Royal College of Physicians | NACAP

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

Outcomes of patients included in the 2017 COPD clinical audit

(patients with COPD exacerbations discharged from acute hospitals in England and Wales between February and September 2017)

Audit report

Published May 2019

In association with:

ARNS Association of Respiratory Nurse Specialists; asthma UK; British Lung Foundation; British Thoracic Society; Imperial College London; PCRS Primary Care Respiratory Society UK; RCGP Royal College of General Practitioners; RCPCH Royal College of Paediatrics and Child Health Leading the way in Children's Health

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National Asthma and Chronic Obstructive Pulmonary Disease (COPD) Audit Programme
NACAP is a programme of work that aims to improve the quality of care, services and clinical outcomes for patients with asthma and COPD in England, Scotland and Wales. Spanning the entire patient care pathway, NACAP includes strong collaboration with asthma and COPD patients, as well as healthcare professionals, and aspires to set out a vision for a service which puts patient needs first. To find out more about the NACAP visit: www.rcplondon.ac.uk/nacap

COPD: Outcomes of patients included in the 2017 COPD clinical audit
This report was prepared by the following people, on behalf of the COPD advisory group (the full list of members can be found on the NACAP resources page here: www.rcplondon.ac.uk/nacap-resources).

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Document purpose

Document purpose	To disseminate the results of the outcomes of the cohort of patients included in the clinical audit of COPD[a] exacerbations discharged from acute units in England and Wales between 1 February and 13 September 2017.
Title	Outcomes of patients included in the 2017 COPD clinical audit.
Author	National Asthma and Chronic Obstructive Pulmonary Disease Audit Programme (NACAP), Royal College of Physicians
Publication date	9 May 2019
Audience	Healthcare professionals; NHS managers, chief executives and board members; service commissioners; policymakers and voluntary organisations.
Description	This outcomes report describes the findings from linkage of the 2017 audit patient cohort (patients admitted to hospital on or after 1 February and discharged by 13 September 2017) with the following datasets: Hospital Episode Statistics (HES) for Admitted Patient Care (APC), NHS Wales Informatics Service (NWIS)'s Patient Episode Database for Wales (PEDW) and Office for National Statistics (ONS). This has allowed derivation of medium-term outcomes for the cohort, namely 30 and 90-day readmission and mortality rates. It is intended to be read as an addendum to the clinical report, *COPD: Working together*, published in April 2018, which is available at www.rcplondon.ac.uk/working-together. Together, these reports provide a comprehensive picture of the care provided to patients admitted to hospital for an exacerbation of COPD during this period of 2017 and what happened after they were discharged. The report is designed to provide readers with a basis for identifying areas that are in need of change and to facilitate the development of improvement programmes that are relevant not only to secondary care providers but also to commissioners and policymakers. There is no scheduled review date for the report.
Supersedes	Stone RA, Holzhauer-Barrie J, Lowe D, McMillan V, Saleem Khan M, Searle L, Skipper E, Welham S, Roberts CM. *COPD: Who cares when it matters most? National Chronic Obstructive Pulmonary Disease (COPD) Audit Programme: Outcomes from the clinical audit of COPD exacerbations admitted to acute hospitals in England 2014.* National supplementary report. London: RCP, February 2017.
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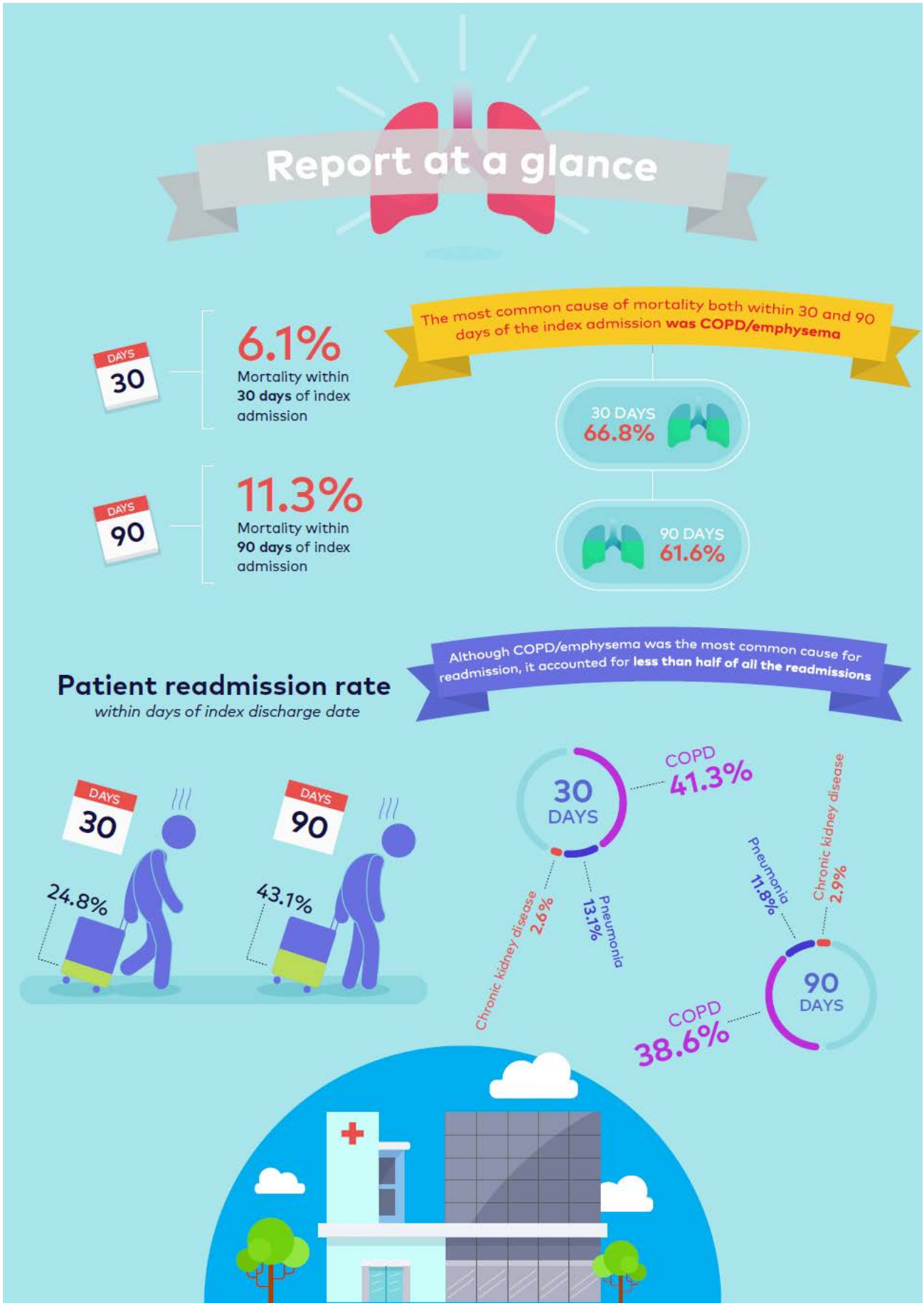
[a] The other components of NACAP will report separately (adult asthma in winter 2019 and 2020, children and young people asthma in autumn 2020, pulmonary rehabilitation in spring 2020).



