Population Health Analyses to understand cost drivers in Cwm Taf Morgannwg (CTM) University Health Board

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- 1999 - MBBS degree University of Lagos, Nigeria
- 2000-2003 - General and Infectious Diseases Medicine, largest Health Maintenance Organisation in West Africa
- 2004 – MSc Tropical Medicine & International Health, LSHTM
- 2005 – Commenced Public Health Specialist Training, Oxford
- 2006 – MPH Global Health, University of Oxford
- 2009 – Appointed NHS Consultant, Berkshire PCT
- 2011 – PhD Public Health & Epidemiology, Oxford University
- 2012 – Deputy Director of Public Health, Bristol City Council
- 2014 – Director of Public Health, Plymouth City Council
- 2015 – Hon Professorship in Public Health, Plymouth University
- 2016 – Executive Director of Public Health, Caldicott Guardian and Exec Lead for Research & Development and Innovation
- 2018 – Independent Member, Board of Governors, Cardiff Met
- 2021 - Hon Professorship in Public Health, Plymouth University

Introduction

- Between 2001 and 2011, an increase in NHS resources to deprived areas in England accounted for a reduction in the gap between deprived and affluent areas in:

  - male mortality amenable to healthcare of 35 deaths per 100 000 population, and

  - female mortality of 16 deaths per 100 000.

- Effective resource allocation requires good understanding of cost drivers

- Exploring the drivers of healthcare costs more widely was a key recommendation of Welsh Government's Resource Allocation Review programme

- At a local/regional level, Cwm Taf Morgannwg has been using population health analytics in our Population Health Management programme to understand these drivers
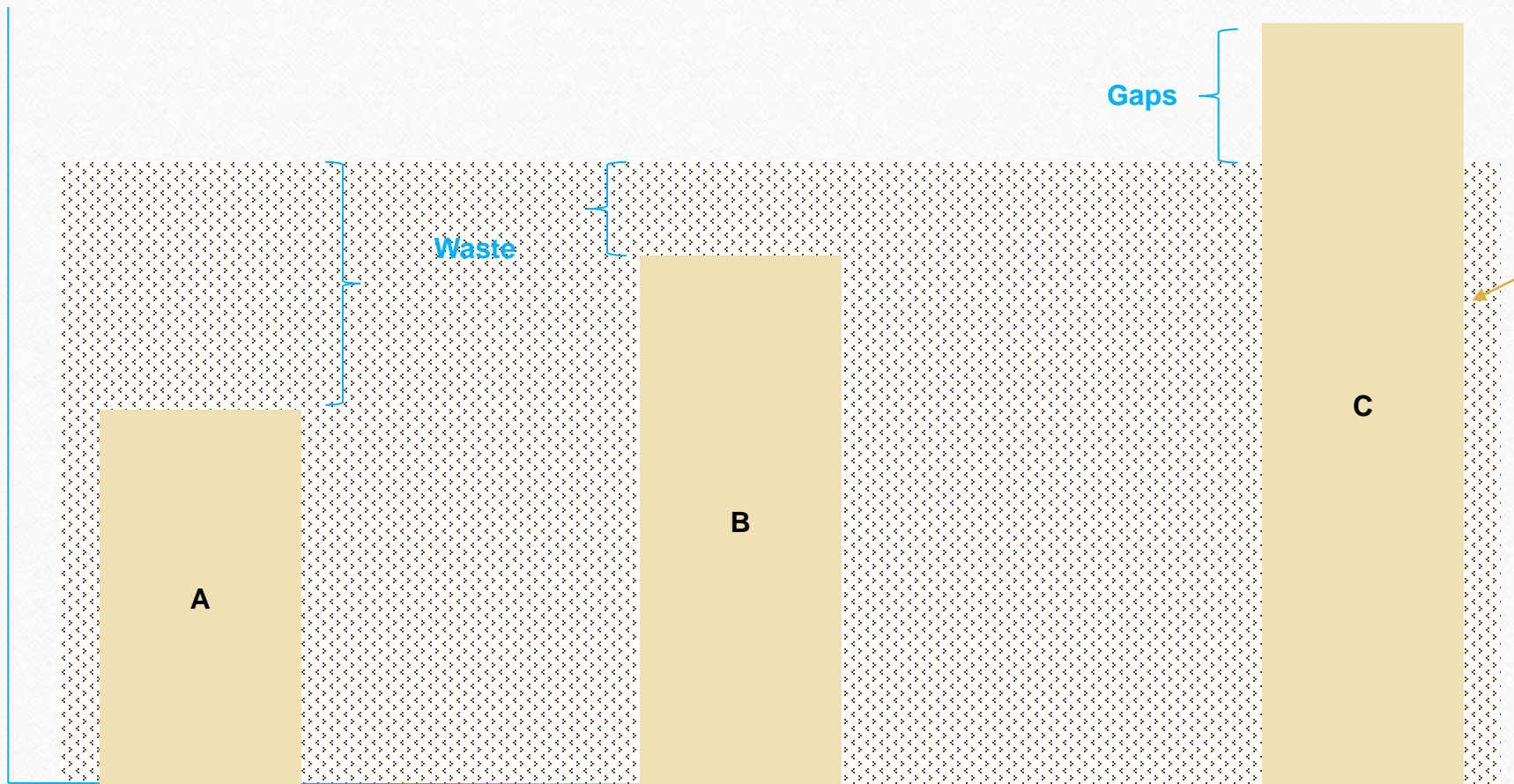
........with Population Health Management
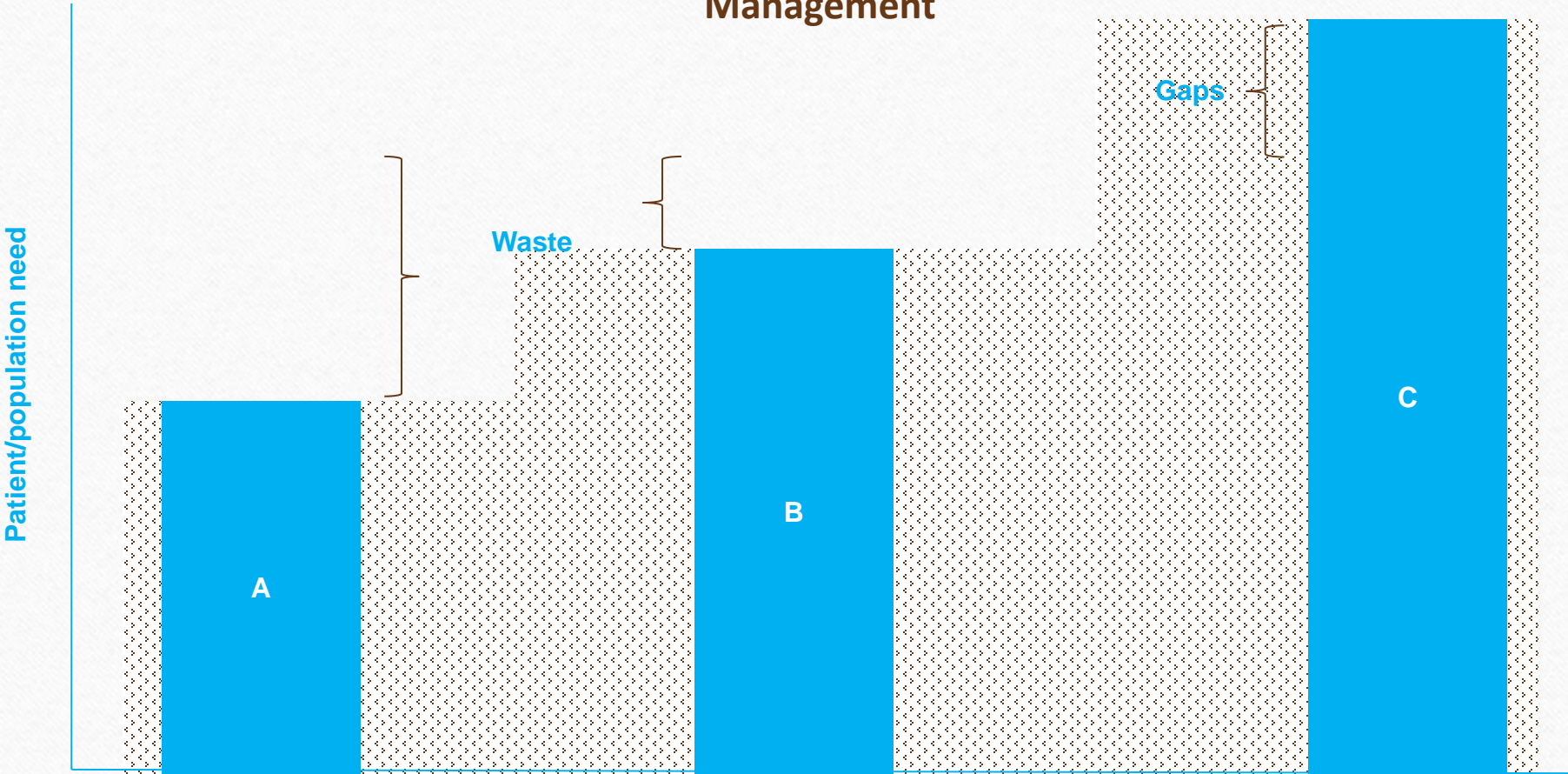
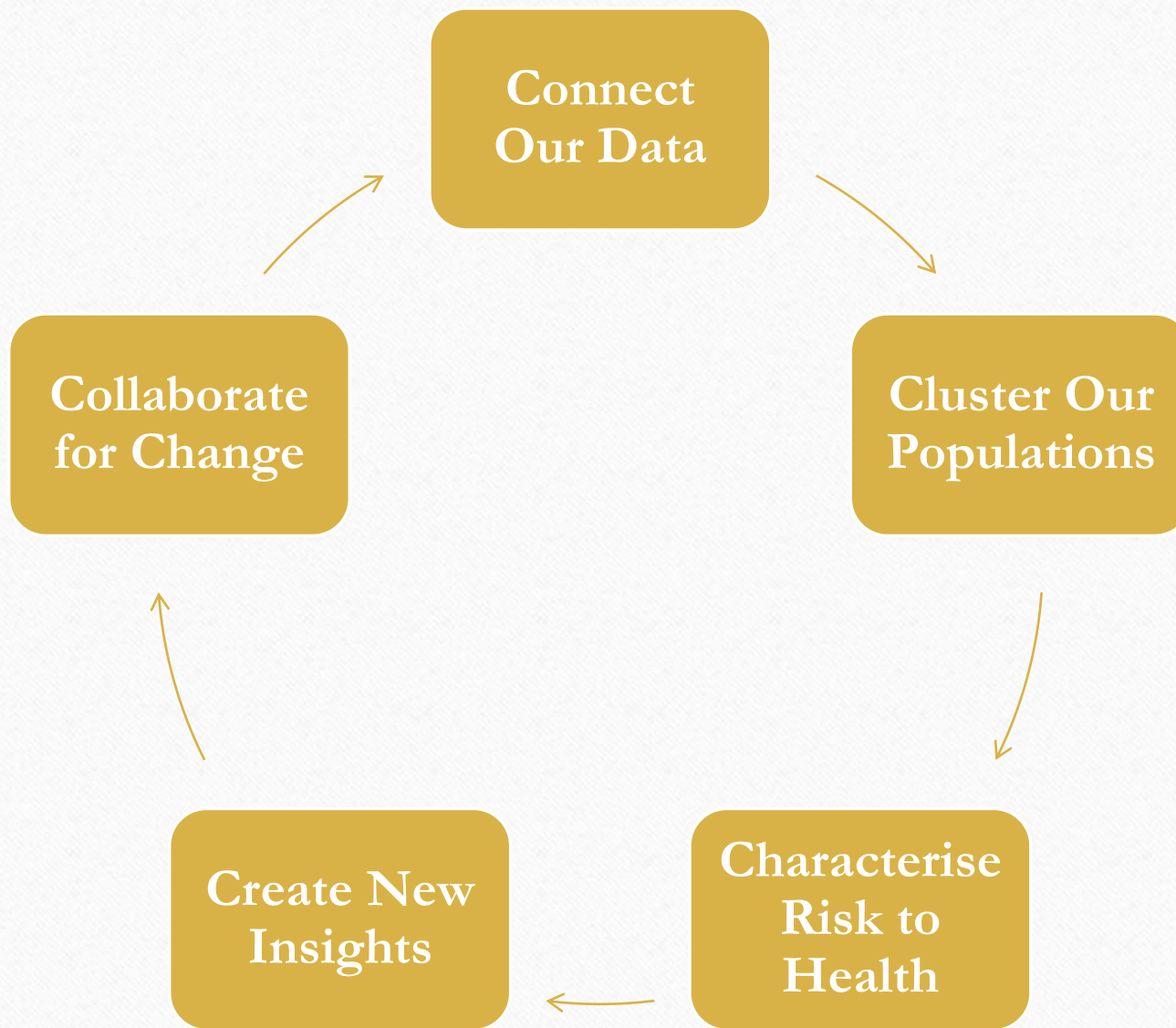5Cs model of Population Health Management in Cwm Taf Morgannwg

