NATIONAL SEPSIS REPORT 2011-2015

RECOGNISE SEPSIS • ENHANCE SURVIVAL

Feidhmeannacht na Seirbhíse Sláinte
Health Service Executive

Clinical Strategy and Programmes Division

7th December 2016

Dear Colleagues,

The National Sepsis Report will be published annually; its purpose is to highlight the burden of sepsis to the community and to the healthcare system. It will allow monitoring of the impact of National Clinical Guideline No. 6: Sepsis Management[1], its implementation and its aims of mortality reduction and decreased healthcare usage.

The National Sepsis Team was given the remit to use existing databases to measure and monitor implementation, this, in effect, is the Hospital Inpatient Enquiry system (HIPE). Administrative data has been validated in monitoring quality improvement projects, particularly in sepsis[2,3,4]. Although the quality of data does not match that of research studies and definitions are not strictly adhered to by clinicians, it has the advantage of large numbers and, as HIPE coding is based on what is documented in the patients' clinical notes, it reflects the incidence and outcomes of patients with sepsis as determined by their treating clinicians. This report needs to be interpreted in this context.

In order to optimize the quality of data, seven sepsis workshops for coders were held and in 2015 there was a positive external review of coding practice in HIPE (www.hpo.ie). The Sepsis Programme has made available (www.hse.ie/sepsis) and is promoting the use of sepsis screening forms as clinical decision support tools to aid sepsis diagnosis, accurate risk stratification and timely management. An e-learning programme on sepsis, its recognition and treatment using the sepsis screening form is available on HSEL and (https://www.hseland.ie/dash/Account/Login). Coders can code off this form when used and signed by the treating doctor.

This report has been produced by the Sepsis Audit Subcommittee (Appendix 1) and ratified by the National Sepsis Steering Committee (Appendix 2).

The National Sepsis Programme was set up by Dr Aine Carroll, National Director Clinical Strategy & Programmes Division and informs Dr Colm Henry, National Clinical Advisor and Group Lead Acute Hospitals.

The National Sepsis Team (Appendix 3) would like to acknowledge the work being done by Healthcare Professionals throughout the country to improve sepsis recognition and management. It is their work that results in patients getting the best opportunity to survive.

Particular thanks to Ms. Grainne Cosgrove, Senior Statistician, Measurement for Improvement Team, Quality Improvement Division, HSE, for extracting the data for this report.

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National Clinical Lead Sepsis

Contents

Tables

Figures

Executive Summary

An analysis of sepsis incidence, and associated mortality and healthcare usage was extracted from the HIPE database using the codes outlined in appendix[4].

Between 2011 and 2015:

The number of sepsis cases increased by 37% and the rate of in-hospital sepsis associated mortality decreased by 15%. These figures mirror the international experience in the Industralised World and are largely related to an ageing population with a longer life expectancy and increased co-morbidity load. Mortality reduction as a result of overall better care is also reported in these populations.[8,11,13,14]

Increased healthcare usage was partially offset by a 13.6% decrease in average length of stay, however, patients with infection and/or sepsis as whole or part of their clinical diagnosis occupied 48% of all hospital bed days in 2015. Bundle compliant sepsis management has been demonstrated to reduce hospital length of stay as well as mortality rates.[13]

There was an 11% decrease in mortality in the critical care cohort despite a 17.8% increase in the numbers admitted to critical care (CCU, HDU or ICU) and a reduction in the availability of critical care beds.

Mortality is associated with increasing age, the presence of co-morbidities and season. Whilst the incidence is greater in males there was no sex-related mortality difference demonstrated.

In 2015:

There were 8,888 cases of sepsis documented in adult inpatients. It affected 2% of all adult hospital patients and contributed to 18.8% of all hospital deaths. 70-80% of all sepsis cases are admitted from the community via the Emergency Department. (CDC).[17]

The average crude mortality of patients with diagnosis of uncomplicated sepsis as part of their discharge diagnoses and managed on the ward was 17.7%.

29% of cases were admitted to a critical care area.

The average crude mortality of those patients with a diagnosis of sepsis, severe sepsis or septic shock admitted to a critical care area was 33.4%.

Key Findings

Number of cases, 2015	**8,888**
Crude in-hospital sepsis-associated mortality rate, 2015	**22.7%**
Increase in cases, 2011 – 2015	**37%**
Decrease in average length of stay, 2011 – 2015	**13.6%**
Mortality rate increases with age and with co-morbidities	

Key Recommendations

1. Develop and validate a sepsis mortality prediction model for Ireland based on the HIPE database to enable the benchmarking of hospital sepsis mortality as a key patient safety indicator.

2. The use of the sepsis screening form as a clinical decision support tool to optimise patient care and data quality.

3. Vaccination; sepsis has a very high mortality rate and morbidity burden in survivors. Its incidence and mortality increases in the winter season some of which is preventable with vaccination i.e. pneumococcal and seasonal flu vaccinations. Older patients and those with co-morbidities have increased mortality risk and therefore increased benefit from preventative therapies. Herd vaccination reduces prevalence and confers societal benefit.

4. Support other preventative measures such as hand hygiene and careful management and separation of the patient area and the work area to reduce the transmission of infectious diseases.

5. Antimicrobial stewardship; this requires the rational identification of patients with infection and sepsis and evidence based management following local antimicrobial guidelines targeting the
   a. Site e.g. respiratory tract, intra-abdominal, urinary tract etc.
   b. Source e.g. community, healthcare-associated, hospital-acquired
   c. Patients factors
      c.i. Recent antimicrobial use
      c.ii. Known colonisation
      c.iii. Allergy status.

   Using the Start Smart, then Focus approach, as microbiological results become available. Blood cultures are often negative (in up to 60% of severe sepsis cases) and therapy rationalisation then depends on the patient's clinical response.

National Sepsis Report

An Overview of the Burden Of Sepsis-Associated Mortality and Healthcare Usage, 2011 - 2015, as captured by the Hospital In-Patient Enquiry database (HIPE).

Introduction

National Clinical Guideline No. 6: Sepsis Management[1] was published in November 2014 and it outlines recommendations for the diagnosis and treatment of patients with sepsis with the aim of reducing morbidity and mortality from sepsis in Ireland.

In order to document the burden of sepsis, and its impact on mortality, the Hospital In-Patient Enquiry (HIPE) dataset was interrogated. Administrative data is widely used in quality improvement efforts (QI)[2,3] and has been validated in sepsis QI assessment.[4]

The National Sepsis Report will be published annually by the Sepsis Programme with the purpose of informing the acute sector of the burden of sepsis and its associated mortality rates. This will allow tracking of incidence and mortality rates that in turn will help guide healthcare resourcing and support ongoing efforts to give patients the best opportunity to survive.

At the beginning of 2016, a gap analysis of the recommendations in the National Guideline to support improved sepsis management processes was performed and subsequently three process audits were done. These audits were fed back to the acute hospitals and the hospital groups for their information and action. An outline of these audits is included in this report.

HIPE dataset

The data captured in this dataset is dependent on the documentation in the patients' medical notes and its' coding. An external, independent body reviewed the quality of coding in 2015 and the subsequent report is available at www.hpo.ie.

The National Sepsis Programme provides clinical decision support tools, the Sepsis Screening forms[5], that facilitate diagnosis and correct risk stratification and from which Coders can code, provided a medical professional signs the form. A series of seven sepsis workshops for Coders were held around the country and more than 95% of Coders attended. These workshops introduced the forms, included a sepsis education presentation and had robust question and answer sessions. Further questions were invited by email and addressed in the form of a feedback report to participants. Using these screening forms facilitates documentation and optimises data quality.

The National Team visited all acute hospitals with education forums and presented on sepsis recognition and management and outlined the benefits of using the sepsis screening forms. In addition, the team met with hospital management and clinical leads to discuss implementation of the national sepsis guideline. All acute hospitals were advised to establish sepsis committees to support the implementation process. Six group Sepsis Assistant Directors of Nursing were appointed to support, audit and feedback on the rollout.

Population studied

ICD–10–AM Diagnosis codes were used to identify patients with sepsis (appendix 4a) and infection (appendix 4b). In 2015, the 8th edition of ICD-10-AM was introduced and this includes new codes

R57.2 Septic Shock

R65.0 Systemic inflammatory response syndrome (SIRS) of infectious origin without acute organ failure

R65.1 Systemic inflammatory response syndrome (SIRS) of infectious origin with acute organ failure (severe sepsis).

The inclusion of these new codes means the datasets analysed pre- and post-2015 are not identical and this needs to be taken into consideration when interpreting trends over the past 5 years.

These codes were interrogated in patients aged 16 + in the acute hospital sector. Maternity patients with sepsis, identified by maternity specific codes (appendix 4c), were excluded as they are subject to analysis and reporting by Maternal Death Enquiry Ireland.[6]

Limitations

Administrative databases are limited to what is documented in the patients' case notes (The Coding Process, Appendix 4). It is noted that there is limited usage of the diagnosis 'severe sepsis'; rather the term 'sepsis' is used covering both uncomplicated sepsis and severe sepsis. This is in line with what has been experienced in other jurisdictions and in the published literature.[7]

In order 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 CCU, HDU, ICU or an Intensive Care Consultant code. 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 take into account 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 but not mortality has also been identified[8] and this is also the case in Ireland.

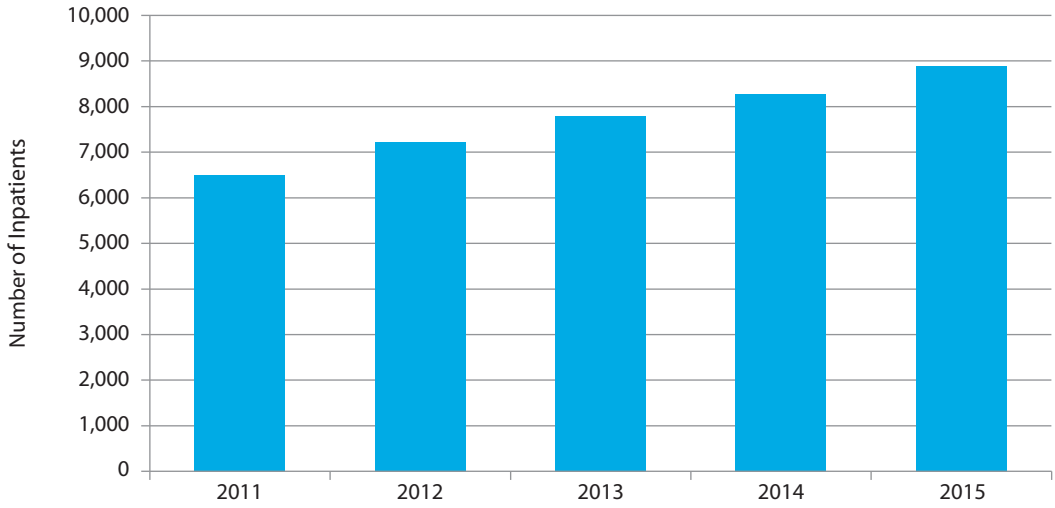
Based on the current analysis, the requirement to develop and validate a sepsis mortality prediction model and an associated mortality prediction score for the HIPE database is identified. Similar models for sepsis mortality have been developed and validated for administrative data in the U.S.[9]

The data presented in this report are based on inpatients in publically 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 not necessarily directly due to sepsis.