Foreword by John Hurst, COPD audit clinical lead

There was a significant change to the national COPD audit in February 2017, with the introduction of continuous clinical audit. We recognise that this change was challenging to implement for many units, and an additional burden for hard-working multi-professional respiratory clinical and audit teams. We applaud their commitment to improving the care of patients admitted with COPD.

This report presents the outcomes of the first cohort of patients included in the continuous audit, those admitted to hospitals in England and Wales between 1 February and 13 September 2017. The care received by these patients is detailed in the clinical report that was published in April 2018 (*COPD: Working together* www.rcplondon.ac.uk/working-together). During this initial period of continuous audit, new data collection processes were becoming embedded in care pathways and, therefore, these results are best considered as a baseline against which to measure future change.

This report is being published a year later than the clinical process report as it does not rely solely on data inputted into the audit tool by hospitals. Indeed, this report presents longer term (1 and 3 months post the audit admission) patient outcomes that required linkages to external sources of data. We hope that for future patient cohorts obtaining these linked data will be more rapid.

This report provides important data looking at the causes of death and readmissions at 30 and 90 days in people who had exacerbations of COPD. Mortality after index admission remains high, 6.1% at 30 days and 11.3% at 90 days, and readmissions are common, 24.8% of patients were readmitted at least once within 30 days and 43.1% were readmitted at least once within 90 days of index discharge date. **The key message from these data is that a large proportion of both deaths (approximately 40%) and readmissions (approximately 60%) were not due directly to COPD. Consequently, a holistic approach to care focusing on multimorbidity[1] is likely to benefit readmission and mortality rates.** Reflecting this, the clinical audit dataset was revised to explicitly ask about cardiovascular disease and mental health comorbidities. This dataset, which launched in October 2018, is available to download from www.rcplondon.ac.uk/nacap-copd-resources.

This report concludes with recommendations for hospital teams, commissioners, and primary care. Working together we can build on our successes to date and continue to improve the care of people admitted to hospital with exacerbation of COPD. Taking a holistic approach to care and addressing multimorbidity is likely to have the greatest impact for those living with COPD and this will require working across traditional specialty and organisational boundaries.

The overarching objectives of the NACAP is continuous quality improvement, facilitated in part by near real-time feedback of data to individual hospitals. The second annual clinical audit report, which includes data on patients discharged between 14 September 2017 and 30 September 2018, was also published today (www.rcplondon.ac.uk/copd-2017-18). This report shows us that the move to continuous data and focus on quality improvement (QI) has been adopted by hospitals, as patients are now beginning to reap the rewards of that dedication in improved care quality. We hope that this will be reflected in the next outcomes report.

Section 1: Mortality after index admission

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Key findings

- **Mortality within 30 days** of index admission was **6.1%**.
- **Mortality within 90 days** of index admission was **11.3%**.
- The most common cause of **mortality both within 30 and 90 days** of the index admission was **COPD/emphysema** (30 days: 66.8%; 90 days: 61.6%).

Demographics

Females were 11% less likely to die within 30 days of admission (AOR[b]: 0.89 [95% CI[c]: 0.80–0.98]) and **10% less likely to die within 90 days** of admission (AOR: 0.90 [95% CI: 0.83–0.97]).

- **Older patients** were more likely to die within both **30 and 90 days** of admission.
  - Patients aged **85 or older were nearly 5 times more likely to die within 30 days** (AOR: 4.95 [95% CI: 3.39–7.23]) and **nearly four and a half times more likely to die within 90 days** (AOR: 4.46 [95% CI: 3.41–5.82]) of admission than those aged 45–54.
- The **most deprived** patients (1st and 2nd quintiles) were **19% less likely to die within 30 days** of admission (AOR: 0.81 [95% CI: 0.69–0.96] and AOR: 0.81 [95% CI: 0.68–0.96], respectively) than the **least deprived** quintile (5th quintile).
  - There was however, after adjustment, **no significant effect of deprivation** with regard to **mortality within 90 days** of admission.

