

Year-to-year trajectories of hospital utilisation rates among patients with COPD: a retrospective cohort study

Supplemental table S1 Variables included in the CGH COPD database warehouse

Variable	Description
Demographics	Age
	Sex
	Ethnicity
	Height
	Weight
Comorbidities	All comorbidities including, but not limited to:
	Myocardial infarction
	Congestive heart failure
	Peripheral vascular disease
	Cerebrovascular disease
	Hemiplegia or paraplegia
	Dementia
	Chronic pulmonary disease
	Rheumatologic disease
	Peptic ulcer disease
	Diabetes (with or without complications)
	Renal disease
	Malignancy
	Metastatic solid tumour
	Liver disease (mild, moderate or severe)
	Acquired immune deficiency syndrome
	Hypertension
	Dyslipidaemia
	Asthma
	Gastroesophageal reflux disease
	Depression
	Anxiety
COPD classification (grading or ABCD grouping)	FEV ₁
	CAT score
	Exacerbations leading to hospitalisation
Smoking status	Ex-smoker
	Current smoker
	Never-smoker

Variable	Description
	Pack-year history
Vaccines	Pneumococcal (PCV13 or PPSV23) vaccinations
	Influenza vaccinations
Investigations	Laboratory results, including full blood count (eg, eosinophils), C-reactive protein, procalcitonin and arterial blood gases
	Microbiology results, including sputum gram stain and culture, tuberculosis smear and culture
	Lung function tests, including pre- and post-bronchodilator spirometry (FEV ₁ /FVC ratio), diffusion capacity, lung volumes, 6-minute walk test, exhaled nitric oxide test
	Radiology, including chest x-ray and computed tomography
	2D echocardiography, including left ventricular ejection fraction and pulmonary hypertension echocardiography
Patient-reported outcomes	CAT score
Medications (only within CGH)	Quantity of medications prescribed and quantity of medications dispensed within CGH
	All medications including, but not limited to (including combinations of):
	SABA
	SAMA
	LABA
	LAMA
	ICS
	Methylxanthine (eg, theophylline)
	Phosphodiesterase type 4 inhibitor (eg, roflumilast)
	Antibiotics (eg, penicillins, fluoroquinolones, macrolides, tetracycline)
	Beta-blockers
	Diuretics
	Antiplatelets and angiotensin-converting enzyme inhibitors
Mortality	Date of death
Hospital encounters, including dates and times	ED visits
	All-cause and COPD-related admissions
	Mechanical ventilation (invasive and non-invasive)
	Diagnostic codes
	Outpatient visits

Variable	Description
	Severity of exacerbation (ICU/mechanical ventilation or not)
	2D, two-dimensional; CAT, COPD Assessment Test; CGH, Changi General Hospital; COPD, chronic obstructive pulmonary disease; ED, emergency department; FEV ₁ , forced expiratory volume in 1 second; FVC, forced vital capacity; ICS, inhaled corticosteroid; ICU, intensive care unit; LABA, long-acting β_2 -agonist; LAMA, long-acting muscarinic antagonist; SABA, short-acting β_2 -agonist; SAMA, short-acting muscarinic antagonist.

Supplemental table S2 Patient baseline characteristics

	Total (N=396)	Analysis of COPD-related hospitalisations/ED visits (n=394)	Analysis of all-cause hospitalisations/ED visits (n=389)
Age, years, median (IQR)	70 (60–79)	70 (61–79)	70 (61–79)
Male, n (%)	346 (87.4)	344 (87.3)	339 (87.1)
Ethnicity, n (%)			
Chinese	218 (55.1)	218 (55.3)	215 (55.3)
Malay	95 (24.0)	94 (23.9)	92 (23.7)
Indian	36 (9.1)	36 (9.1)	36 (9.3)
Other	47 (11.9)	46 (11.7)	46 (11.8)
Smoking history, n (%)			
Current smoker	162 (40.9)	161 (40.9)	158 (40.6)
Ex-smoker	159 (40.2)	158 (40.1)	156 (40.1)
Never-smoker	40 (10.1)	40 (10.2)	40 (10.3)
Unknown	35 (8.8)	35 (8.8)	35 (9.0)
Body mass index, kg/m ²			
Median (IQR)	23.4 (19.5–27.4)	23.4 (19.5–27.3)	23.4 (19.5–27.4)
Unknown, n (%)	141 (36.2)	142 (36.0)	141 (36.2)
CAT score			
Median (IQR)	14 (9–19)	14 (9–19)	14 (9–20)
Unknown, n (%)	258 (65.4)	258 (65.4)	255 (65.6)
Lung function test, median (IQR)			
Post-bronchodilator FEV ₁ (L)	1.52 (1.12–2.00)	1.53 (1.12–2.00)	1.53 (1.12–2.01)
Post-bronchodilator FEV ₁ % predicted	70 (54–84)	70 (54–84)	70 (55–84)
GOLD grade, n (%)			

