Point Prevalence Survey of Hospital-Acquired Infections & Antimicrobial Use in European Acute Care Hospitals: May 2012

CRITICAL CARE REPORT: FEBRUARY 2013

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1.0 Executive Summary & Introduction

Executive Summary

- Data was collected on 215 patients aged 16 years and older, admitted to 45 critical care units in 33 Irish hospitals.
- Level 3 critical care units with a medical and surgical casemix accounted for 70% of admissions.
- Critical care patients tended to be older, with a higher prevalence of risk factors for hospital-acquired infections, including a history of surgery and use of invasive medical devices in comparison with the overall population.
- The prevalence of hospital-acquired infections (HAI) was over four times higher in patients admitted to critical care units (23.3%) than the overall patient population (5.2%).
- Pneumonia was the most common HAI in critical care patients and was ten times more prevalent than in the overall patient population.
- Bloodstream infection was the second most common HAI in critical care patients, with an infected vascular catheter identified as the underlying source in just under half of the cases.
- Of the HAI identified in critical care patients, positive microbiology results were available for 60% of infections, with *Enterobacteriaceae, Candida spp.* and enterococci the top three pathogens detected.
- Of the *Enterobacteriaceae* causing HAI in critical care patients, 43% displayed resistance to third-generation cephalosporins and of the enterococci causing HAI in critical care patients, 42.9% displayed resistance to glycopeptides (i.e., VRE).
- The prevalence of antimicrobial use in patients admitted to critical care was over twice that of the overall population (74.4% versus 34.4%).

Introduction

A national point prevalence survey (PPS) was conducted in May 2012 to assess the prevalence of hospital-acquired infections (HAI) and antimicrobial use in Irish hospitals. Fifty acute hospitals participated, with 9,030 eligible patients surveyed. The PPS was coordinated in Ireland by the Health Protection Surveillance Centre (HPSC). The national PPS protocol and report may be accessed at the following link:

http://www.hpsc.ie/hpsc/A-Z/MicrobiologyAntimicrobialResistance/InfectionControlandHAI/Surveillance/HospitalPointPrevalenceSurveys/2012/

This supplementary report provides analysis of data collected from eligible patients aged 16 years and over, who were documented as being admitted to the following ward specialties:

- Medical intensive care unit (ICU): where >80% of patients are typically medical patients
- Surgical ICU: where >80% of patients are typically surgical patients
- Mixed general ICU: typically admits both medical and surgical patients
- Specialised ICU: where >80% of patients typically belong to a single specialty (e.g., cardiothoracic, neurosurgery)
- Other ICU: e.g., high dependency unit (HDU)

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:

- Hospitals in Europe Link for Infection Control through Surveillance (HELICS) HAIICU definitions for bloodstream infection, pneumonia, catheter-related infection and urinary tract infection
- HELICS HAISSI definitions for surgical site infection
- European Society for Clinical Microbiology and Infectious Diseases Study Group on *C. difficile* (ESCMID-ESGCD) definitions for *C. difficile* infection
- US Centers for Disease Control and Prevention (CDC) definitions were used for other infections with no existing European definitions

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

2.0 Participating Hospitals and Critical Care Units

Of the 50 participating hospitals, 33 surveyed patients in 45 critical care units (Table 2.1). Critical care units were classified locally by ICU type, in accordance with the PPS protocol.

Table 2.1: Participating hospitals and ICU types categorised by hospital ownership

Ownership	Hospital Name	ICU Type
HSE Dublin-North East (DNE)	Beaumont Hospital, Dublin	Mixed General ICU Specialised ICU
	Cavan General Hospital, Cavan	Mixed General ICU
	Connolly Hospital, Dublin	Mixed General ICU
	Our Lady of Lourdes Hospital, Drogheda	Mixed General ICU (x2)
	Our Lady's Hospital, Navan	Mixed General ICU
HSE Dublin Mid-Leinster (DML)	Adelaide, Meath & National Children's Hospital, Tallaght	Mixed General ICU Surgical ICU
	Midland Regional Hospital, Mullingar	Mixed General ICU
	Midland Regional Hospital, Portlaoise	Mixed General ICU
	Midland Regional Hospital, Tullamore	Mixed General ICU
	Naas General Hospital, Naas	Mixed General ICU
	St. Columcille's Hospital, Loughlinstown	Mixed General ICU
	St. James's Hospital, Dublin	Mixed General ICU Surgical ICU Other ICU
	St. Michael's Hospital, Dun Laoghaire	Other ICU
	St. Vincent's University Hospital	Mixed General ICU Other ICU
HSE South	Kerry General Hospital	Mixed General ICU
	Mercy University Hospital, Cork	Mixed General ICU
	South Infirmary-Victoria Hospital, Cork	Other ICU
	South Tipperary General Hospital, Clonmel	Mixed General ICU
	St. Luke's General Hospital, Kilkenny	Mixed General ICU
	Waterford Regional Hospital	Mixed General ICU Other ICU
	Wexford General Hospital	Mixed General ICU
HSE West	Galway University Hospitals	Mixed General ICU (x2) Specialised ICU Other ICU
	Letterkenny General Hospital	Mixed General ICU
	Mid-Western Regional Hospital, Dooradoyle	Mixed General ICU Other ICU
	Mid-Western Regional Hospital, Ennis	Other ICU
	Portiuncula Hospital, Ballinasloe	Mixed General ICU
	Sligo General Hospital	Mixed General ICU
Private Hospitals	Bon Secours, Cork	Mixed General ICU Other ICU
	Bon Secours, Glasnevin	Other ICU
	Bon Secours, Tralee	Mixed General ICU
	Galway Clinic, Doughiska	Mixed General ICU
	Mater Private Hospital	Specialised ICU
	UPMC Beacon Hospital, Dublin	Medical ICU

3.0 Results

3.1 Eligible Patients

3.1.1 Patient Location, by ICU Type

Data was collected on 215 eligible patients, aged ≥16 years, who were admitted to 45 critical care units in Ireland. The majority of patients were admitted to mixed general ICUs (70.2%).

Table 3.1: Number of surveyed wards and patients, by ICU type

ICU Type	Number of Units	Number of Patients	Percentage of Patients
Mixed General ICU	29	151	70.2
Specialised ICU	3	17	7.9
Surgical ICU	2	8	3.7
Medical ICU	1	2	0.9
Other ICU (HDU)	10	37	17.2
Total	**45**	**215**	**100**

3.1.2 Patient Demographics – Gender and Age Groups

Of the 215 patients, 118 (54.9%) were male, with a median age of 68 years (inter-quartile range [IQR] 55-76.5 years). Patient age and gender distribution is presented Table 3.2. Over half of the survey population (54.9%; n=118) were aged ≥65 years.

Table 3.2: Number of patients surveyed, by age and gender

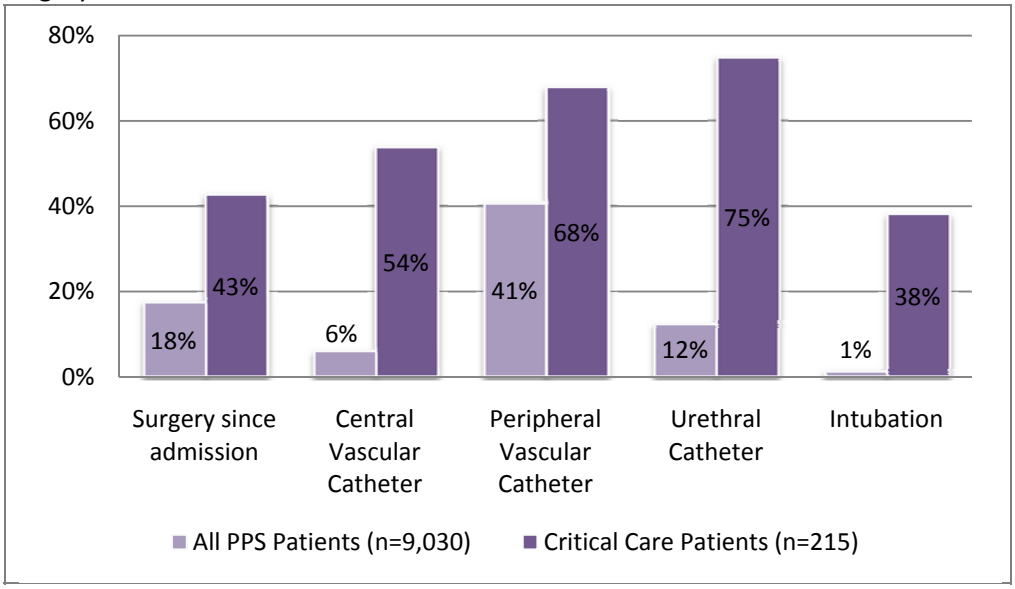
Age Group	Male		Female		Total	
	N	%	N	%	N	%
16 – 29 years	5	4.2	1	1.0	6	2.8
30 – 49 years	16	13.6	10	10.3	26	12.1
50 – 64 years	35	29.7	30	30.9	65	30.2
65 – 79 years	46	39.0	39	40.2	85	39.5
80+ years	16	13.6	17	17.5	33	15.3
Total	**118**	**100**	**97**	**100**	**215**	**100**

3.1.3 Patient Risk Factors for HAI

Risk factors for HAI in the overall cohort of 9,030 eligible patients and the cohort of 215 patients requiring critical care are described in Figure 3.1. The prevalence of all HAI risk factors was higher in critical care patients compared to the overall PPS population.

