NATIONAL SEPSIS REPORT 2021

Clinical Design and Innovation

March 2023

National Sepsis Outcome Report 2021

Dear Colleagues,

This is the seventh National Sepsis Outcome Report describing the burden of sepsis on our patients and the healthcare system. Understanding the pattern of sepsis incidence in Ireland is essential to inform the programme about the characteristics of individuals who are at increased risk both of developing sepsis and of dying from sepsis. This allows us to have heightened vigilance for sepsis amongst these individuals.

Sepsis does not discriminate. It can happen to anybody irrespective of their age. However, it is much more common in the extremes of age and in individuals with co-morbidities.

The most effective way to reduce mortality from sepsis is by prevention. Preventative measures are those measures to stay healthy and prevent infection. These include good sanitation, personal hygiene, healthy eating, exercising moderately, breast feeding, avoiding unnecessary antibiotics and vaccination for vaccine preventable infections. During the COVID-19 pandemic we have learned of the benefit of good infection prevention and control measures, including social distancing, mask wearing and handwashing.

The next most effective way to combat sepsis is through early recognition and treatment.
Six processes must occur to give a person the best opportunity to survive:

i) The person, their family or carer must be aware of the signs and symptoms of sepsis and the need to seek early medical review.
ii) Early recognition of sepsis by healthcare staff at the point of presentation or deterioration.
iii) Timely escalation to medical review to ensure that a thorough history and examination is carried out to identify infection as the likely (or suspected cause) of the patient being unwell and either detecting new onset organ dysfunction consequent to that infection or identifying that the person is in a group that puts them at an increased risk of developing and indeed dying from sepsis.
iv) The person with sepsis is treated with the Sepsis 6, which includes blood tests being sent to assess organ function.
v) Healthcare staff review the person's response to initial therapy and amend the treatment plan accordingly.
vi) Adequate critical care capacity is available to accommodate those patients who fail to respond to treatment and require critical care.

This report outlines the status of sepsis in Ireland based on data extracted from the Hospital Inpatient Enquiry (HIPE) dataset for 2021. All datasets have limitations and are dependent on methodologies used to identify and extract data. The strengths in this report include the education of the acute healthcare sector and the coders in a standardised approach to assessment and documentation of sepsis and using a consistent dataset.

This report shows that the associated in-hospital mortality rate for sepsis in 2021 has increased when compared to the 2020 data (20.3% vs 19.0%). Over the same period the number of documented cases of sepsis has also increased by 9.7% (13,319 vs 12,142). The crude mortality rate for septic shock has also increased from 40.8% to 45%. It appears that COVID-19 may be a major determinant of this increase. Further analysis has demonstrated that the incidence of sepsis plus COVID-19 increased markedly in 2021 alongside an increase in mortality in this cohort (see Table 10). This may represent a true increase in mortality for these patients or may represent more accurate documentation and coding.

The outcomes in this report are the result of the hard work and dedication of the staff caring for sick people in our acute healthcare sector and recognition must be given to the improvements that they have achieved through their willingness to engage in this quality improvement (Q.I.) programme. Each hospital's sepsis Q.I. programme was coordinated by their Sepsis Committee, which in many included a dedicated Sepsis Nurse, who took on these additional responsibilities. Credit also to the Group Sepsis Assistant Directors of Nursing who provided awareness, education, and painstaking audit to feedback to the Hospitals, Hospital Groups and to inform national data so that the ongoing education efforts could be strengthened.

We would like to thank Dr. Orla Healy, National Clinical Director Quality and Patient Safety Directorate, HSE for generously supporting this report and to Ms. Gráinne Cosgrove, and Ms. Florina Rizoaica in the National Quality and Patient Safety Directorate, for providing the statistical analysis, without whom this report would not be possible.

Finally, we wish to thank the members of the report subcommittee (Appendix 1) including the Healthcare Pricing Office, the Office of Coding, who manage the HIPE system. The National Sepsis Programme is overseen by the National Sepsis Steering Committee (Appendix 2) and effected through the National Sepsis Team (Appendix 3). The diagnostic codes used for this analysis are outlined in Appendix 4.

Go raibh mile maith agat,

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Executive Summary 2021

Key findings

The following figures include adult, maternity, and paediatric patients.

Number of cases: sepsis and septic shock, 2021	**13,319**
Crude mortality 2021	**20.3%**

The following relate to the adult, non-maternity patient.

Number of cases: sepsis & septic shock	**12,455**
In-hospital crude mortality: Sepsis & Septic Shock	**21.5%**
Average length of stay	**21.2 days**

Specialty based data:

Paediatric sepsis-associated hospital crude mortality	**3.4%**
Maternal sepsis-associated hospital crude mortality	**0%**
Surgical Diagnostic Related Group (DRG) sepsis-associated hospital crude mortality	**27.7%**
Medical DRG sepsis-associated hospital crude mortality	**20.2%**

Key comparators with 2020 (adult non-maternity cohort)

- **A 10.3% increase in documented cases of sepsis and septic shock**
- **A 7.0% relative increase in associated in-hospital crude mortality**
- **A 5.7% decrease in average length of stay**

Sepsis (excluding septic shock): There were 11,265 cases documented in 2021, a 10.7% increase when compared with 2020 (n=10,180), with an in-hospital crude mortality of 19.1%, representing a 6.7% increase in crude mortality over 2020 (n=17.9%). This benchmarks well internationally: UK 20.3%[1], USA 25%[2], Australia 19.7%[3] and globally 27%[4].

Septic Shock: There were 1,190 cases documented in 2021, a 6.8% increase when compared with 2020 (n=1,114), with an in-hospital crude mortality of 45.0%, representing a 10.1% relative increase in crude mortality when compared with 2020 (n=40.8%). This also benchmarks well internationally: global 42%[4].

Key Recommendations

1	Support a public sepsis awareness campaign to facilitate education of the general public on sepsis recognition.
2	Sepsis eLearning should be mandatory for all relevant Healthcare Professionals and be refreshed on a three yearly basis. Each hospital should have a mechanism in place to provide reassurance that this has been completed.
3	Continue to support education on sepsis recognition and integration of sepsis treatment pathways across primary and secondary care.
4	Continue to support the implementation of the Surviving Sepsis Campaign International Guidelines for the Management of Septic Shock and Sepsis-Associated Organ Dysfunction in Children (SSCGC 2020) across the acute hospital service.
5	Development of a sepsis mortality prediction model and scoring system to compare age and co-morbidity adjusted hospital sepsis-associated mortality rates nationally and internationally.
6	Continued support for the sepsis quality improvement programme at a national level and for the hospital sepsis/deteriorating patient committees.
7	Continued education of clinicians and HIPE coders in the Sepsis-3 definition with emphasis on the importance of documentation of sepsis/septic shock, infection and associated organ dysfunction.
8	Continued alignment of the national sepsis programme with national antimicrobial stewardship and antimicrobial resistance prevention programmes.

National Sepsis Report 2021

An overview of the burden of sepsis-associated mortality and healthcare usage (2011-2021), as captured by the Hospital In-Patient Enquiry database (HIPE).

Hospital in-patient enquiry (HIPE) dataset

The data captured in this dataset is dependent on the documentation in the patients' medical notes and its' subsequent coding. An external, independent body reviewed the quality of coding in 2016 and the subsequent report is available at www.hpo.ie.

The National Sepsis Programme has developed a clinical decision support tool, the Sepsis Form, that facilitates diagnosis and correct risk stratification, from which coders can code, providing a medical professional has signed the form.

Population studied

ICD–10–AM Diagnosis codes were used to identify patients with sepsis (Appendix 4a) and infection (Appendix 4b).

These codes were interrogated in all patients in the acute hospital sector. Maternity patients with sepsis are subject to analysis and reporting by Maternal Death Enquiry Ireland (National Perinatal Epidemiology Centre). Therefore, we present limited mortality data for this cohort.