- Connect Our Data
- Cluster Our Populations
- Characterise Risk to Health
- Create New Insights
- Collaborate for Change
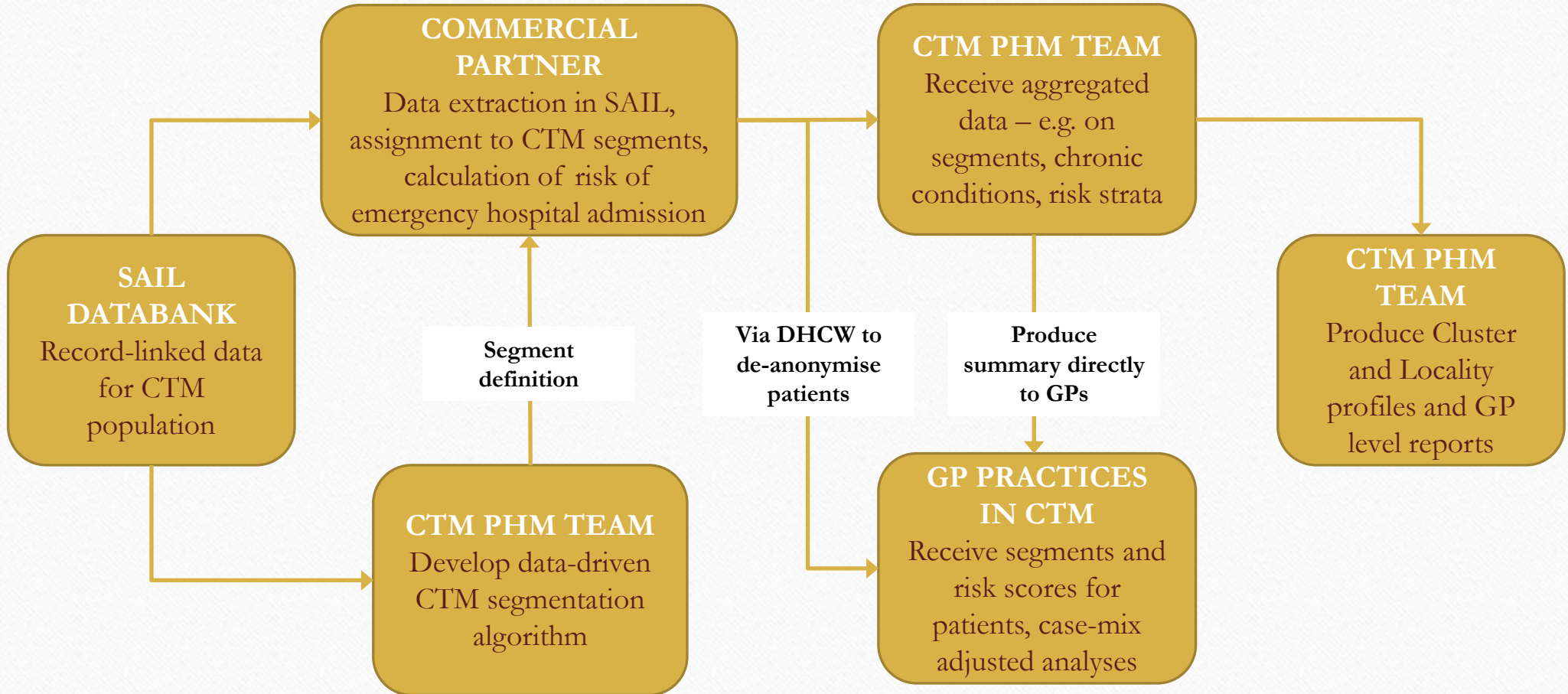
CTM's population health profile

Increasing health care utilisation and comorbidities

| Low need, no chronic conditions | Low need, primary care only, single condition, | Some need, primary care only, multiple conditions | Moderate need in one or more settings, few chronic conditions | High need in some settings | Highest need in most settings |

1 — Very low use; no chronic condition; younger

2 — Low use, average primary care; younger

3 — Managing single chronic condition in primary care; low use

4 — Managing multiple chronic conditions in primary care; older

5 — Higher A&E only, no chronic conditions; mostly young

6 — Raised GP; higher prescription; some outpatients; 1 chronic condition; older

7 — Higher GP, prescription, A&E; some outpatients; around 2 chronic conditions

8 — High emergency care; raised GP ,prescriptions; higher outpatients, few chronic conditions; young

