Care Pathways: Guidance on Appraising Sustainability

Main Document

October 2015

NHS England

Public Health England

Sustainable Development Unit
Working across the NHS, Public Health and Social Care system

AstraZeneca Boehringer Ingelheim Baxter BD

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

Care Pathways: Guidance on Appraising Sustainability

Main Document

October 2015

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For and on behalf of
Environmental Resources Management

Approved by: Simon Aumônier

Signed:

Position: Partner

Date: 12 October 2015

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FOREWORD

ROYAL PHARMACEUTICAL SOCIETY

We are at a critical point in time for the future health of people, communities and our environment. We know we must develop more sustainable healthcare products and services as part of our transformation towards a low carbon economy and take a close look at the way we use resources in healthcare.

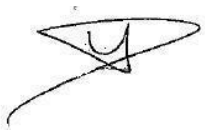
The Coalition for Sustainable Pharmaceuticals and Medical Devices (CSPM) has been leading on the work to address the significant contribution of pharmaceuticals and medical devices to healthcare greenhouse gas (GHG) emissions. In 2012 it published internationally recognised Greenhouse Gas Healthcare Product Guidance to consistently appraise health products which was a great development in understanding the GHG emission of healthcare products through manufacture, use and disposal.

In addition, within the health system we must look beyond healthcare products to address the way we deliver care, to redesign services and to promote prevention. This new Sustainable Care Pathways Guidance supports that approach and extends on the previous GHG Healthcare Product Guidance by providing vital information about the GHG emissions, water and waste impacts of health services, interventions and pathways.

This guidance is well placed to ensure sustainability is a consideration when designing new models of care or optimising existing services. Furthermore it allows us to better understand the environmental benefits of investing in prevention early in a care pathway. We recommend it be used not just by policy makers but by patients, healthcare providers, suppliers and anyone working in health that has the interest or opportunity to improve the sustainability of the health system.

We must all continue to show our commitment to reducing emissions and meeting both national and global levels of ambition and this document is evidence of the CSPM members' commitment to sustainability.

We welcome this guidance as a crucial step towards developing health systems and services to incorporate sustainable development into decision making, and encourage the CSPM to continue its work to ensure it is an integral part of health systems now and in the future.



Howard Duff
Director for England of the Royal Pharmaceutical Society

NICE National Institute for Health and Care Excellence

"NICE is committed to exploring methods for building sustainability into its guidance and to promoting sustainable growth in the health and care system. This guidance represents an important step towards utilising environmental information when designing more sustainable models of care. We strongly support this guidance and thank the CSPM for its development."

Sir Andrew Dillon CBE
CEO of the UK National Institute for Health and Care Excellence

ACKNOWLEDGEMENTS

This guidance has been developed collaboratively through the Coalition for Sustainable Pharmaceuticals and Medical Devices (CSPM), which comprises a group of organisations as listed below. The CSPM operates with the aim of facilitating transition to a more sustainable health system internationally, through the promotion of best practice and the development of sustainability tools and guidelines related to care pathways, pharmaceuticals and medical devices.

Acknowledgement is given to the invaluable input of the following individuals and organisations:

CSPM Leadership Members

- AstraZeneca: Keith Moore and Wesley White.
- Baxter Healthcare: Julie Aspin and Margaret Enos.
- Becton Dickinson: Ivan Welvaert.
- Boehringer Ingelheim: Richard Pitt.
- GlaxoSmithKline: Mark Rhodes and Matt Wilson.
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- Medtronic: Sarah Hill and Silvia Montisci.
- Novo Nordisk: Anne Gadegaard and Nanja Hedal Kløverpris.
- Sustainable Development Unit: Sonia Roschnik.

CSPM Advisory Members

- Association of British Healthcare Industries: Andy Vaughan.
- Association of British Pharmaceutical Industries: Mike Murray.
- Barts Health NHS Trust: Fiona Daly.
- British Generic Manufacturers Association: Paul Fleming.
- Guys & St Thomas Trust: Alex Hammond.
- Hull and East Yorkshire NHS Trust: Marc Beaumont.
- International Sustainability Unit: Laura Partridge.
- Medicines and Healthcare products Regulatory Agency: Ian Harwood.
- National Institute for Health and Clinical Excellence: Jennifer Watts.
- Pharmaceutical Market Support Group: Kevan Wind.
- Royal Pharmaceutical Society: Helen Gordon, Howard Duff and Jamie Woodward.
- UK Department of Health: David Wathey and Danny Palnoch.
- United Nations Development Programme (UNDP) Europe and Central Asia: Christoph Hamelmann.

Convening Body and Technical Author

- Environmental Resources Management Limited (ERM): Tom Penny, Michael Collins, Andy Whiting and Simon Aumônier.

- Trucost: Julie Raynaud, Angela Rose, Miriam Tarin, Rick Lord and Tom Barnett.

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- St. George's Healthcare NHS Trust: Wilfred Carneiro.
- Sustainable Development Unit: Imogen Tennison and Sonia Roschnik.

In addition to the CSPM members, a wider network of healthcare experts has been used to shape and to review this document. Their technical input was integral to the successful development of this guidance and their names are listed in *Annex A*.

GLOSSARY OF TERMS

Activity data - Physical measures of a process that result in emissions or removals relevant to the environmental metrics appraised.

Active Pharmaceutical Ingredient (API) - Any substance or combination of substances used in a finished pharmaceutical product (FPP), intended to furnish pharmacological activity or to otherwise have direct effect in the diagnosis, cure, mitigation, treatment or prevention of disease, or to have direct effect in restoring, correcting or modifying physiological functions in human beings.

Allocation - The partitioning of emissions and removals from a common process between the care pathways, modules or products that are the subject of study.

Assurance - The level of confidence that the inventory results and report are complete, accurate, consistent, transparent, relevant and without material misstatements.

Biogenic - Produced by living organisms or biological processes, but not fossilised or from fossil sources.

Carbon footprint - The sum of greenhouse gas emissions released in relation to a care pathway, product or service, expressed as carbon dioxide equivalents (CO_2e).

Care pathway – A complex intervention for the mutual decision-making and organisation of care processes for a well-defined group of patients during a well-defined period.

Cradle to gate inventory - A partial life cycle of an intermediate product, from material acquisition through to when the product leaves the reporting company's gate (eg immediately following the product's production).

Cradle to grave inventory - Removals and emissions of a studied product from material acquisition through to end of life.

Emission factor – Greenhouse gas emissions, or the value of another environmental metric, per unit of activity data.

End of life - A life cycle stage that begins when the used product is discarded by the consumer and ends when the product is returned to nature (eg incinerated) or allocated to another product's life cycle.

Environmental metric – The sum of resources and emissions relevant to a particular environmental issue and converted to a single value.

Fresh water use – Summation of direct water use within a health care activity and indirect water use from activities upstream of the care pathway.

Functional unit - The quantified performance of the studied product.

Global warming potential - A factor used to calculate the cumulative radiative forcing impact of multiple specific greenhouse gases in a comparable way.

Greenhouse gas (GHG) - Gas released to the atmosphere that absorbs and emits infrared radiation, contributing to the greenhouse effect. Sources of GHGs include combustion, emissions from chemical processes, waste degradation, etc.

Land use change - Occurs when the demand for a specific land use results in a change in carbon stocks on that land, due to either a conversion from one land-use category to another or a conversion within a land-use category.

Life cycle - Consecutive and interlinked stages of a product system, from raw material acquisition or generation of natural resources to end of life.

Life cycle assessment - A method of assessing the environmental impacts of a product, service or care pathway through relevant life cycle stages or activities.

Module – One or more distinct healthcare-related activities performed for, on behalf of, or by, a patient.

Medical device - A product intended to be used for medical diagnosis, cure, treatment or disease prevention, but which does not achieve its principal intended action in or on the human body by pharmacological, immunological or metabolic means.

Patient – An individual or group with a specific condition, noting severity, and further designated by age and location of care.

Pharmaceutical product - A substance used for medicinal purposes, for the purpose of medical diagnosis, cure, treatment or disease prevention.

Primary data - Data from specific processes in the studied care pathway.

Product - Any good, service, activity or care pathway.

Reference flow - The amount of studied care pathway or activity needed to fulfil the function defined in the unit of analysis.

Removal - The sequestration or absorption of GHG emissions from the atmosphere, which most typically occurs when CO_2 is absorbed by biogenic materials during photosynthesis.

Secondary data - Process data that are not from specific processes in the studied care pathway.

Unit of analysis - The basis on which the inventory results are calculated; the unit of analysis is defined as the functional unit for care pathway and the reference flow for intermediate modules and activities.

Waste generation – Substances or objects discarded or intended to be discarded, having arisen from the studied care pathway.

COLOUR BOXES

Boxes are used throughout the document to highlight important information. Colour coding has been has been included to differentiate between types of information, based on the following colour schemes.

Blue highlights important text

White boxes with dark blue borders shows examples

Green shows data to be included

Grey shows data to be excluded

Orange denotes modules

Yellow denotes sub-modules and activities

1 INTRODUCTION

It is recognised globally that health and care systems are undergoing transformative change to adapt to the needs of patients and communities with an increasing need to be financially, socially and environmentally sustainable.

What is a sustainable health system?

The Sustainable Development Strategy, published by the Sustainable Development Unit in January 2014 for and on behalf of the NHS, Public Health and Social Care within the UK provides the following definition of a sustainable health system:

"A sustainable health and care system works within the available environmental and social resources protecting and improving health now and for future generations. This means working to reduce carbon emissions, minimising waste & pollution, making the best use of scarce resources, building resilience to a changing climate and nurturing community strengths and assets."

Appraising the sustainability of models of care is seen as a crucial step to enabling a more sustainable health system. This guidance document has been developed to make it easier to understand the sustainability of new models of care as they are created or existing models of care as they are transformed.

1.1 THE PURPOSE OF THE GUIDANCE DOCUMENT

The principal objective of this guidance document is to enable more consistent quantification of the sustainability performance of care pathways globally, both those that already exist and new and emerging pathways. It is envisaged that this sustainability information will be used to support decision-makers in their choices related to improving the performance of models of care. Currently, the guidance is limited to appraising greenhouse gas (GHG) emissions, water use and waste generation, but it will be expanded to further environmental and social metrics over time.