GOLD grade 1 (≥80%)	86 (21.7)	86 (21.8)	85 (21.9)
GOLD grade 2 (50–79%)	153 (38.6)	152 (38.6)	152 (39.1)
GOLD grade 3 (30–49%)	3 (13.6)	53 (13.5)	52 (13.4)
GOLD grade 4 (<30%)	3 (0.8)	3 (0.8)	1 (0.3)
Unknown	100 (25.3)	100 (25.3)	99 (25.4)
Blood eosinophil count (cells/μl), median (IQR)			
Median (IQR)	200 (100–400)	200 (100–400)	200 (100–400)
Unknown, n (%)	77 (19.4)	76 (19.3)	76 (19.3)
Elixhauser comorbidity score, median (IQR)	8 (3–17)	8 (3–17)	8 (3–18)
Comorbidities, n (%)			
Hypertension	201 (50.8)	200 (50.8)	196 (50.4)
Ischaemic heart disease	163 (41.2)	162 (41.1)	159 (40.9)
Hyperlipidaemia	135 (34.1)	135 (34.3)	132 (33.9)
Diabetes	129 (32.6)	129 (32.7)	126 (32.4)
Chronic kidney disease	80 (20.2)	80 (20.3)	78 (20.1)
Atrial fibrillation/arrhythmias	77 (19.4)	76 (19.3)	75 (19.3)
Asthma	73 (18.4)	71 (18.0)	71 (18.3)
Heart failure	64 (16.2)	64 (16.2)	63 (16.2)
Bronchiectasis	32 (8.1)	31 (7.9)	30 (7.7)
Anxiety/depression	26 (6.6)	24 (6.1)	15 (3.9)
Obstructive sleep apnoea	23 (5.8)	23 (5.8)	23 (5.9)
Stroke/transient ischaemic attack	3 (0.8)	3 (0.8)	3 (0.8)
Pulmonary tuberculosis	2 (0.5)	2 (0.5)	2 (0.5)
Moderate-to-severe COPD exacerbations in year 1			

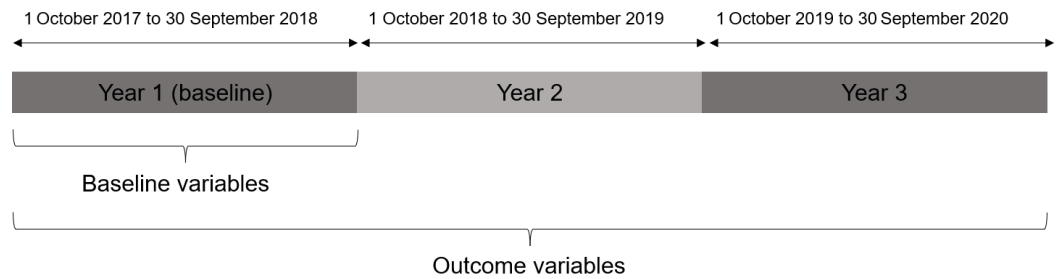
Average, per person per year	0.99	0.88	0.86
Median (IQR)	0 (0–1)	0 (0–1)	0 (0–1)
All-cause hospitalizations/ED visits during baseline			
Average, per person per year	3.07	2.94	2.71
Median (IQR)	2 (1–4)	2 (1–4)	2 (1–4)
CAT, COPD Assessment Test; COPD, chronic obstructive pulmonary disease; ED, emergency department; FEV ₁ , forced expiratory volume in 1 second; GOLD, Global Initiative for Chronic Obstructive Lung Disease; IQR, interquartile range.			

