Online Supplement

Validation of Acute Exacerbation of Chronic Obstructive Pulmonary Disease Recording in Electronic Health Records: A Systematic Review

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Supplementary File 1

Medline search strategy

1. lung diseases, obstructive/ or exp bronchitis/ or exp pulmonary disease, chronic obstructive/

2. (COPD or COAD or emphysema or chronic bronchitis).ab,kf,ti.

3. (chronic obstructive adj (pulmonary or lung or airway$ or airflow) adj disease).ab,kf,ti.

4. 1 or 2 or 3

5. clinical deterioration/

6. (exacerbation$ or hospital$).ab,kf,ti.

7. 5 or 6

8. 4 and 7

9. (AECOPD or ECOPD or AECB).ab,kf,ti.

10. 8 or 9

11. database management systems/ or electronic data processing/ or exp health information management/ or databases as topic/ or databases, factual/ or health information systems/ or consumer health informatics/ or medical informatics/ or health information exchange/ or medical informatics applications/ or medical informatics computing/ or public health informatics/

12. medical records/ or health records, personal/ or patient generated health data/ or medical record linkage/ or medical records, problem-oriented/ or medical records systems, computerized/ or electronic health records/ or registries/

13. Clinical Coding/ or current procedural terminology/ or healthcare common procedure coding system/ or "international classification of diseases"/ or "logical observation identifiers names and codes"/ or rxnorm/ or "systematized nomenclature of medicine"/

14. (EHR$1 or EMR$1 or electronic health record$1 or electronic medical record$1).ab,kf,ti.

15. ((billing or claim$ or admin$ or utili?ation or patient or inpatient or in-patient or outpatient or out-patient or care or medical or clinical or health$ or hospital$ or electronic or digit$ or computer$) adj2 (data$ or record$1 or system$1)).ab,kf,ti.

16. (billing code or discharge code or Read code or SNOMED CT or ICD*).ab,kf,ti.

17. 11 or 12 or 13 or 14 or 15 or 16

18. Validation Studies as Topic/ or Validation Studies/

19. "sensitivity and specificity"/ or "predictive value of tests"/ or roc curve/

20. (validation or validity or verification or verify or identification or identify).ab,kf,ti.

21. ((case or cases) adj2 (definition$ or define$ or evaluat$)).ab,kf,ti.

22. (sensitivity or specificity or PPV or PNV or NPV or positive predictive value$ or predictive positive value$ or predictive negative value$ or negative predictive value$ or likelihood ratio or precision or accuracy or ROC or receiver operating characteristic$ or kappa or "c-statistic" or (concordance adj statistic) or "c-index").ab,kf,ti.

23. 18 or 19 or 20 or 21 or 22

24. 10 and 17 and 23

Embase Search Strategy

1. exp chronic obstructive lung disease/

2. emphysema/

3. exp chronic bronchitis/

4. (COPD or COAD or emphysema or chronic bronchitis).ab,kw,ti.

5. (chronic obstructive adj (pulmonary or lung or airway$ or airflow) adj disease).ab,kw,ti.

6. 1 or 2 or 3 or 4 or 5

7. exp disease exacerbation/

8. hospitalization/

9. (exacerbation$ or hospital$).ab,kw,ti.

10. 7 or 8 or 9

11. 6 and 10

12. (AECOPD or ECOPD or AECB).ab,kw,ti.

13. 11 or 12

14. data base/

15. medical informatics/ or medical information system/

16. exp medical record/ or electronic health record/ or electronic medical record/ or electronic medical record system/ or electronic patient record/ or register/

17. Current Procedural Terminology/ or coding/

18. exp "international classification of diseases"/ or "Systematized Nomenclature of Medicine"/ or "logical observation identifiers names and codes"/

19. (EHR$1 or EMR$1 or electronic health record$1 or electronic medical record$1).ab,kw,ti.

20. ((billing or claim$ or admin$ or utili?ation or patient or inpatient or in-patient or outpatient or out-patient or care or medical or clinical or health$ or hospital$ or electronic or digit$ or computer$) adj2 (data$ or record$1 or system$1)).ab,kw,ti.

21. (billing code or discharge code or Read code or SNOMED CT or ICD*).ab,kw,ti.

22. 14 or 15 or 16 or 17 or 18 or 19 or 20 or 21

23. validation study/

24. "sensitivity and specificity"/ or predictive value/ or receiver operating characteristic/

25. (validation or validity or verification or verify or identification or identify).ab,kw,ti.