This guidance builds upon the requirements of the ISO14040 (1) and ISO14044 (2) Standards for Life Cycle Assessment, the Greenhouse Gas Protocol Product Life Cycle

(1) ISO14040:2006 Environmental management -- Life cycle assessment -- Principles and framework, http://www.iso.org/iso/catalogue_detail?csnumber=37456

(2) ISO14044:2006 Environmental management -- Life cycle assessment -- Requirements and guidelines, http://www.iso.org/iso/catalogue_detail?csnumber=38498

Accounting and Reporting Standard (Product Standard) [1] and the Greenhouse Gas Accounting Sector Guidance for Pharmaceutical Products and Medical Devices (Sector Guidance) [2]. It is intended to be used alongside these documents and avoids replication of their content wherever practicable.

The document is freely available and is intended to be updated as knowledge in this area increases. In particular, it is expected that further care pathway modules and sustainability metrics (social and environmental) will be added over time. The document was developed in 2015 and further information including future updates can be found through the CSPM website (www.sduhealth.org.uk/cspm).

When appraising a care pathway, it is important to ensure that patient data remain confidential.

1.1.1 Limitations

The guidance is focused on a limited number of care pathway modules and environmental metrics. It is expected that further modules and metrics will be added over time in order to allow more detailed sustainable care pathway appraisals to be undertaken.

Activity data and environmental metrics calculations are provided for each module. They are intended for use in the appraisal of care pathways. Where a module case study has been used and found to be material to the care pathway being appraised, more specific data shall be collected.

Currently, this guidance accounts only for greenhouse gas (GHG) emissions, fresh water use and waste generated.

The resulting limitation is that potential trade-offs between environmental impacts other than those appraised across a care pathway can be missed. This is also the case for economic and social impacts. The results of a GHG, water and waste footprint exercise should not be used in isolation to communicate the overall sustainability performance of a care pathway.

It is anticipated that additional metrics, including those relating to social and financial objectives, will be included in future versions.

1.2 *GUIDANCE STRUCTURE*

The guidance contains chapters explaining the purpose of the document, common information applicable to appraising the sustainability of care pathways and recommendations for reporting. These are set out in the sections noted below.

(1) GHG Protocol Product Life Cycle Accounting and Reporting Standard, http://www.ghgprotocol.org/standards/product-standard
(2) GHG Accounting Sector Guidance for Pharmaceutical Products and Medical Devices, 2012, http://www.ghgprotocol.org/feature/pharmaceutical-and-medical-device-sector-guidance-product-life-cycle-accounting

Section 1: Introduction to care pathways guidance

Section 2: Common principles applicable to all modules

Section 3: Reporting recommendations

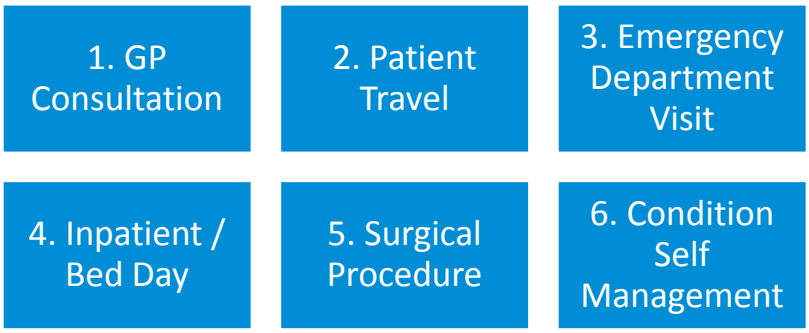
Accompanying this main document are chapters for individual care pathway modules.

The guidance:

- explains the reasons and benefits of completing a sustainability appraisal of a care pathway and the steps that are necessary in order to do so;
- provides useful definitions, documentation and references to where data required may be sourced from in order to undertake a care pathway appraisal;
- provides specific information on the modules of which a care pathway is comprised, including what shall be included/excluded when undertaking an appraisal, example data, units of analysis and estimates of module performance against environmental metrics; and
- includes examples to show practically how to use the module chapters and to build up a care pathway appraisal (added over time as additional documents).

1.2.1 Care Pathway Modules Included

The guidance includes the following care pathway modules as separate supporting chapters:



A further, more detailed, description of these modules can be found in each module-specific separate chapter. These modules were identified by the CSPM as those which are material to a wide range of care pathways and that are therefore useful to include in the first version of the guidance.

There are many more potentially significant modules to a care pathway and it is expected that more modules will be included in future updates to this document. Possible examples of modules to investigate are included in *Annex B*.

Modules Names

Depending on the user, the modules defined in this guidance may be known under different names. It may be useful to include alternative names relevant to the target audience when reporting results.

In the UK, it may be useful to align both module and care pathway names with the following:

- NICE Pathways and Guidelines: http://pathways.nice.org.uk/
- Department of Health NHS Reference Costs: https://www.gov.uk/government/collections/nhs-reference-costs
- PSSRU Unit Costs of Health and Social Care: http://www.pssru.ac.uk/project-pages/unit-costs/

Each module chapter includes the following information:

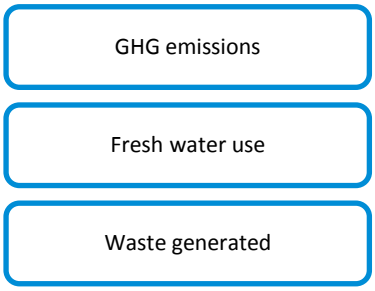
- *description* of the module;
- *boundary setting* including what shall be included and excluded when appraising the module;
- *unit of analysis* defines the basis on which results are calculated and reported for a module or care pathway;
- *activity data* guidance that shall be used when appraising the module;
- *emission factors* guidance that may be used to quantify the sustainability of the module, including references to data sources;
- *module calculation steps* describing allocation of resources and consumables (eg surgical masks) to the module, including steps to calculate the module impacts;
- *example calculations* that combine the activity data and emission factors to provide estimates of the performance of each module against the environmental metrics, including the identification of hotspots; and
- *secondary data and sustainability appraisals* documenting estimated data that can be used in materiality assessments and for quick care pathways appraisals.

1.2.2 Environmental Metrics Included

Each of the module chapters includes example calculations that quantify module performance against the environmental metrics discussed in this document. These calculations provide an estimated value for the environmental metrics and may be used in applications where the specific care pathway module is not material to the outcome of the appraisal. Additionally, they can be used for materiality and screening purposes, as discussed in *Section 2.3.4*.

An example of an environmental metric is the GHG emissions associated with the delivery of a care pathway module and including all of the resources / consumables / energy / waste / etc required to provide that module.

The following environmental metrics have been included in this document:



Although only environmental metrics have been included at this stage, it is expected that future updates will incorporate a wider range of environmental metrics, patient experience, social metrics and other sustainability indicators.

Financial expenditure across the care pathway may also be considered in future updates, similar to a total cost of ownership model for products, but instead applied to a care pathway.

Further, it is recognised that some metrics are not applicable to individual modules, but only to an overall care pathway (eg Quality Adjusted Life Years (QALYs) and patient experience). These metrics shall be included in future updates to the guidance.

1.3 *How to Use the Guidance*

This guidance is intended to be used primarily to support the understanding of what are more sustainable care pathways. This may be achieved either by comparing the sustainability of alternative care pathways, or by investigating how to make a care pathway more sustainable, for example through examining hotspots and identifying improvement opportunities This may be either to compare the sustainability of a care pathway or to investigate making an existing care pathway more sustainable.

The modules described in this document are intended to be additive and can be combined logically to construct a care pathway.

If only a high level appraisal of sustainability is required, the estimates of sustainability metric performance for each module can be added together to produce a care pathway map.

Each module can also be considered as a stand-alone part of the health and care system. Guidance is provided on what the sustainability hotspots are within each module and includes an estimate of the environmental impacts of each service described in the module.

Should a module represent a significant contribution to the sustainability performance of the care pathway being appraised, then further information is provided in each module to allow the user to adapt the care pathway module to their specific circumstances by collecting representative data.

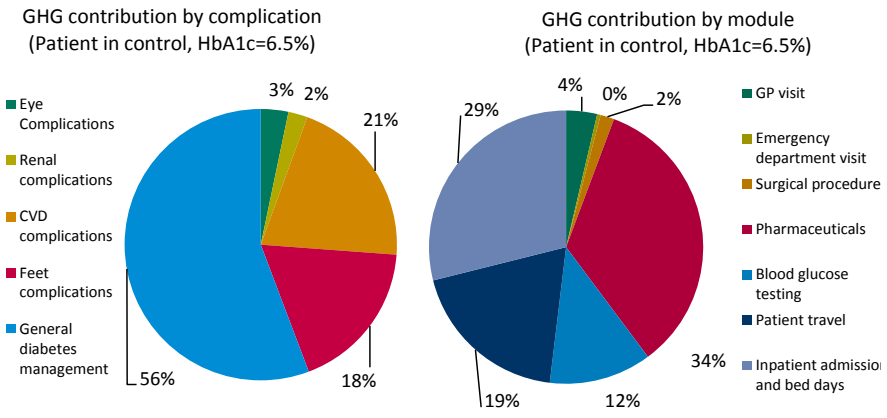
A user could collect activity data on the operation of the module based upon the boundary setting section and combine these with emission factors to develop estimates of sustainability metric performance specific to their situation.

Type 2 Diabetes Management Example

Full case study available via www.sduhealth.org.uk/cspm

Novo Nordisk completed a study using this guidance to appraise the difference in environmental impact between good and poor management of a type 2 diabetes pathway. The appraisal used health economics data to identify the number of GP consultations, inpatient admissions, emergency department visits, patient travel instances, surgeries, pharmaceuticals used and blood glucose testing units. These health economics data were combined with module data from this guidance to calculate the environmental impact of both scenarios.

The results show that on a per year basis the well managed scenario has a 7% lower GHG impact compared to the poorly managed scenario which is primarily due to the reduced complications in a well managed scenario.



1.4 *WHO SHOULD USE THE GUIDANCE?*

This document should be used by anyone interested in understanding further the sustainability of health and care systems globally. Additionally, anyone wanting to improve or understand the sustainability of changing models of care will find this document useful. Furthermore, it may also be useful to:

- *patients* to understand and to influence the sustainability issues regarding their health and care;
- *policy makers and regulators* to allow for sustainability to be considered when developing new models of care;
- *healthcare providers* to understand where changes in operations can lead to an improved sustainability performance of a service;
- *suppliers* to understand how their products or services benefit or impact the sustainability of health and care systems; and
- *sustainability practitioners* to define the boundaries, data sources and requirements to consistently appraise healthcare services.

(Examples of healthcare providers may include frontline workers or clinical commissioning groups).

The guidelines provided in this document may be useful for others within healthcare organisations who wish to improve their understanding of the sustainability of different aspects of the health and care system. Interested staff may include practitioners, consultants, logistics, marketing, environment, facilities management, procurement and a host of other areas.