Comorbidities

- Patients with **more comorbidities were more likely to die** within both **30 and 90 days** of admission.
  - Patients with a **Charlson comorbidity index** (CCI)[d2,3,4] **of 1 were 27% more likely to die** within **30 days** (AOR: 1.27 [95% CI: 1.11–1.44]), and **28% more likely to die within 90 days** (AOR: 1.28 [95% CI: 1.16–1.41]) than a patient without any comorbidities.
  - Patients with a **CCI of 6 or more were 6 times more likely to die within both 30 days** (AOR: 6.00 [95% CI: 4.79–7.52]) **and 90 days** (AOR: 6.63 [95% CI: 5.49–8.00]) of admission than a patient with no comorbidities.

Length of stay

- Patients admitted to hospital for **longer than 4 days** (the median length of stay) **were 30% more likely to die within 30 days** of admission (AOR: 1.30 [95% CI: 1.18–1.44]) and **67% more likely to die within 90 days** of admission (AOR: 1.67 [95% CI: 1.54–1.80]) than those admitted for 4 days or fewer.

Non-invasive ventilation (NIV)

- Patients who received **NIV** during admission were **nearly 4 times more likely to die within 30 days** of admission (AOR: 3.85 [95% CI: 3.41–4.35]) and **more than twice as likely to die within 90 days** of admission (AOR: 2.62 [95% CI: 2.37–2.90]) than those who did not receive NIV.

[b] Adjusted odds ratio
[c] Confidence interval
[d] The Charlson comorbidity index predicts the 10-year mortality for a patient who may have a range of comorbid conditions

1.1 Mortality within 30/90 days of index admission

1.1.1 Mortality within 30/90 days: percentage mortality historical comparison

Mortality	2017 (N=30,294)	2014/15 (N=12,594)
Within 30 days of index admission	1,832 (6.1%)	864 (6.7%)
Within 90 days of index admission	3,426 (11.3%)	1,508 (12.0%)

1.1.2 Mortality within 30/90 days of index admission: by top five causes[e]

	2017 (N=30,294)	
Top five causes of mortality (ICD-10 code)[f]	Mortality <30 days of index admission (N=1,832)	Mortality <90 days of index admission (N=3,426)
1. J44: Other chronic obstructive pulmonary disease & J43: Emphysema	1,223 (66.8%)	2,112 (61.6%)
2. C34: Malignant neoplasm of bronchus and lung	116 (6.3%)	276 (8.1%)
3. I25: Chronic ischaemic heart disease	65 (3.6%)	143 (4.2%)
4. I21: Acute myocardial infarction	40 (2.2%)	77 (2.3%)
5. J18: Pneumonia, organism unspecified	25 (1.4%)	49 1.4%)

1.3 Mortality within 30 days: by variable

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.

[e] Data presented in this table is not comparable with the 2014/15 outcomes data as this time only the top five causes of mortality were analysed.

[f] 21.1% of patients died <30 days of index discharge and 23.7% of patients died <90 days of index discharge of other causes not listed here. However, none of these causes exceeded 1%.

	2017			
Variable	**Odds ratio (OR)**	**95% Confidence interval (CI)**	**Adjusted odds ratio (AOR)[g]**	**95% Confidence interval (CI)**
Gender				
Female	**0.87**	0.79–0.96	**0.89**	0.80–0.98
Quintile of Index of Multiple Deprivation, England (IMD)[5]/ Welsh Index of Multiple Deprivation (WIMD)[6]				
1 (most deprived)	**0.68**	0.58–0.80	**0.81**	0.69–0.96
2	**0.73**	0.62–0.87	**0.81**	0.68–0.96
3	**0.98**	0.82–1.16	**1.06**	0.89–1.26
4	**0.93**	0.78–1.12	**0.97**	0.81–1.17
5 (least deprived)	**1**	–	**1**	–
Age				
35–44	**(NA)[h]**	–	**(NA)[h]**	–
45–54	**1**	–	**1**	–
55–64	**1.89**	1.29–2.79	**1.67**	1.13–2.47
65–74	**2.96**	2.05–4.27	**2.44**	1.68–3.53
75–84	**4.22**	2.93–6.07	**3.49**	2.41–5.04
85+	**6.00**	4.14–8.69	**4.95**	3.39–7.23
Charlson comorbidity index (CCI)				
0	**1**	–	**1**	–
1	**1.47**	1.29–1.66	**1.27**	1.11–1.44
2	**1.80**	1.56–2.08	**1.48**	1.27–1.71
3	**2.39**	2.02–2.82	**1.83**	1.54–2.17
4	**2.61**	2.11–3.23	**1.95**	1.56–2.44
5	**2.67**	1.94–3.69	**1.90**	1.36–2.65
6+	**6.51**	5.23–8.09	**6.00**	4.79–7.52
Length of stay				
≤4 days	**1**	–	**1**	–
>4 days	**1.85**	1.68–2.04	**1.30**	1.18–1.44
Non-invasive ventilation (NIV)				
Patient received NIV	**3.54**	3.16–3.96	**3.85**	3.41–4.35

1.4 Mortality within 90 days: by variable

	2017			
Variable	**OR**	**95% CI**	**AOR[g]**	**95% CI**
Gender				
Female	**0.89**	0.82–0.95	**0.90**	0.83–0.97
Age				
35–44	**0.16**	0.04–0.66	**0.17**	0.04–0.72
45–54	**1**	–	**1**	–
55–64	**1.75**	1.33–2.29	**1.55**	1.18–2.05
65–74	**2.80**	2.17–3.62	**2.31**	1.78–3.00

[g] Mutually adjusted for all variables shown in table.
[h] No one of this age group died within 30 days of index admission.