Supplemental table S3 Patient baseline characteristics of excluded patients

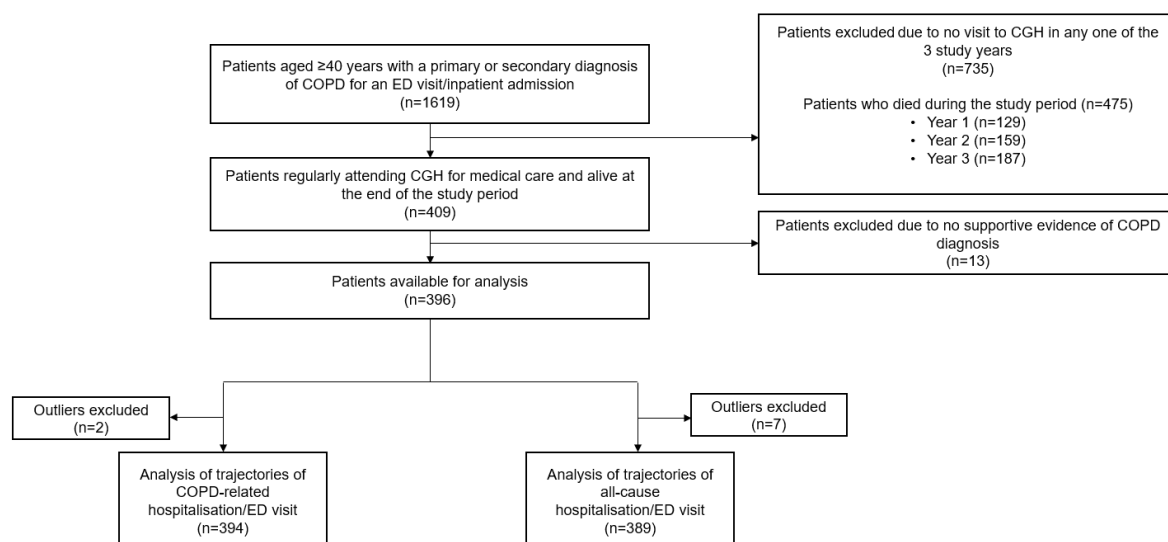
	Patients who died during the study period (n=475)	Patients who were excluded due to zero visits in any one of the study years (n=735)
Age, years, median (IQR)	78 (70–84)	70 (62–79)
Male, n (%)	425 (89.5)	644 (87.6)
Ethnicity, n (%)		
Chinese	329 (69.3)	432 (58.8)
Malay	85 (17.9)	166 (22.6)
Indian	25 (5.3)	57 (7.8)
Other	36 (7.5)	80 (10.8)
Smoking history, n (%)		
Current smoker	138 (29.1)	266 (36.2)
Ex-smoker	224 (47.2)	260 (35.4)
Never-smoker	28 (5.9)	44 (6.0)
Unknown	85 (17.8)	165 (22.4)
Body mass index, kg/m ²		
Median (IQR)	20.1 (17.4–24.2)	22.2 (19.1–25.6)
Unknown, n (%)	224 (47.1)	457 (62.2)
CAT score		
Median (IQR)	16 (11–20)	12 (8–16)
Unknown, n (%)	335 (70.5)	593 (80.6)
Lung function test, median (IQR)		
Post-bronchodilator FEV ₁ (L)	1.29 (0.96–1.73)	1.53 (1.15–1.99)
Post-bronchodilator FEV ₁ % predicted	64 (48–84)	72 (56–88)
GOLD grade, n (%)		
GOLD grade 1 (≥80%)	66 (13.9)	158 (21.5)
GOLD grade 2 (50–79%)	100 (21.1)	171 (23.3)
GOLD grade 3 (30–49%)	53 (11.2)	59 (8.0)
GOLD grade 4 (<30%)	11 (2.3)	10 (1.4)
Unknown	245 (51.6)	337 (45.9)
Blood eosinophil count (cells/μl), median (IQR)		
Median (IQR)	100 (0–237)	150 (5–325)
Unknown, n (%)	131 (27.6)	386 (52.5)
Elixhauser comorbidity score, median (IQR)	14 (8–24)	3 (3–9)

	Patients who died during the study period (n=475)	Patients who were excluded due to zero visits in any one of the study years (n=735)
Comorbidities, n (%)		
Hypertension	233 (50.9)	236 (32.1)
Ischaemic heart disease	217 (45.7)	165 (22.4)
Hyperlipidaemia	114 (24.0)	136 (18.5)
Diabetes	130 (27.4)	136 (18.5)
Chronic kidney disease	130 (27.4)	77 (10.5)
Atrial fibrillation/arrhythmias	112 (23.6)	66 (9.0)
Asthma	15 (3.2)	68 (9.3)
Heart failure	122 (25.7)	77 (10.5)
Bronchiectasis	38 (8.0)	30 (4.1)
Anxiety/depression	28 (5.9)	13 (1.8)
Obstructive sleep apnoea	7 (1.5)	10 (1.4)
Stroke/transient ischaemic attack	1 (0.2)	3 (0.4)
Pulmonary tuberculosis	11 (2.3)	11 (1.5)
Moderate-to-severe COPD exacerbations in year 1		
Average, per person	0.88	0.40
Median (IQR)	0 (0–1)	0 (0–1)
All-cause hospitalisation/ED visits during baseline		
Average, per person	2.52	1.14
Median (IQR)	1 (1–3)	1 (0–2)
CAT, COPD Assessment Test; COPD, chronic obstructive pulmonary disease; ED, emergency department; FEV ₁ , forced expiratory volume in 1 second; GOLD, Global Initiative for Chronic Obstructive Lung Disease; IQR, interquartile range.		