1.5 *HOW WAS IT DEVELOPED?*

This document has been developed through the Coalition for Sustainable Pharmaceuticals and Medical Devices (CSPM), a group of organisations committed to developing tools and guidelines to facilitate transition to a more sustainable health and care system globally.

Pharmaceuticals and medical devices are known to contribute a large proportion of healthcare GHG emissions globally. The Sustainable Development Unit (SDU) of the National Health Service (NHS) in the UK has carried out a top-down footprinting exercise for the NHS, Public Health and Social Care, which estimated that 25% of the health and care system carbon dioxide equivalent (CO_2e) emissions were attributable to pharmaceuticals and medical devices [(1)].

As a result of this discovery, the SDU convened a group of healthcare suppliers, NHS Trusts, non-governmental organisations (NGOs) and other organisations (who would later form the CSPM) to develop a GHG guidance document to encourage more consistent quantification of the GHG emissions associated with pharmaceuticals and

(1) NHS, Public Health and Social Care Carbon Footprint 2012, http://www.sduhealth.org.uk/documents/publications/HCS_Carbon_Footprint_v5_Jan_2014.pdf

medical devices [1]. It was recognised that further research was needed to understand how these products fit into the wider healthcare services and models of care.

This new and innovative guidance document explains how to appraise the sustainability of care pathways and models of care. This was seen by the CSPM as a critical next step, so that sustainability appraisals of healthcare systems can be undertaken in a consistent manner and easily be incorporated into decision-making.

A detailed explanation of the milestones and timescales of the project can be found in *Annex A*.

All documents are freely available and hosted on the CSPM website (www.sduhealth.org.uk/cspm).

(1) GHG Protocol Product Life Cycle Accounting and Reporting Standard (2011): http://www.ghgprotocol.org/standards/product-standard

2 COMMON PRINCIPLES

2.1 PRIMARY REFERENCES

This guidance document should be used with reference to the following parent documents:

- GHG Protocol Product Life Cycle Accounting and Reporting Standard (2011): http://www.ghgprotocol.org/standards/product-standard (the 'Product Standard'); and
- GHG Accounting Sector Guidance for Pharmaceutical Products and Medical Devices (2012): http://www.ghgprotocol.org/feature/pharmaceutical-and-medical-device-sector-guidance-product-life-cycle-accounting (the ' Sector Guidance').

2.2 DEFINITIONS

To ensure consistency across care pathway appraisals, 'care pathway', 'care pathway module' and 'representative patient' are described and defined below.

2.2.1 What is a Care Pathway?

This guidance document uses the definition of a care pathway employed by the European Pathway Association (1).

> *"A care pathway is a complex intervention for the mutual decision making and organisation of care processes for a well-defined group of patients during a well-defined period."*

The key components of the definition for the purpose of this guidance are the care-processes and their organisation for a defined group of patients. This guidance addresses the sustainability appraisal of those care processes (health care-related activities) and their attribution to a defined group of patients or a representative patient.

The European Pathway Association further states that "*The aim of a care pathway is to enhance the quality of care across the continuum by improving risk-adjusted patient outcomes, promoting patient safety, increasing patient satisfaction, and optimising the use of resources*". This guidance may be used to support the aim of optimising resource use throughout a care pathway.

(1) European Pathway Association, http://www.e-p-a.org/clinical---care-pathways/index.html

Other names for a care pathway may include (but are not limited to): models of care, critical pathways, care paths, integrated care pathways, case management plans, clinical care pathways, service lines or care maps.

The Product Standard [1] defines a product as goods and services, and therefore a care pathway should be considered to be a product for its purposes.

2.2.2 What is a Care Pathway Module?

Using the European Pathway Association definition, the following can be used to describe a care pathway module:

> *A care pathway module describes one or more distinct health care-related activities performed for, on behalf of, or by a patient.*
>
> *Care pathway modules are the building blocks which make up the total care pathway.*

Care pathway modules are the building blocks which make up the total care pathway. They are additive and can be combined to build up a composite picture of a care pathway. In *Section 1.2.1*, this guidance document describes a number of care pathway modules that can be used as components of care pathways. However, this is not an exhaustive list and more modules should be developed over time.

The boundaries of each module have been defined through consultation with technical experts in the sector. There are many instances of overlap between modules and these are discussed in the section dedicated to each module. For example, a GP consultation module may not include the pharmaceuticals denoted in a prescription. However, they would still be accounted for in the overall care pathway by way of the inclusion of a pharmacy module, from where the pharmaceuticals are provided directly to the patient.

2.2.3 What is a Representative Patient?

Whether it is an overall care pathway or an individual module that is appraised, the unit of analysis for a module or care pathway will always relate to a patient or a well-defined group of patients.

The representative patient used in an appraisal will vary depending on the objective for appraising a pathway.

(1) GHG Protocol Product Life Cycle Accounting and Reporting Standard, 2011, http://www.ghgprotocol.org/standards/product-standard

A representative patient may be:

An individual patient (or group) with a specific condition, noting severity, and further designated by patient age and location of care.

Whichever patient group is considered, it shall always be specific to a care pathway or care pathway module and reflect either an average, or a subset of an average, of a well-defined group of patients over a well-defined period of time. Further guidance on patients is included in each of the sections of the guidance dealing with module units of analysis.

2.2.4 Determining an Appropriate Functional Unit (Unit of Analysis) for a Care Pathway

Reporting a module separately may be useful in some instances. However, when appraising a care pathway, a number of modules need to be combined using a common unit of analysis in order to calculate the overall results. This common unit of analysis is known as the *functional unit* and it will be used as the basis for reporting results. When appraising a care pathway, the representative patient definition in *Section 2.2.3* will be applied in defining the functional unit. The following questions may be useful when defining the functional unit.

- What is the care pathway being appraised (ie what condition and how severe)?
- What type of patient is being appraised (ie age, gender and other characteristics that may influence the results)?
- Where are the services of the care pathway undertaken (ie what geographic location)?
- How long is the care pathway (ie average length of time of the care pathway)?

The length of time over which a care pathway is manifested may vary significantly, depending on the pathway identified, the severity of the condition and the type of patient. Variation in the care pathway time period will result in significantly different results. It is particularly important to consider the length of time for long term conditions (eg whether a functional unit describes one year or 30 years of condition management).

2.3 *CARE PATHWAY MAPPING GUIDELINES*

The following sections describe how to initially map a care pathway and undertake an appraisal of the modules identified. A list of common activities and resources to include and exclude is also provided (unless specifically stated in the module section). Guidance is given on how to identify activities material to the care pathway and how to allocate shared activities and resources to a module.

Additional guidance can be found in Chapter 6 of the Product Standard *'Establishing the Scope of a Product Inventory'*.

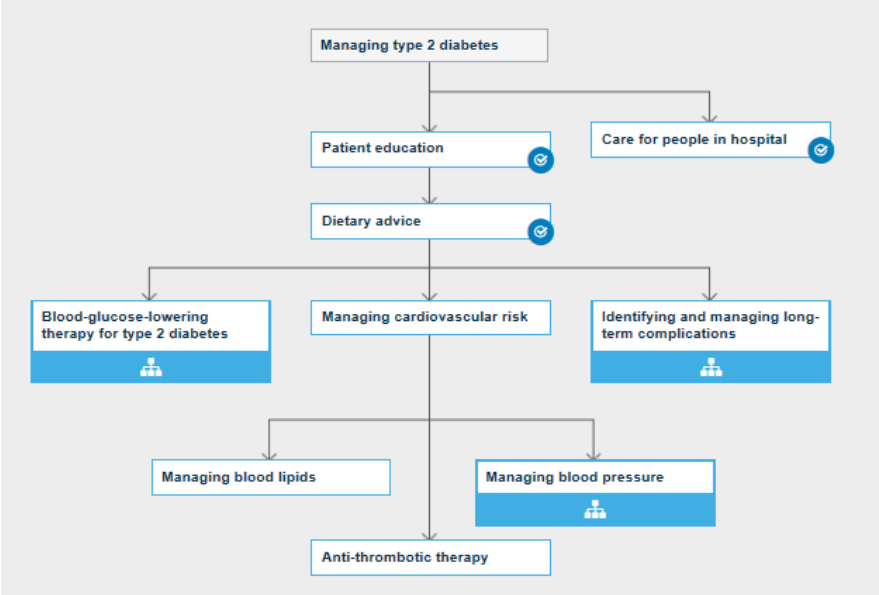
2.3.1 Steps to Map a Care Pathway

This section explains the typical steps that will be undertaken when appraising a care pathway.

1. Define the objectives of the care pathway appraisal (these may be to improve an existing pathway, develop new pathways, compare alternatives or investigate improving an individual module).
2. Define the care pathway to be appraised, including a draft of the activities required to provide the pathway.
3. Define the unit of analysis for the care pathway (based on the guidance in *Section 2.2.4*) which, as a minimum, will include patient type and representativeness, condition and severity, geographical coverage and age of the patient group.
4. Create a detailed map of the activities required in a care pathway by consulting literature and technical experts relevant to the pathway.
5. Group activities into modules to simplify the care pathway where possible, using guidance provided for modules in each of the separate module chapters where specific module guidance is available or in *Section 2* where a module is not yet defined.
6. Complete a materiality assessment to reduce the primary data collection requirements for the care pathway and each module (described in *Section 2.5*).
7. Calculate each module based on the guidance below and the information provided in each separate module chapter.
8. Add the correct multiples of modules together to develop an appraisal of the care pathway as a whole.
9. Interpret and report the findings, including any information that may be useful to improve the sustainability of similar care pathways.

NICE Pathways – A UK Example
http://pathways.nice.org.uk/

A useful source of information when determining the activities to include in a pathway is the detailed guidance provided by the National Institute for Health and Care Excellence (NICE). An example pathway for managing type 2 diabetes is shown below.



Note that there may be additional modules to be included when appraising type 2 diabetes management, depending on the specific pathway in question. For example, exercise may be included to assist in prevention of an acute condition.

2.3.2 *Defining a Module*

After mapping the scope of a care pathway, it is important to group activities into modules to simplify the care pathway and focus data collection efforts. *Modules shall be clearly documented in terms of the activities that are included.*

When following the steps to map a pathway as described in *Section 2.3.1,* it can be difficult to identify which activities or services are to be included in the module and which are part of a separate related module. The guidance below provides further explanation of a module.

The definition of a module used in this guidance is below.

A module describes one or more distinct health care-related activities performed for, on behalf of, or by a patient.