Of the 215, 92 (43%) had a history of a surgical procedure since admission to the participating hospital. Ninety-six percent (n=206) of the critical care patients had at least one invasive device *in situ* at the time of survey.

Figure 3.1: Percentage of patients surveyed in overall PPS and critical care units, by surgery since admission and device utilisation



The McCabe score is a subjective score of underlying illness severity and was used to categorise patients during the PPS.[1] Table 3.3 presents the McCabe score distribution for the overall patient cohort versus the critical care patient cohort. A higher proportion of patients requiring critical care were deemed to have a 'rapidly fatal or end-of-life prognosis' (life expectancy less than one year), 11.6% compared to 3.4% in the overall patient cohort. The proportion of patients reported as having an 'ultimately fatal or life-limiting prognosis' (life expectancy between one and four years) was also higher in the critical care patient cohort (32.1% versus 21.7%).

Table 3.3: Number of patients surveyed in overall PPS and critical care units, by McCabe Score

McCabe Score	All PPS Patients		Critical Care Patients	
	N	%	N	%
Non-fatal	6,673	73.9	120	55.8
Ultimately fatal	1,955	21.7	69	32.1
Rapidly fatal/end-of-life	311	3.4	25	11.6
Not known	91	1.0	1	0.5
Total	**9,030**	**100**	**215**	**100**

3.2 Hospital-Acquired Infections

The PPS HAI results should be reviewed and interpreted in conjunction with the HAI definitions used in this survey. These are available in the PPS All Ireland Protocol Version 1.3 [Appendix B pages 60 – 85], which may be accessed on the HPSC website:

http://www.hpsc.ie/hpsc/A-Z/MicrobiologyAntimicrobialResistance/InfectionControlandHAI/Surveillance/PointPrevalenceSurvey/2012/Protocol/

3.2.1 Prevalence of Hospital-Acquired Infections

Of the overall cohort of 9,030 eligible patients, 467 (5.2%; 95% CI: 4.7-5.6) were classified as having an active hospital acquired infection (HAI). Overall, a total of 501 HAI were identified, which equates to 1.07 HAI per infected patient.

Of the 215 eligible patients admitted to critical care units, 50 (23.3%; 95% CI: 18.1-29.3) were classified as having an active hospital-acquired infection (HAI). Overall, a total of 59 HAI were identified, which equates to 1.18 HAI per infected patient.

Table 3.4: Number of HAI per patient in overall PPS and critical care units

Number of HAI reported per patient	All PPS Patients		Critical Care Patients	
	N	%	N	%
0	8,563	94.8	165	76.7
1	434	4.8	41	19.1
2	32	0.4	9	4.2
3	1	0.0	0	0.0
Total	**9,030**	**100**	**215**	**100**

3.2.2 HAI Prevalence, by ICU Type and Admitting Consultant Specialty

The HAI prevalence of HAI, by ICU type is shown in Table 3.4. HAI prevalence was highest in specialised ICUs (29.4%; 95% CI: 13.3 – 53.1) and lowest in units categorised as 'other ICUs' (e.g., HDU).

Table 3.4: HAI prevalence, by ICU type

ICU Type	Total Number of Patients	Number of patients with HAI	HAI Prevalence (%)	95% Confidence Interval
Mixed General ICU	151	39	25.8	19.5 – 33.3
Specialised ICU	17	5	29.4	13.3 – 53.1
Surgical ICU	8	2	25.0	7.1 – 59.1
Medical ICU	2	0	0.0	0.0 – 65.8
Other ICU	37	4	10.8	4.3 – 24.7
Total	**215**	**50**	**23.3**	**18.1 – 29.3**

In this PPS, 17 patients (7.9%) were recorded as being admitted under a consultant in intensive care medicine, with the remainder admitted under either medical or surgical consultants. The prevalence of HAI by admitting consultant is shown in Table 3.5. HAI prevalence was highest in the 17 patients admitted under the care of a consultant in intensive care medicine (35.3%; 95% CI: 17.3-58.7), followed by the 96 patients admitted under the care of a surgical consultant (28.1%; 95% CI: 20.1-37.8).

Table 3.5: HAI prevalence by admitting consultant specialty

Consultant Specialty	Total Number of Patients	Number of patients with HAI	HAI Prevalence (%)	95% Confidence Interval
Medical	98	16	16.3	10.3 – 24.9
Surgical	96	27	28.1	20.1 – 37.8
Intensive Care	17	6	35.3	17.3 – 58.7
Care of the Elderly	4	1	25.0	4.6 – 69.9
Total	**215**	**50**	**23.3**	**18.1 – 29.3**

3.2.3 Onset and Origin of HAI

Figure 3.2 describes whether signs and symptoms of the HAI were present at the patient's admission to hospital and Figure 3.3 describes the facility where the patient acquired the infection. As each patient's date of admission to the critical care unit was not recorded in the PPS, it is not possible to differentiate HAI from critical care unit-acquired infections. Therefore, it is likely that some of the HAI were acquired in participating critical care units and that for other HAI; the patient may have required transfer to the critical care unit for management of complications of the infection.

Of the 59 HAI reported in 50 patients admitted to critical care units, nine (15%) were already evident on the date of the patient's current admission to hospital. Of those, three (33%) had origin in the current hospital (i.e. infection related to a prior admission to the current hospital) and six (67%) had origin in another acute hospital. Therefore, 10% of the 59 HAIs reported in patients admitted to critical care units during the PPS were attributable to another acute hospital. It is possible that some patients with HAI originating in another acute hospital may have required transfer to the critical care unit of the reporting hospital for management of complications related to the HAI.

Figure 3.2: Percentage of HAI, by HAI onset

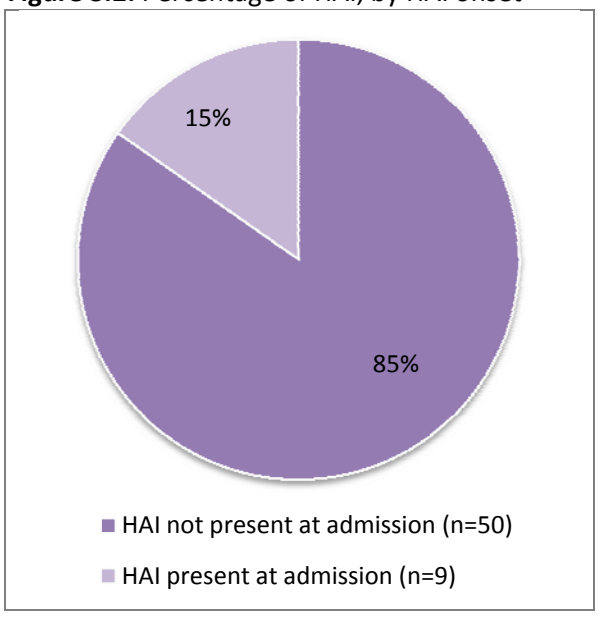
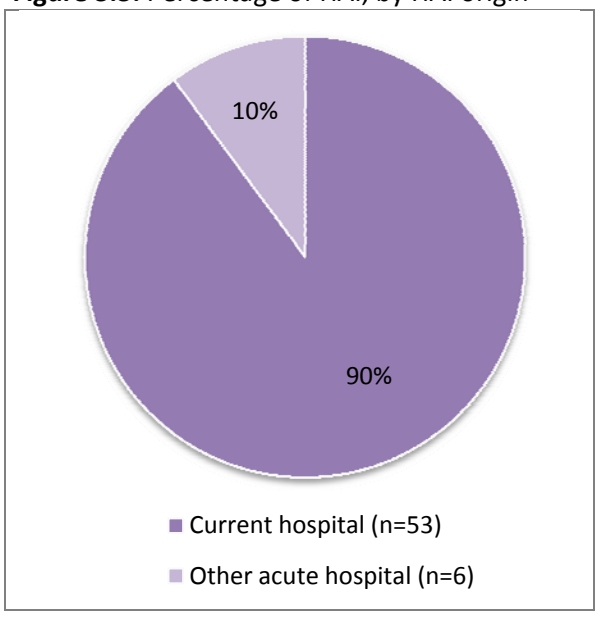


Figure 3.3: Percentage of HAI, by HAI origin



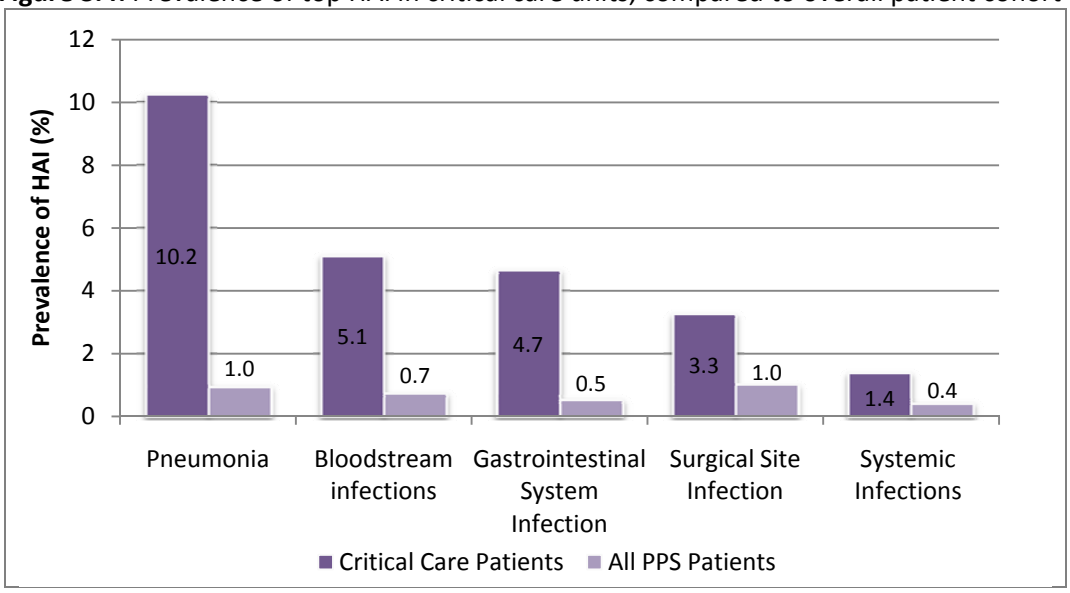
3.2.4 Distribution of HAI, by Type

Table 3.6 presents the distribution of the 59 HAI. The five most prevalent HAI types accounted for 90% of the HAIs reported in critical care units. Figure 3.4 displays the prevalence of the top five HAI in patients admitted to critical care units versus the top five HAI in the overall patient cohort.

