. However, C3G resistance was reported in 21 (15%) and carbapenem resistance in one (1%) *Enterobacteriaceae* isolated from clinical specimens. There were 19 patients with HAI caused by resistant *Enterobacteriaceae.* Compared with PPS 2012, a higher proportion of *Enterobacteriaceae* were reported with unknown antimicrobial susceptibility (25% versus 15%)

- The majority of *S. aureus* causing HAI (63%) retained susceptibility to flucloxacillin (MSSA). However, 28% (n=16) of *S. aureus* causing HAI were reported as flucloxacillin resistant (MRSA). There were 14 patients with HAI caused by MRSA. Compared with PPS 2012, a higher proportion of *S. aureus* were reported with unknown antimicrobial susceptibility (9% versus 4%)

- The third most frequent pathogens reported in the survey were enterococci (n=36; 9%). Of the enterococci, 39% (n=14) were reported as glycopeptide resistant (vancomycin resistant enterococci, or VRE), an increase from 26% in PPS 2012. There were 14 patients with HAI caused by VRE. Compared with PPS 2012, a higher proportion of enterococci were reported with unknown antimicrobial susceptibility (22% versus 15%)

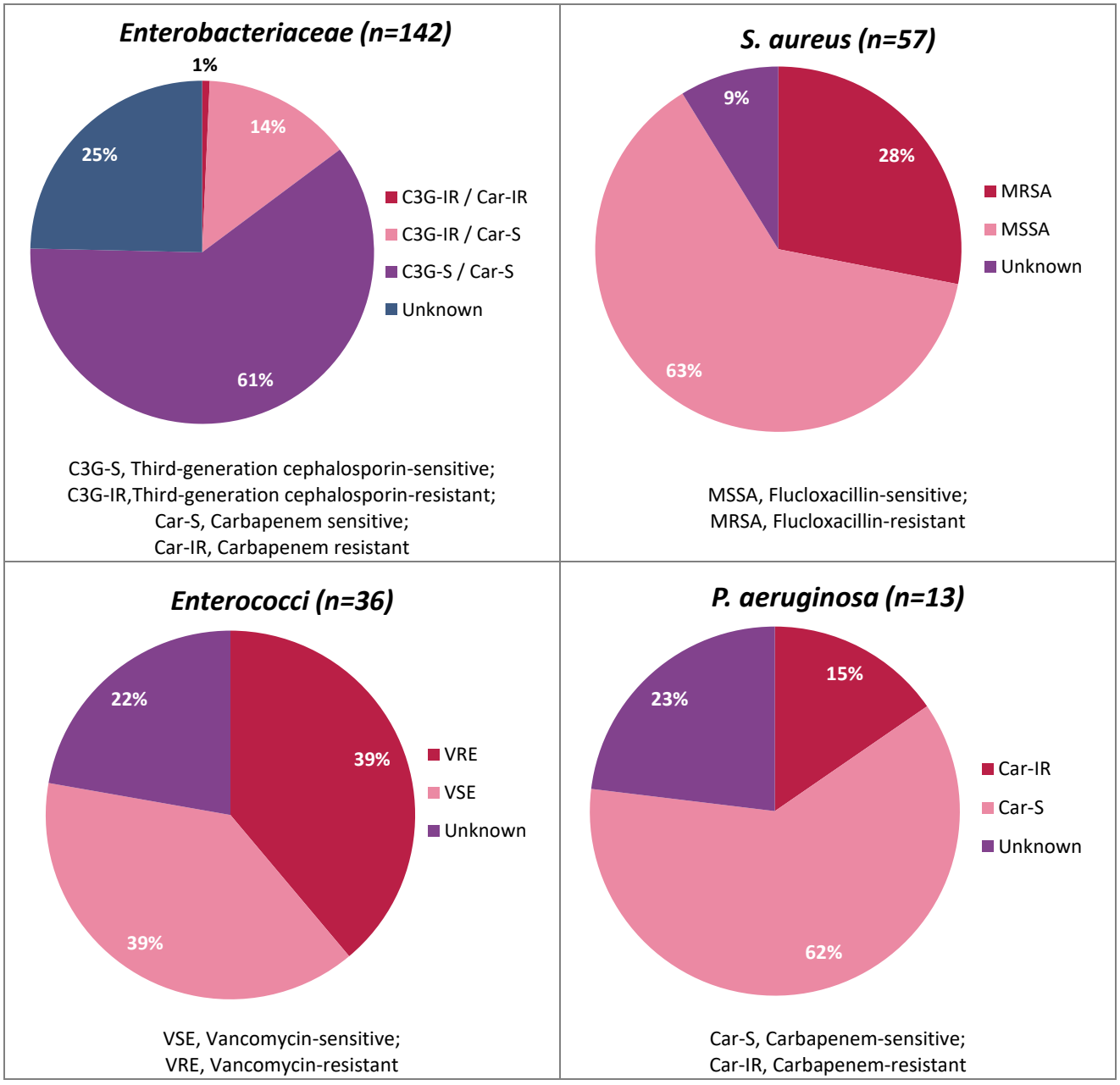


Figure 4.18. Microorganism breakdown by key antimicrobial resistance markers

4.5 Antimicrobial Use (AMU)

The PPS antimicrobial use results should also be reviewed and interpreted in conjunction with the methodology and definitions used in this survey. They 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/

4.5.1 Overall Prevalence of AMU

Of the 10,333 eligible patients, 4,105 were classified as receiving systemic antimicrobials, resulting in an AMU prevalence of 39.7% (95% CI = 38.8–40.7), an increase compared with PPS 2012 [34% (95% CI 33.4–35.4%)]. Overall, 5,813 antimicrobials were prescribed (5,580 antibacterials and 233 antifungals). At the time of survey, 1,334 patients were prescribed two or more antimicrobials (Table 4.22).

Table 4.22. Number of antimicrobials prescribed per patient

Number of antimicrobials prescribed per patient	Patients	
	N	%
0	6,228	60.3
1	2,771	26.8
2	1,058	10.2
3	205	2.0
4	51	0.5
5+	20	0.2
Total	**10,333**	**100.0**

The breakdown of AMU prevalence, by hospital type and for each of the 60 participating hospitals is provided in Section 4.6.

4.5.2 AMU Patient Risk Factors

Figure 4.19 displays the prevalence of risk factors in patients prescribed antimicrobials. A greater proportion of the 4,105 patients receiving antimicrobials had a history of surgery since admission to the participating hospital, in comparison with the overall cohort of 10,333 eligible patients (23% versus 18%). The patients with a history of surgery since admission were prescribed 1,307 antimicrobials, of which 711 (54%) were for treatment of infection, 514 (39%) for surgical antimicrobial prophylaxis and 82 (6%) for other indications.

The prevalence of invasive device utilisation was also greater for all devices across the antimicrobial use patient cohort than the overall eligible patient cohort [PVC; 71 versus 49%, CVC; 13 versus 8%, urethral catheterisation; 20% versus 13% and respiratory tract intubation; 3 versus 2%]. As 63% of antimicrobials were administered via the parenteral route, the presence of an intravascular catheter may also have been for administration of antimicrobials, rather than solely as a risk factor for the patient being prescribed antimicrobials.

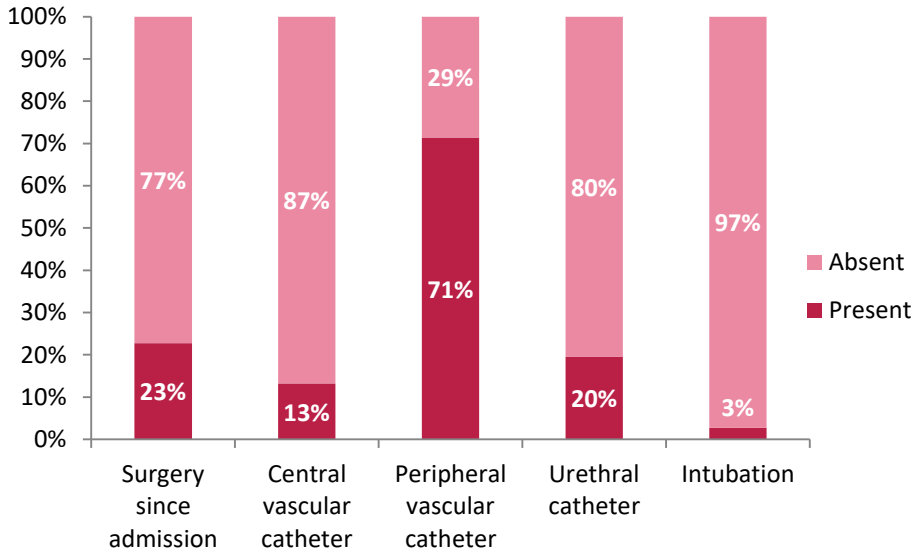


Figure 4.19. Prevalence of risk factors in patients on antimicrobials

4.5.3 AMU Prevalence by Gender, Age, McCabe Score & Birth Weight

The AMU prevalence by gender, age and McCabe Score, with univariate odds ratio (OR) analysis is presented in Table 4.23. Of the 4,105 patients receiving antimicrobials, males accounted for 2,071 (50%), having a significantly higher AMU prevalence (41.7%) than females (37.9%; p <0.001).

The vast majority of patients receiving antimicrobials (n=3,855; 94%) were aged ≥15 years. The remaining 250 patients (6%) were aged 0 to 14 years. Overall, the AMU prevalence was significantly higher in patients aged 50 to 64 (44.1%) and 65 to 79 (43.4%) years.

The AMU prevalence was significantly higher in patients with a life-limiting disease prognosis defined by the McCabe score (46.6%; OR 1.43).

Table 4.23. AMU prevalence by gender, age and McCabe score

Risk factor	Category	N patients	N patients with AMU	AMU prevalence (%)	AMU Prevalence 95% CI		Odds Ratio	Odds Ratio 95% CI		P-value
					Lower	Upper		Lower	Upper	
Gender	Female*	5,371	2034	37.9	36.6	39.2	-	-	-	-
	Male	4,962	2071	41.7	40.4	43.1	1.18	1.09	1.27	**<.0001**
Age group	<1 month	506	60	11.9	9.2	15.0	0.20	0.15	0.27	**<.0001**
	1-23 months	209	79	37.8	31.2	44.7	0.91	0.60	1.22	0.55
	2-14	271	111	41.0	35.0	47.1	1.04	0.81	1.35	0.74
	15-29	535	205	38.3	34.2	42.6	0.94	0.77	1.13	0.49
	30-49	1,534	565	36.8	34.4	39.3	0.88	0.77	1.00	0.05
	50-64	1,717	758	44.1	41.8	46.5	1.19	1.05	1.35	**0.006**
	65-79	3,091	1341	43.4	41.6	45.2	1.15	1.04	1.28	**0.009**
	80+ years*	2,470	986	39.9	38.0	41.9	-	-	-	-
McCabe score	None/non fatal*	7,933	3009	37.9	36.9	39.0	-	-	-	-
	Life limiting prognosis	1,875	874	46.6	44.3	48.9	1.43	1.29	1.58	**<.0001**
	End of life prognosis	406	170	41.9	37.0	46.8	1.18	0.96	1.44	0.11
	Not known	119	52	43.7	34.6	53.1	1.27	0.88	1.83	0.20

* Reference group for odds ratio calculation; significant P-values are highlighted in bold

Patients aged <1 month had a significantly lower AMU prevalence of 11.9% (OR 0.20). The birth weight of neonates represented a new question in PPS 2017. Of 506 neonates, birth weight was normal (2.5 – 4.0 kg) for 298 (59%), high (>4.0 kg) for 67 (13%) and low (<2.5 kg) for 131 (26%). The AMU prevalence was significantly greater in 14 high birth weight neonates (20.9%) [OR 2.5; 95% CI 1.3 – 5.2], as displayed in Table 4.24.

Table 4.24. AMU prevalence by birth weight

Birth weight category	Total patients	AMU		AMU prevalence 95% CI		Odds Ratio	Odds Ratio (95% CI)		P-value
		N	%	Lower	Upper		Lower	Upper	
Normal*	298	28	9.4	6.3	13.3	-	-	-	-
Low birth weight	131	18	13.7	8.4	20.8	1.5	0.8	2.9	0.2
High birth weight	67	14	20.9	11.9	32.6	2.5	1.3	5.2	**0.008**
Unknown	10	0	0.0	-	-	-	-	-	-

4.5.4 AMU Prevalence by Ward Specialty & Admitting Consultant Specialty

The AMU prevalence by ward specialty is shown in Table 4.25. AMU prevalence was highest in adult ICUs (70.4%), although lower than that observed in PPS 2012 (74.4%) and in surgical wards (48.4%), where it was higher than that observed in PPS 2012 (40.5%). The lowest AMU prevalence was recorded in psychiatry wards (7.8%).