National Trends in Sepsis

KEY FINDING: THE NUMBER OF CASES HAS INCREASED BY 36.8%

FIGURE 1: The number of inpatients with a diagnosis of sepsis, 2011-2015



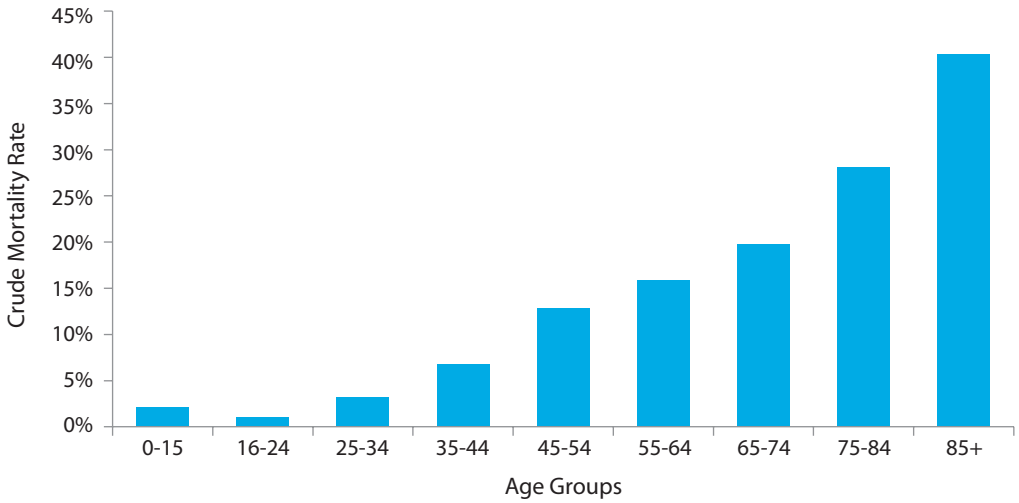
Note: Data exclude paediatric and maternity inpatients

During this time period the population has increased by 3.7% according to Census 2016. In 2011, people aged ≥ 65 years constituted 11.7% of the population and this cohort is predicted to increase to 1.4 million, that is 22% of the population by 2041.

In 2011, 62% of hospitalised patients with sepsis were ≥ 65, this had increased to 67% by 2015. Measuring the burden of sepsis is an essential part of planning for the increasing healthcare requirements of the ageing population. Ensuring prompt recognition and treatment reduces healthcare usage as well as mortality.[10]

KEY FINDING: IN-HOSPITAL MORTALITY FOR INPATIENTS WITH A DIAGNOSIS OF SEPSIS BY AGE GROUPS, 2015

FIGURE 2: In-hospital mortality for inpatients with a diagnosis of sepsis by age groups, 2015



Note: Figure 2 includes paediatrics and maternity cases. ICD-10-AM diagnosis codes O85 [Puerperal Sepsis] and P36 [Bacterial Sepsis of Newborn] are included in addition to the sepsis diagnosis codes specified in Appendix 4a.

Age is a critical factor in outcome from sepsis . A study of US sepsis using administrative data from 1979 to 2002 demonstrated that age ≥ 65 years was independently associated with a 2.3 times higher risk of death. The U.S. mortality in patients 18-65 averaged 17.7% and in patients ≥ 65, 27.7%. In this study 2.4% of hospitalisations involved sepsis and the mean age was 68.2 and men were more likely to get sepsis than women. Severe sepsis occurred in 30.9% of cases.[11]

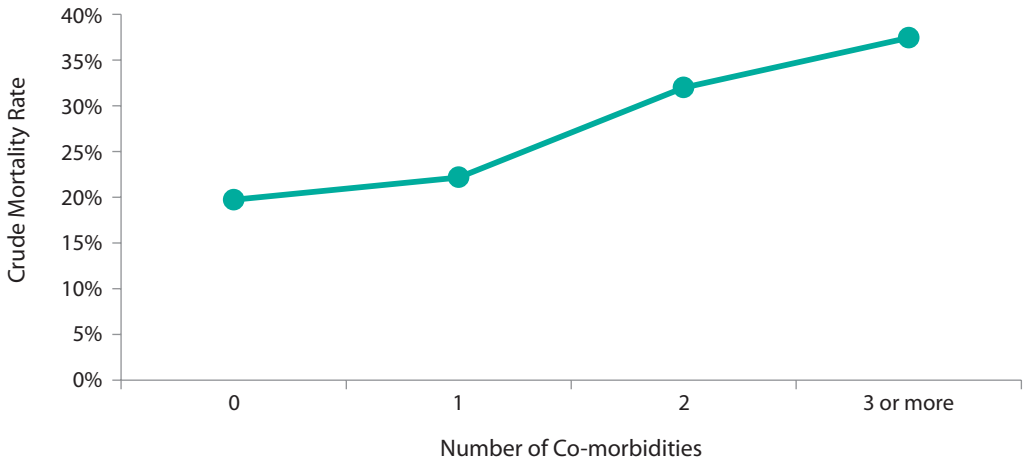
In Ireland in 2015, the mean age was 68.6 for hospitalisations involving sepsis and 47% of the sepsis population was female. The mortality in patients 16 - 64 years was 12.1% and for those ≥ 65 was 27.9%. The term 'severe sepsis' was rarely used in the patients medical notes in 2015 (a feature commonly noted in the international literature and a driver for the discarding of that term in the new definition) so the surrogate of 'patients with a sepsis diagnosis and admitted to a critical care' was used and this consitituted 28.97% of sepsis cases.

TABLE 1: Inpatients with a diagnosis of sepsis and with selected co-morbidities; number of cases and crude mortality rates, 2015 (appendix 4d)

Co-morbidity	Number of cases	Crude Mortality Rate %
Mental & Behavioural Disorders due to Alcohol	378	27.2
Chronic Obstructive Pulmonary Disease	970	33.5
Cancer	2243	22.3
Chronic Kidney Disease	1228	30.5
Chronic Liver Disease	362	42.0
Diabetes	1804	24.4
HIV Disease	39	30.8

Note: Cases with more than one of the co-morbidities above are included in each of the relevant co-morbidity groups. The co-morbidites shown have been demonstrated to be associated with increased mortality in sepsis.[12]

FIGURE 3: Inpatients with a diagnosis of sepsis with selected co-morbidities; crude mortality rates by number of co-morbidities, 2015

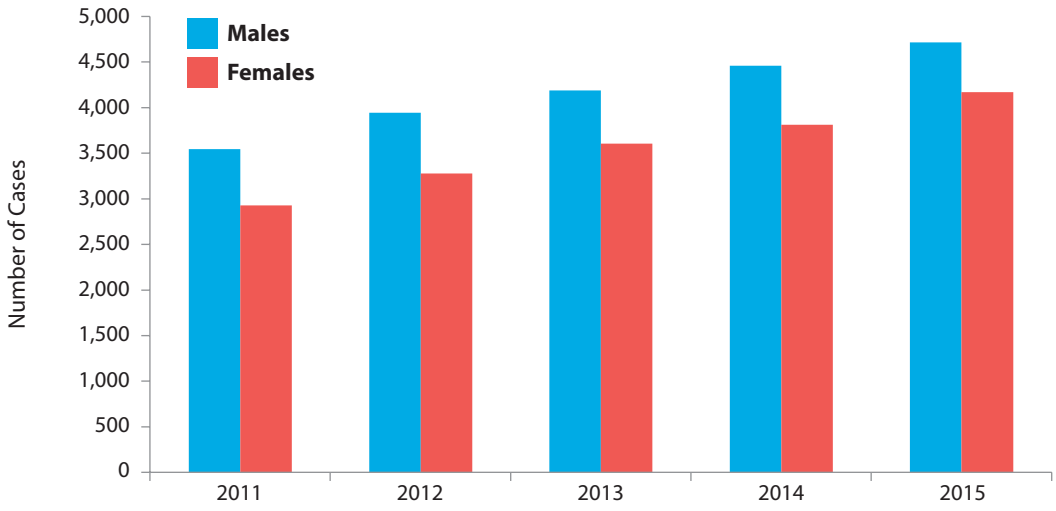


Note: the number of co-morbidities refers only to the 7 selected conditions listed in table above.

The development of a mortality prediction model incorporating age and co-morbidity risk analysis is required to use sepsis mortality as a key patient safety indicator. This is outside the remit of this report but is recommended for future analysis in order to optimize the documentation of the burden of sepsis in Ireland and to monitor and guide the National Sepsis Programmes' primary aim which is to reduce the mortality from sepsis in Ireland and to promote patient centered care to ensure that each individual receives their best opportunity to survive.

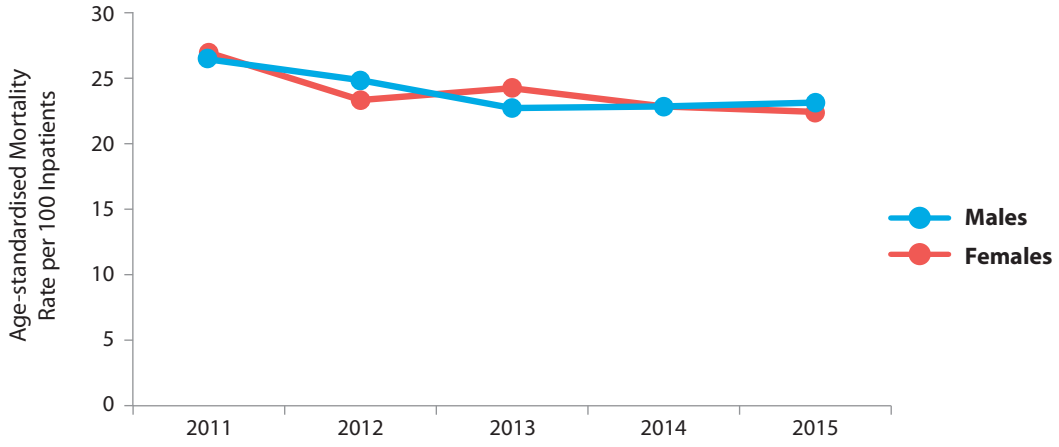
KEY FINDING: SEPSIS IS MORE COMMON IN THE MALE SEX

FIGURE 4: Number of males and females with a diagnosis of sepsis, 2011-2015



KEY FINDING: THERE IS NO DIFFERENCE IN AGE-ADJUSTED HOSPITAL MORTALITY RATES BETWEEN THE SEXES.

FIGURE 5: In-hospital mortality for males and females with a diagnosis of sepsis, 2011-2015



National mortality trends over past 5 years

KEY FINDING: THERE HAS BEEN A 15% DECREASE IN AGE-STANDARDISED MORTALITY IN INPATIENTS WITH A DIAGNOSIS OF SEPSIS.

FIGURE 6: Age-standardised in-hospital mortality rate for inpatients with a diagnosis of sepsis, 2011-2015

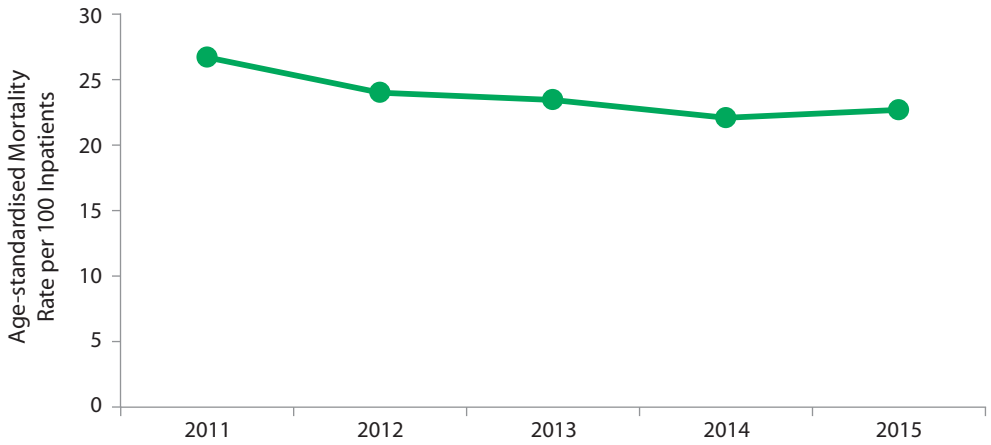


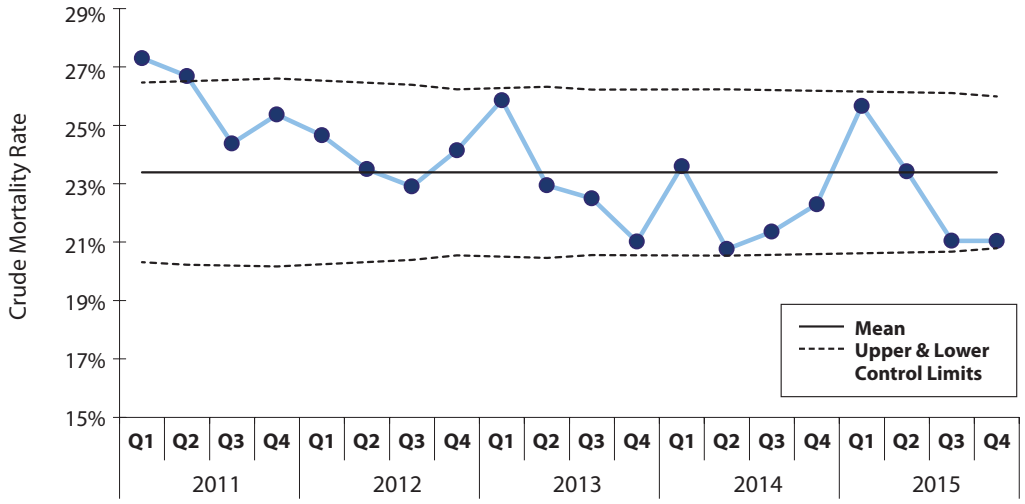
TABLE 2: Inpatients with a diagnosis of sepsis, crude & age-standardised mortality rates. 2011-2015

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	6495	1686	26.0	26.8
2012	7227	1720	23.8	24.1
2013	7797	1799	23.1	23.5
2014	8275	1821	22.0	22.1
2015	8888	2021	22.7	22.7

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

A Statistical Process Control (SPC) chart with quarterly data suggests that this may be a 'real' signal of improvement, although further data points are required to confirm this and will be collected and published in the next report.