Table 3.6: Number, percentage and prevalence of HAI, by HAI type

Rank Order	HAI Infection Site	N	% of Total	Prevalence (%)
1	Pneumonia (PN)	22	37.3	10.2
2	Bloodstream infections (BSI)	11	18.6	5.1
3	Gastrointestinal system infections (GI)	10	16.9	4.7
4	Surgical site infections (SSI)	7	11.9	3.3
5	Systemic infections (SYS)	3	5.1	1.4
6	Urinary tract infections (UTI)	2	3.4	0.9
7	Catheter-related infections (CRI)	1	1.7	0.5
8	Skin and soft tissue infections (SST)	1	1.7	0.5
9	Bone and joint infections (BJ)	1	1.7	0.5
10	Eye, ear, nose, throat or mouth infections (EENT)	1	1.7	0.5
	Total	**59**	**100**	

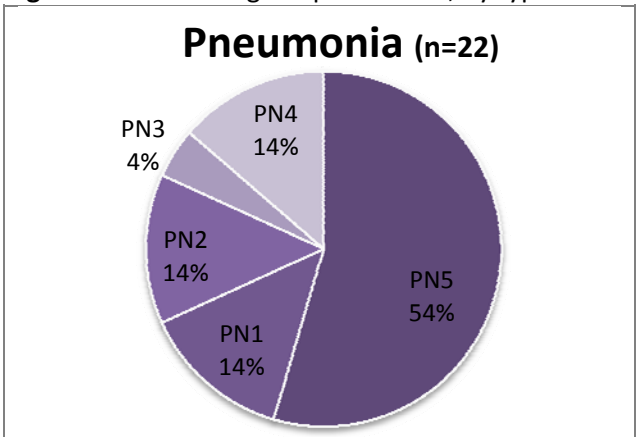
Figure 3.4: Prevalence of top HAI in critical care units, compared to overall patient cohort



Pneumonia (PN)

Pneumonia was the most common HAI, with 22 cases reported. Pneumonia accounted for over one-third of HAI (37%), with prevalence of 10.2% in critical care patients (See **Appendix B** for pneumonia case definition). Of the 22 pneumonia cases, 54% were not microbiologically confirmed (Figure 3.5) and respiratory tract intubation was present for 13 (59%) (Table 3.7). This differs from the overall patient cohort, where pneumonia was the second most common HAI, accounting for just under one-fifth of HAI, with prevalence of 1.0%.

Figure 3.5: 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

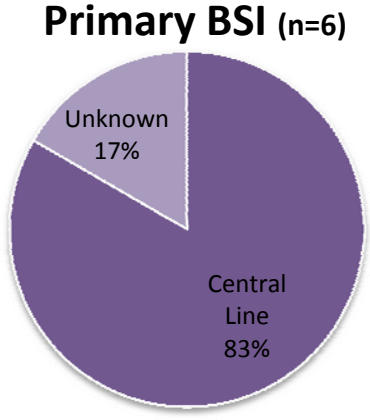
Bloodstream Infection (BSI)

The second most prevalent HAI in critical care was bloodstream infection (BSI), which accounted for just under one-fifth of HAI (18.6%), with prevalence of 5.1% in critical care patients (See **Appendix B** for BSI case definition). Of the 11 critical care patients with BSI, 5 (45%) were noted to have a vascular catheter present (Table 3.7). In contrast, BSI was the fourth commonest HAI in the overall patient cohort, accounting for 13.2% of HAI, with prevalence of 0.8%.

BSI may be classified as primary BSI (which may be due to an infected vascular catheter or of unknown origin, where no source is identifiable) or secondary BSI, which may be further classified based on the underlying infection site. Of the 11 BSI, six (55%) were classified as primary BSI and five (45%) as BSI arising secondary to infection elsewhere in the body:

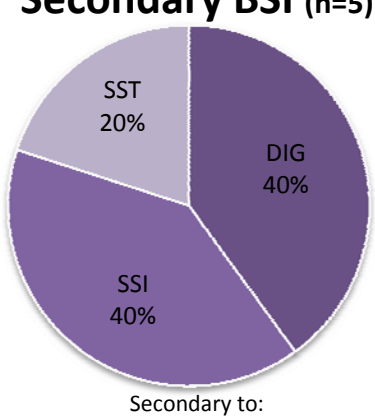
- Of the six primary BSI, an indwelling central vascular catheter (CVC) was implicated as the source for five (83%) cases. For the remaining primary BSI, no underlying source was identified (Figure 3.7)
- Of the five secondary BSIs, two resulted from digestive tract infection (40%), two from surgical site infection (40%) and the remaining BSI (20%) resulted from skin and soft tissue infection (Figure 3.8)

Figure 3.7: Percentage of primary BSI, by origin



Central Line: Central vascular catheter infection; **Unknown:** Primary BSI of unknown origin

Figure 3.8: Percentage of secondary BSI, by origin



Secondary to:
DIG: Digestive tract infection; **SSI:** Surgical site infection; **SST:** Skin/soft tissue infection

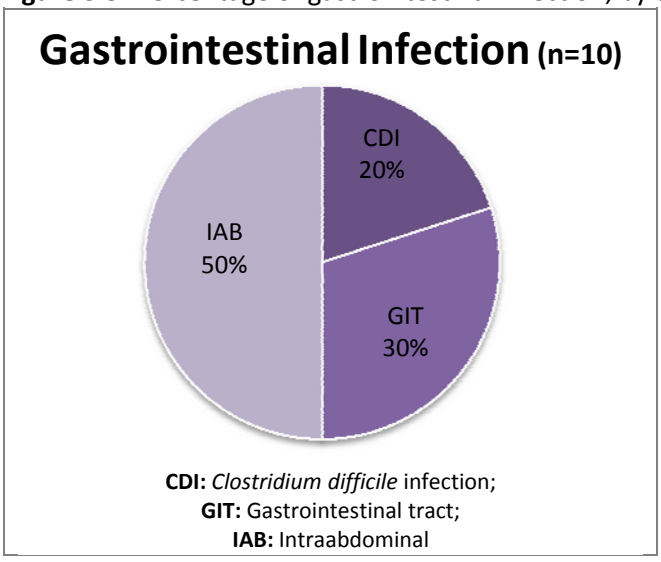
Table 3.7: Number and percentage of device-associated HAI

HAI Type	HAI	
	N	%
Pneumonia:		
Respiratory tract intubation present	13	59
Respiratory tract intubation absent	9	41
Total	**22**	**100**
Blood stream infection:		
Vascular catheter present	5	45
Vascular catheter absent	6	55
Total	**11**	**100**

Gastrointestinal Infections (GI)

The third most prevalent HAI in critical care patients was gastrointestinal system infection (GI), which accounted for 10 HAI (16.9%), with prevalence of 4.7% in critical care patients (See **Appendix B** for GI infection case definitions). This differed from the overall patient cohort, where GI infection was the fifth commonest HAI, accounting for 9.8% of HAI, with prevalence of 0.5%. The breakdown of GI infections, by type is presented in Figure 3.9. There were two patients with *Clostridium difficile* infection admitted to critical care during the PPS.

Figure 3.9: Percentage of gastrointestinal infection, by type

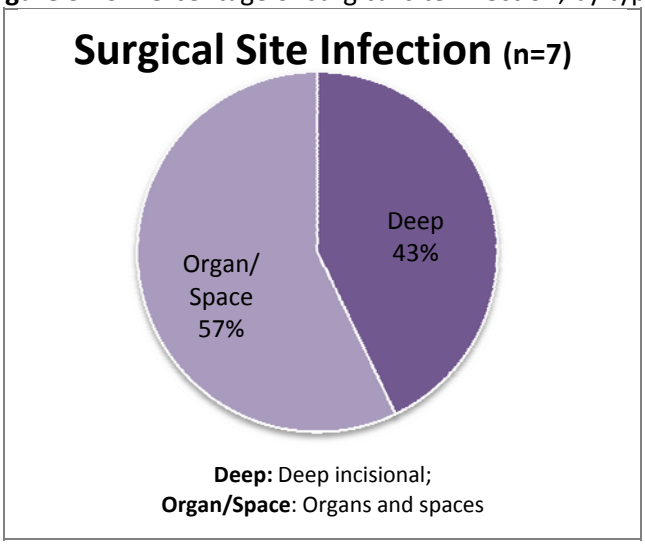


Surgical Site Infection (SSI)

The fourth most prevalent HAI in critical care patients were surgical site infections (SSI), which accounted for seven HAI (11.9%), with prevalence of 3.3% (See **Appendix B** for SSI case definition). All of the SSI were classified as either deep incisional or organ/space infections. Figure 3.10 presents the categorisation of the SSI.