Table 4.25. AMU prevalence by ward specialty

Ward specialty	Total N patients	N patients with AMU	AMU prevalence (%)	95% CI	
				Lower	Upper
Adult Intensive Care	196	138	70.4	63.5	76.7
Mixed*	923	449	48.6	45.4	51.9
Surgery	2,258	1,092	48.4	46.3	50.4
Medicine	3,866	1,581	40.9	39.3	42.5
Paediatrics	451	183	40.6	36.0	45.3
Geriatrics	320	74	23.1	18.6	28.1
Neonatal	197	38	19.3	14.0	25.5
Obstetrics/gynaecology	959	162	16.9	14.6	19.4
Rehabilitation	245	28	11.4	7.7	16.1
Psychiatry	64	5	7.8	2.6	17.3
Other**	854	355	41.6	38.2	45.0
Total	**10,333**	**4,105**	**39.7**	**38.8**	**40.7**

* Mixed ward specialty: Only two specialties on a ward, with one speciality accounting for <80% of patients

** Other ward specialty: <80% of patients belong to a single speciality, with mixed medical and surgical patients. Emergency Department (ED) was categorised as 'Other' ward specialty for the purposes of capturing admitted patients who remained in ED at the time of PPS

The AMU prevalence by admitting consultant specialty is shown in Table 4.26.

Table 4.26. AMU prevalence by admitting consultant specialty

Consultant specialty	Total N patients	N patients with AMU	AMU prevalence (%)	95% CI	
				Lower	Upper
Surgical	3,158	1,455	46.1	44.3	47.8
Medical	4,798	2,057	42.9	41.5	44.3
Paediatrics	361	127	35.2	30.3	40.4
Geriatrics/care of the elderly	556	175	31.5	27.6	35.5
Obstetrics /gynaecology	803	199	24.8	21.8	27.9
Neonatal	380	46	12.1	9.0	15.8
Rehabilitation	172	15	8.7	5.0	14.0
Psychiatry	64	5	7.8	2.6	17.3
Other	41	26	63.4	66.4	97.2
Total	**10,333**	**4,105**	**39.7**	**38.8**	**40.7**

While the highest AMU prevalence (63.4%) was recorded for the category 'other specialty' (n= 41 patients), 23 of those patients were recorded as being admitted under the care of a consultant in intensive care medicine and 18 were admitted under the category of 'other consultants – not specified'. In Ireland, the majority of paediatric and adult patients admitted to ICU tend not to be admitted under the care of a named consultant in intensive care medicine. Rather, such patients tend to be admitted under the care of a medical or surgical consultant.

4.5.5 Route of Administration of Antimicrobials

The route of administration of the 5,813 prescribed antimicrobials is displayed in Table 4.27. The majority (n=3,660; 63%) were administered via the parenteral or intravenous (IV) route.

Table 4.27. Number and percentage of antimicrobials by route of administration

Route of administration	Antimicrobials prescribed	
	N	%
Parenteral	3,660	63.0
Oral	2,131	36.7
Inhalation	22	0.4
Total	**5,813**	**100.0**

4.5.6 Documentation of Indication and Compliance with Local Guidelines

Information regarding documentation of the indication for the antimicrobial prescription was available for 5,776 prescriptions (99%). For 5,228 prescriptions (91%), the indication was documented in the patient's healthcare record and/or medication chart (Figure 4.20). This reflected an improvement on 83% of antimicrobial prescriptions with a documented indication in PPS 2012. Of 5,813 prescriptions, the antimicrobial was deemed assessable against a local prescribing guideline for 5,209 (90%), an increase on 72% of antimicrobial prescriptions deemed assessable in PPS 2012.

An antimicrobial prescription may be non-assessable where:

- There is no local guideline available for that indication
- The patient has a documented antimicrobial allergy precluding prescription of the recommended agent
- The indication for prescription is for medical prophylaxis or use of erythromycin as a pro-kinetic agent
- The antimicrobial has been advised on advice of an infection specialist (clinical microbiologist or infectious diseases (ID) physician)
- The reason cannot be determined from review of the patient's notes and discussion with staff caring for the patient, or the information is missing from the ward

Of the 5,209 assessable prescriptions, 21% were deemed non-compliant with local guidelines (Figure 4.21), an improvement on 27% non-compliance observed in PPS 2012.

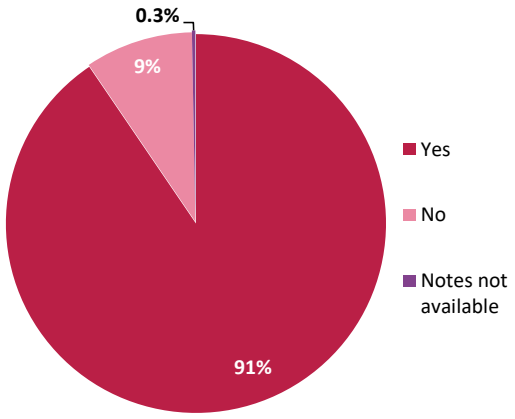


Figure 4.20. Documented indication for the prescribed antimicrobial (n=5,776)

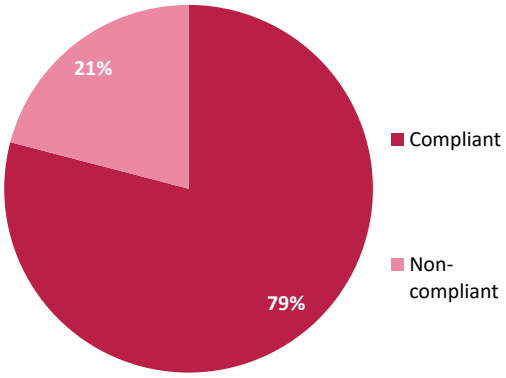


Figure 4.21. Assessable prescriptions and compliance with local guidelines (n=5,209)

4.5.7 Antibacterials

Twenty agents collectively accounted for 90% of prescribed antibacterials (n=5,048). The most commonly prescribed antibacterial class was the β lactam-β lactamase inhibitor combination (co-amoxiclav and piperacillin-tazobactam), together accounting for 1,995 (36%) prescriptions. Table 4.28 demonstrates the breakdown of the 5,580 antibacterials. Compared with PPS 2012, the top six ranked antimicrobials were essentially unchanged, other than flucloxacillin climbing from 6th to 4th and ciprofloxacin dropping from 4th to 6th ranking. Meropenem's ranking and proportion of total remained unchanged versus PPS 2012.

Table 4.28. Number and percentage of prescribed antibacterials

Rank order	Antibacterial agent	Antibacterials prescribed	
		N	%
1	Co-amoxiclav	1,164	20.9
2	Piperacillin-tazobactam	831	14.9
3	Metronidazole	348	6.2
4	Flucloxacillin	316	5.7
5	Clarithromycin	284	5.1
6	Ciprofloxacin	276	4.9
7	Cefuroxime	261	4.7
8	Vancomycin	254	4.6
9	Gentamicin	219	3.9
10	Meropenem	169	3.0
11	Co-trimoxazole	165	3.0
12	Benzylpenicillin	125	2.2
13	Ceftriaxone	121	2.2
14	Nitrofurantoin	94	1.7
15	Amoxicillin	85	1.5
16	Azithromycin	83	1.5
17	Doxycycline	67	1.2
17	Levofloxacin	67	1.2
19	Trimethoprim	60	1.1
20	Clindamycin	59	1.1
	Other agents	532	9.5
	Total	**5,580**	**100.0**

4.5.8 Antifungals

Table 4.29 demonstrates the breakdown of the 233 antifungals. Antifungal distribution remained essentially unchanged versus PPS 2012.

Table 4.29. Number and percentage of prescribed antifungals

Rank order	Antifungal agent	Antifungals prescribed	
		N	%
1	Fluconazole	100	42.9
2	Nystatin	48	20.6
3	Amphotericin B	22	9.4
4	Caspofungin	17	7.3
5	Anidulafungin	15	6.4
6	Posaconazole	15	6.4
7	Voriconazole	11	4.7
	Other agents	5	2.1
	Total	**233**	**100.0**

4.5.9 Indication for Antimicrobial Prescribing

Table 4.30 describes the prescriber's indication for the antimicrobials. The majority of prescriptions (n=4,579; 78.8%) were for treatment of infection. Surgical antimicrobial prophylaxis (SAP) accounted for 552 prescriptions (9.5%) and medical prophylaxis for 537 prescriptions (9.2%).

Table 4.30. Number and percentage of antimicrobials by prescriber's indication

Prescriber's indication	Antimicrobials prescribed	
	N	%
Treatment of infection	4,579	78.8
community infection (CI)	3,311	57.0
hospital infection (HI)	1,111	19.1
long-term care infection (LI)	157	2.7
Surgical antimicrobial prophylaxis	552	9.5
single dose (SP1)	169	2.9
one day (SP2)	185	3.2
> 1 day (SP3)	198	3.4
Medical prophylaxis	537	9.2
Other	42	0.7
Unknown	103	1.8
Total	**5,813**	**100.0**

4.5.10 Treatment of Infection

Of the 4,579 prescriptions for infection treatment, the majority were for community infections (3,311 prescriptions; 72%), followed by hospital (1,111 prescriptions; 24%) and long-term care facility infections (157 prescriptions; 3%) (Figure 4.22).

The prescriber's diagnosis or suspected body site of infection was also recorded. Figure 4.23 displays the breakdown regardless of infection origin. The respiratory tract accounted for 1,647 (36%) [pneumonia: 1,351 (29.5%); and bronchitis: 296 (6.5%)], skin, soft tissue and surgical site for 691 (15%), urinary tract for 495 (11%) [cystitis: 278 (6%); and pyelonephritis: 217 (5%)] and intra-abdominal infection for 458 (10%) prescriptions.

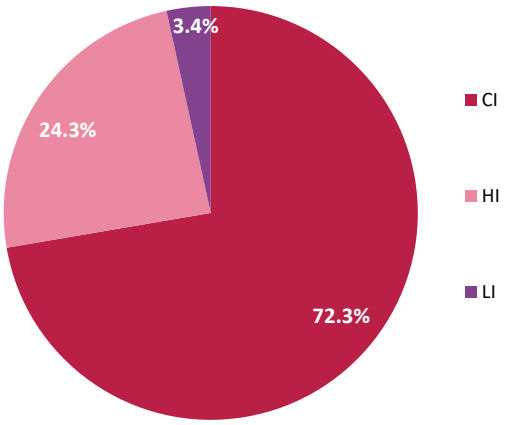


Figure 4.22. Breakdown of infection treatment prescriptions by origin of infection (n=4,579)

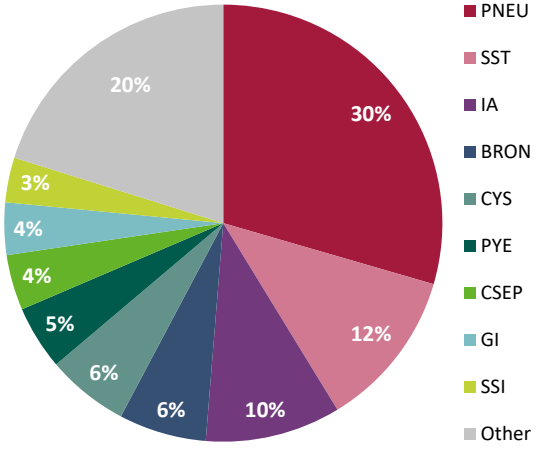


Figure 4.23. Breakdown of infection treatment prescriptions by body site (n=4,579)

Further breakdown of prescriptions for treatment of infection, by origin of infection is displayed in Figure 4.24 for community infections (CI) and Figure 4.25 for hospital infections (HI). In HI, SSI was the second commonest type (13%), with clinical sepsis ranking third.

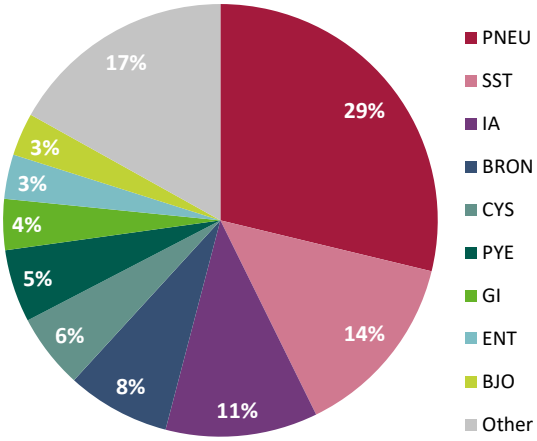


Figure 4.24. Breakdown of antimicrobials for treatment of community infection (CI) by site of infection (n=3,311)

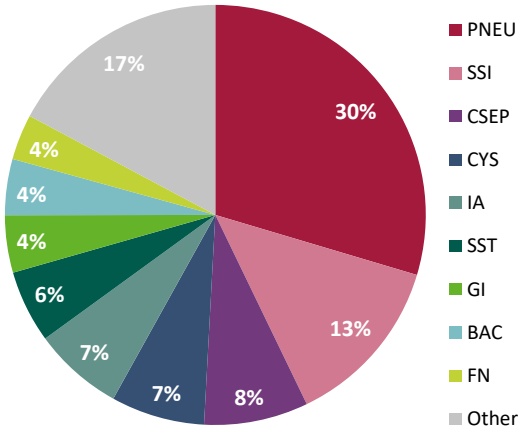


Figure 4.25. Breakdown of antimicrobials for treatment of hospital infection (HI) by site of infection (n=1,111)

CI: community infection; HI: hospital infection; LI: long-term care infection
BRON: bronchitis; BAC: Laboratory-confirmed bloodstream infection; BJO: septic arthritis/osteomyelitis; FN: febrile neutropenia; CSEP: clinical sepsis; CYS: cystitis; ENT: infection of ear/nose/throat; GI: gastrointestinal infection; IA: intraabdominal infection; PNEU: pneumonia; SSI: surgical site infection; SST: skin/soft tissue infection; PYE; pyelonephritis; Other: other infection sites

Figures 4.26 to 4.30 and Table 4.31 demonstrate the most frequently-prescribed antimicrobials (number and cumulative percentage) for the most common infections, as diagnosed by prescribers.