Limitations

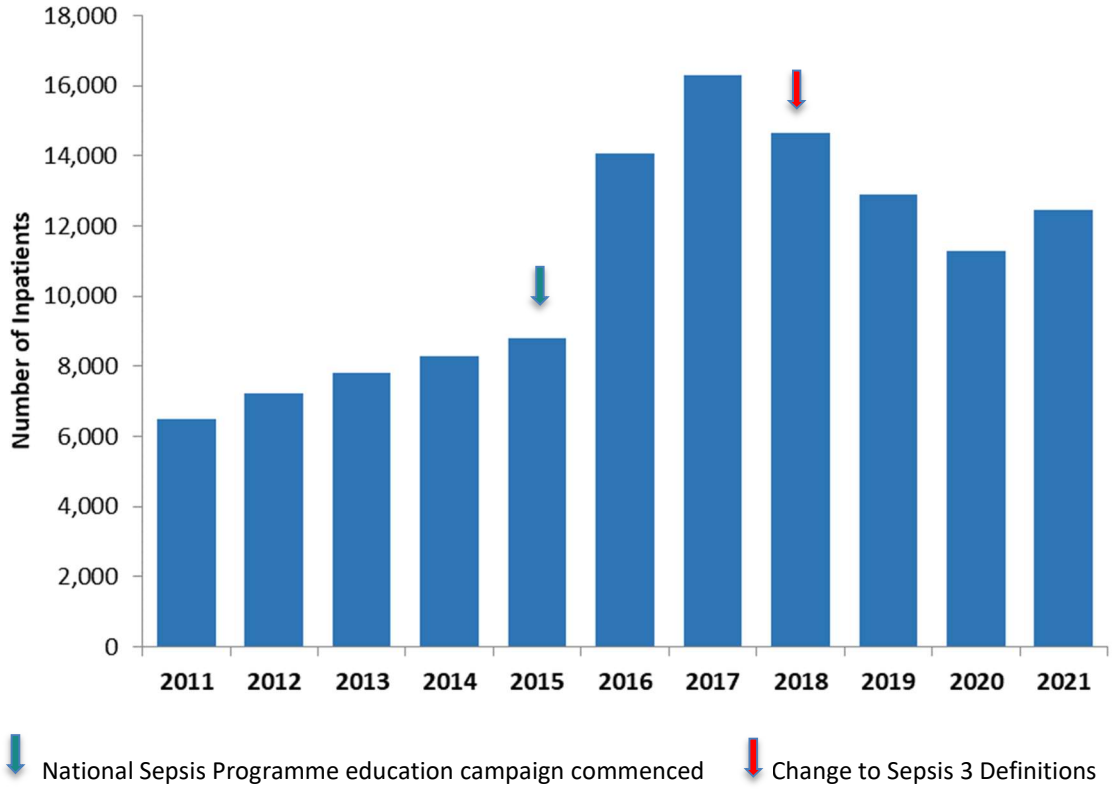
Administrative databases are limited to what is documented in the patients' case notes (The Coding Process, Appendix 4).

To severity-adjust for limited benchmarking, the surrogate of 'patients with a diagnosis of sepsis and critical care admission' was used. Critical care requirement was identified by admission to Coronary Care Unit (CCU), High Dependency Unit (HDU) or Intensive Care Unit (ICU), or the presence of an Intensive Care Consultant code recorded in the HIPE record. The advantage is that it includes critically ill patients where there was 'an intention to treat', and some limited comparison with critical care databases can be done. The disadvantages are that it assumes that there is always a critical care bed available, and it fails to consider that patients admitted to critical care are a heterogeneous group varying from requiring modest respiratory or cardiovascular support with a lower mortality predictive score to multi-organ failure and a high score. This current analysis provides age-adjusted mortality rates and provides an insight into the burden of sepsis in our healthcare system. Both age and co-morbidities are strongly associated with higher mortality from sepsis. Sex difference in sepsis incidence occurs but not in mortality. Based on the current analysis, the requirement to develop and validate a sepsis mortality prediction model for the HIPE database remains and has been highlighted again in key recommendations.

The data presented in this report are based on inpatients in publicly funded acute hospitals with the diagnosis of sepsis coded on the HIPE system. Causality cannot be inferred, as sepsis may be one of many diagnoses that complicated the patients' admission. Thus, mortality rates reported are sepsis-associated and include both direct and indirect deaths due to sepsis. Other limitations include; not all Irish hospitals participate in submitting data to HIPE; patients who attend the Emergency Department are not captured by HIPE (unless admitted to a ward); patients who attend an outpatient clinic are not captured by HIPE.

The Epidemiology of Sepsis in Ireland

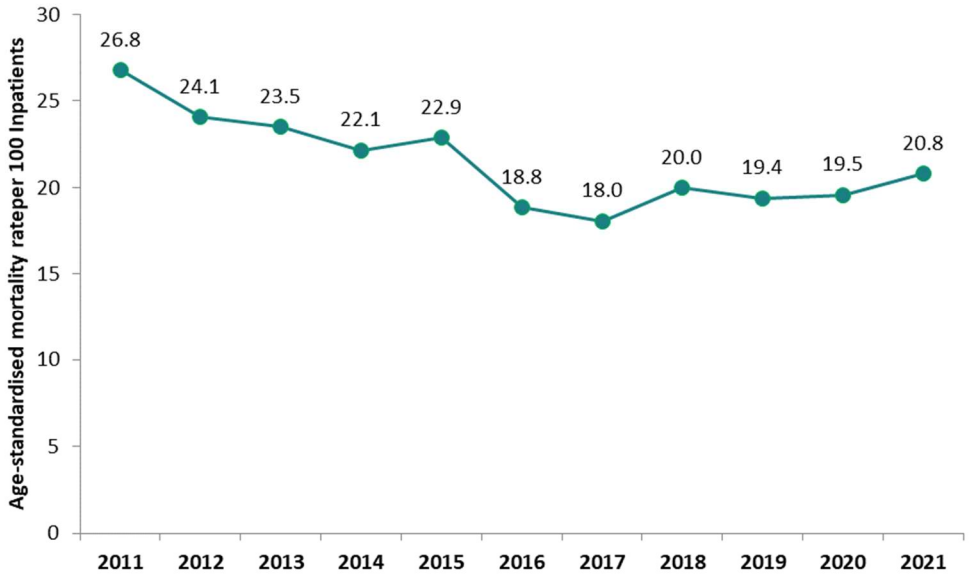
Figure 1: The number of adult patients with a diagnosis of Sepsis & Septic Shock, 2011- 2021 (excludes paediatric and maternity).



Between 2011 and 2015 documented cases of sepsis were increasing by approximately 8% per annum. In 2015, there was a nationwide education campaign as part of the implementation programme of the 2014 National Clinical Guideline. This resulted in a 60% increase in the recognition and documentation of sepsis cases. The effect of ongoing sepsis awareness education is reflected in the increase in cases documented since 2015 (Figure 1). However, the decrease now observed in reported sepsis cases from the peak recorded in 2017 to 2021 could plausibly represent a waning of the effect of the eLearning and education program. Consequently, the programme has recommended that sepsis eLearning should become mandatory for all relevant healthcare professionals and be refreshed on a three yearly basis. Each hospital should have a mechanism in place to provide reassurance that this has been completed.

Sepsis-3 definitions identify a cohort of patients with a higher acuity than previously documented as sepsis. It is reasonable to expect a lower number of cases in this cohort with a higher mortality. In Ireland, the effect may be seen in the decrease in cases documented between 2017 and 2018 (Figure 1) and the increase in mortality since 2017 (Figure 2).

Figure 2: Age-standardised hospital mortality rate for adult inpatients with a diagnosis of sepsis, 2011 – 2021.



High risk cohort

Risk stratification and prognosis in sepsis is important because high-risk patients may benefit from earlier clinical interventions, whereas low-risk patients may benefit from not undergoing unnecessary procedures[5]. Chronic comorbid conditions that alter immune function and increase the risk of sepsis include chronic renal failure, diabetes mellitus, and alcohol abuse, and cumulative comorbidities are associated with greater acute organ dysfunction[6].

Co-morbidities and Sepsis in Ireland

As per previous National Sepsis Reports, the average age of patients with sepsis was in the mid-seventies and they had an average of at least two co-morbidities.

As in previous years, in 2021, whilst sepsis incidence increases with age in adults (Figure 3), mortality peaks at the extremes of age (Figure 4). With a crude mortality of over 20%, a person aged over 75 years is considered at high risk for sepsis mortality.

With ageing, co-morbidities are accumulated, and the immune system gradually deteriorates leading to increases in both incidence and mortality (Figure 5).