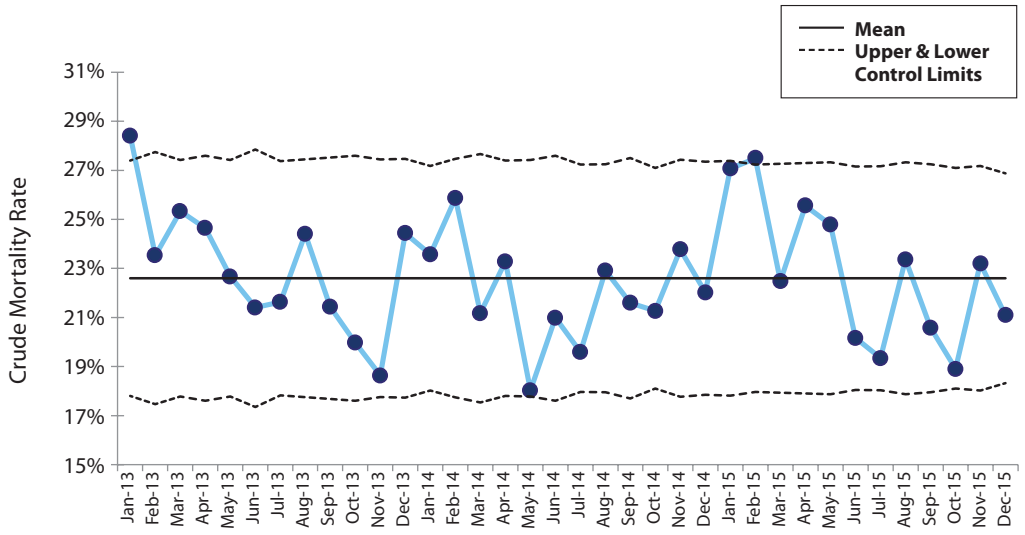
FIGURE 7: In-hospital mortality for inpatients with a diagnosis of sepsis, quarterly data, 2011-2015



The seasonal variation in sepsis-associated mortality is clearly apparent and is largely driven by the increase in respiratory tract infections that occurs during the winter season and is potentially modifiable with 'flu and pneumococcal vaccination.

KEY FINDING: THERE IS SEASONAL VARIATION IN SEPSIS-ASSOCIATED MORTALITY.

FIGURE 8: In-hospital mortality for inpatients with a diagnosis of sepsis, monthly data, 2013-2015



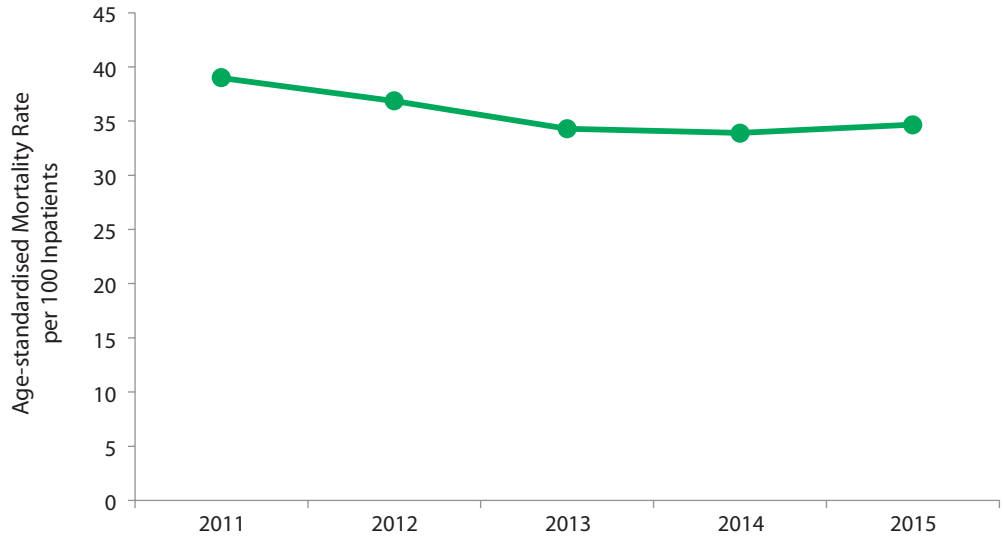
Sepsis incidence is increasing annually. This has been documented in the international literature in the industralised world[13] and is thought to be multifactorial including an ageing population, patients with co-morbidities having longer predicted survivals, an increasing cohort of patients being managed on immunosuppressive therapies and improved recognition.

Although outside the remit of this report, for completion, it must be noted that sepsis incidence is also increasing in the paediatric and maternity populations.

TABLE 3: Paediatric & Maternal Sepsis-associated incidence and crude mortality rates

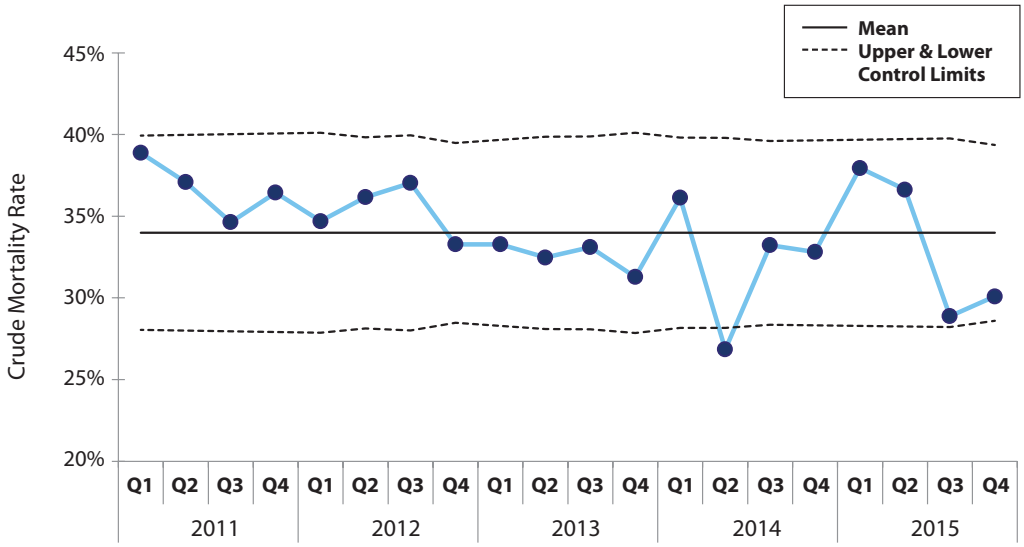
Year	Children aged 0-15 Years with a Diagnosis of Sepsis		Pregnancy Related Cases with a Diagnosis of Sepsis		All Other Adults aged 16+ with a Diagnosis of Sepsis		Total Cases	
	Number of Inpatients	Crude Mortality Rate	Number of Inpatients	Crude Mortality Rate	Number of Inpatients	Crude Mortality Rate	Number of Inpatients	Crude Mortality Rate
2011	737	3.0%	190	1.6%	6,495	26.0%	7,422	23.1%
2012	763	3.9%	192	0.5%	7,227	23.8%	8,182	21.4%
2013	763	3.8%	271	0.0%	7,797	23.1%	8,831	20.7%
2014	746	4.0%	282	0.0%	8,275	22.0%	9,303	19.9%
2015	766	2.1%	308	0.3%	8,888	22.7%	9,962	20.5%

FIGURE 9: Age-standardised mortality rates for inpatients with a diagnosis of sepsis and admitted to a critical care area, 2011-2015



This represents an 11% decrease in mortality over the 5-year period whilst there was a 17.8% increase in the numbers admitted to critical care.

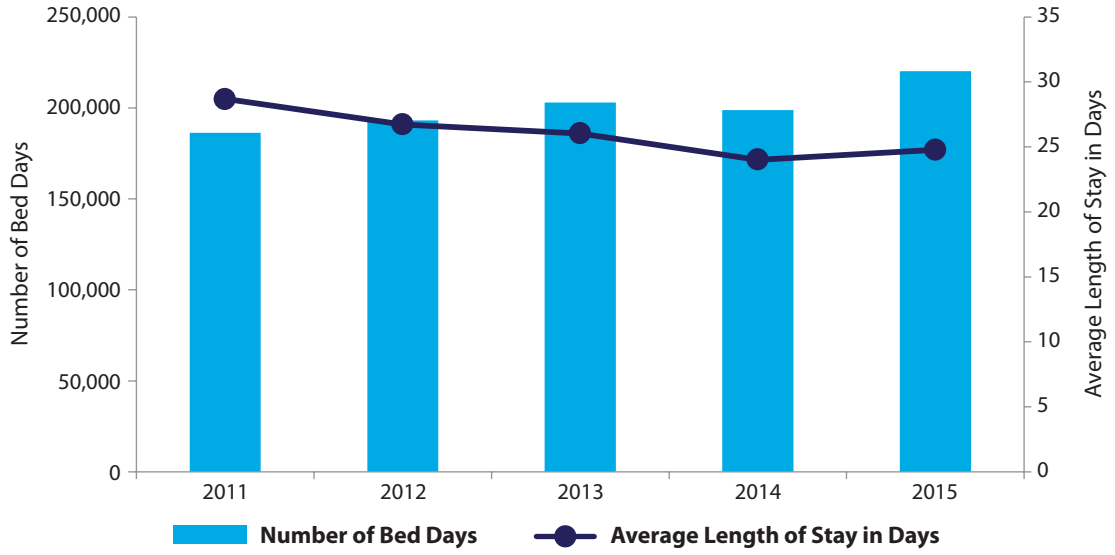
FIGURE 10: In-hospital mortality for inpatients with a diagnosis of sepsis and admitted to a critical care area by quarter, 2011-2015



This SPC chart does not confirm the mortality decrease, there may be a signal of improvement but more data points will be needed to see if it is sustained. The increase in incidence of sepsis and the decrease in the capacity of critical care has lead to a higher acuity admitted to critical care that acts as a confounder.

