National Audit of Hospital Mortality Annual Report 2018

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NCA National Office of Clinical Audit

NAHM National Audit of Hospital Mortality

NATIONAL AUDIT OF HOSPITAL MORTALITY

ANNUAL REPORT 2018

PREPARED BY THE NAHM REPORT WRITING GROUP WITH ASSISTANCE FROM THE NAHM GOVERNANCE COMMITTEE

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NATIONAL OFFICE OF CLINICAL AUDIT (NOCA)

The National Office of Clinical Audit (NOCA) was established in 2012 to create sustainable clinical audit programmes at national level. NOCA is funded by the Health Service Executive Quality Improvement Team and operationally supported by the Royal College of Surgeons in Ireland.

The National Clinical Effectiveness Committee (NCEC, 2015) defines national clinical audit as "a cyclical process that aims to improve patient care and outcomes by systematic, structured review and evaluation of clinical care against explicit clinical standards on a national basis".

NOCA supports hospitals to learn from their audit cycles.

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ACKNOWLEDGING SIGNIFICANT CONTRIBUTIONS FROM THE FOLLOWING:

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DESIGNED BY SWERVE

NCA National Office of Clinical Audit

National Audit of Hospital Mortality

ANNUAL REPORT 2018

National Office of Clinical Audit

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6th November 2019

Dear Ms Egan,

I wish to acknowledge receipt of the National Audit of Hospital Mortality Annual Report 2018. Following the presentation by Dr Jennifer Martin to the NOCA Governance Board on the 5th November 2019 and feedback from our membership, we are delighted to endorse this report.

On behalf of the NOCA Governance Board, I wish to congratulate you and your committee on an excellent report which gives assurance to patients that mortality is being carefully monitored in Irish hospitals.

As we discussed at the presentation, there are now focussed opportunities to further improve reliability of the data and in parallel to utilise the data for quality improvement purposes.

Please accept this as formal endorsement from the NOCA Governance Board.

Yours sincerely,

Professor Conor O' Keane FFPath FRCPI
Chair
National Office of Clinical Audit Governance Board

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GLOSSARY

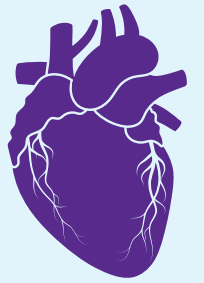
ACRONYM	FULL TERM
ACCD	Australian Consortium for Classification Development
ADST	Analysis and Display Scientific Team
AHRQ	Agency for Healthcare Research and Quality
AMI	acute myocardial infarction (heart attack)
CAD	coronary artery disease
CCS	Clinical Classifications Software
CI	confidence interval
COPD	chronic obstructive pulmonary disease
CuSum	cumulative summary control chart
HIPE	Hospital In-Patient Enquiry scheme
HIQA	Health Information and Quality Authority
HIU	Health Intelligence Unit, Strategic Planning and Transformation, HSE
HPO	Healthcare Pricing Office
HPSIR	Hospital Patient Safety Indicator Report
HSE	Health Service Executive
ICD-10-AM/ ACHI/ACS	International Statistical Classification of Diseases and Related Health Problems, Tenth Revision, Australian Modification/Australian Classification of Health Interventions/Australian Coding Standards
IHFD	Irish Hip Fracture Database
NAHM	National Audit of Hospital Mortality. A structured review and evaluation of care as part of the clinical audit cycle.
NHQRS	National Healthcare Quality Reporting System
NOCA	National Office of Clinical Audit
NQAIS	National Quality Assurance Improvement System. A suite of audit and performance-monitoring tools developed by the Health Intelligence Unit, Strategic Planning and Transformation, HSE.
NQAIS NAHM	National Quality Assurance Improvement System, National Audit of Hospital Mortality web-based tool
NSTEMI	non-ST-elevation myocardial infarction
PCI	percutaneous coronary intervention
PPCI	primary percutaneous coronary intervention
PPI	Public and Patient Interest Representative
PRINCIPAL DIAGNOSIS	The diagnosis which was established after investigation and found to be responsible for the episode of admitted patient care, as represented by a code. National Casemix and Classification Centre, Australian Health Services Research Institute, University of Wollongong (2013)
SMR	standardised mortality ratio
STEMI	ST-elevation myocardial infarction

EXECUTIVE SUMMARY

This is the fourth *National Audit of Hospital Mortality Annual Report*. It provides mortality information across six key diagnoses: acute myocardial infarction (heart attack), heart failure, ischaemic stroke, haemorrhagic stroke, chronic obstructive pulmonary disease, and pneumonia. These diagnoses were chosen based on clinical and methodological selection criteria in order to ensure a focus on quality, safety and improvement in acute hospital care; hospitals can also view all diagnoses locally via the National Quality Assurance Improvement System, National Audit of Hospital Mortality (NQAIS NAHM) web-based tool. The purpose of this report is to provide patients, families, the public and the wider health system with details of national hospital mortality, and to assure them that hospitals are continually monitoring patient mortality locally. This report outlines how the audit is used by hospitals and how the National Office of Clinical Audit (NOCA) engages with hospitals.

NQAIS NAHM displays in-hospital mortality patterns and standardised mortality ratios (SMRs) in a national context on a web-based tool where hospitals have an ongoing view of their mortality data and can produce local reports. The SMR is based on the principal diagnosis (the primary reason a patient is admitted to hospital). The source of data for NQAIS NAHM is the Hospital In-Patient Enquiry (HIPE) scheme, which is a health information system designed to collect clinical and administrative data on patient discharges from acute hospitals in Ireland. In order to ensure that like is compared with like across the diversity of hospitals, potentially confounding factors (i.e. factors that may directly influence the outcome) are accounted for in the analysis – for example, patient age and the presence of other serious illnesses. SMRs do not enable hospitals to compare outcomes against one another, but they do enable comparison against a national average.

In-hospital mortality rates for the six diagnoses contained in this report are summarised as follows:



ACUTE MYOCARDIAL INFARCTION	HEART FAILURE
There has been a significant reduction (35%) in in-hospital mortality for acute myocardial infarction (AMI) over the past 10 years, from 74 deaths per 1,000 admissions in 2009 to 48 deaths per 1,000 admissions in 2018.	There was a 6% (not significant) reduction in in hospital mortality for heart failure over the past 10 years, from 82 deaths per 1,000 admissions in 2009 to 77 deaths per 1 ,000 admissions in 2018

ISCHAEMIC STROKE	HAEMORRHAGIC STROKE
There was a significant reduction (38%) in in-hospital mortality for ischaemic stroke over the past 10 years, from 123 deaths per 1,000 admissions in 2009 to 76 deaths per 1,000 admissions in 2018, and this reflects the results reported in the National Stroke Register in 2018	There was a 17% reduction in in-hospital mortality for haemorrhagic stroke over the past 10 years, from 302 deaths per 1,000 admissions in 2009 to 252 deaths per 1,000 admissions in 2018.

CHRONIC OBSTRUCTIVE PULMONARY DISEASE	PNEUMONIA
In comparison to other conditions, there was no reduction (0%) in in-hospital mortality for chronic obstructive pulmonary disease (COPD) over the past 10 years, with 37 deaths per 1,000 admissions in both 2009 and 2018.	There was a significant reduction (28%) in in-hospital mortality for pneumonia over the past 10 years, from 145 deaths per 1,000 admissions in 2009 to 104 deaths per 1,000 admissions in 2018.

OUTLIERS

On the SMR funnel plot for pneumonia on page 41 two hospitals are outside the 99.8% control limits. The first hospital, Cork University Hospital, had a statistical outlier for pneumonia in 2018; it engaged with NOCA and conducted a preliminary review.

The second hospital, St James's Hospital, was not a statistical outlier for monitoring and escalation in 2018. Its SMR on the funnel plot displays the first quarterly period where the SMR and cumulative summary control chart (CuSum) are outside the 99.8% limits, and therefore it does not meet the definition of a National Audit of Hospital Mortality (NAHM) statistical outlier (high SMR and CuSum breach occurring in two consecutive quarterly periods)

DATA QUALITY

Commentary from our user representative on page 16 shows evidence that there is still a requirement to improve consistency of the principal diagnosis in patient's health care records.

PALLIATIVE CARE

There is a year-on-year rise in the national mean rate of application of the palliative care code for patients who die. This rise is most likely due to the awareness raised about the palliative care code and its potential importance to the NQAIS NAHM risk modelling.

HOSPITAL PATIENT SAFETY INDICATOR REPORT

During 2019, NAHM data were included as the source for a mortality indicator in the *Hospital Patient Safety Indicator Report* (HPSIR) – a monthly report of collated key performance indicators in a hospital, which is signed by the hospital CEO/General Manager and published on the Health Service Executive (HSE) website. The inclusion of NAHM data in the HPSIR report will ensure that in-hospital mortality data are continually monitored.

ENHANCEMENTS TO NQAIS NAHM

Enhancements to the NQAIS NAHM web-based analytical tool were released to the live server in Q3 2019. These enhancements were advanced with input from system users and from the Health Intelligence Unit, Strategic Planning and Transformation, HSE, (HIU) and the functionality has greatly improved as a result. The new summary page allows a hospital a quick means to view whether it is an outlier or not. This is invaluable to managers and clinicians for their quality improvement work. These enhancements have enabled a much better user experience, with new views and functionality. See Table 4 on page 46 for more information. Throughout 2019, training on the enhanced NQAIS NAHM tool took place in various locations nationally.

KEY RECOMMENDATIONS

USING NQAIS NAHM

- Hospitals should nominate one accountable person at an executive level to monitor and respond to the NQAIS NAHM web based tool.

IMPROVING DATA QUALITY

- Guidance developed between the Healthcare Pricing Office and the National Clinical Programme for Palliative Care on how to define when code Z51.5 palliative care is applied, (following the change to the 10th Edition of the International Statistical Classification of Diseases and Related Health Problems, Tenth Revision, Australian Modification/ Australian Classification of Health Interventions/Australian Coding Standards (ICD-10-AM/ACHI/ACS) in January 2020), should be shared with all clinicians in order to ensure consistency in documentation and application of the palliative care code.
- NAHM will input to NOCA's programme of paediatric audits, when established, to ensure that NAHM is linked to existing paediatric mortality data.

IMPROVING THE NQAIS NAHM WEB-BASED TOOL

- The NQAIS NAHM Analysis and Display Scientific Team should amend the "fracture neck of femur" Clinical Classifications Software (CCS) group in NQAIS NAHM to reflect the same codes as those used by the Irish Hip Fracture Database (IHFD), which will allow triangulation to the IHFD audit.
- The NQAIS NAHM Analysis and Display Scientific Team should monitor international mortality tools for any changes to risk modelling in paediatric mortality. It should also explore developing the NQAIS NAHM web-based tool to support an extract of paediatric data to assist hospitals in their interpretation.

INTRODUCTION

There has been a change to the layout of the National Audit of Hospital Mortality (NAHM) report this year. This is a condensed report, which contains information on the same six diagnoses and data quality chapters that featured in earlier reports, and is available to download from the National Office of Clinical Audit (NOCA) website www.noca.ie, together with a plain language summary report (with graphics) and supporting information (appendices). This change in approach is to allow a focus on other areas of mortality that are not available through the National Quality Assurance Improvement System, National Audit of Hospital Mortality (NQAIS NAHM) web-based tool. Case reports, research and international benchmarking updates will be explored and published separately through the NAHM page on the NOCA website, as they become available. In previous years we produced a standardised mortality ratio (SMR) trend chart for each hospital for each of the six key diagnoses. In this report, the trend charts have not been reproduced, as the SMR trend data, along with data for all other diagnoses, are available to hospitals locally throughout the year via the NQAIS NAHM web-based tool.

COMMENT FROM NAHM PUBLIC AND PATIENT INTEREST (PPI) REPRESENTATIVE

The data to produce this report were collected using the services of an extensive number of hospital staff; we owe them a huge debt. However, they, like all professionals, use words and technical medical terminology that are particular to their profession. In a report produced for public consumption, it is essential to minimise the use of jargon and, where it is judged they are necessary, to explain them fully. As the Public and Patient Interest (PPI) Representative on NAHM, I too struggle with technical medical terminology and jargon, and I have worked with the writing group to make this report as readable as possible for the public.

We try to use graphs and tables, etc. to explain what is happening in NAHM, as we believe the old saying that a picture is worth a thousand words. However, these must be clear and concise, and the context of their existence must be fully explained in order for them to be of maximum assistance to the reader. As an engineer, graphs and tables are a language of my profession, and I bring that experience to bear in reviewing the graphics. I hope you will find them helpful and useful in understanding this report.

Alan Egan
NAHM Public and Patient Interest (PPI) Representative

WHAT IS NQAIS NAHM?

NQAIS NAHM is a web-based tool developed by the Health Intelligence Unit, Strategic Planning and Transformation (HIU) in the Health Service Executive (HSE) and the software developer OpenApp, with support from Professor Simon Jones (Professor in Population Health, New York University). NQAIS NAHM enables 44 participating hospitals to review their mortality patterns in detail (Table 1). Data are extracted from the Hospital In-Patient Enquiry (HIPE) scheme and are uploaded to the NQAIS NAHM web-based tool. This allows individual hospitals to access their mortality data at hospital, diagnostic group, and individual diagnosis level, i.e. at a total of 260 levels.

NQAIS NAHM calculates an SMR for each diagnosis based on the principal diagnosis (the primary reason a patient is admitted to hospital). An SMR is the observed number of deaths divided by the expected number of deaths in a hospital for a particular diagnosis and time period, adjusted for patient characteristics which are known to impact on inpatient mortality, then multiplied by 100. If a hospital's SMR in an individual diagnosis is outside of expected ranges, it indicates that more patients died than was expected based on the risk factors accounted for in the web-based tool, and further investigation is warranted in order to ascertain the possible reasons.

