Royal College of Physicians | NACAP

National Asthma and Chronic Obstructive Pulmonary Disease Audit Programme (NACAP)

# Clinical outcomes

## Appendix A: Methodology

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In association with:

ARNS Association of Respiratory Nurse Specialists

Asthma + Lung UK

British Thoracic Society

Imperial College London

PCRS

Royal College of General Practitioners

RCPCH Royal College of Paediatrics and Child Health Leading the way in Children's Health

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# Methodology of audit creation and setup

For more information on the creation and setup of NACAP's audits of asthma and COPD secondary care, including recruitment methodology and a list of participating hospitals, please refer to the data analysis and methodology components of the following clinical audit data analysis and methodology reports:

- **Adult asthma** – 2018/19 and 2019/20 (published December 2019 and January 2021)
- **Children and young people asthma** – 2019/20 (published May 2021)
- **COPD** – 2018/19 and 2019/20 (published July 2020 and June 2021)

These links also direct to a full list of published outputs for each workstream.

# Information governance (IG) and data storage, security and transfer

The adult asthma, children and young people asthma and COPD audits operate under Section 251 approval from the Confidentiality Advisory Group (CAG) of the Health Research Authority (HRA). The reference numbers are:

- Adult asthma and COPD (joint approval held) CAG-8-06(b)/2013, and
- Children and young people asthma: 19CAG0001.

A record of the approval can be found at: www.hra.nhs.uk/about-the-hra/our-committees/section-251/cag-advice-and-approval-decisions (April 2013 onwards, non-research). For more information on NACAP's information governance please go to the information governance page at www.rcp.ac.uk/projects/information-governance.

# Data entry

Hospitals are required to enter data via the audit programme's bespoke webtool, created by Crown Informatics Ltd (available at www.nacap.org.uk). Guidance documentation to support participation in the audit is available to download from both the webtool (www.nacap.org.uk) and the NACAP webpages on the RCP website (www.rcp.ac.uk/nacap).

# Analysis methodology

## Data transfer

The audit applied for linkage of audit data to outcome data sources via NHS Digital (application references: Adult asthma – DARS-NIC-357479-S6C7T, Children and young people asthma – NIC-379653-W3G5Q and COPD – DARS-NIC-349273-T3L4K), electronic Data Research and Innovation Service (eDRIS), part of NHS National Services Scotland (application reference 1718-0134), and Digital Health and Care Wales (DHCW) (application reference 29892).

Following this, files containing a unique audit ID and necessary identifiable information (NHS number, date of birth and postcode) for patients within the following audit cohorts:

- **Adult asthma:** those discharged between 1 November 2018 and 31 March 2020
- **Children and young people asthma:** those discharged between 1 June 2019 and 31 January 2020
- **COPD:** those discharged between 1 October 2018 and 29 February 2020

were sent by Crown Informatics to the Data Access Request Service (DARS), eDRIS and DHCW between November 2020 and May 2022.

DARS NHS Digital, eDRIS and DHCW used these identifiers to provide records for people in the audit cohort from the Hospital Episode Statistics (HES) Admitted Patient Care (APC) dataset (NHS Digital), the Information Services Division (ISD) APC dataset for Scotland, and the Patient Episode Database for Wales (PEDW) dataset (DHCW). DARS NHS Digital also provided Office for National Statistics (ONS) mortality data for all people within the cohort in England and Wales. eDRIS provided this information on behalf of the National Records of Scotland. Please note, NHS Digital upheld national opt-outs before providing the data.

DARS NHS Digital, eDRIS and DHCW produced linked datasets containing respectively requested records from HES and ONS (plus the unique audit ID), requested records from ISD (plus the unique audit ID), and requested PEDW records (plus the unique audit ID). The linked data were then anonymised with the removal of NHS number, and the transfer of date of birth to age and postcode to Lower Super Output Area (LSOA).

Anonymised files containing non-identifiable patient data were sent via secure file transfer to the statistical team at Imperial College London (National Heart and Lung Institute) where they were analysed.

## Data cleaning

Data received by Imperial College London were imported into R for cleaning. The bulk of the cleaning of the clinical audit data is described in the secondary care clinical report methodology section. The clinical datasets contained 158,460 admissions, of which 123,921 were index admissions. These were linked to PEDW, HES, SMR, NRS, and ONS datasets according to patient ID, admission date (+/– 1 days), and discharge date (+/– 1 day) to leave 114,478 linked index admissions for analysis (83,994 COPD, 23,768 adult asthma, 6,716 CYP asthma).