Figure 3: The number of inpatients with a diagnosis of sepsis by age group 2021. (Includes maternity and paediatrics)

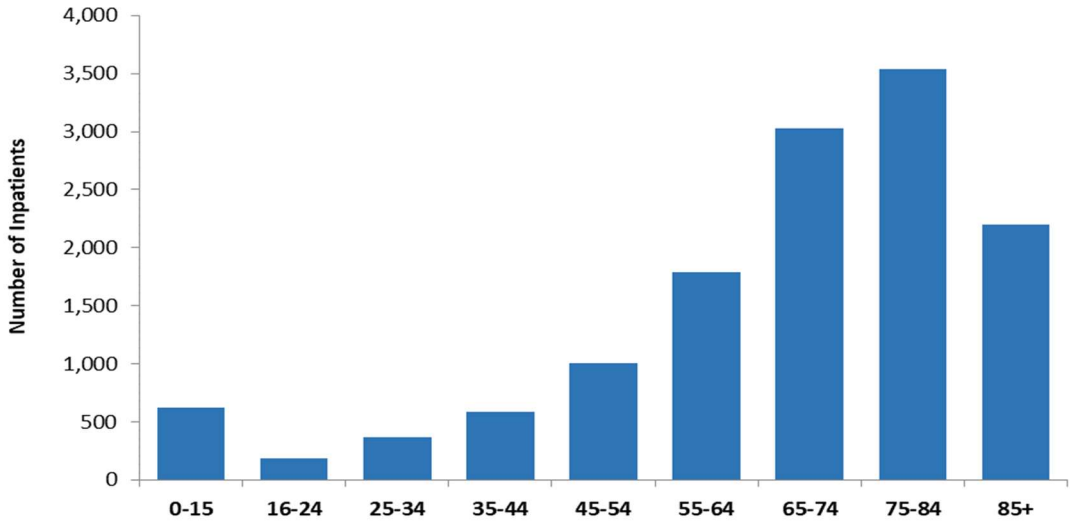


Figure 4: In-hospital crude mortality for inpatients with a diagnosis of sepsis by age groups 2021. (Includes paediatrics and maternity).

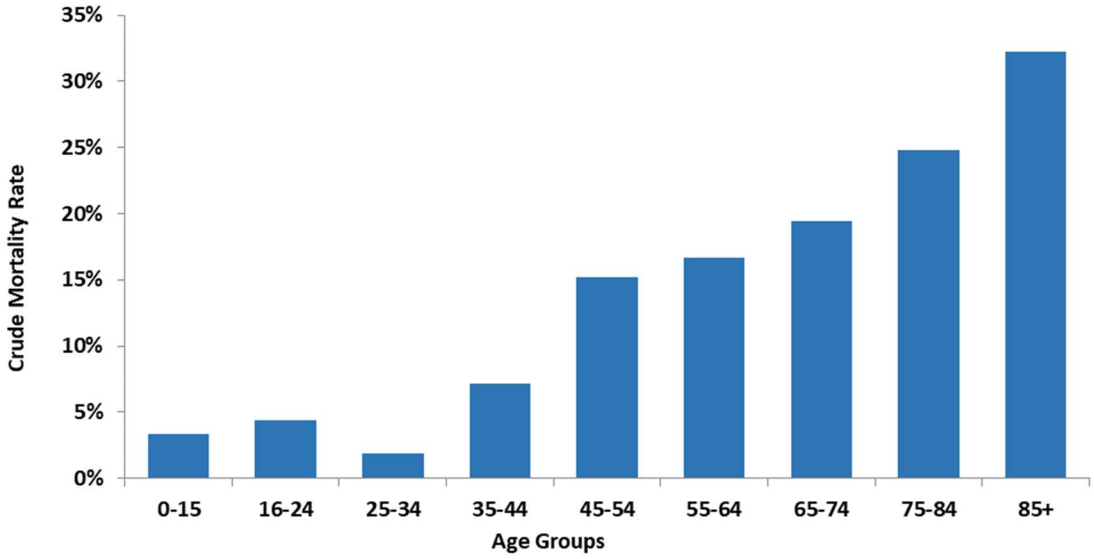


Figure 5: The in-hospital crude mortality for adult inpatients with a diagnosis of sepsis and selected co-morbidities 2021

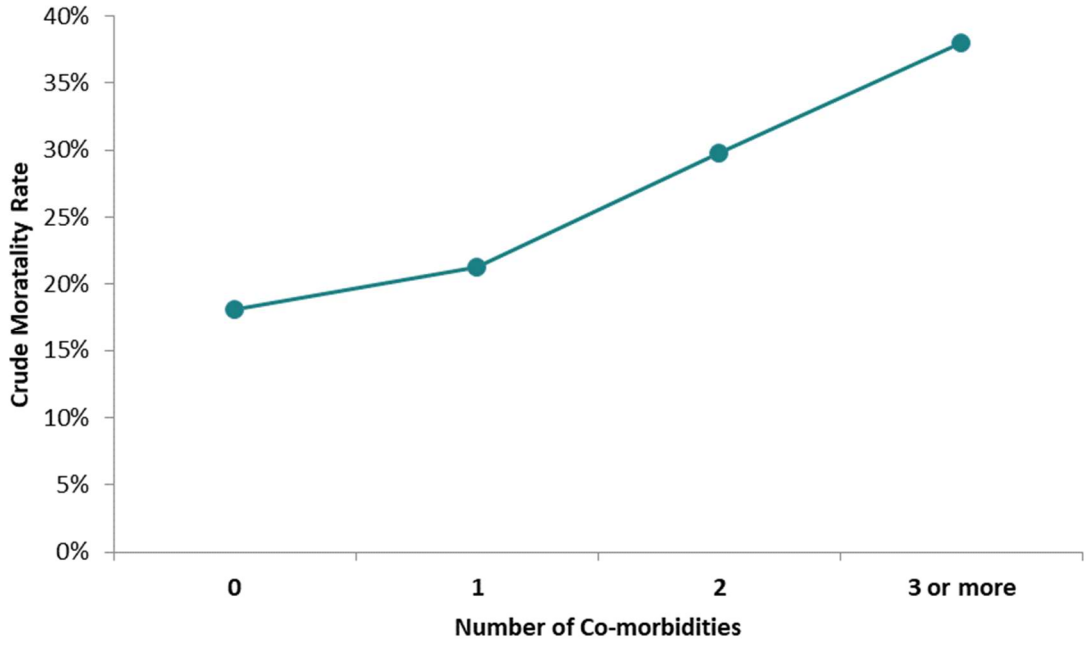


Table 1 summarises the effect of co-morbidities on sepsis and crude mortality.

Table 1: Inpatients with a diagnosis of sepsis and selected co-morbidities; Number of cases and crude mortality rates 2021.

Co-morbidity	Number of cases	Crude Mortality Rate
Mental & Behavioural Disorders due to Alcohol	568	32.2%
Chronic Obstructive Pulmonary Disease	973	32.1%
Cancer	2,919	22.0%
Chronic Kidney Disease	1,579	31.0%
Chronic Liver Disease	489	42.7%
Diabetes	2,978	21.9%

Note: Cases with more than one of the co-morbidities above are included in each of the relevant co-morbidity groups. This excludes paediatrics and maternity.

Effect of Recent Surgery on sepsis mortality.

The 2021 HIPE data identified that sepsis patients with a surgical diagnosis related group (DRG) continue to have a higher mortality than those with a medical DRG (27.7% vs 20.2%). Previous reports identified that the difference in mortality between the medical and surgical cohorts is not due to issues related to recognition and management, but rather inherent in the circumstances of the patient, the immunosuppressant effect of surgery and the different microorganisms and sites of infection that affect these patients. This data is widely replicated in other jurisdictions. Given this higher mortality risk, extra vigilance

should be given to surgical patients who develop signs of infection. For this reason, recent surgery is also considered to place patients in a high-risk group for sepsis.

The more co-morbidities the higher the mortality risk (Figure 5). Therefore, extra vigilance should be given to patients who develop signs of infection and who a) have one or more co-morbidities including those over 75years, or b) with identified chronic conditions or c) recent surgery.

Sepsis-associated mortality, 2011-2021

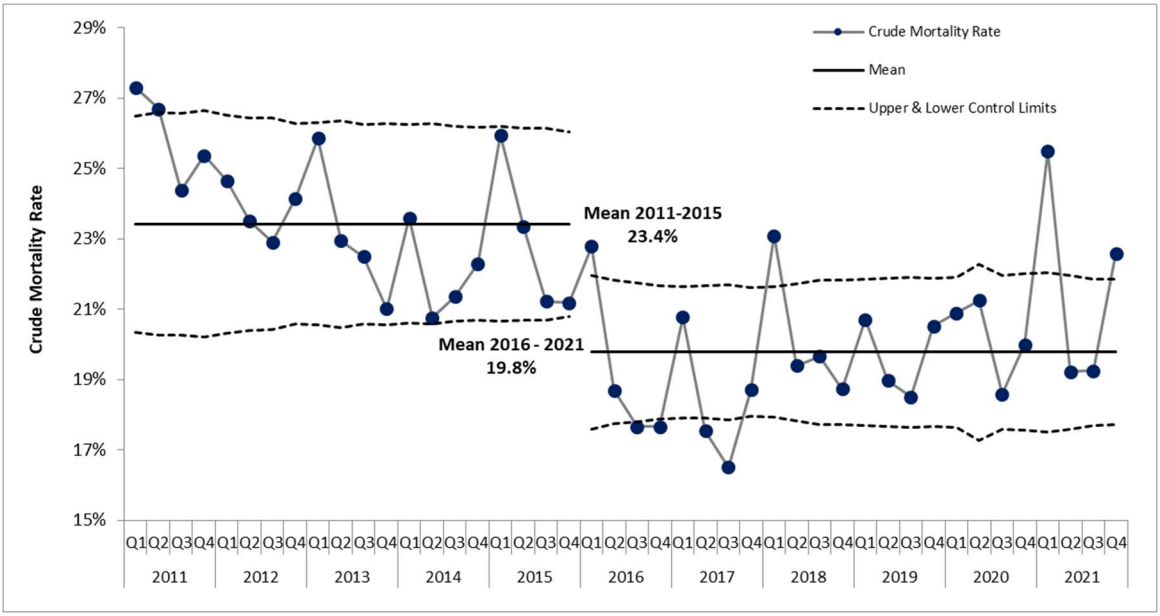
Age-adjusted mortality rates control for the effects of differences in age distributions, and allow for comparisons of mortality rates across years with different age distributions. (Table 2). However, both age and co-morbidities are strongly associated with higher mortality from sepsis in Ireland and the National Sepsis Programme recommend the development of a sepsis mortality prediction model and scoring system to enable the comparison of age and co-morbidity adjusted hospital sepsis-associated mortality rates nationally and internationally.