Refer to *Annex B* as a guide for list of possible modules

Examples of modules include:

- emergency department visit;
- surgical procedure;
- GP consultation; and
- inpatient admission.

An activity should be included if it is distinct activity or service required to achieve the objective of the module.

Examples of activities that should be included within the above:

- triage of a patient within an emergency department visit;
- preparing an operating room prior to a surgical procedure; and
- monitoring of a patient condition during an inpatient admission.

When attributing an activity to a module, consider the purpose of the activity, who is leading the decision making and where the activity occurs.

Where to include an activity

On some occasions, it may be difficult to allocate an activity to a specific module. Similarly, it may not always be clear where consumption or emissions should be allocated in the care pathway being studied. The following guidance is provided:

The life cycle approach described in the Product Standard shall be employed. A module, or activity data shall be included in the care pathway at the point of interaction with the patient.

The point at which the patient interacts with a resource (eg in the use of a MRI machine or in consuming a pharmaceutical) or their treatment creates emissions (eg anaesthetic gas release) is where the impact is attributed. Attributing the impact to the point of responsibility (eg attributing the MRI scan to the GP consultation that prescribes it) is not supported.

The allocation of pharmaceuticals is discussed in the example below.

Including Pharmaceuticals

Pharmaceuticals required within the scope of the care pathway being studied shall always be included. The module that they are allocated to depends on where the patient interacts with the pharmaceuticals. Three examples are discussed below.

1. A GP gives a travel injection to a patient.

Pharmaceuticals are stored at the general practice and the patient interacts with the pharmaceuticals during the GP consultation. The pharmaceutical manufacture, storage and administration at general practice and shall be attributed to the GP consultation.

2. A patient receives pharmaceuticals while staying in hospital as an inpatient.

Storage occurs onsite at the hospital pharmacy and administration occurs whilst being an inpatient. The impacts associated with pharmaceutical manufacture, storage at the hospital pharmacy, and the administration by staff, including use of devices, shall be attributed to the inpatient/bed day.

3. A GP gives a prescription for pharmaceuticals that the patient must pick up from a pharmacy and self-administer.

A GP provides a prescription and the patient travels to a pharmacy to collect the pharmaceuticals then self-administers. In this example, the GP is not the only decision-maker, as the patient decides to which pharmacy to travel, whether to self-administer and/or whether to complete the course of prescribed medication and the pharmacy makes a decision on procurement, storing and providing the prescribed pharmaceutical. The travel to the pharmacy, storage at the pharmacy, administration (self) and pharmaceutical manufacture shall be recorded as a separate self-management module whereas the pharmaceutical consumption is still included in the care pathway but under a self-management module instead of a GP consultation or inpatient/bed day as the patient does not interact with the pharmaceutical in these latter modules.

2.3.3 Steps to Calculate a Module

For each module defined through the mapping of a care pathway, it is important to identify all processes and activities that contribute to its performance against the environmental metrics being appraised.

The guidance provided for specific modules in the associated chapters shall be used in the first instance. Should guidance not be available for the modules identified

through care pathway mapping, then the guidance below shall be used in addition to Chapter 7 of the Product Standard [1].

The following steps are suggested when defining the boundaries of a module.

- Identify the activities within the care pathway module that are directly connected to the studied system and its ability to perform its function.
- Group the activities into sub-modules if required.
- Identify the resources needed (eg materials, energy, etc) or outputs released (eg direct emissions to air and water, waste, etc) for each activity.
- Illustrate the activities of a module through a process map (similar to the example process map in each module section).

Modules must not include activities already covered by other modules in the care pathway map. This way, modules can be additive without the risk of double-counting activities. Examples of activities that could be included in multiple modules are pharmaceuticals, diagnostics and hospital overheads, amongst others.

Once the boundaries have been set, then the following steps can be taken to calculate the impacts of the module.

- Define the unit of analysis for each module and for the care pathway.
- Define how the modules will be added together to form the care pathway.
- Identify detailed activity data requirements for each activity within the module (eg resources required, emissions released, waste generated, energy use, travel, etc).
- Identify data sources from inside and outside the organisation conducting the study, based upon primary data requirements and the granularity of the data that it is possible to achieve.
- If required, determine the method of allocating processes/activities/resources to the module (see *Section 2.3.5*) based upon identified data sources.
- Conduct a materiality and screening exercise for the processes in the module, as well as for how the module fits into the care pathway, to identify whether any processes can be reasonably excluded (see *Section 2.3.7*).
- Collect the activity data.
- Source emission factors for the activity data using references provided in this guidance, including values in *Annex C*.
- Combine activity and emission factors to calculate the module's performance against the environmental metrics.
- Assess data quality for the appraisal of the care pathway modules and the care pathway.
- Interpret the findings and report based on guidance provided in *Section 3*.

(1) GHG Protocol Product Life Cycle Accounting and Reporting Standard, 2011, http://www.ghgprotocol.org/standards/product-standard

2.3.4 Materiality and Data Screening

Materiality refers to ensuring that all activities that have a significant impact on the sustainability metric results and that could influence a user's decisions are included in the appraisal. Where resources are constrained, and to improve the efficiency of the appraisal, those activities and processes that are insignificant can be excluded.

To determine insignificance, an organisation should perform an estimate using data with upper limit assumptions to determine whether, in the most conservative case, the activities are insignificant with respect to the environmental metrics being appraised, based on either mass, energy, or volume, as well as likely GHG contribution.

The basis for determining insignificance shall be stated, which may include a rule of thumb threshold. For example, a rule of thumb for insignificance may be a material or energy flow that contribute less than 1% of the mass or energy flow for the module or care pathway being appraised. An upper level of exclusion by insignificance is also required, eg the sum of the excluded flows (each less than 1%) shall not exceed 10% of mass, energy or overall sustainability metric contribution for a module or care pathway.

Data screening is an exercise to identify where efforts to collect primary activity data shall be focused and to identify activities that are material and immaterial to the study boundaries. Screening shall be performed by estimating both the activity data and emission factors using secondary data for each of the environmental metrics appraised and ranking the contribution of each activity to the care pathway module and the care pathway.

Some activities in a module may be significant to the study but not identified by physical flows. These cases include activities that:

- are significant by expenditure relative to other activities in the module or pathway;
- offer possible opportunities to significantly improve the performance of the module or pathway against the environmental metrics; and
- are of strategic importance or of interest to the pathway appraisal.

Environmental extended input output analysis (EEIO) may be useful to estimate emission factors when undertaking data screening.

Cut-off rules refer to the procedure of setting a percentage value against which to assess the significance of an activity in materiality and data screening. Each study should report the cut-off rules used.

Significant activities and data should be identified by estimating their contribution to performance against each of the environmental metrics appraised. All activities that contribute more than a selected cut-off percentage for each metric (eg 10% of the total GHG inventory) should be deemed to be significant processes. For each of these processes, details of the data sources and data quality scores or descriptions of both primary and secondary data should be provided.

2.3.5 Allocation

Allocation refers to the process of partitioning activities and resources consumed between modules and services. Although allocation shall be avoided where possible, in many cases the type of data available necessitates allocation (eg aggregated electricity data in a hospital).

Allocation based on physical relationships is preferred, as described in the Product Standard and ISO14040. When determining the allocation approach, a key consideration is which variable is most significant for determining the level of activity. For example, is there a strong relationship between consumption of electricity within a surgical operating room and floor space, number of staff, length of a surgical procedure, total number of surgeries completed or type of operation?

Hospital cleaning services EPD
http://www.environdec.com/en/Detail/epd576

An environmental product declaration (EPD) was developed by Markas to understand the environmental impacts of hospital cleaning services. This appraisal includes the use of products and their manufacture, transport of products, electricity consumed, water used and waste generated. The results are described by cleaning one square metre of a hospital for one year.

Allocation is completed according to the cleaning services product category rule (PCR) which requires allocation of resources and emissions directly to a process where possible (eg electricity to cleaning equipment). Where this is not practical, the PCR allows for allocation on a floor area basis (ie calculating total resource and emissions for cleaning and dividing by total floor area).

The results of cleaning $1m^2$ of a hospital for 1 year are:

- GHG emissions: 3.81 kg CO_2e
- Water use: 192.2 litres
- Waste generated: 0.037 kg

Examples of relationships that can be used to allocate resources between activities and modules may include (but are not limited to):

- floor space (eg area required in a facility to provide a service, such as the space taken by an emergency department in a hospital);
- relative intensity (eg the number of staff or patients in different hospital wards);
- the time used to deliver the service based on the unit of analysis (eg hours of a surgical procedure); and
- technical experts with service knowledge (eg percentage use of an x-ray machine for an emergency department).

Should it not be possible to allocate based on physical relationships, other methods can be used and recorded. One example is allocating based on service costs. In the UK, the Patient Level Information and Costing Systems may be a method of performing resource allocation.

2.3.6 General Inclusions for a Care Pathway Module

Specific activity data requirements are provided for each module in the module chapters. There are a number of categories of activity data that apply to all modules and shall be collected, unless deemed to be immaterial, through a data screening exercise, as described in *Section 2.3.4*.

Activity data common to all modules include the following (assuming they are material to the study).

- Consumables used by each activity, both medical (eg surgical masks), non-medical (eg office paper) and pharmaceuticals.
- Equipment used for each sub-module, both medical (eg MRI machine) and non-medical (eg furniture).
- Direct emissions arising from each activity that contribute to the environmental metrics appraised (eg anaesthetic gases).
- Fuel, electricity, water, waste and other facilities data from buildings required to provide each activity service (eg electricity consumption of a hospital ward).
- Travel of staff required to provide the services of each activity (eg travel of a surgeon to a hospital to provide a surgical procedure). Note, patient travel shall be excluded from each module but included in the care pathway as a standalone module using guidance provided in each separate module chapter.
- An allocation of the support services and administrative functions required to provide the activity services (eg cleaning, maintenance, record keeping, etc).

It is important to consider the materiality and cut-off rules described in *Section 2.3.4* when collecting significant activity data (eg it may be possible to exclude office paper if this falls below the cut-off criteria defined in the study).

Pharmaceuticals shall be included in a care pathway and included in the care pathway module where the pharmaceuticals are administered to the patient.

Where applicable, patient food shall be included in a module (eg food consumed during a hospital inpatient bed day) when it is provided or prescribed as part of the care pathway.

The cradle-to-gate impacts of single use consumables (eg surgical masks) can be attributed directly to an activity. However, where reusable equipment (eg a MRI machine) is required, this shall be allocated to an activity for the unit of analysis, based upon the number of uses and lifetime of the equipment.