Whilst SSI were the most common HAI reported in the overall patient cohort, accounting for 18.2% of infections, with prevalence of 1.0%, just under half (44%) of those were classified as superficial incisional and the remaining 66% were classified as either deep incisional or organ/space SSI.

Figure 3.10: Percentage of surgical site infection, by type



3.3 Microbiology & Key Antimicrobial Resistance Markers

The PPS microbiology and antimicrobial resistance results should be reviewed and interpreted in conjunction with the definitions used in this survey. These are available in the PPS All Ireland Protocol Version 1.3 [Appendix A – Tables 8 & 9 (pages 55 – 59)], which may be accessed on the HPSC website:

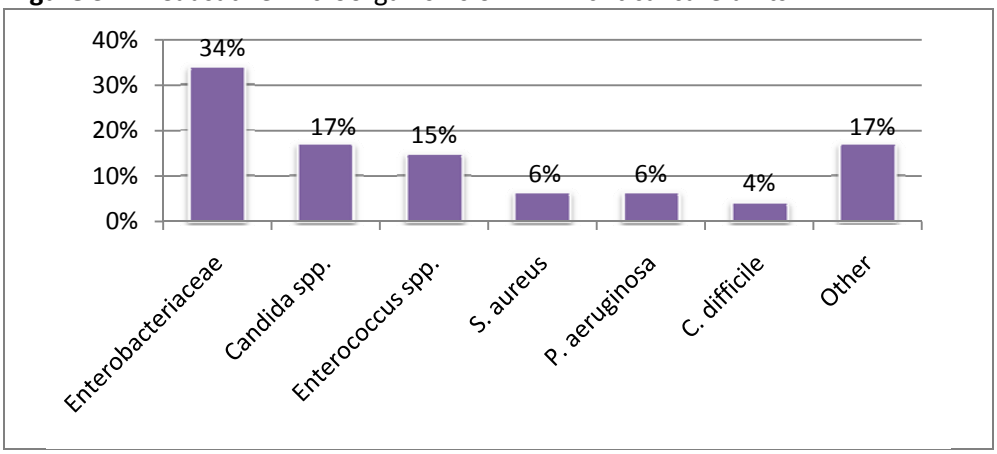
http://www.hpsc.ie/hpsc/A-Z/MicrobiologyAntimicrobialResistance/InfectionControlandHAI/Surveillance/PointPrevalenceSurvey/2012/Protocol/

3.3.1 Microbiology and Antimicrobial Resistance Data

Of the 501 HAI identified in the overall patient cohort, positive microbiology results were available for 261 (52%) with a total of 310 microorganisms identified from relevant specimens.

Of the 59 active HAI identified in patients admitted to critical care units, positive microbiology results were available for 36 (61%) with a total of 47 microorganisms identified from relevant specimens. Figure 3.11 illustrates the distribution of these microorganisms.

Figure 3.11: Causative microorganisms of HAI in critical care units



- Of the 47 microorganisms isolated, *Enterobacteriaceae* (n=16; 34%) were the most frequently detected. Of the *Enterobacteriaceae*, *Escherichia coli* was the most commonly isolated (n=9; 56%). Resistance to third-generation cephalosporins was reported for seven (43.8%) and resistance to carbapenems was reported from one (6.3%) *Enterobacteriaceae* isolated from clinical specimens. There were five patients with HAI caused by resistant *Enterobacteriaceae,* with two of the patients having two different resistant *Enterobacteriaceae* isolated.
- *Candida* spp. were the second most frequently detected pathogens critical care HAI (n=8; 17%).
- There were seven (15%) HAI with enterococci implicated as causative pathogens, of which three (42.9%) were reported as resistant to glycopeptides [i.e., vancomycin resistant enterococci (VRE)].
- There were three *Staphylococcus aureus* isolates (6%), all retaining susceptibility to flucloxacillin (MSSA)
- There were three *Pseudomonas aeruginosa* isolates (6%), with one resistant to carbapenems.

Table 3.8: Number of microorganisms, by key antimicrobial resistance markers

Microorganism	Antimicrobial Susceptibility Results	N	%
Enterobacteriaceae	3rd generation cephalosporin sensitive; Carbapenem sensitive	9	56.3
	3rd generation cephalosporin resistant; Carbapenem sensitive	6	37.5
	3rd generation cephalosporin resistant; Carbapenem resistant	1	6.3
	Total	**16**	**100**
Enterococcus spp.	Vancomycin/teicoplanin (glycopeptides) sensitive (VSE)	3	42.9
	Vancomycin/teicoplanin (glycopeptides) resistant (VRE)	3	42.9
	Unknown susceptibility result	1	14.3
	Total	**7**	**100**
Staphylococcus aureus	Flucloxacillin sensitive (MSSA)	3	100.0
	Flucloxacillin resistant (MRSA)	0	0.0
	Total	**3**	**100**
Pseudomonas aeruginosa	Carbapenem sensitive	2	66.7
	Carbapenem resistant	1	33.3
	Total	**3**	**100**

3.3.2 Causative Pathogens of the Most Common HAI Types in Critical Care

Pneumonia: Of the 22 patients with pneumonia, positive microbiology results were reported for 10 (55%), with 14 pathogens isolated: *E. coli* (n=3; 21%), *Pseudomonas aeruginosa* (n=2; 14%), *Haemophilus influenza* (n=2; 14%) and *Stenotrophomonas maltophilia* (n=2; 14%).

Bloodstream infections: The causative pathogen was reported for all 11 BSI with *Candida* spp. (n=3; 27%) and *Enterococcus* spp. (n=3; 27%) the most commonly isolated pathogens.

Gastrointestinal system infections: Of the ten patients with gastrointestinal system infections, positive microbiology results were reported for six (60%), with eight pathogens isolated: *E. coli* (n=2; 25%) *Candida* spp. (n=2; 25%) and *C. difficile* (n=2; 25%) were the most commonly detected pathogens.

Surgical site infections: Of the seven patients with SSI, positive microbiology results were reported for six (86%), with 11 pathogens isolated: *Enterococcus* spp. (n=3; 27%) and *E. coli* (n=2; 18%) were the most commonly detected pathogens.

3.4 Antimicrobial Use

The PPS antimicrobial use results should also be reviewed and interpreted in conjunction with the methodology and definitions used in this survey. These are available in the PPS All Ireland Protocol Version 1.3 [Section 4.6.4 (pages 32 – 36) and Appendix A: Tables 4 & 5 (pages 50 – 52)], which may be accessed on the HPSC website:

http://www.hpsc.ie/hpsc/A-Z/MicrobiologyAntimicrobialResistance/InfectionControlandHAI/Surveillance/PointPrevalenceSurvey/2012/Protocol/

3.4.1 Prevalence of Antimicrobial Use

Of the 9,030 eligible patients in the overall patient cohort, 3,108 (34.4%; 95% CI: 33.4-35.4) were classified as receiving systemic antimicrobials. A total of 4,532 antimicrobials were prescribed, equating to 1.5 antimicrobials per patient.

Of the 215 eligible patients admitted to critical care units, 160 (74.4%; 95% CI: 68.2-79.8) were classified as receiving systemic antimicrobials. A total of 303 antimicrobials were prescribed, equating to 1.9 antimicrobials per patient.

Table 3.9: Number of antimicrobials prescribed per patient; overall PPS patient cohort and critical care unit patients

Number of antimicrobials prescribed per patient	All PPS Patients		Critical Care Patients	
	N	%	N	%
0	5,922	65.6	55	25.6
1	1,991	22.0	75	34.9
2	984	9.9	49	22.8
3	158	1.8	19	8.8
4	46	0.5	12	5.6
5	19	0.2	5	2.3
Total	**9,030**	**100**	**215**	**100**

3.4.2 Antimicrobial Use Prevalence, by ICU Type and Admitting Consultant Specialty

The prevalence of antimicrobial use (AMU), by ICU type is described in Table 3.10. AMU prevalence was highest in specialised ICUs (88.2%; 95% CI: 65.7-96.7) followed by surgical ICUs (87.5%; 95% CI: 52.9-97.7).

Table 3.10: Antimicrobial use prevalence, by ICU type

ICU Type	Total Number of Patients	Number of patients receiving antimicrobials	Prevalence (%)	95% Confidence Interval
Mixed General ICU	151	114	75.5	68.1 – 81.7
Specialised ICU	17	15	88.2	65.7 – 96.7
Surgical ICU	8	7	87.5	52.9 – 97.8
Medical ICU	2	1	50.0	9.5 – 90.5
Other ICU	37	23	62.2	46.1 – 75.9
Total	**215**	**160**	**74.4**	**68.2 – 79.8**

The AMU prevalence, by admitting consultant specialty is presented in Table 3.11 and was highest in the 96 patients admitted under the care of a surgical consultant (82.3%; 95% CI:73.5-88.6). The lowest AMU prevalence was recorded in 98 patients admitted under the care of a medical consultant (66.3%; 95% CI: 56.5-74.9).