The NAHM Governance Committee defines an outlier as occurring where an SMR for an individual diagnosis is higher than expected, appearing outside the 99.8% confidence intervals, and also when the related cumulative summary control chart (CuSum) breaches its 99.8% control limits. This outlier is considered a *statistical* outlier if this high SMR and CuSum breach occur in two consecutive quarterly releases of data in NQAIS NAHM. When a statistical outlier is identified, NOCA engages with the hospital in line with the NOCA monitoring and escalation policy (NOCA, 2017), requesting a review to investigate the possible reasons for the difference from expected.

NAHM AIMS

- understand and improve the quality of hospital-based mortality data
- promote reflection on the quality of overall patient care
- identify areas for improvement.

WHAT THIS REPORT DOES

This report publishes mortality data for Irish hospitals. NOCA continues to support transparency in mortality reporting, and publishes hospital-identifiable information for six key diagnoses from NQAIS NAHM. A summary report with visual statistics is published separately and is available for download from the NOCA website, https://www.noca.ie/publications/publications-listing/P0/category/4.

WHAT THIS REPORT CANNOT DO

Comparison to other hospitals is not possible, as no two hospitals will have the same patient profile. Some hospitals will have greater numbers of patients with severe conditions; for example, hospitals such as specialist referral centres may only admit patients with more complicated conditions. Hospitals can view their own data in relation to a national average. This report cannot and should not be used to produce league tables or to compare hospitals.

The Department of Health published mortality data in the National Healthcare Quality Reporting System (NHQRS) 2018 for diagnoses of acute myocardial infarction (AMI), haemorrhagic stroke and ischaemic stroke. The basis of this methodology is the Organisation for Economic Co-operation and Development's direct standardised death rate. This method allows for comparison between Ireland and other countries. NQAIS NAHM differs from the NHQRS's methodology, as NQAIS NAHM uses an indirect SMR that adjusts for patient characteristics which are known to impact on inpatient mortality. This allows hospitals to compare their observed death rate against the death rate that would be expected in that hospital if other variables affecting mortality could be taken into consideration. Due to the differences in methodology, it is not possible to compare in-hospital mortality indicators in this report against those presented by the Department of Health in the NHQRS report.

NAHM IN ACUTE HOSPITALS

NOTE: Dublin hospitals have been displayed collectively by hospital group

SAOLTA UNIVERSITY HEALTH CARE GROUP

- LETTERKENNY UNIVERSITY HOSPITAL
- SLIGO UNIVERSITY HOSPITAL
- ROSCOMMON UNIVERSITY HOSPITAL
- PORTIUNCULA UNIVERSITY HOSPITAL
- MAYO UNIVERSITY HOSPITAL
- GALWAY UNIVERSITY HOSPITALS

RCSI HOSPITALS

IRELAND EAST HOSPITAL GROUP

DUBLIN MIDLANDS HOSPITAL GROUP

UL HOSPITAL GROUP

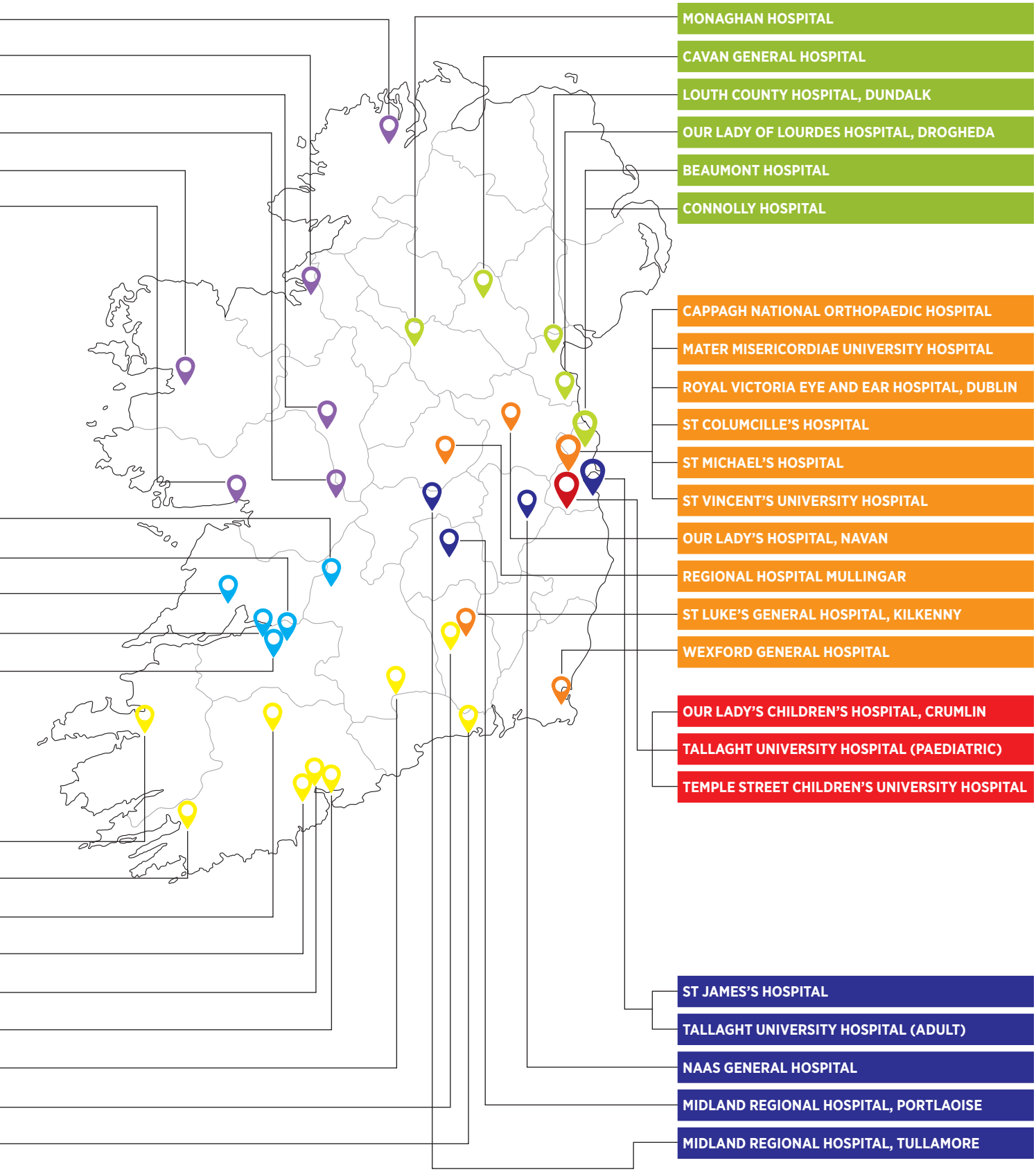
- NENAGH HOSPITAL
- UNIVERSITY HOSPITAL LIMERICK
- ENNIS HOSPITAL
- ST JOHN'S HOSPITAL, LIMERICK
- CROOM HOSPITAL

CHILDREN'S HOSPITAL GROUP

SOUTH/SOUTH WEST HOSPITAL GROUP

- UNIVERSITY HOSPITAL KERRY
- BANTRY GENERAL HOSPITAL
- MALLOW GENERAL HOSPITAL
- CORK UNIVERSITY HOSPITAL
- MERCY UNIVERSITY HOSPITAL
- SOUTH INFIRMARY VICTORIA UNIVERSITY HOSPITAL
- SOUTH TIPPERARY GENERAL HOSPITAL
- KILCREENE REGIONAL ORTHOPAEDIC HOSPITAL
- UNIVERSITY HOSPITAL WATERFORD

TABLE 1: HOSPITALS PARTICIPATING IN NQAIS NAHM


MONAGHAN HOSPITAL
CAVAN GENERAL HOSPITAL
LOUTH COUNTY HOSPITAL, DUNDALK
OUR LADY OF LOURDES HOSPITAL, DROGHEDA
BEAUMONT HOSPITAL
CONNOLLY HOSPITAL
CAPPAGH NATIONAL ORTHOPAEDIC HOSPITAL
MATER MISERICORDIAE UNIVERSITY HOSPITAL
ROYAL VICTORIA EYE AND EAR HOSPITAL, DUBLIN
ST COLUMCILLE'S HOSPITAL
ST MICHAEL'S HOSPITAL
ST VINCENT'S UNIVERSITY HOSPITAL
OUR LADY'S HOSPITAL, NAVAN
REGIONAL HOSPITAL MULLINGAR
ST LUKE'S GENERAL HOSPITAL, KILKENNY
WEXFORD GENERAL HOSPITAL
OUR LADY'S CHILDREN'S HOSPITAL, CRUMLIN
TALLAGHT UNIVERSITY HOSPITAL (PAEDIATRIC)
TEMPLE STREET CHILDREN'S UNIVERSITY HOSPITAL
ST JAMES'S HOSPITAL
TALLAGHT UNIVERSITY HOSPITAL (ADULT)
NAAS GENERAL HOSPITAL
MIDLAND REGIONAL HOSPITAL, PORTLAOISE
MIDLAND REGIONAL HOSPITAL, TULLAMORE

COMMENT FROM NAHM USER REPRESENTATIVE

NQAIS NAHM data are reviewed at least once every quarter and a summary of the findings is included in the Group Clinical Audit Committee report to the UL Hospitals Group (ULHG) Quality and Safety Executive. It is also discussed at the group's Clinical Director Forum and was presented at hospital grand rounds and the ULHG's Clinical Audit and Quality Improvement Conference 2019.

We have been fortunate that, overall, our data have been within the control limits. However, trends are continually kept under review. When an area, for example syncope (fainting) data, was presented between the 95% and 99.8% confidence intervals, local analysis was carried out; this revealed that coding of syncope as a presenting symptom needed to be replaced with the underlying diagnosis wherever possible, in order to maintain the accuracy of HIPE documentation. It would appear that greater accuracy in coding has shown that ULHG is, in fact, within the expected confidence intervals for this diagnostic grouping.

The ability to continually monitor our SMRs against a national average, and to see our trends, is very helpful in providing assurance to the ULHG executive, board and service users.

Deirdre King de Montano
General Manager – Office of the Chief Clinical Director
UL Hospitals Group

DATA QUALITY

The NQAIS NAHM web-based tool uses HIPE data routinely collected in publicly funded hospitals. These data are relevant for the monitoring of in-hospital mortality trends and identification of areas for improvement in quality of care. They also enable hospitals to monitor their in-hospital mortality. A key recommendation in the NAHM Annual Report 2017 was for discharge summaries to "be complete and consistent with source documentation and contain a definitive diagnosis using consistent terminology and all relevant comorbidities" (NOCA, 2018, p. 40). The commentary from our user representative shows evidence that there is still a focus required in this area. NOCA will continue to advocate for accuracy of all clinical information in patients' healthcare records.

One of the objectives of NAHM is to understand and improve the quality of hospital-based mortality data. In October 2018, the Health Information and Quality Authority (HIQA) published *Guidance on a data quality framework for health and social care* to help organisations develop a data quality framework to systematically assess, monitor, evaluate and improve the quality of their data and information (HIQA, 2018). NOCA has undertaken to work to the suggested guidelines, so that patients and service users can be assured that NQAIS NAHM data are as accurate and reliable as possible.

Table 2 highlights the assessment of the quality of NQAIS NAHM 2018 data using the dimensions of data quality documented in the data quality framework developed by HIQA.

TABLE 2: OVERVIEW OF THE QUALITY OF NQAIS NAHM DATA IN 2018

Dimensions of data quality in 2018	Definition (HIQA, 2018)	Assessment of dimension (NQAIS NAHM)
Relevance 	**Relevant data meet the current and potential future needs of users.**	Feedback on relevance was sought from users in November 2018 in relation to developments in the NQAIS NAHM web-based tool, so as to ensure that changes met users' needs. Following users' feedback, the summary page was further enhanced to help hospitals to clearly identify when they are a statistical outlier. Reporting needs were met in 2018, with hospitals receiving updates of data on the tool in February, March, June, September and December 2018. All users were informed by email when the releases of data occurred and when the next release was due. All of these planned release dates were met. Hospital Groups received a report specific to their group in January 2018. The Business Information Unit (HSE), received annual metadata information in February 2018. There was one request for access to NQAIS NAHM data for research purposes in April 2018. The aim of the study was to compare hospitals' mortality rates; this request was declined, as it is not appropriate for NQAIS NAHM to be used in this way.

Dimensions of data quality in 2018	Definition (HIQA, 2018)	Assessment of dimension (NQAIS NAHM)
Accuracy and reliability 	**The accuracy of data refers to how closely the data correctly describe what they were designed to measure. Reliability refers to whether those data consistently measure, over time, the reality of the metrics that they were designed to represent.**	All data used were extracted directly from HIPE; therefore, data validation was carried out both at hospital level and by the Healthcare Pricing Office (HPO). NOCA carried out further validation of HIPE data before every refresh of data to the NQAIS NAHM tool in January, February, May, August and November 2018. NOCA validation identified where one hospital had duplicate cases in May 2018. These duplications were due to admission processes. Corrections were made by the hospital's HIPE office in consultation with the HPO. As all data were extracted from HIPE and all fields used were mandatory, there were no invalid/missing values. HIPE coverage figures were not made available to users by NOCA; rather, they were communicated directly to hospitals by the HPO. HIPE coverage figures are included in Hospital Group reports for 2019. The 2018 report was based on data from the closed HIPE data file.[1]
Timeliness and punctuality 	**Timely data are collected within a reasonable agreed time period after the activity that they measure. Punctuality refers to whether data are delivered on the dates promised, advertised or announced.**	Hospitals are expected to code patient charts within 30 days of discharge (HPO, 2017). The HIPE Coverage Report for January to December 2018 data (March 2019, closed file) shows that 99.89% of discharges on the patient administration system were coded and exported to the national HIPE file. The HPO monitors, validates and anonymises the data before sending them to the HIU HSE, where the statistical modelling is applied, turning HIPE data into NQAIS NAHM information. A final validation process is carried out by NOCA before data are released to the web-based tool for hospitals to view. This processing timeline takes approximately one-and-a-half months, and targets were met throughout 2018. An Information "(i)" button in the NQAIS NAHM web-based tool indicates the date when the data were released to the web-based tool. The date of data covered in the rolling 12-month period is the default display and is available on the "period" button. All data updates to the NQAIS NAHM web-based tool were released as planned in 2018. A schedule of data updates for 2018/2019 was published in the *National Audit of Hospital Mortality Annual Report 2017* (NOCA, 2018), which is publicly available on the NOCA website.

