



Care Pathways: Guidance on Appraising Sustainability

Case Study: Type 2 Diabetes Management Care Pathway

October 2015

Coalition for Sustainable Pharmaceuticals and Medical Devices (CSPM) www.sduhealth.org.uk/cspm

Title:	Lifelong Type 2 Diabetes Management Care Pathway
Organisation(s) completing study:	Novo Nordisk Environmental Resources Management
Contact details:	Anne Gadegaard (agln@novonordisk.com) Tom Penny (tom.penny@erm.com)
Completion date:	26 th August 2015
Assurance:	Internal assurance
Supporting information:	None provided

Summary

Introduction

Two scenarios have been investigated comparing good management of type 2 diabetes (considered as maintaining a glycated haemoglobin level, HbA1c, of 6.5%) with poor management (considered as maintaining a glycated haemoglobin level, HbA1c, of 8.4%) for the lifetime of the patient.

Reason for study

The interest in completing this study is to better understand the trade-off between the environmental impacts associated with good management of type 2 diabetes when compared with the environmental impacts associated with complications that arise from poor management. Of additional interest is to investigate the significance of better self-management and lifestyle changes.

Conclusion

The GHG emissions associated with good management are 1,740 kg CO₂e for the duration of the care pathway. On an annual basis, this equates to 144 kg CO₂e / year per patient. By 2025, an estimated nearly 5 million people in the UK will have type 2 diabetes ⁽¹⁾ and extrapolating the findings, good management of diabetes will have an estimated GHG impact of 720,000 tonnes CO₂e per year.

When comparing management scenarios, the well-managed scenario has a 3% lower GHG impact in total, despite the longer patient lifetime. On a per year basis, the well-managed scenario has a 7% lower GHG impact when compared to the poorly managed scenario. General diabetes management (ie pharmaceutical consumption, blood glucose testing and regular GP visits) is the most significant contribution to the impact, followed by the impact of complications to the feet. The top three contributions for both scenarios are pharmaceutical consumption, patient travel and inpatient admissions. The order of significance of these three contributions may change as more accurate data are incorporated into the appraisal.

Scope

Description of pathway

Management of type 2 diabetes is considered in this appraisal. Health economics data have been used to model different management scenarios. Two scenarios are modelled: the first where the patient is in good control of their condition (denoted by HbA1c=6.5% as per NHS

(1) Diabetes UK, Diabetes: Facts and Stats, <https://www.diabetes.org.uk/Documents/About%20Us/Statistics/Diabetes-key-stats-guidelines-April2014.pdf>, March 2014NN

guidelines); and a second where the patient is in poor control of their condition (denoted by HbAc1=8.4%). The additional complications arising from poor management are included.

Pharmaceutical use by the patient is assumed to be the same, in order to ensure comparability and because of the significant variation that can be caused from differences in patient lifestyle and treatment adherence.

Description of patient

The patient simulated using health economics data resides in the United Kingdom, is 56 years old, has had type 2 diabetes for 6 years, has a BMI of 32 and is treated with a hypothetical pharmaceutical combination of products equal to the average consumption of diabetes medication by a patient in the UK. This scenario is considered as a typical diabetic patient within the scope of the study.

Environmental impacts appraised

Only greenhouse gas (GHG) emissions have been considered in this appraisal by using the approach set out in *"Care Pathways: Guidance on Appraising Sustainability"*. Although the guidance also includes fresh water use and waste generation, data were not available for diabetes related pharmaceuticals and blood glucose testing, and so the study scope was reduced accordingly.