9 — Highest need in most settings, not acute, oldest

10 — Highest need in most settings including acute; oldest

Demographic overview of CTM data-driven segments, 2021

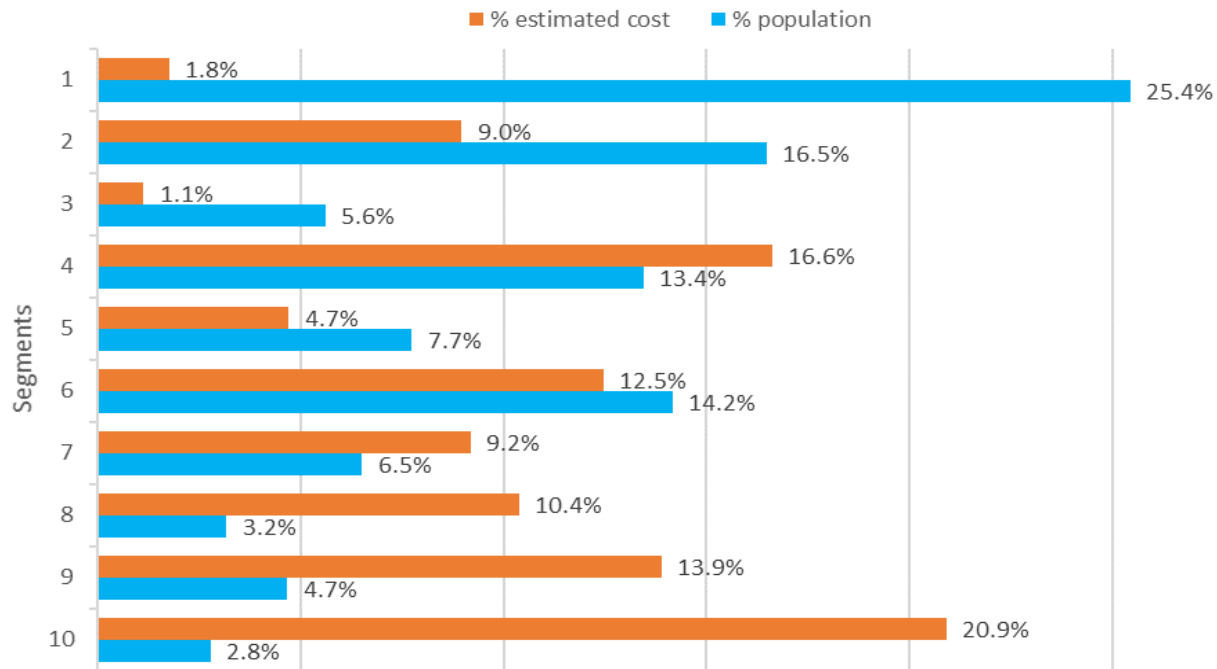|	1	2	3	4	5	6	7	8	9	10
Demographics										
N	108,696	70,458	23,971	57,450	33,074	60,481	27,794	13,505	19,957	11,859
Proportion of CTM population	25.4%	16.5%	5.6%	13.4%	7.7%	14.2%	6.5%	3.2%	4.7%	2.8%
Average age	30.1	34.4	43.9	62.2	25.8	49.3	47.2	30.1	67.8	66.6
% Female	39.6%	58.1%	40.2%	55.1%	44.2%	57.3%	55.4%	48.3%	58.6%	54.8%
% in 40% most deprived	53.5%	54.6%	52.5%	58.2%	59.5%	55.5%	60.4%	60.4%	58.6%	63.6%

Note: Segments based on health care utilisation and comorbidities; using primary care data from Jan - Nov 2021, secondary care data from Nov 2020-Nov 2021 and Chronic conditions prevalence since 2001. Colouring is based on intervals within the range of values to highlight variation. Based on 45 of 49 CTM practices.

Average number and prevalence of selected chronic conditions by CTM data-driven segments, November 2021

	1	2	3	4	5	6	7	8	9	10
Average number of:										
Chronic conditions	0.09	0.48	1.13	3.37	0.29	1.67	2.23	0.88	5.08	4.82
Prevalence (%):										
Asthma	0.0%	0.5%	31.3%	26.6%	0.4%	21.4%	28.8%	7.4%	29.4%	25.4%
Anxiety/Depression	0.3%	2.0%	32.8%	43.9%	1.2%	35.1%	45.8%	12.1%	47.3%	43.0%
CHD	0.0%	0.0%	0.7%	8.9%	0.0%	1.2%	3.1%	0.6%	20.4%	18.8%
COPD	0.0%	0.0%	0.7%	8.1%	0.0%	1.3%	2.9%	0.8%	15.4%	16.1%
Dementia	0.0%	0.2%	0.2%	2.7%	0.1%	0.8%	1.9%	1.0%	6.5%	10.1%
Diabetes	0.0%	0.0%	2.2%	24.4%	0.0%	3.6%	7.9%	1.8%	36.1%	30.9%
Heart failure	0.0%	0.0%	0.1%	2.3%	0.0%	0.2%	0.6%	0.2%	8.1%	9.3%
Hypertension	0.0%	0.1%	14.2%	55.0%	0.0%	17.7%	21.5%	4.7%	64.4%	57.0%
Mental illness	0.0%	0.0%	0.6%	3.1%	0.0%	0.7%	1.9%	0.5%	3.9%	4.7%

Health care utilisation by CTM segments, 2021

Average number of:	1	2	3	4	5	6	7	8	9	10
GP practice contacts	0.48	4.76	1.79	10.96	3.60	7.78	10.52	7.80	19.95	21.65
Prescriptions	0.31	2.86	1.04	7.70	2.07	4.67	6.53	4.85	13.58	15.34
Outpatients first	0.03	0.29	0.03	0.11	0.41	0.34	0.64	0.80	1.70	1.54
Outpatients follow-up	0.12	0.60	0.20	0.82	0.62	0.81	1.23	2.10	3.06	3.93
Emergency admissions	0.00	0.02	0.00	0.01	0.00	0.01	0.00	1.40	0.04	1.54
Elective admissions	0.01	0.06	0.02	0.08	0.05	0.12	0.15	0.28	0.73	0.75
A&E attendances	0.00	0.00	0.01	0.01	1.39	0.00	1.52	1.73	0.24	2.30

Note: Segments based on health care utilisation and comorbidities; using primary care data from Jan - Nov 2021, secondary care data from Nov 2020-Nov 2021.
GP practice contacts have been estimated from read codes likely to indicate contact. Colouring is based on intervals within the range of values to highlight variation. Based on 45 of 49 CTM practices.

Understanding cost drivers

CTM segments: cost and population share

**Percentage of estimated cost and population by segment, CTM UHB, 2021**

Legend: ■ % estimated cost ■ % population

Segment	% estimated cost	% population
1	1.8%	25.4%
2	9.0%	16.5%
3	1.1%	5.6%
4	16.6%	13.4%
5	4.7%	7.7%
6	12.5%	14.2%
7	9.2%	6.5%
8	10.4%	3.2%
9	13.9%	4.7%
10	20.9%	2.8%

Notes: Cost estimated using record-linked secondary care data (HRG), estimated GP practice contacts and prescriptions with English estimates, 45 out of 49 GP practices included. CTM segments developed using healthcare utilisation and comorbidities: 1 (low need) to 10 (highest need)

- Highest need population segment makes up 3% of our population but was responsible for 21% of healthcare costs consumed in the year