	2017			
Variable	**OR**	**95% CI**	**AOR[g]**	**95% CI**
75–84	**3.83**	2.97–4.95	**3.04**	2.34–3.94
85+	**5.76**	4.43–7.47	**4.46**	3.41–5.82
Quintile of IMD/WIMD				
1 (most deprived)	**0.77**	0.68–0.87	**0.92**	0.81–1.05
2	**0.83**	0.73–0.95	**0.92**	0.80–1.05
3	**0.95**	0.83–1.08	**1.03**	0.89–1.18
4	**1.01**	0.88–1.16	**1.06**	0.92–1.23
5 (least deprived)	**1**	–	**1**	–
CCI				
0	**1**	–	**1**	–
1	**1.48**	1.35–1.63	**1.28**	1.16–1.41
2	**1.92**	1.72–2.13	**1.56**	1.39–1.74
3	**2.46**	2.16–2.80	**1.86**	1.63–2.12
4	**2.90**	2.47–3.41	**2.15**	1.82–2.55
5	**2.71**	2.11–3.49	**1.91**	1.47–2.47
6+	**7.55**	6.29–9.06	**6.63**	5.49–8.00
Length of stay				
≤4 days	**1**	–	**1**	–
>4 days	**2.15**	2.00–2.31	**1.67**	1.54–1.80
NIV				
Patient received NIV	**2.63**	2.39–2.88	**2.62**	2.37–2.90

Section 2: Readmissions after index discharge

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Key findings

- **24.8%** of patients were **readmitted at least once within 30 days** and **43.1%** were readmitted at least once within **90 days** of index discharge date.
- The **median time to first readmission was approximately 52 days** for those readmitted.
- Although **COPD/emphysema was the most common cause for readmission**, it accounted for **less than half of all the readmissions within 30 days** (41.3%) and **90 days** (38.6%) of index discharge date.

Demographics

- There was **no significant difference by gender or age for odds of readmission within either 30 or 90 days** of index discharge.
- The **most deprived** patients (1st quintile) were **15% more likely to be readmitted within 90 days** of index discharge (AOR: 1.15 [95% CI: 1.06–1.25]) than the least deprived patients (5th quintile).
    - There was **no significant difference between the most and least deprived patients for odds of readmission within 30 days** of index discharge.

Comorbidities

- Patients with **comorbidities** were **more likely to be readmitted within both 30 and 90 days** of index discharge.
    - Patients with a **CCI of 1** were **11% more likely to be readmitted within 30 days** (AOR: 1.11 [95% CI: 1.04–1.19]) and **19% more likely to be readmitted within 90 days** (AOR: 1.19 [95% CI: 1.12–1.26]) of index discharge than a patient with no comorbidities.
    - Patients with a **CCI of 6 or more** were **73% more likely to be readmitted within 30 days** (AOR: 1.73 [95% CI: 1.44–2.07]) of index discharge and **52% more likely to be readmitted within 90 days** (AOR: 1.52 [95% CI: 1.28–1.80]) than a patient with no comorbidities.

Length of stay

- Patients who were admitted to hospital **for longer than the median length of stay of 4 days** were **32% more likely to be readmitted within 30 days** of index discharge (AOR: 1.32 [95% CI: 1.25–1.40]) and **25% more likely to be readmitted within 90 days** of index discharge (AOR: 1.25 [95% CI: 1.19–1.31]), than those admitted for 4 or fewer days.

NIV

- After adjustment, **patients who received NIV were not significantly more likely to be readmitted within either 30 or 90 days** of index discharge than those who did not receive NIV.

2.1 Readmission within 30/90 days of index discharge date[i]

2.1.1 Number of admissions with readmissions within 30 days of index discharge date historical comparison

Number of readmissions within 30 days of index discharge	2017 (N=30,294)	2014/15 (N=12,054)
None	22,786 (75.2%)	9,123 (75.7%)
One	5,926 (19.6%)	2,324 (19.3%)
Two	1,246 (4.1%)	497 (4.1%)
Three or more	336 (1.1%)	110 (0.9%)

2.1.2 Number of admissions with readmissions with 90 days of index discharge date

Number of readmissions within 90 days of index discharge	2017 (N=30,294)	2014/15 (N=12,054)
None	17,241 (56.9%)	6,858 (56.9%)
One	7,447 (24.6%)	2,969 (24.6%)
Two	3,140 (10.4%)	1,255 (10.4%)
Three or more	2,466 (8.1%)	972 (8.1%)

2.1.3 Top five reasons for all readmissions within 30 days of index discharge date

Top five reasons for readmissions within 30 days of index discharge (ICD-10 code)	2017 (N=9,757)
1. J44: Other chronic obstructive pulmonary disease & J43: Emphysema	4,026 (41.3%)
2. J18: Pneumonia, organism unspecified	1,277 (13.1%)
3. N18: Chronic kidney disease	255 (2.6%)
4. C34: Malignant neoplasm of bronchus and lung	211 (2.2%)
5. A41: Other sepsis	194 (2.0%)

2.1.4 Top five reasons for all readmissions within 90 days of index discharge date

Top five reasons for readmissions within 90 days of index discharge (ICD-10 code)	2017 (N=24,055)
1. J44: Other chronic obstructive pulmonary disease & J43: Emphysema	9,289 (38.6%)
2. J18: Pneumonia, organism unspecified	2,840 (11.8%)
3. N18: Chronic kidney disease	699 (2.9%)
4. A41: Other sepsis	517 (2.2%)
5. I50: Heart failure	474 (2.0%)

[i] Same day readmissions have been excluded from the analysis.