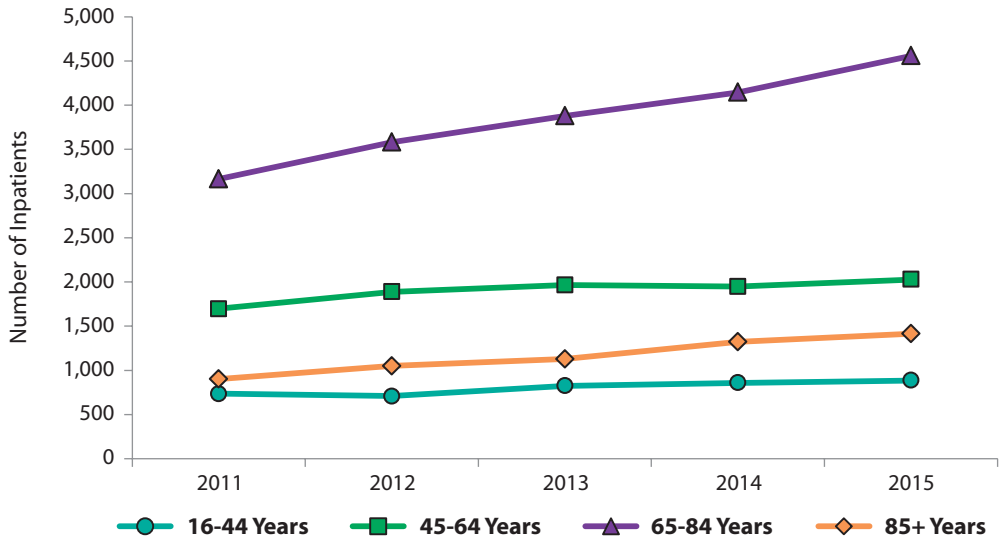
Despite a 36.8% increase in the total number of cases over the 5 years, bed occupancy rates increased by only 18.2% due to the decrease in hospital length of stay. The increase in incidence and reduced length of stay is seen in all patient age subgroups. (appendix 5).

FIGURE 11: Number of bed days and average length of stay for inpatients with a diagnosis of sepsis



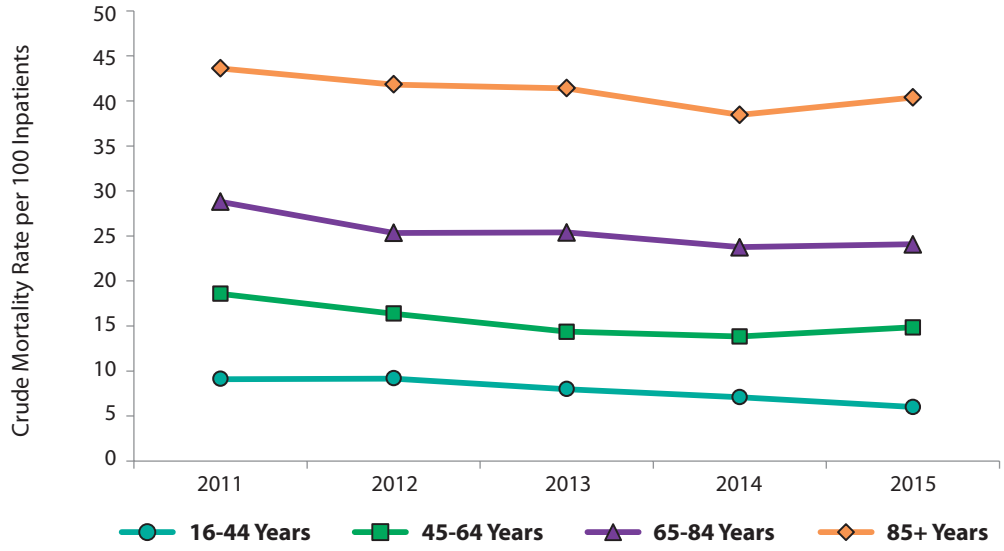
KEY FINDING: THE NUMBER OF INPATIENTS IS INCREASING IN ALL AGE GROUPS

FIGURE 12: Number of inpatients with a diagnosis of sepsis by age group, 2011-2015



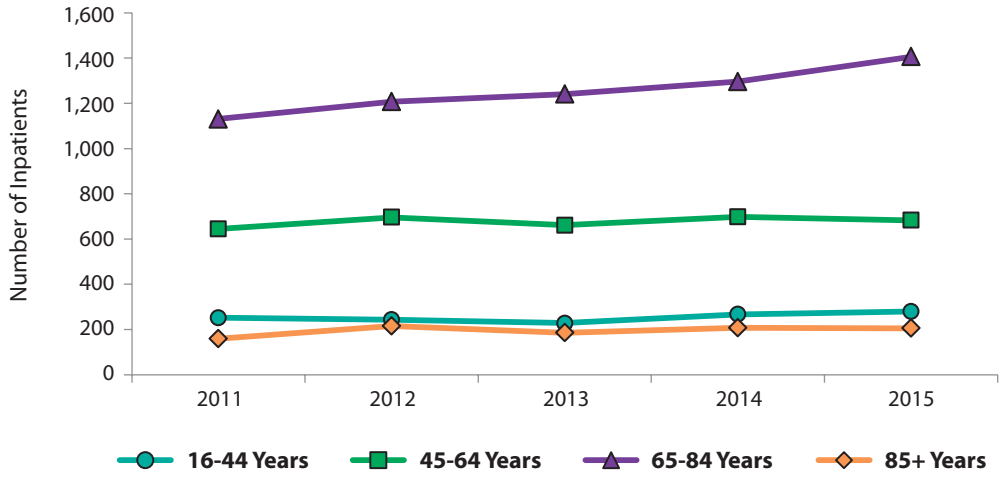
KEY FINDING: CRUDE MORTALITY RATE IS DECREASING FOR INPATIENTS WITH A DIAGNOSIS OF SEPSIS IN ALL AGE GROUPS, 2011-2015

FIGURE 13: In-hospital mortality rate for inpatients with a diagnosis of sepsis, by age group, 2011-2015



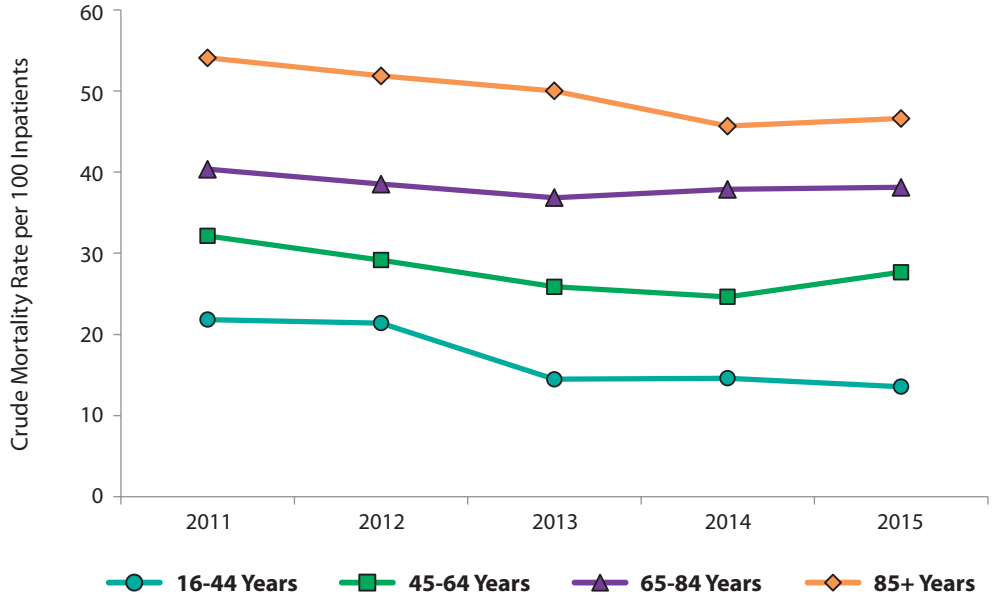
KEY FINDING: THERE HAS BEEN A 17.8% INCREASE IN THE ADMISSION OF PATIENTS WITH A SEPSIS DIAGNOSIS TO CRITICAL CARE.

FIGURE 14: Number of inpatients with a diagnosis of sepsis and admitted to a critical care area, by age groups, 2011-2015



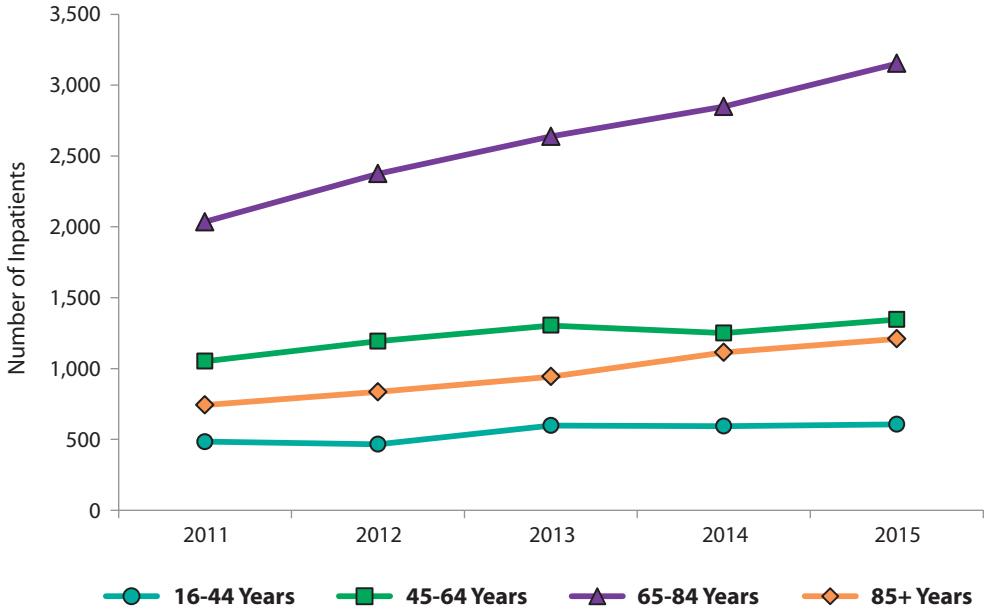
KEY FINDING: THE MORTALITY OF PATIENTS WITH A SEPSIS DIAGNOSIS HAS DECREASED IN ALL AGE GROUPS ADMITTED TO CRITICAL CARE.

FIGURE 15: In-hospital mortality rate for inpatients with a diagnosis of sepsis admitted to crtical care, by age group, 2011-2015



KEY FINDING: NUMBER OF PATIENTS WITH SEPSIS DIAGNOSIS NOT ADMITTED TO CRITICAL CARE HAS INCREASED BY 46.5%.

FIGURE 16: Number of inpatients with a diagnosis of sepsis and not admitted to a critical care area, by age groups, 2011-2015



KEY FINDING: CRUDE HOSPITAL MORTALITY FOR PATIENTS WITH A DIAGNOSIS OF SEPSIS AND NOT ADMITTED TO CRITICAL CARE HAS DECREASED BY 10%.