Table 3.11: Antimicrobial use prevalence, by admitting consultant specialty

Consultant Specialty	Total Number of Patients	Number of patients receiving Antimicrobials	Prevalence (%)	95% Confidence Interval
Medical	98	65	66.3	56.5 – 74.9
Surgical	96	79	82.3	73.5 – 88.6
Intensive Care	17	13	76.5	52.7 – 90.4
Care of the Elderly	4	3	75.0	30.1 – 95.4
Total	**215**	**160**	**74.4**	**68.2 – 79.8**

3.4.3 Documentation of Indication and Compliance with Local Policy

For 231 (76.2%) of the 303 antimicrobial prescriptions in critical care units, the indication was documented in the patient's healthcare record and/or medication chart (Figure 3.12).

Of the 303 prescriptions, 194 (64%) were assessable against a local prescribing policy, of which 24.2% (n=47) were deemed to be non-compliant (Figure 3.13).

Figure 3.12: Documented indication for the prescribed antimicrobial

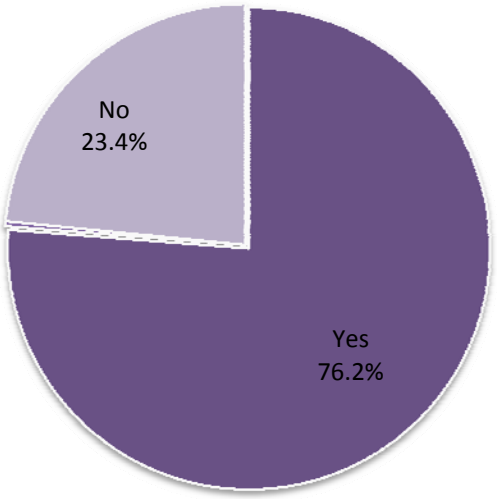
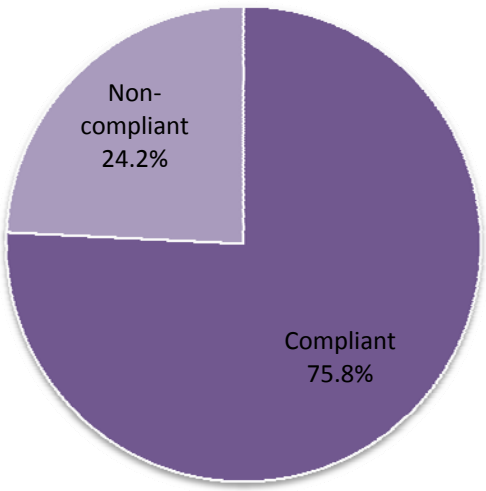


Figure 3.13: Percentage of assessable prescriptions, compliant with local prescribing policy (n=194)



3.4.4 Description of Prescribed Antibacterials

Table 3.12 presents the breakdown of the 275 prescribed antibacterials. The 15 most commonly prescribed agents accounted for 90% (n=248) of all antibacterials prescriptions. The most common antibacterial was piperacillin-tazobactam (n=56, 20.4%), which was prescribed to 26.0% of patients in critical care units.

Table 3.12: Number, percentage and prevalence of prescribed antibacterials

Rank Order	Antibacterial Agent	Prescribed Antibacterials		
		N	% of Total	Prevalence (%)
1	Piperacillin-tazobactam	56	20.4	26.0
2	Vancomycin	27	9.8	12.6
3	Meropenem	25	9.1	11.6
4	Metronidazole	23	8.4	10.7
5	Co-amoxiclav	21	7.6	9.8
6	Gentamicin	18	6.5	8.4
7	Ciprofloxacin	17	6.2	7.9
8	Cefuroxime	15	5.5	7.0
9	Linezolid	11	4.0	5.1
10	Clarithromycin	10	3.6	4.7
11	Erythromycin	7	2.5	3.3
12	Trimethoprim & sulfamethoxazole (co-trimoxazole)	5	1.8	2.3
13	Cefotaxime	5	1.8	2.3
14	Flucloxacillin	4	1.5	1.9
15	Clindamycin	4	1.5	1.9
	Other	27	9.8	
	Total	**275**	**100**	

3.4.5 Description of Prescribed Antifungals

Table 3.13 presents the breakdown of the 28 prescribed antifungals. The most commonly prescribed antifungals were caspofungin (n=10, 35.7%) and fluconazole (n=10, 35.7%), which were both prescribed to 4.7% of patients in critical care units.

Table 3.13: Number, percentage and prevalence of prescribed antifungals

Rank Order	Antifungal Agent	Prescribed Antifungals		
		N	%	Prevalence (%)
1	Caspofungin	10	35.7	4.7
2	Fluconazole	10	35.7	4.7
3	Nystatin	5	17.9	2.3
4	Anidulafungin	2	7.1	0.9
5	Amphotericin B	1	3.6	0.5
	Total	**28**	**100**	

3.4.6 Indication for Antimicrobial Prescribing

Table 3.14 describes the prescriber's indication for the antimicrobial prescription, for the overall PPS patient cohort and for patients admitted to critical care units. Eighty percent of prescriptions in critical care were for the treatment of infection (n=243), which was slightly higher than the proportion of prescriptions for treatment of infection in the overall PPS patient cohort (77.8%). The proportion of prescriptions for prophylaxis was lower in critical care (13.9%) compared to the overall PPS patient cohort (19.2%).

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

Prescriber's Indication	Antimicrobials Prescribed in Overall PPS		Antimicrobials Prescribed in Critical Care	
	N	%	N	%
Treatment of infection	3,526	77.8	243	80.2
Surgical prophylaxis	508	11.2	33	10.9
Medical prophylaxis	361	8.0	9	3.0
Other	38	0.8	8	2.6
Unknown	99	2.2	10	3.3
Total	**4,532**	**100**	**303**	**100**

3.4.7 Antimicrobials Prescribed for the Treatment of Infection

Of the 243 antimicrobials prescribed for the treatment of infection, 52% (n=126) were for hospital-associated infections and the remaining 48% (n=117) were for community-associated infections (Figure 3.14). The majority of antimicrobials (39%; n=95) were prescribed to treat pneumonia (Figure 3.15).

Figure 3.14 Percentage of antimicrobials prescribed for treatment of infection, by origin of infection (n=243)

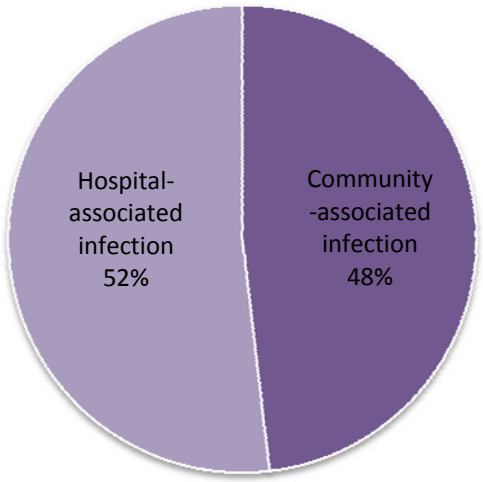
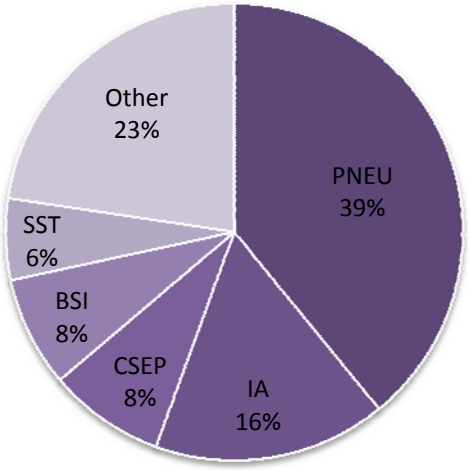


Figure 3.15: Percentage of antimicrobials prescribed for treatment of infection, by site of infection (n=243)



PNEU: Pneumonia; **IA:** Intrabdominal infection; **CSEP:** Clinical Sepsis; **BSI:** Bacteraemia/ bloodstream infection; **SST:** Skin and soft tissue infection

4.0 Discussion

There was excellent participation in the 2012 point prevalence survey (PPS), with critical care units in 33 hospitals (27 public and six private) submitting anonymous data on hospital-acquired infections (HAI) and antimicrobial use from 215 patients aged over 16 years. Of the 45 critical care units, 35 could be classified as level 3 (intensive care units) and 10 were classified as level 2 (high dependency units) in accordance with the 2009 UK Intensive Care Society Levels of Critical Care for Adult Patients.[2]

Patients admitted to critical care were older than the overall patient cohort (68 years versus 63 years) and were predominantly male (54.9%), versus the overall cohort, where there was a female predominance (53.7%).[3] Critical care patients also had a higher prevalence across all risk factors for HAI, including a history of surgery during the current hospital admission and use of invasive medical devices, including peripheral and central vascular catheters, urethral catheters and intubation of the respiratory tract. Additionally, a higher proportion of critical care patients had more severe underlying illness in comparison with the overall patient cohort, as measured by the McCabe score.

The prevalence of HAI in critical care patients was 23.3%, which was higher than that of the overall patient cohort (5.2%). Additionally, the percentage of patients with more than one active HAI type at the time of survey was higher in critical care units (4.2%) than the overall patient cohort (0.4%).

As the date of admission to critical care was not recorded during the PPS, it was not possible to determine whether or not each patient's HAI had been acquired prior or subsequent to critical care unit admission. The reason for the patient's admission to the critical care unit was not recorded in the PPS. Ten percent of HAI in the critical care patient cohort were attributable to another hospital, a figure which was lower than that for the overall patient cohort (14%).