Fig 1. Kaplan-Meier: Time to first readmission

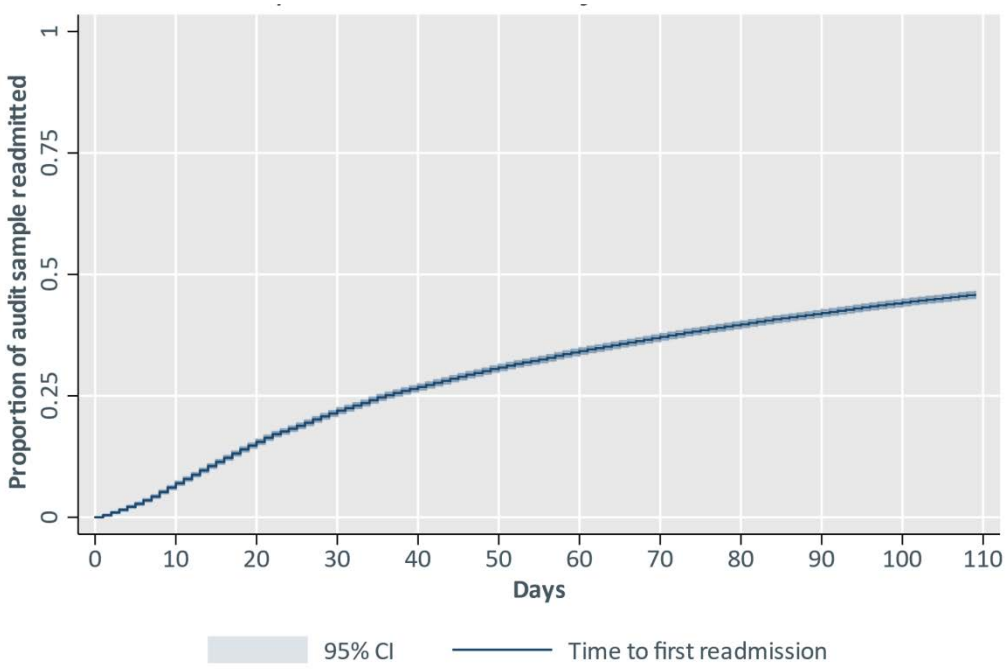

Figure 1, the Kaplan-Meier curve shows the proportion of the audit sample readmitted at 10-day intervals after their index admission discharge date. At 30 days after discharge, approximately 22% of the audit sample have been readmitted to hospital. At 90 days after discharge, approximately 42% of the audit sample have been readmitted. It should be noted that median time to readmission cannot be established from this graph as not all patients will be readmitted.

2.1.5 Readmission within 30 days of discharge: by variable

	2017			
Variable	**OR**	**95% CI**	**AOR[g]**	**95% CI**
Gender				
Female	**0.95**	0.91–1.01	**0.96**	0.91–1.01
Age				
35–44	**0.80**	0.59–1.09	**0.80**	0.59–1.09
45–54	**1**	–	**1**	–
55–64	**1.02**	0.89–1.16	**0.97**	0.85–1.11
65–74	**1.11**	0.98–1.25	**1.02**	0.90–1.16
75–84	**1.13**	1.00–1.28	**0.99**	0.87–1.12
85+	**1.16**	1.02–1.33	**0.99**	0.86–1.13
Quintile of IMD/WIMD				
1 (most deprived)	**1.08**	0.98–1.18	**1.10**	1.00–1.22
2	**1.06**	0.96–1.17	**1.08**	0.97–1.19
3	**0.99**	0.89–1.10	**1.00**	0.90–1.10
4	**1.09**	0.98–1.21	**1.10**	0.99–1.22
5 (least deprived)	**1**	–	**1**	–

CCI				
0	**1**	–	**1**	–
1	**1.14**	1.07–1.22	**1.11**	1.04–1.19
2	**1.36**	1.26–1.47	**1.31**	1.21–1.42
3	**1.44**	1.30–1.60	**1.38**	1.24–1.53
4	**1.61**	1.41–1.84	**1.52**	1.32–1.74
5	**1.72**	1.40–2.12	**1.62**	1.31–1.99
6+	**1.81**	1.51–2.17	**1.73**	1.44–2.07
Length of stay				
≤4 days	**1**	–	**1**	–
>4 days	**1.37**	1.30–1.44	**1.32**	1.25–1.40
NIV				
Patient received NIV	**1.11**	1.02–1.21	**1.02**	0.93–1.11