FIGURE 17: In-hospital mortality rate for inpatients with a diagnosis of sepsis not admitted to critical care, by age group, 2011-2015

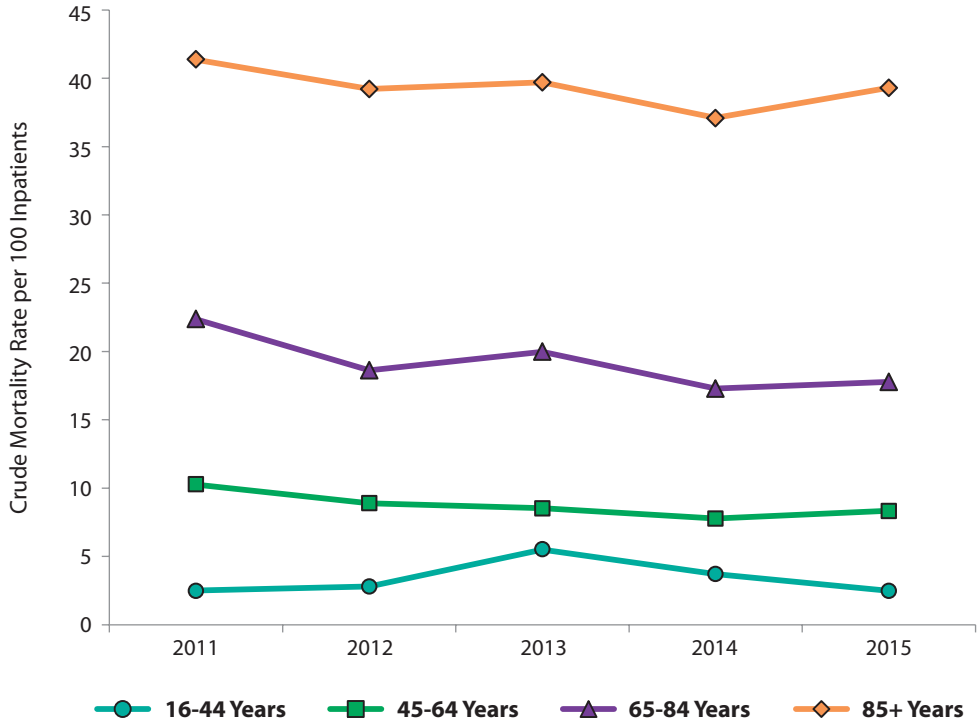
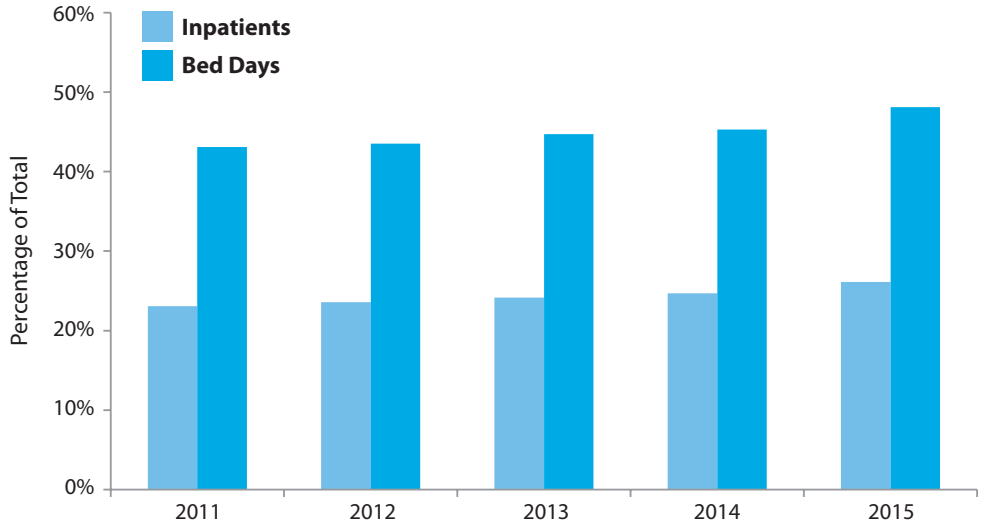


FIGURE 18: Inpatients with a diagnosis of sepsis or infection: Number & Bed days as a percentage of total inpatients & bed days (appendix 6)

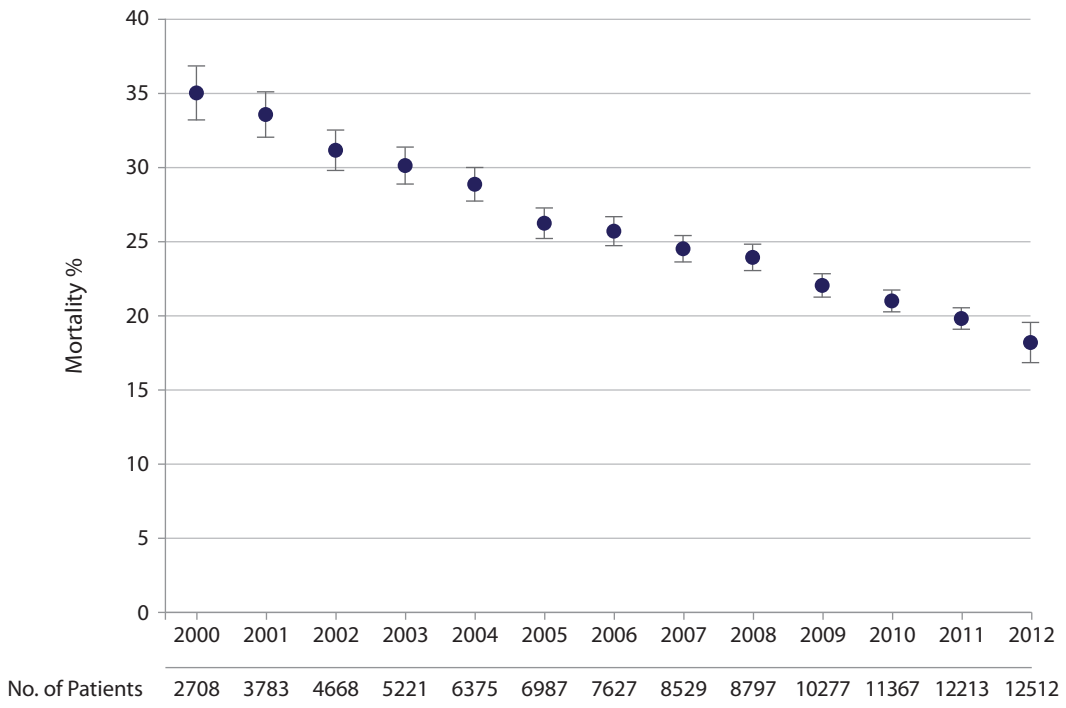


Summary

Sepsis incidence has increased by 36.8% and age-standardised hospital mortality has decreased by 15%. Amongst the sicker cohort of patients who were admitted to a critical care area, incidence increased by 17.8% and mortality decreased by 9%. The increase in the number of cases was partially offset by a shorter length of stay, however bed occupancy rates for patients with infection or sepsis as principal diagnosis or complicating their hospitalisation remains just under 50%. This represents a huge proportion of the resources utilized in the acute sector. Early recognition and treatment of sepsis is associated not only with decreasing mortality but also with reducing critical care admission and hospital length of stay thus freeing up healthcare resources for other urgent and elective needs.

Australia is generally considered to have the best sepsis outcomes in the world and although their database, the Australian and New Zealand Intensive Care Society Adult ICU patient database, is too different to be able to compare directly against the data from the Irish HIPE database, it demonstrates the potential to decrease sepsis mortality substantially with good recognition, management and early appropriate ICU referral given the appropriate resources.

FIGURE 19: Mortality Related to Severe Sepsis and Septic Shock Among Critically Ill Patients in Australia and New Zealand, 2000-2012. JAMA. 2014; 311(13): 1308-1316



In 2008, Kaiser Permanante Northern California, a private hospital group with 21 hospitals and providing for a population of 3.3 million people initiated a sepsis quality improvement programme and decreased mortality from a baseline of 24.6% to below 9% in May 2012.[15]

Once again these numbers cannot be compared directly with the Irish database but demonstrate that mortality decrease can be achieved and that annual measurement informs and supports these initiatives.

National Sepsis data, Jan 1st - Dec 31st, 2015

Sepsis was the principal diagnosis in 26.5% of cases and the overall in-hospital mortality rate was 22.7%

The most common sites for infection were the respiratory system, the genitourinary system and the digestive system.

21% of cases occurred in surgical patients with an overall in-hospital mortality rate of 26%.

Inpatients with a diagnosis of sepsis, by Surgical /Medical Diagnosis Related Group, 2015

Surgical / Medical DRG*	Number of Inpatients	% of Total	Crude Mortality Rate
Surgical	1857	20.9%	26.0%
Medical	7031	79.1%	21.9%
Total	**8888**	**100%**	**22.7%**

* '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 that 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.

TABLE 4: Incidence of sepsis, severe sepsis, septic shock and crude mortality rates for sepsis, severe sepsis, septic shock

	Number of cases	Crude Mortality Rate
Sepsis	8275	21.3%
Severe Sepsis	117	35.0%
Septic Shock	496	44.2%
Total	8888	22.7%

TABLE 5: Admission and crude hospital mortality rates of inpatients admitted to a critical care area with a sepsis, severe sepsis, or septic shock diagnosis.

	Total Number of Cases	Number of cases admitted to critical care	Proportion of cases admitted to critical care	Crude Mortality Rate of cases admitted to critical care
Sepsis	8275	2136	25.8%	31.6%
Severe Sepsis	117	76	65.0%	39.5%
Septic Shock	496	363	73.2%	42.4%
Total	8888	2575	29.0%	33.4%

FIGURE 20: Number of inpatients with a diagnosis of sepsis by age group, 2015

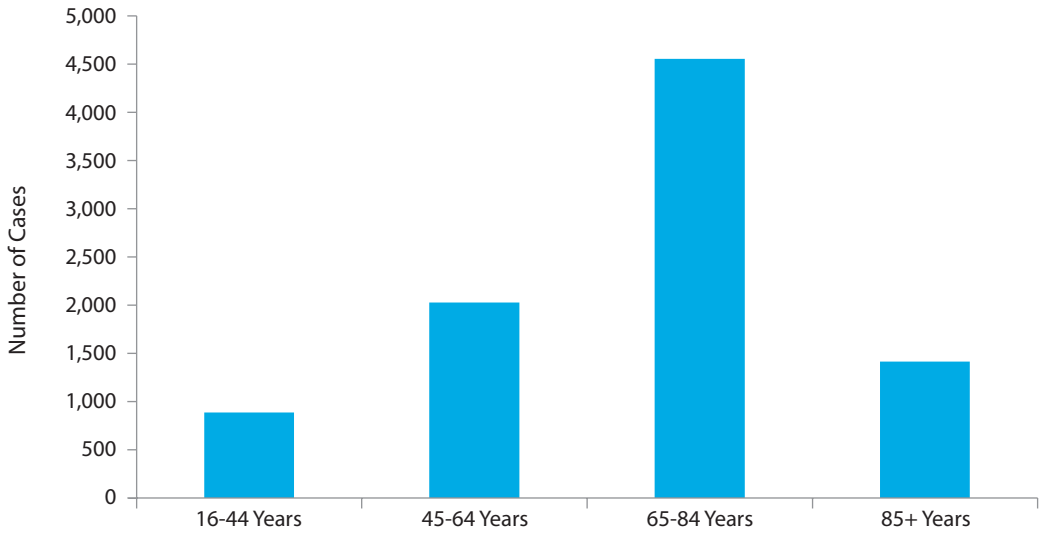
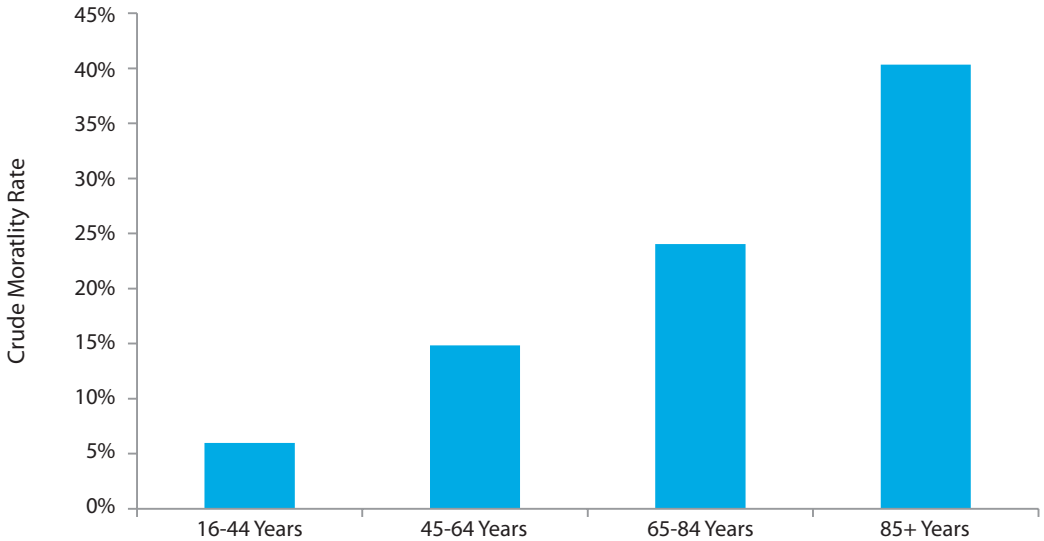
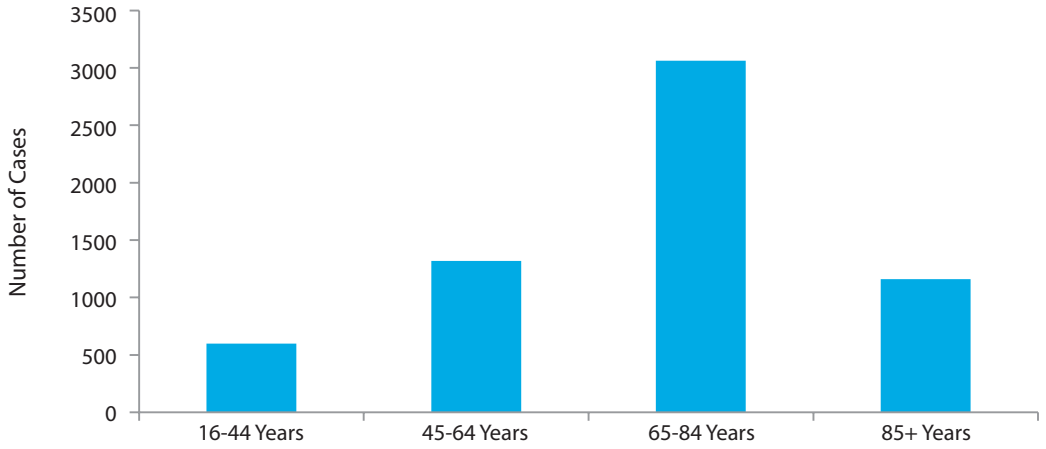