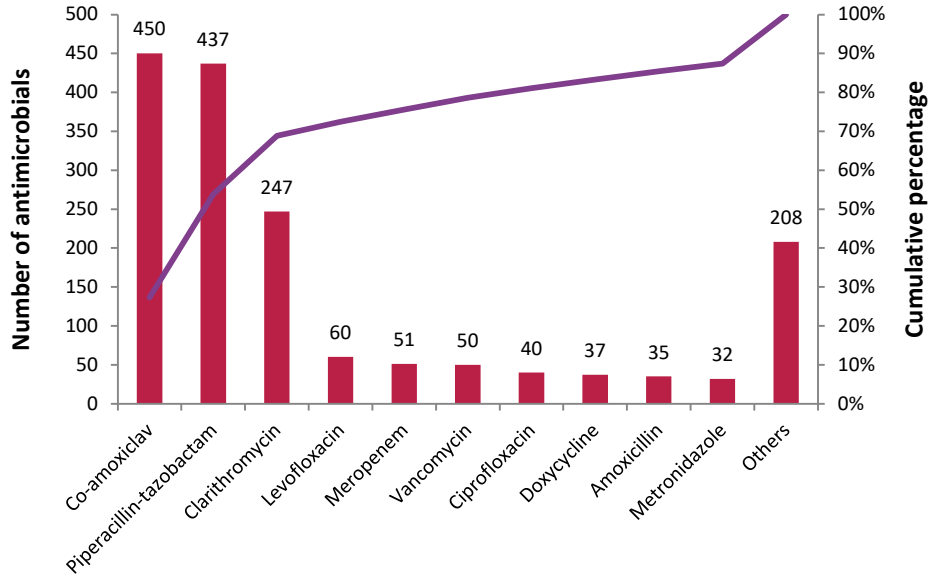


Figure 4.26. Number and cumulative percentage of antimicrobials prescribed to treat respiratory infections (pneumonia and bronchitis) (n=1,647)

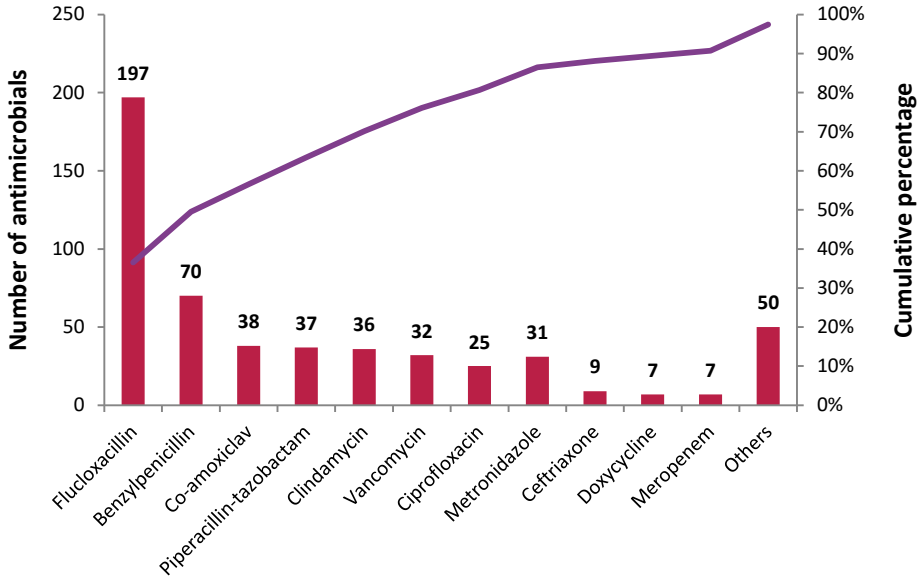


Figure 4.27. Number and cumulative percentage of antimicrobials prescribed to treat skin/soft tissue and surgical site infections (n=539)

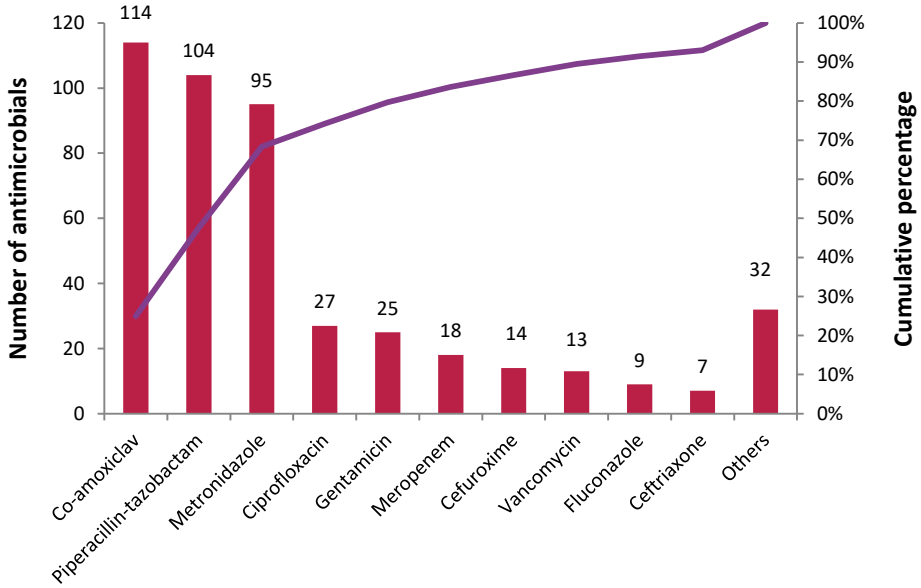


Figure 4.28. Number and cumulative percentage of antimicrobials prescribed to treat intra-abdominal infections (n=458)

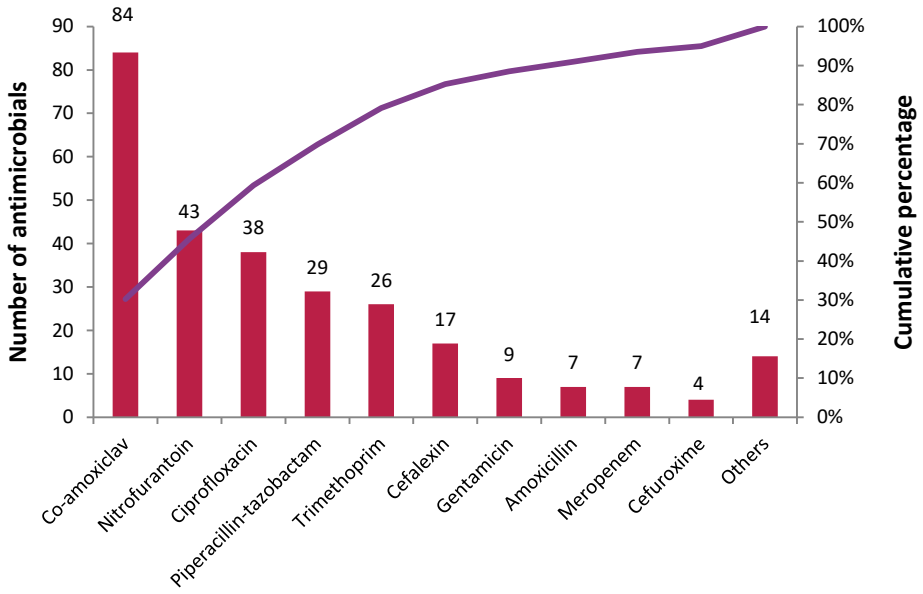


Figure 4.29. Number and cumulative percentage of antimicrobials prescribed to treat cystitis or symptomatic lower urinary tract infections (n=278)

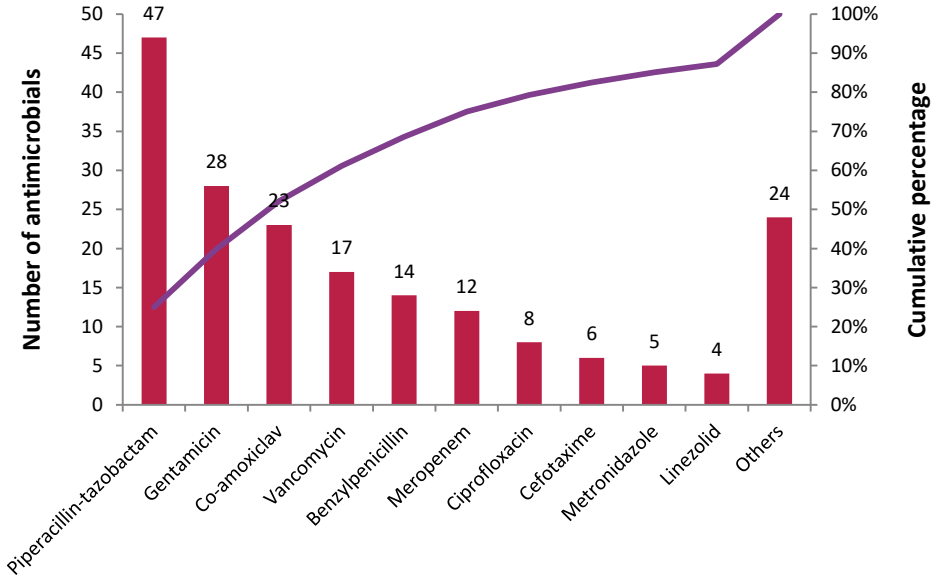


Figure 4.30. Number and cumulative percentage of antimicrobials prescribed to treat clinical sepsis (n=188)

The PPS protocol (page 58) defines clinical sepsis as; suspected bloodstream infection in a non-immunocompromised/non-neutropenic patient without microbiology laboratory confirmation of positive blood cultures/blood culture results not yet available/blood cultures not collected/blood cultures sterile after five days incubation.

Table 4.31. Number and percentage of antimicrobials prescribed for treatment of common infection types

Diagnosis/Site of Infection being Treated	Rank order	Antimicrobial Agent	Antimicrobial	
			N	%
Respiratory	1	Co-amoxiclav	450	27.3
	2	Piperacillin-tazobactam	437	26.5
	3	Clarithromycin	247	15.0
	4	Levofloxacin	60	3.6
	5	Meropenem	51	3.1
	6	Vancomycin	50	3.0
	7	Ciprofloxacin	40	2.4
	8	Doxycycline	37	2.2
	9	Amoxicillin	35	2.1
	10	Metronidazole	32	1.9
		Others	208	12.6
		Total	**1,647**	**100.0**
Skin and soft tissue infection	1	Flucloxacillin	197	36.5
	2	Benzylpenicillin	70	13.0
	3	Co-amoxiclav	38	7.1
	4	Piperacillin-tazobactam	37	6.9
	5	Clindamycin	36	6.7
	6	Vancomycin	32	5.9
	7	Ciprofloxacin	25	4.6
	8	Metronidazole	31	5.8
	9	Ceftriaxone	9	1.7
	10	Doxycycline	7	1.3
	10	Meropenem	7	1.3
		Others	50	9.3
		Total	**539**	**100.0**
Intra-abdominal infection	1	Co-amoxiclav	114	24.9
	2	Piperacillin-tazobactam	104	22.7
	3	Metronidazole	95	20.7
	4	Ciprofloxacin	27	5.9
	5	Gentamicin	25	5.5
	6	Meropenem	18	3.9
	7	Cefuroxime	14	3.1
	8	Vancomycin	13	2.8
	9	Fluconazole	9	2.0
	10	Ceftriaxone	7	1.5
		Others	32	7.0
		Total	**458**	**100.0**
Cystitis or symptomatic lower urinary tract infection	1	Co-amoxiclav	84	30.2
	2	Nitrofurantoin	43	15.5
	3	Ciprofloxacin	38	13.7
	4	Piperacillin-tazobactam	29	10.4
	5	Trimethoprim	26	9.4
	6	Cefalexin	17	6.1
	7	Gentamicin	9	3.2
	8	Amoxicillin	7	2.5
	9	Meropenem	7	2.5
	10	Cefuroxime	4	1.4
		Others	14	5.0
		Total	**278**	**100.0**

In PPS 2017, the start date of antimicrobials prescribed for treatment of infection (CI, HI or LI) was a new question asked. As displayed in Table 4.32, on average, a patient had been on a treatment antimicrobial for six days before their inclusion in the PPS (median: 3 days).