The rank order and prevalence of HAI, by infection type differed between the overall patient and critical care patient cohorts, with pneumonia, BSI and GI tract infections the three most commonly identified HAI in critical care, versus SSI, pneumonia and urinary tract infection in the overall patient cohort. Of the primary BSIs, a higher percentage were attributable to infection of a central vascular

catheter in critical care patients (83%), than in the overall patient cohort (57%). Positive microbiology results were available for all 11 BSI in critical care patients, with *Candida spp* and *Enterococcus spp* accounting for three cases each. This differed from the overall patient cohort, where the most common pathogens isolated from BSI were *S. aureus, E. coli* and coagulase negative staphylococci, respectively.

The percentage of infections caused by *Enterobacteriaceae* that were resistant to third-generation cephalosporins was higher in critical care patients (37.5%) than in the overall patient cohort (23%) and the percentage of infections caused by enterococci that were glycopeptide resistant (i.e. vancomycin resistant enterococci/VRE) was also higher in the critical care patients (42.9% versus 26%).[3]

The prevalence of antimicrobial use in critical care patients was 74.4%, a figure which was over twice that of the overall patient cohort (34.4%). The percentage of patients who were prescribed more than one antimicrobial was higher for critical care patients than the overall patient cohort, with 2.3% of critical care patients prescribed five separate antimicrobials versus 0.2% in the overall patient cohort.

The percentage of antimicrobial prescriptions for which there was no documentation was higher in critical care patients (23.4% versus 15%). The percentage of antimicrobial prescriptions that were in compliance with local hospital policy was slightly higher for critical care patients (75.8 versus 73%).

Piperacillin-tazobactam was the most commonly prescribed antibacterial in critical care patients (20.4% of all antibacterials), with a prevalence of 26% and meropenem was the third most commonly prescribed antibacterial (9.1%), with a prevalence of 11.6%. For the overall patient cohort, piperacillin/tazobactam ranked second and meropenem ranked tenth.

Of a total of 163 antifungals prescribed in the PPS, 28 were prescribed in critical care patients (17%), where fluconazole and caspofungin ranked joint first at ten prescriptions each.

5.0 Conclusion

Analysis of the data captured from the adult critical care population in Ireland during the 2012 PPS illustrates that critical care patients tend to be older, with more severe underlying illnesses and have more risk factors for developing HAI. Such patients have a higher prevalence of HAI than the general patient population and have a higher prevalence of antimicrobial use. Where HAI develop in critical care patients, the findings of the survey demonstrated that the proportion of infections caused by antimicrobial resistant pathogens is higher than that of the overall patient population.

The implementation priorities (immediate, short-term and medium-to-longer term) recommended in the PPS national report are especially relevant to this high-risk group of critically ill patients. In addition to local implementation and actions, some of the identified priorities should be considered for coordination at a regional and national level (e.g., surveillance of unit-acquired infections).

It is hoped that the national PPS will be repeated every five years to monitor the impact of implementation of quality improvement initiatives. It is recommended that the date of admission to critical care is included in future prevalence surveys so that the prevalence of unit-acquired infections can be recorded and monitored.

6.0 Implementation Priorities

Immediate Priorities

1. Ensure that the local and national results of the 2012 PPS have been shared with all staff and that each hospital's local results have been reviewed in detail. Local implementation priorities and action plans should be developed, based on individual hospital PPS results and case mix.

2. Ensure that all healthcare workers receive ongoing education and training regarding the importance and impact of healthcare-associated infections and antimicrobial resistance, including preventative strategies outlined below.

3. Improve hand hygiene compliance in all staff. The World Health Organisation (WHO) five moments for hand hygiene should be consistently observed by all staff.[4] Hand hygiene compliance should be audited regularly, with feedback of results to staff.

4. Ensure compliance with the HIQA National Standards for Prevention & Control of Healthcare-Asssociated Infections, specifically Standard 8: 'Invasive medical device-related infections are prevented or reduced'.[5]

    a. Implement routine daily review of intravascular devices on clinical team ward rounds and ensure ongoing audit and improvement with peripheral and central line care bundle compliance, in line with national guidelines for prevention of intravascular catheter related infections.[6]

    b. Implement the recommendations of the national guidelines for the prevention of catheter-associated urinary tract infections, which includes the use of locally-adapted care bundles for management of urinary catheters.[7]

    c. Implement the recommendations of the national guidelines for the prevention of ventilator-associated pneumonia (VAP) in adults, which includes the use of a VAP care bundle.[8]

5. Ensure compliance with the HIQA National Standards for Prevention & Control of Healthcare-Asssociated Infections, specifically Standard 12: 'There are systems in place to reduce and control antimicrobial resistance'.[5]

6. Implement the core, high impact interventions to promote prudent antimicrobial prescribing recommended in the national guidelines for antimicrobial stewardship.[9]

    a. Routine review of suitability for intravenous to oral antimicrobial switch after 48 hours (and daily thereafter) on clinical team ward rounds.

    b. Improve antimicrobial prescribing documentation by all prescribers.

    c. Improve compliance with hospital prescribing policies, including empiric prescribing for infection and surgical antimicrobial prophylaxis. Where policies are not available, they should be developed, based on local case mix.

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

8. Ensure that key infection prevention and control, antimicrobial stewardship and surveillance staff are not diverted to tasks outside their designated roles.

9. Educate patients on their role in preventing HAI, including the importance of hand hygiene and care of indwelling medical devices.

Short-term Priorities – Implement within the Next Year

1. Implement the Royal College of Physicians of Ireland (RCPI) & Royal College of Surgeons in Ireland (RCSI) Antibiotic Care Bundle, launched nationally on November 21st 2012.

2. Introduce the HSE medication prescription and administration record, once it has been launched.

3. Implement the RCSI Surgical Quality Improvement Tool, once it has been launched.

4. Plan for implementation of pilot surgical site infection surveillance programmes, to inform the resources required to develop and implement prospective and ongoing SSI surveillance, based on local case mix and clinical need. Device-related surgical procedures should receive priority for surveillance.

5. Plan for implementation of pilot critical care-acquired infection surveillance programmes, to inform the resources required to develop and implement prospective and ongoing critical care infection surveillance. Bloodstream infection surveillance and device-related infection surveillance (vascular catheter-related infection, ventilator-associated pneumonia and catheter-related urinary tract infections) should be prioritised.

Medium-to-Longer Term Priorities – Implement within the Next Five Years

1. Ensure that there is round-the-clock access in every hospital to the advice of an infection management specialist (clinical microbiologist, infectious diseases physician) and access to accredited microbiological laboratory services.[5,9]

2. A healthcare environment that promotes HAI prevention practices, including adequate space, isolation capacity and a physical environment conducive to decontamination is a critical component in safe patient care. Single-patient room accommodation capacity should be reviewed within each hospital and plans put in place to minimise multiple-patient room accommodation, in line with national guidelines.[10]

3. Ensure that any hospital information technology (IT) redevelopment plans incorporate modern technology such as; electronic prescribing with prescriber decision support, electronic patient records and laboratory information systems. Such developments have enormous potential to positively impact on suboptimal prescribing practices, medication errors, improve documentation, manage demand on resources and to reduce waste.

4. Ensure that infection prevention and control, healthcare-associated infection surveillance and antimicrobial stewardship staffing and initiatives are resourced appropriately.

5. Develop new and strengthen existing national reference laboratory capacity, to support the ongoing epidemiological surveillance and resistance monitoring of the key pathogens, frequently implicated in HAI, which includes but is not limited to; *Clostridium difficile*, *Enterococcus spp.*, *Enterobacteriaceae* and *Staphylococcus aureus.*[11,12,13]

6. It is anticipated that the national PPS of hospital-acquired infections and antimicrobial use may be repeated in five years.

a. In the interim, consideration should be given to annual participation in the ESAC Hospitals Care point prevalence survey of antimicrobial use, which is coordinated by the Irish Antimicrobial Pharmacists Group and the Health Protection Surveillance Centre.

b. In the interim, consideration should be given to performing periodic local mini-prevalence surveys of hospital-acquired infections on selected wards. The protocol and HAI definitions used in the 2012 PPS should be used for conducting repeat local surveys.

Table 6.1 demonstrates some key areas for immediate to short-term improvement, with examples of indicators or measures to track improvement.