26. ((case or cases) adj2 (definition$ or define$ or evaluat$)).ab,kw,ti.

27. (sensitivity or specificity or PPV or PNV or NPV or positive predictive value$ or predictive positive value$ or predictive negative value$ or negative predictive value$ or likelihood ratio or precision or accuracy or ROC or receiver operating characteristic$ or kappa or "c-statistic" or (concordance adj statistic) or "c-index").ab,kw,ti.

28. 23 or 24 or 25 or 26 or 27

29. 13 and 22 and 28

Supplementary File 2

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QUADAS-2 (adapted for validation of AECOPD recording in healthcare databases review)

Domain 1: Patient selection

A. Risk of bias

Describe methods for patient selection:

- Was a consecutive or random sample of patients enrolled? YES/NO/UNCLEAR
- Was a case-control design avoided? YES/NO/UNCLEAR

• Did the study avoid inappropriate exclusions? YES/NO/UNCLEAR

Could the patient selection have introduced bias? RISK: HIGH/LOW/UNCLEAR

(Score low if answers to all signalling questions were yes. Score high if any answers were no. Score unclear if any were answered as unclear with remainder scoring low)

B. Concerns regarding applicability

Describe included patients:

• Were patients from a single EHR database that comprised patients from one specific

setting (e.g. primary or secondary care only patients)? YES/NO/ UNCLEAR

• Were patients aged 35 years or more with a recorded diagnosis of COPD?

YES/NO/UNCLEAR

Is there concern that the included patients do not match the review question?

CONCERN: HIGH/LOW/UNCLEAR

(*Score low answered yes to both questions. Score high if no to both questions. Score unclear if one marked as unclear.)*

Domain 2: Index test(s)

A. Risk of bias

Describe the index test and how it was conducted and interpreted:

• Was the AECOPD detection algorithm designed without knowledge of the result of the

reference standard (in the final validated population)? YES/NO/UNCLEAR

Could the interpretation of the index test have introduced bias?

RISK: HIGH/LOW/UNCLEAR

(Score low if all answers to signalling questions were yes. Score high if any were answered no. Score unclear if any were answered as unclear with remainder scoring low).

B. Concerns regarding applicability

• Were specific clinical codes / algorithms used to identify patients (i.e. a free text search wasn't used as part of patient identification)? YES/NO

Is there concern that the index test, its conduct or interpretation differ from the review question? CONCERN: HIGH/LOW/UNCLEAR

(Score low if clear descriptions of clinical codes/algorithms were given to identify patients.)

Domain 3: Reference standard

A. Risk of bias

Describe the reference standard and how it was conducted and interpreted:

• Is the reference standard likely to correctly classify the target condition?

YES/NO/UNCLEAR

• Were the reference standard results interpreted without knowledge of the index test?

YES/NO/UNCLEAR

Could the reference standard, its conduct, or its interpretation have introduced bias?

RISK: HIGH/LOW/UNCLEAR

(Score low if all answers to signalling questions were yes. Score high if any were answered no. Score unclear if any were answered as unclear with remainder scoring low)

B. Concerns regarding applicability

• Was there a diagnosis of COPD confirmed using spirometry? YES/NO/UNCLEAR

• Was diagnosis confirmed by a physician reviewing the patient's medical record?

YES/NO/UNCLEAR

• Did more than one physician review the medical record to confirm diagnosis and was

there strong agreement between the reviewing physicians? YES/NO/UNCLEAR

Is there concern that the target condition as defined by the reference standard does not match the review question? CONCERN: HIGH/LOW/UNCLEAR

(Score low if all answers to signalling questions were yes. Score high if any were answered no. Score unclear if any were answered unclear with the remainder low).