FIGURE 21: In-hospital mortality for inpatients with a diagnosis of sepsis, by age group, 2015



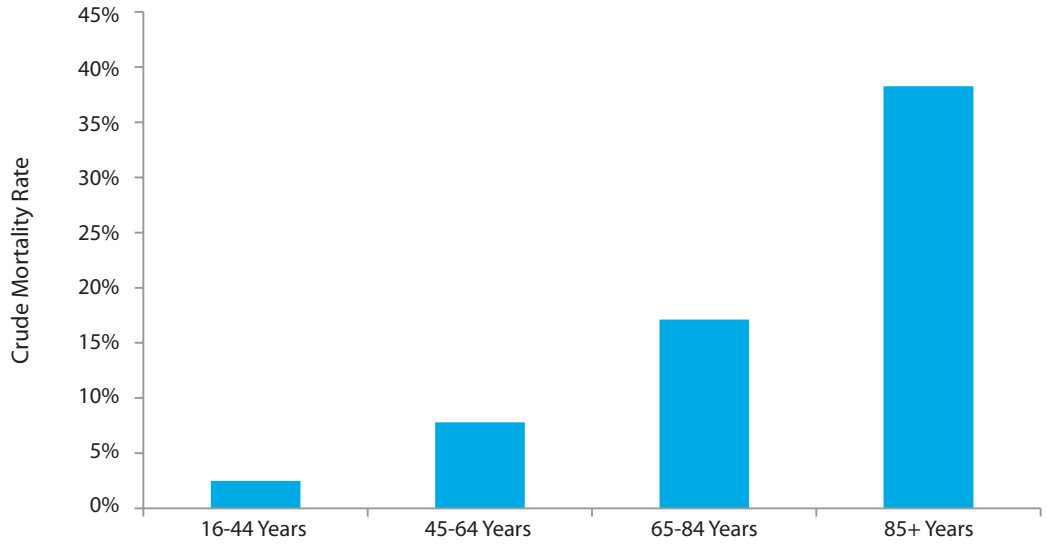
UNCOMPLICATED SEPSIS DIAGNOSES (NO SEVERE SEPSIS, SEPTIC SHOCK OR CRITICAL CARE ADMISSION) MANAGED ON THE WARD AS PRINCIPAL DIAGNOSIS OR COMPLICATING HOSPITAL STAY.

FIGURE 22: Number of inpatients with a diagnosis of sepsis (excluding severe sepsis & septic shock) and not admitted to critical care, 2015



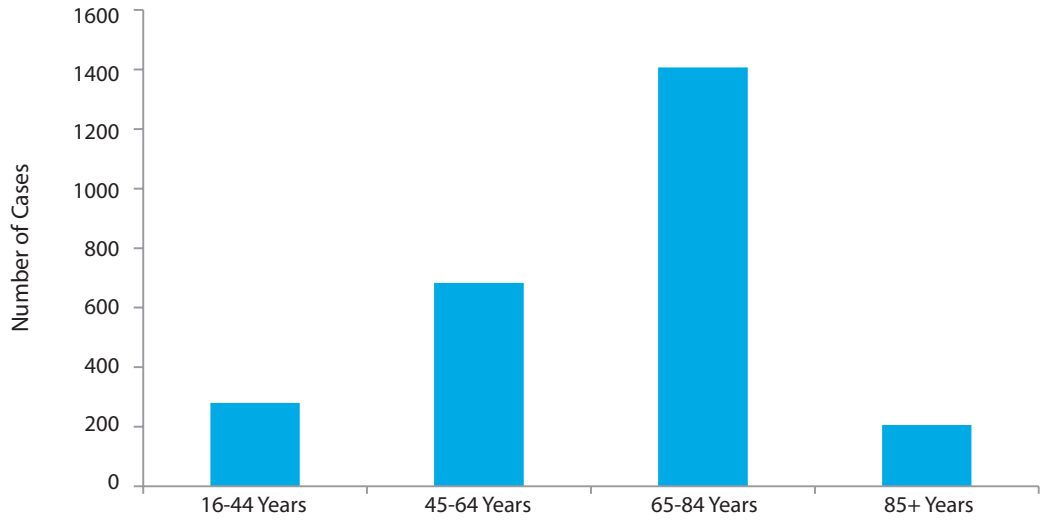
KEY FINDING: CRUDE HOSPITAL MORTALITY FOR PATIENTS WITH AN UNCOMPLICATED SEPSIS DIAGNOSIS BY AGE GROUPS, AVERAGE HOSPITAL MORTALITY 17.7%.

FIGURE 23: In-hospital mortality for inpatients with a diagnosis of sepsis (excluding severe sepsis & septic shock) and not admitted to critical care, 2015



INPATIENTS WITH A DIAGNOSIS OF SEPSIS, SEVERE SEPSIS OR SEPTIC SHOCK AND ADMISSION TO CRITICAL CARE, 2015

FIGURE 24 : Number of inpatients with a diagnosis of sepsis, severe sepsis or septic shock and admission to critical care, 2015



KEY FINDING: CRUDE HOSPITAL MORTALITY FOR PATIENTS WITH A SEPSIS DIAGNOSIS AND ADMISSION TO CRITICAL CARE BY AGE GROUPS, AVERAGE HOSPITAL MORTALITY 33.4%

FIGURE 25: In-hospital mortality for inpatients with a diagnosis of sepsis, severe sepsis or septic shock and admission to critical care, 2015

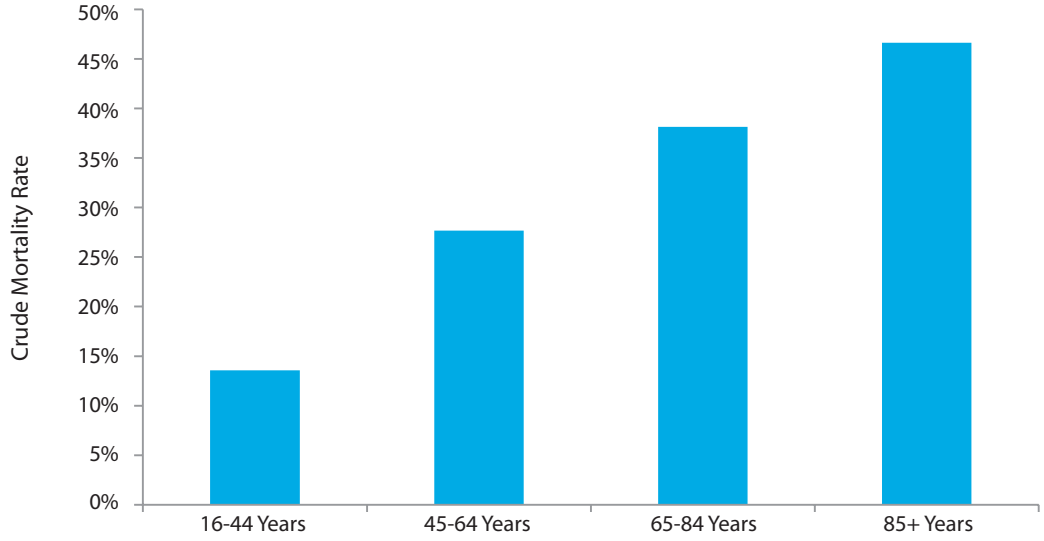
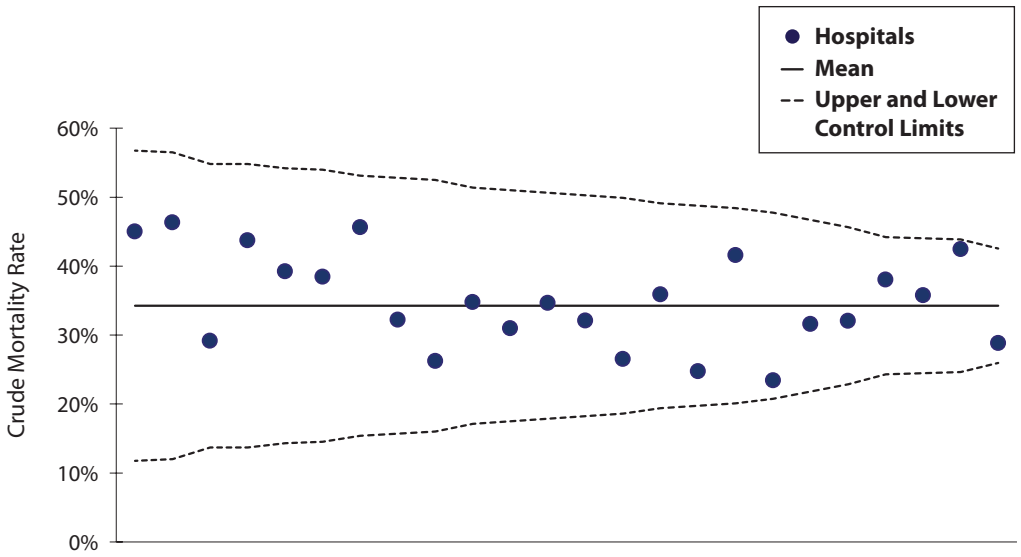


FIGURE 26: SPC Funnel plot of in-hospital mortality rates amongst patients with a diagnosis of sepsis and critical care admission, by hospital, 2015



Note: hospitals with < 40 sepsis cases admitted to critical care not displayed due to insufficient numbers for this statistical analysis. These hospitals all had mortality rates lower than the mean.

The funnel plot demonstrates that any variation in mortality in the hospital sites is due to statistical variance as they all lie within the control limits.

Patients admitted to critical care is used as these are the cohort of patients where early recognition and treatment have been demonstrated to decrease mortality. There is also an intention to treat in the first instance.

In US 6% of all deaths are due to sepsis[13], in Canada it is 5.5%[12].
It is associated with 7.9% of all hospital deaths in the UK[14] as documented on the death certificate. In Ireland using the HIPE database 18.8% of hospital deaths occur in patients who have a sepsis diagnosis as part of their final hospitalization, we cannot infer causality from this analysis rather a contributory role. In only a quarter of cases was sepsis documented as the prinicipal diagnosis.