[1] HIPE_2018_ASOF_0419_V18_CLOSE_ENC_EPI_DOB_HI_TODEC.fil

Dimensions of data quality in 2018	Definition (HIQA, 2018)	Assessment of dimension (NQAIS NAHM)
Coherence and comparability 	**Coherent and comparable data are consistent over time and across providers and can be easily combined with other sources.**	In 2018, NQAIS NAHM was based on the 8th Edition of the Australian Coding Standards ICD-10-AM. These ICD codes are then matched to Clinical Classifications Software (CCS) groups, which allow for statistical analysis. CCS groupings are used internationally in all mortality models. There are some variations, in order to reflect practices in Ireland; for example, 'Stroke' is divided into three categories: • haemorrhagic stroke • ischaemic stroke • subdural/extradural haemorrhage. A NQAIS NAHM data dictionary was not available in 2018 and is under development in 2019. This will be published on the NOCA website when it is finalised. NQAIS NAHM uses definitions sourced from the HPO's HIPE data dictionary, which is available on http://www.hpo.ie/hipe/hipe_data_dictionary/HIPE_Data_Dictionary_2019_V11.0.pdf NQAIS NAHM is not comparable to international models due to differences in the risk model, i.e. ages, day cases, 30-day mortality figures, etc. Therefore, international or regional benchmarking is not possible.
Accessibility and clarity 	**Data are easily obtainable and clearly presented in a way that can be understood.**	The NAHM team has published four annual reports focusing on six key diagnoses which have a high burden of illness and meet specified inclusion criteria. Hospitals can view their in-hospital mortality data for all diagnoses via the NQAIS NAHM web-based tool throughout the year. A summary report in clear language with graphics is also produced and available for download from the NOCA website. NQAIS NAHM users within each hospital/Hospital Group are trained on the NQAIS NAHM web-based tool, with monthly training sessions available. This training schedule is published on the NOCA website, www.noca.ie. In 2018, There are 275 users trained and have access to the NQAIS NAHM web-based tool.

Data are released to the NQAIS NAHM web-based tool quarterly. In line with recommendations from the NAHM Governance Committee, in order to enable users to have a timely view of NQAIS NAHM in the approach to the closure of the HIPE file (31 March for the past three years), there are also two additional releases of data scheduled for January and February of each year. Table 3 shows the scheduled dates for the release of data to the NQAIS NAHM web-based tool in 2020. Release dates for 2019 were met (see *National Audit of Hospital Mortality Annual Report 2017* (NOCA, 2018)).

TABLE 3: CALENDAR OF DATA RELEASES TO NQAIS NAHM IN 2020

Release of data to NQAIS NAHM	Data periods included in the NQAIS NAHM data release	Comments Type of release
January 2020	November 2018 to October 2019	Monthly update
February 2020	December 2018 to November 2019	Monthly update
March 2020	January 2019 to December 2019	Quarterly
June 2020	April 2019 to March 2020	Closed HIPE file/ quarterly
September 2020	July 2019 to June 2020	Quarterly
December 2020	October 2019 to September 2020	Quarterly

PALLIATIVE CARE

Palliative care is an approach to medical treatment for people suffering from a life-threatening illness. This encompasses the patient themselves and also their families. The palliative care approach focuses on the prevention and relief of suffering by means of assessing and treating pain and other physical or psychosocial problems at any stage of the patient's illness, not just the end of life. In Ireland, current guidance to clinical coders states that the palliative care code should be assigned when there is documentation that the patient has been seen by or attended to by a palliative care specialist or palliative care team (HPO, 2019).

Despite this guidance, there is variation in the application of the palliative care code between hospitals, which is evident in Figure 1. This variation may not be unexpected, as the code does not differentiate between treatment being provided by a palliative care specialist/team and an assessment being provided where no further treatment is required. Its application is also dependent on clinicians recording this activity in the healthcare record.

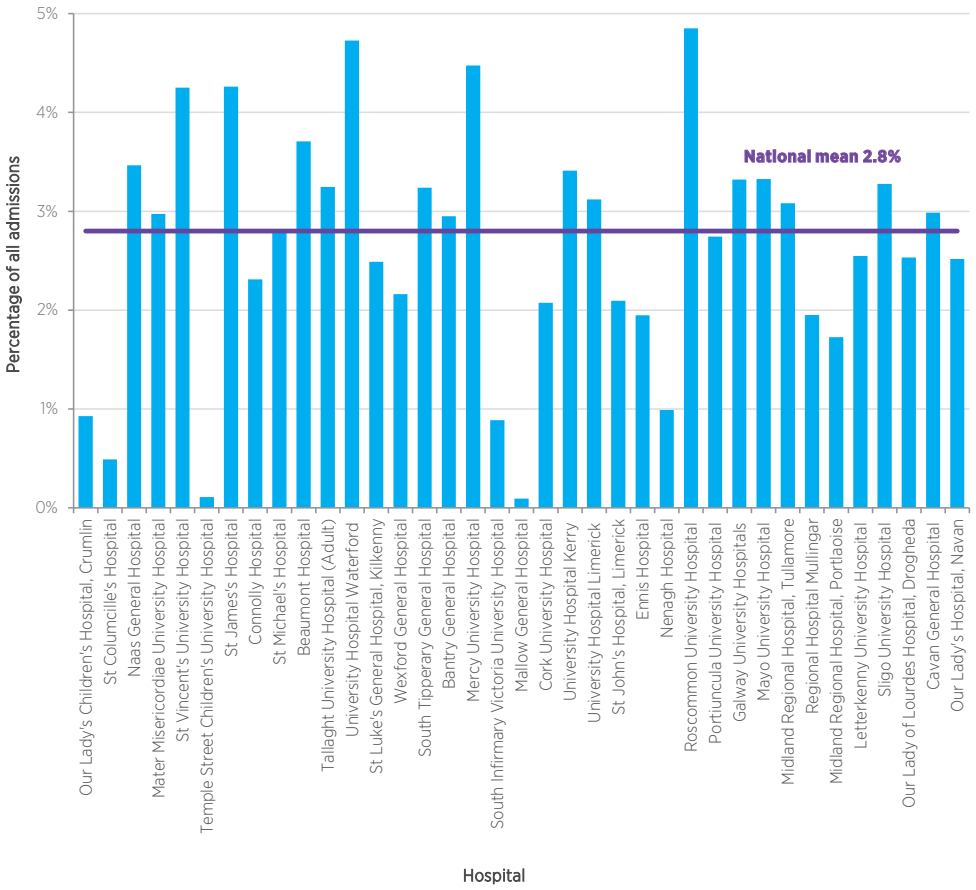


FIGURE 1: APPLICATION OF PALLIATIVE CARE AS A PERCENTAGE OF ALL ADMISSIONS, 2018

The 10th Edition of the classification used in HIPE, the International Statistical Classification of Diseases and Related Health Problems, Tenth Revision, Australian Modification/ Australian Classification of Health Interventions/Australian Coding Standards (ICD-10-AM/ACHI/ACS), will be introduced for all patients discharged on or after 1 January 2020 (Australian Consortium for Classification Development, 2017). The 10th Edition ACS 2116 (*Palliative care*) changes and clarifies how the palliative care code is applied. The palliative care coding standard in the 10th Edition states that the palliative care code will only be coded as an additional diagnosis when there is documented evidence that the patient has been provided with palliative care.

The National Clinical Programme for Palliative Care is working with the HPO to develop guidance on the accepted documented wording to provide evidence of palliative care treatment for patients. This guidance will be used in training on the 10th Edition for all HIPE coders and should be shared with all clinicians in order to ensure consistency in documenting palliative care treatment.

Dr Brian Creedon, Clinical Lead for the National Clinical Programme for Palliative Care, advised: "There remains a challenge to interpret the meaning of the Z51.5 *palliative care* code in that it captures a wide diversity of patients and inferences around mortality are difficult to interpret. The code includes patients who have had input from the specialist palliative care team. These patients may or may not have a life limiting or threatening illness. There are also patients included whom are having treatment with a 'palliative'

intent or for a 'palliative' approach. The supposition that these patients (or some of) are expected to die during their acute hospital admission cannot be assumed. It should be noted that the UK have separated the coding of patients receiving end of life care from those patients who received input from the specialist palliative care team." (Personal email communication 26 August 2019).

Figure 2 shows the national mean rate of application of the palliative care code for patients who died in 2018.

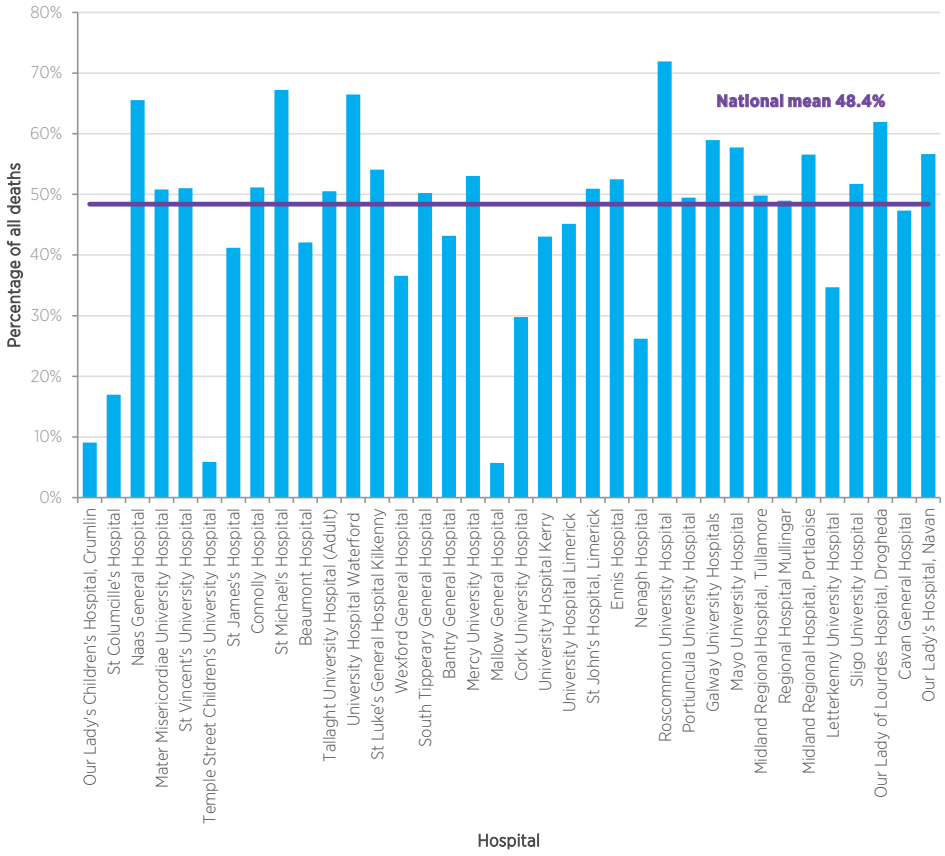


FIGURE 2: APPLICATION OF PALLIATIVE CARE CODE AS A PERCENTAGE OF DEATHS IN ALL ADMISSIONS, 2018

Figure 3 shows a rise in the national mean rate of application of the palliative care code for patients who died in 2018. The year-on-year rise in the application of this code is most likely due to the awareness raised about the palliative care code by NOCA, in partnership with the HPO and NQAIS NAHM, since 2014, and its potential importance to the risk modelling.

	ALL ADMISSIONS MEAN	ALL DEATHS MEAN
2014	2.2%	37.4%
2015	2.4%	40.6%
2016	2.6%	45.7%
2017	2.8%	47.8%
2018	2.8%	48.4%

FIGURE 3: NATIONAL MEAN RATE OF APPLICATION OF PALLIATIVE CARE CODE FOR ALL ADMISSIONS AND FOR ALL DEATHS, 2014-2018

UPDATE ON CODING OF ACUTE MYOCARDIAL INFARCTION AND CORONARY ARTERY DISEASE

The HPO raised a query officially with Australian Consortium for Classification Development (ACCD) relating to the sequencing of AMI versus coronary artery disease (CAD) as the principal diagnosis on HIPE. This is particularly difficult to establish where the patient is treated across two hospitals, with the AMI as the principal diagnosis in the first hospital and then the patient being transferred to the second hospital for treatment. The HPO asked, "In the second hospital, which condition is sequenced first, AMI or CAD, where both are present on the initial presentation and the patient is stented? Does the AMI principal diagnosis carry through to the second hospital where the patient is stented?" (Email communication 4 April 2018).

The ACCD's response is provided below, but unfortunately it is inconclusive.

"A percutaneous coronary intervention (PCI) is performed to open coronary arteries that are narrowed or blocked by atherosclerotic plaque. PCI may be used to relieve symptoms of coronary artery disease (CAD) or to reduce heart damage during or after an acute myocardial infarction (AMI) (National Heart, Lung and Blood Institute, n.d.).

