Type 2 diabetes: estimating the impact of different uptake scenarios of SGLT-2 inhibitors in individuals in UK primary care

1. Introduction

Economic evaluations are a key component of NICE's work, influencing decisions on the commissioning of treatments and interventions for effective NHS and public sector resource use. However, these often do not consider how treatments and interventions may affect health inequalities. To address this gap, methods like distributional cost-effectiveness analysis (DCEA) have been developed to analyse the impact of healthcare interventions on health inequalities related to socioeconomic factors and disadvantaged groups.

NICE is currently piloting a prototype health inequality impact calculation tool developed by the University of York (Prototype Health Equity Impact Calculator (york.ac.uk)). This tool assesses the potential impact of interventions on health inequalities by analysing health effects across indices of multiple deprivation (IMD) quintiles. It is designed to help committees consider how their recommendations may impact health inequalities. Further details regarding the tool are available in the associated report (CHE Research Paper 193).

This analysis explores the distributional health impact of different scenarios for uptake of SGLT-2 inhibitors on adults diagnosed with type 2 diabetes (T2DM). This report provides a brief overview of the methodology used to generate input parameters for the tool, results from the tool and interpretation of the findings for future decision-making.

Executive Summary

NICE’s economic evaluations are important for informing decisions on the allocation of resources for NHS treatments. However, they often miss how these interventions may impact health inequalities. To address this, NICE is piloting a new tool developed by the University of York. It looks at how

interventions might affect health inequalities by analysing health effects across different levels of deprivation.

This document presents the results obtained from using the tool to analyse the uptake and health effects of SGLT-2 inhibitors in individuals aged 18 and over who have type 2 diabetes (T2DM) and a comorbidity.

Key findings:

Prevalence of T2DM and Comorbidities: The highest prevalence of T2DM and related comorbidities is found in the most deprived groups. Variation in prevalence is the key determinant of the estimated quality adjusted life years (QALYs) gained from SGLT-2 inhibitors assuming equal uptake, effectiveness and opportunity costs across deprivation groups.

SGLT-2 Inhibitor Uptake: Uptake of SGLT-2 inhibitors is low across most subgroups (around 22%), with slightly higher uptake in individuals with T2DM and congestive heart failure (CHF) (30%) and those with early onset T2DM (17-24%). Additionally, uptake is relatively uniform across different levels of deprivation.

Potential Health Benefits from Increased Uptake: A scenario analysis of individuals with T2DM, obesity, and a high risk of developing CVD suggests that increasing SGLT-2 uptake could lead to substantial health benefits. Raising uptake from 22% to 80% could raise total health benefits from 52,898 QALYs to 192,355 QALYs. However, high opportunity costs (191,706 QALYs) reduce the overall net gains.

Impact on Health Inequalities: The most deprived groups experience the greatest health benefits due to their larger population size. While total health benefits are positive across all population groups, opportunity costs limit net benefits. These remain positive for the most deprived groups but turn negative for some populations, particularly in the least deprived, where they are negative except for individuals with T2DM and CKD.

Impact of Opportunity Cost Distribution: A scenario analysis of individuals with T2DM, obesity, and a high risk of developing CVD found that introducing

a slight or moderate gradient in opportunity costs, where costs are highest in the most deprived groups and lowest in the least deprived, reduced net health benefits for the most deprived group while increasing them for the least deprived. Even so, total net health benefits remain unchanged and stayed positive. .

Cost-Effectiveness: The economic analyses found SGLT-2 inhibitors were cost effective for three of the seven populations analysed. Individuals with T2DM and chronic kidney disease (CKD) had positive total and net health benefits across all deprivation groups. Those with T2DM, obesity and a high risk of developing CVD also showed overall positive total heath and net health benefits, but net benefits were negative in the less deprived groups (IMD 3 to 5). For the remaining two populations net benefits were negative across three or more deprivation levels despite positive total health gains. For these groups, the health benefits provided by SGLT-2 inhibitors do not sufficiently offset the health losses caused by displacing other interventions to fund this treatment.

Limitations: The analysis has several limitations including assumptions related to distributional inputs, reliance on prescribing data as a proxy for uptake, adherence to treatment regimens, evaluating SGLT-2 inhibitors as a generic class, and the exclusion of other equality related factors such as age, gender and ethnicity.

Conclusion

The Health and Social Care Act 2012 mandates that the NHS and public bodies consider health inequalities in decision-making, and these analyses provide insights into the potential positive and negative impacts on health inequities. They highlight the complexities of balancing health benefits with opportunity costs. While increasing medication uptake can improve outcomes for all, especially the most deprived, careful resource allocation is required to maximise overall population health benefits.

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2. Methods

The prototype tool was used to estimate the distribution of net health benefits (measured in QALYs) on adults diagnosed with T2DM across five deprivation groups based on the Index of Multiple Deprivation (IMD). The IMD measures relative levels of deprivation in 32,844 small areas or neighbourhoods in England and comprises seven distinct domains of deprivation. This analysis explored various scenarios regarding the uptake of SGLT-2 inhibitors.

The four inputs needed for the tool for the present analysis are as follows:

1) Data on the number of people with T2DM and a given comorbidity in each deprivation quintile in England.

2) Data on the uptake of SGLT-2 inhibitors in people with T2DM and a given comorbidity in each deprivation quintile in the UK.

3) Data on the health effects (measured in QALYs) associated with uptake of an SGLT-2 inhibitor for people in each deprivation quintile.

4) Health opportunity costs: the foregone health benefits that could have been provided with alternative use of the resources used for the SGLT-2 inhibitors.

For items 1) and 2), we used data from a cross-sectional analysis of CPRD Aurum on 1st September 2023 to estimate counts of people with T2DM and a given comorbidity and uptake of SGLT-2 inhibitors in that population in primary care practices in the UK. The full details of the methods of analysis are included in this accompanying report, *Uptake of sodium-glucose cotransporter-2 inhibitors in patients with type 2 diabetes: a report for NICE committee members*. CPRD Aurum covers a representative sample of the UK population; we extrapolated from our counts to the population totals with T2DM+ in each IMD quintile in England. We assumed the treatment uptake observed in CPRD held nationally and multiplied the number of patients in each IMD quintile by 5.29. This figure is the ratio of patients aged over 18 in CPRD (n= 8,406,225) to the Office for National Statistics (ONS) estimated population of adults aged 18 years and over in England in 2020

(n=44,456,850). For the analyses of people aged under 40 we recalculated the multiplier as follows. The ONS estimated population of adults aged 18 years to 39 years in England is 16,043,943, while the corresponding figure in CPRD is 2,899,019. Again, assuming that the treatment uptake observed in CPRD holds nationally, we multiplied the number of patients aged 18 years to 39 years in each IMD quintile by 5.53.

Item 3) was taken from the substantive health economic cost utility analysis conducted for 2024 T2DM guideline medicines update. This analysis was presented to the committee and is available in a separate report (Overview | Type 2 diabetes in adults: management | Guidance | NICE). A summary of the incremental QALYs, incremental costs and incremental cost effectiveness ratios (ICERs) for each population group considered in the base-case analyses are shown in Table 1 below.

Table 1: Economic outcomes of SGLT-2 inhibitors for individuals with T2DM by co-morbidity and age group

	Incremental costs	Incremental QALYs	ICER (cost per QALY gained)
T2DM + high risk CVD + living with obesity, age 18+	£4724	0.237	£19,942
T2DM + high risk CVD + living with overweight, age 18+ for	£23,039	0.18	£23,039
Early onset (T2DM + high risk CVD, age 18-39 years)	£6,888	0.25	£28,056
T2DM + aCVD, age 18+	£5,237	0.2394	£21,877
T2DM + CHF, age 18+	£3,154	0.117	£26,919
T2DM + CKD stages 1-3, age 18+	£3,943	0.27	£14,716
T2DM + CKD stage 4, age 18+	£3,381	0.29	£11,666

For Item 4 we used the default values provided in the tool which assume the share of health opportunity costs are evenly distributed across the 5 IMD

groups. These costs are calculated by multiplying the incremental costs from the economic analysis by the total number of recipients and converting them to health opportunity costs using a value of £20,000/QALY. These health opportunity costs are then apportioned equally among all IMD groups, with each group receiving 20%.

As noted earlier, opportunity costs represent the health losses due to intervention costs, because the resources used to fund the intervention could otherwise be used to improve health in other ways. A recent update to the methodology for estimating these costs suggests that treating equality as the base-case in the analysis is a reasonable assumption, in contrast to the previous assumption that opportunity costs disproportionately affect more deprived populations (Cookson and Koh 2023).

In the following section we explore the distributional impact on health outcomes of T2DM medication treatments in the seven subgroups reported in the economic analyses (see Table 1 above). In addition, we explore the effects of increasing uptake of SGLT-2 inhibitors and different assumptions about the distribution of opportunity costs, which reflect the potential health losses that arise when resources are allocated to one intervention rather than others.

3. Results

3.1 Individuals with T2DM, living with obesity and high risk of cardiovascular disease (CVD)

The first set of analyses focus on people with T2DM, living with obesity and a high risk of developing CVD. A summary of the inputs to the tool and corresponding data sources are shown in Table 2.

In England the estimated population aged 18 and over is 44,456,850. The estimated total number of individuals with T2DM, obesity and high-risk of CVD is estimated to be 1,014,532 (ONS/CPRD) resulting in an overall prevalence of 2.3%.

Table 2 shows the gradient in the prevalence of T2DM, obesity and high-risk of CVD, with the highest prevalence found in the most deprived groups (3.0%) and the lowest in the least deprived groups (1.7%). Additionally, the uptake of SGLT-2 inhibitors in this population is relatively uniform, with only small differences between IMD groups.