2.3.7 General Exclusions for a Care Pathway Module

In addition to the general activity data that should be included, as described above, there are activity data that can typically be excluded from each module. These are excluded due to their immateriality with respect to overall performance against the environmental metrics. However, a data screening exercise should be undertaken, if they are thought that they are likely to be material. These include (for each activity):

- capital goods (eg infrastructure);
- corporate services (eg marketing, R&D);
- training of staff (eg initial or ongoing training requirements for GPs); and
- administrative, regulatory or other functions not directly connected to the provision of each service (eg government agencies, centralised procurement, etc).

2.4 *SUSTAINABILITY METRICS*

In the context of this guidance, sustainability metrics may be based on environmental, social or financial indicators that are used to appraise the performance of a care pathway or module. Some metrics can be applied to individual modules (eg the GHG emissions of a GP consultation), whilst others can only be applied to the overall care pathway (eg patient experience or QALYs). Overall care pathway metrics are not currently included in the guidance.

2.4.1 Quantifying Care Pathway Module Sustainability

Conceivably, a large number of sustainability metrics (social, environmental or financial) could be used to appraise a care pathway. This guidance document addresses only a limited number of environmental metrics and does not yet include any social metrics such as QALYs or patient experience. It is anticipated that these will be included over time. The initial metrics have been determined through consultation with technical experts based upon relevant reporting standards, stakeholder interest and data availability. They are:

- greenhouse gas (GHG) emissions;
- fresh water use; and
- waste generation.

Examples of metrics that may be included in future updates to the guidance are:

- patient experience;
- QALYs;
- other environmental impacts such as those listed in the International reference Life Cycle Data system (ILCD) [(1)], eg resource depletion; and
- total financial cost of the care pathway (similar to total cost of ownership).

Appraisals of the impact of air quality may also be included in future versions due to the potential significance of travel and location of hospitals in urban areas.

The term 'environmental metrics' is used throughout the remainder of this guidance and will be updated to 'sustainability metrics' once either social and/or financial metrics are included.

Greenhouse Gas Emissions

Greenhouse gases are gases that contribute to the greenhouse effect by absorbing infrared radiation in the atmosphere, causing climate change. They include both direct and indirect emissions (ie, Scope 1, 2 and 3 as set out in the GHG Protocol, eg GHG emissions from anaesthetic gases and GHG emissions from the manufacture of pharmaceuticals).

(1) European Commission, ILCD Handbook Recommendations for Life Cycle Impact Assessment in the European context, 2011, http://eplca.jrc.ec.europa.eu/?page_id=86

The emissions are expressed in terms of their global warming potential (GWP). This parameter combines the various greenhouse gases that can contribute to global warming and expresses them as a mass of carbon dioxide equivalents (CO_2e). Common GHGs captured under this definition include: carbon dioxide (CO_2); methane (CH_4); nitrous oxide (N_2O); hydrofluorocarbons (HFCs); perfluorocarbons (PFCs); and sulphur hexafluoride (SF6).

The 100-year GWP factors for GHG emissions shall be used when calculating inventory results for pharmaceutical products, based on the IPCC fifth assessment report (2014), or the most recent released version of these GHG factors. A table of the most recent GWP values is available on the GHG Protocol website.

- For each module, results shall be reported as a mass of carbon dioxide equivalents per module unit of analysis (eg kg CO_2e / patient GP consultation). Refer to the *What is a Representative Patient?* in *Section 2.2.3* and the *Unit of Analysis* section in each module chapter. Modules can be combined to develop a full care pathway profile, as discussed in *Section 1.3*.

- When calculating inventory results for modules, it is recommended that some results are reported separately and aggregated as part of the inventory results, in particular any biogenic-derived CO_2 removals/emissions calculated in the assessment, and any GHG emissions from direct land use change. Biogenic-derived CO_2 refers to CO_2 sequestered or released by biogenic sources (ie plants). Further information is available in the GHG Protocol Product Standard [(1)].

Fresh Water Use

This metric reports the fresh water used to create and provide a product or service. It includes direct water use (eg water used by the health care activity) and indirect water use from activities upstream of care pathway modules (eg the water used in the production of pharmaceuticals and water abstracted and lost in the supply of water used by a module).

(1) GHG Protocol Product Life Cycle Accounting and Reporting Standard, 2011, http://www.ghgprotocol.org/standards/product-standard

Water use or water consumption?

An important distinction is the difference between use and consumption of water. The following definitions are from ISO 14046:

- *water use* includes the use of water by human activity; and
- *water consumption* describes water used, but not returned, to the same drainage basin.

Water consumption can occur as a result of evaporation, transpiration, integration into a product, or release into a different drainage basin or the sea.

Therefore, water use refers to the total water requirements of a system, whilst water consumption refers to the net use of water by a system not returned to its source.

Fresh water use includes:

- fresh surface water, including water from wetlands, rivers & lakes;
- ground water;
- rainwater collected directly and used;
- waste water from another organisation; and
- municipal water supplies or other water utilities.

Water use is measured in cubic metres (m^3). This volumetric indicator does not take account of factors such as resource stress based on geographic region and water quality. Examples of further standards and guidance include ISO 14046 (1) and the Global Water Footprint Standard (2). Total direct and indirect water use shall be reported separately for the modules and the care pathway.

Differentiating blue, green and grey water use, as defined in the Global Water Footprint Standard, is not a requirement of this guidance, although results can be reported in this context if they are useful to the study.

The water use metric reported shall quantify the total volume of water either withdrawn from a water source directly by an activity or indirectly through intermediaries such as water utilities. This includes the abstraction of cooling water and turbine water used in electricity generation.

(1) ISO 14046, http://www.iso.org/iso/catalogue_detail?csnumber=43263

(2) Water Footprint Network, Global Water Footprint Standard, http://waterfootprint.org/en/standard/global-water-footprint-standard/

Waste Generation

The definition of waste employed in this guidance is "*any substance or object which the holder discards or intends or is required to discard*" [(1)].

Waste generation shall be calculated for direct waste (ie waste generated from an activity in the care pathway boundaries, eg waste from an emergency department). Waste is to be reported in kilogrammes (kg).

Indirect waste generation, from activities upstream of care pathway modules (eg from the production of materials and energy) can be excluded, as there is a lack of consistent secondary emission factors for waste. If indirect waste generation is to be included, it should be reported separately.

The following categories of waste generated shall be reported:

- hazardous waste (as defined by national legislation at the point of generation);
- non-hazardous waste (all other forms of solid or liquid waste excluding wastewater); and
- the total amount of waste generated as a sum of hazardous waste and non-hazardous waste.

Disposal of sharps will typically be included within the hazardous waste definition. However, if this stream is particularly relevant to the study, this may be reported separately. Other categories that it may be beneficial to report separately include: clinical waste; unused pharmaceuticals; waste electrical and electronic equipment (WEEE); and others.

Where known, it may be useful also to report the waste treatment route for each waste type (eg recycling, incineration with or without energy recovery and landfill).

2.5 *DATA COLLECTION*

To complete a sustainability appraisal of a module or care pathway, both activity data and emission factors are required. Two types of data are defined in this guidance, based upon the Product Standard [(2)]. They are as follows.

- Primary data: data from specific activities within the boundaries of the studied care pathway. This is first-hand information, specific to the activity in question (eg electricity in kWh or water in m^3 consumed by a process at an individual site, or an average across sites), collected internally or from the value chain.
- Secondary data: process data that are not from specific activities within the boundaries of the studied care pathway. They may take the form of average, or typical, information about an activity (eg energy requirements and refrigerant losses for chilled storage) from a published study or other source.

(1) EC Waste Framework Directive, Directive 2008/98/EC, http://ec.europa.eu/environment/waste/framework/

(2) GHG Protocol Product Life Cycle Accounting and Reporting Standard, 2011, http://www.ghgprotocol.org/standards/product-standard

For example, primary data may be those collected for a specific module (eg electricity use by a specific ward) whilst secondary data are generic (eg an estimate of electricity use by hospital wards not specific to the care pathway appraised) and might be of lower quality. Allocated data are defined as primary data, as long as they meet other primary data requirements.

Three types of data are described in the following sections:

- activity data;
- direct activity consumption, waste and emissions data; and
- emission factors.

2.5.1 Activity Data

Activity data shall be collected for each activity within the care pathway that is material to performance against the environmental metrics appraised. Materiality is further discussed in *Section 2.3.4* and in many cases it will be possible to use data estimates for non-material activities.

Activity data are the quantitative measures of a level of activity that results in a contribution to the environmental metrics appraised. Activity data can be measured, modelled, or calculated.

Three types of activity data are considered in this guidance, as follows.

1. Process activity data: these data are physical measures of a process that result in a contribution to performance against the environmental metrics appraised (eg kWh of electricity consumed in a process, kg of cleaning chemicals used to provide a service). Typically, they describe a unit of activity for a specific year (eg 100 latex gloves per patient per year). This also includes details of any transportation of staff, incoming materials, wastes or transport of samples for laboratory testing (eg distances travelled, vehicles used, etc).

2. Direct activity consumption, waste and emissions data: these data refer to the direct contribution to performance against the environmental metrics, ie use of water, the generation of waste and the emission of greenhouse gases from a process (eg leakage of refrigerant from cooling systems).

3. Financial activity data: these data are monetary measures of activities or flows that contribute to performance against the environmental metrics appraised (eg expenditure (£GBP, $USD, etc) on electricity or on cleaning chemicals). These data can then be combined with a financial emission factor (eg environmentally extended input-output [EEIO] emission factors for GHG emissions, water and waste).

Financial activity data cannot be used to meet primary data collection requirements described in the Product Standard and so they are always classified as secondary data. The use of financial activity data should be minimised to ensure greater accuracy and consistency between studies.

Secondary activity data are provided for each module in the module-specific chapters. These data should only be used as an indicator of performance against the environmental metrics for that module, for appraisals of materiality or as part of a care pathway appraisal where the contribution of the module being considered is immaterial to the overall findings.

Primary activity data are preferred for all activity data for each module. However, secondary data may be used for activities deemed not to be material to the appraisal as defined in *Section 2.3.4*.

After mapping a care pathway or module, data collection should be initiated. Useful sources of activity data may include:

- the governing body that controls each of the modules or activities that constitute part of the care pathway (eg regulatory agency for a hospital district);
- relevant technical subject matter experts to review and confirm the mapping of module activities;
- procurement teams to collect resource consumption use via procurement / supply chain databases;
- facilities managers to identify energy use, water and other infrastructure requirements; and
- external contractors where service outsourcing occurs (eg waste management contractors for quantities and types of waste disposed).