Code assignment for the cited scenarios is dependent upon documentation in the clinical record (i.e. determined on a case by case basis). Assign principal and additional diagnoses by applying the guidelines in ACS 0001 *Principal Diagnosis* and ACS 0002 *Additional Diagnoses.*

However, note also the following:

- Where a patient is admitted with an AMI, a PCI may be performed to provide rapid access to reperfusion therapy as well as treat the CAD. Reperfusion therapy is treatment that prevents or minimises further tissue damage to the heart by restoring blood flow through blocked coronary arteries. It includes thrombolytic drugs, coronary artery angioplasty or coronary artery bypass grafting. Early reperfusion therapy is critical for eligible patients with AMI as the restored blood flow reintroduces oxygen within cells of the heart, resulting in improved cellular activity and heart function, ultimately reducing the probability of heart failure, arrhythmias and death.

- Where a patient is admitted specifically for a coronary angiogram, angioplasty or bypass graft following a recent AMI, and CAD is a documented finding/indication for the intervention, assign a code for the CAD as principal diagnosis. Assign as an additional diagnosis, a code from category I21 *Acute myocardial infarction,* if the admission is within 4 weeks (28 days) from onset of the AMI.

Documentation within the episode of care should clarify the indication for the PCI. Where documentation is ambiguous, seek clinical clarification. Amendments may be considered for a future edition of ICD-10-AM/ACHI/ACS."

In light of the issues outlined in the ACCD's response to the HPO's query, caution must be exercised when reviewing cases with a principal diagnosis of AMI or CAD. Sequencing may be affected by the chart documentation, discharge letter or other information presented in the healthcare records to the coder indicating the reason for care, and thus guiding the coder towards either condition as the principal diagnosis.

CARDIOVASCULAR DIAGNOSES

BACKGROUND

Cardiovascular disease is the number one cause of death globally, causing approximately 17.9 million deaths each year. Of these deaths, 85% are due to heart attack or stroke (World Health Organization, 2019a). Cardiovascular diseases are a group of disorders affecting the heart and blood vessels. These conditions include coronary heart disease (myocardial infarction and heart attack), cerebrovascular disease (ischaemic and haemorrhagic stroke), heart failure, and rheumatic heart disease.

The NQAIS NAHM web-based tool includes data for all patients who have a cardiovascular principal diagnosis, not solely those diagnoses presented in this report. Each hospital can access its data locally and conduct reviews as required.

For the purposes of public reporting, the NAHM Governance Committee applied inclusion criteria to the framework for the NAHM report. The following cardiovascular diagnoses meet the reporting criteria: acute myocardial infarction, heart failure, ischaemic stroke and haemorrhagic stroke.

ACUTE MYOCARDIAL INFARCTION

BACKGROUND

Acute myocardial infarction (AMI) is the medical name for a heart attack. A heart attack is a life- threatening event that happens when the coronary arteries that supply blood to your heart muscle suddenly become blocked. If this blockage happens, it causes damage to your heart muscle (Irish Heart Foundation, 2019).

Heart attacks most often occur as a result of coronary heart disease, which the World Health Organization estimates is the leading cause of death worldwide (World Health Organization, 2018).

AMI causes an interruption of blood flow to the heart muscle, which will weaken or permanently damage its ability to function. While there are important clinical differences between subtypes of myocardial infarction (e.g. ST-elevation myocardial infarction (STEMI) and non-ST-elevation myocardial infarction (NSTEMI)) (HSE Clinical Strategy and Programmes Division and Royal College of Physicians of Ireland, 2015), for the purposes of this report, these subtypes are grouped together.

The HSE's HeartBeat Portal records data on STEMI patients brought directly, or referred from surrounding general hospitals, to designated primary percutaneous coronary intervention (PPCI) centres plus data from PCI centres where a PPCI may be done. HeartBeat has been governed by the Acute Coronary Syndrome programme since 2013. During this time, the in-hospital mortality rate for AMI has declined steadily. There are a number of factors contributing to this reduction, such as how care is delivered, PPCI being the main treatment for STEMI in a smaller number of dedicated treatment centres, and improved timeliness of treatment (HSE Clinical Strategy and Programmes Division and Royal College of Physicians of Ireland, 2018).

Governance of the HeartBeat audit will transfer to NOCA during 2019, to form part of the National Cardiovascular Audit Programme.

AMI in NQAIS NAHM is based on ICD-10-AM codes I21, I210, I211, I212, I213, I214, I219, I22, I220, I221, I228, and I229, and is fully defined in the online appendices which can be found at https://www.noca.ie/publications/publications-listing/P0/category/3/0.

FINDINGS

Figure 4 presents the crude in-hospital mortality rate for AMI from 2009 to 2018, with a 95% confidence interval (CI). These data have not been adjusted for differences in age profile or comorbidities over time, but they provide background information to hospital presentations for this time period. There has been a significant reduction (35%) in in-hospital mortality for AMI over the past 10 years, from 74 deaths per 1,000 admissions in 2009 to 48 deaths per 1,000 admissions in 2018.

When performing a statistical analysis, small sample sizes may provide erratic results; for this reason, only hospitals with 100 or more admissions are included for analysis in order to ensure statistical reliability. Of the 44 participating hospitals, only 22 met this criterion for 2018. The number of patients with a principal diagnosis of AMI admitted to these hospitals in 2018 ranged from 101 to 664 patients.

The number of hospitals which meet the inclusion criterion may appear to be a relatively small sample of our participating hospitals (N=44); however, the included hospitals have a high number of admissions and account for 93% of patients admitted with a principal diagnosis of AMI in 2018.

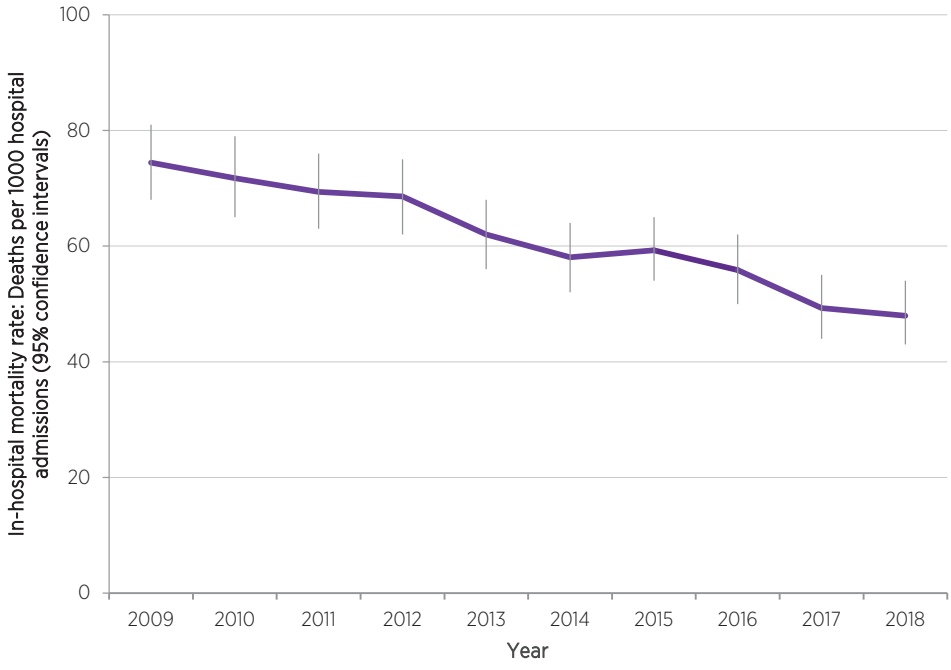


FIGURE 4: NATIONAL IN-HOSPITAL MORTALITY FOLLOWING ADMISSION WITH PRINCIPAL DIAGNOSIS OF AMI, 2009–2018

Figure 5 presents the SMRs for these hospitals in a funnel plot, with 99.8% control limits. These limits represent the upper and lower limits of expected variation. Each individual hospital's control limits are calculated based on that hospital's patient details. If an SMR appears outside the 99.8% control limits, it is very unlikely that this is due to chance (1 in 500 likelihood to be due to chance alone), and further investigation is warranted. All hospitals had an SMR within the control limits of 99.8% for AMI, indicating that all hospitals' SMRs were within the expected range for 2018. Twenty-two hospitals are not included in this analysis, as they did not meet the selection criterion relating to a defined number of admissions and expected events.

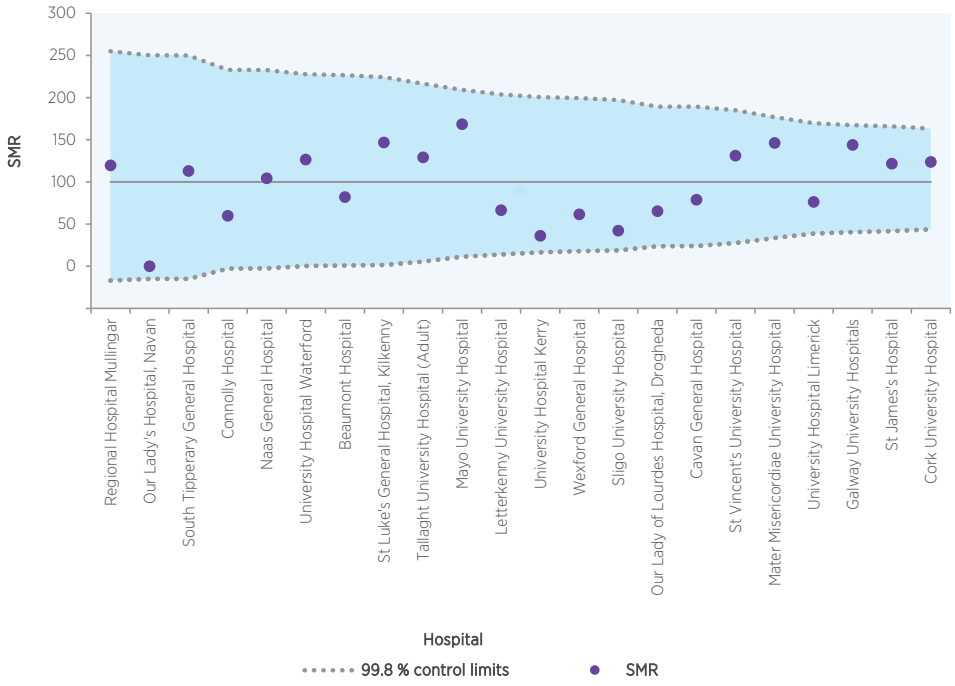


FIGURE 5: NATIONAL IN-HOSPITAL SMR FOLLOWING ADMISSION WITH PRINCIPAL DIAGNOSIS OF AMI, 2018

HEART FAILURE

BACKGROUND

Heart failure is a term used when the heart is not working as effectively as it should, resulting in a reduction in the heart's ability to pump sufficient amounts of blood needed around the body to supply organs and other tissues, which can cause fatigue. Because the heart is not pumping enough blood, it can cause a buildup of blood waiting to enter the heart which can cause fluid to leak out of your blood vessels and into the surrounding tissues. This leads to excess fluid, usually in the legs and abdomen, and fluid congestion in the lungs (Heart Failure Matters, 2019).

Common symptoms are breathlessness, fatigue, loss of energy and ankle swelling. It is often misdiagnosed due to the vast majority of sufferers being elderly and suffering from other complications and comorbidities. The incidence of heart failure is increasing with our ageing population, and is therefore causing a higher burden of illness.

Heart failure can develop as a result of other medical conditions, such as AMI or high blood pressure, both of which put extra stress on the heart and cause damage to the heart muscle. The condition can be either acute (rapid onset) or chronic (recurring) and result in prolonged hospitalisation at any stage of the illness.

Heart failure in NQAIS NAHM is based on ICD-10-AM codes I50, I500, I501, and I509, and is fully defined in the online appendices which can be found at https://www.noca.ie/publications/publications-listing/P0/category/3/0

FINDINGS

A crude in-hospital mortality rate from 2009 to 2018 for heart failure is presented in Figure 6, with a 95% CI. These data have not been adjusted for differences in age profile or comorbidities over time, but they provide background information to hospital presentations for this time period. There was 6% (not significant) reduction in in-hospital mortality over the past 10 years, from 82 deaths per 1,000 admissions in 2009 to 77 deaths per 1,000 admissions in 2018.

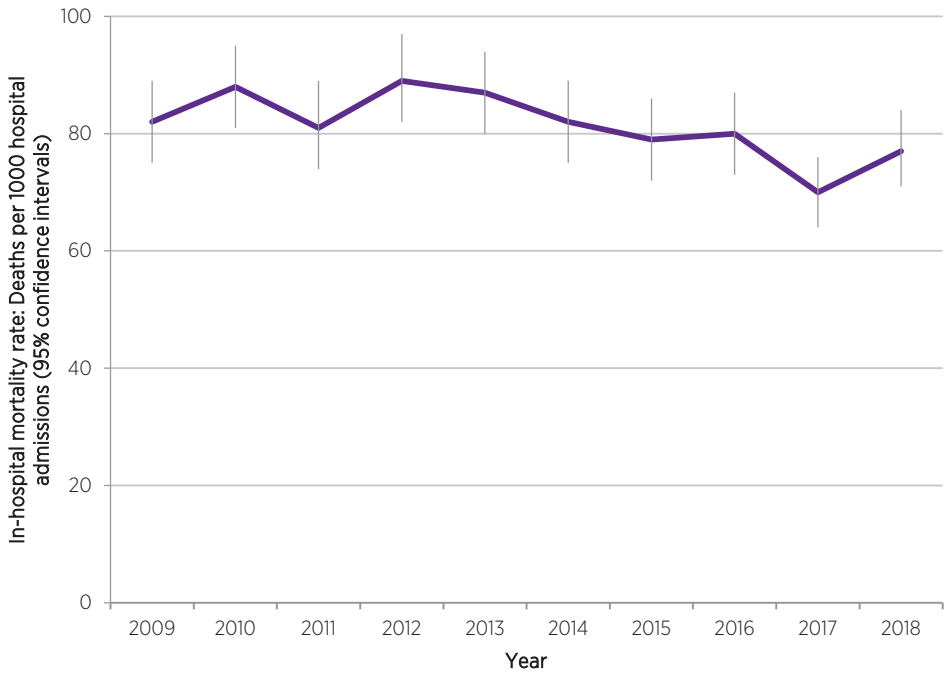


FIGURE 6: NATIONAL IN-HOSPITAL MORTALITY FOLLOWING ADMISSION WITH PRINCIPAL DIAGNOSIS OF HEART FAILURE, 2009–2018

When performing a statistical analysis, small sample sizes may provide erratic results; for this reason, only hospitals with 100 or more admissions are included for analysis in order to ensure statistical reliability. Of the 44 participating hospitals, only 31 met this criterion for heart failure in 2018. The number of patients with a principal diagnosis of heart failure admitted to these hospitals in 2018 ranged from 110 to 440 patients.