Table 2 Summary of input parameters for individuals with T2DM, high-risk of CVD and living with obesity by IMD

Data source	**IMD Quintile 1=most deprived**				
	1	**2**	**3**	**4**	**5**
Age 18+ ONS 2020	8416780	9129081	9196807	8989415	8724767
Number of people with T2DM+obesity+high risk CVD (CPRD/ONS)	251,582	234,061	197,386	180,177	151,326
Prevalence of T2DM+obesity+high risk CVD (%)	3.0	2.6	2.1	2.0	1.7
Share of T2DM+obesity+high risk CVD by IMD in total population of T2DM (CPRD)	0.248	0.2307	0.1946	0.1776	0.1492
Uptake of SGLT-2i (CPRD)	0.2218	0.223	0.2235	0.2297	0.2303
Average Incremental QALYs per person for SGLT-2i (economic analysis)	0.237	0.237	0.237	0.237	0.237
Share of opportunity costs	0.2	0.2	0.2	0.2	0.2

Base-case results: Figure 1 shows the distribution of individuals in England with T2DM, obesity and high-risk CVD who have been prescribed SGLT-2

inhibitors. The total number of recipients is 228,350 with the highest number observed in the most deprived group (n=55,806) and the lowest in the least deprived group (n=34,837). Although these results combine both prevalence and uptake, the similar uptake rates across IMD groups mean these findings primarily reflect the prevalence of T2DM, obesity and high-risk of developing CVD.

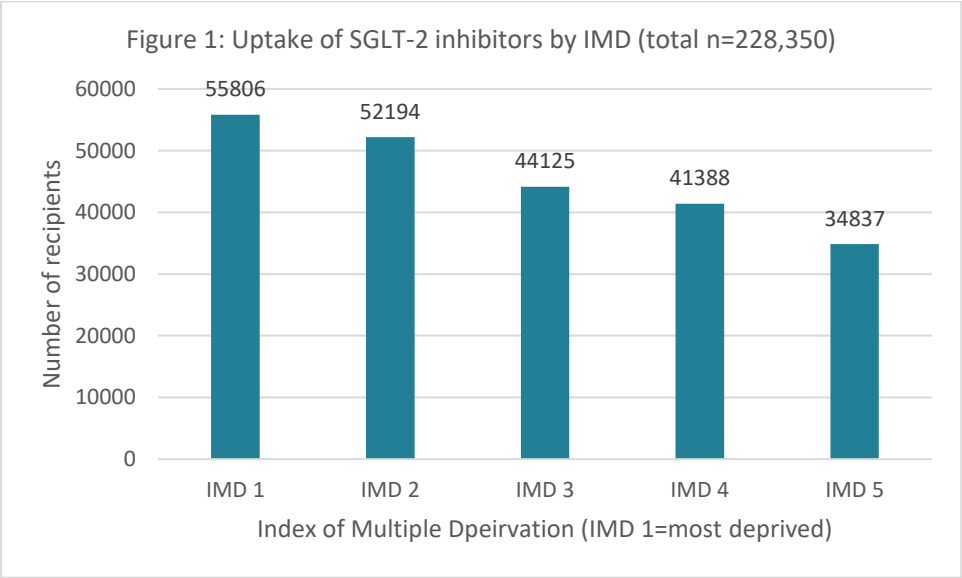
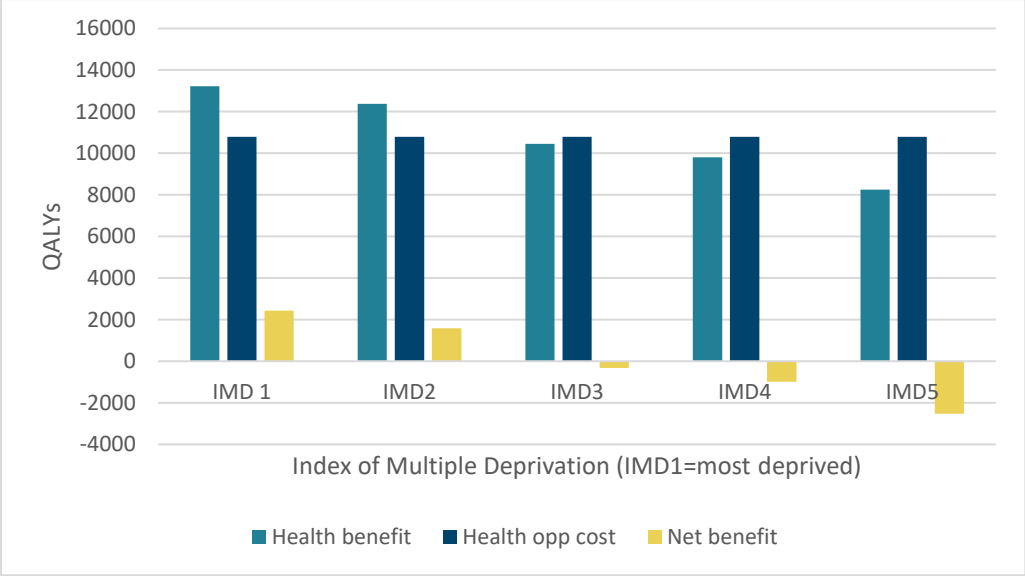


Table 3 and Figure 2 show the distribution of health effects associated with receiving SGLT-2 inhibitors. Health benefits are quantified as QALY gains, while opportunity costs are represented by QALY losses. The net benefit combines these QALY gains and losses. This analysis is based on data from the economic analysis for the intervention and population, which estimated an incremental gain of 0.237 QALYs, incremental costs of £4,724 and an ICER of £19,942/QALY. The results indicate that the total health benefits are positive for all groups, with the highest benefits observed in the most deprived group. However, the net health benefits, which factor in the potential health opportunities lost elsewhere in the system as a result of funding the intervention and are assumed to be equal across all groups, remain positive only for IMD groups 1 and 2. In contrast, for IMD groups 3 to 5 the net benefits turn negative. Nevertheless, it is important to note that the total net health benefits are positive.

Table 3 Distribution of health effects measured in QALYs of SGLT-2 inhibitors in individuals with living with T2DM, obesity and at high-risk of CVD (population totals)

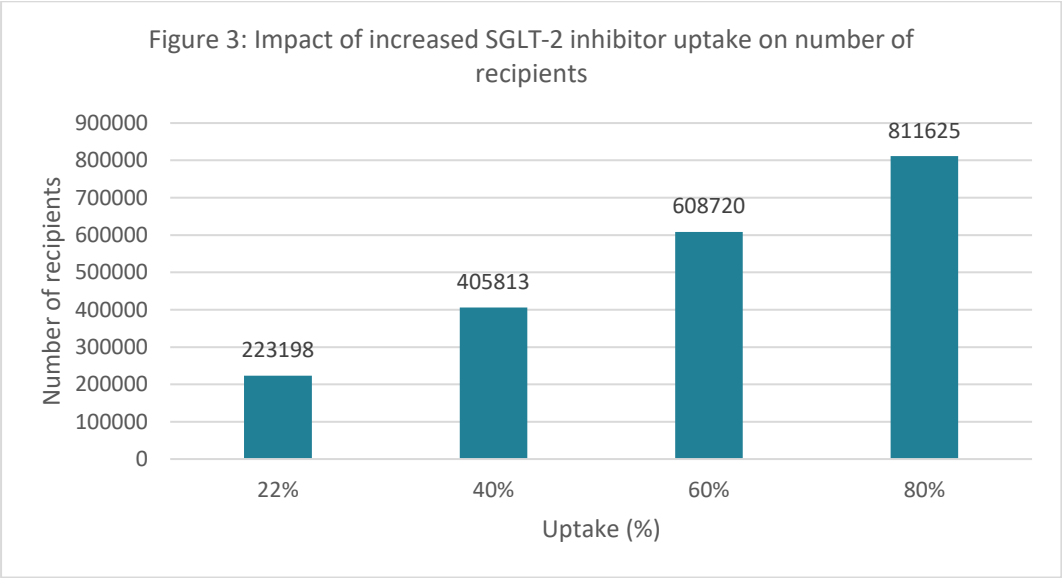
	Index of multiple deprivation (IMD 1 = most deprived)					
Outcome	IMD 1	IMD2	IMD3	IMD4	IMD5	Total
Health benefit	13226	12370	10458	9809	8256	54119
Health opp cost	10787	10787	10787	10787	10787	10787
Net benefit	2439	1583	-330	-978	-2531	183

Figure 2 Distribution of health effects (in QALYs) of SGLT-2 inhibitors in individuals with T2DM, obesity and high-risk of CVD (population totals)



3.1.1 Scenario 1: Impact of increasing the % of individuals with T2DM, obesity and high-risk of developing CVD who use SGLT-2 inhibitors

Figure 3 shows the effects of increasing the uptake of SGLT-2 inhibitors from 22% to 40%, 60% and 80%. For instance, at an uptake of 22% the total number of recipients in England is 223,198 which rises to 811,625 with an increase in uptake to 80%. Additionally, in line with the base-case analysis, the highest number of recipients is found in the most deprived group while the least deprived group consistently shows the lowest numbers across all levels of increase in uptake. Note that this analysis applies a flat 22% uptake rate across IMD groups unlike the base-case results where 'actual' rates varied slightly between 22% and 23%.



The health effects of these increases are shown in Table 4 and Figure 4. As expected, total health benefits increase from 52,898 QALYs with a 22% uptake to 192,355 QALYs with an 80% uptake, with increases observed across all IMD groups. A similar trend is seen in net health benefits though the gains are substantially lower due to associated opportunity costs. Additionally, in line with the base-case analysis, total benefits follow a deprivation gradient, which are highest in the most deprived group and lowest in the least deprived group across all levels of increase in uptake. Overall, net health benefits are positive for the more deprived groups IMD 1 and 2 but negative for IMD groups 3 to 5 as shown in Figure 5. Nevertheless, it is important to note that the total net health benefits are positive. This is in line with the distributional results observed in the base-case analysis.

