Wirral Long Term Conditions Model 2017.

Wirral Intelligence Service

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Version Number	Date	Author	Reviewer	Actions
0.6	04/09/2017	BC	Sarah Kinsella John Highton Robbie Minshall Rebecca Mellor	Acted on some suggestions, expanded inpatient costs section. Corrected error in asthma prevalence for 2026. Updated all data with new cut of data. Changed cancer projections after feedback from Becky Mellor from cancer group.
1.0	06/10/2017	BC		

1. Summary

This report used a combination of primary care data for Wirral, combined with mortality and population trends and epidemiological estimates from the research literature to estimate the potential burden of a set of long term conditions for the 15 years from 2016-2031. Estimates were produced for diagnosed prevalence, inpatient costs, morbidity-related quality adjusted life years (QALYs) lost and mortality-related QALYs lost for 2016 to give a total burden of QALYs lost for each disease. To our knowledge, this has never been done before.

The results from this model should be used for planning for health and social care services in Wirral. This report may be used in conjunction with the Commissioning for Value LTC pack[1] and with several new models around LTCs such as the "Realising the Value" tool developed by Nesta and the Health Foundation,[2] or the

[1] https://www.england.nhs.uk/rightcare/wp-content/uploads/sites/40/2016/08/cfv-wirral-ltc.pdf
[2] http://www.nesta.org.uk/publications/impact-and-cost-economic-modelling-tool-commissioners

"Long Term Conditions Financial Modelling Tool"[3] developed by SIMUL8, Datalytics, NHSE and Kings Health Partners. These models can be used to look at interventions to improve management of people with long term conditions.

1. Trends in population

The overall population in Wirral is estimated to increase by 3% from 2016-2031 based on data from Office for National Statistics (ONS). In this time, the population of people aged 65 and over is set to increase by around 29% for men and women while the population aged 85 and over is set to increase by 82% for women and 37% for men. This does not take into account housebuilding plans; the maximum scenario in the Wirral Strategic Housing Market Analysis (2016) was around 10% population growth from 2014-2032.

2. Trends in Long Term Conditions

This model included only long term conditions measured on the QOF (Quality and Outcomes Framework, a mechanism for incentivising GPs), so it did not include some common diseases like anxiety, chronic liver disease, or arthritis. Based on this model, the long term condition likely to show the greatest relative increase is dementia, which had a 42% increase from 2016-2031. Atrial fibrillation, heart failure, and chronic kidney disease also had large relative increases of around one third. Hypertension showed the biggest absolute increase (in terms of numbers) of around 7,600 people, a 17% increase. A lot of these diseases have common risk factors like poverty, diet and tobacco so action to improve population health may reduce the incidence of these diseases.

3. Data by age, gender, deprivation quintile

Some LTCs like chronic obstructive pulmonary disease (COPD), diabetes and lifetime depression show a strong gradient by socioeconomic position, with higher prevalence in deprived areas. Other LTCs like lifetime cancer and hypertension show an inverse gradient, with higher prevalence in affluent areas. This may be related to more affluent areas having a higher proportion of older people and people surviving longer after being diagnosed with these diseases.

4. Biggest costs

Long term conditions made up around 20% of inpatient activity and costs in Wirral (using primary diagnosis only), at around £42million in 2015/16. This 'bottom up' micro costing approach is likely to be an underestimate of the true cost which may be as much as 60% of total costs. The modelled costs increased slightly between

[3] https://www.simul8healthcare.com/nhs-england

2016-2031 to around £47milion in 2016 prices. The biggest costs were for cancer (£16m) which is increasing over time, while the next biggest costs were for cardiovascular diseases like CHD (£7m) and stroke (£6m) which were modelled to fall over time. This is most likely to be as risk factors like smoking and diet are improving as well as primary prevention and treatment. It may be useful to think of the extent to which disease costs are planned for in the commissioning process.

5. Biggest morbidity and mortality losses

Mortality related quality adjusted life years (QALYs) lost (aged under 85) and morbidity related QALYs lost (all ages) were both calculated for 2016. Only morbidity related QALYs were projected over time, based on trends in diagnosed prevalence. Mortality-related QALYs were not been projected over time in this version of the model, because the relationship between levels of disease and cause of death can be complex and difficult to model. Overall, of the long term conditions considered, the greatest QALYs lost through early death were from cancer, which was modelled to increase over time. QALYs lost through COPD were also projected to increase. Hypertension, diabetes and chronic kidney disease were the biggest causes of morbidity-related quality of life loss, with depression likely to be a major cause as well (there is uncertainty around actual prevalence of depression, as the data available was for lifetime prevalence only).

6. Most common co-morbidities

The most common co-morbidities were combinations of LTCs with hypertension or asthma. This is not surprising, as these were the most prevalent conditions, and in the case of hypertension, people with other LTCs are likely to have their blood pressure measured more regularly and so will be more likely to be diagnosed with hypertension.

7. Notable exceptions and future work

Further outputs could be developed from this model to answer questions about specific populations, age groups, or socioeconomic groups. There are several chronic or long term conditions not included in this analysis that cause a large burden of disease such as anxiety, chronic liver disease, back and neck pain, osteoarthritis, migraines and anaemia (see Appendix 4). In future, this work could be expanded to include more disease cost estimates beyond inpatient admissions. Future work could look at incidence as well as prevalence, include cohort effects, undiagnosed prevalence and look at risk factors such as smoking and alcohol as well as long term conditions. The model could also potentially be integrated with- or compared to - ongoing work around applying the Global Burden of Disease outputs to Wirral.

2. Rationale

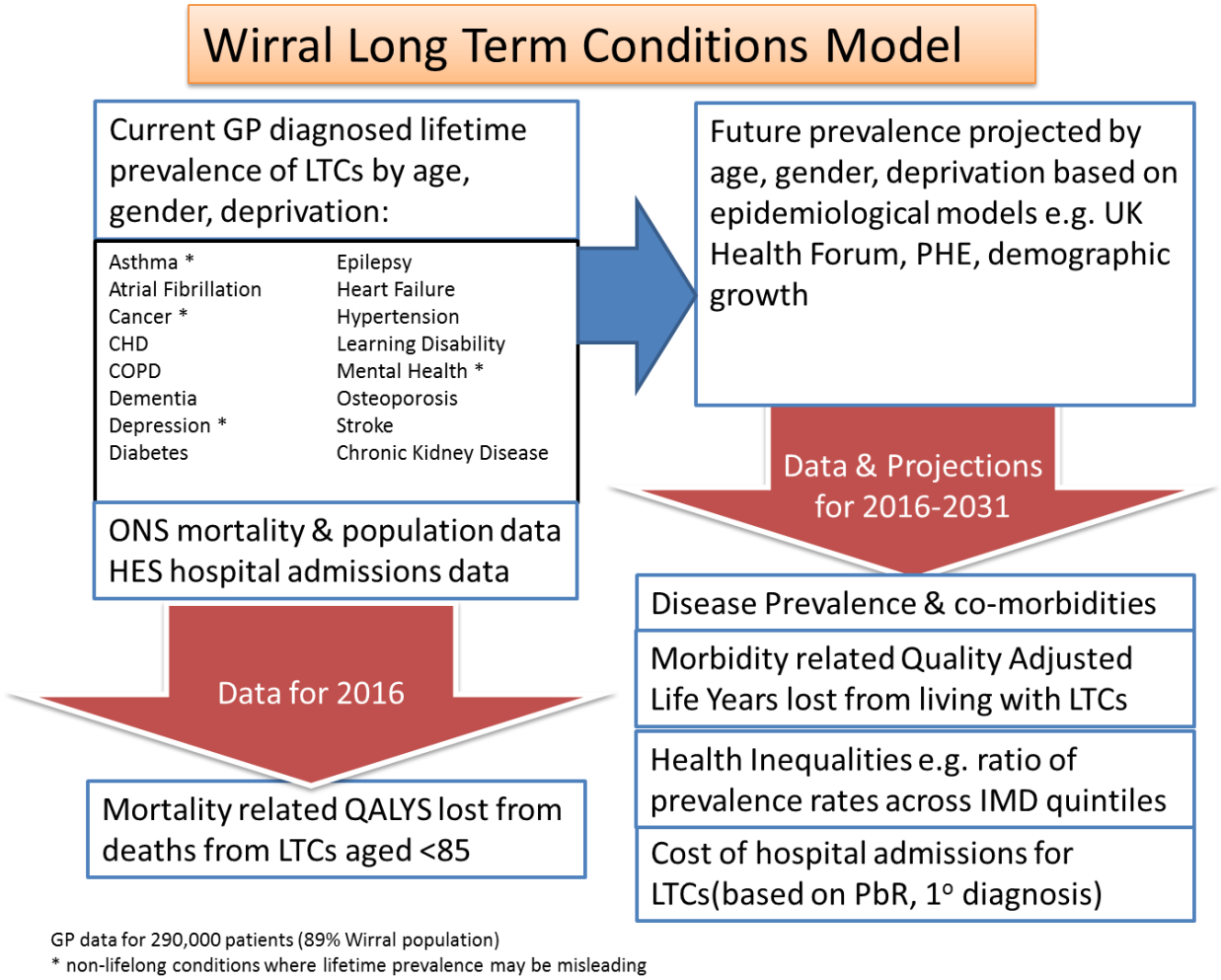
The ambition of this piece of work is to use primary care data to understand more about the Wirral population. Traditionally, public health intelligence is distorted towards the data we have that is well coded; typically hospital inpatient data and mortality data. A lot of NHS modelling uses techniques from finance that do not consider changes in epidemiology or burden of disease. This modelling work aims to use primary care data to add to this intelligence and answer these three questions:

1. What is the current picture in terms of how many QALYs are lost to long term conditions in Wirral; both in terms of people living with disease (morbidity); and people dying prematurely from a disease (mortality)?
2. How is diagnosed prevalence of LTCs likely to change in Wirral, based on demographic growth and epidemiological trends?
3. How will the volume and costs of LTC-related hospital inpatient activity change in Wirral based on demographic growth and epidemiological trends?

3. Methods

Diagnosed long term conditions data was extracted from EMIS General Practice clinical electronic record system for Wirral, covering 89% of the population which is good level of coverage. It may however, be skewed if people with LTCs are more likely to opt out of sharing their data. This data was as of March 2017. Population data was used for 2014-based population projections for 2016, 2021 and 2026 by age group and LSOA from ONS. Mortality data was from ONS for 2012-2016. Figure 1 shows a schematic representation of the model. This model is a cell-based model in Excel with around 28 million data points.

Figure 1. Schematic of Wirral Long Term Conditions Model.



GP data for 290,000 patients (89% Wirral population)
* non-lifelong conditions where lifetime prevalence may be misleading

4. Demographic change estimates

Disease prevalence was multiplied by the ratio of population by 180 clusters of combinations of five year age group (from 0-4 up to 85+), gender, and deprivation quintile for each time period (year 2016, 2021, 2026 and 2031), so for example, if 100 females in IMD quintile 4 aged 35-39 have asthma, then the population for this quintile will grow from 1,790 in 2016 to 1,873 in 2021 which is a ratio of 1.046 which means the model will estimate that there will be around 105 people in this group with asthma in 2021. The Index of Multiple Deprivation (IMD) quintiles for each area were assumed to stay constant; in actual fact some parts of Wirral are becoming less deprived over time in relative terms (the quintiles measured relative to all other areas in England), and certainly in absolute terms (if areas were compared to how deprived they were five or ten years ago). The population estimates are based on trends in demographic change, such as birth and death rates, and population inflows and outflows (e.g. migration) but do not factor in strategic development plans, such as new housing developments.