The number of hospitals which meet the inclusion criterion may appear to be a relatively small sample of our participating hospitals (N=44); however, the included hospitals have a high number of admissions and account for 97% of patients admitted with a principal diagnosis of heart failure in 2018.

Figure 7 presents the SMRs for these hospitals in a funnel plot, with 99.8% control limits. These limits represent the upper and lower limits of expected variation. Each individual hospital's control limits are calculated based on that hospital's patient details. If an SMR appears outside the 99.8% control limits, it is very unlikely that this is due to chance (1 in 500 likelihood to be due to chance alone), and further investigation is warranted. All hospitals had an SMR within the control limits of 99.8% for heart failure, indicating that all hospitals' SMRs were within the expected range for 2018. Thirteen hospitals are not included in this analysis, as they did not meet the selection criterion relating to a defined number of admissions and expected events.

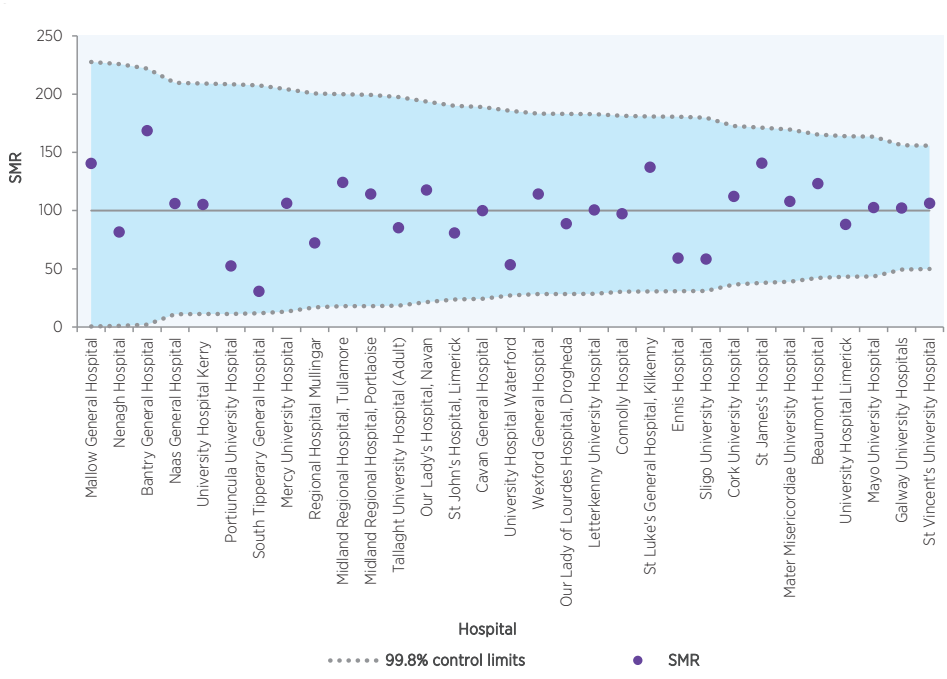


FIGURE 7: NATIONAL IN-HOSPITAL SMR FOLLOWING ADMISSION WITH PRINCIPAL DIAGNOSIS OF HEART FAILURE, 2018

STROKE

BACKGROUND

A stroke is a serious, life-threatening medical condition. There are two main types:

1) **Ischaemic,** where the blood supply to the brain is stopped due to a blood clot; this accounts for approximately 85% of all strokes.
2) **Haemorrhagic**, where a weakened blood vessel supplying the brain ruptures, causing bleeding into or around the brain. This accounts for the remaining 15% of strokes (King's College London for the Stroke Alliance for Europe (SAFE), 2017).

Like all organs, the brain needs oxygen and nutrients provided by blood in order to function properly. If the supply of blood becomes interrupted or cut off, brain cells begin to die rapidly. When the affected brain cells die, the motor, visual or cognitive function (e.g. speech) controlled by these cells stops working. Depending on the location and size of the affected area, a stroke can lead to very significant brain injury and disability, and possibly even death. Stroke affects 17 million people worldwide each year and it is the second leading cause of death and second leading cause of dementia in the developed world. In Ireland, HIPE recorded a total of 6,224 patients with an acute stroke as their principal diagnosis (codes I60, I61, I63 and I64) in 2018. Approximately 7,000 admissions with stroke were recorded in the *Irish Heart Foundation/HSE National Stroke Audit 2015* (McElwaine *et al*., 2015).

The reduction in mortality and in the predicted increase of stroke admissions is multifactorial. Primary care interventions, including detection and management of hypertension and atrial fibrillation, are key drivers of this trend. National policies such as Healthy Ireland have increased public awareness of cardiovascular risk factors and general healthier living practices (e.g. exercise and smoking cessation), which may also be impacting the trend. In addition, time-dependent acute treatments for ischaemic stroke, such as thrombolysis and thrombectomy, have improved greatly in recent years. This has been achieved as the result of an Acute Stroke Collaborative Programme run by the Royal College of Physicians of Ireland which has reduced the door to decision time across the acute hospital sector, and by further expansion and development of the National Thrombectomy Service.

There is an ongoing need to increase public awareness of stroke, and the National Clinical Programme for Stroke s working with the Department of Health and the Irish Heart Foundation to reinstate the F.A.S.T. campaign.

In 2019, the National Stroke Register will become the Irish National Audit of Stroke (INAS) under the governance of NOCA.

There are 27 hospitals in Ireland with stroke units. The figures below are reflective of these hospitals rather than all 44 NAHM participating hospitals.

ISCHAEMIC STROKE

BACKGROUND

Ischaemic stroke is the most common form of stroke. In an ischaemic stroke, blood flow to the brain is interrupted either by the formation of a clot in situ in a blood vessel in the brain (cerebral thrombosis) or by movement of a clot from elsewhere in the body's circulatory system (usually from the heart, but also from the diseased wall of the aortic arch or carotid artery), which in turn causes blockage in a blood vessel in the brain (cerebral embolism).

Ischaemic stroke in NQAIS NAHM is based on ICD-10-AM codes I63, I630, I631, I632, I633, I634, I635, I636, I638, and I639, and is fully defined in the online appendices which can be found at https://www.noca.ie/publications/publications-listing/P0/category/3/0

FINDINGS

A crude in-hospital mortality rate from 2009 to 2018 for ischaemic stroke is presented in Figure 8, with a 95% CI. These data have not been adjusted for differences in age profile or comorbidities over time, but they provide background information to hospital presentations for this time period. There was a significant reduction (38%) in in-hospital mortality over the past 10 years, from 123 deaths per 1,000 admissions in 2009 to 76 deaths per 1,000 admissions in 2018, which reflects the results reported in the National Stroke Register in 2018.

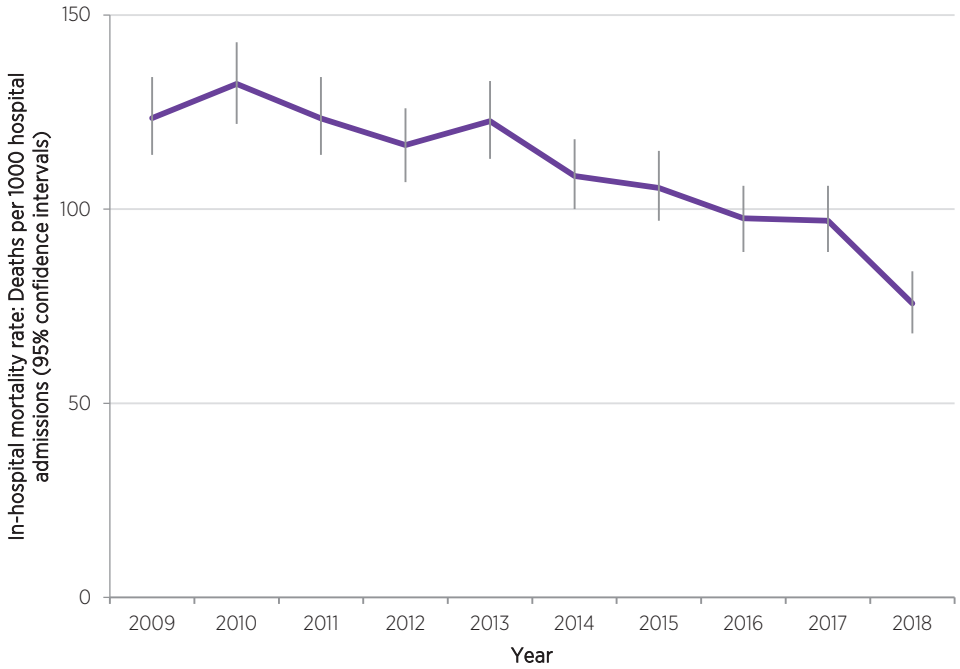


FIGURE 8: NATIONAL IN-HOSPITAL MORTALITY FOLLOWING ADMISSION WITH PRINCIPAL DIAGNOSIS OF ISCHAEMIC STROKE, 2009–2018

When performing a statistical analysis, small sample sizes may provide erratic results; for this reason, only hospitals with 100 or more admissions are included for analysis in order to ensure statistical reliability. Twenty-seven of the participating hospitals admit acute stroke patients, and 17 of these met the inclusion criterion for 2018. The number of patients with a principal diagnosis of ischaemic stroke admitted to these hospitals in 2018 ranged from 110 to 501 patients.

The number of hospitals which meet the inclusion criterion may appear to be a relatively small sample of the 27 hospitals admitting acute stroke patients; however, the 17 included hospitals have a high number of admissions and account for 82% of patients admitted with a principal diagnosis of ischaemic stroke in 2018.

Figure 9 presents the SMRs for these hospitals in a funnel plot, with 99.8% control limits. These limits represent the upper and lower limits of expected variation. Each individual hospital's control limits are calculated based on that hospital's patient details. If an SMR appears outside the 99.8% control limits, it is very unlikely that this is due to chance (1 in 500 likelihood to be due to chance alone), and further investigation is warranted. All hospitals had an SMR within the control limits of 99.8% for ischaemic stroke, indicating that all hospitals' SMRs were within the expected range for 2018. Ten of the 27 hospitals with stroke units are not included in this analysis, as they did not meet the selection criterion relating to a defined number of admissions and expected events.

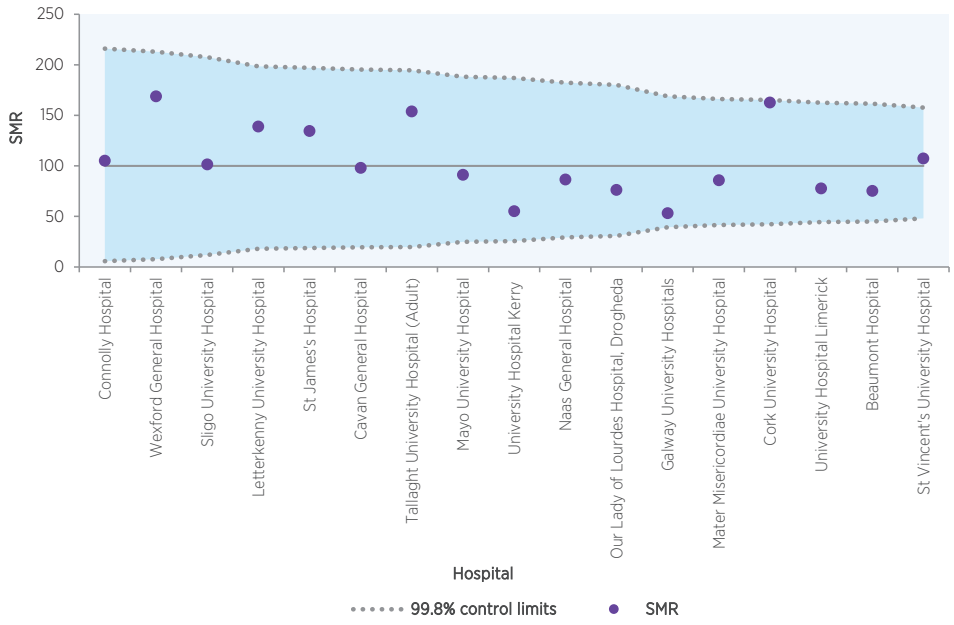


FIGURE 9: NATIONAL IN-HOSPITAL SMR FOLLOWING ADMISSION WITH PRINCIPAL DIAGNOSIS OF ISCHAEMIC STROKE, 2018

HAEMORRHAGIC STROKE

BACKGROUND

Haemorrhagic stroke is generally caused by intracerebral or subarachnoid bleeding caused by ruptured blood vessels that lead to bleeding within or around the brain (bleeding in the subarachnoid space around the brain and bleeding in the brain itself have different causes and patient characteristics; many centres do not treat subarachnoid bleeding in the same way as they treat stroke). Brain haemorrhages should only be classified as stroke if they are non-traumatic, are caused by a vascular event, and result in injury or ischaemia to the central nervous system/brain. Haemorrhagic stroke occurs less frequently than ischaemic stroke but can have much higher associated mortality and morbidity (Sacco *et al*., 2013).