2.1.6 Readmission within 90 days of discharge: by variable

	2017			
Variable	**OR**	**95% CI**	**AOR[g]**	**95% CI**
Gender				
Female	**0.95**	0.91–0.99	**0.96**	0.92–1.01
Age				
35–44	**0.95**	0.74–1.21	**0.94**	0.73–1.21
45–54	**1**	–	**1**	–
55–64	**1.01**	0.91–1.14	**0.98**	0.87–1.10
65–74	**1.13**	1.02–1.26	**1.06**	0.95–1.18
75–84	**1.22**	1.09–1.35	**1.08**	0.97–1.20
85+	**1.24**	1.10–1.40	**1.06**	0.94–1.19
Quintile of IMD/WIMD				
1 (most deprived)	**1.11**	1.02–1.20	**1.15**	1.06–1.25
2	**1.03**	0.94–1.12	**1.04**	0.96–1.14
3	**1.01**	0.93–1.11	**1.02**	0.94–1.12
4	**1.04**	0.95–1.15	**1.05**	0.96–1.16
5 (least deprived)	**1**	–	**1**	–
CCI				
0	**1**	–	**1**	–
1	**1.22**	1.16–1.29	**1.19**	1.12–1.26
2	**1.48**	1.38–1.59	**1.41**	1.32–1.52
3	**1.51**	1.38–1.66	**1.44**	1.31–1.58
4	**1.69**	1.49–1.91	**1.58**	1.39–1.79
5	**2.05**	1.69–2.49	**1.91**	1.57–2.33
6+	**1.60**	1.35–1.90	**1.52**	1.28–1.80
Length of stay				
≤4 days	**1**	–	**1**	–
>4 days	**1.29**	1.23–1.35	**1.25**	1.19–1.31
NIV				
Patient received NIV	**1.00**	0.92–1.08	**0.93**	0.86–1.01

Section 3: Parity of esteem

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Under the parity of esteem agenda,[7] mental health conditions should be given the same consideration as physical health conditions. There is a well-established link between chronic disease and mental health conditions and evidence suggests that comorbid mental health conditions can increase healthcare costs by at least 45%.[8] These data are presented to demonstrate the incidence of mental health conditions in people with COPD and highlight the importance of managing mental health concurrently with COPD to reduce the risk of readmission and mortality.

Key findings

- Just over one-fifth (**20.2%**) of the audit sample **had a co-existent mental health diagnosis**.
  - At **30 days 5.0%** of those **with a mental health diagnosis had died**.
  - At **90 days 10.0%** of those **with a mental health diagnosis had died**.
  - At **30 days 27.3%** of those with a **mental health diagnosis had been readmitted**.
  - At **90 days 45.9%** of those with a **mental health diagnosis had been readmitted**.

3.1 Mental health status

3.1.1 Mental health status of audit sample

Mental health status	2017 (N=30,294)
No mental health diagnosis	24,204 (79.9%)
Mild/moderate mental health diagnosis[j]	4,186 (13.9%)
Severe mental health diagnosis[k]	1,904 (6.3%)

3.1.2 Mental health status: by mortality within 30/90 days of index admission[l]

Mental health status	2017	
	Mortality in 30 days (N=1,832)	Mortality in 90 days (N=3,426)
No mental health diagnosis (N=24,204)	1,527 (6.3%)	2,820 (11.7%)
Mild/moderate mental health diagnosis (N=4,186)	236 (5.6%)	451 (10.8%)
Severe mental health diagnosis (N=1,904)	69 (3.6%)	155 (8.1%)

3.1.3 Mental health status: by readmissions within 30/90 days of index discharge date[l]

Mental health status	2017	
	Readmitted within 30 days of discharge (N=7,508)	Readmitted within 90 days of discharge (N=13,053)
No mental health diagnosis (N=24,204)	5,848 (24.2%)	10,256 (42.4%)
Mild/moderate mental health diagnosis (N=4,186)	1,130 (27.0%)	1,900 (45.4%)
Severe mental health diagnosis (N=1,904)	530 (27.8%)	897 (47.1%)

[j] Mild/moderate mental health diagnosis was defined by a combination between both depression and anxiety ICD-10 codes as follows; depression codes: F32, F33, F34, F38, F39; anxiety codes: F40, F41.
[k] Severe mental health diagnosis was defined by the following ICD-10 codes: F06, F10, F11, F12, F13, F14, F15, F16, F18, F19, F20, F23, F24, F25, F28, F30, F31, F60.
[l] This analysis is unadjusted due to time constraints in the publication of the report.

Section 4: Case ascertainment

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Case ascertainment rates were calculated based on the number of records entered to the audit compared to data obtained from the Hospital Episode Statistics (HES) Admitted Patient Care (APC) dataset for England and the NHS Wales Informatics Service (NWIS) Patient Episode Database for Wales (PEDW). To see the latest figures and find out more about case ascertainment please visit: www.rcplondon.ac.uk/COPD-CA.

The total number of patients discharged from English and Welsh hospitals recorded by HES APC and NWIS PEDW datasets between 1 April and 13 September 2017[m] was 61,869. The total number of records submitted to the audit by English and Welsh hospitals during the same period was 31,511.[n] The median case ascertainment rate for this period was 54.3% with an interquartile range of 31.3–73.1%. Possible reasons why this figure is lower than may be expected include:

- Patients with COPD tend to be admitted across the hospital, rather than solely to respiratory wards. This can make local case identification challenging.
- The relatively short length of stay for these patients (4 days[9]) compounds challenges in case identification.
- The volume of admitted cases (over 140,000 per annum[10]) is high, which poses a considerable administrative and resource challenge for local teams to enter into the audit, assuming all cases could be identified locally.
- Local coding procedures, which can make retrospective case identification difficult, such as potential over-coding of COPD admissions (falsely reducing case ascertainment) due to the frequent overlap between respiratory tract infections (eg pneumonia) and COPD exacerbations.