Table 4 Total health effects of increasing uptake of SGLT-2 inhibitors in individuals with living with T2DM, obesity and at high-risk of CVD

	Increasing uptake of SGLT-2 inhibitors			
Uptake %	22%	40%	60%	80%
Health benefit	52898	96178	144267	192,355
Health opp cost	52719	95853	143780	191706

Net benefit	179	325	487	649

Figure 4: impact of increasing uptake of SGLT-2 inhibitors (IMD groups combined)

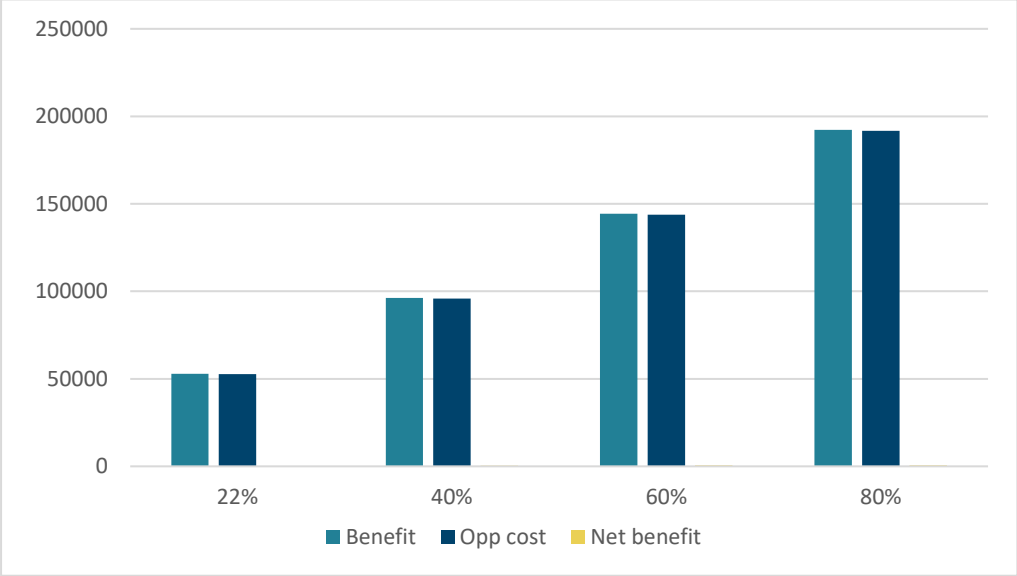
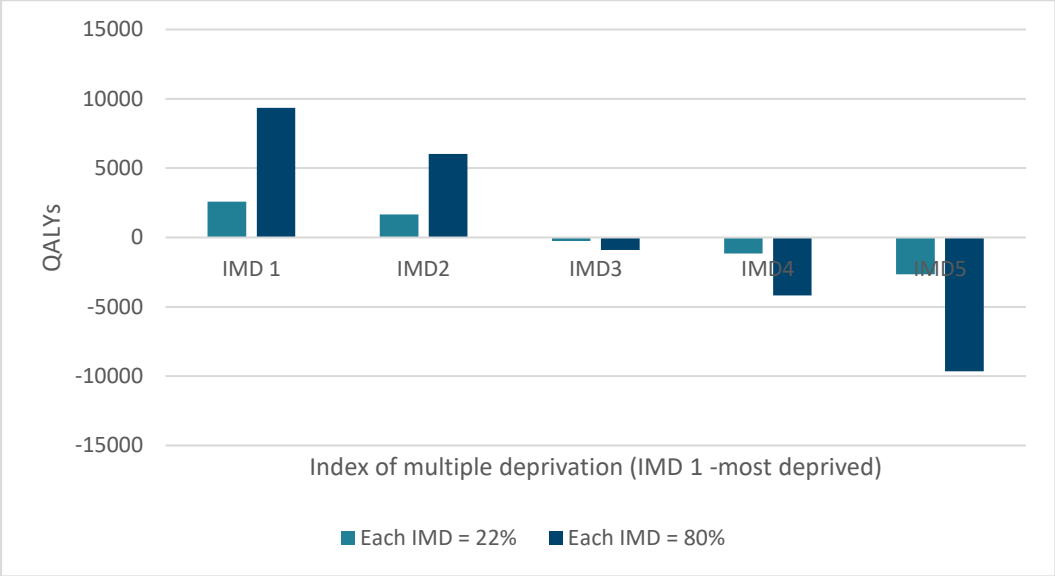


Figure 5: Impact on net benefits of increasing uptake of SGLT-2 inhibitors from 22% to 80%



3.1.2 Scenario 2: Health effects of adjusting the gradient in opportunity costs

In Scenario 2 we explore the impact of changing the assumption that opportunity costs are equally distributed across all IMD groups. This scenario uses the same incremental costs (£4,724) and QALYs (0.237) as the base-case analysis. Table 5 shows how the opportunity costs are distributed across these groups under three different assumptions: a flat, slight or moderate gradient. The flat gradient assumes the opportunity costs are shared equally across the 5 groups with each group absorbing 20%. The slight gradient assumes a higher proportion of these costs fall on the most deprived group (22%) while the least deprived bears the smallest share (18%). The moderate gradient assumes the most deprived group faces an even greater burden, absorbing 24% of the opportunity costs.

Table 5: Share of opportunity costs by IMD across 3 different gradients

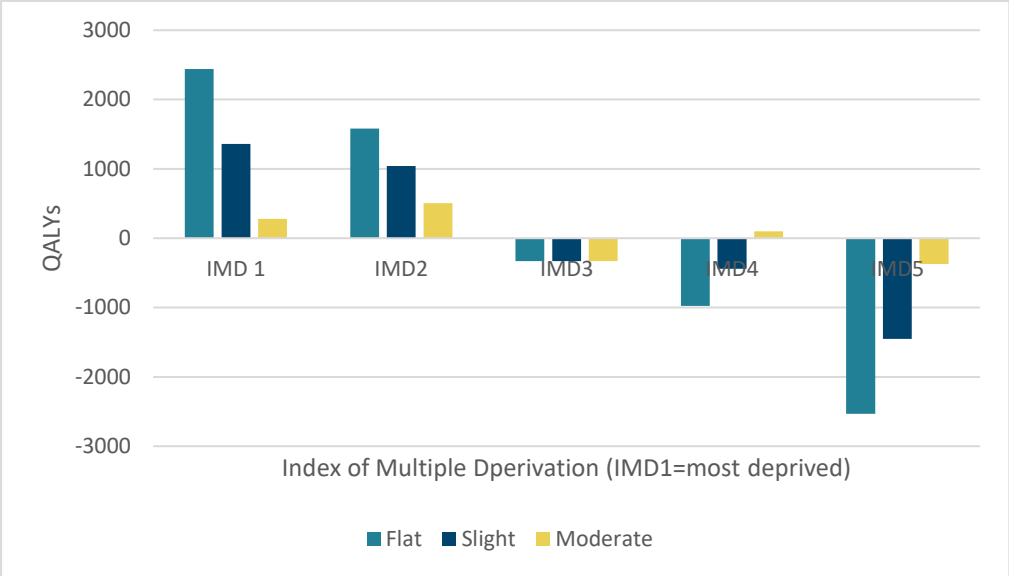
	Share of opportunity costs (IMD 1 = most deprived)				
Gradient	**IMD 1**	**IMD2**	**IMD3**	**IMD4**	**IMD5**
Flat	0.2	0.2	0.2	0.2	0.2
Slight	0.22	0.21	0.2	0.19	0.18
Moderate	0.24	0.22	0.2	0.18	0.16

The net health benefit across all deprivation groups under varying assumptions about the gradient in opportunity costs are shown in Table 6. Although the total net health benefits remain unchanged across all gradients, applying the slight and moderate gradients increases opportunity costs for the most deprived group while reducing them for the least deprived. As a result, net benefits decline for the most deprived group and rise for the least deprived, with the effect becoming more pronounced as the gradient steepens. Under the moderate gradient, this shift results in positive net health benefits for IMD 4 but remain negative for IMD 3 and 5, as shown in Figure 6 (in base-case analysis net health benefits were negative for IMD 3 to 5).

Table 6: Effect on net health benefits of varying the gradient in opportunity costs

	Index of Multiple Deprivation (IMD1=most deprived)					
Gradient	IMD 1	IMD2	IMD3	IMD4	IMD5	Total
Flat	2439	1583	-330	-978	-2531	183
Slight	1360	1043	-330	-439	-1452	183
Moderate	281	504	-330	100	-373	183

Figure 6: Impact on net health benefits of changing the gradient in opportunity costs



3.2 Individuals with T2DM, high risk CVD and living with overweight

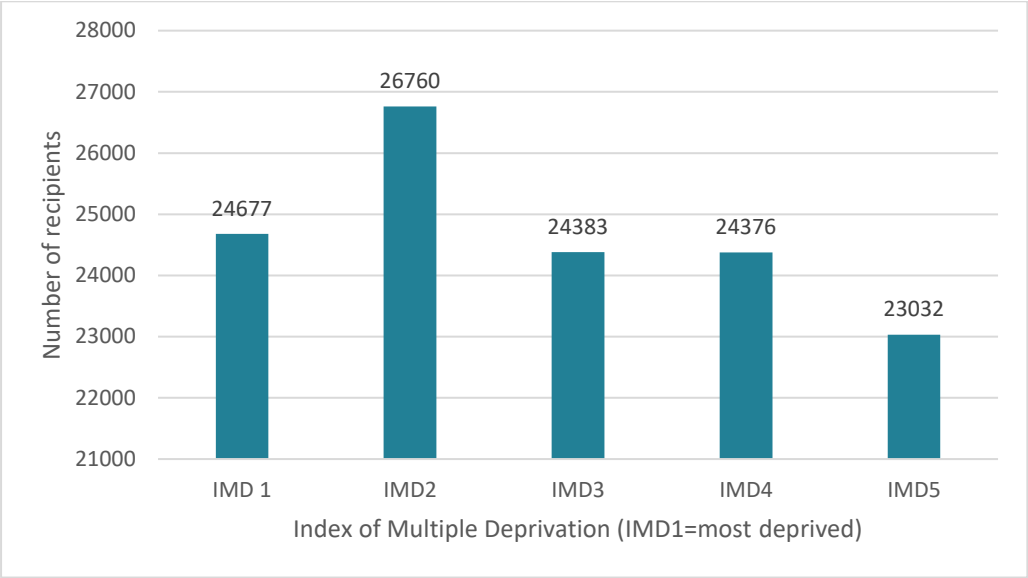
These analyses focus on individuals with T2DM who are living with obesity and at high risk of developing CVD. Table 7 summarises the inputs to the tool and their corresponding data sources. An estimated 582,752 individuals age 18 and over in England have T2DM, are overweight and are at high-risk of developing CVD, equating to an overall prevalence of approximately 1.3%. Table 7 also shows that SGLT-2 inhibitor uptake is similar across IMD groups.