There is more work to be done in the management of haemorrhagic stroke in order to begin to improve outcomes, and Ireland is participating in international trials investigating novel therapies and formulating an agreed care pathway for haemorrhagic stroke.

Haemorrhagic stroke in NQAIS NAHM is based on ICD-10-AM codes I60, I600, I601, I602, I603, I604, I605, I606, I607, I608, I609, I61, I610, I611, I612, I613, I614, I615, I616, I618, and I619, and is fully defined in the online appendices which can be found at https://www.noca.ie/publications/publications-listing/P0/category/3/0.

FINDINGS

A crude in-hospital mortality rate from 2009 to 2018 for haemorrhagic stroke is presented in Figure 10, with a 95% CI. These data have not been adjusted for differences in age profile or comorbidities over time, but they provide background information to hospital presentations for this time period. There was a 17% reduction in in-hospital mortality over the past 10 years, from 302 deaths per 1,000 admissions in 2009 to 252 deaths per 1,000 admissions in 2018.

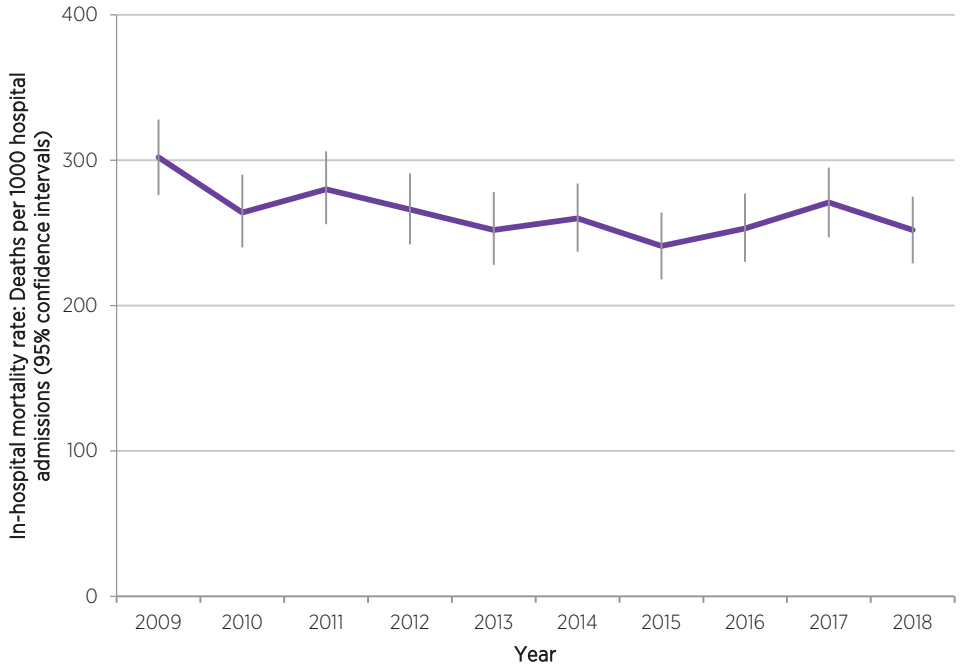


FIGURE 10: NATIONAL IN-HOSPITAL MORTALITY FOLLOWING ADMISSION WITH PRINCIPAL DIAGNOSIS OF HAEMORRHAGIC STROKE, 2009–2018

When performing a statistical analysis, small sample sizes may provide erratic results; for this reason, only hospitals with 100 or more admissions are included for analysis in order to ensure statistical reliability. Due to the low numbers of patients with a principal diagnosis of haemorrhagic stroke, data for the three-year period from 2016 to 2018 were combined. Twenty-seven of the participating hospitals admit acute stroke patients, and only 12 of these met the inclusion criterion for 2016 to 2018. The number of patients with a principal diagnosis of haemorrhagic stroke admitted to these hospitals between 2016 and 2018 ranged from 102 to 923 patients.

The number of hospitals which meet the inclusion criterion may appear to be a relatively small sample of the 27 hospitals admitting acute stroke patients; however, the 12 included hospitals have a high number of admissions and account for 74% of patients admitted with a principal diagnosis of haemorrhagic stroke between 2016 and 2018.

The SMRs for these hospitals are presented in a funnel plot, with 99.8% control limits (Figure 11). These limits represent the upper and lower limits of expected variation. Each individual hospital's control limits are calculated based on that hospital's patient details. If an SMR appears outside the 99.8% control limits, it is very unlikely that this is due to chance (1 in 500 likelihood to be due to chance alone), and further investigation is warranted. All hospitals had an SMR within the control limits of 99.8% for haemorrhagic stroke, indicating that all hospitals' SMRs were within the expected range for 2016 to 2018. Fifteen of the 27 hospitals with stroke units are not included in this analysis, as they did not meet the selection criterion relating to a defined number of admissions and expected events.

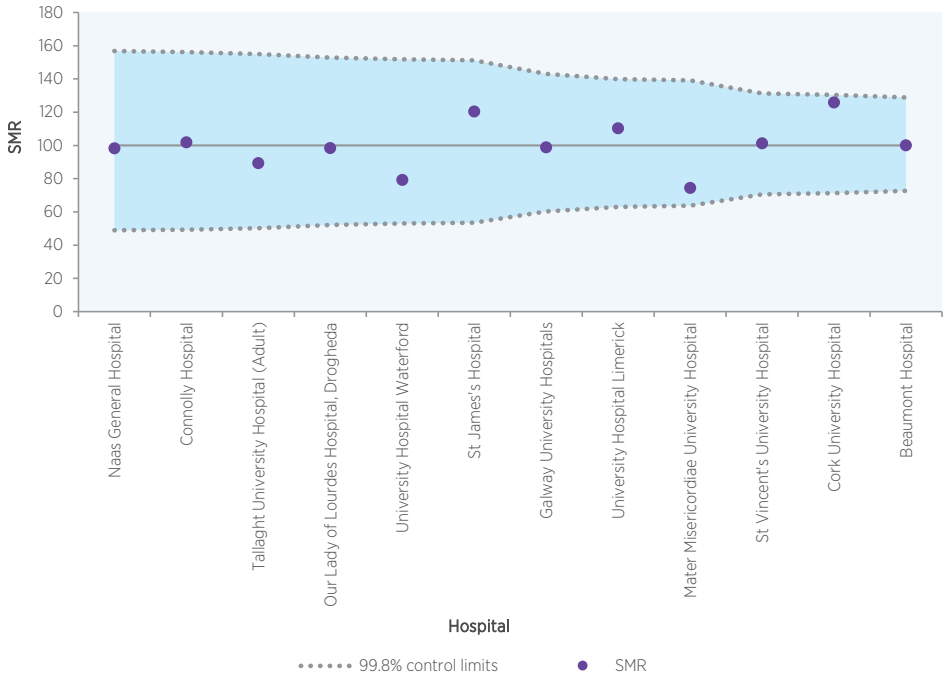


FIGURE 11: NATIONAL IN-HOSPITAL SMR FOLLOWING ADMISSION WITH PRINCIPAL DIAGNOSIS OF HAEMORRHAGIC STROKE, 2016–2018

RESPIRATORY DIAGNOSES

Respiratory diseases are diseases of the airways and other structures of the lung. Some of the most common are chronic obstructive pulmonary disease (COPD), asthma, occupational lung diseases and pulmonary hypertension. Data on these diseases, among others, are available to hospitals to view locally on the NQAIS NAHM web-based tool.

For the purposes of public reporting, the NAHM Governance Committee applied inclusion criteria to the framework for the NAHM report. The following respiratory diagnoses meet the reporting criteria: COPD and pneumonia, which are two of the most common causes of respiratory hospitalisations in Ireland.

CHRONIC OBSTRUCTIVE PULMONARY DISEASE (COPD)

BACKGROUND

COPD is a progressive, life-threatening lung disease that causes breathlessness and is the most common chronic respiratory disease in adults. COPD develops slowly and can remain undiagnosed for many years. Globally, the most common cause of COPD remains tobacco smoke and the exposure to both indoor and outdoor air pollution. However, with changes in levels of tobacco exposure, there is increasing evidence of the adverse impact of childhood factors and the role of genetics. COPD is currently the fourth leading cause of death worldwide and is predicted to become the third by 2020 (Global Initiative for Chronic Obstructive Lung Disease, 2019). The economic and social burden of COPD is also predicted to increase as a result of our ageing population, with more people living with long-term effects of COPD. In 2018, 73% of inpatients admitted with a principal diagnosis of COPD were over the age of 65. This figure is expected to rise as life expectancy in Ireland is increasing faster than the European Union average, with expectancy at birth in Ireland in 2015 at 81.5 years compared with the European Union average of 80.6 years (Organisation for Economic Co-operation and Development and European Observatory on Health Systems and Policies, 2017).

COPD is characterised by persistent respiratory symptoms and airflow limitation that is due to airway and/or alveolar abnormalities usually caused by significant exposure to noxious particles or gases. The chronic airflow limitation that is characteristic of COPD is caused by a mixture of small airways diseases (e.g. obstructive bronchiolitis) and parenchymal destruction (e.g. emphysema), although the relative contributions of these two factors vary from person to person (Global Initiative for Chronic Obstructive Lung Disease, 2018). COPD has considerable impacts both on the quality and longevity of the patient's life, involving long-term medical care and frequent hospital admissions for many, and often ending in premature death. COPD is the most common disease-specific cause of emergency hospital admissions among adults in Ireland (Department of Health, 2019).

COPD in NQAIS NAHM is based on ICD-10-AM codes J40, J41, J410, J411, J418, J42, J43, J430, J431, J432, J438, J439, J44, J440, J441, J448, J449, and J47, and is fully defined in the online appendices which can be found at https://www.noca.ie/publications/publications-listing/P0/category/3/0.

FINDINGS

A crude in-hospital mortality rate from 2009 to 2018 for COPD is presented in Figure 12, with a 95% CI. These data have not been adjusted for differences in age profile or comorbidities over time, but they provide background information to hospital presentations for this time period. There was no reduction (0%) in in-hospital mortality for COPD over the past 10 years, with 37 deaths per 1,000 admissions in both 2009 and 2018.

The COPD crude mortality rate has gone back up to the same level in 2018 that it was at in 2009, with 37 in-hospital mortalities per 1,000 admissions. That is a change from the previous few years' downward trend. The number of patients admitted with COPD as a principal diagnosis has also increased in that time, rising from 11,373 in 2009 to 16,089 in 2018. In response to this information provided to the National Clinical Programmes, Dr Tim McDonnell, Clinical Lead, National Clinical Programme for Respiratory stated that "the increased COPD admissions are related to an ageing population. We should be better at getting more and superior care in primary care and the new GP contract will help this. However, any progress to date has been offset by an increase in the ageing population."(Personal email communication 17 October 2019).

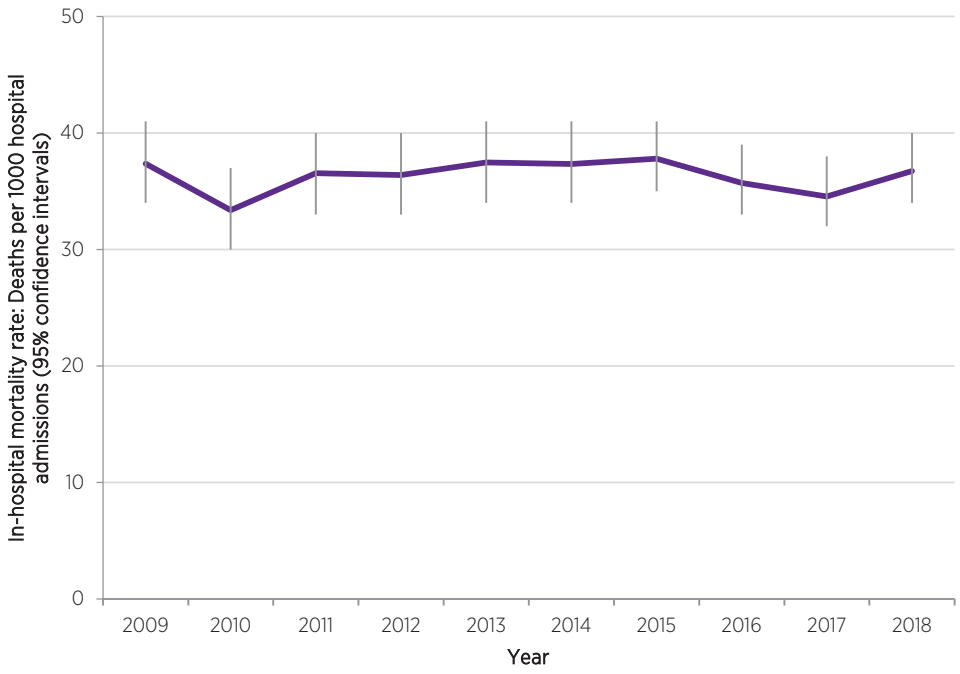


FIGURE 12: NATIONAL IN-HOSPITAL MORTALITY FOLLOWING ADMISSION WITH PRINCIPAL DIAGNOSIS OF COPD, 2009–2018

When performing a statistical analysis, small sample sizes may provide erratic results; for this reason, only hospitals with 100 or more admissions are included for analysis in order to ensure statistical reliability. Of the 44 participating hospitals, only 32 met this criterion for 2018. The number of patients with a principal diagnosis of COPD admitted to these hospitals in 2018 ranged from 171 to 834 patients.

The number of hospitals which meet the inclusion criterion may appear to be a small sample of our participating hospitals (N=44); however, the included hospitals have a high number of admissions and account for 99% of patients admitted with a principal diagnosis of COPD in 2018.