Overall, the Wirral population is estimated to increase slightly from 321,304 in 2016 to 330,545 in 2031, a 2.8% increase. This increase is higher in the most deprived quintile at around a 5% increase, and lower in the least deprived quintile at around zero %. In the fifteen years from 2016-2031, the population of people aged 65 and over is set to increase by around 29% for men and women (Figure 2) while the population aged 85 and over is set to increase by 82% for women and 37% for men. This may increase the demand for treatment of diseases that affect older people and increase the chance of a large multi-morbid population, that is, people with multiple diseases.

The model uses demographic growth but this does not account for cohort effects, so for instance if there is a cohort of people with asthma moving through the population age bands then the model may not account for this. Demographic growth was applied by 5 year age band (up to 85+), gender, and deprivation quintile to each individual in the model from 2016.

Figure 2. Wirral population aged 65 and over by year, gender and deprivation quintile.

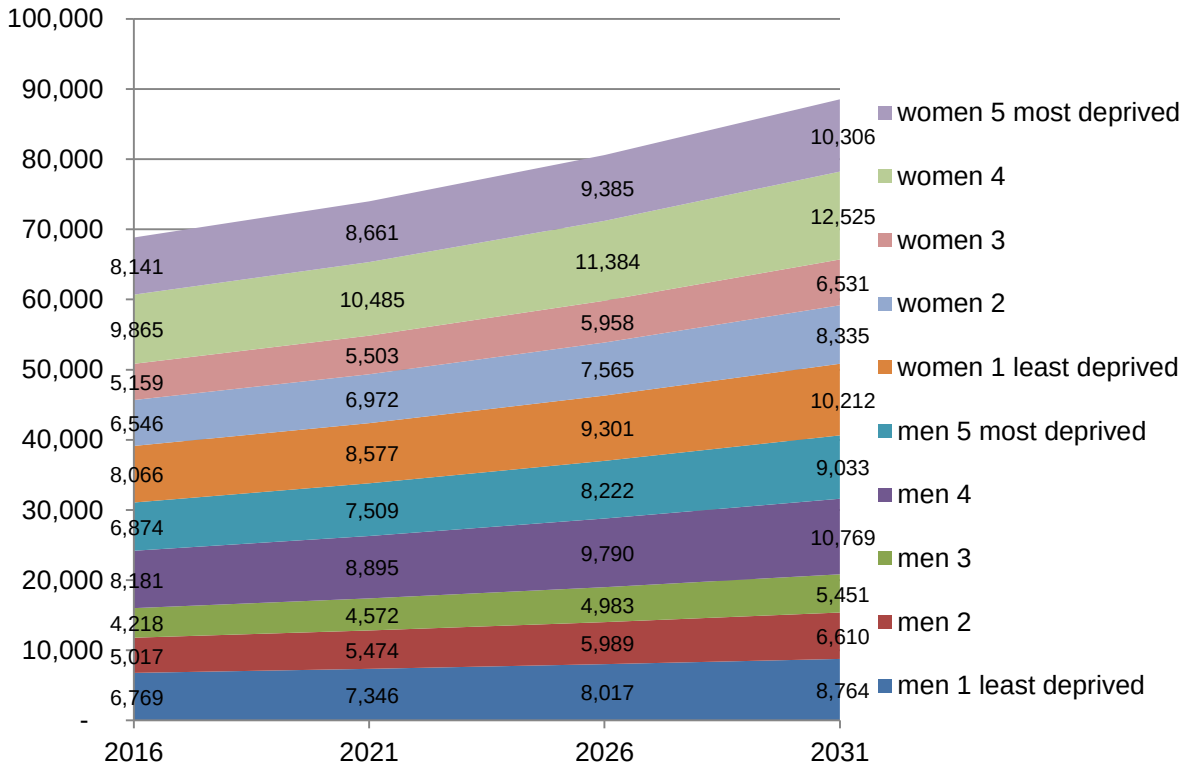
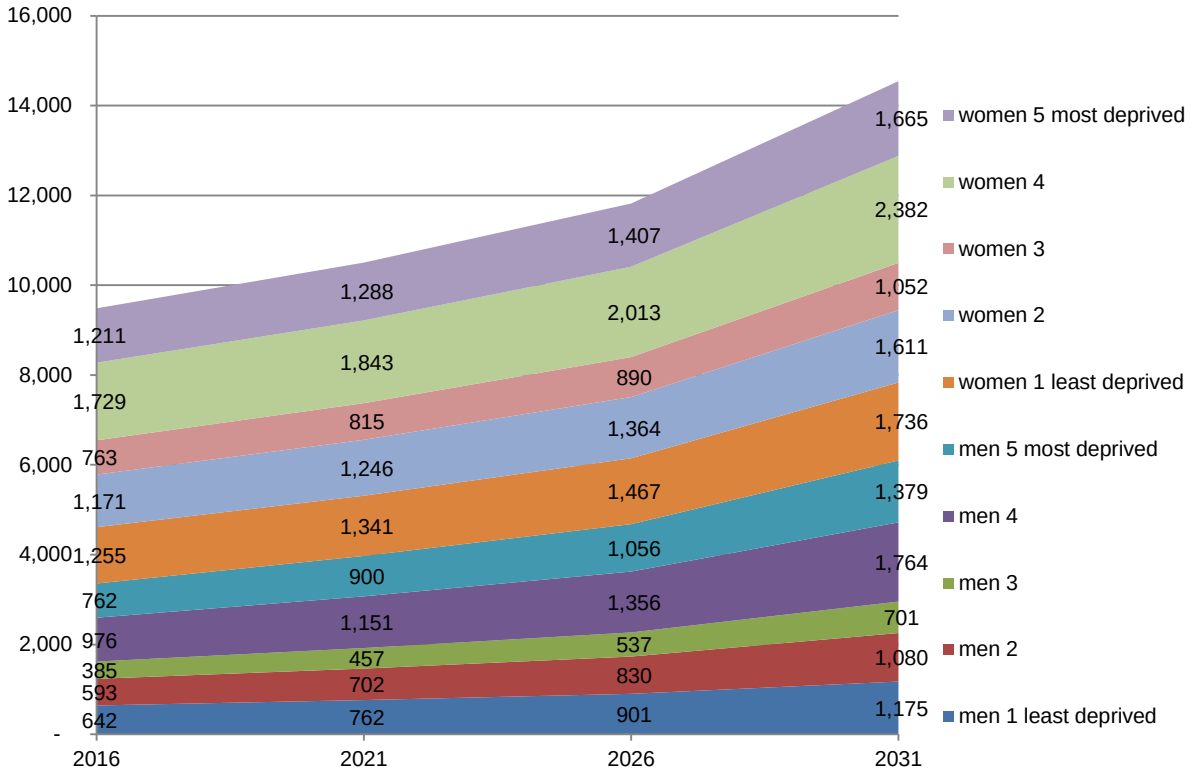


Figure 3. Wirral population aged 85 and over by year, gender and deprivation quintile.



5. Baseline disease prevalence estimates

Baseline lifetime disease prevalence data was drawn from the CCG's long term conditions tool which was collected from EMIS GP clinical systems based on read codes. Although often called a rate, in practice prevalence is actually a ratio at any one point in time of the number of people with a disease divided by a total number of people. This data covered around 89% of the Wirral population (around 281,000 people). It has disease prevalence in the same categories used in the Quality and Outcomes Framework (QOF). This data currently does not include some common chronic illnesses like anxiety, liver disease, anaemia, migraines, vision or hearing loss, osteoarthritis, or chronic back or neck pain.

It is important to recognise that this is diagnosed lifetime prevalence only; disease prevalence is a function of the number of people alive with a disease, and some diseases are lifelong like hypertension, while people can recover from some diseases like childhood asthma. Consequently, this data is more accurate for those diseases individuals do *not* typically recover completely from, such as CHD, diabetes, stroke, COPD and heart failure. Some diseases may be progressive or have a zero chance of full recovery like heart failure; for some diseases like CHD people can achieve some functional improvement but will still be regarded as having the disease; while some diseases like depression, cancer or asthma people can

make a full recovery. Lifetime prevalence is less useful for diseases like depression, severe mental illness, asthma and cancer from which people can recover and for this reason we put less emphasis on these results. In addition, we cannot infer incidence (number of new cases) from this data. At any one time a proportion of people will have a disease, but not be diagnosed with it – this will vary by disease, so nearly everybody with diabetes will be diagnosed at some time as it can be fatal without treatment, whereas for some diseases like hypertension, a proportion of people may potentially never be diagnosed in their lives. Some diseases are also easier to diagnose than others and diagnosis also varies by socioeconomic position, so people from deprived areas may be less likely to be diagnosed. This may mean that inequalities in prevalence are smaller than true inequalities in terms of need. There may be a 'healthy survivor effect' where lifetime prevalence of some diseases like cancer is actually higher in more affluent areas as people are more likely to have lived for long enough to have cancer, and are more likely to have survived cancer for a period of time. This can be seen with diabetes where diabetes deaths have fallen significantly, but years lived in suboptimal health from diabetes have increased as a consequence.

Disease prevalence estimates were produced by groups of IMD quintile, age group and gender, but could also be done by locality or GP practice in Wirral.

Baseline Results by Area and Deprivation Quintile

Age and gender was recorded for 100% of people in the EMIS dataset. There were 3,316 (1.2%) people with no deprivation quintile recorded, who were given a deprivation quintile of 2 which was the median quintile in the Wirral population. Prevalence of long term conditions was slightly higher in the most deprived parts of Wirral, with COPD and lifetime depression prevalence having particularly steep socioeconomic gradients. This is despite the more affluent areas of Wirral having an older population structure. Some diseases like lifetime cancer, atrial fibrillation and osteoporosis had an inverse gradient, with higher prevalence in the least deprived (or most affluent) quintile which may reflect an older age profile and people surviving longer after being diagnosed (Table 1). This could be investigated in the future if we can compare incidence with prevalence. The average number of LTCs per person was higher in deprived areas at 0.72, 8% higher than the most affluent areas (0.66 per person). On average people in Wirral lose at least 5% of their health-related quality of life per year from LTCs.

Table 1. Diagnosed current lifetime prevalence of long term conditions by deprivation quintile in Wirral, 2017.

Long Term Condition	National IMD quintile					Gradient	Wirral total
	1 - most deprived	2	3 - average	4	5 - least deprived		
Asthma	14.0%	12.2%	11.4%	11.1%	10.6%		12.2%
Atrial Fibrillation	1.7%	2.4%	2.6%	2.9%	3.0%		2.4%
Cancer	2.4%	3.0%	3.5%	3.9%	4.5%		3.3%
CHD	3.4%	3.6%	3.8%	3.7%	3.5%		3.6%
COPD	3.6%	2.6%	2.1%	1.7%	1.4%		2.5%
Dementia	0.8%	1.0%	0.8%	1.0%	0.7%		0.9%
Depression	23.1%	18.8%	16.2%	14.7%	12.7%		18.0%
Diabetes	6.1%	5.8%	5.6%	5.2%	4.7%		5.6%
Epilepsy	1.8%	1.5%	1.2%	1.2%	0.9%		1.4%
HF	0.9%	1.1%	0.9%	1.1%	1.0%		1.0%
Hypertension	13.0%	14.8%	15.4%	16.5%	16.0%		14.8%
LD	0.27%	0.26%	0.19%	0.15%	0.10%		0.21%
Mental Health	0.44%	0.36%	0.28%	0.23%	0.15%		0.31%
Osteoporosis	2.1%	2.8%	3.0%	3.4%	3.7%		2.9%
Stroke	1.1%	1.1%	1.1%	1.1%	1.0%		1.1%
Chronic Kidney Disease	4.1%	4.5%	4.8%	5.6%	4.5%		4.6%
QALYS lost/person	0.0500	0.0507	0.0503	0.0493	0.0503		0.05011
LTCs/person	0.69	0.70	0.70	0.68	0.70		0.69

As with deprivation quintile, prevalence of long term conditions varies by locality in Wirral, with diabetes higher in Wallasey locality, while CHD is higher in both Wallasey and Wirral South. Hypertension is highest in Wirral South, depression is highest in Birkenhead. See **Table 2**.