- On the other hand, 25% of the population are in lowest need segment and accounted for only <2% of the total healthcare cost for CTM
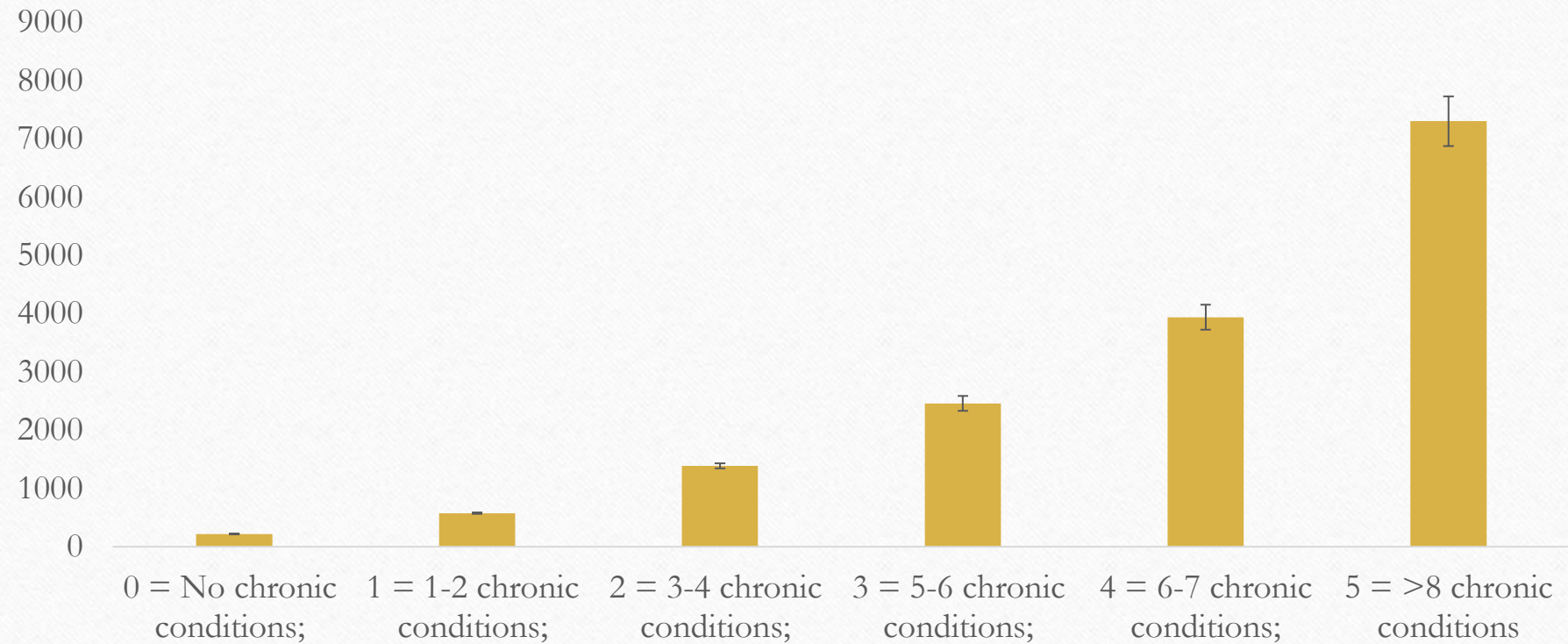
Average Total Cost of Healthcare (£) by Age Group, Cwm Taf Morgannwg
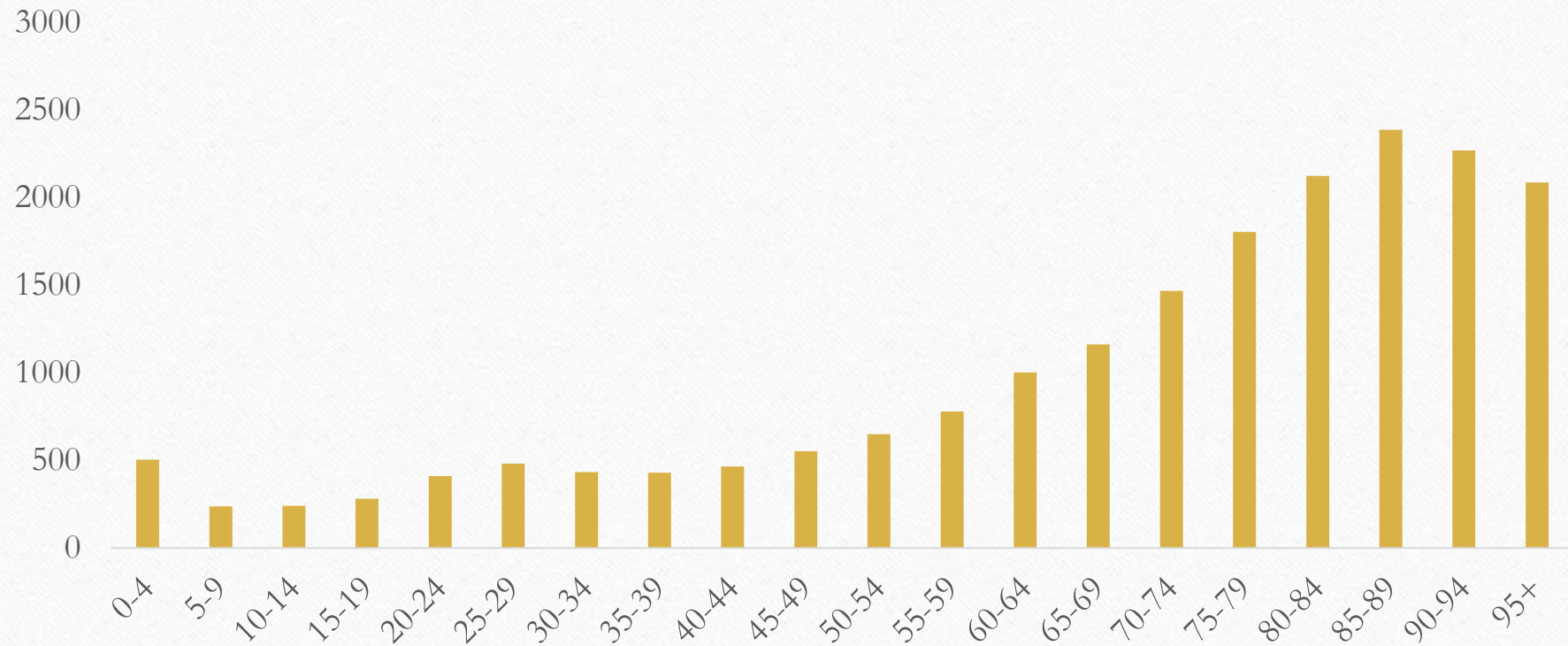
Average Total Cost of Healthcare (£) by setting & Age Group, Cwm Taf Morgannwg
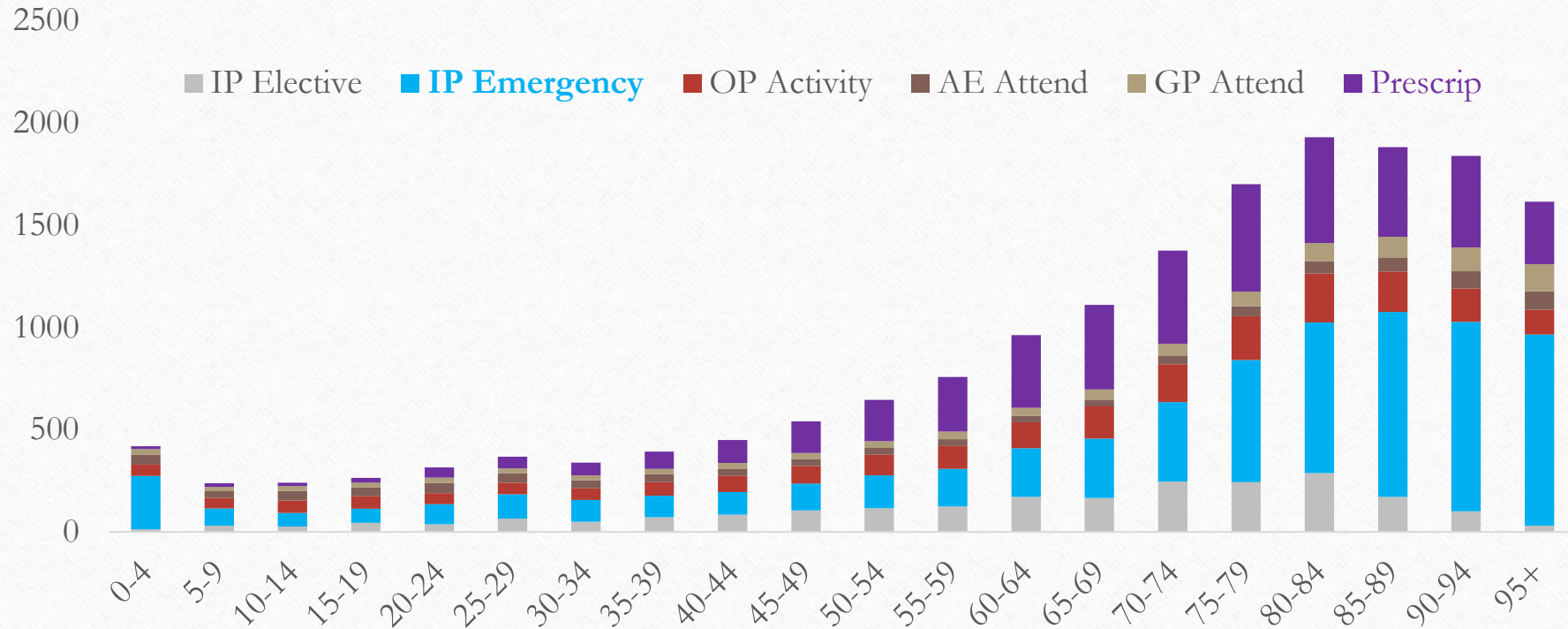
Average Total Healthcare Cost (£) by number of Chronic Conditions, Cwm Taf Morgannwg

So what's the driver – age or multiple chronic conditions?

- Mutually exclusive segments were created based on number of chronic conditions and age.
- The group number combination corresponds to the number of chronic conditions and the patient's age group.