Table 4.32. Interval between initiation of treatment antimicrobial and PPS date

Infection treatment duration by PPS date	N days
Mean	6
Median	3
IQR	5
Range	0-724

Additional information was sought about treatment antimicrobials and whether the prescription on the PPS date represented a change from that originally prescribed for the same infection type. For 32.5% of treatment antimicrobials, a different antimicrobial had originally been prescribed, as displayed in Figure 4.31. The reason for changing the treatment antimicrobial was also a new question, with the findings displayed in Figure 4.32. In 49% of cases, the antimicrobial had been escalated from a narrower spectrum agent. In 21% of cases, de-escalation from a broader spectrum agent had occurred and for a further 21%, an IV to oral (PO) switch had been possible. Adverse drug reactions accounted for 3% of adjustments to treatment antimicrobials.

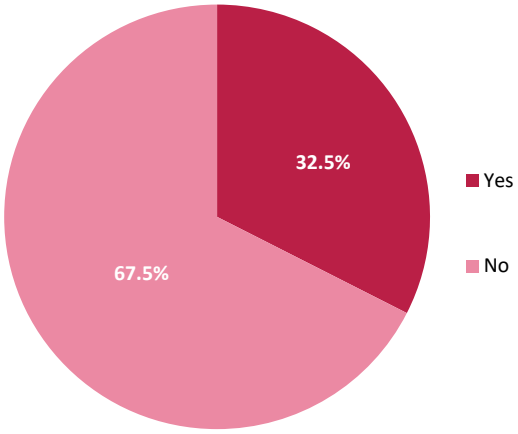


Figure 4.31. Does the current antimicrobial represent a change from what was originally prescribed? (n=4,577)

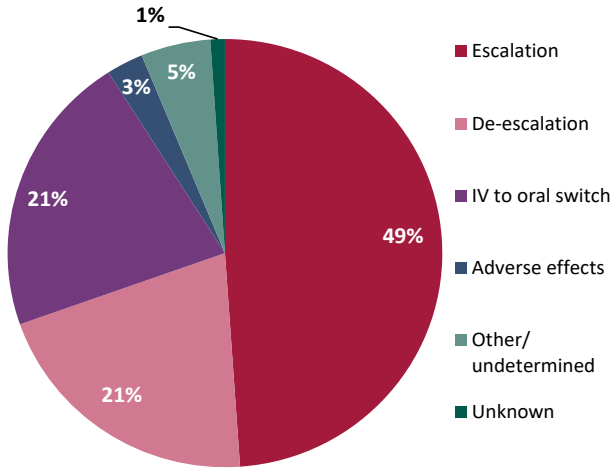


Figure 4.32. Reason for changing the antimicrobial (n=1,487)

4.5.11 Surgical Antimicrobial Prophylaxis

Surgical antimicrobial prophylaxis (SAP) accounted for 552 (9.5%) prescriptions. Figure 4.33 displays the SAP breakdown by duration. Single-dose SAP (SP1) accounted for 169 (30.6%) prescriptions, an increase from 27.2% in 2012. SAP up to 24 hours duration (SP2) accounted for 185 prescriptions (33.5%), an increase from 26.2% in 2012. A welcome reduction in the proportion of SAP exceeding 24 hours (SP3) was observed between surveys: 46.7% (2012) to 35.9% (2017).

However, in May 2017, 69.4% of all SAP still exceeded a single dose, only a slight reduction on 72.8% observed in 2012.

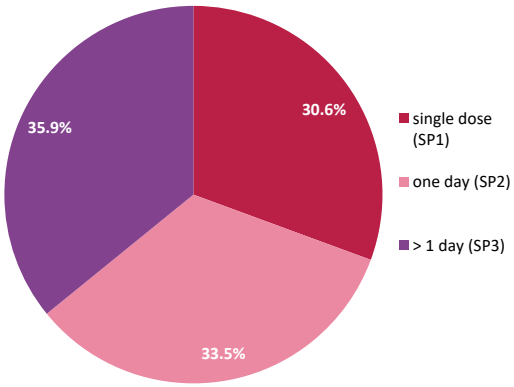


Figure 4.33. SAP duration

Table 4.33 displays the breakdown of antimicrobials prescribed for SAP. Beta lactam agents (co-amoxiclav and cefuroxime) combined accounted for 71.8% of prescriptions.

Table 4.33. Antimicrobials prescribed for SAP

Rank order	Antimicrobial agent	Antimicrobials prescribed	
		N	%
1	Co-amoxiclav	209	37.9
2	Cefuroxime	187	33.9
3	Metronidazole	32	5.8
4	Gentamicin	31	5.6
5	Ciprofloxacin	27	4.9
6	Vancomycin	21	3.8
7	Teicoplanin	12	2.2
8	Ceftriaxone	7	1.3
9	Flucloxacillin	6	1.1
10	Amoxicillin	4	0.7
	Others	16	2.9
	Total	**552**	**100.0**

4.5.12 Medical Prophylaxis

Medical prophylaxis accounted for 537 (9.2%) prescriptions. Table 4.34 displays the breakdown of antimicrobials prescribed for medical prophylaxis. Compared with PPS 2012, azithromycin jumped in rank from 8th to 2nd place in 2017.

Table 4.34. Antimicrobials prescribed for medical prophylaxis

Rank order	Antimicrobial agent	Antimicrobials prescribed	
		N	%
1	Co-trimoxazole	143	26.6
2	Azithromycin	60	11.2
3	Nitrofurantoin	37	6.9
4	Fluconazole	36	6.7
5	Rifaximin	26	4.8
6	Trimethoprim	24	4.5
7	Co-amoxiclav	22	4.1
8	Nystatin	18	3.4
9	Phenoxymethylpenicillin	17	3.2
10	Gentamicin	16	3.0
	Others	138	25.7
	Total	**537**	**100.0**

4.6 HAI & AMU Prevalence by Hospital Ownership & Type

Sixty acute hospitals (46 public, 14 private) participated in PPS 2017. The overall HAI prevalence for public hospitals was slightly higher than that for private hospitals (6.2% versus 5.8%). The overall AMU prevalence for public hospitals was lower than that of private hospitals (38.8% versus 45.6%), as shown in Table 4.35.

Table 4.35. Participating hospitals by ownership, overall HAI and AMU prevalence

Hospitals	N participating hospitals	N eligible patients	HAI prevalence (%)	95% CI		AMU prevalence (%)	95% CI	
				Lower	Upper		Lower	Upper
Public	46	8,989	6.2	5.7	6.7	38.8	37.8	39.9
Private	14	1,344	5.8	4.6	7.2	45.6	42.9	48.3
Total	**60**	**10,333**	**6.1**	**5.7**	**6.6**	**39.7**	**38.8**	**40.7**

Table 4.36, Figures 4.34 and 4.35 display HAI and AMU prevalence by hospital type. For the purposes of analysis by hospital type, 13 specialist public and one specialist private hospital have been grouped together. The specialist private hospital has not been included in the analysis of the private hospitals (hence, there are 14 private hospitals in Table 4.35 compared with 13 in Table 4.36). The HAI prevalence was highest in tertiary (8.7%) and lowest in specialist (3.4%) hospitals. The AMU prevalence was quite similar across public hospitals (38.8–42.9%), highest in private hospitals (45.4%) and lowest in specialist hospitals (26.5%). However, private hospitals had a much higher percentage of patients on surgical wards (37%) in comparison to public hospitals (20%), a factor which may have contributed to the higher AMU prevalence observed in private hospitals.

Table 4.36. Participating hospitals by type, overall HAI and AMU prevalence

Hospitals	N participating hospitals	N eligible patients	HAI prevalence (%)	95% CI		AMU prevalence (%)	95% CI	
				Lower	Upper		Lower	Upper
Primary	9	577	7.6	5.6	10.1	38.8	34.8	42.9
Secondary	17	3,514	4.2	3.5	4.9	39.0	37.4	40.7
Tertiary	7	3,700	8.7	7.8	9.6	42.9	41.3	44.5
Specialist*	14	1,229	3.4	2.5	4.6	26.5	24.1	29.1
Private†	13	1,313	5.9	4.7	7.4	45.4	42.7	48.1

*includes one private specialist hospital; †excludes one private specialist hospital

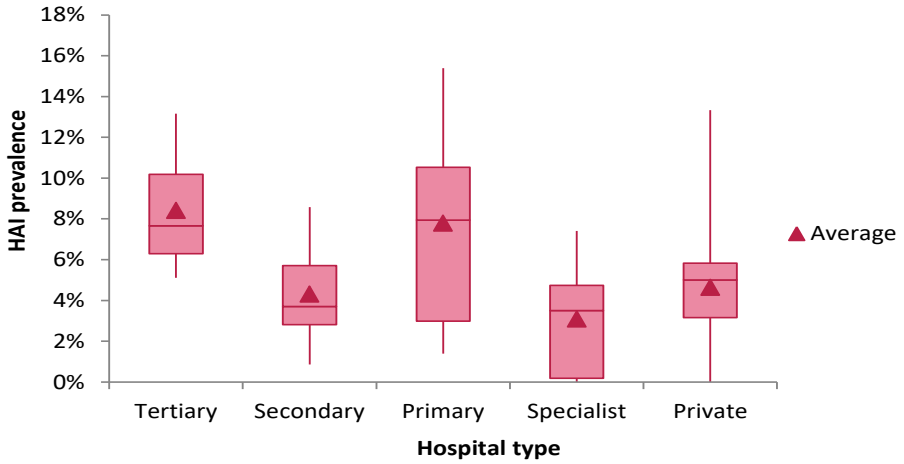


Figure 4.34. HAI prevalence box plots by hospital type

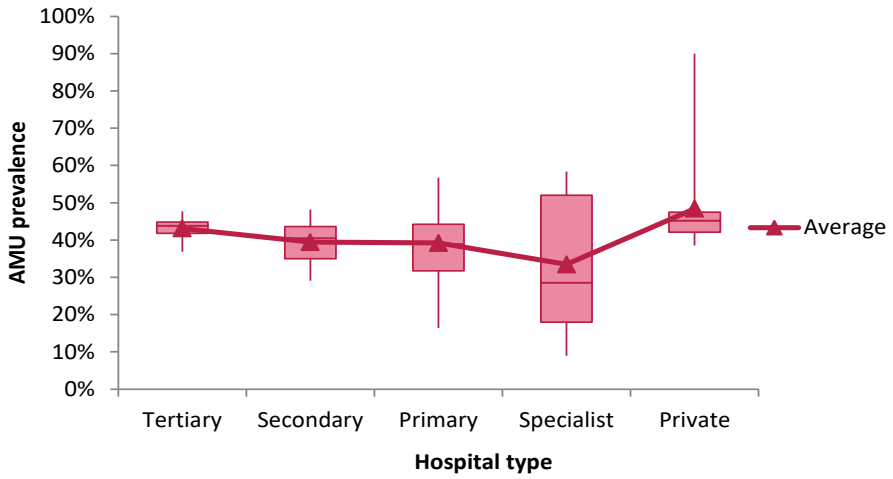


Figure 4.35. AMU prevalence box plots by hospital type

Table 4.37 displays the HAI and AMU prevalence by participating hospital in PPS 2017, with further breakdown of HAI prevalence (overall HAI and HAI deemed acquired in the participating hospital). For the purposes of reporting, the 46 public hospitals are presented by hospital group and the private hospitals are grouped separately. Direct comparison of HAI and AMU prevalence in acute hospitals within the same group is not recommended, owing to differences in hospital type and case mix. Likewise, direct comparison of HAI and AMU prevalence between private hospitals is not recommended. Inter-hospital comparisons between similar hospital types should be undertaken with caution, as individual hospitals have differing patient case mix and acuity. For example, elective admissions only versus both elective and emergency admissions, predominance of day surgery versus major surgery, admissions to an on-site ED or critical care unit versus no on-site ED and critical care unit, etc. Such factors will have significant impact on the prevalence of HAI and AMU within and between hospitals and limit the validity of inter-hospital comparisons.

Table 4.38 compares the HAI and AMU prevalence for the 49 hospitals that participated in both PPS 2012 and 2017.

Table 4.37a. HAI & AMU prevalence by participating hospital, with public hospitals presented in their Hospital Group (continued overleaf).