Depending on the geographic location of the care pathway being appraised, there may also be additional organisations and databases that are useful to the study.

United Kingdom Activity Data

There are a number of relevant databases in the UK that contain useful activity data. These include (but are not limited to):

- Patient Level Information and Costing Systems (PLICS) data that include activity codes used to assign costs to organisations or patients depending on services used: https://www.gov.uk/government/publications/patient-level-information-and-costing-systems-plics-and-reference-costs-best-practice-guide
- Hospital Episode Statistics (HES) data that include all admissions, outpatient appointments and A&E attendances in NHS England: http://www.hscic.gov.uk/hes
- Estates Return Information Collection (ERIC) data that include Trust and hospital facilities energy use and other useful data: http://data.gov.uk/dataset/eric-annual-returns

2.5.2 *Emission Factors*

Once activity data are collected, they shall be multiplied by the relevant sustainability metric emission factors to calculate the performance of a module or care pathway against environmental metrics. Emission factors are values that convert activity data quantities into GHG emissions, fresh water use and waste generated – based on the GHG emissions, fresh water use and waste generated associated with producing and processing, materials/ fuels/energy, operating transport carriers, treating waste, etc.

Emission factors are values that reflect the contribution made per unit of activity data to performance against a sustainability metric (eg GHG emissions kg CO_2e per kWh of UK grid electricity).

Emission factors typically include all of the resources and emissions from upstream activities. For example, the range of GHG emissions associated with a UK grid electricity emission factor shall include: combustion of fuels needed to generate the electricity; distribution of those fuels to the power generation facility; extraction of those fuels from ground or other sources; transmission/distribution electricity losses to provide the electricity; and other activities.

Emission factors can however be appraised for data quality as described in *Section 2.6*.

2.5.3 Choosing Primary Data or Secondary Data

Section 8.2 of the Product Standard [1] states that *"Companies shall collect primary data for all processes under their control"*. A company or organisation owns or controls a process if it is under its operational or financial control.

Where an activity is not under the control of the organisation appraising the care pathway (eg a pharmaceutical company conducting a study on their product that requires GP practice data for the care pathway appraisal), the Product Standard points to the benefits of collecting primary data from the value chain (eg the GP practice) where these data are available and of sufficient quality. Each module discusses likely hotspots and areas to focus data collection based on a screening exercise.

For activities identified in the process map that are outside the direct control of the organisation, suitable secondary data sources for activity data can be used. The collection of primary data is preferred where practicable. This is because primary data are generally more representative of the process under investigation, and increase the accuracy of the appraisal. Secondary data are usually less accurate, as they will relate to processes only similar to the one that actually takes place, or to an industry average for that process.

There are examples in this guidance document of where the use of secondary data is suggested, for example when including pharmaceuticals in the overall care pathway.

Wherever there is a choice between the use of primary data or secondary data, it is important that data quality and materiality are considered (as outlined in *Section 2.6*) and the appraisal team shall seek to use the highest quality data available. This means that, where the quality of primary data is poor, good quality secondary data may be preferred.

2.5.4 Collecting Primary Data

Data collection is one of the most critical steps undertaking a sustainability appraisal due to the time requirement and engagement of stakeholders. Studies can often fail at the data collection phase, in many cases due to insufficient planning. Ensure that:

- the project has been appropriately defined and clear boundaries are set;
- a screening/materiality assessment has been completed to limit data requirements;
- key contacts for data are identified and engaged early in the process;
- these stakeholders understand why they are providing data; and
- support is offered throughout the data collection phase.

It is important to consider how to engage stakeholders necessary for data collection. Before approaching them, consider their motivation for participating in the study (eg

(1) GHG Protocol Product Life Cycle Accounting and Reporting Standard, 2011, http://www.ghgprotocol.org/standards/product-standard

an interest in sustainability). Support from senior management is often an effective way to ensure successful data collection.

Effective data collection

Data collection can be a time-consuming process and is likely to require the engagement of stakeholders from a broad background, who haven't necessarily participated in sustainability projects previously. Consider the following when collecting primary data from either within or outside your organisation.

- Plan appropriately before starting data collection. Know the system boundaries, module scope, likely hotspots, types of data required and potential sources.
- Conduct the screening exercise before starting primary data collection to limit the data that are needed.
- Communicate the purpose and benefits of the project to the stakeholder. Ensure that they understand the wider context of the study and how investing their time will be beneficial.
- Use language appropriate to the stakeholder (eg single use medical devices may be described differently between procurement teams and frontline health workers).
- Be clear and concise with the data collection request. Only ask what is absolutely needed and anticipate clarification questions to minimise the need for a second round of data collection.
- Develop a questionnaire that is clear and in a format usable by the stakeholder.
- Explain the questionnaire to the stakeholder and answer any questions.
- Don't set a deadline and then walk away. Offer support and guidance throughout the data collection process, rather than leaving a stakeholder to populate a questionnaire and return it by a given date.

It is important to consider from where data shall be collected.

Within Your Organisation

Identifying clear requirements and communicating these in a relevant way to data owners within the organisation is key to the successful collection of data.

The following steps are adapted from the GHG Protocol Supplier Engagement Guidance [(1)], but are also applicable to other metrics and to the collection of data from within your own organisation.

- Identify internal departments responsible for data collection and departments/sites that will hold the data.
- Develop a method for managing data, including the data collection process and quality assessment.
- Provide a training or information session to all those involved in the data collection process, explaining the wider context.
- Make requests as simple as possible and questions as relevant as possible – taking into account the recipient's role.
- Assess data quality and follow up with internal departments to resolve data questions and to identify ways of improving data collection in future.

Outside Your Organisation

Engaging other organisations, such as suppliers, in the appraisal process will help you to collect specific primary data for your value chain, giving greater insight into the sources of water use, waste generation and GHG emissions. It can also encourage future co-operation in terms of finding practicable opportunities to improve sustainability.

The following steps are proposed in the GHG Protocol Supplier Engagement Guidance:

- internal planning prior to engaging suppliers:
    - identify relevant internal departments;
    - select suppliers and identify supplier information (eg based on materiality, spend, output, etc);
    - engage procurement staff to ensure that the correct suppliers have been identified; and
    - develop a method for managing the supplier data, including the data collection process and quality assessment; and
- working with suppliers to collect data:
    - contact suppliers and discuss their processes prior to developing and sending any survey forms / data collection templates;
    - provide a training or information session if required;
    - check in periodically with suppliers regarding their progress;
    - determine the consequences for suppliers that choose not to respond; and
    - assess data quality and follow up with suppliers to resolve data questions.

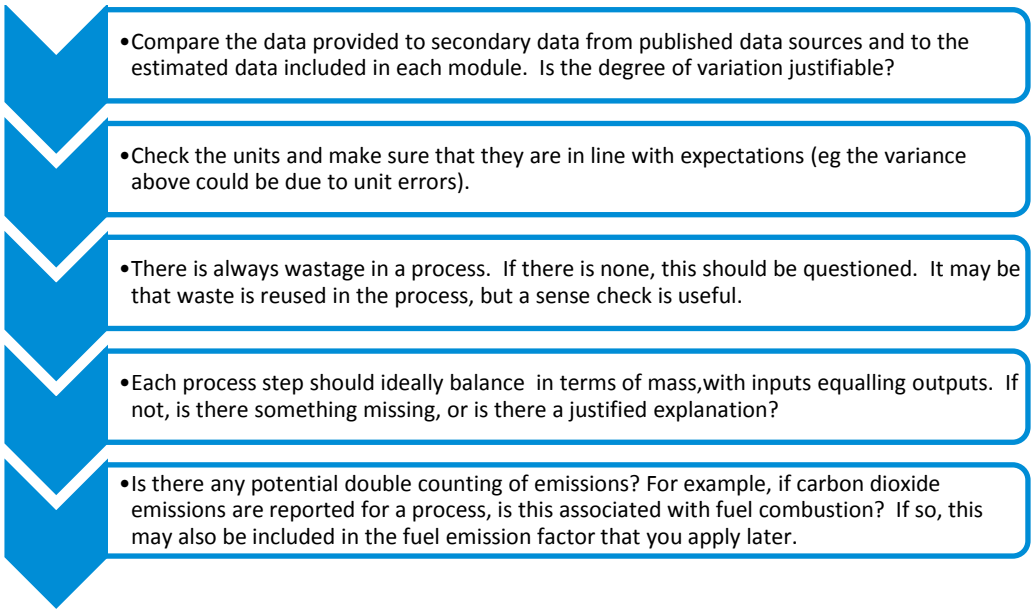
Often the best way to collect data from an actor in the care pathway is through the preparation of a survey form or data collection template, specifying the data required, together with all necessary information to assess the quality of the data. The most successful data collection templates are tailored to a specific product or

(1) GHG Protocol Supplier Engagement Guidance - http://www.ghgprotocol.org/standards/product-standard

activity, but if tailoring is not possible (eg due to a lack of information), a generic template will still be a valuable tool.

Once data have been received from the supplier, it is important to assess the accuracy and quality of the information provided. A data quality assessment process is described in *Section 2.6.* Initial checks can also highlight any errors and whether the data are suitable for use. Typical checks are outlined below.

Figure 2.1 Primary Data Checks



Additionally, it may be beneficial to check data sources with other technical experts (eg other suppliers/facilities) or to gain external verification of data.

Sampling

In some cases, an activity will be undertaken at a large number of sites. Data collection for each site in such an instance could be prohibitively time consuming. If this is the case, a sampling approach is recommended. The Product Standard provides some guidance on sampling options.

2.5.5 Collecting Secondary Data

In general, the following hierarchy for secondary data sourcing is recommended.