All data presented in this report should be reviewed taking into account that 45.7% of cases reported by HES and PEDW have not been included in the audit. However, notwithstanding this, the large number of records included provide sufficient statistical power to ensure confidence in the data presented. There is also no evidence of any geographical correlation with low case ascertainment.

[m] Case ascertainment was not measured for the first 2 months of the audit (February and March 2017), primarily due to the proximity to the launch of the audit (1 February 2017). Hospitals are not reasonably expected to enter a significant number of cases without time to embed audit processes in their work flow.

[n] The total number of records entered for the reporting period (1 February – 13 September 2017) is 36,341.

Recommendations

For providers

1. Facilitate working across traditional specialty and organisational boundaries, to improve optimal identification and management of multimorbidity in people living with COPD and reduce the risk of readmission.
2. Embed the COPD audit into everyday practice and use real-time data feedback to implement local QI initiatives to address readmission rates.
3. Mortality rates remain high. Apply evidence-based interventions to treat and prevent COPD exacerbations in a timely manner in order to impact positively on survival.[o]

For commissioners/health boards/sustainability and transformation partnerships (STPs) and integrated care systems (ICSs)

1. It is notable that the majority of readmissions to hospital are not primarily due to COPD and therefore multiprofessional working should be actively supported across long-term conditions and organisational boundaries.

For primary care

1. Recognise that the time following discharge from hospital following an exacerbation of COPD is one of high risk for readmission. Therefore, ensure review of patients in the post-discharge period to identify risks for readmissions.
2. Ensure annual review templates are fit for purpose and specifically, that they include documentation of prior exacerbation history which is the best guide to future exacerbation risk, and a focus on multimorbidity, including cardiovascular disease and mental health.

[o] To avoid duplication, this recommendation only appears once. However, it is particularly relevant across the spectrum of providers and commissioners, including STPs, ICSs and primary care. We feel that commissioners, STPs and ICSs are best placed to plan systems that support organisations to work together to support multimorbid patients.

Appendix A: Methodology

Methodology of audit creation and setup

NACAP's COPD secondary care continuous clinical audit is built upon the learning from the 2014 snapshot clinical audit.[11] The structure of the dataset is similar to that used in 2014, however, it has been considerably streamlined to account for the change in methodology from snapshot (in 2014) to continuous audit, which commenced in February 2017. The first annual report since the start of continuous data collection presented the results of the cohort of patients discharged between 1 February and 13 September 2017. This can be found at: www.rcplondon.ac.uk/working-together.

All hospitals in England and Wales that admit patients with acute exacerbations of COPD (AECOPD) were eligible to participate in the audit (n=192). 182 hospitals (95%) participated in the period outlined above. A full list of participating hospitals can be found in the national report at: www.rcplondon.ac.uk/working-together.

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

The audit operates under Section 251 approval from the Confidentiality Advisory Group (CAG) of the Health Research Authority (HRA). The reference number is CAG-8-06(b)/2013. This approval also grants the RCP permission to link audit data to externally held sources of data (using patient identifiable data items) for derivation of longer-term outcomes of the patient cohort. 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).

To find out more about the audit's information governance, legal basis, or data storage, security and transfer arrangements please refer to the fair processing document, IG frequently asked questions (FAQs) and data flow diagram, all of which can be found on the audit resources page: www.rcplondon.ac.uk/nacap-copd-resources. In addition, a patient leaflet and poster are available to download from the same page.

Recruitment

The recruitment process for the continuous audit started in 2016. For further details of the recruitment methodology employed, please refer to appendix C of the data analysis and methodology component of the 2017 clinical audit report, which can be found at: www.rcplondon.ac.uk/working-together.

Audit question development and pilot

The audit dataset was based on the snapshot 2014 dataset. It was developed in 2016 iteratively by the audit programme team and clinical lead, in consultation with the workstream group. For further information on the piloting of the audit please refer to appendix C of the data analysis and methodology component of the 2017 clinical audit report at: www.rcplondon.ac.uk/working-together.

Data entry

Hospitals are required to enter data via the audit programme's bespoke web-tool, created by Crown Informatics Ltd (available at www.nacap.org.uk).

Guidance documentation to support participation in the audit such as the dataset with help notes, data collection sheets, audit technical guidance and frequently asked questions are available to download from both the web tool (www.nacap.org.uk) and the COPD audit resources webpage on the RCP website (www.rcplondon.ac.uk/nacap-copd-resources).

Data entry to the audit is regularly reviewed by the NACAP team. Where few records are entered (eg fewer than 50–100 a year, depending on the size of the hospital) or where there is a notable change in participation rates (eg a hospital that has entered 50% less records in the current 6 months than in the 6 months prior) the NACAP team communicate directly with the hospital to understand the reasons behind lack of participation and to provide support where possible. Regular email updates and newsletters are also sent to participants with reminders about data entry timelines.

Telephone and email support

The audit programme team at the RCP provide a helpdesk from 9am to 5pm every working day, which is available via both telephone and email, so that participants can contact the team directly with any questions.

Analysis methodology

Data transfer

The audit applied for linkage of audit data to outcome data sources via NHS Digital (application reference: DARS-NIC-349273-T3L4K-v3.7) and NHS Wales Informatics Service (NWIS) (application reference 29892).

Following this, a file containing a unique audit ID and necessary identifiable information (NHS number, date of birth and postcode) for the audit cohort (those discharged between 1 February and 13 September 2017) was sent to the Data Access Request Service (DARS) at NHS Digital and NHS Wales Informatics Service (NWIS) by Crown Informatics on 31 July 2018.