HSE Hospital Group	Hospital name	Hospital type	Number of eligible patients	HAI prevalence				Antimicrobial use prevalence	
				All HAI		*Current hospital**			
				N	%	*N*	*%*	N	%
Children's Hospital group	Children's University Hospital, Temple Street	Specialist	78	5	6.4	*3*	*3.8*	42	53.8
	Our Lady's Childrens Hospital, Crumlin	Specialist	172	8	4.7	*7*	*4.1*	82	47.7
	Tallaght Children's Hospital	Specialist	28	0	0.0	*0*	*0.0*	8	28.6
Dublin Midlands	St James's Hospital	Tertiary	607	70	11.5	*66*	*10.9*	258	42.5
	Tallaght Hospital	Tertiary	418	32	7.7	*27*	*6.5*	172	41.1
	Midland Regional Hospital, Tullamore	Secondary	189	7	3.7	*5*	*2.6*	91	48.1
	Naas General Hospital	Secondary	184	12	6.5	*11*	*6.0*	83	45.1
	Midland Regional Hospital, Portlaoise	Primary	116	1	0.9	*1*	*0.9*	43	37.1
	Coombe Women and Infant's University Hospital	Specialist	178	8	4.5	*7*	*3.9*	32	18.0
Ireland East	Mater Misericordiae University Hospital	Tertiary	570	75	13.2	*64*	*11.2*	255	44.7
	St Vincent's University Hospital	Tertiary	455	27	5.9	*25*	*5.5*	204	44.8
	Midland Regional Hospital, Mullingar	Secondary	174	3	1.7	*2*	*1.1*	57	32.8
	St Luke's General Hospital, Kilkenny	Secondary	205	3	1.5	*3*	*1.5*	83	40.5
	Wexford General Hospital	Secondary	180	15	8.3	*14*	*7.8*	63	35.0
	Our Lady's Hospital, Navan	Primary	76	8	10.5	*8*	*10.5*	32	42.1
	St Columcille's Hospital, Loughlinstown	Primary	96	8	8.3	*8*	*8.3*	28	29.2
	St Michael's Hospital, Dun Laoghaire	Primary	72	1	1.4	*1*	*1.4*	28	38.9
	National Maternity Hospital, Holles Street	Specialist	198	5	2.5	*5*	*2.5*	41	20.7
	Cappagh National Orthopaedic Hospital	Specialist	78	5	6.4	*3*	*3.8*	14	17.9
	Royal Victoria Eye and Eye Hospital	Specialist	15	0	0.0	*0*	*0.0*	8	53.3
RCSI group	Beaumont Hospital	Tertiary	634	56	8.8	*54*	*8.5*	278	43.8
	Cavan & Monaghan Hospital	Secondary	233	13	5.6	*13*	*5.6*	100	42.9
	Connolly Hospital, Blanchardstown	Secondary	255	9	3.5	*7*	*2.7*	100	39.2
	Our Lady of Lourdes Hospital, Drogheda	Secondary	337	16	4.7	*14*	*4.2*	98	29.1
	Louth County Hospital	Primary	55	8	14.5	*5*	*9.1*	9	16.4
	Rotunda Hospital	Specialist	145	2	1.4	*1*	*0.7*	26	17.9
	St Luke's Hospital, Rathgar	Specialist	42	2	4.8	*1*	*2.4*	12	28.6

Table 4.37a continued. HAI & AMU prevalence by participating HSE hospital presented in their Hospital Group

HSE Hospital Group	Hospital name	Hospital type	Number of eligible patients	HAI prevalence				Antimicrobial use prevalence	
				All HAI		*Current hospital**			
				N	%	*N*	*%*	N	%
Saolta group	Galway University Hospital	Tertiary	586	40	6.8	*36*	*6.1*	216	36.9
	Letterkenny University Hospital	Secondary	279	14	5.0	*11*	*3.9*	119	42.7
	Mayo University Hospital, Castlebar	Secondary	249	9	3.6	*8*	*3.2*	101	40.6
	Portiuncula University Hospital, Ballinasloe	Secondary	133	8	6.0	*8*	*6.0*	58	43.6
	Sligo University Hospital	Secondary	284	8	2.8	*7*	*2.5*	97	34.2
	Roscommon County Hospital	Primary	52	8	15.4	*8*	*15.4*	23	44.2
South/ South-West group	Cork University Hospital	Tertiary	†	†	†	†	†	†	†
	University Hospital Waterford	Tertiary	†	†	†	†	†	†	†
	Mercy University Hospital	Secondary	210	12	5.7	*12*	*5.7*	95	45.2
	South Infirmary/Victoria University Hospital	Secondary	70	6	8.6	*3*	*4.3*	25	35.7
	South Tipperary General Hospital, Clonmel	secondary	169	3	1.8	*3*	*1.8*	79	46.7
	University Hospital Tralee, Tralee	Secondary	247	8	3.2	*7*	*2.8*	79	32.0
	Bantry General Hospital	Primary	63	5	7.9	*5*	*7.9*	20	31.7
	Mallow General Hospital	Primary	†	†	†	†	†	†	†
	Kilcreene Regional Orthopaedic Hospital, Kilkenny	Specialist	12	0	0.0	*0*	*0.0*	7	58.3
UL group	University Hospital Limerick	Tertiary	430	22	5.1	*22*	*5.1*	205	47.7
	St John's Hospital Limerick	Primary	67	2	3.0	*2*	*3.0*	38	56.7
	University Hospital Ennis	Primary	54	1	1.9	*1*	*1.9*	30	55.6
	University Hospital Nenagh	Primary	42	3	7.1	*3*	*7.1*	16	38.1
	Croom Orthopaedic Hospital	Specialist	27	2	7.4	*2*	*7.4*	13	48.1
	University Maternity Hospital, Limerick	Specialist	136	1	0.7	*1*	*0.7*	16	11.8
Other	National Rehabilitation Hospital, Dun Laoghaire	Specialist	89	4	4.5	*3*	*3.4*	8	9.0
TOTAL FOR ALL HSE HOSPITALS			**8,989**	**555**	**6.2**	***497***	***5.5***	**3,492**	**38.8**
TOTAL FOR ALL PARTICPATING HOSPITALS			**10,333**	**633**	**6.1**	***564***	***5.5***	**4,105**	**39.7**

Table 4.37b. HAI & AMU prevalence by private hospital

Hospital Group	Hospital name	Hospital type	Number of eligible patients	HAI prevalence				Antimicrobial use prevalence	
				All HAI		*Current hospital**			
				N	%	*N*	*%*	N	%
Private	Aut Even Hospital, Kilkenny	Private	31	0	0.0	*0*	*0.0*	14	45.2
	Beacon Hospital, Sandyford	Private	130	7	5.4	*7*	*5.4*	59	45.4
	Blackrock Clinic	Private	120	7	5.8	*7*	*5.8*	64	53.3
	Bon Secours Hospital, Limerick at Barringtons	Private	10	0	0.0	*0*	*0.0*	9	90.0
	Bon Secours Hospital, Cork	Private	183	6	3.3	*5*	*2.7*	75	41.0
	Bon Secours Hospital, Galway	Private	59	1	1.7	*1*	*1.7*	28	47.5
	Bon Secours Hospital, Glasnevin	Private	80	4	5.0	*4*	*5.0*	38	47.5
	Bon Secours Hospital, Tralee	Private	79	4	5.1	*4*	*5.1*	34	43.0
	Galway Clinic	Private	109	8	7.3	*7*	*6.4*	42	38.5
	Hermitage Medical Clinic	Private	95	3	3.2	*3*	*3.2*	39	41.1
	Mater Private Hospital, Cork	Private	57	2	3.5	*2*	*3.5*	24	42.1
	Mater Private Hospital, Dublin	Private	180	24	13.3	*16*	*8.9*	81	45.0
	Sports Surgery Clinic, Santry	Private	31	0	0.0	*0*	*0.0*	17	54.8
	St Vincents Private Hospital	Private	180	12	6.7	*11*	*6.1*	89	49.4
TOTAL FOR ALL PRIVATE HOSPITALS			**1,344**	**78**	**5.8**	***67***	***5.0***	**613**	**45.6**
TOTAL FOR ALL PARTICPATING HOSPITALS			**10,333**	**633**	**6.1**	***564***	***5.5***	**4,105**	**39.7**

*HAI which were acquired in the current hospital (based on the origin of the first HAI reported per patient); †Did not participate

Table 4.38. Comparison of HAI & AMU prevalence for 49 hospitals participating in both 2017 & 2012 PPS (continued overleaf)

HSE Hospital Group	Hospital name	Hospital type	2017			2012		
			Number of eligible patients	HAI prevalence %	AMU prevalence %	Number of eligible patients	HAI prevalence %	AMU prevalence %
Children's Hospital group	Children's University Hospital, Temple Street	Specialist	78	6.4	53.8	72	5.6	37.5
	Our Lady's Childrens Hospital, Crumlin	Specialist	172	4.7	47.7	151	5.3	46.4
	Tallaght Children's Hospital	Specialist	28	0.0	28.6	*	*	*
Dublin Midlands	St James's Hospital	Tertiary	607	11.5	42.5	727	6.3	30.0
	Tallaght Hospital	Tertiary	418	7.7	41.1	496	6.0	38.7
	Midland Regional Hospital, Tullamore	Secondary	189	3.7	48.1	152	3.9	48.0
	Naas General Hospital	Secondary	184	6.5	45.1	169	5.9	49.1
	Midland Regional Hospital, Portlaoise	Primary	116	0.9	37.1	108	0.0	36.1
	Coombe Women and Infant's University Hospital	Specialist	178	4.5	18.0	197	4.1	21.8
Ireland East	St Vincent's University Hospital	Tertiary	455	5.9	44.8	354	7.3	36.4
	Midland Regional Hospital, Mullingar	Secondary	174	1.7	32.8	186	3.2	39.2
	St Luke's General Hospital, Kilkenny	Secondary	205	1.5	40.5	148	2.0	33.1
	Wexford General Hospital	Secondary	180	8.3	35.0	156	3.8	34.6
	Our Lady's Hospital, Navan	Primary	76	10.5	42.1	105	1.9	30.5
	St Columcille's Hospital, Loughlinstown	Primary	96	8.3	29.2	104	5.8	36.5
	St Michael's Hospital, Dun Laoghaire	Primary	72	1.4	38.9	67	4.5	38.8
	Cappagh National Orthopaedic Hospital	Specialist	78	6.4	17.9	26	7.7	34.6
	National Maternity Hospital, Holles Street	Specialist	198	2.5	20.7	171	2.3	18.1
	Royal Victoria Eye and Eye Hospital	Specialist	15	0.0	53.3	20	5.0	35.0
RCSI group	Beaumont Hospital	Tertiary	634	8.8	43.8	558	10.9	37.3
	Cavan & Monaghan Hospital	Secondary	233	5.6	42.9	206	3.4	36.9
	Connolly Hospital, Blanchardstown	Secondary	255	3.5	39.2	189	3.2	36.5
	Our Lady of Lourdes Hospital, Drogheda	Secondary	337	4.7	29.1	340	4.1	37.1
	Louth County Hospital	Primary	55	14.5	16.4	33	3.0	6.1
	Rotunda Hospital	Specialist	145	1.4	17.9	196	4.6	18.9
	St Luke's Hospital, Rathgar	Specialist	42	4.8	28.6	66	12.1	21.2

Table 4.38. Comparison of HAI & AMU prevalence for 49 hospitals participating in both 2017 & 2012 PPS

HSE Hospital Group/ Affiliation	Hospital name	Hospital type	Number of eligible patients	HAI prevalence		Antimicrobial use		Number of eligible patients	HAI prevalence		Antimicrobial use	
				N	%	N	%		N	%	N	%
Saolta group	Galway University Hospital	Tertiary	586	40	6.8	216	36.9	600	41	6.8	249	41.5
	Letterkenny University Hospital	Secondary	279	14	5.0	119	42.7	293	7	2.4	105	35.8
	Mayo University Hospital, Castlebar	Secondary	249	9	3.6	101	40.6	†	†	†	†	†
	Portiuncula University Hospital, Ballinasloe	Secondary	133	8	6.0	58	43.6	136	3	2.2	52	38.2
	Sligo University Hospital	Secondary	284	8	2.8	97	34.2	191	9	4.7	64	33.5
	Roscommon County Hospital	Primary	52	8	15.4	23	44.2	48	11	22.9	20	41.7
South/ South-West group	Cork University Hospital	Tertiary	†	†	†	†	†	†	†	†	†	†
	University Hospital Waterford	Tertiary	†	†	†	†	†	347	23	6.6	101	29.1
	Mercy University Hospital	Secondary	210	12	5.7	95	45.2	158	8	5.1	58	36.7
	South Infirmary/Victoria University Hospital	Secondary	70	6	8.6	25	35.7	91	5	5.5	34	37.4
	South Tipperary General Hospital, Clonmel	Secondary	169	3	1.8	79	46.7	139	14	10.1	65	46.8
	University Hospital Tralee, Tralee	Secondary	247	8	3.2	79	32.0	221	9	4.1	58	26.2
	Bantry General Hospital	Primary	63	5	7.9	20	31.7	†	†	†	†	†
	Mallow General Hospital	Primary	†	†	†	†	†	†	†	†	†	†
	Kilcreene Regional Orthopaedic Hospital, Kilkenny	Specialist	12	0	0.0	7	58.3	14	0	0.0	10	71.4
UL group	University Hospital Limerick	Tertiary	430	22	5.1	205	47.7	345	27	7.8	157	45.5
	St John's Hospital Limerick	Primary	67	2	3.0	38	56.7	37	1	2.7	21	56.8
	University Hospital Ennis	Primary	54	1	1.9	30	55.6	51	3	5.9	24	47.1
	University Hospital Nenagh	Primary	42	3	7.1	16	38.1	49	2	4.1	17	34.7
	Croom Orthopaedic Hospital	Specialist	27	2	7.4	13	48.1	32	1	3.1	2	6.3
	University Maternity Hospital, Limerick	Specialist	136	1	0.7	16	11.8	149	2	1.3	15	10.1
Private	Aut Even Hospital, Kilkenny	Private	31	0	0.0	14	45.2	†	†	†	†	†
	Beacon Hospital, Sandyford	Private	130	7	5.4	59	45.4	129	2	1.6	75	58.1
	Blackrock Clinic	Private	120	7	5.8	64	53.3	†	†	†	†	†
	Bon Secours Hospital, Limerick at Barringtons	Private	10	0	0.0	9	90.0	†	†	†	†	†
	Bon Secours Hospital, Cork	Private	183	6	3.3	75	41.0	199	6	3.0	48	24.1
	Bon Secours Hospital, Galway	Private	59	1	1.7	28	47.5	48	1	2.1	20	41.7
	Bon Secours Hospital, Glasnevin	Private	80	4	5.0	38	47.5	101	2	2.0	37	36.6
	Bon Secours Hospital, Tralee	Private	79	4	5.1	34	43.0	89	1	1.1	35	39.3

* Tallaght Children's Hospital data reported within Tallaght Hospital data in PPS 2012

5.0 Prevalence of HAI and AMU: Ireland and Neighbouring Countries

England (May 2016), Scotland (Autumn 2016), Wales (June 2017) and Northern Ireland (May 2017) also participated in the latest European PPS. At the time of finalising this report, Scotland and Wales had published national PPS reports and ECDC had published headline PPS results of participating European Countries in November 2018.[4,5,21,22] Table 5.1 summarises the HAI prevalence and top five HAI and Table 5.2 summarises the AMU prevalence and proportion of antimicrobials prescribed via the parenteral (i.e., intravenous) route and proportion with a documented indication for Ireland, Scotland and Wales.