Figure 13 presents the SMRs for these hospitals in a funnel plot, with 99.8% control limits. These limits represent the upper and lower limits of expected variation. Each individual hospital's control limits are calculated based on that hospital's patient details. If an SMR appears outside the 99.8% control limits, it is very unlikely that this is due to chance (1 in 500 likelihood to be due to chance alone), and further investigation is warranted. All hospitals had an SMR within the control limits of 99.8% for COPD, indicating that all hospitals' SMRs were within the expected range for 2018. Twelve hospitals are not included in this analysis, as they did not meet the selection criterion relating to a defined number of admissions and expected events.

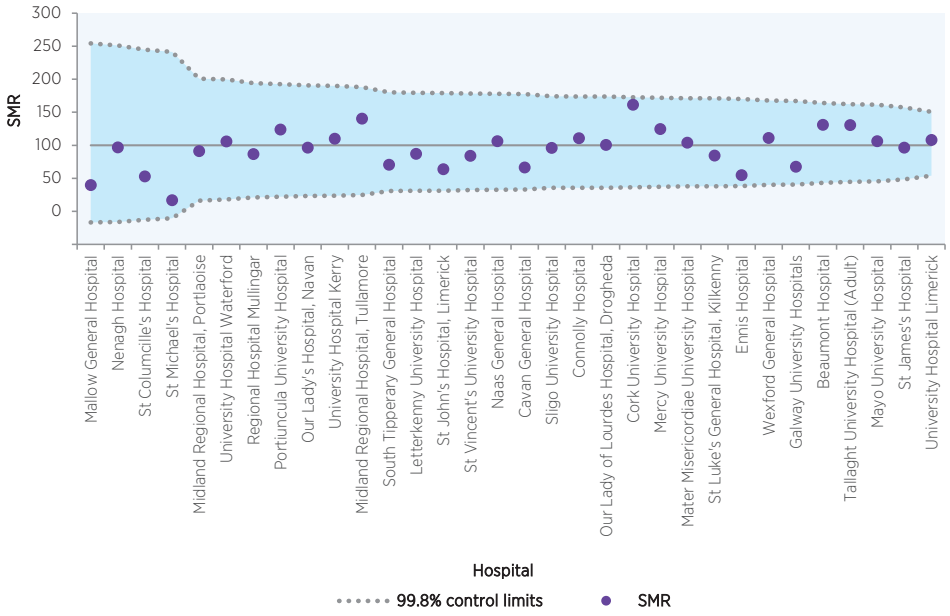


FIGURE 13: NATIONAL IN-HOSPITAL SMR FOLLOWING ADMISSION WITH PRINCIPAL DIAGNOSIS OF COPD, 2018

PNEUMONIA

BACKGROUND

Pneumonia is an inflammation of the lungs which is most commonly caused by bacterial infection but can also be viral or fungal. Infants, young children, the elderly, and people with other serious health conditions or a weakened immune system are at a higher risk of developing pneumonia. For those groups of people, pneumonia can be severe and therefore hospitalisation is required, as complications may develop.

The lungs are made up of small sacs called alveoli, which fill with air when a healthy person breathes. When an individual has pneumonia, the alveoli are filled with pus and fluid, which makes breathing painful and limits oxygen intake (World Health Organization, 2019b).

Pneumonia in NQAIS NAHM is based on ICD-10-AM codes A202, A212, A221, A310, A420, A430, A481, A78, B012, B052, B250, B583, B59, B671, J12, J120, J121, J122, J123, J128, J129, J13, J14, J15, J150, J151, J152, J153, J154, J155, J156, J157, J158, J159, J16, J160, J168, J17, J170, J171, J172, J173, J178, J18, J180, J181, J182, J188, J189, J85, J850, and J851, and is fully defined in the online appendices which can be found at https://www.noca.ie/publications/publications-listing/P0/category/3/0.

FINDINGS

A crude in-hospital mortality rate from 2009 to 2018 for pneumonia is presented in Figure 14, with a 95% CI. These data have not been adjusted for differences in age profile or comorbidities over time, but they provide background information to hospital presentations for this time period. This shows a significant reduction (28%) in in-hospital mortality for pneumonia over the past 10 years, from 145 deaths per 1,000 admissions in 2009 to 104 deaths per 1,000 admissions in 2018.

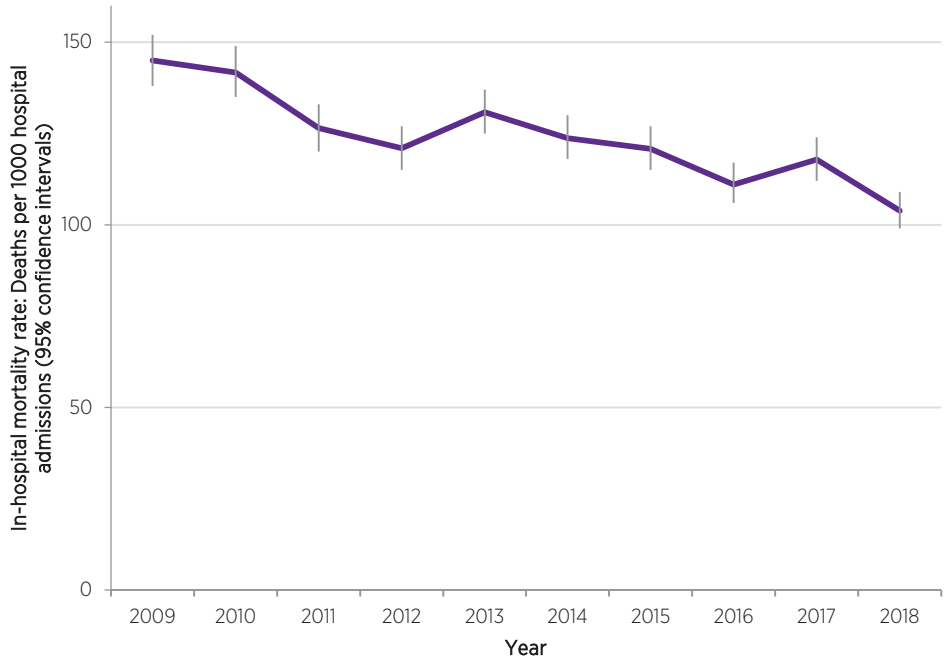


FIGURE 14: NATIONAL IN-HOSPITAL MORTALITY FOLLOWING ADMISSION WITH PRINCIPAL DIAGNOSIS OF PNEUMONIA, 2009–2018

When performing a statistical analysis, small sample sizes may provide erratic results; for this reason, only hospitals with 100 or more admissions are included for analysis in order to ensure statistical reliability. Of the 44 participating hospitals, only 32 met this criterion for 2018. The number of patients with a principal diagnosis of pneumonia admitted to these hospitals in 2018 ranged from 103 to 862 patients.

The number of hospitals which meet the inclusion criterion may appear a small sample of our participating hospitals (N=44); however, the included hospitals have a high number of admissions and account for 97% of patients admitted with a principal diagnosis of pneumonia in 2018.

Figure 15 presents the SMRs for these hospitals in a funnel plot, with 99.8% control limits. These limits represent the upper and lower limits of expected variation. Each individual hospital's control limits are calculated based on that hospital's patient details. If an SMR appears outside the 99.8% control limits, it is very unlikely that this is due to chance (1 in 500 likelihood to be due to chance alone), and further investigation is warranted. Thirty hospitals had an SMR within the control limits of 99.8%; however, two hospitals had an SMR outside the controls limits: Cork University Hospital and St James's Hospital. Twelve hospitals are not included in this analysis, as they did not meet the selection criterion relating to a defined number of admissions and expected events.

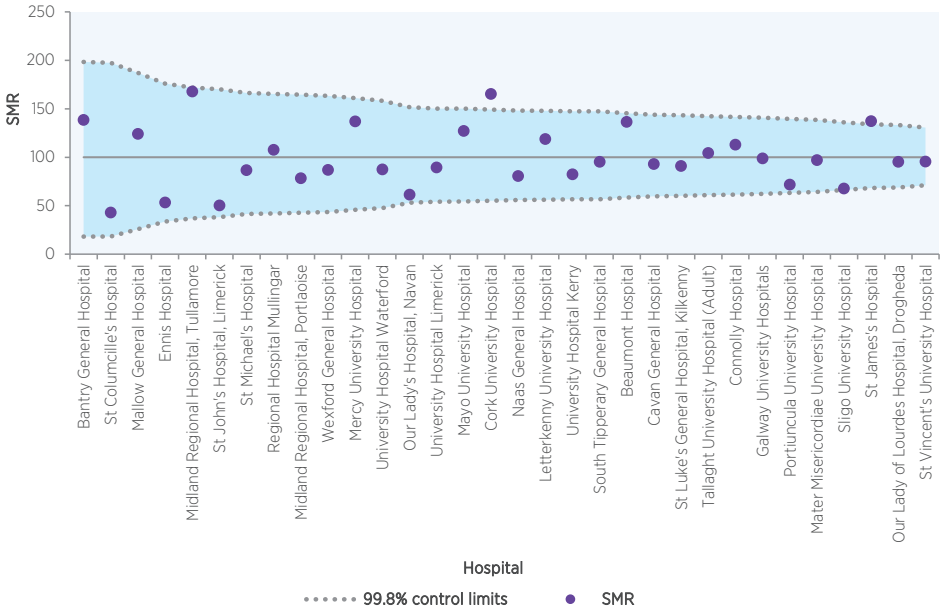


FIGURE 15: NATIONAL IN-HOSPITAL SMR FOLLOWING ADMISSION WITH PRINCIPAL DIAGNOSIS OF PNEUMONIA, 2018

STATISTICAL OUTLIERS

The NAHM Governance Committee defines an outlier as occurring where an SMR for an individual diagnosis is higher than expected, appearing outside the 99.8% CI, and also when the related cumulative summary control chart (CuSum) breaches its 99.8% control limits. This outlier is considered a *statistical* outlier if this high SMR and CuSum breach occur in two consecutive quarterly periods in NQAIS NAHM. For St James's Hospital, the outlier for pneumonia seen in Figure 15 is a first occurrence and therefore it is not a statistical outlier for monitoring and escalation at year end 2018. St James's Hospital's pneumonia SMR stabilised during 2019 and, at the time of writing this report, its SMR is within expected ranges.

Cork University Hospital had an SMR outside of the upper control limit (99.8%) in 2018, this is a statistical outlier as the high SMR and high CuSum breach were present for two consecutive quarterly data releases. NOCA engaged with the hospital and a preliminary review on a random sample of pneumonia cases was undertaken. This work is ongoing in Cork University Hospital. NOCA will support the hospital in the investigation of this statistical outlier and a summary of the review carried out will be included in the NAHM Annual Report 2019.

AUDIT UPDATE

HOSPITAL PATIENT SAFETY INDICATOR REPORT

The *Hospital Patient Safety Indicator Report* (HPSIR) is a monthly report that collates a range of patient safety indicators and is reviewed by the senior accountable officer at both hospital and Hospital Group level before publication on the HSE website. The purpose of the HPSIR is to assure the public that the indicators selected and published for the report are monitored by senior management of both the hospital and Hospital Group on a monthly basis as a key component of clinical governance. The HPSIR has been published monthly since January 2017, and is also a continuing key performance indicator on the HSE annual National Service Plan. A review of the HPSIR was undertaken in order for the report to be more clinically relevant and more easily understood by the public.

As part of that review, NAHM was approached to recommend a mortality indicator for the revised HPSIR. The recommended indicator is as follows:

"Has there been a mortality statistical outlier in the previous 12 months under review? Yes or No."

Concise explanatory notes on how to identify a statistical outlier in NQAIS NAHM are included in the HPSIR forms. The addition to the enhanced NQAIS NAHM summary page, which shows hospitals their CuSums (cumulative summary control chart confidence limits for a diagnosis breached) and their corresponding SMR, allows users to easily identify where they have an outlier. If this outlier is present for two quarterly data releases in a row, then the hospital is deemed to be a *statistical outlier* and the answer to the HPSIR question regarding the mortality indicator will be "Yes". NOCA encourages all hospitals to have at least one nominated person trained on the latest enhancements in order to enable the completion of the mortality indicator from NQAIS NAHM.

The new format of the HPSIR has been published on the HSE website since August 2019.

NOCA welcomes the inclusion of NQAIS NAHM data in the HPSIR. Mortality is one indicator of quality of care in a hospital but should not be interpreted in isolation. The requirement to have the HPSIR signed by the hospital CEO/General Manager and by the Hospital Group CEO will ensure that mortality data are continually being monitored. Hospitals should nominate one accountable person at an executive level to monitor and respond to the NQAIS NAHM web-based tool.

Mortality monitoring using the NQAIS NAHM web-based tool is valuable work and the learning from statistical outliers is shared in annual reports. Unusual or unexpected mortality patterns need to be reviewed and this work should be resourced and supported by hospitals, especially where there are statistical outliers.

CHANGES TO NQAIS NAHM

The NQAIS NAHM web-based tool uses the principal diagnosis for a patient in HIPE as the main driver for its risk modelling, so this is a very important factor for the SMR. NQAIS NAHM follows the categorisation of ICD-10-AM codes into clinically meaningful groups as specified by the CCS, developed by the Agency for Healthcare Research and Quality (AHRQ). This approach is used internationally in mortality modelling.

It has come to the attention of the NAHM team that not all of the hip fracture codes which are identified within the Irish Hip Fracture Database (IHFD) are included in the AHRQ "fracture neck of femur" CCS group. Some of the hip fracture codes are included in another CCS group entitled "lower limb fracture".

This was raised for discussion by the NQAIS NAHM Analysis and Display Scientific Team (ADST) and the NAHM Governance Committee. It was recommended to the NAHM Governance Committee that a change be made within the "fracture neck of femur" CCS group in NQAIS NAHM in order to reflect the same codes as are used by the IHFD, which will allow triangulation to the IHFD audit.

The ADST has contacted the developer of the CCS groups, the AHRQ, to request that it looks at this anomaly. We await its response.