In the US, analysing administrative data between 1979 and 2000, 1.6% of all hospitalizations involved sepsis with severe sepsis occurring in 30.9%.[11]

In this analysis of 2015, sepsis occurred in 2.1% of hospitalizations and 29% of this population was admitted to critical care.

FIGURE 27: Inpatients & Deaths with a Diagnosis of Sepsis or Infection, 2015

Diagnosis	Number of inpatients	% of total inpatients	Number of deaths	% of total deaths	Crude hospital mortality rate
Sepsis	8,888	2.1%	2,021	18.8%	22.7%
Infection	102,647	24.0%	4,776	44.4%	4.7%
All other diagnoses	315,720	73.9%	3,963	36.8%	1.4%
Total	427,255	100%	10,760	100%	2.5%

Balancing measures:

The Health Protection Surveillance Centre (HPSC)publishes an annual surveillance report on its website www.hpsc.ie.

Key findings related to the Sepsis Programme include:

1. To the end of Q4 2015, the rate of antimicrobial consumption in acute hospitals remains stable at 81.9 defined daily doses (DDD) per 100 bed days used (BDU), versus 82.0 in 2014.
2. MRSA rates decreased from 18.4% to 14.4%.
3. ESBL producing E. coli increased from 10.5% to 11.7%
4. MDR Klebsiella pneumoniae decreased from 9.8% to 5.7%
5. New hospital acquired C. difficile infection decreased from 2.3 to 1.8 cases per 10,000 BDU

Group Reports 2016

In 2016, to support the implementation of the national sepsis guideline in the acute hospital sector, a series of audits was performed by the Sepsis Assistant Directors of Nursing (ADONs) and Hospital Sepsis Champions. 1,488 charts were reviewed in 3 audit cycles looking for accuracy and timeliness of diagnosis and treatment. The use of the sepsis screening form was assessed and whether it impacted on diagnosis and treatment in a useful way. The group findings are outlined below, these were fed back to the Hospitals and the Groups and used to inform the ongoing implementation process.

Audit results n= 1489

	With form	Without form
Diagnosis made and documented	87%	44%
Risk stratification correct	74%	24%
1st dose antimicrobials within 1 hour	74.5%	46.5%

- Only 56% of sepsis cases were documented as sepsis in the case notes

Dublin Midland Hospital Group

There are 7 hospitals within the Dublin Midland Hospital group. Since the implementation process began all have assigned a medical, nursing/midwifery lead, and have had dedicated sepsis education sessions. 6 have sepsis committees, and have rolled out the Clinical Decision Support tool (sepsis screening form) throughout the hospital.

Dublin Midland Hospital Group HIPE data from 2015 showed 1335 inpatients documented with sepsis, severe sepsis or septic shock. These patients utilised 39,506 bed days with an average length of stay of 29.6 days.

Using the Sepsis 2 definition in the audits performed in the 1st quarter of 2016 57% of sepsis cases were documented as sepsis. This demonstrates that there is under recognition and therefore under coding of sepsis cases.

The audits have shown an improvement in sepsis form completion in ED by 50% from Q1 to Q2. Overall sepsis documentation improved by 35.7% from Q1 to Q2,

When the sepsis forms were used there was 48% accuracy in risk stratification (Q2).

There was a 2-fold increase in antimicrobial administration within the hour with the form in the ED. There were fewer forms used on the wards in Q3 as ward roll out was just starting and antimicrobial administration within in the hour of sepsis diagnosis was 57%.

Tallaght Hospital & Midlands Regional Hospital, Tullamore held initiatives on 13th September World Sepsis Day & 29th September, respectively. Their aim was to raise awareness of sepsis for healthcare professionals, patients and the public with a view to improving recognition and management. Both hospitals manned information stands providing information to patients, visitors and staff.

Staff were asked to complete a sepsis crossword and information leaflets from the national programme were distributed to staff and members of the public.

In Tallaght, multidisciplinary teams visited every ward in the hospital. The younger patients participated in a colouring competition.

In Tullamore, there was a TV set up on a loop with various sepsis videos taken from the worldsepsisday.org website

Ireland East Hospital Group

The Ireland East Hospital Group has 11 acute hospitals, of which 10 have assigned a medical lead and 11 a nurse lead for sepsis. While all 11 hospitals have begun implementing the sepsis screening form, 7 have implemented the sepsis screening form throughout the hospital. One hospital in the group has a 0.25 WTE (nurse) dedicated to Sepsis. All hospitals in the group have rolled out a sepsis education programme and all have established a multidisciplinary sepsis committee.

The Ireland East Hospital Group HIPE data 2015, identified 2318 inpatients documented with sepsis, severe sepsis or septic shock. With an average age of 68 years, these patients accounted for 64,213 bed days. Average length of stay (AVLoS) = 27.7 days.

The Sepsis 2 definition was the standard used in the compliance audits Q1, Q2 & Q3, 2016 to determine compliance with National Clinical Guideline No. 6 – Sepsis Management. There was a 60% improvement in sepsis documentation from Q1 to Q2. While we can see an improvement in sepsis documentation, there is under recognition and therefore under coding of sepsis cases.

The audits have shown an 23% improvement in sepsis form completion and when the sepsis screening form was used there was a 3-fold increase in the accuracy of risk stratification as opposed to when the form was not used.

Antimicrobials were 9% more likely to be given within in the hour with the form than without.

UL Hospital Group

There are 6 hospitals within the UL hospital group, since the implementation process began 6 have assigned a medical lead, 5 a nurse lead, 5 have implemented the Clinical Decision Support tool (sepsis screening form) throughout the hospital. The sixth hospital is a standalone Maternity hospital and they have piloted the Maternity Sepsis screening tool and have continued to use it. There are no dedicated Sepsis Nurse WTE's. All hospitals' have rolled out a Sepsis Education Programme. There is 1 Multidisciplinary Group Sepsis Committee.

UL Hospital Group HIPE data from 2015 showed 338 inpatients documented with sepsis, severe sepsis or septic shock. These patients utilised 7,257 bed days with an average length of stay of 21.5 days. HIPE data from 1 hospital showed 19 patients in the month of August 2015 documented with sepsis, severe sepsis or septic shock and 36 patients in August 2016.

Of note, using the Sepsis 2 definition in the audits performed in the 1st quarter of 2016 only 40% of sepsis cases were documented as sepsis. This demonstrates that there is under recognition and therefore under coding of sepsis cases. The audits have shown a 12-fold improvement in sepsis form completion from Q1 to Q3. Overall sepsis documentation improved 2-fold. When the sepsis forms were used there was 91% accuracy in risk stratification.

Antimicrobials were 50% more likely to be given within the hour with the form than without.

RCSI Hospital Group

The RCSI HG consists of seven hospitals. Progress has been made in the implementation of the sepsis programme within the RCSI HG hospitals with:

- Medical leads and nursing leads identified in 6 hospitals
- Midwifery lead identified in all 3 obstetric departments
- Functioning sepsis committees/steering groups representing all hospitals within the HG.
- Sepsis Screening Form (SSF) rollout is underway in every acute hospital
- Sepsis education in the acute hospitals is delivered through formal education sessions or the National eLearning programme

A series of national audits were undertaken in 2016. The Q2 audits for ED & AMAUs demonstrated a 4-fold improvement in the use of the SSF, a 27.6% increase in antimicrobial administration within 60 minutes when the form was used and a 40% improvement in the correct classification and documentation of sepsis with the form.

Although these figures show an improvement in documentation/classification they demonstrate that under recognition/documentation of sepsis exists resulting in HIPE under coding thus affecting the remuneration received for sepsis cases.

Of note, the HIPE data for the RCSI HG in 2015 showed that 1412 inpatients were documented with sepsis, severe sepsis or septic shock, utilising 35,443 bed days, with an average length of stay of 25.1 days.

At the Third Sepsis Summit in September the Emergency Department in Cavan General received an award for *'Best Quality Improvement in the Emergency Department'* in recognition of the excellent audit results achieved in Q2 vs. Q1.

Saolta University Health Care Group

The 7 Saolta Group hospitals have established individual multidisciplinary Sepsis Committee including a named Medical & Nurse Lead. The Group Sepsis Committee coordinates implementation.

Sepsis education programmes are ongoing in all hospitals. The National Sepsis e-learning programme is being adopted throughout the Group.

The National Clinical Guideline on Sepsis Management is supported by a Group Sepsis policy.

Saolta Group HIPE data for 2015 identified 1611 inpatients with sepsis, severe sepsis and septic shock, using 36,411 bed days with an average length of stay of 22.6 days.

National compliance audits demonstrated that use of the Sepsis Screening Form increased by 70% from Q1 to Q3. Improved compliance with the forms allow for HIPE coding for accurate data collection and funding purposes as well as improving recognition and management.

ED & AMAU compliance with the Sepsis Screening Form has increased 3-fold from Q1 to Q2. The number of patients receiving antimicrobial therapy in <60 minutes improved 40.5%.

The Q3 audit also established a baseline of compliance on nominated Medical, Surgical & Haematology/ Oncology Wards. There was 25% compliance with the Sepsis Screening Form use and 78% of patients received antimicrobial therapy within 1 hour of diagnosis.

The Saolta Group has been represented at a number of Conferences in 2016 including:

- The National Sepsis Summit
- International Forum on Quality and Safety in Healthcare, Gothenburg
- International Sepsis Forum, Paris

South/Southwest Hospital Group

There are 9 hospitals within the SSW group, since the implementation process began 8 have assigned a medical lead, 7 a nurse lead, 8 have implemented the Clinical Decision Support tool (sepsis screening form) throughout the hospital and 4 have a dedicated Sepsis Nurse. All hospitals' have rolled out a Sepsis Education Programme and have a Multidisciplinary Sepsis Committee.

South/South West Hospital Group HIPE data from 2015 showed 1845 inpatients documented with sepsis, severe sepsis or septic shock. These patients utilised 36,650 bed days with an average length of stay of 19.9 days.

Of note, using the Sepsis 2 definition in the audits performed in the 1st quarter of 2016 only 30% of sepsis cases were documented as sepsis. This demonstrates that there is under recognition and therefore under coding of sepsis cases. The audits have shown an improvement in sepsis form completion by 48.7% from Q1 to Q3. Overall sepsis documentation improved by 50% from Q1 to Q3. When the sepsis forms were used there was 80% accuracy in risk stratification.

Antimicrobials were 80% more likely to be given with the form than without.

The SSWHG held a Sepsis Conference in October 2016 with over 200 attendees and it was a very informative day with national and international experts. This conference was collaboration between all hospitals in the South/Southwest Hospital Group.