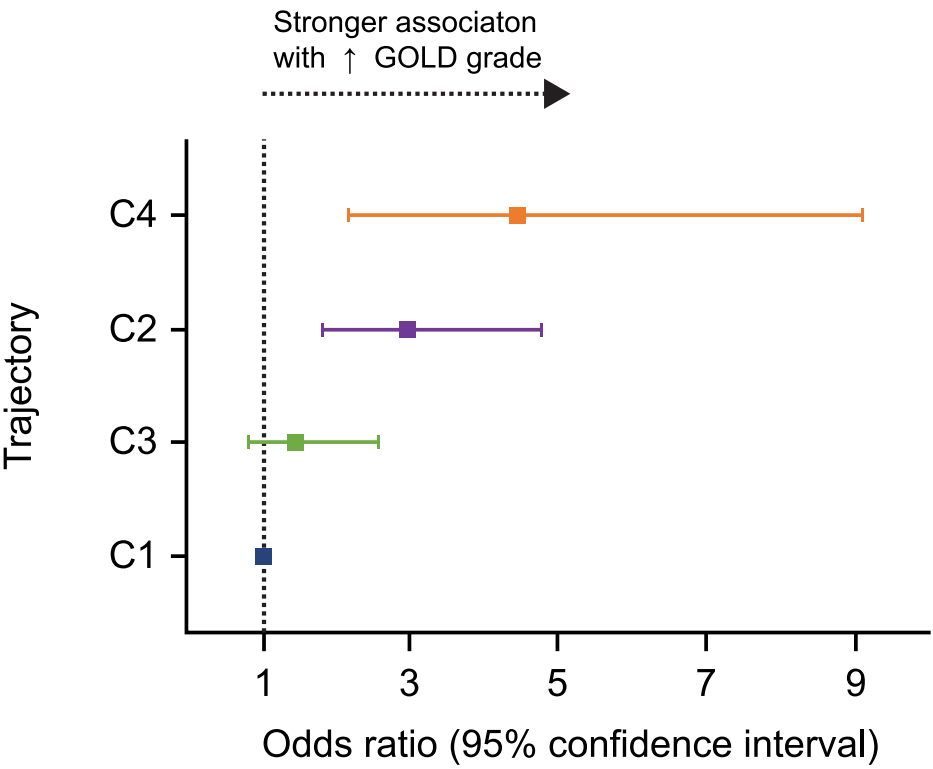
Supplemental figure S1 Study design.