Table 2. Diagnosed current lifetime prevalence of long term conditions by locality in Wirral, 2017.

Long Term Condition	Locality				Wirral total
	Birkenhead	Wallasey	Wirral South	Wirral West	
Asthma	13.4%	12.6%	11.3%	10.9%	12.2%
Atrial Fibrillation	2.1%	2.1%	2.7%	3.0%	2.4%
Cancer	2.7%	2.8%	3.9%	4.1%	3.3%
CHD	3.7%	3.5%	3.5%	3.8%	3.6%
COPD	3.2%	2.6%	1.9%	1.8%	2.5%
Dementia	0.9%	0.7%	0.9%	0.9%	0.9%
Depression	21.9%	17.5%	16.5%	14.3%	18.0%
Diabetes	6.0%	5.8%	5.1%	5.1%	5.6%
Epilepsy	1.7%	1.4%	1.3%	1.1%	1.4%
HF	1.0%	0.9%	1.1%	1.0%	1.0%
Hypertension	14.7%	14.3%	14.6%	15.9%	14.8%
LD	0.3%	0.2%	0.2%	0.2%	0.2%
Mental Health	0.4%	0.3%	0.2%	0.2%	0.3%
Osteoporosis	2.5%	2.4%	3.2%	3.7%	2.9%
Stroke	1.1%	1.0%	1.0%	1.2%	1.1%
Chronic Kidney Disease	5.6%	4.2%	4.0%	4.4%	4.6%
QALYS lost/person	*0.0500*	*0.0501*	*0.0503*	*0.0501*	*0.0501*
LTCs/person	*0.691*	*0.692*	*0.694*	*0.693*	*0.692*

Long term conditions by age group

Figure 4 shows the proportion of the population by number of long term conditions (out of a maximum of 16 conditions). As you may predict, this increases with age with 50% of the population having at least one LTC at age 60, and having at least 2 LTCs at age 70. However even at 85+, there are 10% of people with no diagnosed LTCs which may indicate that a proportion of people can stay relatively healthy throughout their lifetime. There is a clear step change in the proportion of people with LTCs between 15-19 and 20-24. Figure 5 shows the trend in LTC cases by age group. In younger age groups this is mainly driven by asthma and depression which may not be reliable as this is lifetime prevalence and people can recover from asthma and depression. This chart shows how cases of LTCs like diabetes, hypertension and chronic kidney disease really ramp up from around age 45 which indicates that the early 40s may be a crucial time to intervene. This may also be an effect of increased diagnosis associated with NHS Health Checks.

Figure 4. Proportion of the population by number of long term conditions (LTCs), from a maximum of 16 LTCs; data for Wirral, 2016.

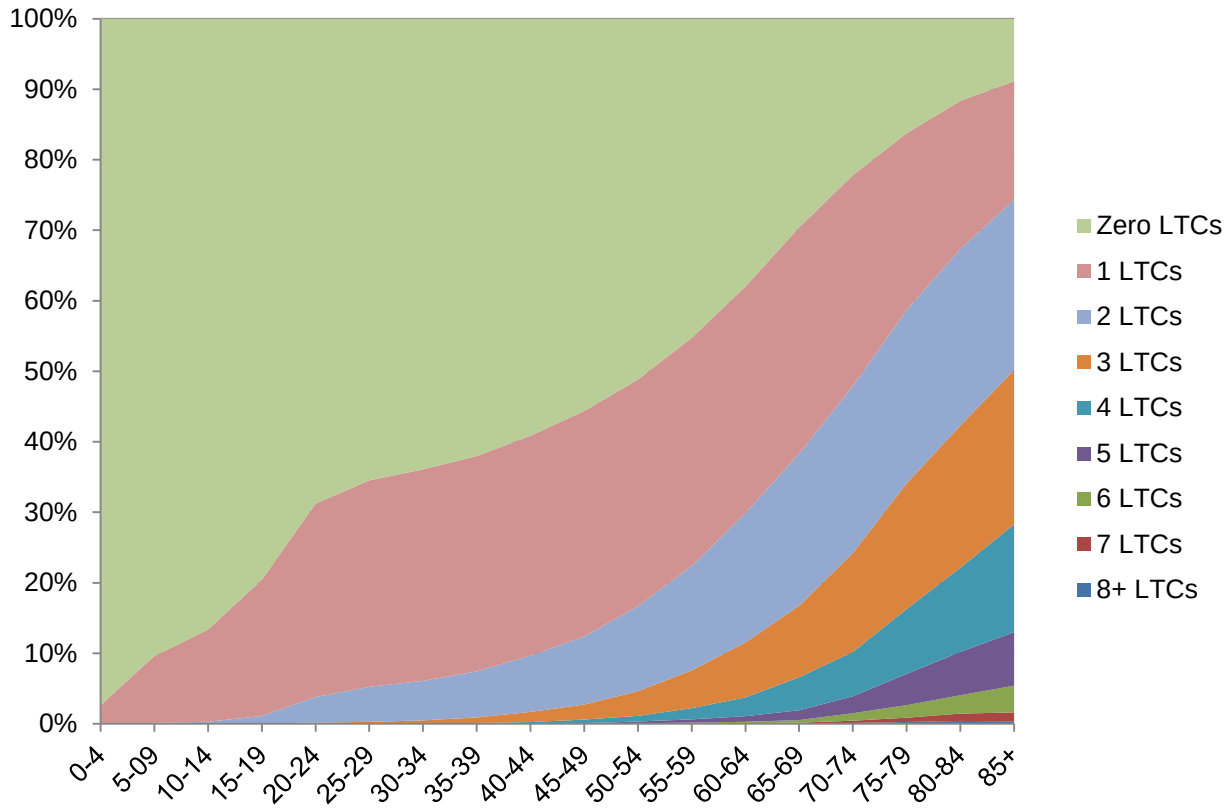
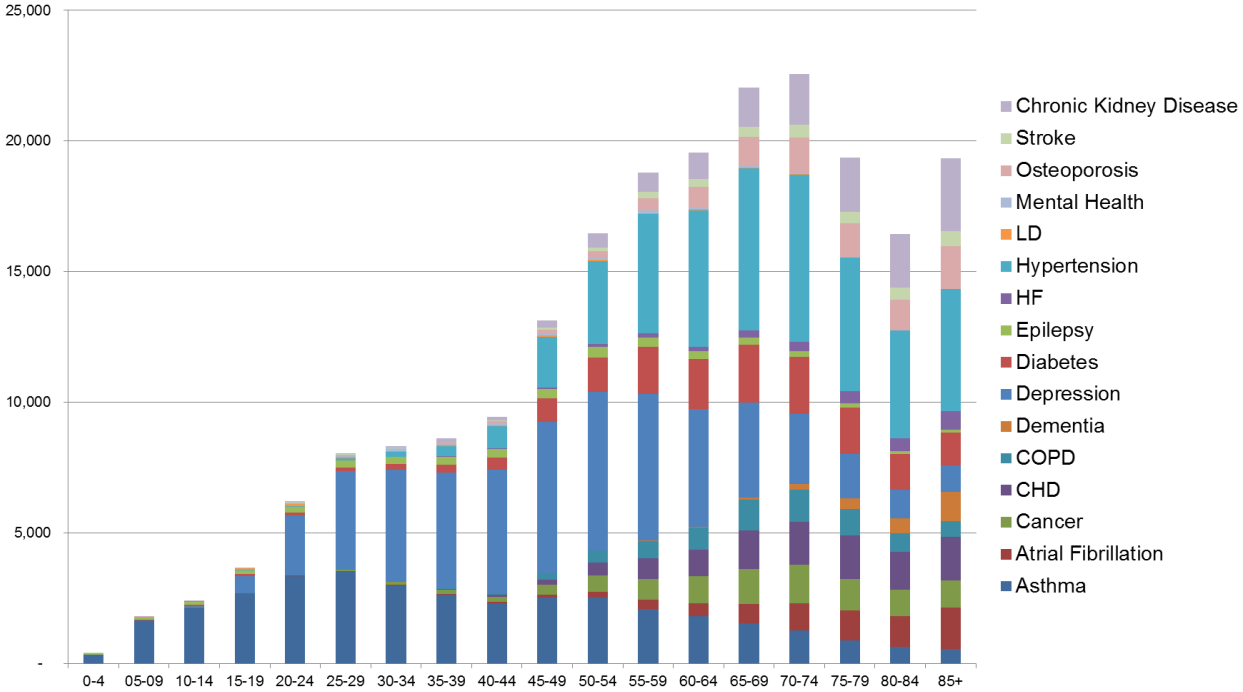


Figure 5. Number of cases of long term conditions in Wirral by age group, 2016.



6. Summary of sources of disease projections or trends

The model factors in the impact of demographic change on disease projections, so we were interested only in finding disease trends that were *not* accounted for by demographic growth. The model only includes diagnosed cases – for many diseases there are a large undiagnosed population, and there are some specific estimates of the proportion of cases who are undiagnosed for diseases like hypertension, chronic kidney disease, diabetes and COPD. Disease projections were drawn from models we were familiar with, as well as from carrying out non-systematic literature searches for UK and England prevalence projections, models or trends (Table 3). Appendix 1. Sources of disease projections or trends has more detail on sources of disease projections.

The utility change is used to calculate the morbidity related QALYs, so if someone lives for one year with depression, they would lose 0.112 of a QALY, or around 11% of their health related quality of life when compared to a full health state of which would have a utility score of 1.0. The disutility estimates are from Sullivan (2011).[4]

[4] Sullivan, Patrick W., Julia F. Slejko, Mark J. Sculpher, and Vahram Ghushchyan. "Catalogue of EQ-5D scores for the United Kingdom." *Medical Decision Making* 31, no. 6 (2011): 800-804.

Table 3. Sources of change in disease prevalence, and QALY decrements for disease groups in LTC model. UKHF = UK Health Forum.

Disease group	Model for change from 2016-2031	ICD 9 codes for Utility	Morbidity related QALY loss	ICD 10 codes for hospital admissions /mortality
Asthma	Demographic	493	-0.046	J45-J46
Atrial Fibrillation	Lane et al 2017	427	-0.038	I48
Cancer	Demographic	Used average of 153 colon, 162 lung, 174 breast	-0.069	C00-D48
CHD	UKHF	410-414	-0.068	I20-I25
COPD	ERPHO COPD Prevalence model	Used average of 491 chronic bronchitis,492 emphysema,496 chronic airway obstruction NEC	-0.096	J40-J44, J47
Dementia	Demographic	294	-0.068	F00-F03
Depression	Demographic	311	-0.112	F34.1
Diabetes	PHE model	250	-0.071	E10-E14
Epilepsy	Demographic	345	-0.040	G40-G41
Heart Failure	Demographic	428	-0.117	I11.0, I25.5, I42.0, I42.9 I50.0, I50.1, I50.9
Hypertension	Demographic	401	-0.046	I10-I15
Learning Disability	Demographic	315	-0.025	None
Mental Health	Demographic	Used average of 295 schizophrenic disorders & 296 affective psychoses	-0.120	F10.5, F11.5, F12.5, F13.5, F14.5, F15.5, F16.5, F19.5, F20-F29, F30.2, F31.2, F31.5, F32.3, F33.3.
Osteoporosis	Demographic	733	-0.036	M80-M82
Stroke	UKHF	Use average of 433 precerebral occlusion, 435 transient cerebral ischemia, 436 CVA, 437 other cerebrovascular disease, 438 late effects cerebrovascular disease.	-0.058	I60-I69
Chronic Kidney Disease	Demographic	586	-0.110	N18,I12

7. Hospital activity data

The House of Commons Health Committee report on estimates that LTC care accounts for 55% of GP appointments, 68% of outpatient and A&E appointments and 77% of inpatient bed days in England.[5] However the only data we have that is well coded to ICD-10 is inpatient activity data. We conducted a micro-costing exercise to estimate the inpatient costs of long term conditions.