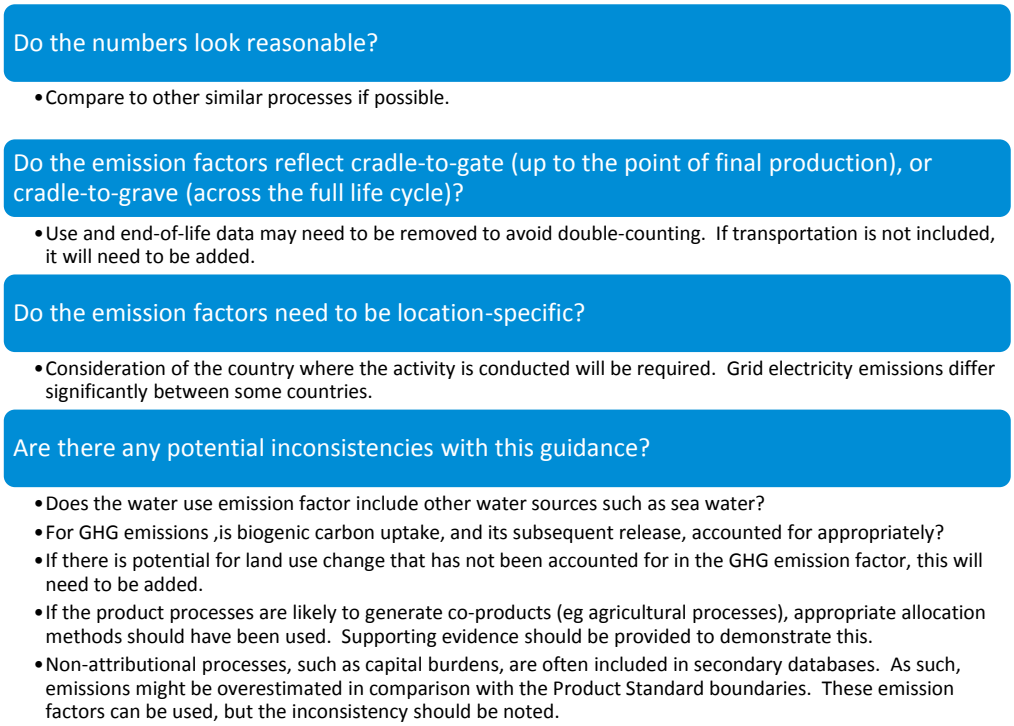
1. Emission factors generated from average industry data and contained in life cycle inventory databases, industry association reports and government reports, and that are compliant with ISO Life Cycle Assessment standards [(1)] and that have been critically reviewed.
2. Where these are unavailable, other existing peer-reviewed life cycle data from published life cycle studies or from proprietary packages should be used.

(1) ISO14040:2006, Life Cycle Assessment: Principles and Framework and ISO14044:2006, Life Cycle Assessment: Requirements and Guidelines, http://www.iso.org/iso/catalogue_detail?csnumber=37456

3. Where an emission factor for a specific material input or process is unavailable, substitute data may be used – for example, substituting materials with similar manufacturing processes.

If you are using aggregated secondary data / emission factors, care needs to be taken that that they are fit for purpose. As an example, is the system boundary of the subject product consistent with the boundary requirements in the Product Standard and in this guidance document? If not, the emission factor may need to be amended before use. Some recommended checks are outlined below. Box 8.5 in Chapter 8 of the Product Standard [1] also provides a list of questions to assist with selecting a life cycle inventory database.

Figure 2.2 *Emission Factor Checks*



Useful emission factors are listed in *Annex C*. A number of databases that may be useful when sourcing or modelling additional emission factors are listed below.

- Defra/DECC GHG Conversion Factors (http://www.ukconversionfactorscarbonsmart.co.uk/)
- GHG Protocol Third Party Databases (http://www.ghgprotocol.org/Third-Party-Databases)
- European reference Life Cycle Database (ELCD) (http://eplca.jrc.ec.europa.eu/ELCD3/)
- US Life Cycle Inventory Database (US LCI) (http://www.nrel.gov/lci/)

(1) GHG Protocol Product Life Cycle Accounting and Reporting Standard, 2011, http://www.ghgprotocol.org/standards/product-standard

- US EPA GHG Emission Factors Hub (http://www.epa.gov/climateleadership)
- ecoinvent (http://www.ecoinvent.ch/)
- GaBi LCA databases (http://www.gabi-software.com/databases/gabi-databases/)
- AUSLCI (http://alcas.asn.au/AusLCI/)
- Inventory of Carbon and Energy (ICE) (http://www.circularecology.com/embodied-energy-and-carbon-footprint-database.html)
- Environmental Extended Input Output (EEIO) databases – various (other are available) (http://www.eiolca.net/, http://www.cml.leiden.edu/software/data-e3iot.html)

Some of these databases include detailed life cycle inventories (LCIs) describing all of the resources required and emissions and waste generated from an activity. It is possible to use these LCI datasets to calculate emission factors by analysing the LCI datasets using impact assessment methods.

Specialist software is normally required to complete this process (examples include SimaPro, GaBi, OpenLCA and others). The preferred impact assessment method to use when calculating emission factors via this approach is included in *Annex D*.

Pharmaceuticals Secondary GHG Data

There may be instances when appraising a care pathway where primary data for pharmaceuticals consumption are not available. In these situations, the following steps may be employed.

- Apply the Sector Guidance where possible.
- Identify the type of pharmaceutical, active ingredient, manufacturing process and synthesis steps.
- Contact the manufacturer for data on the specific product.
- Search for suitable data via a literature review and in life cycle inventory databases.
- If the product is a small molecule blister pack, then the GHG emissions can be estimated using the ABPI tool (http://www.abpi.org.uk/our-work/mandi/Pages/sustainability.aspx).

Estimating GHG Emissions of an Active Ingredient
http://pubs.acs.org/doi/abs/10.1021/es502562d?journalCode=esthag

In absence of primary data for active ingredient manufacture it is possible to estimate the GHG emissions. Using the approach described in the article titled: *"Environmental Sustainability Assessments of Pharmaceuticals: An Emerging Need for Simplification in Life Cycle Assessments"*.

- The formula to calculate GHG emission for a single synthesis step is:
  $$\mathrm{LOG}(\mathrm{GHG}_{\text{Synthesis Step}}) = -0.32 + 0.258 * \mathrm{LOG}(\text{Organic Solvent}) - 0.907 * \mathrm{LOG}(\text{Molar Efficiency}) + 0.33 * \mathrm{LOG}(\Delta t)$$

- The GHG emissions of the API can then be calculated by adding together the GHG emissions of each synthesis step multiplied by a conversion factor based on how much of the synthesis step output is required to produce the final API:
  $$\mathrm{GHG}_{\text{API}} = \sum_{i=1}^{n} \text{Conversion factor}_{(i)} * \mathrm{GHG}_{\text{Synthesis step(i)}}$$

Where:
n = Number of synthesis steps
GHG_{API} = GHG emissions from API production (kg CO_2e / mol)
$Conversion\ factor = \frac{\text{Input moles of synthesis step required to produce API}}{\text{Output moles of final API}}$ (mol/mol)
$\mathrm{GHG}_{\text{Synthesis Step}}$ = GHG emissions from production of a synthesis step (kg CO_2e / mol)
$Organic\ Solvent =$ Total net consumption of organic solvents in a synthesis step (L/mol)
$Molar\ Efficiency = \frac{\text{Output moles of product from a synthesis step}}{\text{Input moles of product of raw materials in a synthesis step}}$ (mol/mol)
Δt = Time duration of a synthesis step per mole output (s/mol)

Example:
For a hypothetical linear production route with three steps, the yields and conversion factors are as follows:

	Synthesis step A	Synthesis step B	Synthesis step C (final)
Yield	40%	60%	80%
GHG (kgCO_2e/mole)	3.0	9.0	7.5
Conversion factor	(1/0.8)/0.6 = 2.08	1/0.8 = 1.25	1

Medical Devices Secondary GHG Data

Similarly, it may be necessary to estimate the medical device consumables or equipment in a care pathway. A possible approach is outlined below. Note that this is a guide only and other estimation methods may be used.

- Collect information specific to the medical device such as weight, key components, material types, packaging, use scenario, disposal options and bill of materials if possible.
- Identify life cycle inventory data representative of the materials and model an estimate of the product based on key components, weights and material types. Ensure that each component has a representative estimate for manufacturing as well as assembly of the medical device. eg if a plastic component is used, then it may require the combination of polycarbonate plastic granulate LCI data and injection moulding LCI data.
- If these specific data are not available, estimate the weight of the medical device and key material makeup then model an estimate of the device. eg 5 grams of stainless steel including manufacturing estimate.

When including multi use medical devices, it is important to allocate the burden based on estimated number of uses and years of use.

2.6 *DATA QUALITY AND UNCERTAINTY*

2.6.1 Data Quality Principles

The Product Standard [(1)] requires that "*During the data collection process, companies shall assess the data quality of activity data, emission factors, and/or direct emissions data by using the data quality indicators".*

Ultimately, the accuracy or 'quality' of the result of an appraisal is dependent on the quality of the data used to calculate it. It is critical to consider the quality of the primary and secondary data used, and to demonstrate that they appropriately characterise the care pathway assessed.

Drawing on the Product Standard, it defines five data quality indicators to use in assessing data quality. They are:

(1) GHG Protocol Product Life Cycle Accounting and Reporting Standard, 2011, http://www.ghgprotocol.org/standards/product-standard

1. Technological representativeness: the degree to which the data reflect the actual technology (-ies) used in the process;
2. Geographical representativeness: the degree to which the data reflect actual geographical locations of the processes within the boundary (eg country or site);
3. Temporal representativeness: the degree to which the data reflect the actual time (eg year) or age of the process;
4. Completeness: the degree to which the data are statistically representative of the process sites; and
5. Reliability: the degree to which the sources, data collection methods, and verification procedures used to obtain the data are dependable.

Assessing data quality is not an exact science. There are many ways in which data quality assessments can be performed, and different scoring approaches could be used in each case. The key principle is that due consideration is given to the quality of the data, and that this is carried out and reported transparently. Semi-quantitative and qualitative methods for assessing data quality are outlined in *Section 2.6*.

The data quality assessment, along with any accompanying assumptions, shall be reported together with the appraisal calculations.

Significant processes and data points should be identified by assessing their contribution to the overall performance against the environmental metrics. All of those processes that make a contribution above a selected cut-off level for each metric (eg 10% of the total GHG inventory) should be deemed significant processes. For each of these, details of the data sources and data quality scores or descriptions for both primary and secondary data should be provided.

Collecting data and assessing their quality should be an iterative process, with the objective of improving the accuracy of the appraisal and ensuring that it is fit for purpose. As part of assessing performance against environmental metrics, it is important to identify the most significant processes in terms of their contribution. A focus on improving data quality for these processes will be most effective in making the overall appraisal more accurate and the conclusions drawn more robust.

2.6.2 Assessing Primary Data Quality

Different methods for assessing the quality of primary data are applicable in different contexts, as follows.

1. Semi-quantitative assessment: a semi-quantitative approach is recommended in support of external disclosures, to aid consistency and transparency. A semi-quantitative approach may also add value to internal assessments, potentially allowing greater comparability and consistency over time.
2. Qualitative assessment: for internal assessments (eg to identify hotspots in the value chain), formal assessment/recording may not be needed, but it is

important to ensure that differences in data quality are not unduly influencing findings and conclusions.