Domain 4: Flow and timing

A. Risk of bias

• Did all patients receive a reference standard? YES/NO/UNCLEAR

• Did patients receive the same reference standard? YES/NO/UNCLEAR

• Were all patients included in the analysis? YES/NO/UNCLEAR

Could the patient flow have introduced bias? RISK: HIGH/LOW/UNCLEAR

(Score low if all answers to signalling questions were yes. Score high if any answers were no. Score unclear if any were answered as unclear with the remainder scoring low

Table 6. Detailed Summary of ICD-9 validation studies of AECOPD definitions

Study	***Algorithm (codes)***	***Gold standard reference***	***N***	***PPV / Derived PPV (95% CI)***	***NPV / Derived NPV (95% CI)***	***Sensitivity / Derived Sensitivity (95% CI)***	***Specificity / Derived Sensitivity (95% CI)***
Ginde et al., 2008 *(41)* *Median age = 71* *Retrospective cohort study. 2 emergency departments.*	*491.2x*	*Consensus by two emergency physicians from abstracted chart data*	*181*	*100% (98-100)*	-	-	-
	492.8	*Consensus by two emergency physicians from abstracted chart data*	*4*	*75% (19-99)*	-	-	-
	496	*Consensus by two emergency physicians from abstracted chart data*	*15*	*60% (32-84)*	-	-	-

	491.2x, 492.8, or 496	*Consensus by two emergency physicians from abstracted chart data*	*200*	*97% (93-99)*	-	-	-
Stein et al., 2010(48) *Mean age:* *Algorithm 1 = 69.4* *Algorithm 2 = 69.5* *Algorithm 5 = 68.8* *Nationwide Inpatient Sample in US.*	*Algorithm 1: 491.21 (Obstructive chronic bronchitis with acute exacerbation) primary diagnosis*	*Primary diagnosis recorded in physician notes*	*Sample of 200*	*74%*	-	-	-
	Algorithm 2: 491.x, 492.x, or 496 (Chronic airway obstruction, not elsewhere classified) primary diagnosis	*Primary diagnosis recorded in physician notes*		*62%*	-	-	-
	Algorithm 5: 491.0 (Simple chronic bronchitis), 491.1 (Mucopurulent chronic bronchitis), 491.21 (Obstructive chronic bronchitis with acute exacerbation), 491.22 (Obstructive chronic bronchitis with acute exacerbation), 491.8 (Other chronic bronchitis), 491.9 (Unspecified chronic bronchitis), 492.0	*Primary diagnosis recorded in physician notes*		*60%*	-	-	-

	(Emphysematous bleb), 492.8 (Other emphysema), 493.22 (Chronic obstructive asthma with acute exacerbation), or 496 (Chronic airway obstruction, not elsewhere classified) primary diagnosis OR 518.81 (Acute respiratory failure), 518.82 (Other pulmonary insufficiency not elsewhere classified), or 518.84 (Acute and chronic respiratory failure) primary diagnosis AND 491.0, 491.1, 491.21, 491.22, 491.8, 491.9, 492.0, 492.8, 493.22, or 496 secondary diagnosis						
***Stein et al., 2012** (47)* *Mean age = 56.1.* *2 urban academic medical*	*Primary diagnosis of COPD (490, 491.x, 492.x, 493.22, 496) OR primary diagnosis of respiratory failure (518.81, 518.82, 518.84, 799.1) AND secondary diagnosis of COPD (defined using same codes as primary diagnosis) (age >=25)*	*Physician chart abstraction: physician diagnosis of COPD; presence of cough, dyspnoea, or sputum production on presentation; and hospitalisation for one of these respiratory symptoms*	*50*	*81.2%*	*93.9%*	*24.7%*	*99.5%*

centres in US.	*Primary diagnosis of COPD (491.0, 491.1, 491.21, 491.22, 491.8, 491.9, 492.0, 492.8, 493.22, 496) OR primary diagnosis of respiratory failure (518.81, 518.82, 518.84) AND secondary diagnosis of COPD (defined using same codes as primary diagnosis) (age >=40)*	*Physician chart abstraction: physician diagnosis of COPD; presence of cough, dyspnoea, or sputum production on presentation; and hospitalisation for one of these respiratory symptoms*	*46*	*85.4%*	*93.9%*	*24.3%*	*99.7%*
	Primary diagnosis of COPD: 491.x, 492.x, 496 (age>=40)	*Physician chart abstraction: physician diagnosis of COPD; presence of cough, dyspnoea, or sputum production on presentation; and hospitalisation for one of these respiratory symptoms*	*29*	*85.6%*	*93.2%*	*14.5%*	*99.8%*
	Primary diagnosis of AECOPD: 491.21 (age>=40)	*Physician chart abstraction: physician diagnosis of COPD; presence of cough, dyspnoea, or sputum production on presentation; and*	*20*	*97.2%*	*93%*	*12.3%*	*100%*