Hospital activity was matched to long term conditions based on primary diagnosis only. This may underestimate the true cost of particular conditions such as diabetes where the majority of costs may be from complications like foot and eye problems. Hospital activity was grouped by financial year, LTC, gender, age group, IMD quintile, then activity and cost.

National PbR tariff costs for 2016/17 were used; when costs did not have national tariffs (i.e. were local tariff only), local tariffs for Wirral CCG for 2017/18 were used (Wirral had a block contract in 2016/17 so did not have local costs). The costs were not weighted by market forces factor.

Not all admissions will be the same people who are on LTC registers, for instance some people who have initial fatal strokes or myocardial infarctions will have never been on QOF CHD or stroke registers. And some diagnoses are subject to more uncertainty or may not initially be coded as a chronic disease.

Over three years of hospital activity data, the long term conditions we looked at made up 20% of costs, and 20% of activity (£116m / £581m costs and 42,000 / 209,000 admissions). This is based on primary diagnosis only so it is likely that long term conditions may make a contribution to many more admissions. Chronic kidney disease had the highest number of admissions (mainly for dialysis which is zero costed in PbR terms), while cancer had the highest costs. Cancer has overtaken CVD as the biggest cause of morbidity and mortality in Wirral and in England, because reductions in population levels of risk factors like smoking and diet have reduced the risk of CVD very quickly, but take many years to reduce the risk of cancer. This is why cancer admissions are increasing while CVD admissions are stable or decreasing. Cancer and heart failure costs have shown a steep increase, where admissions are increasing, and average cost per admission is also increasing. This is based on SUS (Secondary Use Service) data which was charged to Wirral CCG so does not include all admissions for low volume, high cost codes which may fall under specialised commissioning which happens at NHS England level.

[5] House of Commons Health Committee. Managing the care of people with long-term conditions. Second report of Session 2014-15. Volume 1. 3 July 2014.

Figure 6. Trend in numbers of admissions with primary diagnosis of long term condition, data for Wirral 2013/14 to 2015/16.

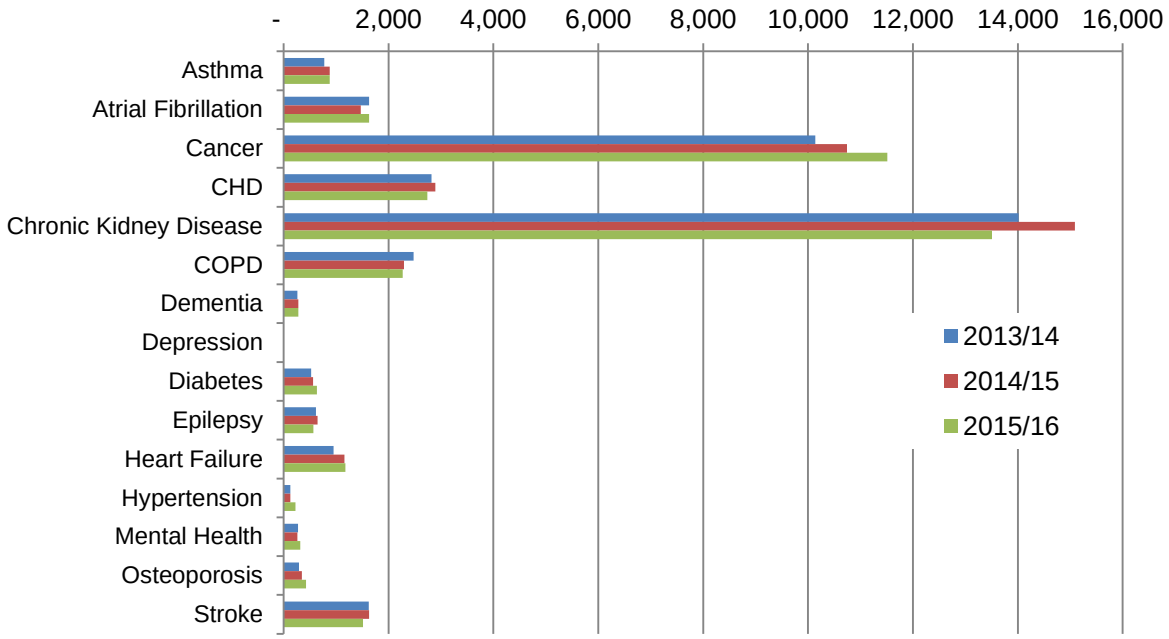
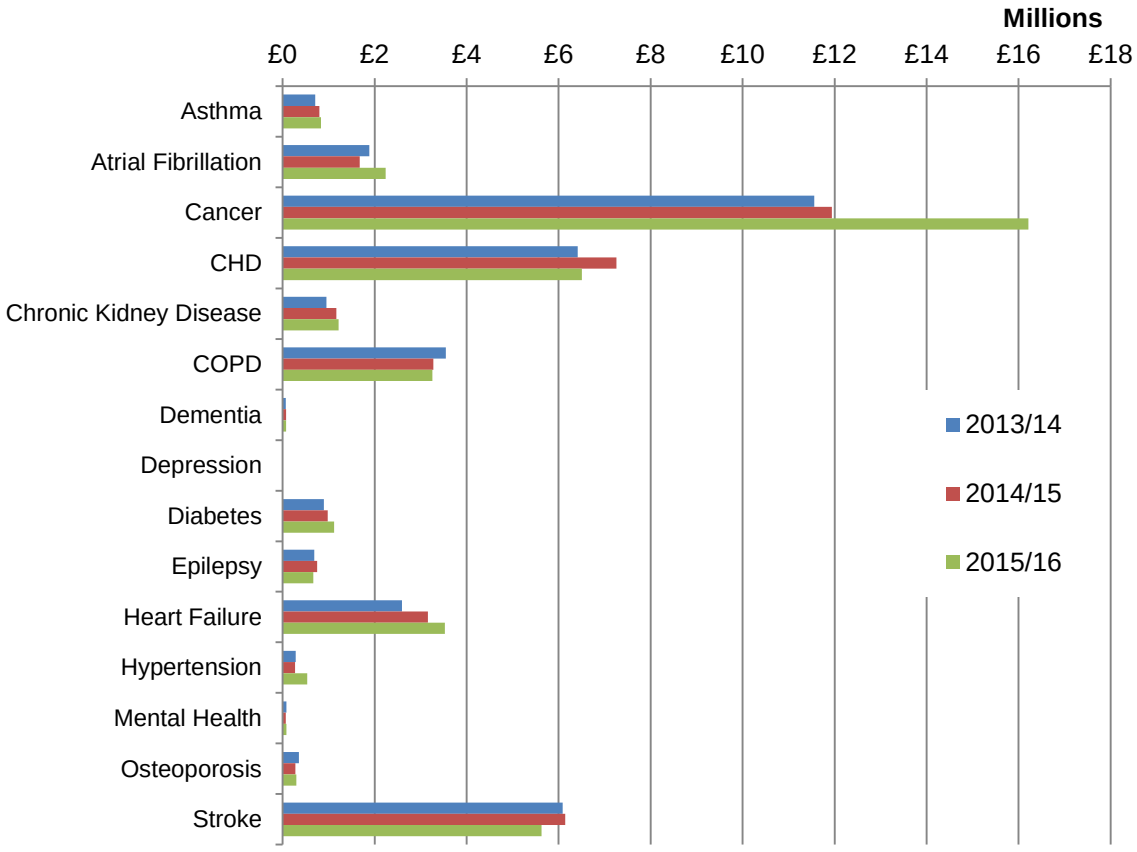


Figure 7. Trend in estimated costs of admissions with primary diagnosis of long term condition, data for Wirral 2013/14 to 2015/16.



Hospital activity costs were projected based on changes in prevalence. Costs are measured in 2016 prices, i.e. not discounted or inflated, and do not account for changing costs of treating the same disease through inflation or new technologies.

8. QALYs lost through mortality and morbidity

There are different methods of measuring and adjusting years of life lost (YLL). In the UK, years of life lost are typically measured as years of life lost under age 75, however in the US premature deaths are seen as those occurring under 85. People's total life expectancy increases as they get older, particularly stepping up once they survive the first two years of life. UK cohort life expectancy at age 65 was 18.5 years for men (83.5 years total) and 20.9 years (85.9 years total) for women in 2013-2015.

In the global burden of disease study, years of life lost in each age group are compared to the highest global life expectancy in each age group (from males or females). For example, if a 20-year-old male died in a car accident in South Africa in 2010, he has 66 years of life lost, that is, the highest remaining life expectancy in 20-year-olds, which is the life expectancy experienced by 20-year-old females in Japan. In the GBD study for 2015, the highest life expectancy in a large population was for Japan, which was 86.6 years.

When somebody dies of a disease, the years of life lost are generally attributed to the primary cause of death, even if other diseases or causes may have contributed, so somebody who has diabetes may die of a myocardial infarction where the diabetes has contributed to their death, but 100% of the YLL will be attributed to the MI and 0% to the diabetes. This contrasts with morbidity-related QALYs, or years lived with disability (YLD), where a range of diseases can contribute, so someone may lose 2 QALYs, or experience the equivalent of 2 YLD while they are alive, and 1.5 may be through diabetes, 0.5 through heart disease.

In the present piece of work we aimed to estimate the current burden of disease (morbidity and mortality) for long term conditions in Wirral in terms of quality adjusted life years (QALYs lost).