Table 7: Summary of inputs for individuals with T2DM, high risk CVD and living with overweight (n=582,752).

	Index of Multiple Deprivation Quintiles (IMD 1 = most deprived)				
Data source	**IMD 1**	**IMD 2**	**IMD 3**	**IMD 4**	**IMD 5**
Age 18+ ONS 2020	8,416,780	9,129,081	9,196,807	8,989,415	8,724,767
Number of people with T2DM+Overweight+High-Risk CVD (CPRD/ONS)	114,539	126,061	116,597	115,904	109,651
Prevalence of T2DM+Overweight +HR CVD	1.4%	1.4%	1.3%	1.3%	1.3%
Share of T2DM+Overweight +HR CVD	0.1965	0.2163	0.2001	0.1989	0.1882
CPRD Uptake of SGLT-2i	0.2155	0.2123	0.2091	0.2103	0.21
Average Incremental QALYs per person SGLT-2i	0.18	0.18	0.18	0.18	0.18
Opportunity costs	0.2	0.2	0.2	0.2	0.2

Base-case results: Figure 7 shows the distribution of individuals aged 18 and over in England with T2DM, overweight and high-risk CVD that have been prescribed SGLT-2 inhibitors. The total number of recipients is 123,228 with the highest number observed in the second most deprived group (n=26,760) and the lowest in the least deprived group (n=23,032). IMD3, which is the second most populous group, has a similar number of recipients as IMD4.

Figure 7 Distribution of recipients of SGLT-2 inhibitors (n=113,110)



The health impacts of the SGLT-2 inhibitors are shown in Figure 8 and Table 8. These findings are based on the economic analysis conducted for this subgroup which estimated an incremental cost of £4,218 and incremental gain of 0.18 QALYs leading to an ICER of £23,039 per QALY gained. The results show that the total health benefits are positive across all groups. In contrast the net benefits, which take into account the opportunity costs of funding the intervention, are negative across all groups.

Figure 8: Health effects of SGLT-2 inhibitors by IMD

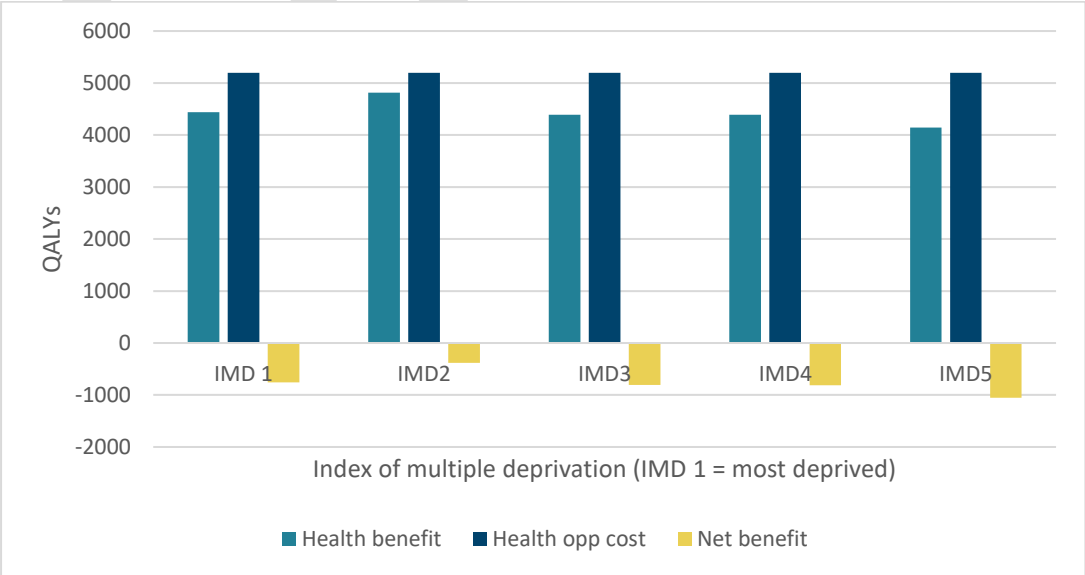


Table 8: Distribution of health effects of SGLT-2 inhibitors (IMD 1 = most deprived)						
Outcome	IMD 1	IMD2	IMD3	IMD4	IMD5	Total
Health benefit	4442	4817	4389	4388	4146	22181
Health opp cost	5198	5198	5198	5198	5198	25989
Net benefit	-756	-381	-809	-810	-1052	-3808

3.3 Individuals aged 18 to 39 with T2DM and high-risk CVD (early onset)

The estimated population in England of people aged 18 years to 39 years is 16,043,943. The estimated total number of individuals with T2DM and high-risk CVD in this age range is estimated to be 12,784 (ONS/CPRD) resulting in an overall prevalence of 0.07%.

Table 9 summarises the inputs to the tool and their corresponding data sources. It shows a gradient in prevalence which is highest in the most deprived group and lowest in the least deprived group. It also shows differences in uptake, with the lowest uptake at 19% in the most deprived group and highest at 24%% in the least deprived group.

Table 9 Summary of input parameters for individuals age 18 to 39 with T2DM and high-risk CVD (n=13,271)

	Index of Multiple Deprivation Quintiles (IMD 1 = most deprived)				
Data source	**IMD 1**	**IMD 2**	**IMD 3**	**IMD 4**	**IMD 5**
Age 18-39 ONS 2020	3,607,589	3,764,352	3,310,463	2,871,162	2,490,377
Number of people with T2DM+HR CVD +<40(CPRD/ONS)	5,058	3,326	2,081	1,367	952
Prevalence of T2DM+HR CVD + <40(CPRD/ONS)	0.14%	0.09%	0.06%	0.05%	0.04%
Share of T2DM+HR CVD+<40 (CPRD)	0.39567	0.26017	0.16277	0.10693	0.07446
Uptake of SGLT-2i (CPRD)	0.1871	0.2097	0.2207	0.2105	0.2442
Average Incremental QALYs per person SGLT-2i	0.25	0.25	0.25	0.25	0.25
Opportunity costs	0.2	0.2	0.2	0.2	0.2

Base-case results: Figure 9 below shows the distribution of individuals in England aged 18-39 years with T2DM and high-risk CVD who have been prescribed SGLT-2 inhibitors. The total number of recipients is 2,622 with the greatest number in the most deprived group (n=946) and the lowest in the least deprived group (n=232). This reflects the population size within each IMD group which masks the difference in uptake of SGLT-2 inhibitors across these groups.

Figure 9 Distribution of recipients of SGLT-2 inhibitors (n=2622)

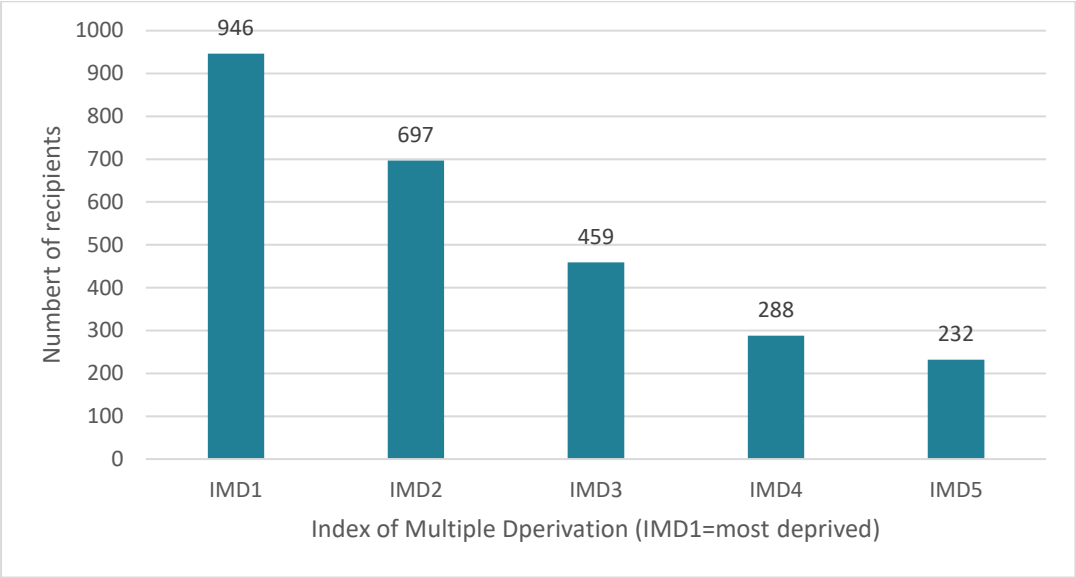


Figure 10 and Table 10 show the health effects SGLT-2 inhibitors, indicating that they provide positive health benefits for all IMD groups. The economic analysis indicated that this treatment offers greater health benefits but is also more expensive than the comparator, with incremental QALYs of 0.25 and incremental costs of £6880 leading to an ICER of £28,056/QALY. As a result of these findings, the opportunity costs, which are assumed to be equally distributed across IMD groups, exceed the health benefits in all but the most deprived group (IMD 1), resulting in negative net health benefits for IMD 2-5.