		hospitalisation for one of these respiratory symptoms					
Pu et al., 2017 (42) *Mean age = 60.* *Hospital database in US.*	*491.21 (AECOPD)*	*Chart review*	*620*	*91% (88-93)*	*31% (27-35)*	*57% (54-61)*	*76% (70-81)*
Stanford et al., 2020 (49) *Mean age = 67.6* *US healthcare claims database.*	*Claims based algorithm (modified from the Stein 2012 algorithm through the addition of further ICD-9 codes - 493.12, 493.92, 494.1, 466.0)*	*Review of exacerbation history in medical records by patient's physician.*	*402*	*67.5%*	-	*84.90%*	-
Mapel et al., 2021 (44) *Mean age:* *Reliant = 72.7*	***Moderate exacerbations**: At least 1 office or outpatient non-emergency department visit with any of the following ICD-9-CM codes as the primary diagnosis:*	*Chart review by trained pulmonary nurses using GOLD COPD 2017 definition.*	*298*	*98.3% (96.1–99.5)*	*75.0% (65.3, 83.1)*	-	-

KPMAS = 68.9	*466,486,490, 491, 492.xx, 493.20, 493.22, 493.92, 496, 518.81, 518.82, 518.84, 786.0, 786.05, 786.2, 786.5, 786.07, 799.0.* ***AND*** *at least 1 associated pharmacy dispensing for theophylline (intravenous) or aminophylline (intravenous) or systemic steroids or any of the following antibiotics (amoxicillin, beta-lactamase inhibitor, 2nd to 4th generation cephalosporins, macrolides or doxycycline).*						
	Severe exacerbations: *At least 1 inpatient hospital stay or 2 or more days with any of the following ICD-9-CM codes as primary diagnosis:* *491, 492, 493.20, 493.22, 496, 518.81, 518.82, 518.84.*	*Chart review by trained pulmonary nurses using GOLD COPD 2017 definition.*	*225*	*96.0% (92.5–98.2)*	*95.0% (88.7, 98.4)*	-	-

Table 7. Detailed summary of ICD-10 validation studies of AECOPD definitions

Study	***Algorithm(s)***	***Gold standard reference***	***N***	***PPV / Derived PPV (95% CI)***	***NPV / Derived NPV (95% CI)***	***Sensitivity / Derived Sensitivity (95% CI)***	***Specificity / Derived Sensitivity (95% CI)***
Thomsen et al., 2011 (45) *Median age = 74* *Danish National Patient Registry (DNPR)*	*PPV: J44 (COPD) primary or secondary diagnosis*	*Physician review of patient medical records*	*1581*	*92% (91-93)*	-	-	-
	PPV: J44 (COPD) as primary diagnosis	*Physician review of patient medical records*	*1223*	*93% (92-95)*	-	-	-
	PPV: J44 (COPD) as secondary diagnosis, acute respiratory failure or pneumonia as primary diagnosis	*Physician review of patient medical records*	*358*	*87% (84-91)*	-	-	-
	NPV: Pneumonia (J13-J18) or acute respiratory failure (J96) without J44	*Physician review of patient medical records*	*1546*	-	*81% (79-83)*	-	-
	NPV: Pneumonia (J13-J18) without J44	*Physician review of patient medical records*	*1432*	-	*82% (80-84)*	-	-
	NPV: Acute respiratory failure (J96) without J44	*Physician review of patient medical records*	*114*	-	*59% (49-68)*	-	-
Rothnie et al., 2016	*Specific AECOPD code (J44.0 or J44.1) or LRTI*	*Hospital discharge summary*	*40*	-	-	*87.5% (72.4-94.9)*	-

(39) (HES/ICD-10) *Age (%)* *65-74 = 31.4%* *≥75 = 21.7%*	*code (J22) in any position or COPD code (J44.9) in the first position in any FCE during spell*						
	Specific AECOPD code (J44.0 or J44.1) or COPD code (J44.9) in any position in any FCE during spell	*Hospital discharge summary*	*40*	*-*	*-*	*85.0% (69.6-93.3)*	*-*
	Specific AECOPD code (J44.0 or J44.1) in any position or LRTI code (J22) or COPD code (J44.9) in the first position in any FCE during spell	*Hospital discharge summary*	*40*	*-*	*-*	*85.0% (69.6-93.3)*	*-*
	Specific AECOPD code (J44.0 or J44.1) in any position or COPD code (J44.9) in the first position in any FCE during spell	*Hospital discharge summary*	*40*	*-*	*-*	*77.5% (61.3-88.2)*	*-*
	Specific AECOPD code (J44.0 or J44.1) in any position in any FCE during spell	*Hospital discharge summary*	*40*	*-*	*-*	*77.5% (61.3-88.2)*	*-*
	Specific AECOPD code (J44.0 or J44.1) in the first	*Hospital discharge summary*	*40*	*-*	*-*	*65.0% (48.5-78.6)*	*-*