Total QALYs lost were made up of:

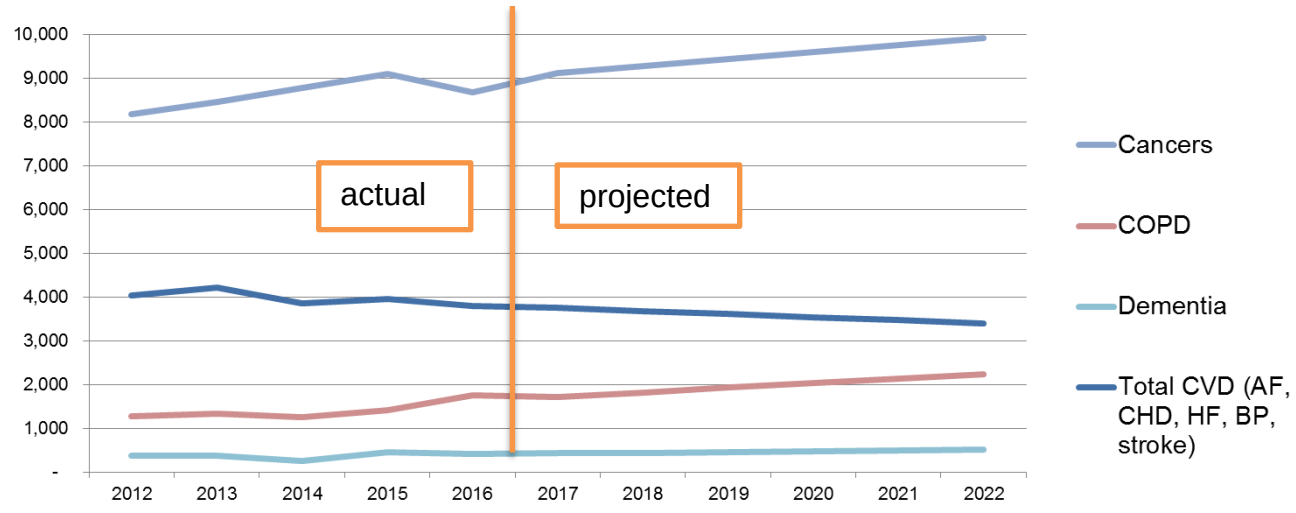
Morbidity related QALYs lost – QALYs lost through reduced HRQOL (Health Related Quality of Life) from disease (all ages) – this is based on diagnosed disease data from EMIS, multiplied by utility weights from the UK-MEPS study.[4] Morbidity related QALYs are QALYs lost while people are alive, through having lower health related quality of life from long term conditions. In the model, people can lose QALYs through LTCs at any age (unlike mortality related QALYs which were restricted to under 85 years), and can lose QALYs through multiple LTCs; the QALYs lost are

treated additively e.g. someone with COPD and hypertension will lose 0.096 QALYs per year through COPD and 0.046 QALYs per year through hypertension.

Mortality related QALYs lost – QALYs lost through years of life lost from early deaths (aged under 85) – this is based on mortality data from ONS, which was weighted for the average quality of life someone of a given age would expect if they were alive, for example, if someone dies aged 56, they would lose 29 years compared to if they lived to 85, and this would equate to 21.9 quality adjusted life years lost. Mortality related QALYs are only ever attributed to one cause of death.

Overall, of all the long term conditions considered, the greatest QALYs lost through early death were from cancer, which were increasing over time; QALYs lost through COPD were also increasing. Dementia QALYs lost were increasing but were smaller than other LTCs. Many dementia deaths would not contribute to this figure because they occur in people aged over 85. CVD QALYs lost were decreasing over time, reflecting the improvement in CVD risk factors, plus the age profile of people dying from CVD is increasing. COPD QALYs seem to be increasing; this is because they are related to historical smoking rates, so even though smoking prevalence has fallen hugely in Wirral, there is still a long legacy of COPD.

Figure 8. Trend in mortality-related QALYs lost in deaths at age under 85 for selected long term conditions in Wirral; actual data from 2012-2016 with linear projection from 2017-2022.

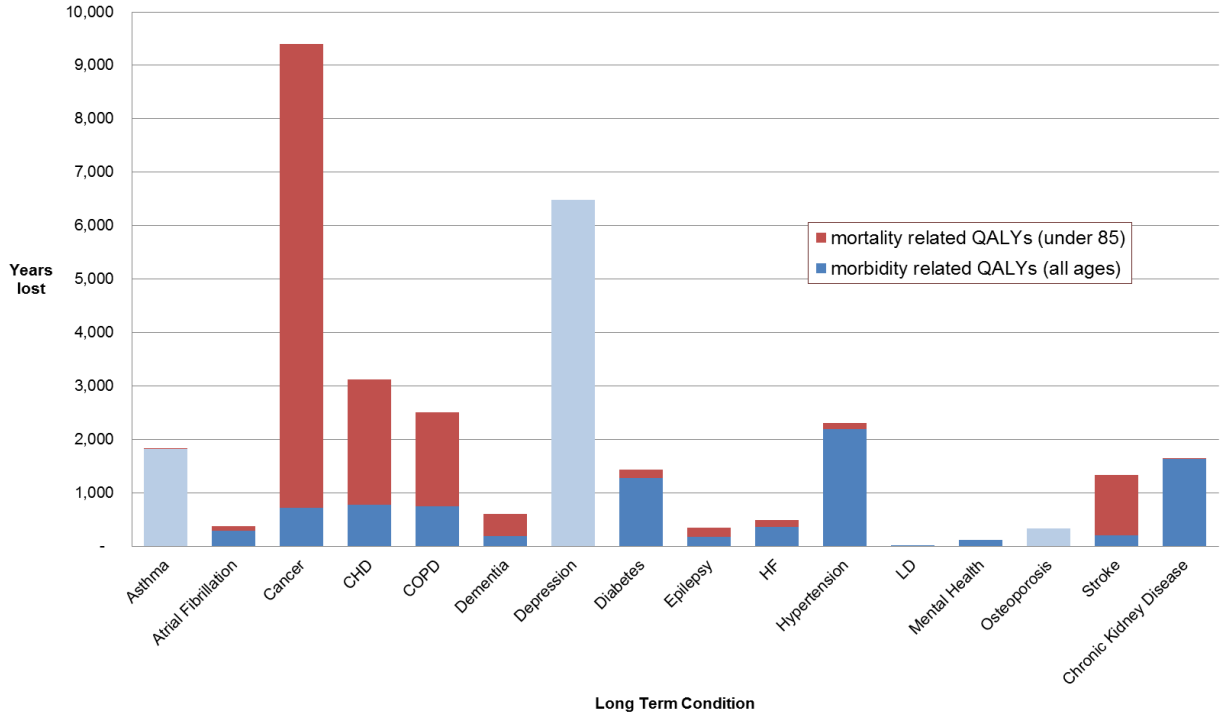


9. Model Results

QALYS lost through long term conditions

Figure 9 shows the total estimated quality adjusted life expectancy lost per year through long term conditions. Cancer was the biggest single cause of mortality related QALYs lost, as the average age for a cancer death is around 75 and there are around 1000 cancer deaths per year in Wirral. CHD, COPD and stroke were also all significant causes of mortality-related QALY loss. Depression is a considerable cause of morbidity-related QALY loss, although this is subject to uncertainty due to being based on lifetime, rather than current prevalence. At the same time however, depression may be often undiagnosed, which would mean true prevalence is increased. Hypertension, diabetes and chronic kidney disease are considerable causes of morbidity-related quality of life loss, which further highlights the need to prevent these diseases, via for instance, promoting a healthier diet.

Figure 9. Quality adjusted life years (QALYs) lost per year in Wirral from long term conditions, made up of morbidity-related QALYs lost (all ages) and mortality-related QALYs lost (aged under 85).



* Asthma and depression are lifetime prevalence and subject to a high degree of uncertainty. Osteoporosis prevalence is also subject to uncertainty as does not match with other estimates.

Projections for Wirral

Figure 10 shows the results for Wirral for 2016, 2021, 2026, and 2031. Results over the five years from 2016-2021 are shown in Appendix 2. Based on this model, the long term condition likely to show the greatest increase is dementia, which had a 42% increase. This fits in with projections that estimated the total number of people with dementia in Wirral will increase by 46% from 4,798 in 2015 to 7,019 in 2030.[6] It is also similar to predictions from the POPPI website, which estimates a 39% increase from 4,834 people in 2017 to 6,731 people in 2030.[7] Atrial fibrillation, heart failure, and chronic kidney disease also had large increases of around one third. Cancer increased by 19% but there is a lot of uncertainty around cancer trends as cancer has many risk factors and may increase if other diseases diminish. Diabetes increased by 11%, which is consistent with the 11% increase predicted from PANSI and POPPI websites (predicts 15,101 people in 2017 rising to 16,773 people in 2030).[8] Hypertension had the biggest increase in terms of numbers of around 8,100 people (17% increase), as hypertension already affects a large cohort of people.

Over the same time period, the Wirral population is set to increase by just 3%, so these changes are driven by changes in the age, gender and deprivation distribution of the population combined with trends in lifestyle risk factors. These trends may be used for planning health and social care services going forward. It is important to remember that these are projections in *diagnosed* prevalence; for many of these diseases covered, there are a proportion of people who are currently undiagnosed. This means that as efforts to diagnose people earlier increase, and new technologies may make it easier to diagnose people (for instance mobile ECGs to diagnose atrial fibrillation[9]), the total numbers may show a steeper increase. We have not projected death rates from long term conditions or mortality-related QALYs lost, but this could possibly be done in future. The estimates for cancer are subject to a lot of uncertainty and it may be that particular cancers increase over time, and prevalence increases as people live longer with cancer.

The average number of long term conditions per person is estimated to increase by 14% based on demographic change, but the true increase may be greater as life expectancy increases and people have a higher probability of developing multiple morbidities.

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[6] Wirral JSNA Dementia Section. December 2016. Calculated based on Alzheimer's Society, Dementia UK: Update (2014) http://info.wirral.nhs.uk/document_uploads/JSNA%202016/Wirral%20JSNA%20Dementia%20FINAL%20Dec%2016.pdf

[7] Projecting Older People Population Information System http://www.poppi.org.uk/

[8] Projecting Adult Needs and Service Information http://www.pansi.org.uk/

[9] Haberman, Zachary C., Ryan T. Jahn, Rupan Bose, Han Tun, Jerold S. Shinbane, Rahul N. Doshi, Philip M. Chang, and Leslie A. Saxon. "Wireless Smartphone ECG Enables Large-Scale Screening in Diverse Populations." *Journal of cardiovascular electrophysiology* 26, no. 5 (2015): 520-526.

The cost of LTC-related hospital admissions is set to increase by about 10% from around £42milllion to £47million a year in 2016 prices. However, true costs will be higher as they will increase with inflation and also because healthcare costs per head typically increase more quickly than inflation due to new technologies, greater expectations etc. Costs were projected for individual diseases so do not include a multiplier effect of increases in multi-morbidity. The biggest absolute changes are for cancer (increases by £3.1million) and heart failure (increases by £1.1million per year).Overall costs may increase a lot more than these figures suggest as these costs are only for primary diagnoses of long term conditions which account for 20% of inpatient costs and less than 10% of total healthcare costs (Figure 12). The increase in hypertension and dementia prevalence may increase the costs of other admissions, for instance for falls. A large increase in dementia may increase costs elsewhere in the healthcare system and certainly could increase social care costs.

Figure 10. Estimated trend in long term conditions prevalence in Wirral, 2016-2031.