## Data analysis

- Comorbidities were defined using the Charlson comorbidity index (CCI) (www.ncbi.nlm.nih.gov/pubmed/3558716)[1] with updated weights (https://pubmed.ncbi.nlm.nih.gov/21330339)[2] using primary and all secondary diagnosis codes from the index admission. The 'comorbidity' package in R was used to calculate the CCI for the diagnosis codes of each index admission. When categorising CCI, the lowest category was taken as '0–1' rather than '0' as all patients are expected to have a diagnosis of pulmonary disease.
- Mixed effects logistic regression models were created using the R package 'lme4' to find odds of 30-day and 90-day readmission or death by gender, deprivation (quintiles of IMD/WIMD), age (categorical: 35–44, 45–54, 55–64, 65–74, 75–84, 85+, or as a continuous variable with polynomial), CCI (0–1, 2, 3, 4, 5, 6, 7+, or as a linear effect), length of hospital stay (+1 day), receipt of NIV (yes, no), asthma severity, and IV asthma medication used. Models varied in included variables according to disease and outcome, according to variable relevance and limitations in numbers of outcome events. CYP asthma had too few deaths for a regression model to be built. Models were mutually adjusted for all exposure variables.

## Adjusted odds ratios (see tables 1.2 and 2.2 of the summary report)

- An odds ratio (OR) is a measure of association between an exposure and an outcome. The OR represents the odds that an outcome will occur given a particular exposure, compared with the odds of the outcome occurring in the absence of that exposure. For example, an odds ratio of 0.75 means that in that particular group the outcome is 25% less likely to occur. An odds ratio of 1.33 means that in that particular group the outcome is 33% more likely to occur.
- An adjusted odds ratio takes into account the effect due to other variables included in the analysis, ie it helps to account for confounding.
- Odds ratios have been broken down by country, for England and Wales specifically, but not for Scotland. Small numbers within the Scottish cohort mean that these would be accompanied by a high degree of uncertainty and that inaccurate messages could potentially be drawn from them. It was additionally felt that enough could be gleaned from the national (All) odds ratios data, from a national and country specific level, to warrant this exclusion.

## Case ascertainment

- Case ascertainment calculations are based on the number of records entered to the audits compared with national hospital asthma attack and COPD exacerbation data obtained from HES APC (England), ISD APC (Scotland) and DHCW PEDW (Wales) datasets. Monthly hospital-level data are requested (with an accumulative total for the period).
- Hospitals that submitted at least one record during the audit period are included in the calculations. Hospitals who have submitted no records are excluded and are presented as non-participants for the report (Registered – no data submitted; not registered).
- HES data has suppression and rounding rules applied for the purposes of patient confidentiality (figures <8 are replaced with an *; all data are rounded to a multiple of 5). For the purposes of NACAP's calculations, the following rules are applied to provide as accurate a case ascertainment picture as possible:

- For children and young people asthma, where the data point in the total column is represented by an * and the monthly columns have more than one * – the total = 7 (the maximum figure without applying rounding rule).
- For children and young people asthma, where the data point in the total column is represented by an * and the monthly columns have only one * – the total = 3.5 (the midpoint between 1 and 7 without applying rounding rule).
- For adult asthma and COPD where the total number of records is *, this has been replaced with a 7 (the maximum it could have been).
- For all audits, where the number of records for a particular month is *, this has been replaced with 3.5 (the middle 'expected' value it could have been).

This, however, means that there may be a discrepancy between English service level case ascertainment rates used to calculate the England and National figures in this report and the actual case ascertainment if exact numbers had been available. For this reason, we have not reported service level case ascertainment within the accompanying data file for this report.

## References

1 Charlson ME, Pompei P, Ales KL, MacKenzie CR. A new method of classifying prognostic comorbidity in longitudinal studies: development and validation. *J Chronic Dis* 1986;40. https://pubmed.ncbi.nlm.nih.gov/3558716 [Accessed November 2022]

2 Quan H, Li B, Couris CM *et al*. Updating and validating the Charlson comorbidity index and score for risk adjustment in hospital discharge abstracts using data from 6 countries. *Am J Epidemiol* 2011;173. https://pubmed.ncbi.nlm.nih.gov/21330339 [Accessed November 2022]

**Care Quality Improvement Directorate**
11 St Andrews Place
Regent's Park
London NW1 4LE

The Spine
2 Paddington Village
Liverpool L7 3FA

**Tel: +44 (020) 3075 1526**
**Email: nacap@rcp.ac.uk**

www.rcp.ac.uk/nacap

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