	position in first FCE during spell						
Sperrin et al., 2019 (43) *EHR data from Salford Integrated Record in UK and case report forms from Salford Lung Study.*	*Algorithms for both* ***read codes from Rothnie et al., 2016 (38) AND ICD-10 codes from Rothnie et al.,(39)*** *Results from a 'best-case scenario', using the full algorithm in primary and secondary care, and allowing a maximum gap in the start or end dates of the episodes of up to 15 days*	*Moderate and severe AECOPD episodes reported in the eCRF for a clinical trial*	*3,042*	*73.6%*	-	*69.1%*	-
Echevarria et al., 2020 (46) *2 hospitals in England: one urban and one rural.*	*COPD codes J44*	*Consensus of 2 respiratory specialists using GOLD guidelines*	*1,014*	*63.9%*	*75.5%*	*70.7%*	*69.4%*

Awano et al., 2023 (40) *2 acute hospitals in Tokyo*	*COPD codes J410, J411, J42, J43, J44, J449, J841*	*Physician review of patient medical records*	*92*	*72.1%*	*82.9%*	*33.7%*	*96.1%*

Table 8. Detailed summary of Read code validation studies of AECOPD

Study	***Algorithm(s)***	***Gold standard reference***	***N***	***PPV / Derived PPV (95% CI)***	***NPV / Derived NPV (95% CI)***	***Sensitivity / Derived Sensitivity (95% CI)***	***Specificity / Derived Sensitivity (95% CI)***
Rothnie et al., 2016 (38) *UK database (Clinical Practice Research Datalink).* *Age (%):*	*Oral corticosteroid (OCS) prescription*	*Review of GP questionnaires and other relevant material from patient notes by two respiratory physicians*	*1152*	*73.0% (69.5-76.5)*	*-*	*30.2% (25.8-34.6)*	*-*
	Antibiotic prescription	*Review of GP questionnaires and other relevant material from patient notes by two respiratory physicians*	*5840*	*60.9% (59.0-62.9)*	*-*	*71.1% (66.8-75.4)*	*-*

55-64 = 36.3% *65-74 = 30.5%* *≥75 = 11.7 %*	*Oral corticosteroid and antibiotic prescription (on the same day)*	*Review of GP questionnaires and other relevant material from patient notes by two respiratory physicians*	*823*	*79.3% (75.8-82.9)*	-	*24.5% (20.4-28.6)*	-
	Exacerbation Symptom definition (increase in 2 or more of: dyspnoea, cough, sputum)	*Review of GP questionnaires and other relevant material from patient notes by two respiratory physicians*	*142*	*64.8% (56.2-73.3)*	-	*2.6% (1.1-4.0)*	-
	Exacerbation Symptom definition and oral corticosteroid prescription (on the same day)	*Review of GP questionnaires and other relevant material from patient notes by two respiratory physicians*	*88*	*89.8% (82.9-96.7)*	-	*2.2% (0.9-3.6)*	-
	Exacerbation Symptom definition and antibiotic prescription (on the same day)	*Review of GP questionnaires and other relevant material from patient notes by two respiratory physicians*	*57*	*93.0% (85.6-100.0)*	-	*1.8% (0.6-3.1)*	-
	Exacerbation Symptom definition and oral corticosteroid & antibiotic prescription (on the same day)	*Review of GP questionnaires and other relevant material from patient notes by two respiratory physicians*	*48*	*97.9% (94.5-100.0)*	-	*1.7% (0.5-2.9)*	-