- 0 = No chronic conditions;
- 1 = 1-2 chronic conditions;
- 2 = 3-4 chronic conditions;
- 3 = 5-6 chronic conditions;
- 4 = 6-7 chronic conditions;
- 5 = >8 chronic conditions

- 1 = 0-4
- 2 = 5-9
- 3 = 10-14
- 4 = 15-19
- 5 = 20-24
- 6 = 25-29
- 7 = 30-34
- 8 = 35-39
- 9 = 40-44
- 10 = 45-49

- 11 = 50-54
- 12 = 55-59
- 13 = 60-64
- 14 = 65-69
- 15 = 70-74
- 16 = 75-79
- 17 = 80-84
- 18 = 85-89
- 19 = 90-94
- 20 = >95

Average total healthcare cost by degree of Multiple Chronic Conditions and Age categories
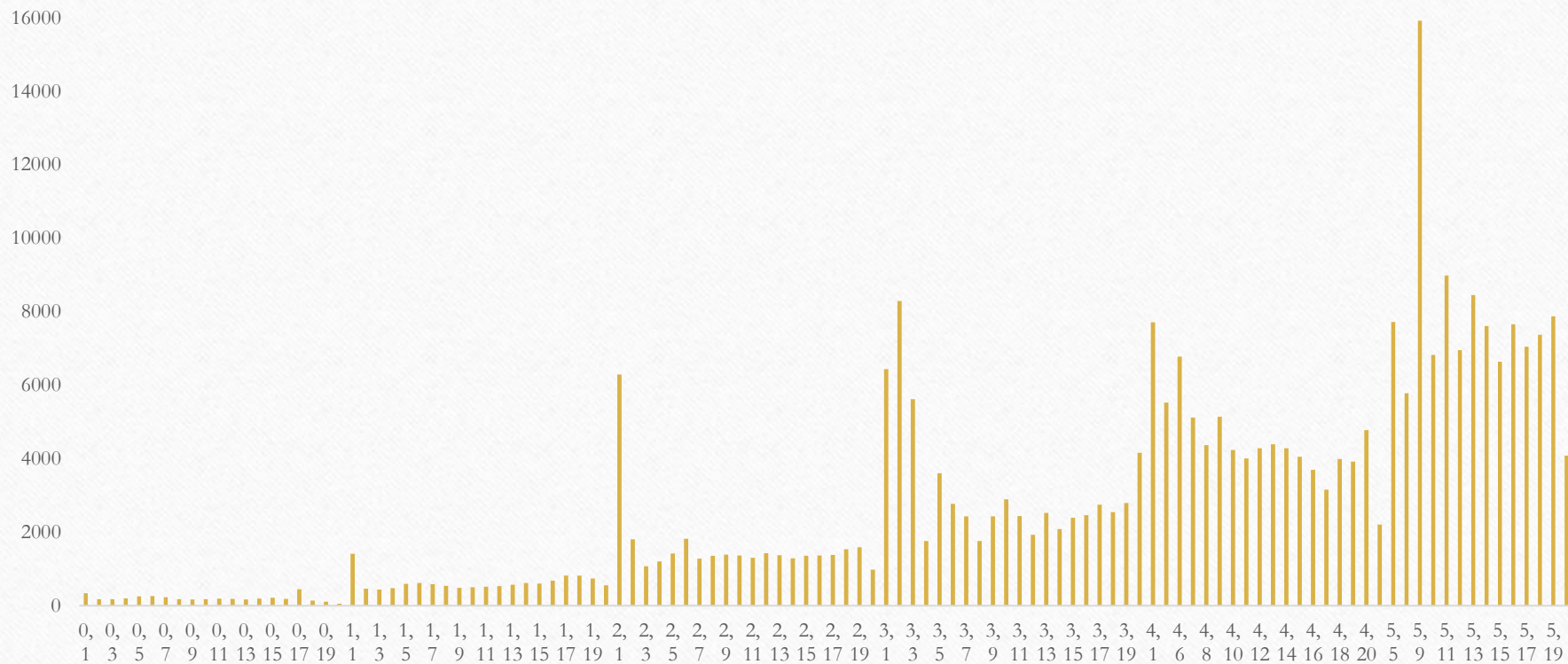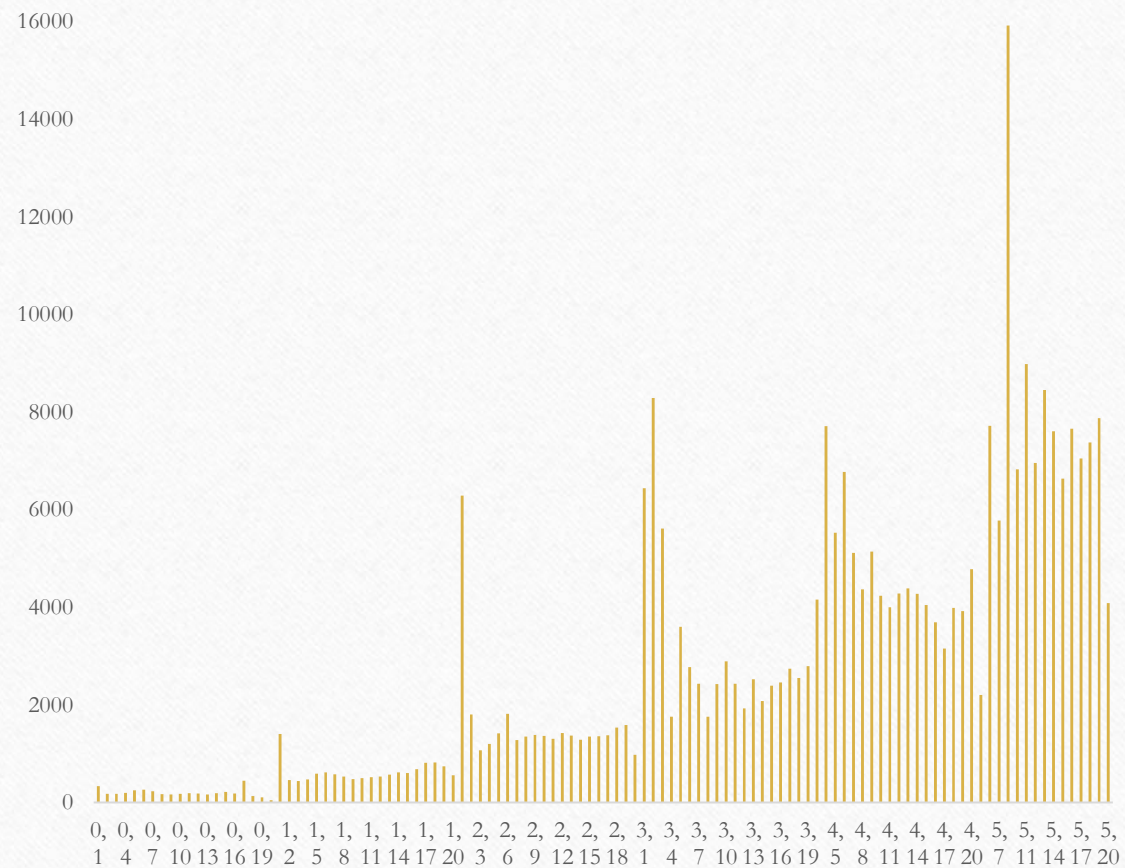
It's both

- The general trend of this graph suggests that average total healthcare cost rise with both age and multiple morbidity

- Therefore, both multimorbidity and rising age drive healthcare costs


Average total healthcare cost by Multiple Chronic Conditions and Age categories

…but it's more about multiple morbidity than it is age…

- Consider 1, 19 vs. 4, 6 (red arrows)
- 1, 19 = 90-94 years old with only 1-2 chronic conditions
  - **Average cost - £742**
- 4, 6 = 25-29 yr olds with 7-8 chronic conditions
  - **Average cost - £6,774**

Average total healthcare cost by Multiple Chronic Conditions and Age categories
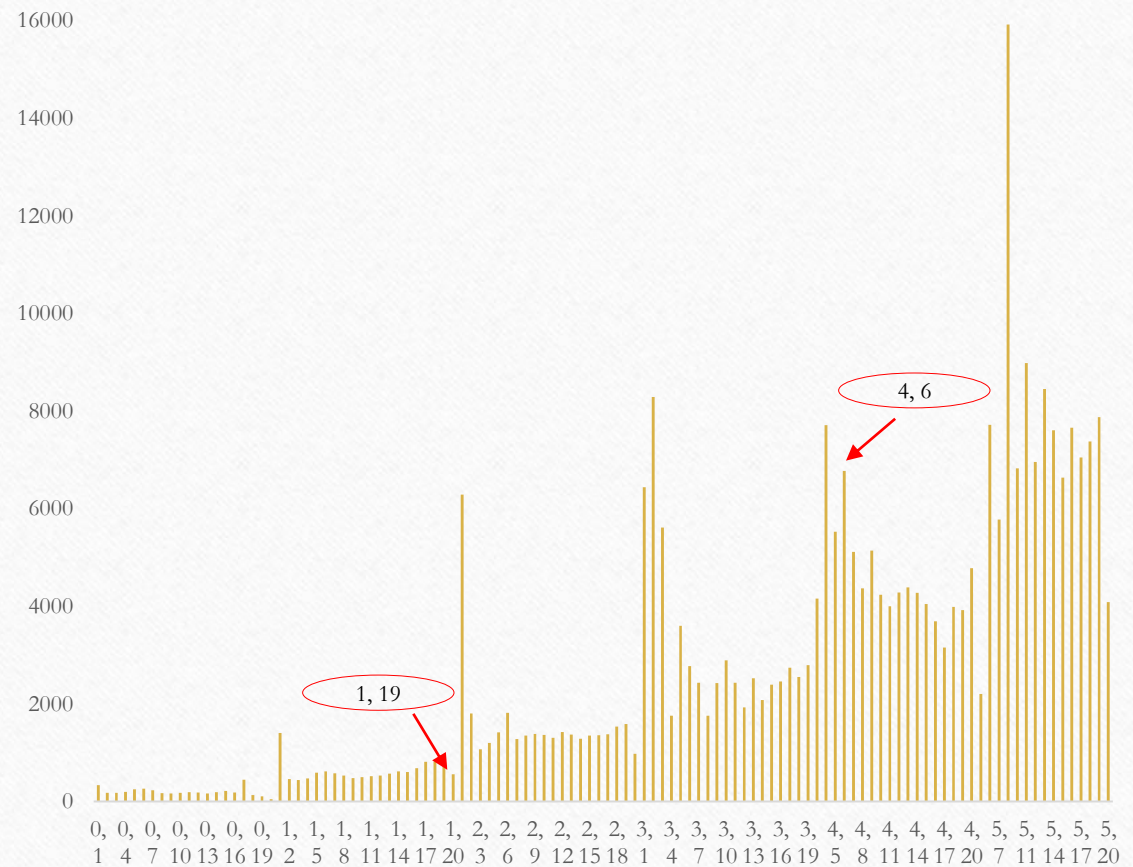
. regress totalcost age