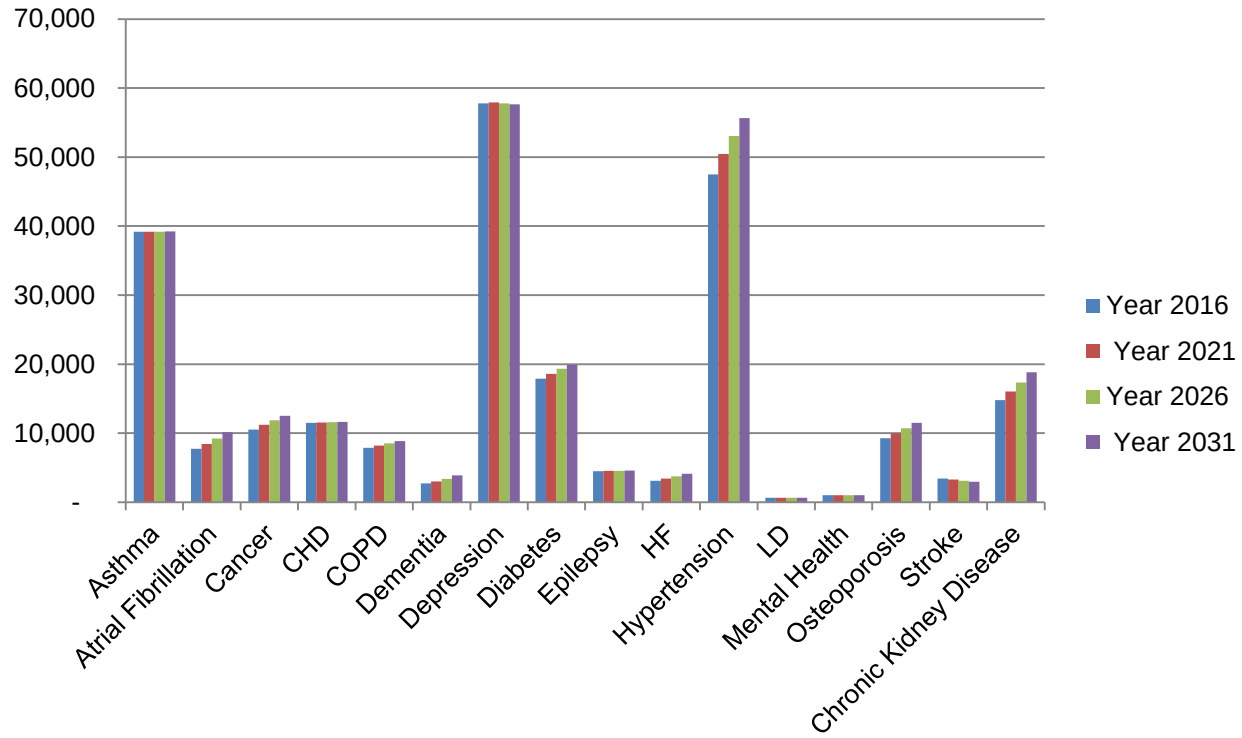


Table 4. Estimated number of people living with long term conditions in Wirral, cost of LTC admissions, and LTCs per person for 2016, 2021, 2026 and 2031.

Long Term Condition	Year 2016	Year 2021	Year 2026	Year 2031	% Change	Change in numbers
Asthma*	39,171	39,183	39166	39,252	0%	81
Atrial Fibrillation	7,720	8,445	9,224	10,132	31%	2,412
Cancer*	10,516	11,233	11,892	12,543	19%	2,026
CHD	11,493	11,536	11,580	11,624	1%	131
COPD	7,891	8,214	8,538	8,863	12%	972
Dementia	2,738	3,019	3,385	3,893	42%	1,155
Depression*	57,767	57,910	57,803	57,636	0%	-131
Diabetes	17,883	18,606	19,318	19,888	11%	2,005
Epilepsy	4,479	4,520	4,549	4,577	2%	97
HF	3,126	3,423	3,748	4,124	32%	998
Hypertension	47,492	50,463	53,074	55,636	17%	8,144
LD	659	647	640	636	-3%	-23
Mental Health	1,009	1,016	1,014	1,008	0%	-1
Osteoporosis*	9,252	9,949	10,694	11,521	25%	2,269
Stroke	3,451	3,286	3,121	2,957	-14%	-494
Chronic Kidney Disease	14,801	16,024	17,329	18,830	27%	4,029
Total number of LTCs	*222,223*	*247,474*	*255,073*	*263,121*	*18%*	*40,897*
Population	*321,304*	*324,883*	*327,913*	*330,545*	*3%*	*9,241*
Cost of LTC admissions (£)	*42,195,804*	*43,949,494*	*45,665,945*	*47,483,212*	*13%*	*£5,287,409*
LTCs/person	*0.69*	*0.76*	*0.78*	*0.80*	*15%*	*0.10*

* Asthma, depression and cancer are lifetime prevalence and subject to a high degree of uncertainty. Osteoporosis prevalence is also subject to uncertainty as does not match with other estimates.

Figure 11. Projected hospital inpatient admissions costs for long term conditions in Wirral, 2016-2031, measured in 2016 prices.

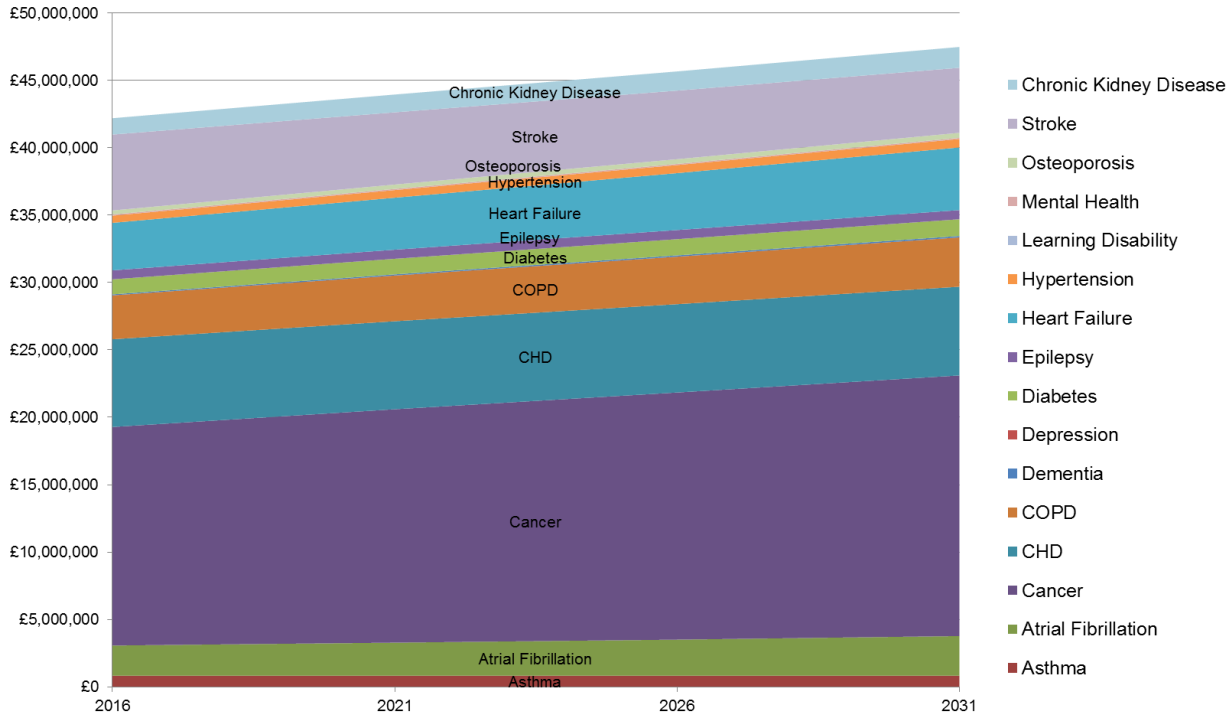
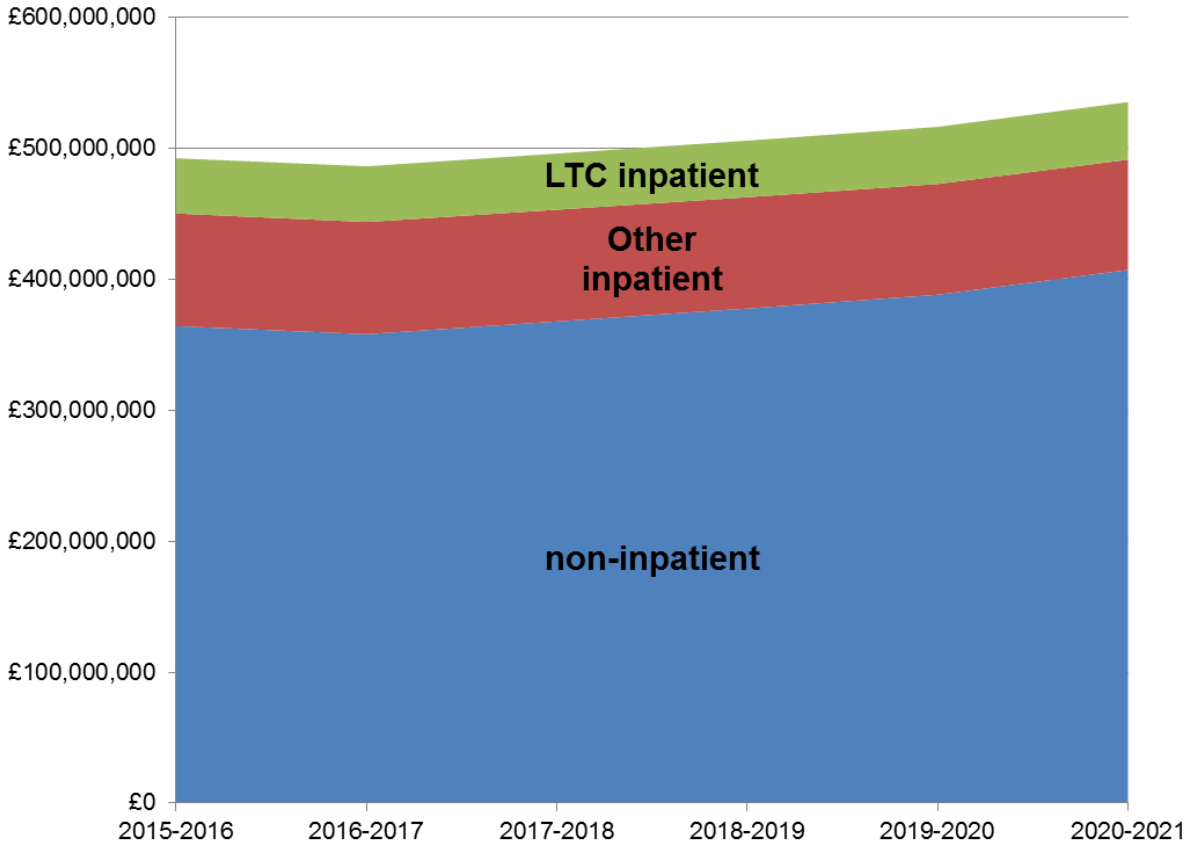


Figure 12. Estimated proportion of total Wirral CCG spend that is LTC inpatient spend (primary diagnosis). Total spend based on NHS England resource allocations for 2015/16 to 2020/21.



In terms of QALYs lost, the amount of quality of life lost per year varies between diseases and so is not totally in proportion with prevalence. The overall number of morbidity-related QALYs lost is estimated to increase by 16% per year over the fifteen years from 2016-2031. Of diseases with a high level of certainty (of current prevalence), the highest QALYs lost are for hypertension, diabetes and chronic kidney disease. These are therefore likely to be the long term conditions that cause the biggest loss of functional health in Wirral. Although hypertension causes a smaller QALY loss per person than other diseases such as chronic kidney disease, the total QALY loss across the population is high because hypertension affects a much larger number of people.

It may be the case for chronic kidney disease that the QALY losses in the literature are for people with more severe disease, whereas the definition used here is for all stages of chronic kidney disease, which would mean that total QALY losses are overstated. Similarly with COPD the diagnostic criteria has expanded since the utility source data (MEPS) was collected from 2000-2003, meaning more people are now included as having COPD. What was before 2004 classed as subclinical COPD is now mild, what was previously mild is now moderate COPD. This may mean that more people now have mild COPD so the average QALY losses are overstated (see Appendix 3 for COPD diagnostic criteria).[10] Although we cannot be certain of current depression prevalence, it is likely that it is a significant cause of QALY losses; as even though lifetime diagnosis will give an over-estimate, it is likely that a high proportion of depression is undiagnosed, which would partly balance out this effect.

[10] http://www.blizard.qmul.ac.uk/ceg-resource-library/clinical-guidance/clinical-guidelines/5-chronic-obstructive-pulmonary-disease-june-2012/file.html

Table 5. Estimated morbidity-related QALYs (quality adjusted life years) lost through diagnosed long term conditions in Wirral, for 2016, 2021, 2026 and 2031.