Table 2: Adult inpatients (non-maternity) with a diagnosis of Sepsis, crude, and age-standardised mortality rates, 2011-2021.

Year	Number of Inpatients with a Diagnosis of Sepsis	Number of Deaths among Inpatients with a Diagnosis of Sepsis	Crude Mortality Rate per 100 Inpatients	Age-standardised Mortality Rate per 100 Inpatients*
2011	6,495	1,686	26.0	26.8
2012	7,227	1,720	23.8	24.1
2013	7,797	1,799	23.1	23.5
2014	8,275	1,821	22.0	22.2
2015	8,789	2,010	22.9	22.9
2016	14,079	2,676	19.0	18.8
2017	16,312	3,004	18.4	18.1
2018	14,639	2,979	20.3	20.0
2019	12,908	2,542	19.7	19.4
2020	11,294	2,273	20.1	19.6
2021	12, 455	2, 682	21.5	20.8

* Data have been age-standardised using a standard population based on the numbers of inpatients with a diagnosis of sepsis in 2015

Figure 6: Quarterly rates of in-hospital mortality for adult patients with a diagnosis of Sepsis, quarterly data, 2011 – 2021.



Seasonal variation

Peaks in mortality occur in the winter season corresponding with the higher incidence of respiratory tract infections, a number of which are vaccine preventable. This report clearly demonstrates the vulnerability of the older patient and those with co-morbidities to sepsis and it is recommended that this cohort avail of the relevant vaccinations (e.g., influenza, pneumococcal, COVID-19), as prevention is always better than cure and cure is not always possible even with the very best management.

Quarterly rates of in-hospital mortality for inpatients with a diagnosis of sepsis from 2011 to 2021 were analysed using statistical process control (SPC) methods (Figure 6). The use of SPC methods allows us to see whether the changes we made resulted in improvements and allow us to distinguish between variation that may have happened by chance alone and variation that indicates a real improvement in mortality rates.

The mean in-hospital crude mortality rate for inpatients with a diagnosis of sepsis from 2011- 2015 showed an average of 23.4%. Using control limits based on SPC methods it was expected during this period that the quarterly mortality rate would vary from around 20 to 26% by chance alone. The quarterly mortality rate has averaged 19.8% and has been below the previous average of 23.4% since 2016 indicating an improvement in mortality rates that is not explained by chance alone. The control limits in the SPC chart have been re-calculated to reflect this reduction. We can now expect that this improvement will be sustained, and the average crude mortality rate will remain below 20% (with some variation due to seasonal effects). We note substantial increases in mortality in Q1 and Q4 of 2021. On further analysis of the data, very similar spikes of patients with sepsis and COVID-19 were noted for these timeframes, and this may account for the outliers in Figure 6 above. The programme will continue to monitor the impact of COVID-19 on sepsis mortality.

Septic shock.

Septic shock is considered a sub-group of sepsis, where patients experience more severe disease characterised by hypotension necessitating vasopressor administration. This sub-group of patients consistently experience worse outcomes (Table 3).

Table 3: Adult inpatients (non-maternity) with a diagnosis of sepsis or septic shock, 2019-2021

Diagnosis	2019			2020			2021		
	No. of Inpatients	No. of Deaths	Crude Mortality Rate	No. of Inpatients	No. of Deaths	Crude Mortality Rate	No. of Inpatients	No. of Deaths	Crude Mortality Rate
Sepsis	11,819	2,139	18.1%	10,180	1,818	17.9%	11,265	2,147	19.1%
Septic Shock	1,089	403	37.0%	1,114	455	40.8%	1,190	535	45.0%
Total	**12,908**	**2,542**	**19.7%**	**11,294**	**2,273**	**20.1%**	**12,455**	**2,682**	**21.5%**

Specialties:

Maternity

In 2021, there were 238 pregnancy-related cases of sepsis, with no associated deaths (Table 4).

Table 4: Maternal sepsis-associated incidence and crude mortality rates, 2011-2021.

Year	Pregnancy Related Cases with a Diagnosis of Sepsis	
	Number of Inpatients	Crude Mortality Rate
2011	190	1.6%
2012	192	0.5%
2013	271	0.0%
2014	282	0.0%
2015	306	0.3%
2016	402	0.0%
2017	473	0.2%
2018	420	0.5%
2019	380	0.0%
2020	257	0.0%
2021	238	0.0%

Paediatrics

The majority of paediatric morbidity and mortality occurs in the under ones when the immune system is still immature (Table 5).

A paediatric sepsis form was developed in 2021 to support the implementation of the Surviving Sepsis Campaign International Guidelines in paediatric settings in Ireland, and to help support clinicians in standardising the recognition and management of sepsis in children. It is anticipated that the number of documented cases will increase next year because of increase recognition, and it is hoped that there will be an associated reduction in the crude mortality rate to mirror that experienced in the adult population.

Figure 7: Paediatric sepsis-associated incidence and crude mortality, 2011- 2021.

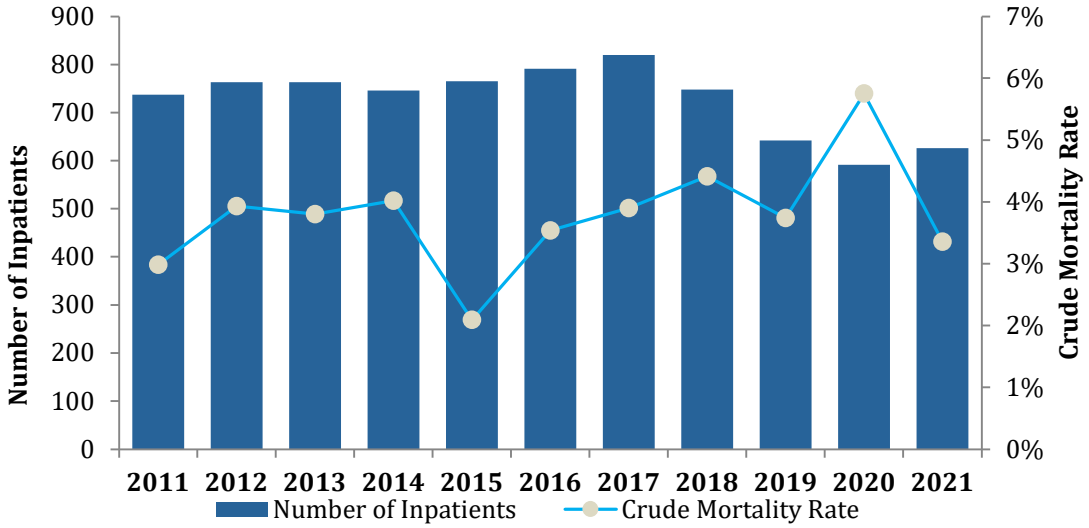


Table 5: Paediatric sepsis-associated incidence and crude mortality, by age group 2018 - 2021.

Age Group	Number of Inpatients	Number of Deaths	Crude Mortality Rate
Under 1 Year	2030	86	4.2%
1-15 Years	577	26	4.5%
Total	**2,607**	**112**	**4.3%**

Medicine and Surgery

In 2021, adult sepsis inpatients with a medical DRG accounted for 82% of all adult inpatients with sepsis (excluding maternity) while those with a surgical DRG accounted for 18% of adult inpatients with sepsis. However, adult sepsis inpatients with a surgical DRG spent over twice as long in hospital and had a higher mortality rate than their medical counterparts (Table 6).

Table 6: Adult inpatient with a diagnosis of sepsis by Surgical/Medical Diagnostic Related Group (DRG), 2021.