Source	SS	df	MS			
Model	1.6725e+10	1	1.6725e+10			
Residual	2.9662e+11	81,284	3649183.94			
Total	3.1335e+11	81,285	3854898.36			

Number of obs = 81,286
F(1, 81284) = 4583.26
Prob > F = 0.0000
R-squared = 0.0534
Adj R-squared = 0.0534
Root MSE = 1910.3

totalcost	Coef.	Std. Err.	t	P>|t|	[95% Conf. Interval]	
age	19.04965	.2813844	67.70	0.000	18.49814	19.60116
_cons	-55.97734	13.49324	-4.15	0.000	-82.42401	-29.53068

. regress totalcost WIMDQ

Source	SS	df	MS			
Model	6394226.45	1	6394226.45			
Residual	3.1334e+11	81,284	3854867.12			
Total	3.1335e+11	81,285	3854898.36			

Number of obs = 81,286
F(1, 81284) = 1.66
Prob > F = 0.1978
R-squared = 0.0000
Adj R-squared = 0.0000
Root MSE = 1963.4

totalcost	Coef.	Std. Err.	t	P>|t|	[95% Conf. Interval]	
WIMDQ	-10.22938	7.942548	-1.29	0.198	-25.79672	5.337964
_cons	765.979	23.58105	32.48	0.000	719.7603	812.1977

. regress totalcost chronicconditioncount

Source	SS	df	MS			
Model	8.2516e+10	1	8.2516e+10			
Residual	2.3083e+11	81,284	2839786.09			
Total	3.1335e+11	81,285	3854898.36			

Number of obs = 81,286
F(1, 81284) = 29057.20
Prob > F = 0.0000
R-squared = 0.2633
Adj R-squared = 0.2633
Root MSE = 1685.2

totalcost	Coef.	Std. Err.	t	P>|t|	[95% Conf. Interval]	
chronicconditioncount	505.8287	2.967403	170.46	0.000	500.0126	511.6448
_cons	37.8663	7.194029	5.26	0.000	23.76605	51.96655

. regress totalcost age gender WIMDQ efi chronicconditioncount

Source	SS	df	MS			
Model	8.3972e+10	5	1.6794e+10			
Residual	2.2937e+11	81,280	2822020.31			
Total	3.1335e+11	81,285	3854898.36			

Number of obs = 81,286
F(5, 81280) = 5951.17
Prob > F = 0.0000
R-squared = 0.2680
Adj R-squared = 0.2679
Root MSE = 1679.9

totalcost	Coef.	Std. Err.	t	P>|t|	[95% Conf. Interval]	
age	-5.927635	.3243264	-18.28	0.000	-6.563313	-5.291958
gender	-80.60321	11.88942	-6.78	0.000	-103.9064	-57.30003
WIMDQ	23.5068	6.811487	3.45	0.001	10.15634	36.85727
efi	-410.2005	117.7029	-3.49	0.000	-640.8974	-179.5036
chronicconditioncount	558.2074	4.721823	118.22	0.000	548.9526	567.4621
_cons	298.0869	28.74473	10.37	0.000	241.7474	354.4264

What individual and combinations of chronic conditions drive costs?

Average Total Healthcare Cost by Specific Chronic Conditions, Cwm Taf Morgannwg
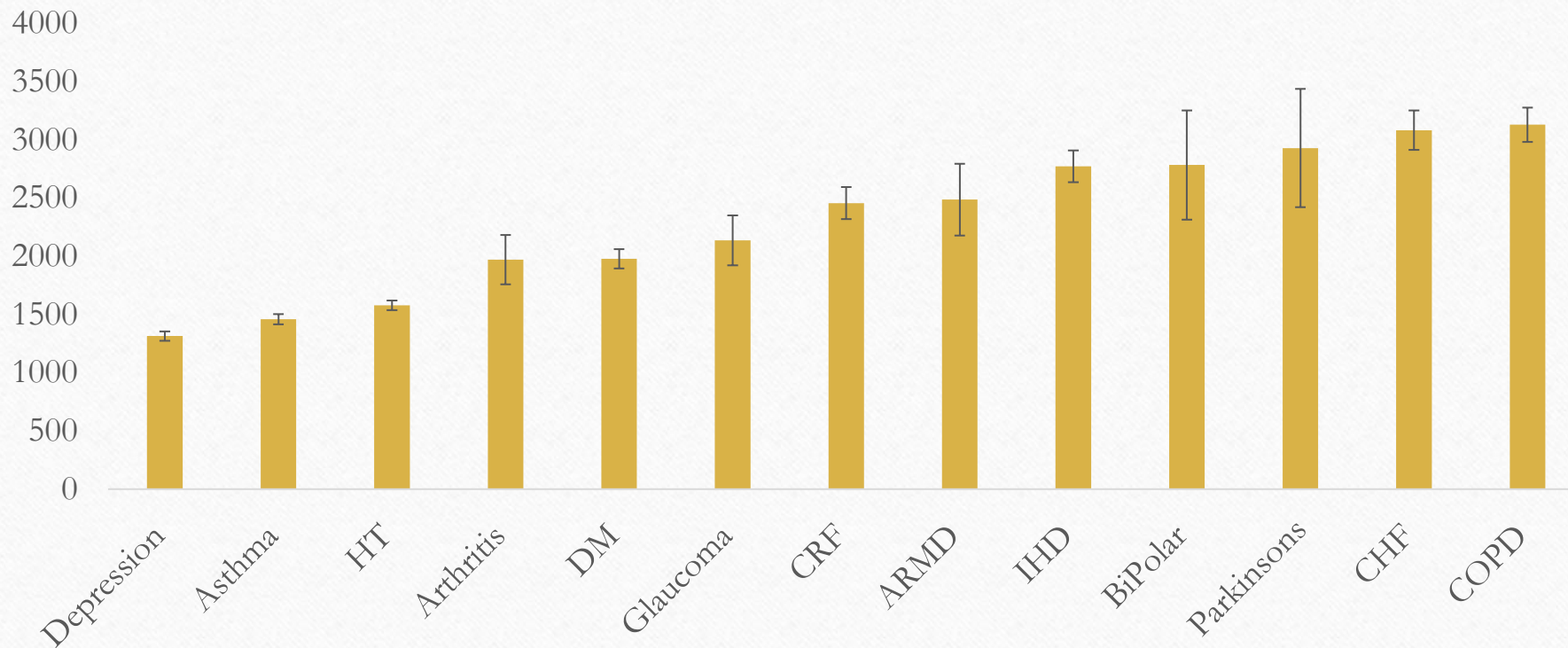
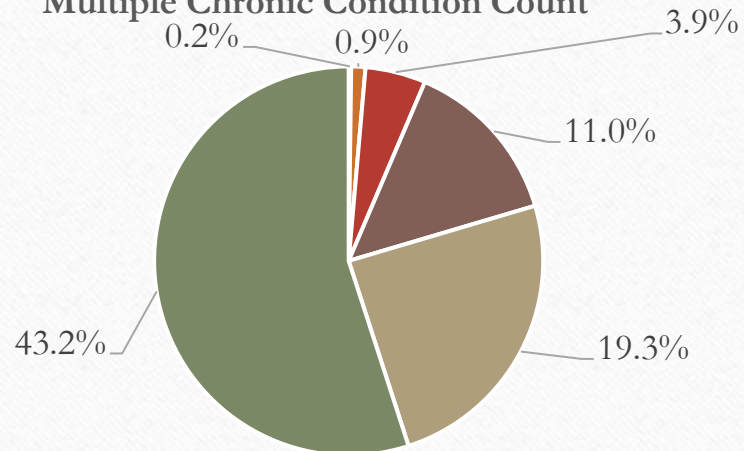Average Total Healthcare cost (£) by Chronic Condition Combinations, Cwm Taf Morgannwg
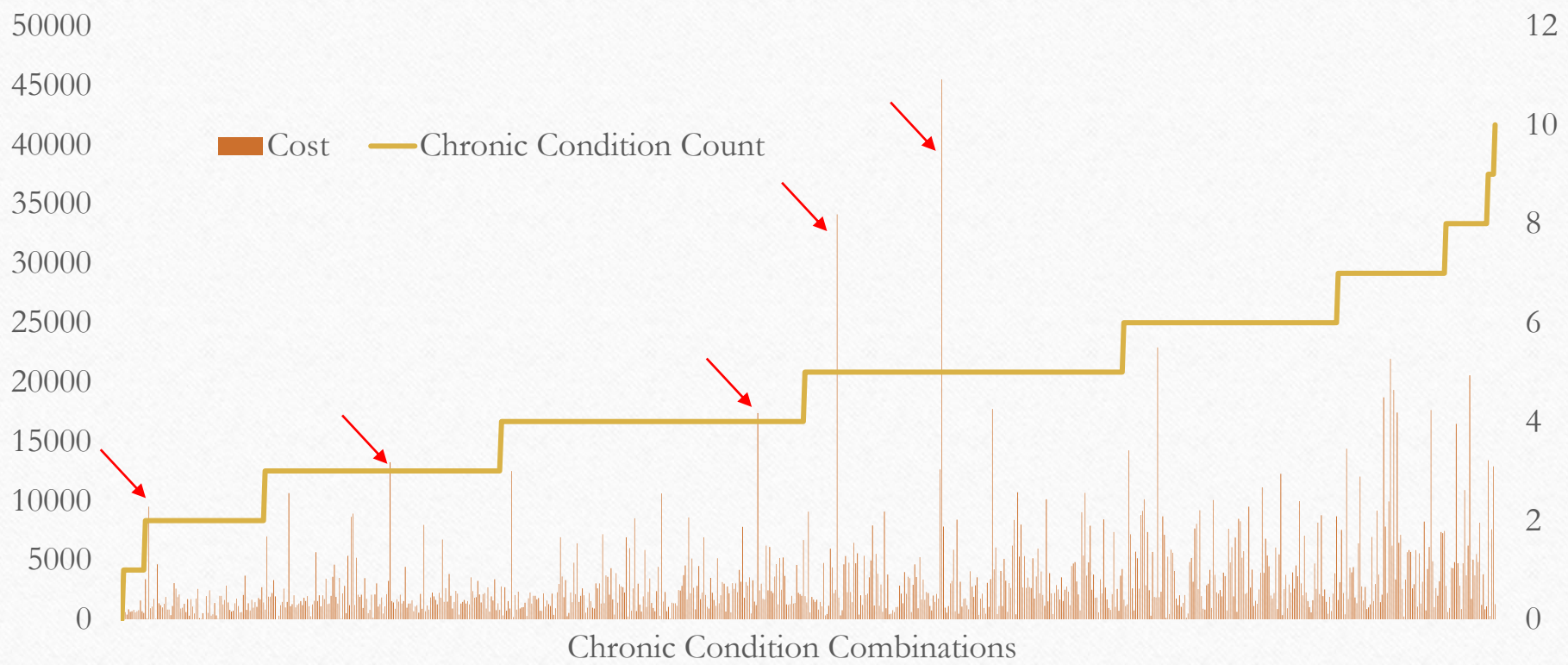
Combinations of chronic conditions accounting for higher-than-average costs