	Lower respiratory tract infection (LTRI) code (excluding pneumonia)	*Review of GP questionnaires and other relevant material from patient notes by two respiratory physicians*	*1745*	*79.6% (76.9-82.3)*	-	*23.0% (19.2-26.8)*	-
	LTRI code and oral corticosteroid prescription (on the same day)	*Review of GP questionnaires and other relevant material from patient notes by two respiratory physicians*	*1558*	*81.4% (78.7-84.1)*	-	*19.9% (16.3-23.5)*	-
	LTRI code and antibiotic prescription (on the same day)	*Review of GP questionnaires and other relevant material from patient notes by two respiratory physicians*	*393*	*88.3% (84.4-92.2)*	-	*12.0% (9.3-14.7)*	-
	LTRI code and oral corticosteroid & antibiotic prescription (on the same day)	*Review of GP questionnaires and other relevant material from patient notes by two respiratory physicians*	*371*	*88.1% (84.1-92.1)*	-	*11.4% (8.8-14.0)*	-
	AECOPD code	*Review of GP questionnaires and other relevant material from patient notes by two respiratory physicians*	*885*	*96.0% (94.5-97.6)*	-	*25.1% (20.9-29.2)*	-

	AECOPD code and oral corticosteroid prescription (on the same day)	*Review of GP questionnaires and other relevant material from patient notes by two respiratory physicians*	*638*	*96.9% (95.4-98.3)*	-	*18.2% (14.6-21.8)*	-
	AECOPD code and antibiotic prescription (on the same day)	*Review of GP questionnaires and other relevant material from patient notes by two respiratory physicians*	*423*	*96.5% (94.5-98.4)*	-	*17.5% (13.8-21.2)*	-
	AECOPD code and oral corticosteroid & antibiotic prescription (on the same day)	*Review of GP questionnaires and other relevant material from patient notes by two respiratory physicians*	*377*	*96.8% (95.0-98.6)*	-	*16.0% (12.6-19.5)*	-
Rothnie et al., 2016 (38) *(subset with additional patient data)*	*Oral corticosteroid (OCS) prescription*	*Review of GP questionnaires and other relevant material from patient notes by two respiratory physicians (with additional information provided by GPs)*	*367*	*72.2% (66.5-77.9)*	-	*22.7% (16.1-29.2)*	-

	Antibiotic prescription	*Review of GP questionnaires and other relevant material from patient notes by two respiratory physicians (with additional information provided by GPs)*	*2245*	*61.3% (58.3-64.3)*	-	*63.4% (55.4-71.4)*	-
	Oral corticosteroid and antibiotic prescription (on the same day)	*Review of GP questionnaires and other relevant material from patient notes by two respiratory physicians (with additional information provided by GPs)*	*251*	*79.7% (73.5-85.8)*	-	*18.6% (12.4-24.7)*	-
	Exacerbation Symptom definition (increase in 2 or more of: dyspnoea, cough, sputum)	*Review of GP questionnaires and other relevant material from patient notes by two respiratory physicians (with additional information provided by GPs)*	*83*	*63.9% (52.7-75.0)*	-	*2.1% (0.1-4.0)*	-

	Exacerbation Symptom definition and oral corticosteroid prescription (on the same day)	*Review of GP questionnaires and other relevant material from patient notes by two respiratory physicians (with additional information provided by GPs)*	*50*	*94.0% (88.0-100.0)*	-	*2.1% (0.1-4.0)*	-
	Exacerbation Symptom definition and antibiotic prescription (on the same day)	*Review of GP questionnaires and other relevant material from patient notes by two respiratory physicians (with additional information provided by GPs)*	*36*	*94.4% (86.8-100.0)*	-	*1.6% (0.1-3.2)*	-
	Exacerbation Symptom definition and oral corticosteroid & antibiotic prescription (on the same day)	*Review of GP questionnaires and other relevant material from patient notes by two respiratory physicians (with additional information provided by GPs)*	*31*	*100% (88.8-100.0)*	-	*1.6% (0.1-3.2)*	-

	Lower respiratory tract infection (LTRI) code (excluding pneumonia)	*Review of GP questionnaires and other relevant material from patient notes by two respiratory physicians (with additional information provided by GPs)*	*693*	*82.8% (78.8-86.9)*	-	*24.7% (18.8-30.7)*	-
	LTRI code and oral corticosteroid prescription (on the same day)	*Review of GP questionnaires and other relevant material from patient notes by two respiratory physicians (with additional information provided by GPs)*	*621*	*84.5% (80.6-88.5)*	-	*20.6% (15.2-26.0)*	-
	LTRI code and antibiotic prescription (on the same day)	*Review of GP questionnaires and other relevant material from patient notes by two respiratory physicians (with additional information provided by GPs)*	*142*	*93.0% (88.3-97.6)*	-	*12.4% (7.8-16.9)*	-