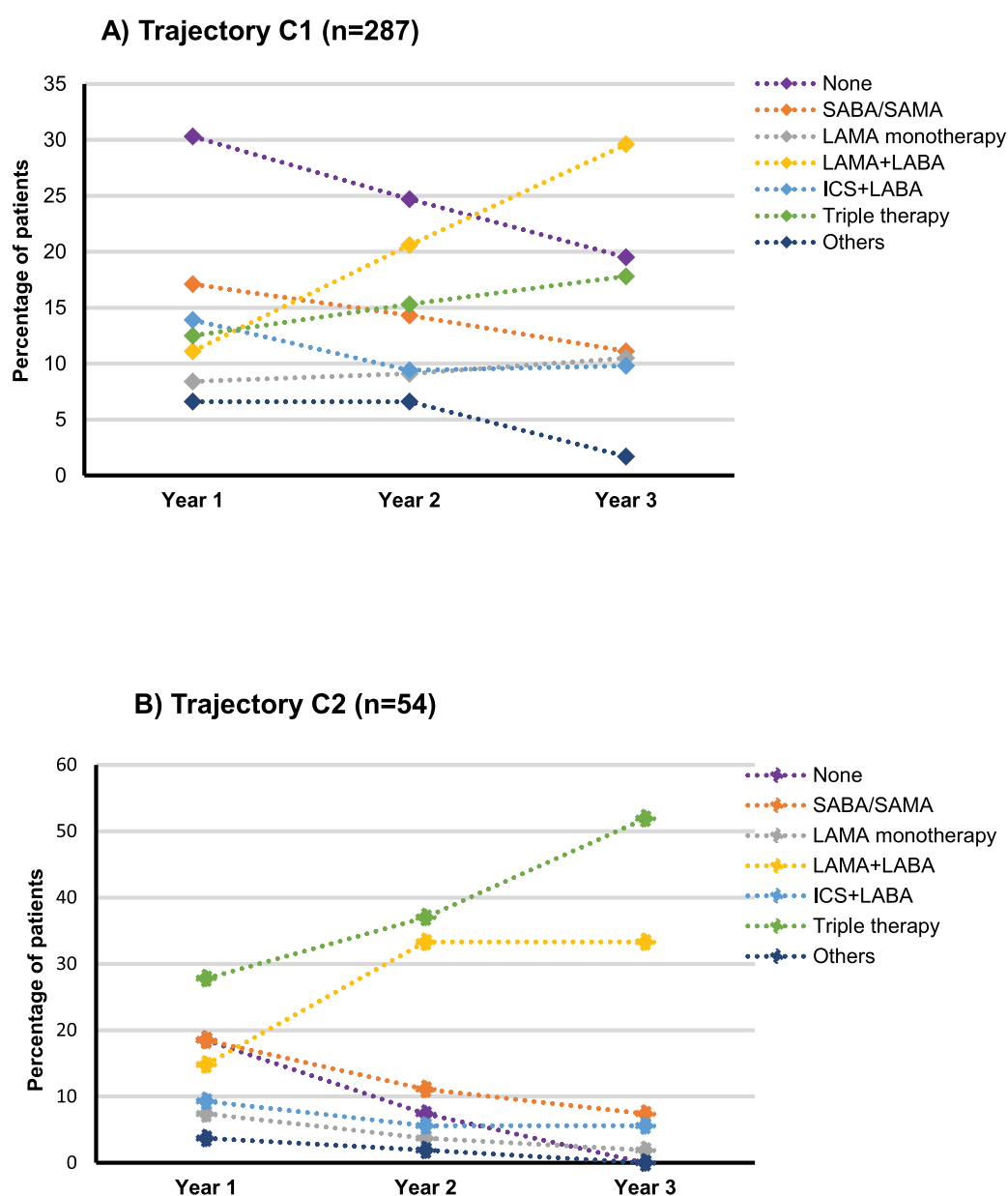
Supplemental figure S2 Patient disposition. CGH, Changi General Hospital; COPD, chronic obstructive pulmonary disease; ED, emergency department.

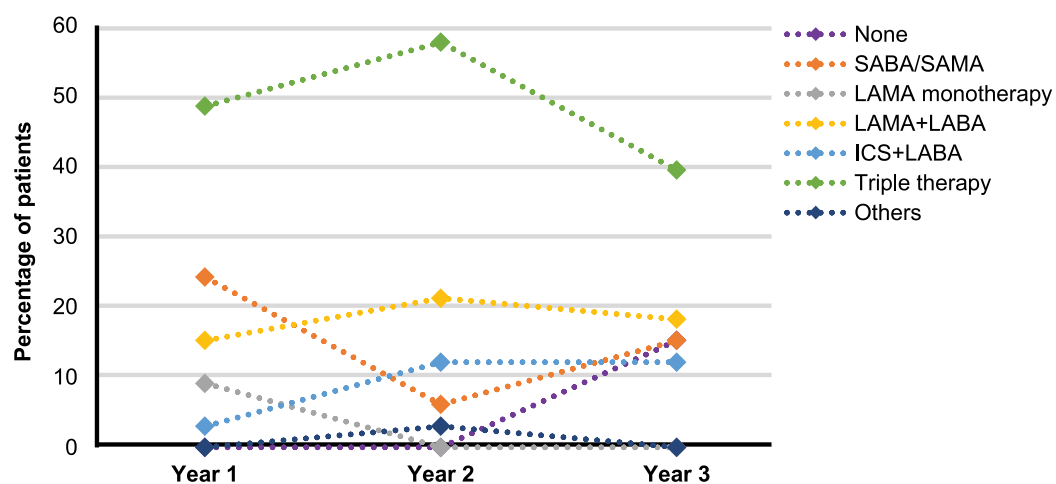


Supplemental figure S3 Association between GOLD grade and likely trajectory.
GOLD, Global Initiative for Chronic Obstructive Lung Disease.



Supplemental figure S4 (A–D) Treatment regimen by trajectory for COPD-related hospitalisations/ED visits. ‘Others’ includes ICS monotherapy, ICS with SABA and ICS with LAMA. COPD, chronic obstructive pulmonary disease; ED, emergency department; ICS, inhaled corticosteroid; LABA, long-acting β_2 -agonist; LAMA, long-acting muscarinic antagonist; SABA, short-acting β_2 -agonist; SAMA, short-acting muscarinic antagonist.



C) Trajectory C3 (n=33)**D) Trajectory C4 (n=20)**