- Compared with the previous PPS, Scotland reported a reduction in overall HAI prevalence, with increases observed in both Ireland and Wales
- In the latest PPS, the HAI prevalence in Ireland (6.1%) was higher than that reported by both Wales (5.5%) and Scotland (4.5%)
- The top three HAI reported in each country were similar, with differences in the rank order of each HAI type:
    - PN was the commonest HAI in Ireland and Wales and second commonest in Scotland
    - SSI was the second commonest HAI reported in Ireland, ranking third in Scotland and Wales
    - UTI was the commonest HAI in Scotland, ranking second in Wales and third in Ireland
- Compared with the previous PPS, all three countries reported an increased overall AMU prevalence
- In the latest PPS, the AMU prevalence in Ireland (39.7%) was higher than that reported by both Scotland (35.3%) and Wales (34.2%)
- The percentage of all antimicrobials administered via the parenteral route was 63% in Ireland, 53% in Wales and 51% in Scotland
- The percentage of all antimicrobial prescriptions with a documented indication was 90% in Ireland, 91% in Scotland and 98% in Wales
- The percentage of SAP exceeding single dose was highest in Ireland (69.4%), followed by Wales (50%) and lowest in Scotland (35.1%)

Table 5.1. HAI prevalence and top five HAI: Ireland, Scotland & Wales

	IRELAND	SCOTLAND*	WALES**
Eligible patients	10,333	11,547	6,400
Patients with active HAI	633	517	352
HAI prevalence % (95% CI)	6.1	4.5	5.5
	(5.7-6.6)	(4.0-5.0)	(5.0-6.1)
Number of HAI	678	547	364
Top 5 HAIs - number (%)			
1	PN	UTI	PN
	196 (28.9)	129 (23.5)	70 (19.2)
2	SSI	PN	UTI
	122 (18)	119 (21.7)	58 (15.9)
3	UTI	SSI	SSI
	98 (14.5)	89 (16.2)	41 (11.3)
4	BSI	BSI	GI
	67 (9.9)	50 (9.1)	40 (11.0)
5	SYS	SST	BSI
	42 (6.2)	39 (7.1)	36 (9.9)

Table 5.2. AMU prevalence and indicators of quality prescribing: Ireland, Scotland & Wales

	IRELAND	SCOTLAND*	WALES**
Number of eligible patients	10,333	11,605	6,400
Patients receiving systemic antimicrobials	4,105	4,094	2,186
AMU prevalence % (95% CI)	39.7 (38.8-40.7)	35.3 (33.8-36.7)	34.2 (33.0-35.3)
Number of systemic antimicrobials	5,813	6,213	2,969
Number via parenteral route (%)	3,660 (63.0)	3,158 (51.4)	1,581 (53.3)
Number with documented indication (%)	5,228 (89.9)	5,485 (91.0)	2,911 (98.0)
% SAP >1 dose	69.4	35.1	50.0

*Scottish PPS reported route and documented indication by adult and paediatric prescriptions separately

**Welsh PPS reported route and documented indication by prescriber's indication separately

Table 5.3 presents headline data for Ireland and all neighbouring UK countries from two recent papers published by ECDC in Eurosurveillance in November 2018 (note: some minor differences with national reports, including 95% CIs).[4,5] The HAI prevalence was highest in England (6.4%), similar in Ireland and Northern Ireland (6.1%) and lowest in Scotland (4.3%). The AMU prevalence was highest in Ireland (39.7%), followed by Northern Ireland (37.4%) and lowest in Wales (34.2%).

Table 5.3. Headline HAI & AMU prevalence data: Ireland & UK PPS 2016-17

	IRELAND	ENGLAND	NORTHERN IRELAND	SCOTLAND	WALES
Number of eligible patients	10,333	20,148	3,813	11,623	6,400
Patients with active HAI	633	1,297	234	504	363
HAI prevalence % (95% CI)	6.1 (5.0-7.5)	6.4 (5.4-7.6)	6.1 (4.8-7.9)	4.3 (3.5-5.3)	5.7 (4.7-6.7)
Patients receiving systemic antimicrobials	4,104	7,533	1,385	4,093	2,186
AMU prevalence % (95% CI)	39.7 (37.4-42.0)	37.4 (35.3-39.5)	36.3 (32.3-40.3)	35.2 (33.3-37.1)	34.2 (32.0-36.4)

6.0 PPS Ireland 2017 versus 2012: Key Findings

Table 6.1 displays key demographics and risk factors of the population included in PPS 2012 and 2017 in Ireland.

Table 6.1. Demographics and risk factors of PPS population in 2017 and 2012

	2017	2012
Total number of surveyed patients	10,333	9,030
Number (%) of patients aged <16 years	1,011 (10)	1,092 (12)
Median age (years) [IQR]	67 [43-79]	63 [36-77]
Number (%) of patients aged ≥65	5,561 (54)	4,330 (48)
Number (%) of patients who have had surgery since admission to hospital	1,857 (18)	1,591 (18)
Number (%) of patients with peripheral line (PVC) *in situ* at the time of survey	5,032 (49)	3,679 (41)
Number (%) of patients with a central line (CVC) *in situ* at the time of survey	794 (8)	544 (6)
Number (%) of patients with a urinary catheter *in situ* at the time of survey	1,376 (13)	1,119 (12)
Number (%) of patients intubated at the time of survey	176 (2)	127 (1)

There were 49 acute hospitals that participated in both PPS 2012 and 2017 (accounting for 94% and 81% of all reported HAI per PPS, respectively). There was no major difference observed in the rank order of HAI for those hospitals, other than a 192% increase in the top-ranking category of 'pneumonia and lower respiratory tract infections'. A welcome reduction in the proportion of UTI deemed catheter-associated from 44.9% to 37.8% and in the proportion of BSI deemed device-related from 60% to 25.9% was observed.

The prescribed antimicrobials were similar between both PPS, with a drop in rank of ciprofloxacin from 3rd to 5th position, equating to a 21% reduction. While meropenem retained its ranking of 10th in both PPS, an 8% increase in meropenem prescriptions between the two PPS was observed.

7.0 Discussion

There was excellent participation across Ireland in this voluntary survey, with 60 acute public and private hospitals contributing anonymised data on 10,333 patients. The number of participating hospitals increased from 50 on 2012, with 49 hospitals having participated in both national surveys to date. Ireland's PPS data was submitted to ECDC for inclusion in the European PPS report, which is expected to be published in early 2019, with some headline figures already published in November 2018.[4,5]

All participating hospitals in May 2017 reported having an infection prevention and control nurse (IPCN), which represents continued progress from 2012, when one hospital reported having no IPCN and a 2003 survey of IPCN resources in Ireland when ten hospitals (15%) had no IPCN.[3,23] Seventeen hospitals (28%) reported having no nominated infection prevention and control doctor (IPCD), a reduction on 34% in 2012.[3]

For the first time, information regarding antimicrobial pharmacist (AMP) resource was requested in PPS 2017, with 17 hospitals reported having no designated AMP (28%). It is notable that the AMP resource per 100 inpatient beds was higher in public (0.26) than in private (0.14) hospitals. In 2015, HIQA conducted a review of antimicrobial stewardship resources in acute public hospitals in Ireland, recommending investment and resource sharing for development of antimicrobial stewardship resources particularly in general (primary) hospitals.[24] At the time of this PPS (May 2017), primary hospitals remained underserved with regard to AMP resources (0.14) when compared with secondary (0.34) and tertiary (0.22) hospitals. Private hospitals were not included in the HIQA review.

Information on clinical microbiologist, infectious diseases physician and surveillance scientist staffing was not collected as part of the PPS. These questions should be included in future surveys.

While the overall proportion of single patient rooms increased between surveys from 22% (2012) to 28% (2017), the average proportion was lowest in public primary hospitals (15%), unchanged from 2012, and highest in private hospitals (52%), a further increase from 37% (2012). National infection prevention and control building guidelines for existing and new acute hospitals in Ireland were published in 2009 and recommended that newly-built inpatient accommodation should comprise 100% single-patient rooms. The guidelines also recommended acute hospitals develop plans to minimise multiple-patient rooms and maximise single-patient rooms.[25]

A reduction in mean acute beds was observed from 217 (2012) to 196 (2017), along with a one-day reduction in the average LOS for the latest complete year of data (2016): 4.5 to 3.5 days. Despite a shorter LOS, the proportion of HAI that were evident on admission to hospital remained stable between PPS (24% versus 23%) and a slight increase in the proportion of HAI attributable to the reporting hospital was observed 86% to 89%. HAI detected in a hospital may not always be attributable to or preventable by that hospital. It is for that reason that the overall HAI prevalence and the HAI prevalence attributable to each participating hospital have been reported in Section 4.6, Tables 4.37a and b.

The findings of the 2017 PPS demonstrate the continued high prevalence of some HAI risk factors. Patients with HAI tended to be older, have more severe underlying disease prognosis, to have had surgery during the current admission and invasive medical devices *in situ* (e.g., vascular catheters, urethral catheters, intubation of the respiratory tract) and for neonates with HAI, to be of low birth weight. The prevalence of HAI increased with LOS and was higher in certain clinical areas, such as adult intensive care units (24%) and surgical wards (9.1%). Within ICUs, 56% of HAI were deemed unit-acquired infections and this information was not sought in the 2012 PPS. The finding that 43% of HAI in adult ICUs in May 2017 were not attributable to the unit warrants further study. This suggests that developing a HAI may result in some patients requiring transfer to ICU for further management.

The HAI prevalence was highest in tertiary hospitals (8.7%) in comparison with other hospital types. Because the individual participating hospitals may have a very different patient case mix and may offer different levels of acuity of care, inter-hospital comparisons are not recommended when interpreting HAI prevalence.

Pneumonia (PN) increased in ranking from second to commonest HAI type, with 196 cases reported, also doubling in prevalence since 2012, to affect 1.9% of inpatients in May 2017. A protocol alteration between surveys may have contributed to the increased detection of patients meeting the PN case definition, softening the requirement for two consecutive chest radiological images to support the radiological diagnosis of pneumonia.[1] While intubation is well-recognised as a PN risk factor and 16% of patients with PN were intubated, the vast majority of patients with PN were admitted to wards other than ICU (166; 85%). For the first time in PPS 2017, hospitals were asked to provide information on the availability of local multi-modal strategies for prevention of HAI, such as PN for the hospital overall and the ICU in particular. With regard to prevention of PN, the availability of guidelines, use of PN prevention care bundles, staff education about PN and use of surveillance, audit and feedback was much higher within ICU than the hospital overall, despite most PN being diagnosed and managed outside of the ICU setting. National guidelines on prevention of ventilator-associated pneumonia were published in 2011 and should be updated to encompass prevention of hospital-acquired pneumonia both in and outside of the ICU setting.[26] As the commonest HAI type, PN also presents major challenges for antimicrobial stewardship, as shown in this PPS. The vast majority of patients with PN did not have a microbiological diagnosis (84%), precluding implementation of stewardship strategies, such as de-escalation from broad to narrower spectrum agents with microbiology results or IV to oral switch to complete treatment. Indeed, in this PPS, pneumonia was the commonest body site for which antimicrobials were prescribed to treat hospital infection, accounting for 30% of prescriptions.