	LTRI code and oral corticosteroid & antibiotic prescription (on the same day)	*Review of GP questionnaires and other relevant material from patient notes by two respiratory physicians (with additional information provided by GPs)*	*129*	*92.2% (87.1-97.4)*	-	*10.8% (6.7-15.0)*	-
	AECOPD code	*Review of GP questionnaires and other relevant material from patient notes by two respiratory physicians (with additional information provided by GPs)*	*350*	*98.3% (96.9-99.6)*	-	*26.8% (19.7-33.9)*	-
	AECOPD code and oral corticosteroid prescription (on the same day)	*Review of GP questionnaires and other relevant material from patient notes by two respiratory physicians (with additional information provided by GPs)*	*236*	*99.2% (98.1-100.0)*	-	*18.6% (12.4-24.7)*	-

	AECOPD code and antibiotic prescription (on the same day)	*Review of GP questionnaires and other relevant material from patient notes by two respiratory physicians (with additional information provided by GPs)*	*155*	*98.1% (96.0-100.0)*	-	*17.0% (10.8-23.2)*	-
	AECOPD code and oral corticosteroid & antibiotic prescription (on the same day)	*Review of GP questionnaires and other relevant material from patient notes by two respiratory physicians (with additional information provided by GPs)*	*140*	*98.6% (96.8-100.0)*	-	*15.5% (9.7-21.2)*	-
Rothnie et al., 2016 (38) *(subset with additional patient data - combined algorithms)*	*Algorithms 5, 6, 8, or 12: Symptom definition with prescription of antibiotic or OCS; or LRTI; or AECOPD code*	*Review of GP questionnaires and other relevant material from patient notes by two respiratory physicians (with additional information provided by GPs)*		*88.1% (85.3-90.8)*	-	*51.6% (44.1-59.0)*	-

	Algorithms 3, 5, 6, 8, or 12: Prescription of antibiotics and OCS for 5-14 days; or Symptom definition with prescription of antibiotic or OCS; or LRTI code; or AECOPD code	*Review of GP questionnaires and other relevant material from patient notes by two respiratory physicians (with additional information provided by GPs)*		*85.5% (82.7-88.3)*	-	*62.9% (55.4-70.4)*	-
	All algorithms combined	*Review of GP questionnaires and other relevant material from patient notes by two respiratory physicians (with additional information provided by GPs)*		*63.8% (61.0-66.6)*	-	*88.1% (82.9-93.4)*	-
Rothnie et al., 2016 (39) (CPRD/Read) *Age (%)* *65-74 = 31.4%* *≥75 = 21.7%* *General UK population*	*AECOPD hospitalisation code*	*HES: Specific AECOPD code (J44.0 or J44.1) or LRTI code (J22) in any position or COPD code (J44.9) in the first position in any FCE during spell*		*50.2% (48.5-51.8)*	-	*4.1% (3.9-4.3)*	-
	AECOPD identified using validated algorithm and hospitalisation code	*HES: Specific AECOPD code (J44.0 or J44.1) or LRTI code (J22) in any*		*43.3% (42.3-44.2)*	-	*5.4% (5.1-5.7)*	-

using CPRD data and HES.		*position or COPD code (J44.9) in the first position in any FCE during spell*					
	AECOPD hospitalisation code	*HES: Specific AECOPD code (J44.0 or J44.1) in any position or COPD code (J44.9) in the first position in any FCE during spell*		*49.0% (47.3-50.6)*	-	*4.6% (4.5-4.9)*	-
	AECOPD identified using validated algorithm and hospitalisation code	*HES: Specific AECOPD code (J44.0 or J44.1) in any position or COPD code (J44.9) in the first position in any FCE during spell*		*38.5% (37.6-39.4)*	-	*5.5% (5.2-5.9)*	-
	AECOPD hospitalisation code	*HES: Specific AECOPD code (J44.0 or J44.1) in the first position in first FCE during spell*		*45.9% (44.2-47.6)*	-	*4.7% (4.4-4.9)*	-
	AECOPD identified using validated algorithm and hospitalisation code	*HES: Specific AECOPD code (J44.0 or J44.1) in the first position in first FCE during spell*		*37.2% (36.3-38.1)*	-	*5.7% (5.4-6.0)*	-