Figure 10 Health effects (QALYs) of SGLT-2 inhibitors in individuals age 18-39 with T2DM and high-risk CVD

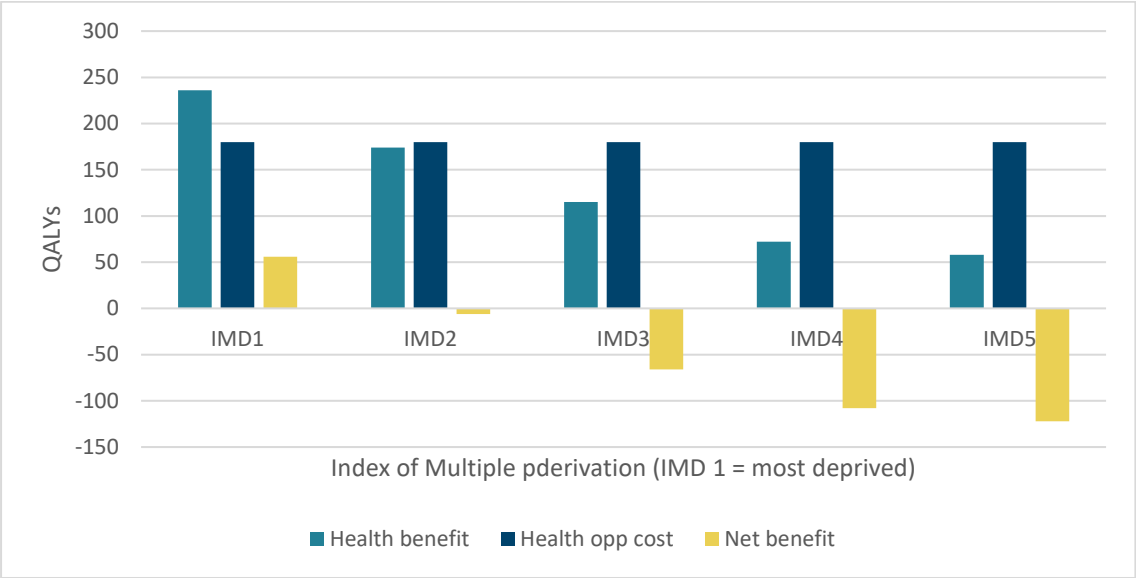


Table 10: Distribution of health effects (QALYs) of SGLT-2 inhibitors in individuals aged 18-39 years with T2DM and high risk CVD

	IMD1	IMD2	IMD3	IMD4	IMD5	Totals
Health benefit	236	174	115	72	58	656
Health opp cost	180	180	180	180	180	902
Net benefit	56	-6	-66	-108	-122	-246

3.4 Individuals with T2DM and atherosclerotic cardiovascular disease (aCVD)

The next set of analyses focus on individuals with T2DM and aCVD. A summary of the inputs and corresponding data sources are shown in Table 11.

The estimated total number of individuals with T2DM and aCVD is 870,586. With a total population of 44,456,850, this results in an overall prevalence of 1.95%. Table 11 shows a gradient in the prevalence of T2DM and aCVD, with the highest rates found in the most deprived groups (2.5%) and the lowest in the least deprived groups (1.6%). The uptake of SGLT-2 inhibitors, estimated using CPRD data, indicates a very slight gradient within this population with

the highest uptake in the most deprived group and the lowest in the least deprived group.

Table 11 Summary of input parameters by IMD for individuals with T2DM and aCVD

	Index of Multiple Deprivation Quintiles (IMD 1 = most deprived)				
Data source	**IMD 1**	**IMD 2**	**IMD 3**	**IMD 4**	**IMD 5**
Age 18+ ONS 2020	8,416,780	9,129,081	9,196,807	8,989,415	8,724,767
Number of people with T2DM+aCVD (CPRD/ONS)	208,987	191,768	166,741	162,387	140,703
Prevalence of T2DM+aCVD	2.5	2.1	1.81	1.81	1.61
Share of T2DM+aCVD	0.2401	0.2203	0.1915	0.1865	0.1616
CPRD Uptake of SGLT-2i	0.2264	0.2208	0.2148	0.2175	0.2114
Average Incremental QALYs per person SGLT-2i	0.2394	0.2394	0.2394	0.2394	0.2394
Opportunity costs	0.2	0.2	0.2	0.2	0.2

Base-case: Figure 11 shows the distribution of the number of individuals with T2DM and aCVD who are prescribed SGLT-2 inhibitors. The total number of recipients is 190,537 and the results show that the number of recipients is largest in the most deprived group and smallest in the least deprived group. These results are primarily a function of the prevalence of T2DM and aCVD across deprivation groups and to a lesser extent the uptake of the intervention which is marginally higher in the most deprived group and lower in the least deprived group.

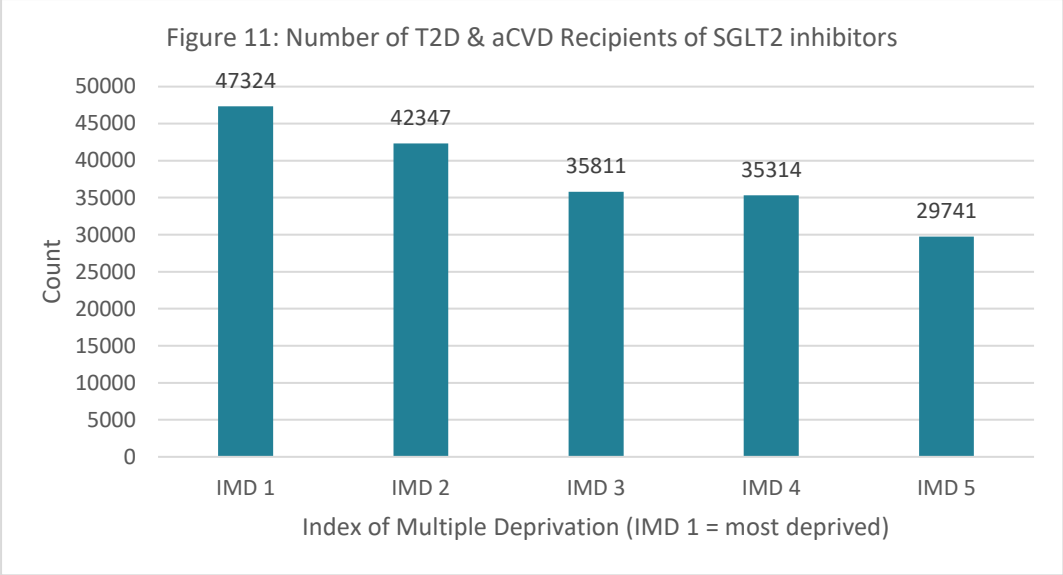


Figure 12 and Table 12 show the distribution of health effects of SGLT-2 inhibitors across different IMD groups. These findings are based on the economic analysis conducted for this subgroup which estimated an incremental cost of £5,237 and incremental gain of 0.2394 QALYs leading to an ICER of £21,877 per QALY gained for this treatment. The results show that the total health benefits are positive across all groups with the highest benefits seen in the most deprived groups. However, when opportunity costs are accounted for net health benefits become negative for IMD groups 3-5 while they remain positive for the most deprived groups (IMD 1 and 2).

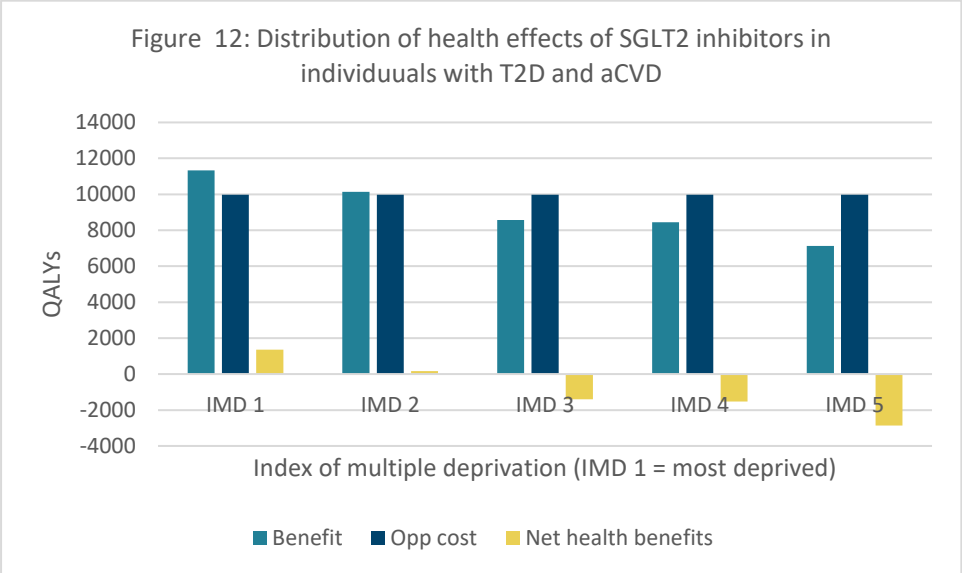


Table 12: Distribution of health effects (QALYs) of SGLT-2 inhibitors in individuals with T2DM and aCVD						
	IMD 1	IMD 2	IMD 3	IMD 4	IMD 5	Totals
Benefit	11329	10138	8573	8454	7120	45615
Opp cost	9978	9978	9978	9978	9978	49892
Net benefits	1351	159	-1405	-1524	-2858	-4278

3.5 Individuals with T2DM and chronic heart failure (CHF)

This next set of analyses focus on individuals with T2DM and CHF. A summary of the inputs to the tool and corresponding data sources is shown in Table 13.