Long Term Condition	Year 2016	Year 2021	Year 2026	Year 2031	% Change
Asthma*	1,815	1,816	1,815	1,819	0%
Atrial Fibrillation	296	324	354	389	31%
Cancer*	722	772	817	862	19%
CHD	780	783	786	789	1%
COPD	755	786	817	848	12%
Dementia	186	205	230	265	42%
Depression*	6,490	6,506	6,494	6,475	0%
Diabetes	1,277	1,329	1,380	1,421	11%
Epilepsy	179	180	181	182	2%
Heart Failure	365	399	437	481	32%
Hypertension	2,186	2,323	2,443	2,561	17%
Learning Disability	17	16	16	16	-3%
Mental Health	121	122	122	121	0%
Osteoporosis*	336	361	388	418	25%
Stroke	200	190	181	171	-14%
Chronic Kidney Disease	1,634	1,769	1,912	2,078	27%
QALYs lost from LTCs	*16,237*	*17,972*	*17,965*	*18,842*	16%

* Asthma and depression are lifetime prevalence and subject to a high degree of uncertainty. Osteoporosis prevalence is also subject to uncertainty as does not match with other estimates. Cancer prevalence is also subject to uncertainty.

10. Discussion

This work found that cancer caused the biggest QALY losses in Wirral and that this would most likely increase over time. COPD is also predicted to increase over time, while CVD is predicted to fall. The model results suggest that diagnosed prevalence of dementia, atrial fibrillation, heart failure and chronic kidney disease will show the greatest increase in over time. This work did not find as steep a socioeconomic gradient as may be expected for some diseases, but this may be partly due to healthy survivor effects and earlier diagnosis. In this regard it would be interesting to look at incidence data as well as prevalence data by socioeconomic position. The model suggested that real total inpatient costs of these LTCs were not likely to change much between 2016 and 2031, although changes in the healthcare system, such as having more services in the community may alter this.

What this work should be used for

This work could be used for long term planning for the local authority and the NHS. The number of comorbidities is useful for estimating levels of need across the population, for instance using the electronic frailty index. Knowing that there will most likely be a significant increase in people with dementia means that there may be more demand for health and social care. Knowing that cancers cause the highest acute costs and highest mortality related QALY loss reinforces the focus on cancers; plus cancers are overtaking CVD as the biggest causes of years of life lost and of inpatient costs. There are potential indications around prevention as well; if prevention can be upscaled then this might prevent some of the estimated increases from happening. A high proportion of long term conditions are related to risk factors like poverty and work, pollution, diet, smoking, alcohol, weight and physical activity.

Strengths and Weaknesses

This work has estimated how prevalence of disease will change, and how hospital activity costs will change over time. A strength of this work is has used QALYs as an outcome which are seen as a gold standard in comparing the effectiveness of interventions, and has used individual level anonymised primary care data which has not been used so much before and allows comorbidities to be measured. The model is in quite close agreement with estimates from other sources like POPPI and PANSI. The model could be replicated by other parts of the country that have access to similar data. Weaknesses are that this work has sometimes used national estimates of changes in incidence to estimate prevalence change, only accounts for lifetime diagnosed prevalence, not undiagnosed cases, and does not account well for diseases that people recover from. This piece of work does not account for cohort effects although this could be added in future, with the model potentially using a mixture of demographic growth and cohort ageing.

Future Work

Potential future work:

- Embed model in different software e.g. SQL instead of Excel to increase capabilities, stability and speed.
- Model expanded to include more long term conditions that affect large numbers of people such as chronic liver disease, osteoarthritis and others.
- Create a more robust model for cancer incidence, prevalence and mortality.
- The model could be developed so that it is based on prevalence in the last 12-36 months rather than lifetime prevalence, to make it more accurate for conditions from which people recover.
- Give estimates of uncertainty based on sensitivity analysis of model assumptions.

- Estimate total (diagnosed + undiagnosed) prevalence rather than just diagnosed prevalence.
- Look at disease risk factors like smoking and diet.
- Disaggregate results for different levels of disease severity.
- Include more disease cost estimates beyond primary diagnosis inpatient costs, for instance there are estimates from the academic literature of total disease costs for CHD, stroke, diabetes etc., but these are not specific to Wirral. There are also estimates of other costs beyond healthcare costs like productivity and informal care costs that could be included.
- Costs and outcomes in the model could be adjusted for health inequalities; there is evidence that people from deprived areas with the same disease may experience greater quality of life losses and higher healthcare costs than people from more affluent areas.
- In the longer term if we can get matched data across the whole system for individuals that includes primary and secondary care, and possibly social care, we can start to understand the total cost and activity of a year of care for someone with a particular long term condition.

11. Appendix 1. Sources of disease projections or trends

Many of the disease projections were from a UK Health Forum microsimulation model which was around different smoking scenarios. We used the relative change in incidence to predict changes in prevalence for cancer, CHD and stroke. This model also included COPD but we used ERPHO COPD prevalence model for this as this was calibrated more for local demographics and produced for each CCG area.

1. Asthma

The UK has some of the highest rates of asthma in Europe and the highest rate in the world of measured asthma symptoms in children.[11] A large scale study suggested that incidence of asthma in England has peaked in the mid-1990s then has fallen,[12] but lifetime prevalence may continue to increase, although not dramatically.[13] Because of this finding, asthma prevalence in the model was based on demographic growth.

[11] https://www.asthma.org.uk/about/media/facts-and-statistics/
[12] http://thorax.bmj.com/content/62/1/85
[13] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3072257/

2. Atrial Fibrillation

Atrial fibrillation (AF) incidence increases with age. Estimates of AF produced by PHE in 2015 suggested that the expected number of people with AF in Wirral was 9,222; based on QOF data for 2013/14 there were 6,871 people diagnosed, which suggested that 25% of people with AF were undiagnosed. Nationally an estimated 35% of people were undiagnosed so Wirral had a higher detection rate. [14] A recent study estimated trends in AF based on data from the UK Clinical Practice Research Datalink (CPRD).[15] This projected AF prevalence in the UK would increase from 700,000 patients in 2010 to between 1.3 and 1.8 million patients by 2060. The data from this paper was used to estimate the relative increase from 2016 to 2031 in AF. It may be that new technologies such as mobile phone based ECGs may increase AF diagnosis rates even further.

3. Cancer

Cancer is a group of diseases with a complex set of causes, but including lifestyle risk factors such as smoking, diet, and alcohol. *UK health forum model, scenario 0* projected that overall cancer incidence would be around 14% lower in 2031. However some research by Cancer Research UK predicted that overall age standardised cancer incidence would increase by 3% for women and 0.5% for men between 2014 and 2035, and that the total number of cases in terms of numbers would show a large increase of 36% for males and 48% for females.[16] It may be that in future, projections of specific cancers could be done; for instance lung cancer is mainly caused by smoking so will show a strong relationship with historic smoking rates. Because of this overall uncertainty, we modelled cancer with demographic growth only but will look at doing a more robust model of cancer in the longer term. Because the data we have is lifetime prevalence, this may not correlate well with incidence trends as survival is increasing. The UKHF estimates were modelled as a separate scenario analysis.

4. CHD (Coronary Heart Disease)

CHD risk factors include high blood pressure, high cholesterol, diabetes and high blood sugar, overweight and obesity, smoking, lack of physical activity, unhealthy diet and stress. Many of these risk factors like smoking, blood pressure and cholesterol are improving, while some like obesity have increased over time. Trends in CHD were modelled using *UK health forum model, scenario 0.*

[14] https://www.gov.uk/government/publications/atrial-fibrillation-prevalence-estimates-for-local-populations

[15] http://jaha.ahajournals.org/content/6/5/e005155

[16] https://www.nature.com/bjc/journal/v115/n9/pdf/bjc2016304a.pdf

5. COPD (Chronic Obstructive Pulmonary Disease, chronic lung diseases like emphysema and bronchitis)

The vast majority of COPD (90%) is caused by tobacco smoking. Tobacco smoking has shown a downward trend, however disease prevalence is related to smoking prevalence over the last 20-40 years. Smoking prevalence peaked nationally in the 1960s, and it is likely that in Wirral it peaked later on, in the 1970s. COPD trends were based on local authority level estimates produced from the ERPHO COPD Prevalence Model (2011).[17] The model combines age, gender and smoking status of the population as well as ethnicity and deprivation to calculate an estimate of the number of people likely to have COPD.

6. Dementia

There are differences in dementia prevalence estimates. Some recent estimates have suggested that dementia increases may not be as rapid as previously thought, because vascular dementia has common risk factors with CVD, and these risk factors are improving over time. Some studies have predicted a 2% annual decline in incidence,[18] but if people are living longer with dementia, this may not translate into lower prevalence. Dementia prevalence in the model was based on demographic growth. As with other diseases, if dementia is underdiagnosed, then the model will underestimate the true prevalence. Data suggests that around 72% of dementia is diagnosed in Wirral, which is greater than the England proportion of 68% (data for 2015/16 from the PHOF).[19]

7. Depression

The projecting adult needs population system (PANSI) suggests that prevalence of common mental health disorders is likely to be relatively stable over next ten years. Depression has many causes, but it is estimated that depression prevalence is relatively stable.[20] Because of this, depression prevalence in the model was based on demographic growth. The Wirral data from EMIS is for lifetime diagnosed

[17] http://www.apho.org.uk/resource/item.aspx?RID=111122

[18] https://alzres.biomedcentral.com/articles/10.1186/s13195-016-0188-8

[19] http://www.phoutcomes.info/search/dementia#page/0/gid/1/pat/6/par/E12000002/ati/102/are/E08000015

[20] Kings Fund (2008) Paying The Price: The cost of mental health care in England to 2026. https://www.kingsfund.org.uk/sites/files/kf/Paying-the-Price-the-cost-of-mental-health-care-England-2026-McCrone-Dhanasiri-Patel-Knapp-Lawton-Smith-Kings-Fund-May-2008_0.pdf p 17 says "The view of epidemiologists contacted reinforces this finding that the prevalence of depression is relatively stable."

prevalence of depression rather than for a set period of time, so will include a proportion of people who have recovered from depression.

8. Diabetes

Type 1 diabetes is increasing slightly over time but researchers are uncertain as to why this is. Type 2 diabetes is mainly caused by obesity which peaked in around 2003 after increasing steadily since the 1970s so is likely to increase over the next 20 years. Diabetes prevalence was estimated using PHE's diabetes prevalence model which gives data at CCG and local authority level.[21]

9. Epilepsy

A study in 2013 suggested that childhood epilepsy rates had declined by 4% per year between 2001 and 2008, which may have been partly related to the introduction of a series of meningitis vaccines in 1992, 1999 and 2006, as well as a reduction in traumatic head injuries in young children.[22] It may have also been due to changes in definitions and more specificity in epilepsy diagnosis. However, if this trend was due to step changes in policy such as vaccinations, it may not be a continuing trend. For this reason, we have assumed that epilepsy changes will go along with demographic growth.

10. Heart Failure

Heart failure is mainly caused by CHD, and as survival rates for myocardial infarction and CHD have increased, so prevalence rates of heart failure have increased. Other causes of heart failure include COPD and left ventricular systolic dysfunction (LVSD). We could not find any epidemiological studies reporting trends or projections for heart failure in the UK. QOF heart failure prevalence has been fairly stable over the last ten years both for England and for Wirral. We assumed that heart failure will change with demographic growth.