Both surveys in Ireland were performed during the month of May, after the influenza season. Indeed for the European PPS, participating countries had the option of performing their national survey during one of four waves in either 2016 or 2017 (April – June or September – November).[1] As the PPS waves fell outside of the usual Northern Hemisphere influenza season and influenza infection is not listed within the HAI case definitions, the burden of influenza as a HAI cannot be captured within the existing PPS design. It is recommended that for future surveys, the option of a data collection period during the influenza season should be considered, along with the addition of an influenza case definition to the PPS protocol.

Surgical site infections (SSI) were the second commonest HAI encountered in this survey, affecting 1.2% of inpatients, having dropped in rank from first place in 2012. It is likely that the PPS has underestimated the true burden of SSI in Ireland, in particular the category of superficial incisional SSI. In the era of increasing day surgery and shorter LOS post-operatively, it is likely that many superficial incisional SSIs are diagnosed and managed following patient discharge from hospital, either by the patient's general practitioner or via the hospital's outpatient department. SSI was the second commonest body site for which antimicrobials were prescribed to treat hospital infection, accounting for 13% of prescriptions.

Prevention of SSI is multi-factorial and encompasses pre-, intra- and post-operative interventions, description of which is beyond the scope of this report. One evidence-based measure to prevent SSI, applicable to certain categories of surgery, is the administration of a single dose of surgical antimicrobial prophylaxis (SAP), within one hour prior to skin incision.[10,27,28,29] Intra-operative redosing of certain antimicrobials as SAP may be indicated in the event of significant intra-operative blood loss (over 1.5 litres in an adult) or when a procedure exceeds four hours duration.[27,29] For the majority of surgical procedures, continuation of SAP post-operatively is not supported by evidence and is not recommended.[10] Extended SAP may increase the patient's risk of subsequent *C. difficile* infection, adverse drug reactions or select for colonisation with multi-drug resistant organisms, so in the event that a SSI develops, it may be due to a pathogen which is more resistant and thus more difficult and costly to treat.[30] Additionally, as prophylaxis is usually given via the intravenous route,

extended durations may contribute to the risk of vascular catheter infections and waste valuable nursing time.

In this PPS, SAP accounted for 9.5% of all antimicrobial prescriptions and the majority of SAP exceeded single dose (69.4%), representing a small reduction from that observed in 2012 (73%).[3] A greater reduction in SAP exceeding 24 hours duration was observed between surveys (47% to 36%). However, given the minimal progress since 2012, coupled with rapidly increasing incidence of antimicrobial resistance, especially in *Enterobacterales*, there remains an urgent need to engage with surgeons to optimise SAP duration and the associated unintended consequences of prolonged use. It is noteworthy that in Scotland's PPS, just 35% of SAP prescriptions exceeded single dose, almost half that observed in Ireland and the underlying reasons for such a large difference warrant further investigation.[21]

Bloodstream infections (BSI) ranked fourth most common HAI in Ireland during the PPS, which is unchanged in ranking from 2012.[3] Although a reduction in the proportion of primary BSI due to CVCs was observed between surveys, a slight increase in those due to infected PVCs was observed. Compared with Scotland (51.4%) and Wales (53.3%), a much higher proportion of antimicrobials were administered via the intravenous (IV) route in Ireland (63%).[21,22] The implementation of IV to oral antimicrobial switch strategy can expedite removal of vascular catheters. BSI associated with vascular catheter infections are potentially preventable through avoiding unnecessary use, inserting and maintaining catheters with care and removing catheters when they are no longer required. These interventions form part of intravascular catheter care bundles, which have already been successfully implemented in many Irish hospitals and are recommended in national guidelines.[9]

As seen in PPS 2012, *Enterobacteriaceae* were the most common pathogens isolated from HAI in 2017. Of those, 15% were resistant to third-generation cephalosporins (C3G), a marker for the production of extended-spectrum β-lactamases (ESBLs) and while this is lower than that observed in 2012, it must be noted that for 25% of isolates, susceptibility was reported as unknown and that this represented an increase on 15% for which results were unknown in 2012. Increasing C3G resistance in *Enterobacteriaceae,* such as *E. coli* and *K. pneumoniae* causing BSI in Ireland and reported via the European Antimicrobial Resistance Surveillance Network (EARS-Net) has been observed in recent years. Latest available EARS-Net data for Ireland are available on the HPSC website: https://www.hpsc.ie/a-z/microbiologyantimicrobialresistance/europeanantimicrobialresistancesurveillancesystemearss/ears-netdataandreports/

Such resistance is a cause for concern as HAIs caused by these bacteria are difficult and more expensive to treat, drive increasing reliance on carbapenems as a treatment option and are associated with increased patient morbidity and mortality. Indeed, the emergence of carbapenem-resistant *Enterobacteriaceae* (CRE) also known as carbapenemase-producing *Enterobacteriaceae* or, more recently, *Enterobacterales* (CPE) has been reported worldwide over the past decade, and has emerged in Ireland since 2009, with a rapidly increasing incidence since 2016, prompting the Minister of Health to declare CPE a national public health emergency in October 2017, followed by the introduction of monthly CPE surveillance reports.[31,32,33,34] There are extremely limited treatment options for CPE infections and there will be no new antimicrobials available in the foreseeable future.

In this PPS, 39% of patients were prescribed antimicrobials, an increase from 34% in 2012.[3] The antimicrobial prevalence in Ireland was higher than that reported by each of the UK countries and the EU overall.[5] Antimicrobial use is a well-known risk factor for antimicrobial resistance. The prevalence of antimicrobial use increased with age and was highest in certain ward types (e.g., ICU and surgical wards). The prevalence was highest in private (45.4%) and tertiary (42.9%) hospitals. Although this may partly be explained by a higher proportion of patients on surgical wards in private hospitals (37%) than in public hospitals (20%), it is important that all hospitals ensure that the recommendations on the prudent use of antimicrobials and good prescribing practices from the

HIQA National Standards for the Prevention and Control of Healthcare-Associated Infections and the Guidelines for Antimicrobial Stewardship are being implemented locally.[12,14] The association between higher antimicrobial use prevalence and a much lower antimicrobial pharmacist resource in private hospitals than that observed in public hospitals warrants further exploration and prioritisation of antimicrobial pharmacist roles in private hospitals is recommended.

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9.0 Appendices

Appendix A: PPS 2017 Steering Group Membership

MEMBER	REPRESENTING
Dr Karen Burns (Chair)	HPSC
Ms Helen Murphy	HPSC
Ms Sarah Hennessy	HPSC (until April 2017)
Mr Stephen Murchan	HPSC
Mr Myles Houlden	HPSC
Ms Margaret Nadin	NMPDU
Dr Rob Cunney	HSE HCAI & AMR Clinical Programme
Ms Roisin Breen	HSE HCAI & AMR Clinical Programme
Ms Mary McKenna	HSE HCAI & AMR Clinical Programme
Professor Hilary Humphreys	Faculty of Pathology RCPI
Dr Fidelma Fitzpatrick	RCSI
Dr Rachel Grainger	Clinical Microbiology SpR
Ms Sheila Donlon	ADON IPC Beaumont Hospital
Ms Mary Regan	Antimicrobial Pharmacist, Sligo University Hospital & IAPG
Ms Annette Cuddy	ADONM (Prescribing) ONMSD
Ms Clare MacGabhann	DONM (Prescribing) ONMSD
Ms Sarah O'Sullivan	Quality & Patient Safety Lead, Bon Secours Hospital, Limerick Private Hospitals Association
Ms Elaine Doherty	CNS IPC, Hermitage Clinic, Dublin

Appendix B: List of Acronyms

AMP	Antimicrobial Pharmacist
AMR	Antimicrobial Resistance
AMRO	Antimicrobial Resistant Organisms
AMU	Antimicrobial Use
BMT	Bone Marrow Transplant
BSI	Bloodstream Infection
CAG	Clinical Advisory Group
CDC	US Centers for Disease Control and Prevention
CDI	*Clostridium difficile* infection
CI	Community infection
CPE	Carbapenemase Producing *Enterobacteriaceae* (*Enterobacterales*)
CRE	Carbapenem Resistant *Enterobacteriaceae* (*Enterobacterales*)
CRI	Catheter Related Infection
CVC	Central Vascular Catheter
C3G	3rd Generation Cephalosporin
EARS-Net	European Antimicrobial Resistance Surveillance Network
ECDC	European Centre for Disease Prevention and Control
ED	Emergency Department
EEA	European Economic Area
EENT	Eye, Ear, Nose, Throat or Mouth Infection
ESAC	European Surveillance of Antimicrobial Consumption
ESBL	Extended Spectrum β Lactamase
ESCMID-ESGCD	European Society for Clinical Microbiology and Infectious Diseases Study Group on *C. difficile*
EU	European Union
FAQ	Frequently-asked Questions
GI	Gastrointestinal
HAI	Hospital Acquired Infections
HCAI	Healthcare Associated Infections
HDU	High Dependency Unit
HI	Hospital Infection
HIQA	Health Information & Quality Authority
HPSC	Health Protection Surveillance Centre
HSE	Health Service Executive
IAPG	Irish Antimicrobial Pharmacists Group
ICU	Intensive Care Unit
ID	Infectious Disease
IPCD	Infection Prevention & Control Doctor

IPCN	Infection Prevention & Control Nurse
IQR	Interquartile Range
IV	Intravenous (Parenteral)
KISS	Krankenhaus-Infektions-Surveillance-System, Germany
LI	Long-term care facility infection
LOS	Length-of-Stay
MDRO	Multi-Drug Resistant Organisms
MRSA	Meticillin/Flucloxacillin Resistant *Staphylococcus aureus*
MSSA	Meticillin/Flucloxacillin Susceptible *Staphylococcus aureus*
NHSN	National Healthcare Safety Network
OR	Odds Ratio
PHA	Public Health Agency
PN	Pneumonia
PO	Oral (Enteral)
PPS	Point Prevalence Survey
PVC	Peripheral Vascular Catheter
RCPI	Royal College of Physicians of Ireland
RCSI	Royal College of Surgeons in Ireland
SAP	Surgical Antimicrobial Prophylaxis
SSI	Surgical Site Infection
SYS-CSEP	Systemic Infection – Clinical Sepsis
UK	United Kingdom
UTI	Urinary Tract Infection
VAP	Ventilator-Associated Pneumonia
VRE	Vancomycin Resistant Enterococci
VT	Validation Team
WHO	World Health Organisation
WTE	Whole Time Equivalent

Appendix C: PPS Data Collection Forms
Ward List (Form A1)

2017 SURVEY OF HOSPITAL-ACQUIRED INFECTIONS AND ANTIMICROBIAL USE

Ward List A1

Ward name for internal use [not recorded on WebForm] _____

Please record details below for each Ward.
Completed Ward Lists should be returned to PPS Team for entry to Web System

Hospital & Ward code — Hospital code [ ][ ][ ] Ward code [ ][ ]

Ward specialty [ ]

Survey date [D][D] / [M][M] / [Y][Y]

On this ward, is a review performed on the appropriateness of antimicrobials within 72 hours from the initial order? ☐ Yes ☐ No

[ ][ ] Total number of beds

[ ][ ] Number of beds occupied on the day of PPS

[ ][ ] Number of beds with functioning AHR dispensers at point of care

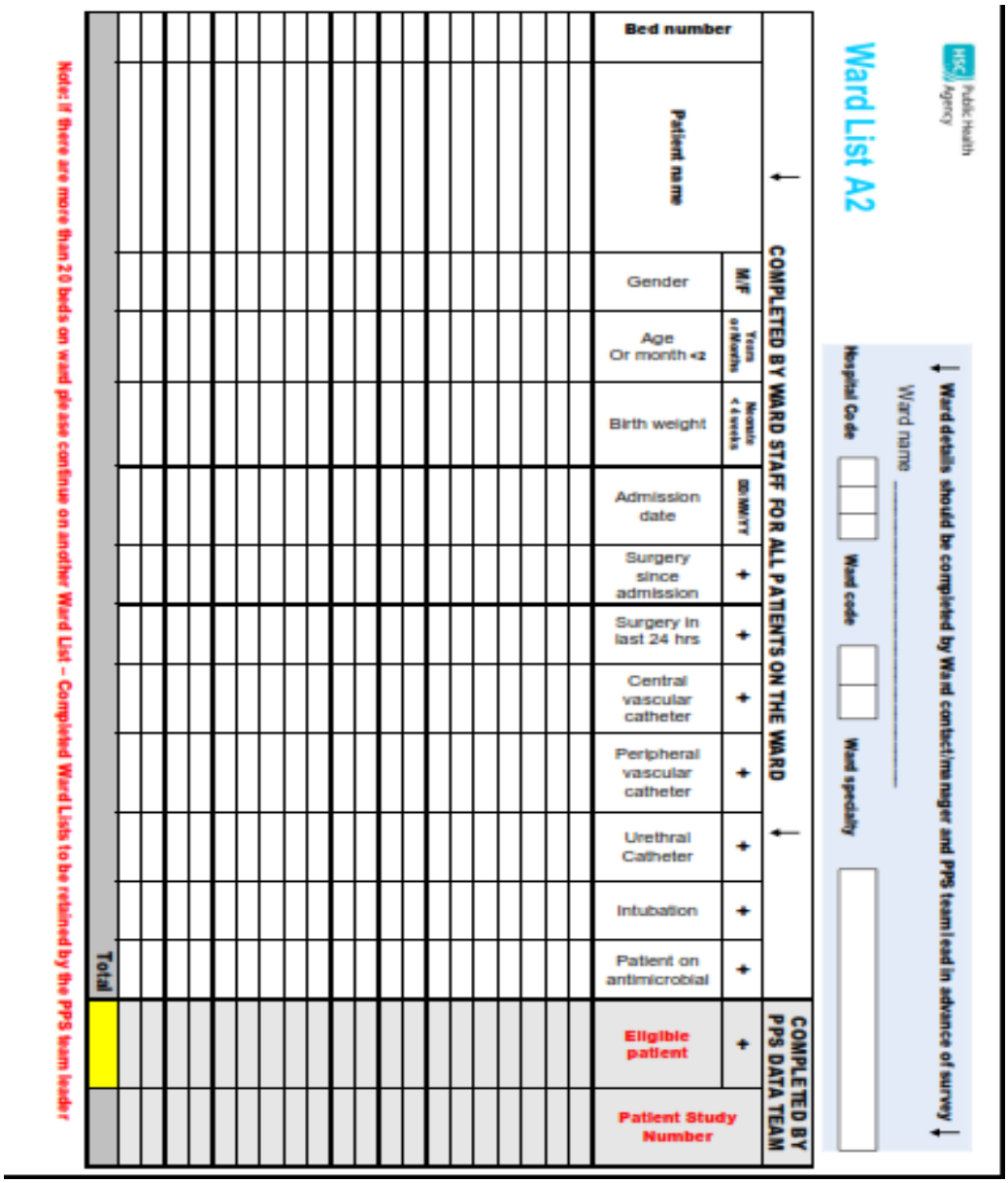
[ ][ ] Number of patient rooms in ward

[ ][ ] Number of single patient rooms

[ ][ ] Number of single patient rooms with *en suite* bathroom, i.e. toilet & shower/bath