- Bar 1 – 2 Chronic Conditions – Bipolar, Glaucoma

- Bar 2 – 3 Chronic Conditions – CHF, COPD, CRF

- Bar 3 – 4 Chronic Conditions – Asthma, CHF, Hypertension, ARMD

- Bar 4 – 5 Chronic Conditions – CRF, Depression, Hypertension, IHD, Parkinson's

- Bar 5 – 5 Chronic Conditions – Arthritis, COPD, Depression, Diabetes, Hypertension

Combinations of chronic conditions accounting for higher-than-average costs

- Bar 1 – 2 Chronic Conditions – Bipolar, Glaucoma
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- Bar 3 – 4 Chronic Conditions – Asthma, CHF, Hypertension, ARMD
- Bar 4 – 5 Chronic Conditions – CRF, Depression, Hypertension, IHD, Parkinson's
- Bar 5 – 5 Chronic Conditions – Arthritis, COPD, Depression, Diabetes, Hypertension

What about frailty?

Frailty and health care costs

Proportion of patients with a frailty flag by Multiple Chronic Condition Count

0.2% 0.9% 3.9%

11.0%

43.2%

19.3%

- ■ No chronic conditions;
- ■ 1-2 chronic conditions;
- ■ 3-4 chronic conditions;
- ■ 5-6 chronic conditions;
- ■ 6-7 chronic conditions;
- ■ >8 chronic conditions

	Average Total Healthcare cost	Total No.
No Frailty Flag	£643	79,684
Frailty Flag	£5,431	1,602

## To what extent does deprivation drive healthcare costs?

- Deprived populations in Cwm Taf Morgannwg had more long term conditions per person, compared with less deprived populations

- Given that multiple morbidity drives healthcare costs as we've already shown, we should expect to see more deprived populations account for more healthcare spend in Cwm Taf Morgannwg