The total number of individuals with T2DM and CHF is estimated to be 258,993 (ONS/CPRD). Given a total population of 44,456,850 this leads to an overall prevalence of 0.58%. Table 13 shows a gradient in the prevalence of T2DM and CHF, with the highest rates found in the most deprived groups (0.81%) and the lowest in the least deprived groups (0.53%). The uptake of SGLT-2 inhibitors, estimated using CPRD data, indicates a relatively uniform distribution within this population, showing no significant patterns across the IMD groups.

Table 13 Summary of input parameters for individuals with T2DM and CHF

Data source	**Index of multiple deprivation (IMD 1 = most deprived)**				
	1	**2**	**3**	**4**	**5**
Age 18+ ONS 2020	8416780	9129081	9196807	8989415	8724767
Number of people with T2DM+CHF (CPRD/ONS)	62,316	56,799	49,869	48,208	41,802
Prevalence of T2DM+CHF	0.74%	0.62%	0.54%	0.54%	0.48%
Share of T2DM+CHF	0.24	0.22	0.19	0.19	0.16

CPRD Uptake of SGLT-2i	0.3014	0.3043	0.2921	0.3116	0.3009
Average Incremental QALYs per person SGLT-2i	0.117	0.117	0.117	0.117	0.117
Opportunity costs	0.2	0.2	0.2	0.2	0.2

Base-case results: Figure 13 shows the distribution of the number of individuals in England with T2DM and CHF who are prescribed SGLT-2 inhibitors. The total number of recipients is 78,224 and the results show that the number of recipients is largest in the most deprived group and smallest in the least deprived group. These results are a function of both the prevalence of T2DM and CHF as well as the uptake of the intervention which is relatively flat.

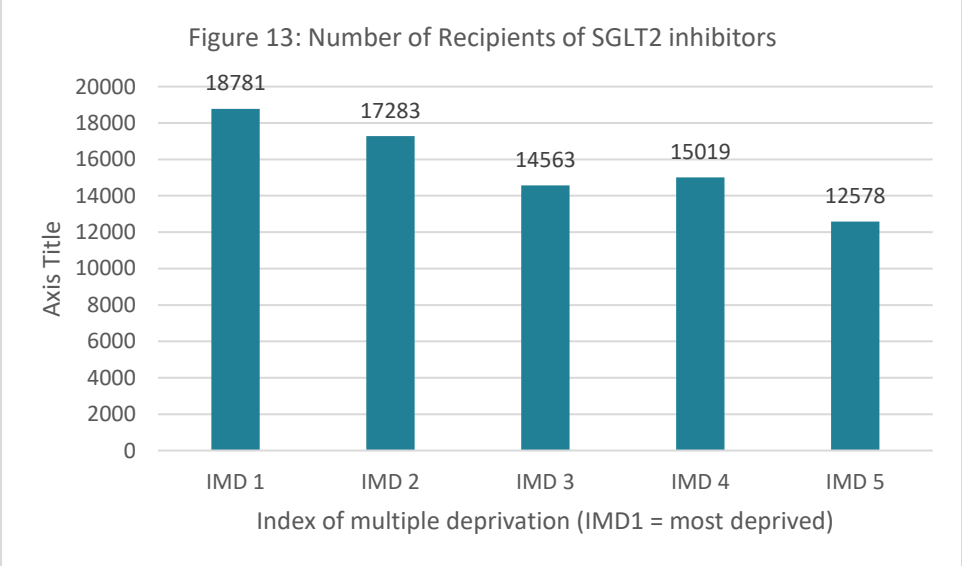


Figure 14 and Table 14 show the health effects SGLT-2 inhibitors based on the economic analysis for this population and intervention which estimated an incremental gain of 0.117 QALYs, incremental costs of £3,154 and an ICER of £26,919 per QALY gained. The results demonstrate that total health benefits are positive across all IMD groups. However, when factoring in the opportunity costs associated with funding the intervention, the net health benefits are negative for all IMD groups 1 – 5. This suggests that the health benefits

provided by SGLT-2 inhibitors do not sufficiently offset the health losses resulting from the other interventions that are displaced to fund this treatment.

Figure 14: Distribution of health effects (QALYs) of SGLT-2 inhibitors in individuals with T2DM and CHF

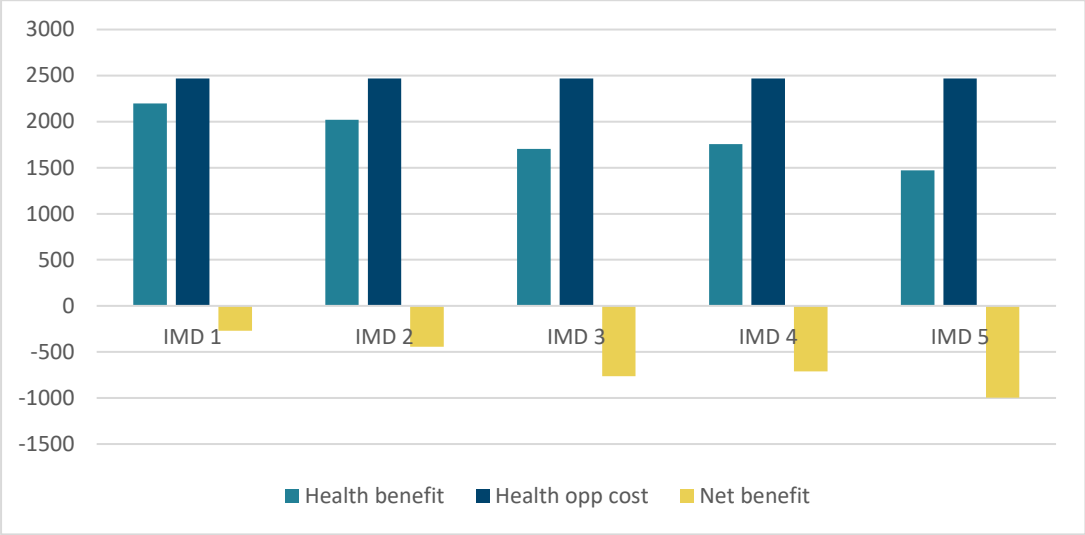


Table 14: Distribution of health effects (QALYs) of SGLT-2 inhibitors in individuals with T2DM and CHF

	IMD 1	IMD 2	IMD 3	IMD 4	IMD 5	Total
Health benefit	2197	2022	1704	1757	1472	9152
Health opp cost	2467	2467	2467	2467	2467	2467
Net benefit	-270	-445	-763	-710	-996	-3184

3.6 Individuals with T2DM and CKD stages 1-3

A total of 991,965 individuals aged 18 and over have T2DM and CKD stages 1-3, representing a prevalence of 2.0% within the overall population of 44,456,850. Table 15 shows the inputs to the health inequalities tool for this population and shows that prevalence is highest in the most deprived group (IMD 1) and lowest in the least deprived group (IMD 5). Additionally, the uptake of SGLT-2 inhibitors is slightly higher among the more deprived groups compared to the less deprived groups.

Table 15 Summary of input parameters by IMD for individuals with T2DM and CKD stages 1-3

	Index of Multiple Deprivation Quintiles (IMD 1 = most deprived)				
Data source	**IMD 1**	**IMD 2**	**IMD 3**	**IMD 4**	**IMD 5**
Age 18+ ONS 2020	8,416,780	9,129,081	9,196,807	8,989,415	8,724,767
Number of people with T2DM+CKD1-3 (CPRD/ONS)	218,853	222,037	196,899	185,928	168,248
Prevalence of T2DM+CKD1-3	2.6%	2.4%	2.1%	2.1%	0.19%
Share of T2DM+CKD1-3	0.22063	0.22384	0.19849	0.18743	0.16961
CPRD Uptake of SGLT-2i	0.2272	0.223	0.2158	0.2147	0.2083
Average Incremental QALYs per person SGLT-2i	0.27	0.27	0.27	0.27	0.27
Share of Opportunity costs	0.2	0.2	0.2	0.2	0.2

Figure 15 shows the distribution of the number of individuals with T2DM and CKD stages 1-3 who have been prescribed SGLT-2 inhibitors. A total of 216,693 are recipients, with the largest number found in the most deprived group and the lowest in the least deprived group. These results reflect both the prevalence of T2DM and CKD stages 1-3 and the uptake of the intervention which both show a decreasing gradient from the most deprived to the least deprived groups.

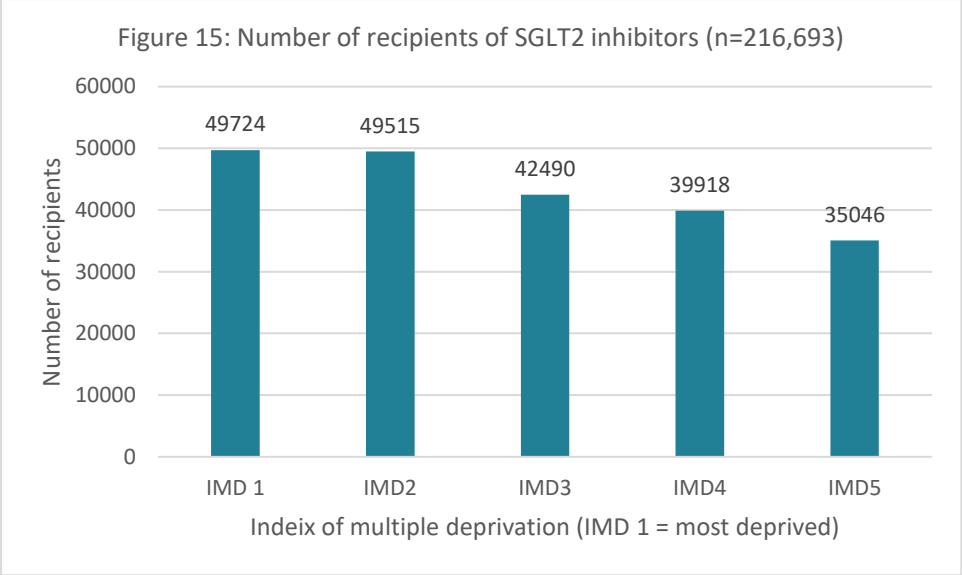


Figure 16 and Table 16 show the health effects SGLT-2 inhibitors. They are based on the economic analysis which estimated an incremental gain of 0.27 QALYs and incremental costs of £3,943 resulting in an ICER of £14,716 per QALY gained. They demonstrate that both total and net health benefits are positive across all IMD groups.