DRG	Number of Inpatients	Number of Bed Days	Average Length of Stay	Crude Mortality
Surgical	2,231	96,352	43.2	27.7%
Medical	10,224	167,894	16.4	20.2%
Total	**12,455**	**264,246**	**21.2**	**21.5%**

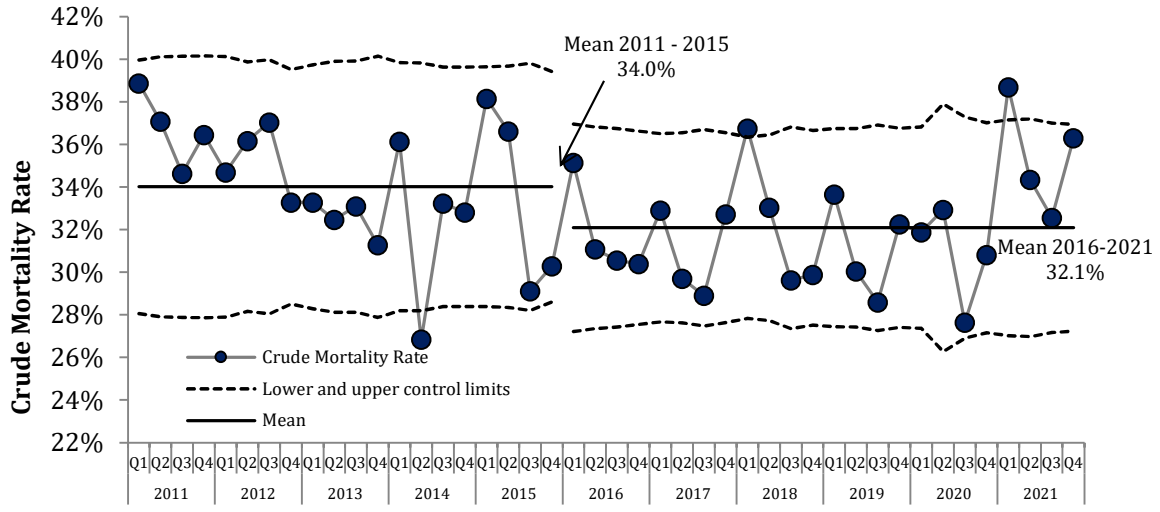
* 'Surgical' refers to inpatients with a surgical Diagnosis Related Group (DRG) which is assigned if there is at least one significant surgical procedure carried out in an operating room during that episode of care. 'Medical' refers to inpatients with a medical DRG which is assigned if there are no significant surgical procedures during that episode of care. The 'Medical' group above also includes a small number of patients with a DRG classified as 'Other', that is they had a non-surgical operating room procedure.

The average length of stay for surgical patients with sepsis is 43.2 days. The opportunity to shorten this by earlier recognition and treatment will not only improve patient outcomes but free up bed days for patients on waiting lists.

Critical Care

The mean in-hospital crude mortality for inpatients with a diagnosis of sepsis or septic shock admitted to critical care from 2011-2015 showed an average of 34% (Figure 7). For the period 2016-2021 this dropped to 32.1% representing a notable improvement since the inception of the national clinical programme for sepsis.

Figure 8: Statistical process control chart of hospital mortality for adult inpatients with a diagnosis of sepsis and admitted to a critical care area, quarterly data, 2011 – 2021.



In 2021, 25.4% of sepsis patients were admitted to a critical care bed and the mortality was more than twice that of those patients with sepsis managed on the ward (Table 7).

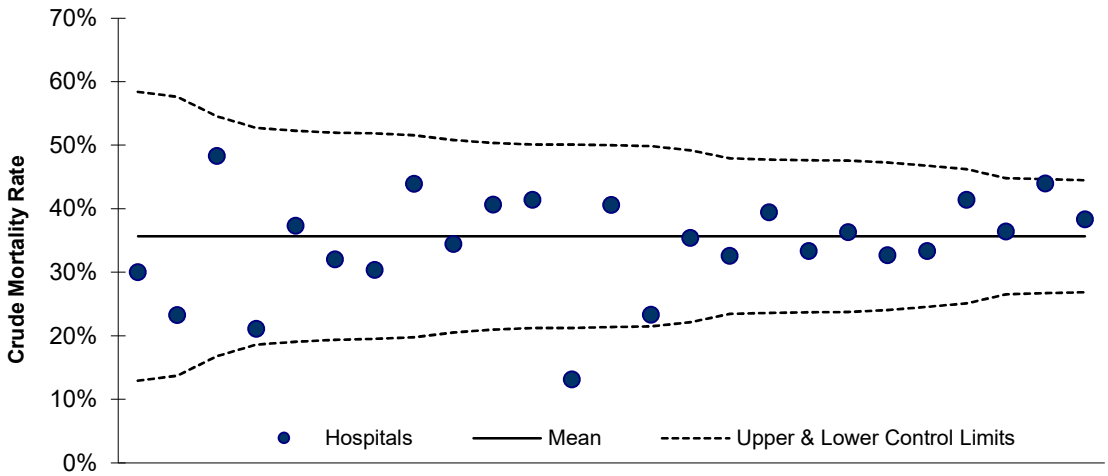
Table 7: Admission and crude mortality for adult inpatients (non-maternity) admitted to a critical care area with a diagnosis of sepsis or septic shock, 2021

	Admitted to Critical Care		Not Admitted to Critical Care	
	Total Number of cases	Crude mortality rate	Total Number of cases	Crude mortality rate
Sepsis + Septic Shock	3,159	35.5%	9,296	16.8%

The Centres for Disease Control and Prevention (CDC) report that 80% of all sepsis cases arise in the community and therefore present to the emergency department. The majority, 74.6%, are managed on a general ward and these patients have a mortality of 16.8%. Capacity in the critical care area remains the limiting factor for admission. Admission to critical care when required, as well as appropriate management on admission, will give the patient the best opportunity to survive.

In the absence of age and co-morbidity adjustment, which would allow each hospital sepsis-associated mortality to be published, the funnel plot (Figure 9) depicts the crude in-hospital mortality of patients with a diagnosis of sepsis or septic shock and who were admitted into a critical care area in hospitals who had more than 40 of such cases. It is the aim of the National Sepsis Programme to produce an age- and comorbidity-adjusted funnel plot for all acute hospitals that manage sepsis patients into the future. This would assure people that their hospital achieves similar outcome goals as others in the state and if a hospital has outlier status, it will facilitate further investigation as to the reasons why and enable timely intervention to correct that status and associated outcomes.

Figure 9: Inpatient crude mortality rate for adult inpatients with a diagnosis of sepsis or septic shock and admitted to a Critical Care area, by hospital, 2021.



Healthcare usage

It is of interest to compare sepsis cases with those coded as infection and all other diagnosis as it demonstrates the clear difference in these disease processes in terms of healthcare usage i.e. bed days used and average length of stay (Table 8) and outcome (Table 9). This is a clear driver to investigate the patient with infection for evidence of organ dysfunction, not just so they can be labelled correctly but also so they can get the urgent time-dependent therapy that is associated with improved outcome and have early input from senior decision makers to drive that therapy forward in terms of source control, critical care management and other complex needs.

Key findings:

Sepsis patients account for only 2.9% of the in-patient population but have a 4-fold higher mortality over patients coded with infection and a 2-fold higher length of stay.

Table 8: Healthcare usage – Sepsis vs infection and all other diagnoses, 2021

Diagnosis	Number of Inpatients	Number of Bed Days	Average Length of Stay, Days
Sepsis	12,455	264,246	21.2
Infection	104,315	1,258,398	12.1
All Other Diagnoses	312,503	1,466,139	4.7
Total	**429,273**	**2,988,783**	**7.0**

Table 9: Healthcare outcomes – Sepsis vs infection and all other diagnoses, 2021

Diagnosis	Number of Inpatients	% Total inpatients	Number of deaths	% Total deaths	Crude mortality
Sepsis	12,455	2.9%	2,682	22.3%	21.5%
Infection	104,315	24.3%	5,784	48.1%	5.5%
All Other Diagnoses	312,503	72.8%	3,569	29.7%	1.1%
Total	**429,273**		**12,035**		**2.8%**

COVID-19

The COVID-19 pandemic presents a unique situation whereby a very large number of patients globally manifest a largely homogenous disease process displaying signs predominantly of respiratory sepsis from a viral origin. The crude mortality for patients with both sepsis and COVID-19 was more than twice that of those without COVID-19 in 2021 (43.7% vs 19.6%) (Figure 10) and across all age groups (Table 10).

Figure 10: Crude mortality for adult inpatients with a diagnosis of infection or sepsis and with/without COVID-19, 2021.