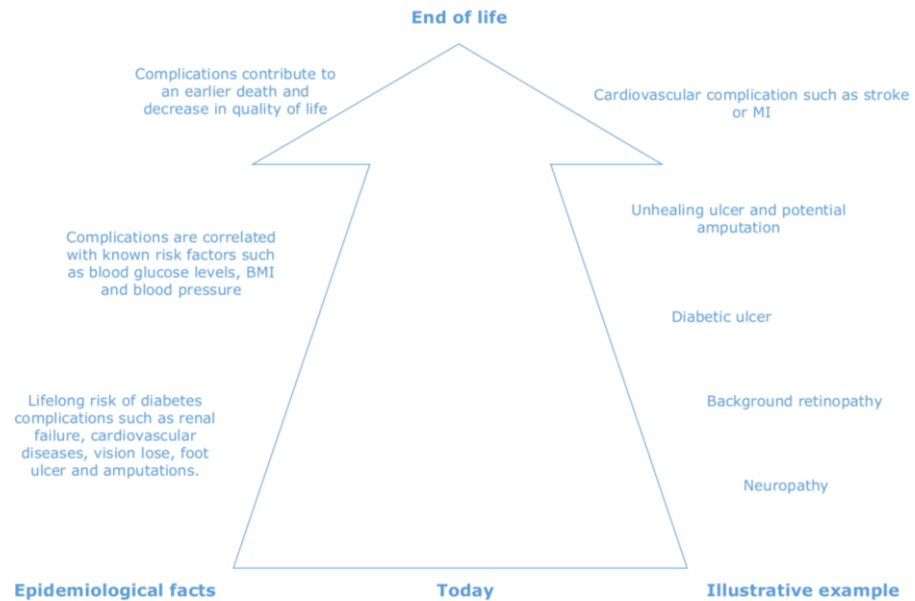
Unit of analysis

The unit of analysis for this appraisal is *"the lifelong treatment of type 2 diabetes for a 56 year old patient with BMI of 32, having had diabetes for 6 years and resides in the United Kingdom"*. Scenarios for good and poor management of the condition are considered. The geographical scope of the study is the UK and the time period for the modelled scenarios begins in 2015.

Care pathway map

The scope of this appraisal includes all relevant GHG emissions associated with management of type 2 diabetes, according to the defined unit of analysis. Also included are the resource use and emissions associated with complications arising from different treatment adherence in the two scenarios. These arise throughout the remaining lifetime of the patient, as shown in the diagram below.

Illustration of the overall diabetes care pathway



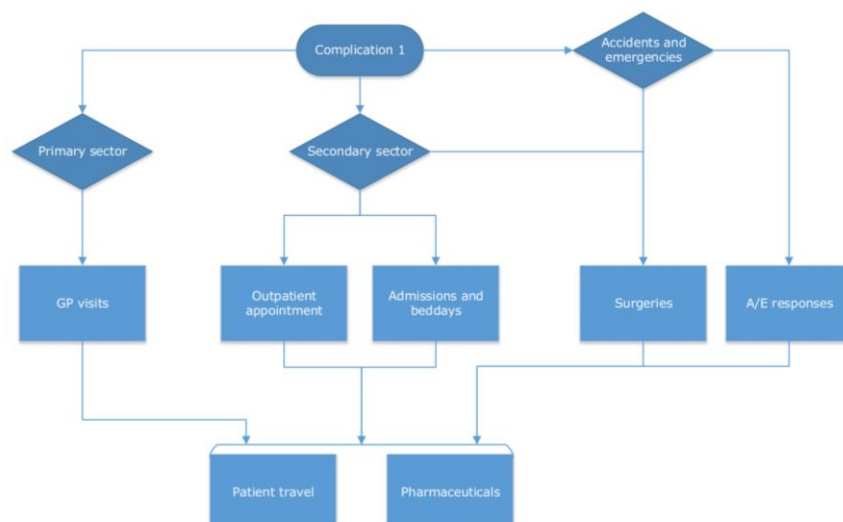
A number of complications can arise from poor management and treatment adherence. The following complications are considered in the two scenarios, in addition to general diabetes management:

- eye complications;
- renal complications;
- cardiovascular disease (CVD) complications; and
- feet complications.

Each complication is accounted for through a combination of care pathway modules. An example is shown in the diagram below.

Example of diabetes related complication

Example of a care pathway for a diabetes related complication



The following care pathway modules are considered in the two scenarios:

- general practitioner (GP) visits;
- emergency department visits;
- surgical procedures;
- consumption of pharmaceuticals during self-management;
- blood glucose testing during self-management;
- travel by patient; and
- Inpatient admission and bed days.

Data to estimate the GHG impact of each module have been sourced from the care pathways guidance and include use of consumables, equipment, medical gas use, staff travel and building energy, water and waste.

Exclusions and limitations

This appraisal has captured 17 stages of diabetes complications that can arise from type 2 diabetes, which is considered a good coverage. However, the potentially significant variation between patient adherence has not been addressed. Environmental impact data from the care pathways guidance have been applied to each module. Therefore, the environmental impact data included are generic and have not been made specific to type 2 diabetes management (eg a generic surgery instead of eye surgery).