DARS NHS Digital and NWIS 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) and the Patient Episode Database for Wales (PEDW) dataset (NWIS). DARS NHS Digital also provided Office for National Statistics (ONS) mortality data for all people within the cohort. Please note, NHS Digital upheld national opt-outs before providing the data.

Two linked datasets, one containing all requested HES and ONS records plus the unique audit ID, and one containing all requested PEDW records plus the unique audit ID, were sent securely to Crown Informatics by NWIS and NHS Digital.

The anonymised files containing non-identifiable patient data was then 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 Stata 15 for cleaning. The original 2017 clinical audit dataset contained no method of identifying unique patients, so a new cut of clinical data with an added pseudonymised patient identifier was extracted and used for the analysis. This has meant that patients and admissions included in the analysis may differ slightly from that which were included in the original national clinical audit report (www.rcplondon.ac.uk/working-together).

The clinical audit dataset was prepared and cleaned as follows:

- All string categorical variables were recoded numerically and labelled with the former string value.
- All string date/time variables were converted to numerical date/time variables.
- All indicator variables (to denote presence or absence) were converted from their current format (eg an 'X' character) to a binary 0 or 1 value.
- Admissions with:
  - An arrival time after admission time were removed (N=0)
  - A discharge date before admission date were removed (N=4)
  - A respiratory specialist review before arrival were removed (N=0)
  - A respiratory specialist review after discharge were removed (N=248)
  - NIV before arrival were removed (N=102)
  - NIV after discharge were removed (N=36)
  - A discharge before arrival were removed (N=0)
  - An age less than 35 years were removed (N=42).
- Patient age was categorised as follows:
  - 35–44
  - 45–54
  - 55–64
  - 65–74
  - 75–84
  - 85+
- English and Welsh quintiles of index of multiple deprivation (IMD) were produced (1=most deprived, 5=least deprived) using the provided IMD rank for each patient.
- Time from arrival to admission was generated by subtracting arrival time from admission time and admissions with admission wait times greater than or equal to 24 hours were removed as this was considered unrealistic (N=426).
- Time from admission to specialist review was generated by subtracting admission time from review time and admissions with review wait times less than or equal to -24 hours (24 hours prior) were removed as this was considered unrealistic (n=0 [removed in previous stage]).
- Time from arrival to NIV was calculated by subtracting arrival time from time of NIV administration.
- Likely duplicate admission entries (identified by Artemis ID[p]) were removed (N=92), with the first entry being kept (identified by created date).

[p] An Artemis ID is a code automatically assigned to every patient entered on the web tool, which serves to anonymise the data. It is presented as a long sequence of letters and numbers, such as 5C920511992C579832C378DF34B8AFBB.

- An admission number was generated for each patient, along with a total admission count for each patient.
- Variables required for analysis and generating odds ratios were created:
  - Length of stay (equal to or below median/above median).

ONS death data were prepared and cleaned as follows:

- Cause of death ICD-10 code was converted to a 3-character ICD-10 code.
- Duplicate entries for patients were removed and just one entry per patient was kept.

HES and PEDW data were prepared and cleaned as follows:

- The 2016 and 2017 HES datasets were combined (HES uses the financial year so the 2016 and 2017 datasets were required to cover the audit period. PEDW provided 2017 calendar year data).
- ICD-10 diagnosis codes were converted to 3-character ICD-10 codes.
- Admissions before the start of the audit period were removed (ie admissions on or after 01/02/2017 were kept).
- For patients with multiple episodes per admission, only the final episode with a discharge date was kept.
- Discharge dates before the start of the audit period were removed (ie admissions with discharges on or after 01/02/2017 were kept).
- Duplicate entries for a single admission were removed.
- HES and PEDW data were combined.
- Admissions after 31/12/2017 (90 days post the last discharge in the 2017 clinical audit report) were removed so that English and Welsh patients had the same duration of follow-up.

Linkage of the audit and HES/PEDW data:

- HES/PEDW admissions before the index audit admission were removed.
- The first contemporaneous (ie that matched the audit recorded admission date) HES/PEDW admission for each patient was defined as the index admission.
- Readmission in 30/90 days was defined as occurring less than (<) 30/90 days since index admission.
- The number of readmissions following an index admission were counted for each patient and a binary flag was used to indicate whether they occurred within either 30 or 90 days of their index admission.

Data analysis

- Comorbidities were defined (mental health and Charlson comorbidity index (CCI)) using primary and all secondary diagnosis codes from the index admission.
  - The CCI algorithm was based on previously published research.[4]
  - The CCI algorithm excluded COPD as all patients should have a COPD diagnosis, and age as this was already included in the logistic regression model.
- Mild/moderate mental health diagnosis was defined by a combination between both depression and anxiety ICD-10 codes as follows; depression codes: F32, F33, F34, F38, F39; anxiety codes: F40, F41.

- Severe mental health diagnosis was defined by the following ICD-10 codes: F06, F10, F11, F12, F13, F14, F15, F16, F18, F19, F20, F23, F24, F25, F28, F30, F31, F60.
- Logistic regression models were created to find odds of readmission or death by deprivation (quintiles of IMD/WIMD), age (35–44, 45–54, 55–64, 65–74, 75–84, 85+), CCI (0, 1, 2, 3, 4, 5, 6+), length of hospital stay (≤4 days, >4 days), receipt of NIV (yes, no). Adjusted models were mutually adjusted for all exposure variables.

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