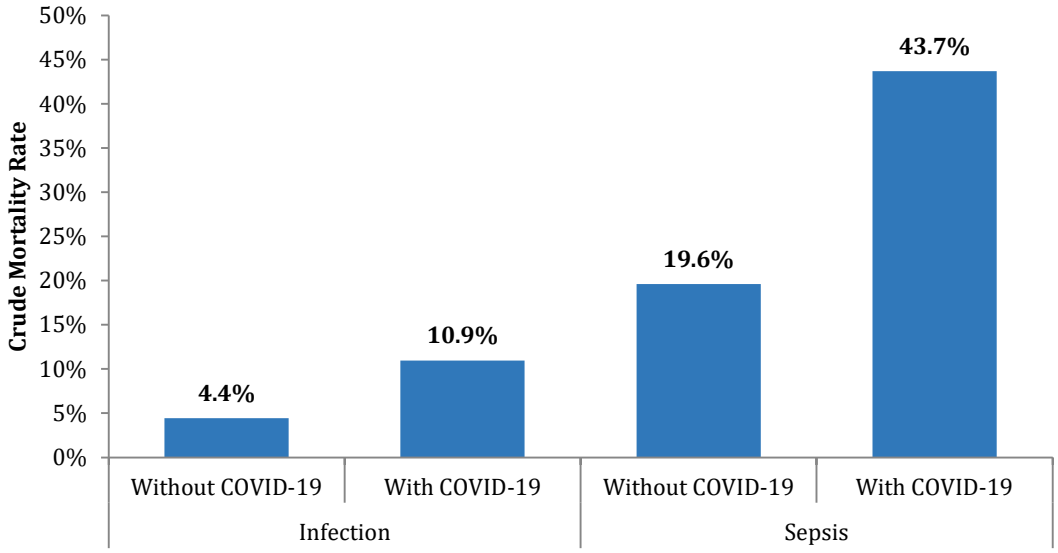


Table 10: Inpatients with a diagnosis of sepsis and with/without COVID-19, by age group 2021, (adult non maternity patients only).

	Sepsis with COVID-19		Sepsis without COVID-19		Total	
Age Group	Number of Inpatients	Crude Mortality Rate	Number of Inpatients	Crude Mortality Rate	Number of Inpatients	Crude Mortality Rate
16-44 Years	62	17.7%	841	5.5%	903	6.3%
45-64 Years	265	35.1%	2,529	14.2%	2,794	16.1%
65-84 Years	528	47.9%	6,036	20.1%	6,564	22.3%
85+ Years	145	55.2%	2,049	30.6%	2,194	32.3%
Total	**1,000**	**43.7%**	**11,455**	**19.6%**	**12,455**	**21.5%**

There was a marked increase in the number of cases of sepsis with COVID-19 in 2021 vs 2020 (1,000 vs 439) as well as the associated mortality (43.7% vs 37.6%). The crude mortality for sepsis without COVID-19 remained largely unchanged between 2021 and 2020 (19.6% vs 19.4%).

Table 11: Inpatients admitted to/not admitted to critical care with a diagnosis of sepsis and with/without COVID-19, 2021.

		Sepsis with COVID-19	Sepsis without COVID-19	Total
Admitted to Critical Care	**Number of Cases**	**465**	**2,694**	**3,159**
	Average Length of Stay in Days	51.4	29.3	32.6
	Crude Mortality	50.8%	32.8%	35.5%
Not Admitted to Critical Care	**Number of Cases**	**535**	**8,761**	**9,296**
	Average Length of Stay in Days	34.1	16.3	17.4
	Crude Mortality	37.6%	15.5%	16.8%
Total	**Number of Cases**	**1,000**	**11,455**	**12,455**
	Average Length of Stay in Days	42.1	19.4	21.2
	Crude Mortality	43.7%	19.6%	21.5%
Proportion Admitted to Critical Care		**46.5%**	**23.5%**	**25.4%**

The numbers of patients admitted to critical care with sepsis and COVID-19 increased in 2021 compared to 2020 (465 vs 194). There was also an increase in mortality (50.8% vs 36.6%).

We would urge caution in the interpretation of these results though, as an internal audit by the National Sepsis Programme revealed that a high proportion of patients with COVID-19 were not coded as having sepsis despite fulfilling criteria.

Balancing measures

The following data is from the Health Protection Surveillance Centre (HPSC). Further details are available at www.hpsc.ie

Multi-drug resistant organisms:

On-going surveillance is key to monitoring the emergence, spread and control of antimicrobial resistance (AMR). Since 1999, AMR surveillance in Ireland, as part of the European Antimicrobial Resistance Surveillance Network (EARS-Net), has been undertaken for a number of important pathogens that cause invasive infections, in particular bloodstream infections (BSIs). In 2021, EARS-Net data were received from 35 of 37 microbiology laboratories in Ireland with an estimated 97% coverage of the Irish population.

In 2021, 6205 isolates of all eight EARS-Net pathogens were reported, which is 4% higher than in 2020 (n=5969) but lower than 2019 (n=6665; the last year pre-pandemic). When comparing only the 35 laboratories that consistently reported over the latest five-year period (2017-2021), the numbers reported in 2021 remain 4% lower than in 2019. Four pathogens saw an increase in the numbers of cases reported when data from 2021 was compared to 2019 (+6% for both *S. aureus* and *Acinetobacter spp.*, *E. faecalis*, +16%; and *E. faecium*, +35%), while three pathogens saw a decrease (*E. coli,* -5%; - *K. pneumoniae*, -10%; and *S. pneumoniae*, -52%) and one pathogen remained relatively unchanged (P. aeruginosa, -1%). Across the EU/EEA, however, the overall number of all pathogens reported increased for *Acintebacter spp*. (+74%), *E. faecium* (33%) and *E. faecalis* (12%); decreased for *S. aureus* (-6%), *E. coli* (-12%) and *S. pneumoniae* (-46%); and relatively unchanged for *K. pneumoniae* and *P. aeruginosa*.

In Ireland, most of the key AMR indicators showed no significant trend over the latest 5-year period (2017-2021) with the following exceptions:

1. **Meticillin-Resistant *S. aureus* (MRSA):** The proportion of MRSA decreased significantly from 16.3% in 2017 to 10.6% in 2021, its lowest level since surveillance began in 1999. In fact, MRSA has been decreasing steadily since 2006, when it peaked at almost 42%. MRSA is also decreasing throughout EARS-Net countries (with a significant 5-year trend) with an EU/EEA weighted mean of 15.8%. The highest proportions are seen in Southern Europe.
2. **Vancomycin-Resistant *E. faecium* (VREfm):** The proportion VREfm decreased from 38.5% in 2017 to 27.6% in 2021, its lowest level since 2008. By contrast, VREfm is increasing across Europe (with a significant 5-year trend) with an EU/EEA weighted mean of 17.2%. Despite the decreasing trend here, Ireland still has one of the highest proportions in Europe, along with countries in Eastern Europe.

Despite decreasing trends for both MRSA and VRE, both of these AMR indicators remain problematic in Irish healthcare settings, accounting for approx. 1 in 10 *S. aureus* and almost 1 in 3 *E. faecium* invasive infections, respectively.

Carbapenem resistant organisms

Resistance to carbapenems is one of the biggest AMR challenges facing the healthcare systems in Ireland and worldwide. Carbapenem resistance in the Enterobacterales (CRE),

(which include *E. coli* and *K. pneumoniae*), and Acinetobacter spp. (CRA) is most commonly via the production of carbapenemase enzymes, e.g. KPCs, NDMs and OXA-type; hence, the terms carbapenemase-producing Enterobacterales (CPE) and carbapenem-producing Acinetobacter (CPA).

CRA is a major problem in most Eastern and Southern European countries. While Ireland reported 1.5% CRA (or one isolate) in 2021, the EU/EEA weighted mean was 39.9%. Twelve countries reported CRA proportions in excess of 60% (up from 11 countries in 2020). Carbapenem resistance among Acinetobacter spp. (especially *A. baumannii*) has been listed as one of the top priorities by the WHO for research and development of novel therapeutic agents.

CRE in Ireland is still very low compared to levels seen in Southern Europe, especially among *K. pneumoniae,* with proportions exceeding 25% in Greece and Italy. While one CRA isolate was reported in Ireland in 2021, the situation here contrasts greatly with what is seen in Southern and Eastern Europe, where CRA has increased to critical levels exceeding 60% in over one-third of EU/EEA countries. Implementation of antimicrobial stewardship and infection prevention and control strategies are required in order to prevent the emergence and spread of such highly resistant strains in Ireland.

Implementation of antimicrobial stewardship and infection prevention and control strategies are required in order to prevent the emergence and spread of such highly resistant strains in Ireland.