Data

Activity data

Data describing the two scenarios were sourced from the CORE Diabetes Model, which is one of the most often used simulation models in diabetes research. The model simulates the occurrence of 17 stages of diabetes-related complications over a patient's life. In the model, the risk of incurring complications is based on patient level risk factors such as HbA1c, systolic blood pressure, age, duration and other factors. When using the model, first the relevant modules needed to treat each complication are mapped to the complication specific pathway. Next, the risk of each complication throughout the patient lifetime is analysed. This approach derives the following data for the two scenarios.

Patient in control of type 2 diabetes management (HbA1c=6.5%), remaining lifetime 12.09 years

Module	Units	Eye complications	Renal complications	CVD complications	Feet complications	General diabetes management	Total
GP visit	Per visit	0.79	0	2.9	28.0	24.2	55.8
Emergency department visit	Per visit	0	0	0.52	0	0	0.52
Surgical procedure	Per visit	0.39	0	0.24	0.12	0	0.75
Pharmaceuticals	per £	0.42	2.2	0	0	2,825	2,828
Blood glucose testing	per £	0	0	0	0	769	769
Patient travel	Per return trip	1.2	0.01	4.1	28.8	24.2	58.2
Inpatient admission and bed days	Per day	0.91	1.0	8.3	3.0	0	13.3

Patient not in control of type 2 diabetes management (HbA1c=8.4%), remaining lifetime 11.52 years

<i>Module</i>	<i>Units</i>	<i>Eye complications</i>	<i>Renal complications</i>	<i>CVD complications</i>	<i>Feet complications</i>	<i>General diabetes management</i>	<i>Total</i>
GP visit	Per visit	0.94	0	3.0	29.6	23.0	56.6
Emergency department visit	Per visit	0	0	0.55	0	0	0.55
Surgical procedure	Per visit	0.49	0	0.29	0.12	0	0.90
Pharmaceuticals	per £	0.47	4.5	0	0	2,688	2,693
Blood glucose testing	per £	0	0	0	0	733	733
Patient travel	Per return trip	1.4	0.02	4.3	30.5	23.0	59.3
Inpatient admission and bed days	Per day	1.1	2.1	8.7	3.2	0	15.2

Emission factors

Emission factors for each module were sourced from the care pathway guidance, with the exception of pharmaceuticals and blood glucose testing. Data for the consumption of different pharmaceuticals was unavailable and so a generic GHG factor was calculated by identifying the diabetes-related drug prescribed in England with the highest expenditure, converting expenditure to volume based on the unit price and calculating an estimate using the ABPI carbon footprint tool. Blood glucose testing strips were calculated using a similar method and applying a range to estimate the GHG emissions. Module data used in the study is shown below.

Emission factors used for each module

Module	Units	GHG emissions (kg CO ₂ e)
GP visit	Per visit	1.1
Emergency department visit	Per visit	13.7
Surgical procedure	Per visit	37.6
Pharmaceuticals	Per £	0.2
Blood glucose testing	Per £	0.3
Patient travel	Per return trip	5.8
Inpatient admission and bed days	Per day	37.9

Data requirements

The following statements are true for the data and models.

- Generic impact factors are sourced for each module.
- Quality of the activity data describing number of complications is considered representative, due to being sourced from health economics models.
- Although GHG factors used in this study are of good quality, they are sufficiently generic and not representative of the diabetes specific activities considered in this study (ie a general GP consultation compared with a diabetes monitoring GP consultation). Using diabetes specific GHG factors would reduce the uncertainty of results. A semi-quantitative data quality assessment or uncertainty appraisal has not been conducted.

