

Trends in hospital admissions associated with an Acute Kidney Injury in England 1998-2020: Statistical Analysis Proposal

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Rationale

One in 5 patients requiring an emergency admission to the hospital will develop an Acute Kidney Injury (AKI).¹ In 2009, the NCEPOD inquiry demonstrated significant shortcomings in the standard of care provided to these patients.² Up to 21% of AKI cases were identified as predictable and avoidable. Poor outcomes often resulted from delayed identification of cases, which translated onto a lack of timely intervention.

This publication inspired the creation of Think Kidneys³, a campaign run jointly by NHS England and the UK Renal Registry, aiming to raise awareness and promote interventions to improve AKI outcomes. As part of this effort, in June 2014 NHS England rolled out automatic Patient Safety Alerts which appear on the Electronic Patient Record system to warn clinicians when their patients' creatinine levels rise rapidly or significantly from baseline to meet the KDIGO-approved definition of AKI.⁴

Since 1998 NHS England has released an annual publication of Hospital Episode Statistics (HES) - aggregate data documenting all admission to NHS hospitals in England categorised by diagnosis. The diagnostic categories are based on the International Statistical Classification of Diseases and Related Health Problems – 10th Revision (ICD-10) – a medical classification manual by the World Health Organisation.

This study will investigate how the interventions introduced in the last decade to improve AKI recognition and outcomes are reflected in the total number of AKI diagnoses in the HES database. It will compare AKI to three other major diseases: pneumonia,⁵ heart failure,⁶ and dementia;⁷ selected due to similar population incidence. It will also map out how specific ICD-10 entities, out of many available, are used to encode cases of AKI. Finally, it will aim to correlate this trend with the number of patients undergoing haemofiltration.

We hypothesise that the number of AKI diagnoses would have seen a disproportionate rise in the last decade given the nation-wide drive to increase recognition and treatment of AKI. We will also analyse the change in number of cases of haemofiltration – a method of kidney replacement therapy (KRT) most commonly used in Intensive Care units for patients with acute kidney failure requiring organ support. We hypothesise that while the total number of AKI diagnoses likely increased disproportionately to background rise in admissions in the last decade, there is no such corresponding rise in the total number of patients requiring haemofiltration, meaning the majority of additional cases diagnosed due to improved detection are mild.

Objectives

To test the hypothesis that in the last decade there has been a disproportionate increase in the number of AKI diagnoses compared to background number of admissions.

To test the hypothesis that the growth in AKI cases has been greater than in other major disease groups.

To test the hypothesis that the number of patients requiring haemofiltration has not risen in proportion to the overall number of AKI diagnoses, indicating that the increase in number of diagnosed cases of AKI is principally accounted for by mild cases

To describe which individual ICD-10 codes related to AKI are responsible for the bulk of this increase

Data analysis

Study design

In this ecological study design, we will use the publicly available Hospital Episode Statistic (HES) summary data published by NHS Digital available under an Open Government License v3.0 6. According to the Health Research Authority this analysis is classified as research but does not require Research Ethics Committee approval.

Data source

HES is an anonymised dataset containing information about all hospital admissions in NHS hospitals in England. It has been published by NHS Digital annually since 1998. It contains the disease codes associated with each finished consultant episode (FCE), defined as a period of treatment in the hospital for one patient under a single specialty. Each of these episodes is associated with one code for the Primary Diagnosis treated on this encounter; and since 2012/13, the datasets also include a number of additional codes for any Secondary Diagnoses, or co-morbidities. The data is split to show the number of cases where the select code was the Primary Diagnosis for the patient; and separately, the number of cases where it featured amongst All Diagnoses. The total counts of episodes recorded for a particular code are then subdivided to reflect whether the admission was on an emergency or elective basis, as well as the mean length of stay and patient age. The age groups are subdivided into 0-14 years, 14-59 years, 60-75 years and 75+ years in all datasets up to years 2011/12; thereafter, it is divided into 24 smaller age brackets.

ICD-10 codes for AKI

Under the ICD-10 umbrella, multiple codes with varying degrees of specificity can be used to encode a case of AKI. Mansfield and colleagues⁸ proposed a list of ICD-10 codes which represent cases of AKI in the HES data (see Table 1). In this study, we will utilise their classification as it is very comprehensive; furthermore, using a unified code list between studies of the same disease entity improves validity and reproducibility of research.⁹

ICD-10 code	Disease entity
N14	Drug- and heavy-metal-induced tubulo-interstitial and tubular conditions
N14.1	Nephropathy induced by other drugs, medicaments and biological substances
N14.2	Nephropathy induced by unspecified drug, medicament or biological substance
N17	Acute renal failure
N17.0	Acute renal failure with tubular necrosis
N17.1	Acute renal failure with acute cortical necrosis
N17.2	Acute renal failure with medullary necrosis
N17.8	Other acute renal failure
N17.9	Acute renal failure, unspecified
N19	Unspecified kidney failure
N99.0	Postprocedural renal failure
R34	Anuria and oliguria
R94.4	Abnormal results of kidney function studies

Table 1: ICD-10 codes used to represent AKI in the HES database, after Mansfield et al.⁸

OPCS-4 codes

The Office of Population Censuses and Surveys Classification of Interventions and Procedures, 4th revision (OPCS-4) classification is used by NHS Digital to classify all procedures and interventions performed in NHS hospitals and is published alongside the ICD-10 data in the HES database. It contains the information on all patients who received Kidney Replacement Therapy (KRT) in NHS hospitals in England between 1998-2019.

From this database we will extract the data on all episodes of Haemofiltration to be used as an index measure for instances of severe AKI requiring KRT. Haemofiltration is a mode of KRT which is used primarily in emergency settings, such as Intensive Care Units (ITU), for patients with renal failure due to acute causes.¹⁰ It is very rarely used for patients with renal failure due to Chronic Kidney Disease (CKD), who more commonly receive haemodialysis.¹¹ The number of codes for haemofiltration will not provide an accurate estimation of the total number of cases of AKI requiring KRT, as some of these patients will receive haemodialysis instead; but it will provide a useful proxy measure of the incidence of cases requiring the initiation of KRT in emergency settings, the majority of which will be accounted for by AKI patients.

Outcomes

Primary outcome

- The change in number of FCEs with an ICD-10 code for AKI amongst primary and secondary diagnosis over the period 1998-2019 in proportion to the change in number of all hospital admissions

Secondary outcomes

- Growth rate of AKI compared to dementia, pneumonia, heart failure
- The change in number of procedural codes for X40.4 haemofiltration in proportion to the change in number of ICD-10 codes for AKI amongst All Diagnoses
- The change in usage of individual ICD-10 codes

Software

We will use Microsoft Excel (2019, version 16.34) to view and process the raw data from HES database. We will use R (R core team; 2019)¹² to complete the statistical analysis.

Processing

We will extract data about the total number of episodes associated with each selected AKI-specific ICD-10 code between 1998-2019.

We will compare the trends in AKI-related FCEs with the background trends for all hospital admissions and acute KRT.

We will compare the growth in AKI cases to that of selected comparator diagnoses, including heart failure, dementia and pneumonia.

We will analyse the trends in use of individual ICD-10 codes amongst the thirteen that are identified to relate to AKI cases, and map out whether any particular codes have experienced an increase in frequency of usage disproportionate to others.

Finally, we will also correlate the proportion in increase of AKI codes with the proportion of increase in OPCS-4 codes for haemofiltration, to determine whether the increase in total disease recognition is associated with an corresponding increase in cases who require emergency KRT.

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