Mean Chronic Condition Count by Welsh Index of Multiple Deprivation
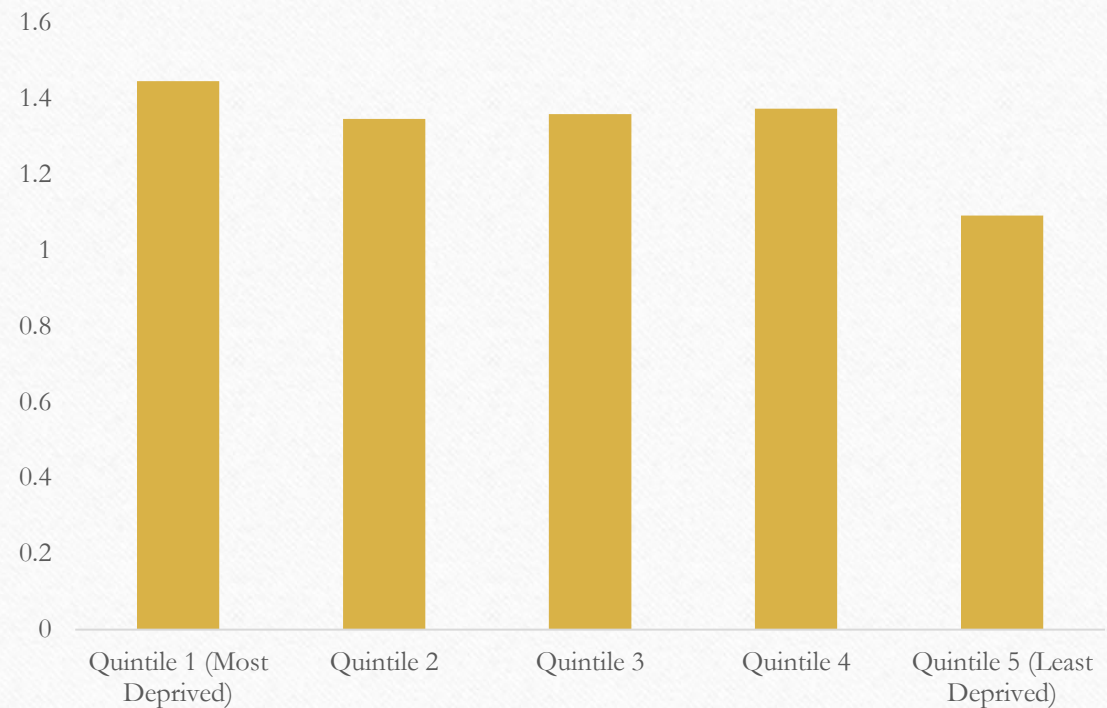
Average Total Healthcare cost (£) by Welsh Index of Multiple Deprivation
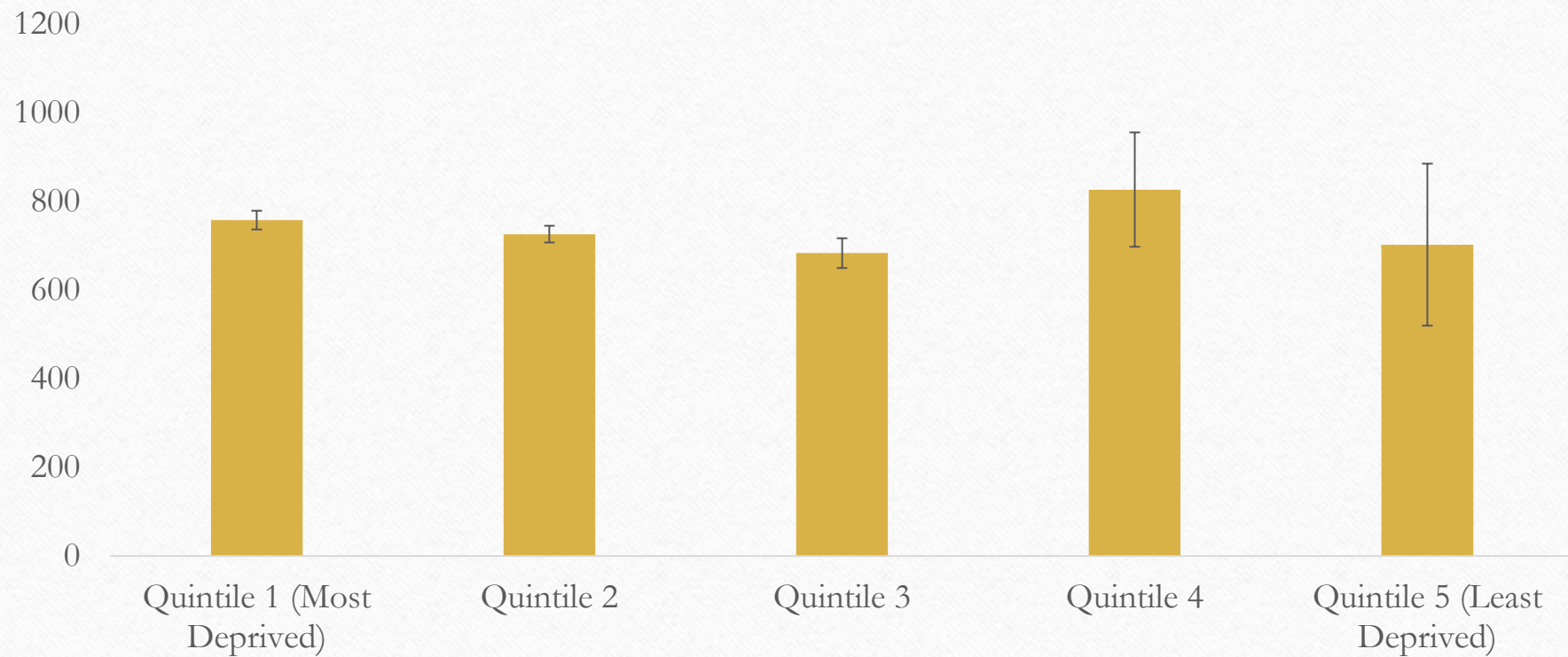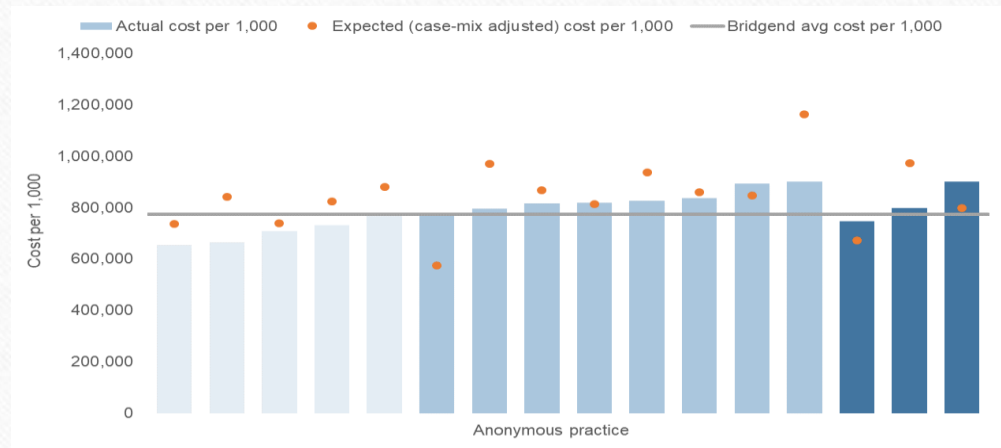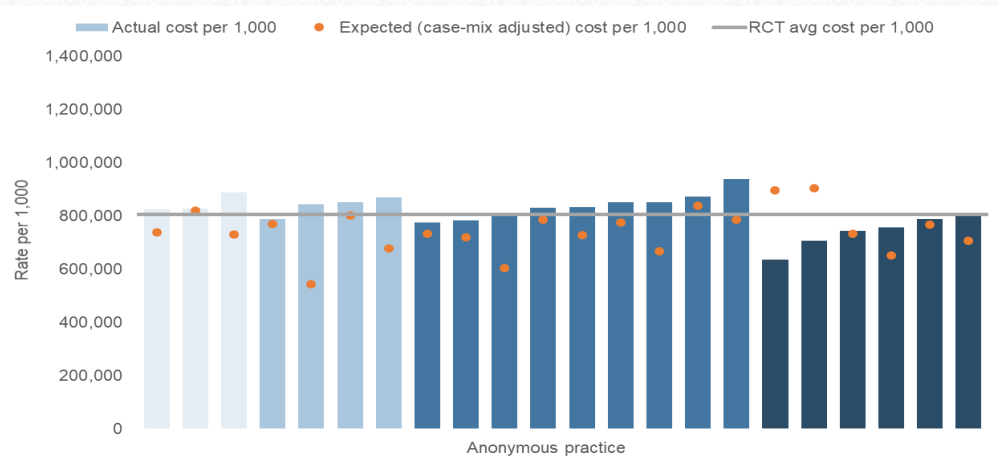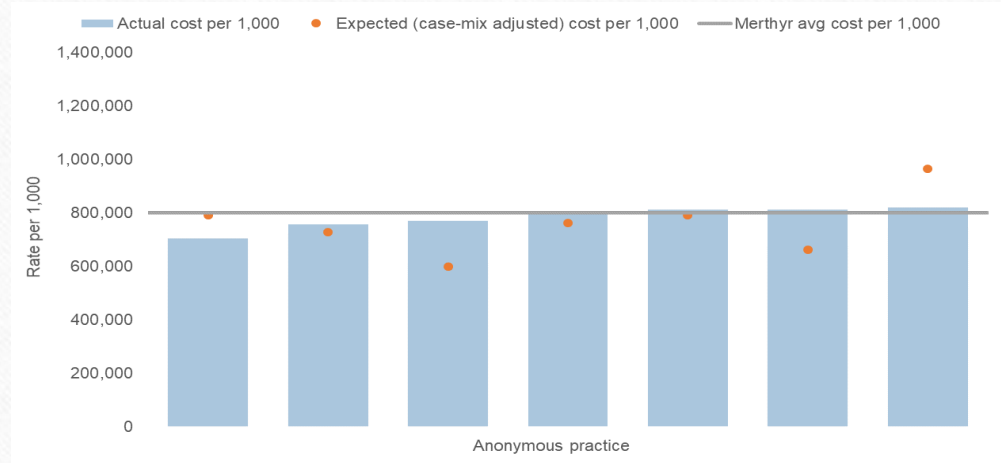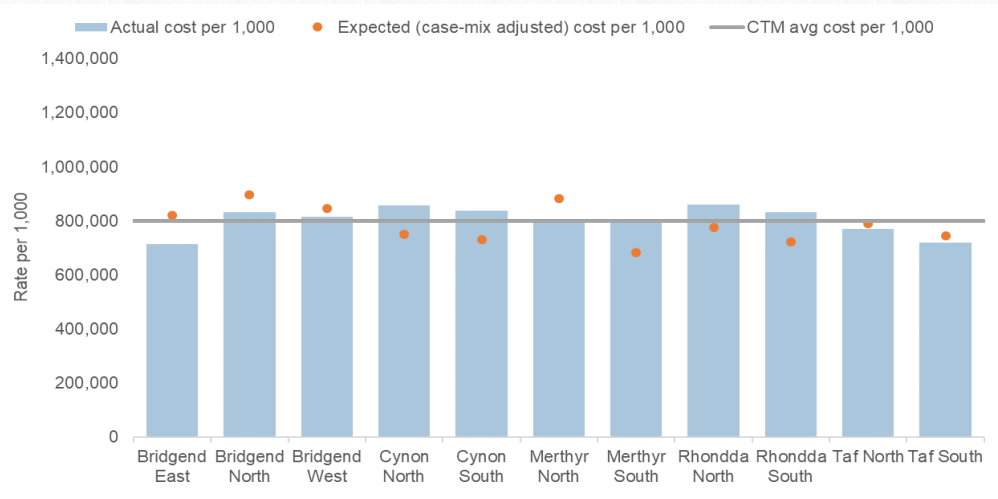
What we've learnt so far in CTM…...

- Our population health data analytics to understand cost drivers has told us that:
  - Multiple chronic conditions are the key cost drivers in our system
    - They mediate high costs through:
      - Prescribing costs – possibly as incurred in disease management
      - Use of urgent and emergency care
  - There are specific chronic conditions which both on their own and in combination are more likely to drive high healthcare costs and chief amongst these are CHF and COPD
  - While deprivation does not appear to be a driver in this analysis, it is possible that this is an artefact of the relatively uniform degree of deprivation in CTM and that an All-Wales analysis could show a stronger impact of deprivation than we've seen here….

Where we want to go with this learning….

- Keep learning and getting more insight

- Collaborate with primary care, planning and commissioning functions of the HB, regional partnerships to change the shape of care for high need, high complexity populations

- Focus on continuous improvement of how we manage multiple chronic (ambulatory care sensitive) conditions in primary care and community

- Target hospital avoidance schemes (both pre- and post-admission encounters) at highest need segments of the population but quickly consider next cadre of need because of scale and dynamic risk

Thank you for your audience