11. Hypertension

Recorded QOF prevalence of hypertension has increased nationally and in Wirral over the last ten years, but this may be because of better identification, such as through NHS healthchecks; as well as demographic change. There are prevalence

[21] PHE diabetes prevalence model (2017) https://www.gov.uk/government/publications/diabetes-prevalence-estimates-for-local-populations

[22] http://adc.bmj.com/content/98/3/195

estimates for hypertension by local authority commissioned by PHE for 2014, but these do not include projections. Hypertension has been assumed to change with demographic growth.

12. Mental Health (Severe Mental Illness)

The severe mental illness categories used in primary care are largely psychoses, that is, schizophrenia and bipolar disorder. Bipolar disorder is not expected to increase substantially in the next twenty years.[20] The incidence of schizophrenia is substantially higher for men from some black and minority ethnic (BME) groups which means that as BME populations are increasing nationally, incidence of schizophrenia is likely to increase by around 3%.[20] This BME effect may be due to risk factors like poverty, a lack of social capital, or experiencing racism. This change in prevalence is not likely to be mirrored in Wirral which has quite a relatively small BME population. Use of skunk-type cannabis which has increased over the last 20 years is a risk factor for schizophrenia particularly if people have a certain gene variation[23], and 10-25% of new cases may be caused by cannabis use.[24] It may be that increases in use of synthetic cannabinoids like 'Spice' or 'Mamba' may carry an elevated risk of schizophrenia, as they have been associated with short term psychosis.[25] Overall the literature is inconsistent around trends in schizophrenia incidence and prevalence.[26] Schizophrenia is a risk factor for suicide and early death so keeping people healthier and reducing suicide risk may mean that prevalence increases as people live longer. Overall there was not clear evidence for a trend for severe mental illness so this was assumed to vary with demographic change.

13. Osteoporosis

Some factors, such as increased survival from breast cancer, may lead to increases in osteoporosis rates as it is related to low levels of human oestrogen in women.[27] Published models of osteoporosis trends have used demographic growth as the main driver.[28] For this reason, demographic growth was used for osteoporosis.

[23] https://www.ncbi.nlm.nih.gov/pubmed/15866551?dopt=Abstract
[24] https://www.ncbi.nlm.nih.gov/pubmed/17362293
[25] http://neptune-clinical-guidance.co.uk/wp-content/uploads/2016/07/Synthetic-Cannabinoid-Receptor-Agonists.pdf
[26] http://www.mentalhealth.com/mag1/scz/sb-time.html
[27] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3500398/
[28] http://www.tandfonline.com/doi/abs/10.3111/200104051062

14. Stroke

Stroke prevalence includes people who have survived a major stroke as well as people who have had one or more transient ischemic attacks (mini strokes where symptoms have resolved within 24 hours). Around 1 in 8 strokes are fatal within the first 30 days and 1 in 4 within 12 months but all stroke mortality has fallen and more people are surviving strokes. A study of stroke trends using the UK General Practice Research Database found that stroke incidence fell by 30%, from 1.48/1000 person-years in 1999 to 1.04/1000 person-years in 2008 while stroke prevalence increased by 12.5%, from 6.40/1000 in 1999 to 7.20/1000 in 2008. For the model we have used UK Health Forum scenario 0 for trends in stroke prevalence.

15. Chronic Kidney Disease

The diagnosed (observed) CKD in NHS Wirral CCG is 4.9%. The estimate of total levels of CKD (diagnosed and undiagnosed) in the population is 6.9% which means around 20% may be undiagnosed.[29] Prevalence increases steeply with age, from 1 in 800 people aged 16-34 up to 1 in 3 people aged over 75. People may have some functional recovery from CKD if they have a kidney transplant so future burden of disease may depend on availability of transplants. A study looking at how chronic kidney disease stage 3-5 prevalence had changed over time in England found that prevalence had fallen, despite risk factors like obesity and diabetes prevalence increasing over the same time period.[30] There was a model developed for CKD but the projections in this model used demographic growth so for this reason we have used demographic growth only.[31]

[29] http://info.wirral.nhs.uk/document_uploads/JSNA%202017/e38000208%20Kidney%20PHE%20June%202017.pdf
[30] http://bmjopen.bmj.com/content/4/9/e005480
[31] https://www.renalreg.org/wp-content/uploads/2014/10/CKD-prevalence-final.pdf

12. Appendix 2. Additional Model Results

Table 6 to 8 show the results for numbers of people with LTCs and QALYs lost over the five years from 2016-2021.

Table 6. Estimated number of people living with long term conditions in Wirral, cost of LTC admissions, and LTCs / person, years 2016-2021.

Long Term Condition	Year 2016	Year 2017	Year 2018	Year 2019	Year 2020	Year 2021
Asthma	39,171	39,173	39,176	39,178	39,180	39,183
Atrial Fibrillation	7,720	7,865	8,010	8,155	8,300	8,445
Cancer	10,516	10,660	10,803	10,946	11,090	11,233
CHD	11,493	11,501	11,510	11,519	11,528	11,536
COPD	7,891	7,956	8,020	8,085	8,149	8,214
Dementia	2,738	2,794	2,851	2,907	2,963	3,019
Depression	57,767	57,796	57,824	57,853	57,881	57,910
Diabetes	17,883	18,028	18,172	18,317	18,462	18,606
Epilepsy	4,479	4,487	4,496	4,504	4,512	4,520
HF	3,126	3,186	3,245	3,304	3,364	3,423
Hypertension	47,492	48,086	48,680	49,274	49,868	50,463
LD	659	656	654	652	649	647
Mental Health	1,009	1,011	1,012	1,013	1,015	1,016
Osteoporosis	9,252	9,391	9,531	9,670	9,809	9,949
Stroke	3,451	3,418	3,385	3,352	3,319	3,286
Chronic Kidney Disease	14,801	15,046	15,291	15,535	15,780	16,024
N LTCs	222,223	227,273	232,323	237,373	242,423	247,474
population	321,304	322,020	322,736	323,451	324,167	324,883
cost of LTC admissions (£)	42,195,804	42,546,542	42,897,280	43,248,018	43,598,756	43,949,494
LTCs/person	0.69	0.71	0.72	0.73	0.75	0.76

Table 7. Estimated morbidity-related QALYs (quality adjusted life years) lost through diagnosed long term conditions in Wirral, years 2016-2021.

Long Term Condition	Year 2016	Year 2017	Year 2018	Year 2019	Year 2020	Year 2021
Asthma	1,815	1,815	1,815	1,815	1,816	1,816
Atrial Fibrillation	296	302	308	313	319	324
Cancer	722	732	742	752	762	772
CHD	780	781	781	782	782	783
COPD	755	761	767	773	780	786
Dementia	186	190	194	198	201	205
Depression	6,490	6,493	6,496	6,499	6,503	6,506
Diabetes	1,277	1,288	1,298	1,308	1,319	1,329
Epilepsy	179	179	179	180	180	180
HF	365	372	379	385	392	399
Hypertension	2,186	2,214	2,241	2,268	2,296	2,323
LD	17	17	17	17	17	16
Mental Health	121	121	121	122	122	122
Osteoporosis	336	341	346	351	356	361
Stroke	200	198	196	194	192	190
Chronic Kidney Disease	1,634	1,661	1,688	1,715	1,742	1,769
QALYs from LTCs	16,237	16,600	16,964	17,328	17,691	18,055

Table 8. Morbidity and mortality related QALYs lost per year from long term conditions in Wirral, based on data from 2016.

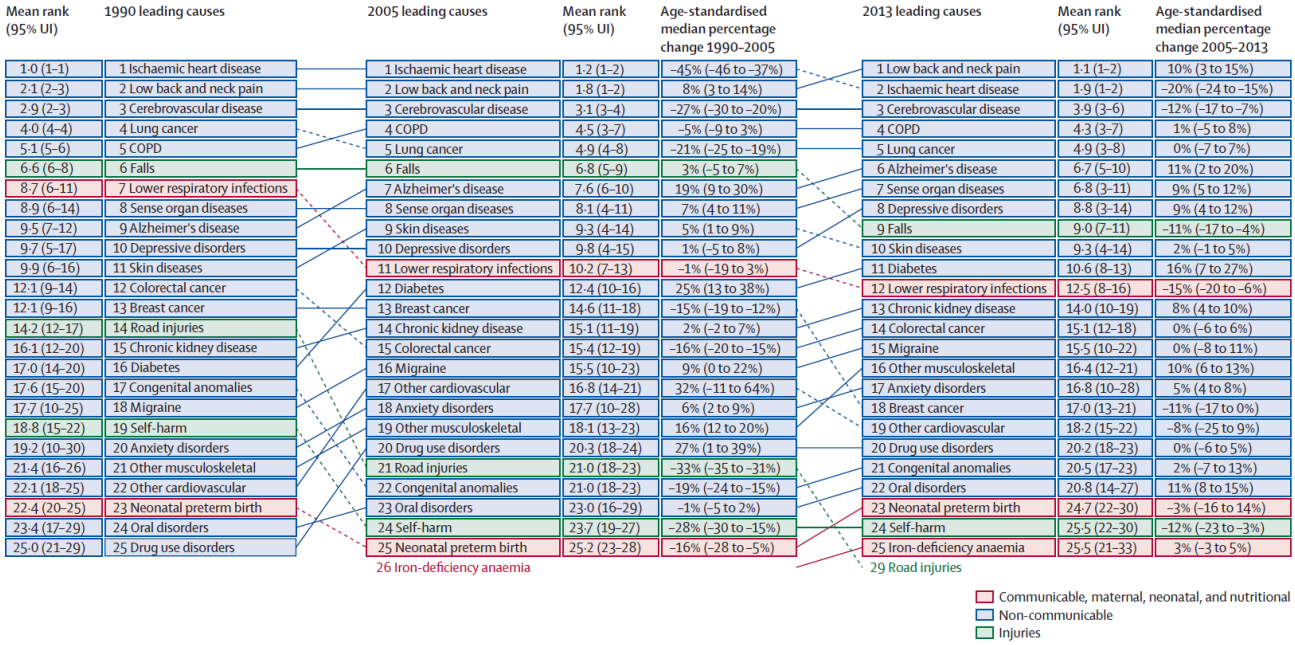
Disease group	Morbidity related QALYs (all ages)	Mortality related QALYs (under 85)
Asthma	1,815	21
Atrial Fibrillation	296	82
Cancer	722	8,678
CHD	780	2,340
COPD	755	1,759
Dementia	186	424
Depression	6,490	
Diabetes	1,277	164
Epilepsy	179	172
HF	365	127
Hypertension	2,186	116
LD	17	
Mental Health	121	
Osteoporosis	336	
Stroke	200	1,139
Chronic Kidney Disease	1,634	6

13. Appendix 3. COPD Diagnostic Criteria.

Severity of airflow obstruction

		NICE 2004	GOLD 2008	NICE 2010
Post-bronchodilator FEV1/FVC	**FEV1 % predicted**	**Post-bronchodilator**	**Post-bronchodilator**	**Post-bronchodilator**
< 0.7	≥ 80%		Stage 1 – Mild*	Stage 1 – Mild*
< 0.7	50-79%	Mild	Stage 2 - Moderate	Stage 2 - Moderate
< 0.7	30-49%	Moderate	Stage 3 - Severe	Stage 3 - Severe
< 0.7	< 30%	Severe	Stage 4 - Very severe**	Stage 4 - Very severe**
*Symptoms should be present to diagnose COPD in people with mild airflow obstruction ** Or FEV1 < 50% with respiratory failure				

14. Appendix 4. Change in main causes of DALYs in England, from 1990-2005-2013, from Global Burden of Disease (GBD).



15. Appendix 5. Estimated deaths by risk factor in Wirral, 2015. Based on GBD data for North West of England.