Figure 16: Health effects (QALYs) of SGLT-2 inhibitors in individuals with T2DM and CKD stages 1-3

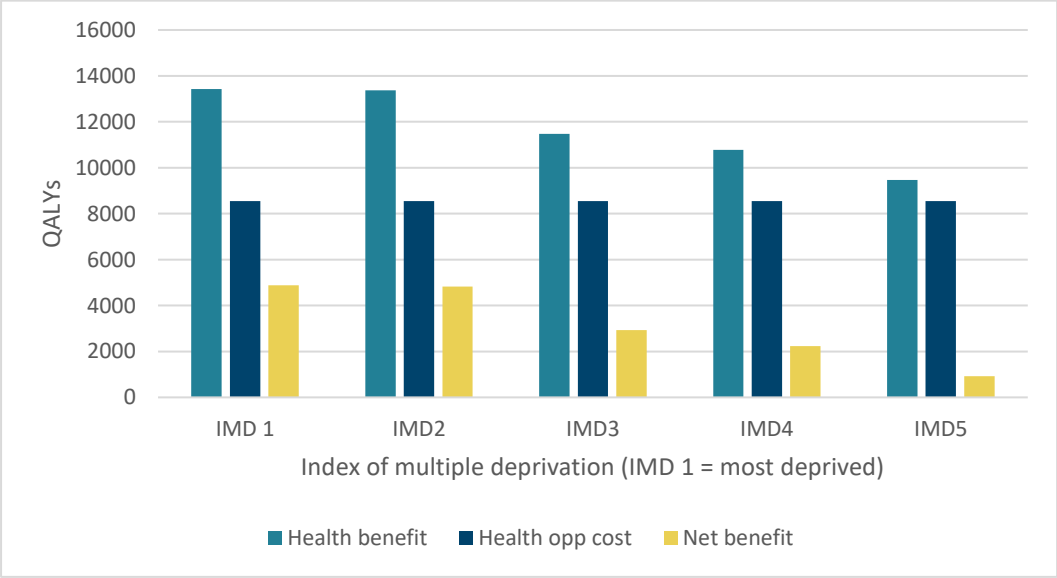


Table 16: Distribution of health effects (QALYs) of SGLT-2 inhibitors (IMD 1 = most deprived)

	IMD 1	IMD2	IMD3	IMD4	IMD5	Total
Health benefit	13425	13369	11472	10778	9462	58507
Health opp cost	8544	8544	8544	8544	8544	42721
Net benefit	4881	4825	2928	2234	918	15786

3.7 Individuals with T2DM and CKD stage 4

A total of 65,247 individuals aged 18 and over in England are estimated to have T2DM and CKD stage 4, representing a prevalence of 0.15% within the overall population of 44,456,850. Table 17 shows the inputs to the health inequalities tool for this population. It shows that prevalence is similar across IMD groups 1-5 with no clear pattern in the uptake of SGLT-2 inhibitors across these groups.

Table 17 Summary of input parameters by IMD for individuals with T2DM and CKD stage 4

	Index of Multiple Deprivation Quintiles (IMD 1 = most deprived)				
Data source	**IMD 1**	**IMD 2**	**IMD 3**	**IMD 4**	**IMD 5**
Age 18+ ONS 2020	8,416,780	9,129,081	9,196,807	8,989,415	8,724,767
Number of people with T2DM+CKD4 (CPRD/ONS)	14,050	14,114	13,241	12,167	11,675
Prevalence of T2DM+CKD4	0.2%	0.2%	0.2%	0.1%	0.1%
Share of T2DM+CKD4	0.21534	0.21631	0.20293	0.18648	0.17894
CPRD Uptake of SGLT-2i	0.227	0.2425	0.2557	0.26	0.2374
Average Incremental QALYs per person SGLT-2i	0.29	0.29	0.29	0.29	0.29

Share of Opportunity costs	0.2	0.2	0.2	0.2	0.2

Figure 17 shows the number of recipients of SGLT-2 inhibitors across the 5 IMD groups. There is no clear discernible pattern among the groups, with the largest number of recipients found in the second most deprived group (IMD2) and the lowest number in the least deprived group (IMD5).

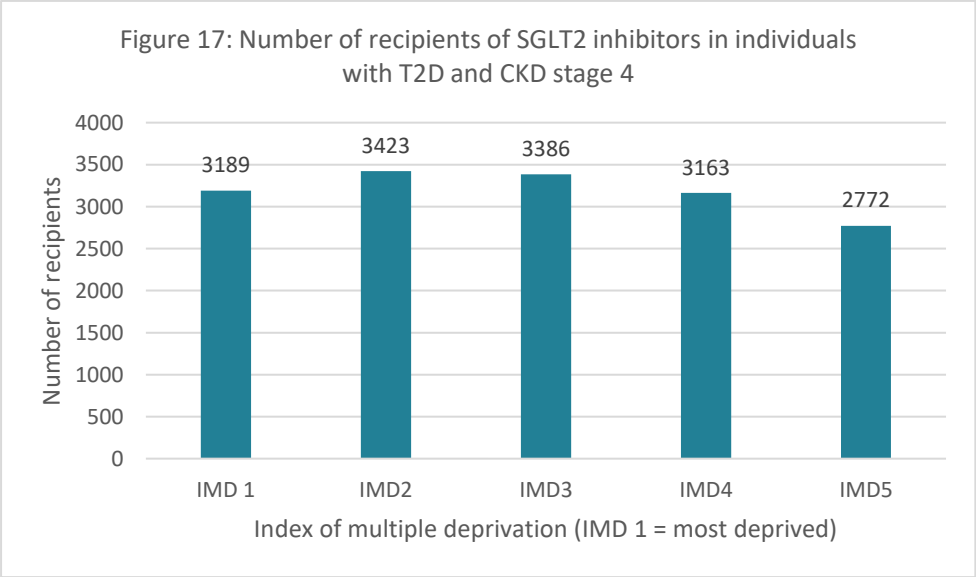


Figure 18 and Table 18 show the health effects SGLT-2 inhibitors. They are based on the economic analysis which estimated an incremental gain of 0.29 QALYs and incremental costs of £3,381 resulting in an ICER of £11,666 per QALY gained. The findings indicate that both total and net health benefits are positive across all IMD groups.

Figure 18: Health effects (QALYs) of SGLT-2 inhibitors in individuals with T2DM and CKD stages 4

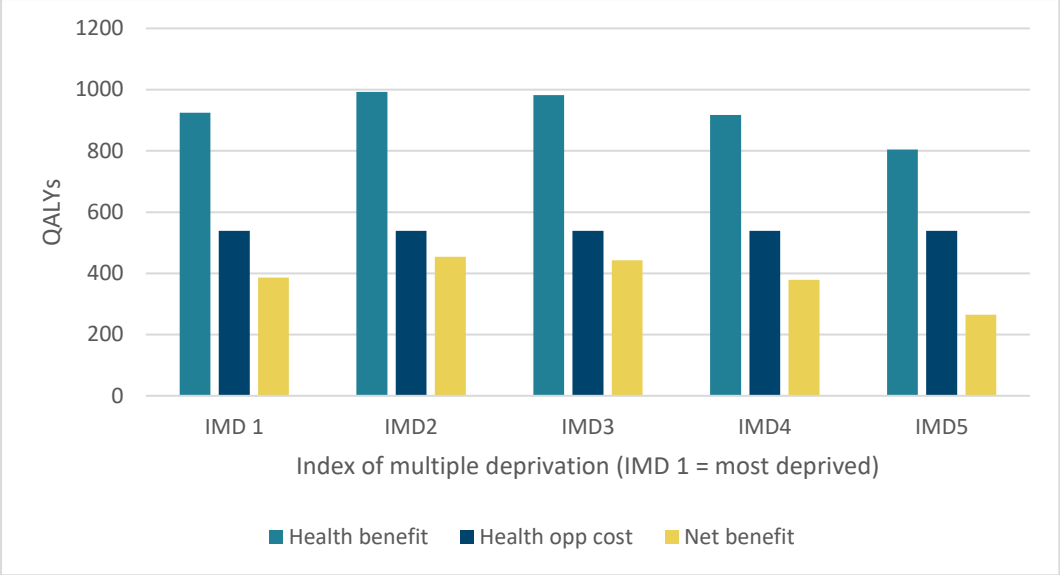


Table 18: Distribution of health effects of SGLT-2 inhibitors in individuals with T2DM and CKD stage 4 (IMD 1 = most deprived)

Outcome	IMD 1	IMD2	IMD3	IMD4	IMD5	Total
Health benefit	925	993	982	917	804	4621
Health opp cost	539	539	539	539	539	2693
Net benefit	386	454	443	379	265	1927

A high-level summary of key findings across the seven population groups is shown in Table 19. For populations where interventions are not cost effective at the £20,000/QALY threshold, total net benefits, which account for opportunity costs, are negative despite positive total health benefits. This trend is largely reflected across all individual IMD groups with two notable exceptions: the early onset group which showed positive net benefits in the most deprived group (IMD1), and individuals with co-morbid aSCVD, who showed positive net benefits in the two most deprived groups (IMD 1 and 2).

For the three populations where the intervention is deemed cost effective, both total and net health benefits are positive. Among two of these groups, those with T2DM and CKD stages 1-3 and stage 4, net benefits are positive across all IMD groups. However, for individuals with T2DM, obesity and HRCVD, net benefits were negative in less deprived groups (IMD 3 to 5).