[ ][ ] Total number of patients included in PPS

Ward List (Form A2)



HSC Public Health Agency

Ward List A2

← Ward details should be completed by Ward contact/manager and PPS team lead in advance of survey →

Ward name _____

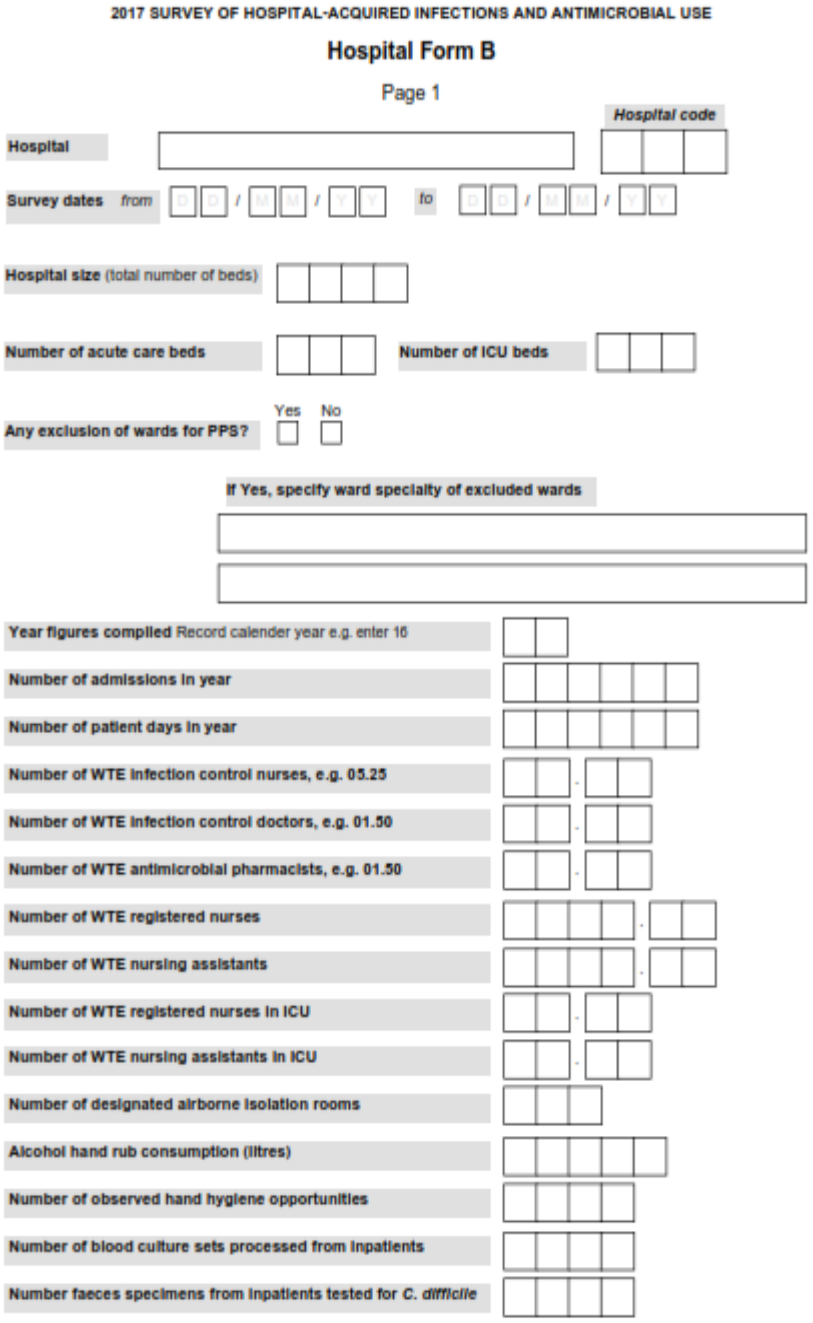
Hospital Code | | | Ward code | | Ward speciality

← COMPLETED BY WARD STAFF FOR ALL PATIENTS ON THE WARD →

Bed number	Patient name	M/F Gender	Years or Months Age Or month <2	Neonate <4 weeks Birth weight	DD/MM/YY Admission date	+ Surgery since admission	+ Surgery in last 24 hrs	+ Central vascular catheter	+ Peripheral vascular catheter	+ Urethral Catheter	+ Intubation	+ Patient on antimicrobial	COMPLETED BY PPS DATA TEAM + Eligible patient	Patient Study Number
Total														

Note: If there are more than 20 beds on ward please continue on another Ward List – Completed Ward Lists to be retained by the PPS team leader

Hospital Form (Form B)



2017 SURVEY OF HOSPITAL-ACQUIRED INFECTIONS AND ANTIMICROBIAL USE

Hospital Form B

Page 1

Hospital code

Hospital

Survey dates from D D / M M / Y Y to D D / M M / Y Y

Hospital size (total number of beds)

Number of acute care beds

Number of ICU beds

Any exclusion of wards for PPS? Yes No

If Yes, specify ward specialty of excluded wards

Year figures compiled Record calender year e.g. enter 16

Number of admissions in year

Number of patient days in year

Number of WTE infection control nurses, e.g. 05.25

Number of WTE infection control doctors, e.g. 01.50

Number of WTE antimicrobial pharmacists, e.g. 01.50

Number of WTE registered nurses

Number of WTE nursing assistants

Number of WTE registered nurses in ICU

Number of WTE nursing assistants in ICU

Number of designated airborne isolation rooms

Alcohol hand rub consumption (litres)

Number of observed hand hygiene opportunities

Number of blood culture sets processed from inpatients

Number faeces specimens from inpatients tested for *C. difficile*

2017 SURVEY OF HOSPITAL-ACQUIRED INFECTIONS AND ANTIMICROBIAL USE

Hospital Form B

Page 2

Infection prevention and control (IPC) programme:

Is there an **annual IPC plan**, approved by the hospital CEO or a senior executive officer? Yes ☐ No ☐

Is there an **annual IPC report**, approved by the hospital CEO or a senior executive officer? Yes ☐ No ☐

Microbiology/diagnostic performance:

At weekends, can clinicians request routine microbiological tests and receive back results?

	Saturday	Sunday
Clinical tests	☐	☐
Screening tests	☐	☐

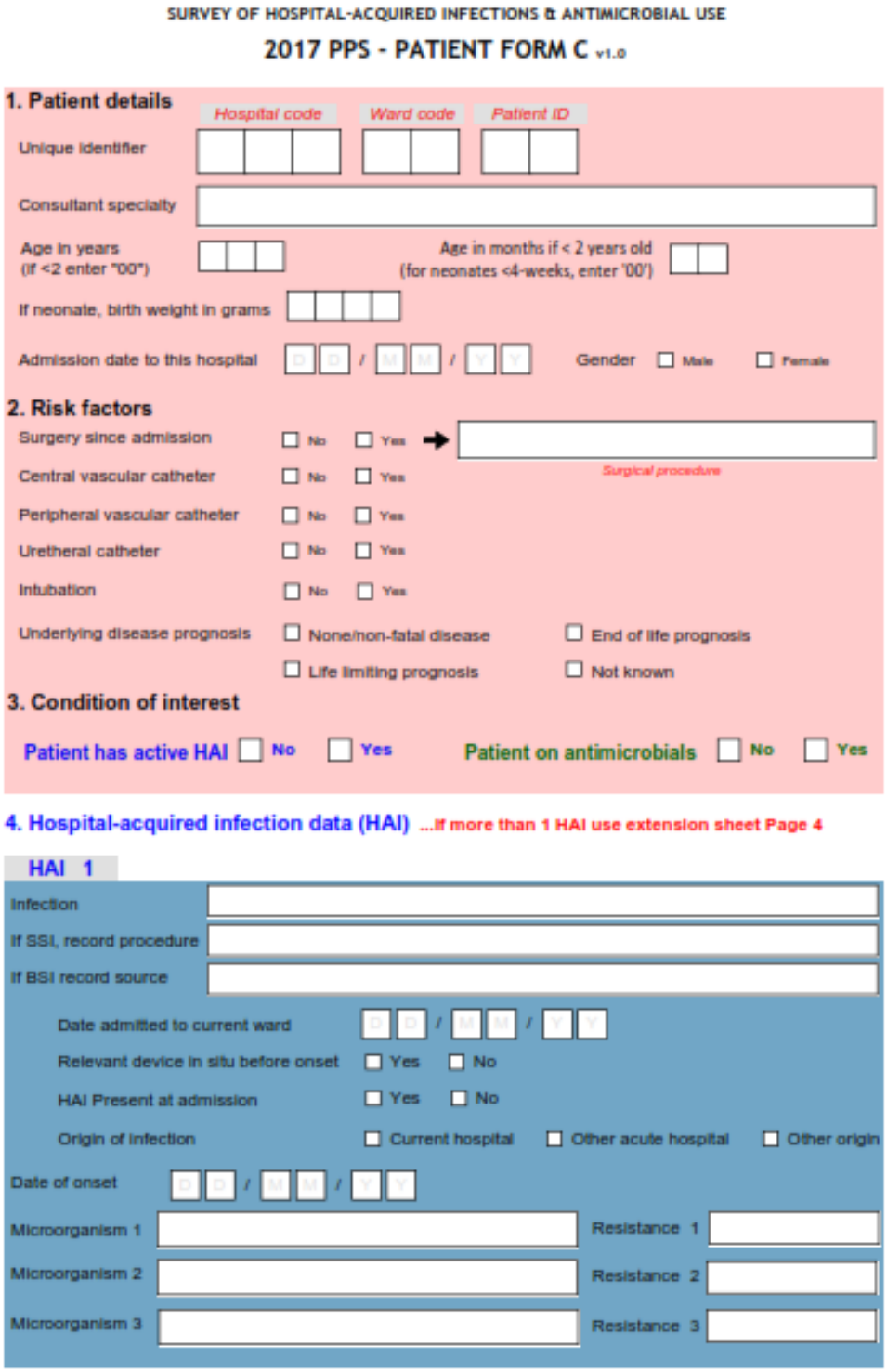
Does your ICU have the following in place for HAI prevention or antimicrobial stewardship?

	Guideline	Care bundle	Training	Checklist	Audit	Surveillance	Feedback
Pneumonia	☐	☐	☐	☐	☐	☐	☐
Blood stream infections	☐	☐	☐	☐	☐	☐	☐
Urinary tract infections	☐	☐	☐	☐	☐	☐	☐
Antimicrobial use	☐	☐	☐	☐	☐	☐	☐

Does your hospital (outside of ICU) have the following for HAI prevention or antimicrobial stewardship?

	Guideline	Care bundle	Training	Checklist	Audit	Surveillance	Feedback
Pneumonia	☐	☐	☐	☐	☐	☐	☐
Blood stream infections	☐	☐	☐	☐	☐	☐	☐
Surgical site infections	☐	☐	☐	☐	☐	☐	☐
Urinary tract infections	☐	☐	☐	☐	☐	☐	☐
Antimicrobial use	☐	☐	☐	☐	☐	☐	☐

Patient Form (Form C) Page 1



SURVEY OF HOSPITAL-ACQUIRED INFECTIONS & ANTIMICROBIAL USE

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	

Patient Form (Form C) Page 2