PAEDIATRIC MORTALITY WITHIN NQAIS NAHM

In 2019, the NAHM Governance Committee reviewed the reporting of paediatric mortality in the NQAIS NAHM web-based tool. The following concerns were identified:

- The Charlson Comorbidity Index (Charlson *et al*., 1987) used in NQAIS NAHM is designed for adult medicine. However, there is no international consensus as to what the appropriate comorbidity index would be for paediatrics.
- Reporting of paediatric data separate from the adult data is not currently possible for most hospitals in the NQAIS NAHM model. One hospital has been split into adults and paediatrics, but this is not appropriate for other hospitals owing to the resulting inability to calculate SMRs and CuSums because of the small number of patients involved.

In 2019, the NQAIS NAHM ADST, in its capacity as specialist advisers for the development and enhancement of the NQAIS NAHM web-based tool, explored the continued inclusion of paediatric mortality in the tool. The findings were that there are both advantages and disadvantages to the inclusion of paediatrics in NQAIS NAHM, but that it was better to continue its inclusion rather than have nothing in place. The NAHM Governance Committee raised its concerns to the NOCA Governance Board. The NOCA Governance Board advised that it is establishing a programme of audits for paediatrics that will include the National Paediatric Mortality Register, Paediatric Intensive Care Audit Network and Trauma Audit and Research Network. NAHM will link with this programme in order to ensure that paediatric mortality is monitored appropriately.

Parallel to this work being carried out by the NOCA Governance Board, the NAHM Governance Committee agreed that further discussion/exploration of this issue is required. The NQAIS NAHM ADST should monitor international mortality tools for any changes to risk modelling in paediatric mortality and should also explore further developing the NQAIS NAHM web-based tool to support an extract of paediatric data in order to assist hospitals in their interpretation.

ENHANCEMENTS

ENHANCEMENTS TO NQAIS NAHM

Enhancements to the NQAIS NAHM system, commenced in 2018, were completed in Q1 2019. They underwent a period of testing and training for system users on the development server prior to being released to the live server at the end of Q3 2019.

These enhancements were originally commissioned in order to allow greater access to NQAIS NAHM data and to increase the tool's functionality. It has always been a principle of development of NQAIS NAHM that it aims to share a similar user interface with other NQAIS modules, thereby making it easier to train users across all functionalities available within the NQAIS systems. Training in the system and its enhancements is ongoing.

All enhancements are endorsed by the NAHM Governance Committee and funding has come from Health Atlas Ireland capital funding approved by the Department of Public Expenditure and Reform. The NQAIS NAHM web-based tool is continually monitored by the NQAIS NAHM ADST in order to ensure that it applies international best practice in terms of clinical, epidemiological and software developments.

TABLE 4: SUMMARY OF ENHANCEMENTS TO THE NQAIS NAHM SYSTEM

Enhancement	Description
SMR changes	The principal change has been to alert the viewer/user to where an SMR band has changed in relation to the previous update. This allows for a timely response, if required.
Summary view	This view can be tailored, depending on the context of the analysis that the user wishes to take. The three sections presented are: (a) key top-level values; (b) SMR and CuSum signals, presented as graphics; and (c) a rolling 12-month CuSum showing the trend in the previous year, which allows a quick view of a hospital that is a statistical outlier in the system. This change was introduced as a result of feedback from users during their training sessions.
Bookmark	This allows a user to save filters settings in order to allow a specified selection of data to be easily accessed more than once.
Look back	This constitutes a chronological ordering of updates in order to allow a user to look back over old data, using the filters and data settings that were in operation at that point in time. This allows the user to determine whether new signals may be due to changes in settings or changes in service delivery.
Plots	This view shows the user a selection of thumbnail plots (SMR plot, SMR trend, CuSum, etc.), allowing the user to select one and expand it in order to gather further information. As each thumbnail is expanded, it offers the option to proceed to the Explorer function.
Explorer	This provides users with a dynamic, interactive view of their data. Altering any of a number of settings will show a series of changes in patient profiles under various headings (e.g. age, gender, Charlson Comorbidity Index score). This avoids the user having to perform pivot table analysis or construct 2x2 tables to illustrate how chosen variables interact.

ENHANCEMENTS

Enhancement	Description
CuSum flatline view	The original CuSum view has been reconfigured to display as a horizontal graphic, with CuSum signals appearing as circles where control limits are breached. Initially, only the high (red) signals were shown on the CuSum chart, whereas now yellow signals are also included.
Record selection	A greater range of HIPE variables are included, meaning that the user has a much broader choice of factors to compare in their data analysis.
Pre-prepared hospital reports	The report function has been expanded to provide data relevant to hospital managers and to Quality and Safety Committees. A drop-down menu allows users to select the reports that they require, and means that NQAIS NAHM can produce valuable reports at the touch of a button.
Crosstabs	The cross-tabulation function has been added to the enhanced tool. This allows the flexible analysis of records chosen either by way of the CuSum selection tool or the Explorer function. The list of data fields reflects the HIPE fields available in NQAIS NAHM and can allow up to a detailed 'four-way' analysis of data. These data can be viewed on screen or exported to an Excel file for further analysis.
Training database	A test database using generic anonymised data supplied from the HPO, was generated to allow training in a group setting for multiple hospital users at a time. The anonymous nature of the data means that no hospital's data are available to view by individuals from outside that hospital. However, because the database used a sample of data and not the complete national file, more iterations were required than expected to generate the desired signals as examples for training. This caused a delay in the launch of the system to the live server until September 2019.
Training	New and existing users were invited to training sessions in multiple locations throughout the country during 2019. Monthly training sessions followed in the Royal College of Surgeons in Ireland (RCSI), with video links for participants to join remotely. There are short 'how-to' video clips outlining the new system on the NOCA website, which complement the formal training sessions.
Technical changes	Additional changes to the model and system include: • audit trail, to show use of the system • extended availability to view pages in PDF/Excel/JPEG format • extended number of three-year combinations • increased expansion functions • introduction of new cross-tabulation tool.

The full description of the enhancements is available in the *National Audit of Hospital Mortality Annual Report 2017* (NOCA, 2018).

KEY RECOMMENDATIONS

USING NQAIS NAHM

- Hospitals should nominate one accountable person at an executive level to monitor and respond to the NQAIS NAHM web based tool.

IMPROVING DATA QUALITY

- Guidance developed between the Healthcare Pricing Office and the National Clinical Programme for Palliative Care on how to define when code Z51.5 palliative care is applied, (following the change to the 10th Edition of the International Statistical Classification of Diseases and Related Health Problems, Tenth Revision, Australian Modification/ Australian Classification of Health Interventions/Australian Coding Standards (ICD-10-AM/ACHI/ACS) in January 2020), should be shared with all clinicians in order to ensure consistency in documentation and application of the palliative care code.
- NAHM will input to NOCA's programme of paediatric audits, when established, to ensure that NAHM is linked to existing paediatric mortality data.

IMPROVING THE NQAIS NAHM WEB-BASED TOOL

- The NQAIS NAHM Analysis and Display Scientific Team should amend the "fracture neck of femur" Clinical Classifications Software (CCS) group in NQAIS NAHM to reflect the same codes as those used by the Irish Hip Fracture Database (IHFD), which will allow triangulation to the IHFD audit.
- The NQAIS NAHM Analysis and Display Scientific Team should monitor international mortality tools for any changes to risk modelling in paediatric mortality. It should also explore developing the NQAIS NAHM web-based tool to support an extract of paediatric data to assist hospitals in their interpretation.

UPDATE ON RECOMMENDATIONS 2017

TABLE 5: UPDATE ON RECOMMENDATIONS FROM THE NAHM ANNUAL REPORT 2017

Recommendation	Key	Summary progress update	Accountable for implementation	Status
Clinicians and clinical coders in hospitals are encouraged to cooperate and work together to create clear and complete healthcare record information and also to validate HIPE coding in order to ensure accuracy between coding classifications and clinical care. This can take place through formal specialty meetings, attendance by clinical coders at clinical meetings, etc.	HPO, NOCA, HSE Acute Operat-ions	Recommendation accepted. NOCA is continually working with the HPO and stakeholders to highlight the need for good healthcare information.	Hospitals, Hospital Groups	Ongoing - continual learning
Hospital management, through its governance structures such as the Quality and Safety Committees, should actively ensure and, where appropriate, lead and support improvement in data quality.	NOCA, HSE Acute Operat-ions	A governance checklist which can be used for quality assurance purposes by hospitals is complete and available from the NOCA website. HSE Acute Hospitals will support implementation through informing hospitals and performance monitoring.	Hospitals, Hospital Groups, hospital boards	Ongoing - NOCA to do analysis to understand root causes of inconsist-encies
Clinicians need to fully and accurately complete discharge summaries (Health Information and Quality Authority, 2012). These should be completed for all patients who are discharged from hospital, including those who die in hospital. Where discharge summaries are used to support coding, they should be complete and consistent with source documentation, and they should contain a definitive diagnosis (using consistent terminology) and all relevant comorbidities.				
Hospitals should continue to use the NQAIS NAHM web-based tool to monitor and review their mortality patterns as part of routine quality improvements and learn from their findings.				
Hospitals should review cases with a principal diagnosis of acute lower respiratory infection (unspecified) in order to ensure that this is an accurate diagnosis. Clinicians should use consistent and specific terminology when documenting respiratory diagnoses.	NOCA, HPO	Recommendation accepted. This recommendation is included as an education/ training item in NAHM training sessions throughout 2019. Analysis will be carried out when full 2019 year's data is available for comparison.	Hospitals, Hospital Groups	Ongoing - best practice
The possibility of expanding the review of heart failure in order to enable broader benchmarking should be explored by the HSE National Clinical Programme for Heart Failure, working with the NAHM Governance Committee.	NOCA	NAHM is to explore this with the HSE National Clinical Programme for Heart Failure. Initial contact has been made and a meeting date is being awaited.	NOCA, Clinical Programme	On hold
The "acute bronchitis" CCS group in NAHM should be renamed "acute lower respiratory infection (unspecified)" in order to more accurately reflect the majority of cases it contains.	NOCA	Recommendation accepted. The CCS group "acute bronchitis" was renamed as "lower respiratory infection other". This change was released to the NQAIS NAHM live tool in April 2019.	NOCA	Closed

CONCLUSION

This report shows that the NQAIS NAHM web-based tool is an established and reliable method for hospitals to view their mortality trends and data at all times throughout the year. Following the hard work and effort from the NQAIS NAHM ADST, the NAHM team hope the launch of the new enhanced web-based tool has made the user's experience much easier. Feedback has been very positive, and the changes to allow easy identification of an outlier, as well as the look back feature, have been particularly welcomed.

Thus far, the ownership of NQAIS NAHM in hospitals has been a challenge because there is no particular accountable person for the audit. The introduction of the NQAIS NAHM web-based tool as the source of the new mortality indicator in the HPSIR will help to establish a dedicated person who is responsible for circulating the information to hospital management and clinicians.

Engagement with hospitals throughout 2019 was very productive, with many hospitals offering to accommodate NQAIS NAHM training sessions and presentations to their clinical forums. NOCA will continue to engage with hospitals around training for new users and to assist where outliers may occur. It is reassuring to know that no areas of clinical concern were identified in any reviews of NQAIS NAHM outliers.

This condensed publication of six key medical diagnoses will continue to be made available to the public as assurance that our hospitals are focusing on patient care and identifying where improvements can be made.

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APPENDIX 1: SMR FUNNEL PLOT

Standardised mortality ratio funnel plot

For this report, standardised mortality ratio (SMR) funnel plots are scatterplots of individual hospitals' SMRs. The upper and lower borders of the funnel are represented by the 99.8% control limits. These borders represent the upper and lower limits of what is referred to as 'expected variation'. The control limits are affected by the number of cases with a particular principal diagnosis in hospitals. Hospitals with smaller numbers of cases have wider control limits and appear to the left of the SMR funnel plot, while hospitals with larger numbers of cases have narrower control limits and appear to the right of the funnel plot.

An SMR is expected to appear within the 99.8% control limits 998 times out of 1000. Statistically, 1 in 500 observations can be expected to appear outside these control limits by chance alone. In other words, if an SMR appears outside these limits, it is very unlikely that this is due to chance. These observations represent variation worthy of further review.

Funnel plots make it very easy to identify these observations worthy of further review. A hospital's SMR should only be compared with its own control limits. There is no basis for ranking institutions into 'league tables' (Spiegalhalter, 2005), therefore it is not valid to directly compare SMRs between hospitals.

SAMPLE NATIONAL FUNNEL PLOT

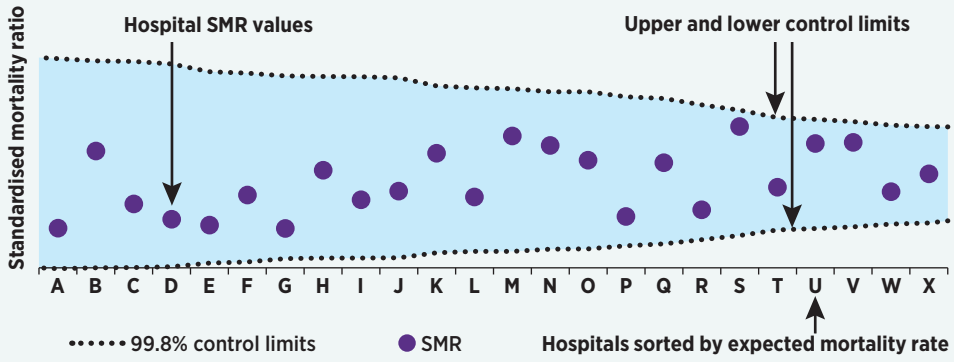

FIGURE A1.1: INFORMATION ON INTERPRETATION OF FUNNEL PLOTS

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