Table 6.1: Key improvement areas and indicators to track improvement

Area	Aim	Element	Example of indicator (s)
Focus on prevention of infection associated with vascular catheters/ IV lines	Good line insertion practices	Education and training of staff inserting IV lines	Presence of educational programme (i.e., hand hygiene / IV line insertion / aseptic technique) % staff receiving education
		Central line insertion checklists	% central lines inserted with completed checklist Audit of checklist components
		Improve hand hygiene before aseptic tasks	Hand hygiene audit results (breakdown by 5 moments and staff group)
	Reduce number of IV lines that are no longer required	IV line maintenance care bundle	% wards implementing peripheral IV line bundle
		Implementation of IV to oral antimicrobial switch policy	See below
	Track IV line infection	Root cause/systems analysis of hospital-acquired IV line related bloodstream infections (BSI)	% IV line-related BSI, where root cause analysis performed
		Surveillance of IV-line related BSI	% BSI associated with IV lines IV line associated infection rates
Good antimicrobial stewardship	Improve antimicrobial prescribing	Implement IV to oral switch policy	Audit % prescriptions where IV to oral decision recorded at 48/72 hours
		Implement the RCPI/RCSI antibiotic care bundle, which will be launched on 21st November 2012	Audit compliance with care bundle
		Improve documentation of indication and duration of antimicrobials	Audit % prescription where indication and review date recorded
	Monitor antimicrobial consumption	Antimicrobial consumption surveillance	Hospital antibiotic consumption expressed as defined daily doses per 100 bed days used (DDD/100 BDU)
Surgical site infection	Prevent infection	Implement single dose surgical antimicrobial prophylaxis policy	Audit % prescriptions where surgical prophylaxis is single dose
		Implement RCSI quality improvement tool for prevention of SSI (due to be published late 2012)	Audit of tool elements
		Monitor infection associated with surgery – if no surveillance programme in place, consider pilot	Surgical site infection rates

7.0 References

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5. Health Information & Quality Authority. National Standards for the Prevention and Control of Healthcare Associated Infections: May 2009
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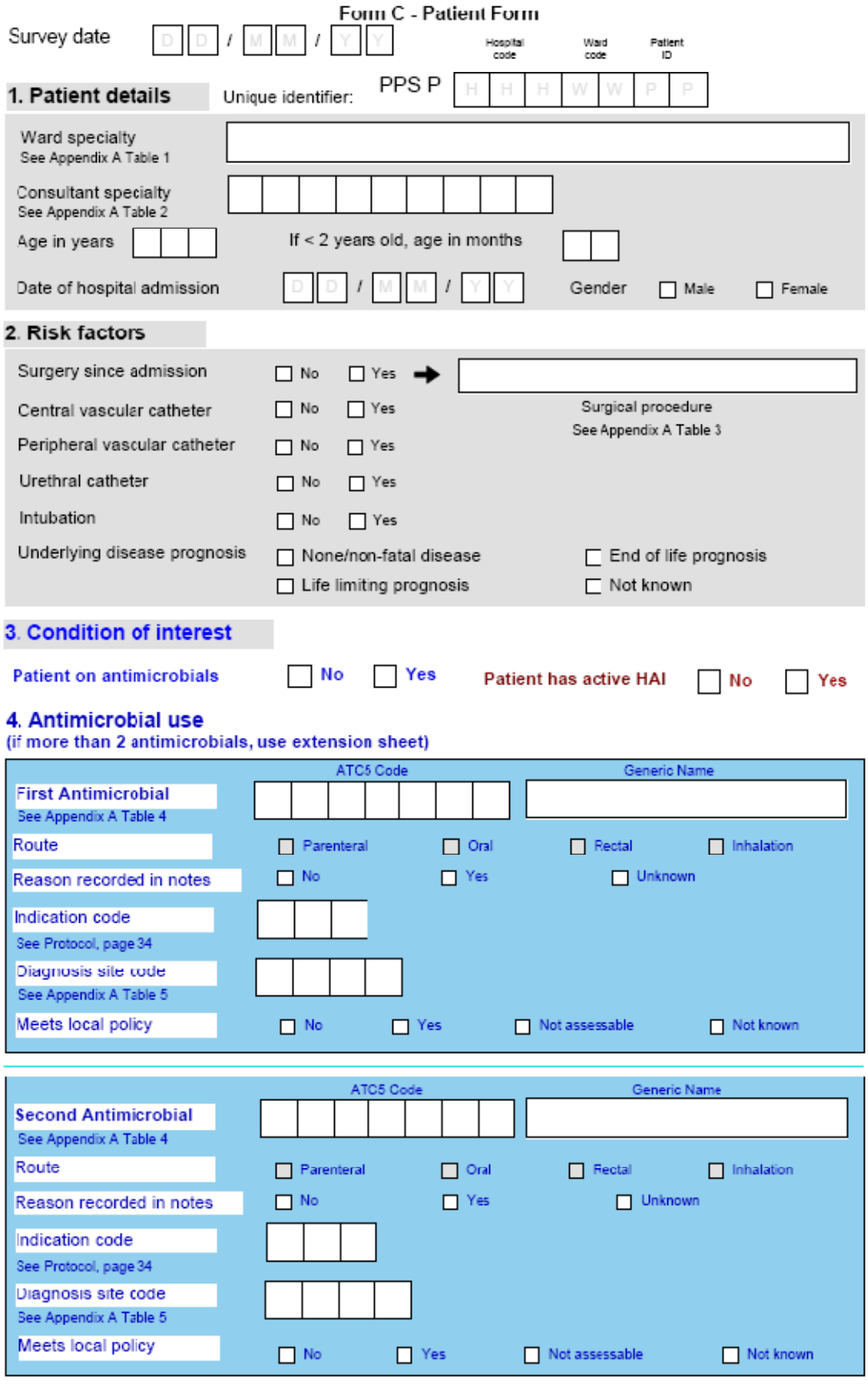
12. Health Protection Surveillance Centre. *Clostridium difficile* Sub-Committee. Surveillance, Diagnosis and Management of *Clostridium difficile*-associated disease in Ireland. 2008.
13. RCPI Clinical Advisory Group for Healthcare Associated Infections and Antimicrobial Resistance. Guidelines for the control and prevention of multi-drug resistant organisms, excluding MRSA, in the healthcare setting. Draft for consultation 2011.

Appendix A: PPS Patient Data Collection Form



Form C - Patient Form

Survey date D D / M M / Y Y

Hospital code | Ward code | Patient ID

1. Patient details Unique identifier: PPS P H H H W W P P

Ward specialty
See Appendix A Table 1

Consultant specialty
See Appendix A Table 2

Age in years | If < 2 years old, age in months

Date of hospital admission D D / M M / Y Y Gender ☐ Male ☐ Female

2. Risk factors

Surgery since admission	☐ No	☐ Yes	→ Surgical procedure (See Appendix A Table 3)
Central vascular catheter	☐ No	☐ Yes	
Peripheral vascular catheter	☐ No	☐ Yes	
Urethral 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 on antimicrobials ☐ No ☐ Yes Patient has active HAI ☐ No ☐ Yes

4. Antimicrobial use
(if more than 2 antimicrobials, use extension sheet)

	ATC5 Code	Generic Name			
First Antimicrobial (See Appendix A Table 4)					
Route	☐ Parenteral	☐ Oral	☐ Rectal	☐ Inhalation	
Reason recorded in notes	☐ No	☐ Yes	☐ Unknown		
Indication code (See Protocol, page 34)					
Diagnosis site code (See Appendix A Table 5)					
Meets local policy	☐ No	☐ Yes	☐ Not assessable	☐ Not known	

	ATC5 Code	Generic Name			
Second Antimicrobial (See Appendix A Table 4)					
Route	☐ Parenteral	☐ Oral	☐ Rectal	☐ Inhalation	
Reason recorded in notes	☐ No	☐ Yes	☐ Unknown		
Indication code (See Protocol, page 34)					
Diagnosis site code (See Appendix A Table 5)					
Meets local policy	☐ No	☐ Yes	☐ Not assessable	☐ Not known	

5. Hospital-acquired infection data (HAI)

Unique identifier: PPS P (Hospital code: H H H; Ward code: W W; Patient ID: P P)

HAI 1

HAI Code
See Appendix A Table 6

If SSI, record the procedure
See Appendix A Table 3

If, BSI: source
See Appendix A Table 7

Relevant device in situ before onset ☐ Yes ☐ No

Active HAI at admission ☐ Yes ☐ No

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

Date of HAI onset D D / M M / Y Y

Microorganism 1
See Appendix A Table 8

Resistance Code 1
See Appendix A Table 9

Microorganism 2

Resistance Code 2

Microorganism 3

Resistance Code 3

HAI 2

HAI Code
See Appendix A Table 6

If SSI, record the procedure
See Appendix A Table 3

If, BSI: source
See Appendix A Table 7

Relevant device in situ before onset ☐ Yes ☐ No

Active HAI at admission ☐ Yes ☐ No

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

Date of HAI onset D D / M M / Y Y

Microorganism 1
See Appendix A Table 8

Resistance Code 1
See Appendix A Table 9

Microorganism 2

Resistance Code 2

Microorganism 3

Resistance Code 3

HAI 3

HAI Code
See Appendix A Table 6

If SSI, record the procedure
See Appendix A Table 3

If, BSI: source
See Appendix A Table 7

Relevant device in situ before onset ☐ Yes ☐ No

Active HAI at admission ☐ Yes ☐ No

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

Date of HAI onset D D / M M / Y Y

Microorganism 1
See Appendix A Table 8

Resistance Code 1
See Appendix A Table 9

Microorganism 2

Resistance Code 2

Microorganism 3

Resistance Code 3

Form C - Extension sheet for antimicrobials 3, 4 and 5 (if required)

Unique identifier:

Hospital code			Ward code		Patient ID	
H	H	H	W	W	P	P

Third Antimicrobial
See Appendix A Table 4

ATC5 Code | Generic Name

Route: ☐ Parenteral ☐ Oral ☐ Rectal ☐ Inhalation

Reason recorded in notes: ☐ No ☐ Yes ☐ Unknown

Indication code
See Protocol, page 34

Diagnosis site code
See Appendix A Table 5

Meets local policy: ☐ No ☐ Yes ☐ Not assessable ☐ Not known

Fourth Antimicrobial
See Appendix A Table 4

ATC5 Code | Generic Name

Route: ☐ Parenteral ☐ Oral ☐ Rectal ☐ Inhalation

Reason recorded in notes: ☐ No ☐ Yes ☐ Unknown

Indication code
See Protocol, page 34

Diagnosis site code
See Appendix A Table 5

Meets local policy: ☐ No ☐ Yes ☐ Not assessable ☐ Not known

Fifth Antimicrobial
See Appendix A Table 4

ATC5 Code | Generic Name

Route: ☐ Parenteral ☐ Oral ☐ Rectal ☐ Inhalation

Reason recorded in notes: ☐ No ☐ Yes ☐ Unknown

Indication code
See Protocol, page 34

Diagnosis site code
See Appendix A Table 5

Meets local policy: ☐ No ☐ Yes ☐ Not assessable ☐ Not known

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

PN: PNEUMONIA

Rx

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

and at least ONE of the following

Symptoms

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

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

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

and according to the used diagnostic method

Microbiology

a – Bacteriologic diagnostic performed by:

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

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

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

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

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

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

c – Others

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

BSI: BLOODSTREAM INFECTION

BSI: Laboratory-confirmed bloodstream infection

- ONE positive blood culture for a recognised pathogen (e.g., *Staphylococcus aureus, Escherichia coli, Candida albicans* etc.) [If any doubt regarding what constitutes a recognised pathogen, please discuss with microbiology]

or

- Patient has at least ONE of the following signs or symptoms: fever (>38°C), chills or hypotension
  and
  TWO positive blood cultures for a common skin contaminant** (the same organism must have been isolated from two separate blood culture samples, usually taken within a 48 hour period).

**Skin contaminants = coagulase-negative staphylococci, *Micrococcus sp., Propionibacterium acnes, Bacillus spp., Corynebacterium spp.*

Primary BSI:

Catheter-related BSI: Primary BSI due to infection of either a peripheral vascular catheter (PVC) or central vascular catheter (CVC).

When the same microorganism was cultured from both the blood and the vascular catheter, this is microbiologically confirmed catheter-related BSI (CRI3): CRI3-PVC or CRI3-CVC. See CRI definitions below for further information (See **Appendix D** for algorithm for diagnosis of catheter related-infection).

When the patient has positive blood cultures (one or more sets with a significant pathogen or at least two sets with organism regarded as a skin contaminant) without microbiological confirmation of the same organism from the vascular catheter and the patient's symptoms improve within 48 hours after removal of the catheter, this is clinically-diagnosed catheter-related BSI without microbiological confirmation linking the blood culture to the vascular catheter (C-PVC or C-CVC).

Unknown origin (UO): Primary BSI of unknown origin. Not related to vascular catheter infection and not meeting definition of secondary BSI below. Decision to classify as BSI-UO has been verified during the point prevalence survey as no identifiable source was found for that BSI).

Secondary BSI:

BSI arising secondary to an infection elsewhere in the body.

When the same micro-organism was cultured from both the blood and another infection site or strong clinical evidence exists that the patient's BSI developed secondary to another infection site, invasive diagnostic procedure or foreign body.

Pulmonary infection resulting in BSI **(S-PUL)**
Urinary tract infection resulting in BSI **(S-UTI)**
Digestive tract infection resulting in BSI **(S-DIG)**
Surgical site infection resulting in BSI **(S-SSI)**
Skin and soft tissue infection resulting in BSI **(S-SST)**
Other infection not covered by those categories above resulting in BSI **(S-OTH)**

Note: Secondary BSI is reported as a separate HAI, in addition to the primary infection, if the primary infection matches the relevant HAI case definition.

BSI Source Unknown (UNK): No information available about the BSI source or information missing.

GI: GASTROINTESTINAL SYSTEM INFECTION

GI-CDI: *Clostridium difficile* infection

Clostridium difficile infection must meet at least ONE of the following criteria:

1. Diarrhoeal stools or toxic megacolon, and a positive laboratory assay for *C. difficile* toxin A and/or toxin B in stools.
2. Pseudomembranous colitis revealed by lower gastro-intestinal endoscopy
3. Colonic histopathology characteristic of *C. difficile* infection (with or without diarrhoea) on a specimen obtained during endoscopy, colectomy or autopsy

NOTE: If clinical signs of *Clostridium difficile* infection appear within 28 days after hospital discharge period, GI-CDI must be defined as hospital-acquired infection (HAI).

Reporting instructions

- If you report CDI as a HAI – Don't forget to also report *C. difficile* as the causative microorganism using MO-code CLODIF. The only circumstance where CLODIF would not be reported would be if the patient's CDI was diagnosed only on the basis of findings of pseudomembranous colitis at endoscopy or colectomy without a positive microbiological result for *C. difficile* toxin.

GI-GE: Gastroenteritis (excluding CDI)

Gastroenteritis must meet at least ONE of the following criteria:

1. Patient has an acute onset of diarrhoea (liquid stools for more than 12 hours) with or without vomiting or fever (>38^{0}C) and no likely non-infectious cause (possible non-infectious causes include: bowel preparation for diagnostic tests, therapeutic regimen other than antimicrobial agents (e.g., laxatives, post-GI surgery), acute exacerbation of a chronic condition or psychologic stress).
2. Patient has at least TWO of the following signs or symptoms with no other recognised cause: nausea, vomiting, abdominal pain, fever (>38^{0}C) or headache **and** at least ONE of the following:
   a. An enteric pathogen (e.g., *Salmonella spp*, *Shigella spp*, *Campylobacter spp*. *E. coli* O157) is cultured from stool or rectal swab.
   b. An enteric pathogen is detected by routine or electron microscopy (e.g., norovirus, small round structured virus, *Cryptosporidium spp.*)
   c. An enteric pathogen is detected by antigen or antibody assay on blood or faeces (e.g., rotavirus, adenovirus)
   d. Evidence of an enteric pathogen is detected by cytopathic changes in tissue culture (toxin assay)
   e. Diagnostic single antibody titre elevated level of IgM) or 4-fold increase in paired sera (elevation of IgG between acute and convalescent serum samples) for pathogen.

GI-GIT: Gastrointestinal tract including oesophagus, stomach, small and large bowel and rectum) excluding gastroenteritis and appendicitis

Gastrointestinal tract infections, excluding gastroenteritis and appendicitis, must meet at least ONE of the following criteria:

1. Patient has an abscess or other evidence of infection seen during a surgical operation or histopathologic examination.
2. Patient has at least TWO of the following signs or symptoms with no other recognised cause and compatible with infection of the organ or tissue involved: fever (>38 C), nausea, vomiting, abdominal pain or tenderness **and** at least ONE of the following:
   a. Organisms cultured from drainage or tissue obtained during a surgical operation or endoscopy or from a surgically-placed drain
   b. Organisms seen on Gram's or potassium hydroxide (KOH) fungal stain or multinucleated giant cells seen on microscopic examination of drainage or tissue obtained during a surgical operation or endoscopy or from a surgically-placed drain
   c. Organisms cultured from blood
   d. Evidence of pathologic findings on radiographic examination
   e. Evidence of pathologic findings on endoscopic examination (e.g., Candida oesophagitis or proctitis).

GI-HEP: Hepatitis

Hepatitis must meet the following criteria:

1. Patient has at least TWO of the following signs or symptoms with no other recognised cause: fever (>38^{0}C), anorexia, nausea, vomiting, abdominal pain, jaundice or history of blood product transfusion within the previous three months **and** at least ONE of the following:
   a. Positive antigen or antibody test for hepatitis A virus, hepatitis B virus, hepatitis C virus or delta hepatitis
   b. Abnormal liver function tests (e.g., elevated ALT/ AST, bilirubin)
   c. Cytomegalovirus (CMV) detected in urine or oropharyngeal secretions

Reporting instructions

- Do not report hepatitis or jaundice of non-infectious origin (alpha-1 antitrypsin deficiency).
- Do not report hepatitis or jaundice resulting from exposure to hepatotoxins (alcoholic or acetaminophen-induced hepatitis).
- Do not report hepatitis or jaundice resulting from biliary obstruction (cholecystitis).

GI-IAB: Intraabdominal, not specified elsewhere; including gallbladder, bile ducts, liver (excluding viral hepatitis), spleen, pancreas, peritoneum, subphrenic or subdiaphragmatic space or other intraabdominal tissue or area not specified elsewhere

Intraabdominal infections must meet at least ONE of the following criteria:

1. Patient has organisms cultured from purulent material from intraabdominal space obtained during a surgical operation or needle aspiration.
2. Patient has abscess or other evidence of intraabdominal infection seen during a surgical operation or histopathologic examination.
3. Patient has at least TWO of the following signs or symptoms with no other recognised cause: fever (>38^{0}C), nausea, vomiting, abdominal pain, or jaundice **and** at least ONE of the following:
    a. Organisms cultured from drainage from surgically-placed drain (e.g., closed suction drainage system, open drain or T-tube drain).
    b. Organisms seen on Gram's stain of drainage or tissue obtained during surgical operation or needle aspiration
    c. Organisms cultured from blood and radiographic evidence of infection (e.g., abnormal findings on ultrasound, CT scan, MRI, or radiolabelled scans [gallium, technetium] or on abdominal x-ray).

Reporting instruction: Do not report pancreatitis (an inflammatory syndrome characterized by abdominal pain, nausea, and vomiting associated with high serum levels of pancreatic enzymes) unless it is determined to be infectious in origin.

SSI: SURGICAL SITE INFECTION

Superficial incisional (SSI-S)

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

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

Deep incisional (SSI-D)

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

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

Organ/Space (SSI-O)

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

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

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