Clostridioides difficile infection (CDI):

Clostridioides difficile are bacteria normally found in the large intestine, and are the primary cause of antibiotic associated diarrhoea. In 2021, 1,766[1] cases of CDI were notified to public health. Of these, 1,532 (87%) were classified as new cases, 109 (6%) as recurrent and 125 (7%) as unknown case type. The national crude incidence rate for new and recurrent CDI per 100,000 population was higher than that reported in 2020 (32.8 versus 30.7; and lower than 39.0, the annual mean for 2015-2019). As in previous years, the majority of CDI was reported in patients aged ≥65 years (65%). Healthcare-associated (HCA) CDI accounted for the origin of 54% (n=964) of all cases, equating to a national incidence rate for new and recurrent HCA-CDI, that originated within the participating hospital, of 2.1 per 10,000 bed days used (BDU), which was lower than that of 2020 (2.4); and of the annual mean for 2015-2019 (2.4).

Antimicrobial consumption

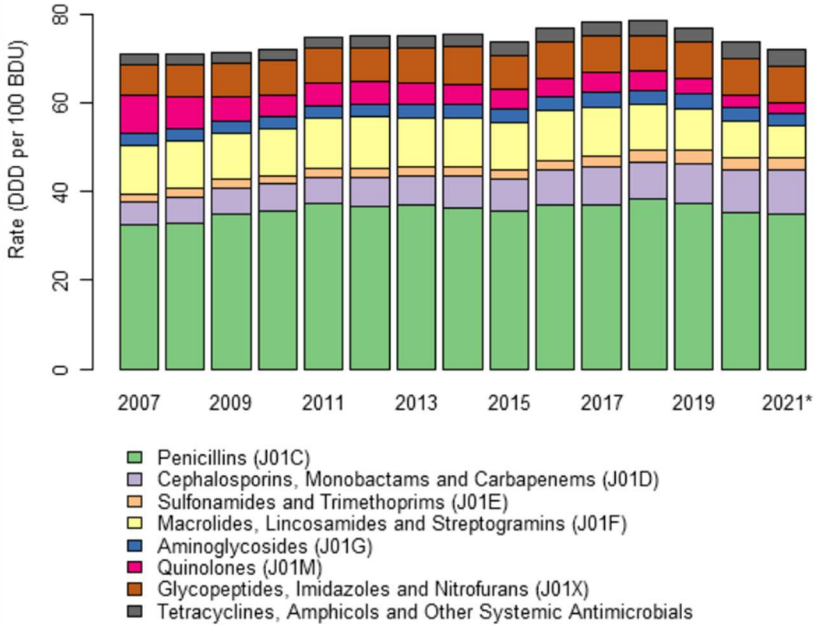
Antimicrobial prescribing is a key part of sepsis management. However, high rates of antimicrobial consumption increases the risk of AMR. Surveillance of both the quantity and the quality of antimicrobial use is therefore crucial, as antimicrobial resistance challenges the treatment of sepsis by reducing the number of antimicrobials effective to treat the condition.

[1] A further 67 late notifications of 2021 cases were notified to public health in 2022 bringing the total to 1,833

Quantity of antimicrobial prescribing (acute hospitals):

- The provisional median rate of systemic antibacterial consumption in 43 public acute hospitals in Ireland for 2021, as expressed in Defined Daily Doses per 100 bed days used (DDD/100BDU) was 70.1, a decrease on the figure of 77.4 in 2020.
- The overall national consumption (mean) decreased from 73.7DDDs/100BDU in 2019 to 71.9DDD/100BDU in 2021. This rate of antimicrobial consumption is mid-range in comparison with other European countries.
- Carbapenem consumption increased slightly from 2020, going from 2.1DDDs/100BDUs to 2.3DDDs/100BDUs. Consumption of fluoroquinolones has stabilised. However, third-generation cephalosporin consumption increased. Use of penicillin in combination with a beta-lactamase inhibitor (such as co-amoxiclav) remained at high levels and increased in 2021.

Title: Annual national hospital antibacterial consumption rate in DDD per 100 BDU by pharmacological subgroup (ATC level 3)



Quality of antimicrobial prescribing (acute hospitals):

52 acute hospitals in 2021 participated in an annual antimicrobial point prevalence study (PPS). The survey gathered key information looking at adherence to local hospital guidelines in antimicrobial prescribing:

- 84% of antimicrobials were considered to be of appropriate duration at the time of the PPS (2020:89%)
- A review date or duration was documented in 47% of prescriptions (2020: 45%)
- The percentage of antimicrobials where agent choice was in line with local guidelines or micro/ID approved remained stable at 84% (2020:85%, 2019: 84%).

For further information on antimicrobial prescribing, please see https://www.hse.ie/eng/services/list/2/gp/antibiotic-prescribing/hospital-related-guidelines/.

Paediatric Sepsis

The National Sepsis Programme convened a multidisciplinary paediatric sepsis working group which recommended adopting the Surviving Sepsis Campaign International guidelines (SSCGC) (HSE, 2021). With permission from the Surviving Sepsis Campaign group, the National Sepsis Programme developed a National Implementation Plan (NIP) to support implementation of the SSCGC recommendations within the acute paediatric healthcare setting in Ireland. Incorporated into the NIP is a clinical decision support tool (Sepsis Form) aimed at providing guidance for clinicians to recognise and treat sepsis in a timely manner. In September 2021 the International Guidelines for the Management of Septic Shock and Sepsis-Associated Organ Dysfunction in Children-National Implementation Plan for the Irish Healthcare System was approved by the Office of the Chief Clinical Officer, Clinical Design & Innovation, HSE. This was launched on 13th September 2021, World Sepsis Day.

All paediatric hospitals and acute hospitals with paediatric units are required to have a sepsis governance/deteriorating patient committee whose remit is to guide the implementation of the National Paediatric Sepsis guideline. Local implementation leads on each site have been identified to coordinate its implementation, supported by the group sepsis ADONs. Interim educational materials have been created by the national team to support this guideline implementation and an e-learning Paediatric Sepsis programme is currently in development. It is expected that this will be available on HSE-Land by July 2022. As part of the implementation process, a national paediatric sepsis audit will be undertaken in 2022 to evaluate current practice in sepsis management. It is envisaged that the information gleaned will inform on-going sepsis education and inform quality initiatives around implementation of the guideline.

Hospital Groups

In 2021, due to the re-deployment of Sepsis ADONs because of the COVID-19 pandemic, the National Sepsis Programme could not conduct process audits.

Sepsis remains a key patient safety improvement priority, as identified in the HSE's Patient Safety Strategy 2019-2024[9]. Robust structures have been put in place to support and monitor implementation of National Clinical Guideline No. 6 – Sepsis Management (NCG), including:

- Sepsis is a standing item on HCAI/AMR Group Oversight Committees which meet quarterly and are chaired by Hospital Group CEOs.
- All Groups have either made sepsis eLearning mandatory for all relevant HCWs or are planning to do so with the launch of the updated Sepsis eLearning programme.
- Group Sepsis ADON/Ms:
    - Are members of local sepsis/deteriorating patient committees providing advice and support.
    - Undertake process audits to measure compliance at hospital level with the NCG and provide feedback on audit results to Local and HG Leadership.
    - Provide information and updates as relevant.

Despite the challenges presented by COVID-19, many hospitals held sepsis awareness events for World Sepsis Day - 13th September and throughout the month of September (Sepsis Awareness Month). These events included: sepsis simulations; information stands for staff, patients, and visitors; virtual and in person presentations; staff quizzes; poster displays and ward-based education. Many Irish hospitals are featured on the annual World Sepsis Day global event poster.

Sepsis associated crude mortality rates for 2021 per Hospital Group are presented in table 11.

Table 12: Hospital Group crude mortality for sepsis & septic shock, 2019-2021 Adult inpatients only, excluding maternity and paediatrics.