Table 19 Key findings across seven populations analysed

Population	ICER	Total health benefits	Opportunity costs	Total net benefits	IMDs with negative net benefits
T2DM+HRCVD+obese	£19,942	54,119	53,936	183	-IMD 3to5
T2DM+HRCVD+overweight	£23,039	22,181	25,989	-3808	-IMD 1to5
T2DM+HRCVD+,40 years (early onset)	£28,056	656	902	-246	-IMD 2to5
T2DM+aSCVD	£21,877	45,615	49,892	-4278	-IMD 3to5
T2DM+CHF	£26,919	9,152	12,336	-3,184	-IMD 1to5
T2DM+CKD stages 1-3	£14,716	58,507	42,721	15,786	No negatives
T2DM+CKD stage 4	£11,666	4,621	2,693	1,927	No negatives

4. Discussion

Our analyses indicate that the prevalence of T2DM and a given comorbidity is highest among the most deprived groups. In addition, we found the uptake of SGLT-2 inhibitors is relatively uniform and low, approximately 22% across all IMD groups and five out of the seven population subgroups analysed. The exceptions are individuals with T2DM and CHF where the uptake is higher at around 30% and those with early onset T2DM where uptake is lowest for the most deprived group at 19% and highest for the least deprived group at 24%. Nevertheless, these figures remain low.

Assuming that SGLT-2 inhibitors are equally effective across all groups, the scenario analysis of individuals with T2DM who are living with obesity and at high risk of developing CVD clearly showed that increasing the uptake of these medications could result in substantial health benefits. For example, the current analysis indicates that if the uptake among individuals with T2DM, high-risk CVD and living with obesity could be increased from the current level of just 22% to an ambitious 80%, the total health benefits for this subgroup alone would increase from 52,898 QALYs to 192,355 QALYs.

While net health benefits would also rise - from 179 QALYs to 649 QALYs - the substantial opportunity costs, amounting to 191,706 QALYs, considerably reduce the overall net gains. These findings suggest that while the treatment provides benefits at the individual level and, to a lesser extent, at the population level, the base-case analysis revealed negative net health benefits for the three less deprived groups (IMD 3 to 5). This suggests that an alternative allocation of resources could yield greater overall health benefits for these groups. However, it's worth noting that in this case, the ICER at £19,942/QALY fell just below the cost effectiveness threshold of £20,000 per QALY gained indicating that the treatment provides health benefits at an acceptable cost.

Across some populations, total health benefits were positive across all deprivation levels, but net benefits varied. For individuals with early onset T2DM, net benefits were negative for IMD groups 2 to 5, while for those with co-morbid aSCVD, they were negative for IMDs groups 3 to 5. Additionally, net benefits were negative across all IMD groups for individuals with T2DM at high risk of developing CVD and overweight, and those with T2DM and comorbid CHF. In all four population groups, total net benefits were negative and ICERs exceeded the cost effectiveness threshold of £20,000 per QALY gained. These findings suggest that providing SGLT-2 inhibitors to these groups would not represent good value for money.

Achieving a balance between individual efficacy and population-level efficiency requires careful consideration of opportunity costs and equitable resource allocation. Given finite healthcare resources, broader impacts should be assessed to optimise overall health gains

Furthermore, when uptake rates are similar and effectiveness is assumed to be equal across groups, the key driver of health outcomes by IMD is the prevalence of the condition within each IMD group. The greater health improvements observed in the most disadvantaged groups mainly reflect their larger population size. To effectively address the highest burden of disease and work towards reducing health inequalities, it is important to adopt strategies that focus on reducing the impact within these groups, such as

prioritizing targeted interventions tailored to their needs. However, if the opportunity costs in these groups are underestimated, interventions targeting disadvantaged groups may not achieve the expected benefits as the health benefits arising from other displaced interventions could be even greater. Additionally, it is important to consider approaches that support and promote uptake among these groups which could include outreach for under-represented groups if effective and cost-effective.

A scenario analysis explored how changing the value assigned to the health opportunity costs affected the outcomes. It focussed on the largest subgroup, people with T2DM, at high risk of developing CVD and living with obesity, and found these changes influenced the results. Shifting from a flat distribution to a slight or moderate gradient, where health opportunity costs were highest in the most deprived group and lowest in the least deprived, led to a reduction in net benefits for the most deprived group and an increase for the least deprived. However, this shift was not enough to outweigh the impact of the steep gradient in prevalence of the condition which drove the positive net benefits for IMD groups 1 and 2. Under a slight gradient, net health benefits remained negative for IMD 3 to 5, while under a moderate gradient, net health benefits became positive for IMD group 4 but remained negative for IMD 3 and 5. As previously noted, opportunity costs reflect the loss of potential health gains in other areas of the health care system. These findings underscore the importance of considering how resources are distributed among different IMD groups, especially in the most deprived areas where the cost of displacing resources may be greater.

The economic analyses for the guideline showed that SGLT-2 inhibitors are cost effective in three of the seven populations considered, all of whom had T2DM but differed in their co-morbidities. While total health benefits were positive for all seven populations, the distributional analysis, incorporating opportunity costs, revealed significant variations in net benefits across IMD groups and populations.

For individuals with T2DM and CKD (stages 1 to 3 or stage 4), both total and net health benefits were positive across all IMD groups with ICERS below the

cost effectiveness threshold (£14,716/QALY and £11,666/QALY respectively). In contrast, for individuals with T2DM at high risk of developing CVD and living with obesity, net benefits for IMD groups 3 to 5 were negative, indicating that the health gains from SGLT-2 inhibitors for these groups do not fully offset the health losses incurred elsewhere in the healthcare system due to the reallocation of resources. However, this does not mean the intervention is ineffective or harmful as the total positive health benefits demonstrate clear value. Notably, the ICER for this population was £19,942/QALY which remains below the cost effectiveness threshold.

For individuals with T2DM, high risk of developing CVD and who are overweight, those with early onset T2DM, those with aSCVD and those with CHF, total net health benefits were negative. Variations across IMD were observed with those who are overweight and those with CHF showing negative net health benefits across all IMD groups. Given that these four groups also had ICERs exceeding the cost effectiveness threshold, providing SGLT-2 inhibitors for these populations would not represent good value for money.

These findings highlight a trade-off at the population level, necessitating decisions aimed at balancing the maximisation of health benefits against the health losses resulting from the uneven impacts across different deprivation groups.

The Health and Social Care Act 2012 introduced legal duties for the NHS and other public bodies to consider health inequalities when making decisions. By showing the health impacts and opportunity costs across different levels of deprivation quintiles, from the most deprived to least, these analyses can highlight the positive and negative effects on health inequalities. Ultimately, it aims to facilitate discussions that ensure new investments yield greater benefits for the most disadvantaged groups compared to current practices.

Importantly, the prevalence of T2DM and specific comorbidities shows a gradient across deprivation groups, with the highest rates found in the most deprived populations. While targeting this condition may not necessarily close

the gap between the most and least deprived groups, it will positively impact all groups, particularly the most deprived, which also represent the largest population cohort.

5. Limitations

One of the key limitations of the analyses reported here concern the assumptions surrounding the distributional inputs used in the tool. The tool uses 4 main inputs. The first two inputs - prevalence of the condition and uptake of the intervention - were estimated using data from CPRD. Consequently, any limitations within that dataset and corresponding analyses are applicable here as well. The third input, effectiveness, was taken from the network meta-analysis and comprehensive economic model, so any limitations associated with those sources are also relevant. Lastly, the input for opportunity costs was assumed to be evenly distributed across IMD groups; however, the evidence base regarding this distribution is relatively limited and is still evolving.

A second limitation arises from the use of prescribing data from CPRD as a proxy for actual intervention uptake. Although prescription data indicate that a medication has been prescribed, we do not know whether it was dispensed and, even if dispensed, we do not know whether the recipient has actually taken the medication. Additionally, other factors such as the number of patients who start the treatment but subsequently stop it, as well as the reasons behind these choices are unknown. In the absence of other evidence, evaluating how accurately prescribing data represents real intervention uptake is challenging.

A third limitation, closely related to the second, concerns adherence to treatment regimens. Simply receiving a prescription does not guarantee the medication has been taken or that the patient is adhering to the prescribed regimen. Both adherence and actual medication intake influence the effectiveness of interventions and variations in these factors might differ widely among populations.

A fourth limitation relates to the consideration of SGLT-2 inhibitors as a generic class rather than evaluating the individual treatments within that class. The economic analysis indicated that the individual treatments differed in their risk and benefit profiles. These differences may impact the distribution of health effects reported in the current analyses.

The final limitation concerns other equality related characteristics of the population that were found to differ across groups, including factors such as age, gender and ethnicity. An overarching analysis of uptake data (ref PM report) identified these factors as significant but they have not been explored in the current analysis which focuses on social distribution.

Annex 1: Examples of health inequality related recommendations

What are the most effective and cost-effective methods to promote increased access to, and uptake of, treatments for people with depression who are under-served and under-represented in current services? [NG222 Depression]

1.6.26 Commissioners, providers and healthcare professionals should address inequalities in CGM access and uptake by:

- monitoring who is using CGM
- Identifying groups who are eligible but who have lower uptake
- Making plans to engage with these groups to encourage them to consider CGM. [2022]

Be aware of the impact of health inequalities (for example deprivation), on outcomes for people with spinal metastases or MSCC. Ensure that:

- information is collected and analysed by local services to identify any health inequalities
- education is provided within services on reducing local health inequalities
- reasonable adjustments are made by local services to address any health inequalities. (draft)

2 Adherence and satisfaction to interventions to reduce arm and shoulder problems

What is the adherence to, and satisfaction with, different intervention formats (for example individual, group, virtual, and face to face) to reduce arm and shoulder problems after breast cancer surgery or radiotherapy, and what is the impact of greater adherence on effectiveness for different groups, such as:

- women, men, trans people and non-binary people
- people from minority ethnic family backgrounds
- people with disabilities
- neurodiverse people?