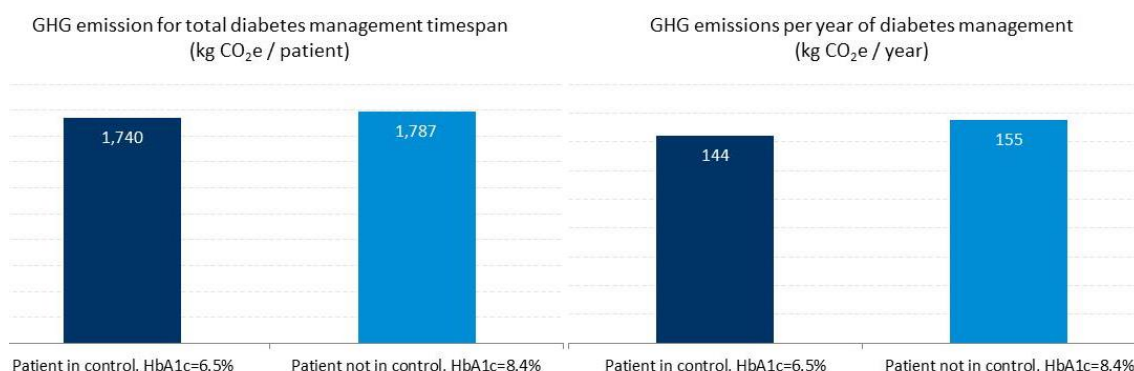
Results

Overall results

The GHG emissions associated with good management are 1,740 kg CO₂e for the lifetime of the patient. On an annual basis, this equates to 144 kg CO₂e / year. The poorly managed scenario has a total lifetime cost of 1,787 kg CO₂e and an annual impact of 155 kg CO₂e / year.

Despite the reduced lifetime of the poor type 2 diabetes management scenario, the well managed scenario achieves a 3% reduction in GHG emissions across the patient's lifetime and a 7% reduction per year of diabetes management.

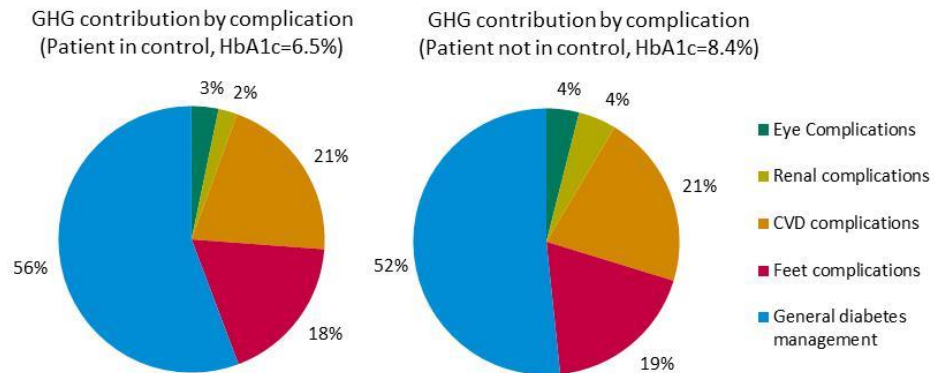
By 2025, an estimated nearly 5 million people in the UK will have type 2 diabetes. Extrapolating the findings above, good management of diabetes will have an estimated GHG impact of 720,000 tonnes CO₂e per year within the UK. If all diabetes were managed poorly, emissions would increase by 56 tonnes CO₂e per year.



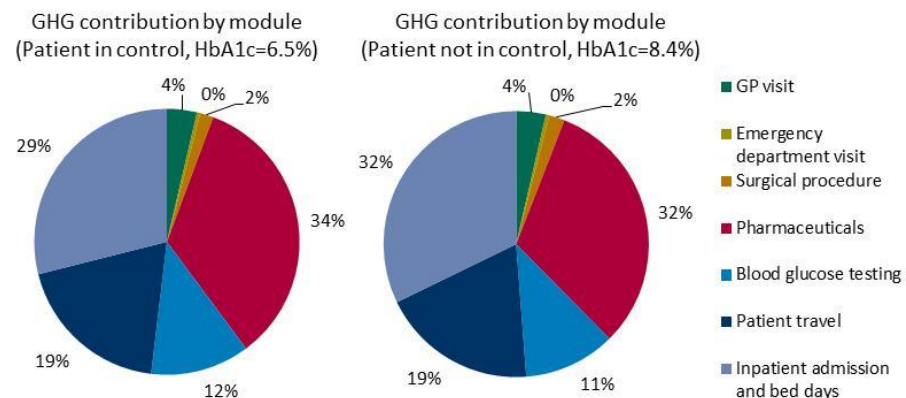
Breakdown

The findings can be analysed by evaluating the contribution both of each complication and of each module to the overall results. The contribution from general diabetes management (pharmaceuticals, blood glucose testing and GP visits) is reduced for the not in control scenario, in part due to the reduced patient lifetime and to the increase in contribution from complications.

The contribution of each complication is shown below for the two pathways.