Hospital Group	2019	2020	2021
Dublin Midlands	20.1%	21.5%	22.2%
Ireland East	19.7%	18.9%	22.5%
Royal College of Surgeons Ireland	18.5%	19.8%	19.9%
SAOLTA	19%	20.4%	20.8%
South Southwest	21%	20.3%	22.4%
University of Limerick	18.6%	22.5%	18.7%
National	**19.7%**	**20.1%**	**21.50%**

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Appendix 1: The National Sepsis Report Subcommittee

Member	Title
Dr. Michael O'Dwyer	National Sepsis Clinical Lead
Gráinne Cosgrove	Senior Statistician, QPS Intelligence, National Quality and Patient Safety Directorate, HSE
Florina Rizoaica	QPS Intelligence, National Office of Quality & Patient Safety
Lorna Quigley	Programme Manager, National Clinical Programme for Sepsis
Celine Conroy	Group Sepsis ADON Ireland East Hospital Group
Prof Fidelma Fitzpatrick	Chair Sepsis Steering Committee

Appendix 2: National Sepsis Steering Committee

Name	Job title and affiliation
Prof Fidelma Fitzpatrick	Consultant Microbiologist, Chair Sepsis Steering Committee
Dr Michael O'Dwyer	National Sepsis Clinical Lead
Vacant	National Sepsis Programme Manager
Prof. Garry Courtney	National Clinical Lead Acute Medicine
Prof Debbie McNamara	National Clinical Programme for Surgery
Dr. Karen Power	National Clinical Programme for Obs & Gynae
Dr. Michael Power	National Clinical Lead Critical Care
Dr. Omar Tujjar	National Clinical Lead Anaesthesia
Dr. Gerry McCarthy	National Clinical Lead Emergency Medicine
Fiona McDaid	Emergency Medicine Programme
Dr. Diarmuid O'Shea	National Clinical Programme for Older Persons
Siobhan Horkin	National Clinical Programme for Paediatrics and Neonates
Prof. Mary Keogan	National Clinical Lead – Pathology
Dr Michael O'Connor	NCAGL Acute Hospitals Division
Dr. Geraldine Shaw	ONMSD
Deirdre Murphy/ Jacqui Curley	Health Pricing Office
Declan McKeown	Health Intelligence Unit
Dr David O'Hanlon	Primary Care
Ms Avilene Casey	Deteriorating Patient Programme
Barbara Egan	Patient representative
Linda Dillon	Patient Advocacy Group
Ms Anne McCabe	NASCCRS (National Ambulance Service and critical care and retrieval services)
Gethin White	Library Services DSH
Tony McNamara	Hospital CEO/GM representative
Celine Conroy	Group Sepsis ADON - Ireland East Hospital Group
Karen D Holden	CNM3 SEPSIS & SSIs - Dublin Midlands Hospital Group
Dr Karn Cliffe	Group Sepsis ADON/M - Dublin Midlands Hospital Group
Mary Bedding	Group Sepsis ADON - RCSI Hospitals
Yvonne Young	Group Sepsis ADON - UL Hospitals Group
Ronán O'Cathasaigh	Group Sepsis ADON - Saolta University Health Care Group
Sinéad Horgan	Group Sepsis ADON - South / Southwest Hospital Group
Denise Mc Carthy	CNM3 Sepsis/SSI - South / Southwest Hospital Group

Appendix 3: The National Sepsis Programme Team 2021

Member	Title
Dr. Michael Dwyer	National Sepsis Clinical Lead
TBC	Programme Manager National Sepsis Programme
Mary Bedding	Group Sepsis ADON RCSI Hospital Group
Karn Cliffe	Group Sepsis ADON/M Dublin Midlands Hospital Group
Celine Conroy	Group Sepsis ADON Ireland East Hospital Group
Sinéad Horgan	Group Sepsis ADON South/South West Hospital Group
Ronan O'Cathasaigh	Group Sepsis ADON Saolta Hospital Group
Yvonne Young	Group Sepsis ADON UL Hospitals Group
Nuala Clarke	Group Sepsis ADON Children's Health Ireland

Appendix 4: The Coding Process

The source document for coding in Ireland for HIPE is the medical record or chart. The clinical coder uses the entire chart to extract the conditions and procedures to provide a complete record of the patient and their health care encounter. The clinical coder, the person who translates medical terminology into alphanumeric code, performs an essential function in providing quality, accurate, and uniform medical information and greatly contributes to the continuous growth of medical knowledge and research. In addition to the discharge summary or letter, additional documentation referenced for coding a case include nursing notes, consultation reports, progress notes, operative reports, pre- and post-operative reports, pathology reports and more recently the sepsis screening form.

The classification used is ICD-10-AM/ACHI/ACS 10th Edition (International Classification of Diseases, 10th Revision, Australian Modification/ Australian Classification of Health Interventions/Australian Coding Standards). The Australian Coding Standards have to be adhered to by clinical coders in their work. These are complemented by the Irish Coding Standards (ICS). The ICS are developed to complement the Australian Coding Standards (ACS) and are revised regularly to reflect changing clinical practice.

ACS 0010 General Abstraction Guidelines state that coders cannot infer diagnoses from laboratory results and that "The listing of diagnoses on the front sheet and/or the discharge summary of the clinical record is the responsibility of the clinician". It further states, "Unless a clinician can indicate that a test result is significant and/or indicates the relationship between an unclear test result and a condition, such test results should not be coded".

All HIPE data are keyed in at the hospital using the HIPE Portal data entry system that runs an extensive number of validations edit checks to ensure the quality of the data. Other data quality activities and data quality tools are in use at local and national HPO level.

Appendix 4a: ICD-10-AM Diagnosis Codes for Sepsis

Sepsis (based on Sepsis-3 definition)

ICD-10-AM Diagnosis Codes	Description
A40	Streptococcal sepsis
A41	Other sepsis
A02.1	Salmonella sepsis
A22.7	Anthrax sepsis
A26.7	Erysipelothrix sepsis
A32.7	Listerial sepsis
A42.7	Actinomycotic sepsis
B37.7	Candidal sepsis
T81.42	Sepsis following a procedure[1]
R65.1	Systemic inflammatory response syndrome [SIRS] of infectious origin with acute organ failure / Severe Sepsis

1. ICD-10-AM 8th Edition code, no corresponding 10th Edition Code.

Septic Shock

ICD-10-AM Diagnosis Codes	Description
R57.2	Septic Shock

NOTE:
Data are based on inpatients grouped into two mutually exclusive categories:
(i) Inpatients with any diagnosis (principal or secondary) of septic shock
(ii) Inpatients with any diagnosis (principal or secondary) of sepsis (including severe sepsis), excluding cases with any diagnosis of septic shock as these are already captured in the septic shock category.

Appendix 4b: ICD-10-AM Diagnosis Codes for Infections

ICD-10-AM Codes	Description
A00 - B99[1]	Certain Infectious & Parasitic Diseases
G00 - G07	Meningitis, Encephalitis, Intracranial and intraspinal abscess and granuloma
J00 - J06	Acute upper respiratory infections
J09 - J18	Influenza and pneumonia
J20 - J22	Other acute lower respiratory infections
J36	Peritonsillar abscess
J44.0	Chronic obstructive pulmonary disease with acute lower respiratory infection
K35.0[2]	Acute appendicitis with generalised peritonitis
K35.2[3]	Acute appendicitis with generalised peritonitis
K35.3[3]	Acute appendicitis with localised peritonitis
K57.0, K57.2, K57.4, K57.8	Diverticular disease of intestine with perforation and abscess
K61	Abscess of anal and rectal regions
K65	Peritonitis
L00–L08	Infections of the skin and subcutaneous tissue
M00–M03	Infectious arthropathies
M86	Osteomyelitis
N10 - N12	Acute, chronic & not specified tubulo-interstitial nephritis
N13.6	Pyonephrosis
N39.0	Urinary tract infection, site not specified
N45	Orchitis and epididymitis
R65.0	Systemic inflammatory response syndrome [SIRS] of infectious origin without acute organ failure
T80.2	Infections following infusion, transfusion and therapeutic injection
T81.4	
T81.41[3]	Wound infection following a procedure
T82.6	Infection and inflammatory reaction due to cardiac valve prosthesis
T82.7	Infection and inflammatory reaction due to other cardiac and vascular devices, implants and grafts
T83.5	Infection and inflammatory reaction due to prosthetic device, implant and graft in urinary system
T83.6	Infection and inflammatory reaction due to prosthetic device, implant and graft in genital tract
T84.5	Infection and inflammatory reaction due to internal joint prosthesis
T84.6	Infection and inflammatory reaction due to internal fixation device [any site]
T84.7	Infection and inflammatory reaction due to other internal orthopaedic prosthetic devices, implants and grafts
T85.7	Infection and inflammatory reaction due to other internal

	prosthetic devices, implants and grafts
T89.02	Open wound with infection
U07.1	Emergency use of U07.1 (COVID-19, virus identified)
U07.2	Emergency use of U07.2 (COVID-19, virus not identified)

[1.] Excluding diagnosis codes already included in the list of sepsis codes, i.e. A40, A41, A02.1, A22.7, A26.7, A32.7, A42.7, B37.7.

[2.] ICD-10-AM 6th Edition code.

[3.] ICD-10-AM 8th Edition code.

Appendix 4c: Pregnancy related exclusions

Admission type = 6 (Maternity) or Any diagnosis (principal or additional) of O00 – O99 (Pregnancy, Childbirth and the Puerperium) or Any diagnosis of

- Z32 Pregnancy examination and test
- Z33 Pregnant state, incidental
- Z34 Supervision of normal pregnancy
- Z35 Supervision of high-risk pregnancy
- Z36 Antenatal screening
- Z37 Outcome of delivery
- Z39 Postpartum care and examination
- Z64.0 Problems related to unwanted pregnancy
- Z64.1 Problems related to multiparity