Sepsis ADONs: aims for 2017

- Foster collaboration and shared learning within the Hospital Group (HG) relating to sepsis management, taking a collaborative approach to learning with sepsis education via e-learning & scenario based training
- Continue to support and act as liaison between the National Sepsis Team and HGs
- Ensure that the HG objectives are aligned to the National Sepsis Programme
- Support all Sepsis Committees
- Continue to support the implementation of the sepsis screening form due to its proven benefits in the recognition, timely treatment and risk stratification of patients with sepsis, severe sepsis and septic shock.
- Support all hospitals to address any issues identified in their Gap Analysis.
- Support the National Sepsis programme in achieving its aims and objectives by:
  - Continuing to audit and provide feedback to individual hospitals
  - Providing regular reports to the Hospital Group and National Clinical Team
  - Participating in national projects
  - Assisting in the updating of the National Clinical Guideline
  - Disseminating all updates within the HG
  - Fostering a culture of excellence in sepsis management
- Become an active member of all Sepsis Committees
- Support the implementation of action plans following compliance audits

Appendix 1: The Sepsis Audit Subcommittee

Member	Title
Vida Hamilton	National Clinical Lead Sepsis, CSPD
Margaret Brennan	Quality and Patient Safety Lead, Acute Hospitals Division
Christina Doyle	Programme Manager, National Sepsis Programme
Deirdre Murphy	Head of HIPE & NPRS, HPO
Jacqui Curley	Coding Manager, HPO
Declan McKeown	Health Information Unit, Division of Health & Wellbeing
Sinead Horgan	Group Sepsis ADON, South/South West Hospital Group
Gráinne Cosgrove	Senior Statistician, Measurement for Improvement Team, Quality Improvement Division, Health Service Executive

Appendix 2: The Sepsis Steering Committee

Member	Title
Fidelma Fitzpatrick	Consultant Microbiologist, Chair Sepsis Steering Committee
Vida Hamilton	National Clinical Lead Sepsis Programme
Kevin Rooney	National Clinical Lead on Sepsis, Healthcare Improvement Scotland
Christina Doyle	Programme Manager National Sepsis Programme
Garry Courtney	National Clinical Lead Acute Medicine Programme
Clare Harney	Programme Manager Acute Medicine Programme
Michael Turner	National Clinical Lead Obstetrics & Gynaecology Programme
Michael Power	National Clinical Lead Critical Care
Frank Keane	National Clinical Lead Surgery
Jeremy Smith	National Clinical Lead Anaesthesia
Robert Cunney	National Clinical Lead – HCAI and AMR prevention & QID representation
Karen Power	Project Manager Obstetrics & Gynaecology Programme
Marina Cronin	National Office Clinical Audit representation
Deirdre Murphy	Head of HIPE & NPRS, HPO
Declan McKeown	Health Information Unit
Diarmuid O'Shea	National Clinical Lead Older Person Programme
Siobhan Horkin	Programme Manager Paediatric and Neonatal Programme
Linda Dillon	Patient Advocacy Representative
David Hanlon	National Clinical Lead Primary Care Lead
Colm Henry	National Clinical Advisory and Group Lead – Acute Hospital
Tony McNamara	CEO/Hospital Manager Representative
Jean Kelly	Group Director of Nursing and IADNAM representative
Anne McCabe	Project manager National Transport Medicine Programme
Gerry McCarthy	National Clinical Lead Emergency Medicine
Fiona McDaid	Nurse Lead National Emergency Medicine Programme
Rachel Gilmore	Emergency Medicine Representative
Geraldine Shaw	Director of Nursing & Midwifery, National Clinical Programmes
Gethin White	Library Services DSH
Mary Bedding	Group Sepsis ADON RCSI Hospital Group
Karn Cliffe	Group Sepsis ADON Dublin Midlands Hospital Group
Celine Conroy	Group Sepsis ADON Ireland East Hospital Group
Sinead Horgan	Group Sepsis ADON South/South West Hospital Group
Ronan O Cathasaigh	Group Sepsis ADON Saolta Hospital Group
Yvonne Young	Group Sepsis ADON Limerick University Hospital Group
Gráinne Cosgrove	Senior Statistician, Measurement for Improvement Team, Quality Improvement Division, Health Service Executive

Appendix 3: The National Sepsis Programme team

Member	Title
Vida Hamilton	National Clinical Lead Sepsis Programme
Christina Doyle	Programme Manager National Sepsis Programme
Mary Bedding	Sepsis ADON RCSI Hospital Group
Karn Cliffe	Sepsis ADON Dublin Midlands Hospital Group
Celine Conroy	Sepsis ADON Ireland East Hospital Group
Sinead Horgan	Sepsis ADON South/South West Hospital Group
Ronan O Cathasaigh	Sepsis ADON Saolta Hospital Group
Yvonne Young	Sepsis ADON University Hospital Group

Appendix 4: The Coding Process[16]

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. 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 8th 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 states 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 validation 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

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
R65.0[1]	Systemic inflammatory response syndrome [SIRS] of infectious origin without acute organ failure

[1] ICD-10-AM 8th Edition code only, no corresponding 6th Edition code.

ICD-10-AM Diagnosis Codes for Severe Sepsis

ICD-10-AM 8th Edition Codes	Description
R65.1[1]	Systemic inflammatory response syndrome [SIRS] of infectious origin with acute organ failure

[1] ICD-10-AM 8th Edition code only, no corresponding 6th Edition code.

ICD-10-AM Diagnosis Codes for Septic Shock

ICD-10-AM 8th Edition Codes	Description
R57.2[1]	Septic Shock

[1] ICD-10-AM 8th Edition code only, no corresponding 6th Edition code.

NOTE:

Data are based on inpatients grouped into three mutually exclusive categories:

(i) Inpatients with any diagnosis (principal or secondary) of septic shock

(ii) Inpatients with any diagnosis (principal or secondary) of severe sepsis, excluding cases with any diagnosis of septic shock as these are already captured in the septic shock category

(iii) Inpatients with any diagnosis (principal or secondary) of sepsis, excluding cases with any diagnosis of septic shock or severe sepsis as these are already captured in the septic shock or severe sepsis categories.

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

ICD-10-AM 8th Edition 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
T802	Infections following infusion, transfusion and therapeutic injection
T81.41	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
T85.71	Infection and inflammatory reaction due to peritoneal dialysis catheter
T85.72	Infection and inflammatory reaction due to nervous system device, implant and graft
T85.78	Infection and inflammatory reaction due to other internal prosthetic devices, implants and grafts
T89.02	Open wound with infection

[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 6h 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

Appendix 4d: Codes for selected co-morbidities

ICD-10-AM Diagnosis Codes for Cancer

ICD-10-AM 8th Edition Codes	Description
C00-C96	Malignant Neoplasms

ICD-10-AM Diagnosis Codes for Chronic Liver Disease

ICD-10-AM 8th Edition Codes	Description
K70.0	Alcoholic fatty liver
K70.2	Alcoholic fibrosis and sclerosis of liver
K70.3	Alcoholic cirrhosis of liver
K70.4	Alcoholic hepatic failure
K70.9	Alcoholic liver disease, unspecified
K71.3	Toxic liver disease with chronic persistent hepatitis
K71.4	Toxic liver disease with chronic lobular hepatitis
K71.5	Toxic liver disease with chronic active hepatitis
K71.7	Toxic liver disease with fibrosis and cirrhosis of liver
K72.1	Chronic hepatic failure
K72.9	Hepatic failure, unspecified
K73.0	Chronic persistent hepatitis, not elsewhere classified
K73.1	Chronic lobular hepatitis, not elsewhere classified
K73.2	Chronic active hepatitis, not elsewhere classified
K73.8	Other chronic hepatitis, not elsewhere classified
K73.9	Chronic hepatitis, unspecified
K74.0	Hepatic fibrosis
K74.1	Hepatic sclerosis
K74.2	Hepatic fibrosis with hepatic sclerosis
K74.3	Primary biliary cirrhosis
K74.4	Secondary biliary cirrhosis
K74.5	Biliary cirrhosis, unspecified
K74.6	Other and unspecified cirrhosis of liver
K76.0	Fatty (change of) liver, not elsewhere classified
K76.9	Liver disease, unspecified

ICD-10-AM Diagnosis Codes for Diabetes

ICD-10-AM 8th Edition Codes	Description
E10	Type 1 diabetes mellitus
E11	Type 2 diabetes mellitus
E13	Other specified diabetes mellitus
E14	Unspecified diabetes mellitus

ICD-10-AM Diagnosis Codes for Chronic Kidney Disease

ICD-10-AM 8th Edition Codes	Description
N18	Chronic kidney disease

ICD-10-AM Diagnosis Codes for COPD

ICD-10-AM 8th Edition Codes	Description
J41	Simple and mucopurulent chronic bronchitis
J42	Unspecified chronic bronchitis
J43	Emphysema
J44	Other chronic obstructive pulmonary disease
J47	Bronchiectasis

ICD-10-AM Diagnosis Codes for HIV

ICD-10-AM 8th Edition Codes	Description
B20	Human immunodeficiency virus [HIV] disease resulting in infectious and parasitic diseases
B21	Human immunodeficiency virus [HIV] disease resulting in malignant neoplasms
B22	Human immunodeficiency virus [HIV] disease resulting in other specified diseases
B23	Human immunodeficiency virus [HIV] disease resulting in other conditions
B24	Unspecified human immunodeficiency virus [HIV] disease

ICD-10-AM Diagnosis Codes for Mental and Behavioral Disorders due to use of Alcohol

ICD-10-AM 8th Edition Codes	Description
F10.1	Mental and behavioural disorders due to use of alcohol, harmful use
F10.2	Mental and behavioural disorders due to use of alcohol, dependence syndrome
F10.3	Mental and behavioural disorders due to use of alcohol, withdrawal state
F10.4	Mental and behavioural disorders due to use of alcohol, withdrawal state with delirium
F10.5	Mental and behavioural disorders due to use of alcohol, psychotic disorder
F10.6	Mental and behavioural disorders due to use of alcohol, amnesic syndrome
F10.7	Mental and behavioural disorders due to use of alcohol, residual and late-onset psychotic disorder
F10.8	Mental and behavioural disorders due to use of alcohol, other mental and behavioural disorders
F10.9	Mental and behavioural disorders due to use of alcohol, unspecified mental and behavioural disorder
Z86.41	Personal history of alcohol use disorder

Appendix 5: The numbers of inpatients, bed days and ALOS by year and age-group

Year		16-44 Years	45-64 Years	65-84 Years	85+ Years	Total for Ages 16+
2011	Number of Inpatients	735	1695	3164	901	6495
	Bed Days	19760	49121	95063	22319	186263
	Average Length of Stay	26.9	29.0	30.1	24.8	28.7
2012	Number of Inpatients	708	1888	3581	1050	7227
	Bed Days	19835	54894	94143	24318	193190
	Average Length of Stay	28.0	29.1	26.3	23.2	26.7
2013	Number of Inpatients	826	1965	3878	1128	7797
	Bed Days	20928	51545	100797	29760	203030
	Average Length of Stay	25.3	26.2	26.0	26.4	26.0
2014	Number of Inpatients	860	1948	4145	1322	8275
	Bed Days	21865	46896	100026	30074	198861
	Average Length of Stay	25.4	24.1	24.1	22.8	24.0
2015	Number of Inpatients	886	2029	4558	1415	8888
	Bed Days	21371	53613	115944	29323	220251
	Average Length of Stay	24.1	26.4	25.4	20.7	24.8

Appendix 6: Bed occupancy rates for patients with sepsis and infection

Year		2011	2012	2013	2014	2015
Inpatients with a Diagnosis of Sepsis	Number of Inpatients	6,495	7,227	7,797	8,275	8,888
	Average Length of Stay in Days	28.7	26.7	26.0	24.0	24.8
	Number of Bed Days	186,263	193,190	203,030	198,861	220,251
	Bed Days as a % of Total Bed Days	6.6%	6.7%	7.1%	6.8%	7.3%
Inpatients with a Diagnosis of Infection	Number of Inpatients	80,009	88,590	92,457	96,295	102,647
	Average Length of Stay in Days	12.9	12.0	11.6	11.6	12.0
	Number of Bed Days	1,030,601	1,062,777	1,075,712	1,121,050	1,227,886
	Bed Days as a % of Total Bed Days	36.5%	36.8%	37.6%	38.5%	40.8%
All Other Inpatients	Number of Inpatients	288,454	310,609	314,919	318,754	315,720
	Average Length of Stay in Days	5.6	5.3	5.0	5.0	4.9
	Number of Bed Days	1,607,190	1,629,440	1,580,253	1,593,958	1,561,043
	Bed Days as a % of Total Bed Day	56.9%	56.5%	55.3%	54.7%	51.9%
Total for All Inpatients	Number of Inpatients	374,958	406,426	415,173	423,324	427,255
	Average Length of Stay in Days	7.5	7.1	6.9	6.9	7.0
	Number of Bed Days	2,824,054	2,885,407	2,858,995	2,913,869	3,009,180

		2011	2012	2013	2014	2015
Inpatients with a Diagnosis of Sepsis or Infection	Number	86,504	95,817	100,254	104,570	111,535
	% of Total Inpatients	23.1%	23.6%	24.1%	24.7%	26.1%
Bed Days of Inpatients with a Diagnosis of Sepsis or Infection	Number	1,216,864	1,255,967	1,278,742	1,319,911	1,448,137
	% of Total Bed Days	43.1%	43.5%	44.7%	45.3%	48.1%

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