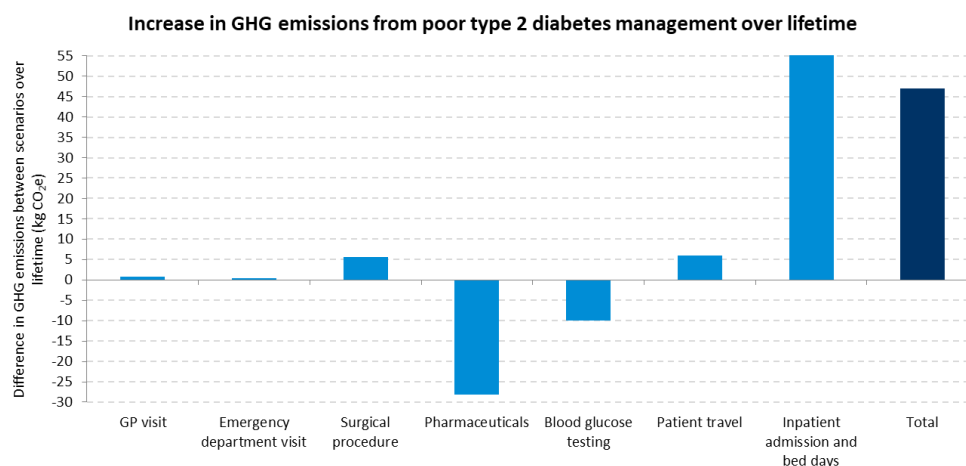


The contribution of each module is shown below for the two pathways.



Comparison

The chart below shows the net difference between the two scenarios over the different patient lifetimes. A positive value (above the x-axis) indicates that the poor management scenario has an increased GHG impact for that part of the pathway, whilst a negative value indicates where the well managed scenario has a higher GHG impact over the total life.



Conclusions

Key findings

Using health economics data to model a type 2 diabetes management pathway has successfully drawn conclusions as to the benefit of good management. Good management does not result in an increase in healthcare GHG emissions, despite the increase in patient lifetime. The well-managed scenario results in a GHG impact which is 3% less than the poorly-managed scenario across the patient lifetime. When results are compared on an annual basis, the additional complications associated with poor management results in the well-managed scenario having a GHG impact which is 7% lower. Although this is a small reduction, when scaled across the total number of diabetes patient it represents a significant reduction. The GHG emission factors sourced from Care Pathways: Guidance on Appraising Sustainability are generic in nature which introduces considerable uncertainty to the study. It is anticipated that improving these GHG emission factors would not change the conclusions identified.

In both scenarios, general diabetes management makes the most significant contribution to the overall performance of the pathway (57% and 61%), followed by GHG emissions associated with feet complications.

When investigating the contribution to the total GHG impact made by each module, pharmaceutical prescriptions are between 32% and 34%, inpatient admissions are 29% and 32% for the well- and poorly-managed scenarios respectively, and patient travel is 19%. However, there is some uncertainty associated with these modules. Pharmaceuticals are modelled as a single generic impact and there is likely to be considerable differences between the GHG emissions attributable to different diabetes drugs. Patient travel has been modelled as self-transport where a small number of patient travel journeys will be provided by emergency services or non-emergency provided transport, where both have a considerably higher GHG impact per journey. The addition of variable travel distances for individual patients is also a significant factor in determining the impact of this module.

Recommendations and improvements

The findings from this type 2 diabetes management investigation have shown there is a small improvement to the GHG emissions resulting from the pathway being well-managed, despite the increase in expected patient lifetime (which implies an improvement in social outcomes). Applied across the number of patients with type 2 diabetes, the environmental savings could be significant.

Further investigation is needed to verify the conclusions of this appraisal. In particular, there is considerable uncertainty as to the GHG emission factors used for each of the modules due to their generic data. Condition-specific emission factors would greatly increase the quality and accuracy of the study. Furthermore, the activity data could be improved to better understand variations within and between scenarios (eg which pharmaceuticals are used and which modes of patient travel are undertaken). Further environmental and social impacts should be considered in future assessments so that a more detailed sustainability appraisal can be undertaken before redesigning the pathway.

Learnings

The findings in this case illustrates how better adherence, lifestyle management or behavioural changes can increase patient lifetime while at the same time lower the health care related GHG emissions. The appraisal suggests to improve early lifestyle intervention and behavioural therapy thereby adding quality and length of life while decreasing GHG emissions.

The care pathway framework is an intuitively easy and understandable framework that can give a good overview of where carbon emissions are highest in the care pathway. As the disease gets more complex, stretching over several years and involving several comorbidities, the framework becomes more difficult to work with. In such cases it is difficult to locate the needed input numbers as well as mapping the average patient care pathway. We have used generic modules throughout the case. Using diabetes specific figures for both health care services, as well as pharmaceutical intervention, will improve the appraisal.