Although a semi-quantitative assessment is recommended, either approach to appraising data quality is permissible in this guidance.

Qualitative Assessment

A qualitative assessment shall take into account the five data quality indicators outlined in *Table 2.3*, assessing them as *Very good*, *Good*, *Fair* or *Poor*, along with relevant commentary. An example scoring procedure is shown below.

Table 2.3 Example Qualitative Data Quality Appraisal

Score	Technology	Time	Geography	Completeness	Reliability
4. Very good	Data generated using the same technology	Data age less than three years	Data from the same area	Data from all relevant process sites over an adequate time period to even out normal fluctuations	Verified data based on measurements
3. Good	Data generated using similar but different technology	Data age between three and six years	Data from the similar area	Data from more than 50% of sites for an adequate time period	Verified data partly based on assumptions or non-verified data based on measurements
2. Fair	Data generated using a different technology	Data age between six and 10 years	Data from different area	Data from less than 50% of sites for an adequate time period to even out normal fluctuations or more than 50% of sites but for a shorter time period	Non-verified data partly based on assumptions or a qualified estimate (e.g. by sector expert).
1. Poor	Data where technology is unknown	Data age greater than 10 years	Data from an area that is unknown	Data from less than 50% of sites for a shorter time period or representativeness is unknown	Non-qualified estimate

Source: adapted from the Product Standard (1)

(1) GHG Protocol Product Life Cycle Accounting and Reporting Standard, 2011, http://www.ghgprotocol.org/standards/product-standard

Semi-Quantitative Assessment

The benefit of a semi-quantitative approach for data quality appraisal is that scores can be generated and summed in order to generate an overall estimate of the quality of data supporting an appraisal of environmental metrics. Whilst this is only an estimate, it provides a clear and simple indication of the potential representativeness of the results of the assessment. A minimum score can also be set where applicable.

Both the ILCD Handbook (Annex A) [1] and the European Commission's harmonised method for the calculation of the environmental footprint of products [2] describe a semi-quantitative approach for data quality appraisal that may be used.

Table 2.4 Example Semi-Quantitative Data Quality Appraisal

Data Quality Example Appraising Time Representativeness for GHG Emissions

Consider the results of a simple study where the contributions to a GHG appraisal are:

- *Pharmaceutical x contributes 60%;*
- *Electricity consumption contributes 30%; and*
- *Road travel by staff contributes 10%.*

Steps to appraise data quality

1. Assign ranking value to the score for each data quality metric. *(eg data age less than 3 years = 4, between 3 and 6 years = 3, between 6 and 10 years = 2 and greater than 10 years = 1).*

2. Determine the ranking value for each data value used. *(eg pharmaceutical x consumption data are 4 years old (score of 3), electricity data are 2 years old (score of 4) and road travel by staff data are 8 years old (score of 2)).*

3. Multiply the ranking value for each data point by the contribution of data point to the environmental metric appraised. *(eg pharmaceutical x = 60%*3 = 1.8, electricity consumption = 30%*4 = 1.2 and road travel = 10%*2 = 0.2).*

4. Sum the results to determine the overall data quality score. *(eg pharmaceutical x (1.8) + electricity consumption (1.2) + road travel (0.2) =time representativeness data quality score of 3.2).*

Therefore semi-quantitative data quality for time representativeness is considered to be *good*.

(1) International Reference Life Cycle Data System (ILCD) Handbook, 2010, http://eplca.jrc.ec.europa.eu/?page_id=86
(2) European Commission Product Environmental Footprint, 2013/179/EU, 2013, http://ec.europa.eu/environment/eussd/smgp/policy_footprint.htm

2.6.3 Assessing Secondary Data Quality

Secondary data (whether they are used for activity data or as an emission factor) shall also be assessed using scores for key criteria, as described in the Sector Guidance [(1)]. The objective of a data quality assessment in this case is to ensure that the secondary data used are the most appropriate, and that any areas of uncertainty are identified. The secondary data shall be assessed against the specific process for which the data are being used. An assessment of data quality is, in particular, recommended for processes deemed significant to the total indicator performance.

As with the scoring of primary data quality, details of semi-quantitative and qualitative scoring systems are provided in the ILCD Handbook [(2)] and in the draft European Commission method for appraising the environmental footprint of products [(3)]. A semi-quantitative approach is recommended in support of external disclosures, as this will aid in assuring that the data are assessed in a consistent and transparent manner. For internal assessments (eg to identify hotspots in the care pathway), formal assessment/ recording may not be needed, but it is important to ensure that differences in data quality do not unduly influence findings and conclusions.

A qualitative assessment is recommended for internal appraisals. This shall take into account the five data quality indicators outlined in *Table 2.3*, assessing them as *Very Good, Good, Fair* or *Poor*, along with a relevant commentary.

2.6.4 Considering Uncertainty

There will be uncertainty and variability in the calculation of performance against the metrics for any activity. Inevitably, there will be inaccuracies, due to limitations in the accuracy of measurements and errors, in standard emission factors used, data collected, knowledge gaps filled by assumptions and methods used.

It is important to understand the uncertainties associated with results and the sources of those uncertainties. The Product Standard [(4)] requires that *"Companies shall report a qualitative statement on sources of inventory uncertainty and methodological choices."*

The Product Standard (*Chapter 10*) describes three types of uncertainty, as follows.

- Parameter Uncertainty**:** uncertainty arising from the inaccuracy of direct emissions data, activity data, emission factors or global warming potentials. Uncertainty can typically be represented by a range or a probability distribution. Further quantitative analysis may then be undertaken using methods such as

(1) GHG Accounting Sector Guidance for Pharmaceutical Products and Medical Devices, 2012, http://www.ghgprotocol.org/feature/pharmaceutical-and-medical-device-sector-guidance-product-life-cycle-accounting
(2) International Reference Life Cycle Data System (ILCD) Handbook, 2010, http://eplca.jrc.ec.europa.eu/?page_id=86
(3) European Commission Product Environmental Footprint, 2013/179/EU, 2013, http://ec.europa.eu/environment/eussd/smgp/policy_footprint.htm
(4) GHG Protocol Product Life Cycle Accounting and Reporting Standard, 2011, http://www.ghgprotocol.org/standards/product-standard

Monte Carlo Analysis (this may be done in common LCA modelling packages such as *SimaPro* or *GaBi*) or Taylor Series expansion.

- Scenario uncertainty: uncertainty arising from methodological choices such as allocation methods, product use assumptions or end of life assumptions. Analysis of this may be undertaken by changing the assumptions made and by comparing the results. This may also commonly be called sensitivity analysis.
- Model Uncertainty**:** uncertainty arising from limitations in the ability of modelling approaches to reflect the real world.

All three types of uncertainty shall be considered in the assessment, but organisations are only required to report a qualitative statement on sources of uncertainty.

Wherever possible, companies should also report quantitative uncertainty. Knowledge of uncertainty will allow for a better assessment of the results when making decisions on hotspot prioritisation, material choices, process choices, etc. Further details of how to undertake quantitative assessments of uncertainty are provided in the supplementary guidance document to the Product Standard [(1)].

(1) GHG Protocol Product Life Cycle Accounting and Reporting Standard, 2011, http://www.ghgprotocol.org/standards/product-standard

3 COMMUNICATION AND REPORTING

3.1 COMMUNICATION SUPPORTED

This guidance is intended for calculating and reporting the performance of care pathways against selected environmental metrics so that the information can be used to inform discussions regarding:

- the design of more sustainable care pathways and models of care;
- identification of sustainability hotspots in the care pathway;
- identification of potential opportunities to improve the sustainability of the pathway; and
- tracking the sustainability performance of a care pathway over time.

Reporting care pathway environmental metrics may also be undertaken for the purposes of:

- informing sustainable care pathway discussions;
- providing information on areas to improve the sustainability of a care pathway; and
- designing more sustainable care pathways and models of care.

Comparisons between care pathways shall only be undertaken if the same conditions are used for both appraisals (eg system boundaries, units of analysis, activity data, allocation, emission factors etc). Further guidance on comparisons can be found in the Product Standard and Sector Guidance [(1)].

When supplying information, organisations should be particularly aware of the recommendations set out in this guidance for reporting (*Section 3.2*) and both data quality requirements and assurance described in the Product Standard [(2)].

In addition, there are a number of guidance documents on making environmental claims that shall be consulted, depending on the region the claim is made. The UK Green Claims Guide is a useful reference (https://www.gov.uk/environmental-claims-and-labels-guidance-for-businesses).

3.2 REPORTING RECOMMENDATIONS

Full reporting requirements and further general guidance for reporting are provided in Chapter 13 of the Product Standard, and shall be consulted for guidance.

Recommendations for producing a care pathway case study are outlined below and a template is provided in *Annex E*.

(1) GHG Accounting Sector Guidance for Pharmaceutical Products and Medical Devices, 2012, http://www.ghgprotocol.org/feature/pharmaceutical-and-medical-device-sector-guidance-product-life-cycle-accounting
(2) GHG Protocol Product Life Cycle Accounting and Reporting Standard, 2011, http://www.ghgprotocol.org/standards/product-standard

General Information and Scope:

- contact information;
- date the study was completed;
- the studied care pathway and its description;
- the unit of analysis;
- a declaration of conformance with this guidance document;
- a disclaimer stating the purpose and intended uses of the case study; and
- for subsequent analysis, a link to previous reports and a description of any methodological changes.

Boundary Setting:

- a process map of the care pathway, identifying each of the modules used;
- a description of the care pathway process map, including its constituent modules;
- a description of the condition/illness and type of patient considered;
- the time period considered; and
- the geographical scope of the study.

Activity Data:

- For significant processes, a descriptive statement concerning the activity data should include:
    - data sources;
    - a qualitative description of data quality; and
    - where it was not possible to source primary activity data and those methods employed in order to overcome data gaps.

Allocation:

- a description of the approach used to allocate activity data to the care pathway and modules; and
- disclosure and justification of the methods used to avoid or perform allocation.

Uncertainty:

- a qualitative statement concerning metric uncertainty and methodological choices, where methodological choices include:
    - the source of emission factors used; and
    - calculation models.

Inventory Results:

- the source and date of the emission factors used;
- total results for the care pathway for each sustainability metric, according to the unit of analysis;
- a breakdown of the overall results according to care pathway module; and

- key contributions to each sustainability metric for the care pathway as a whole and for any significant individual modules as identified through the materiality assessment.

Improvements:

- discussion as to how the quality, accuracy and uncertainty of the study might be improved – ie the limitations of the study; and
- how the findings of the study might be used to improve the sustainability of the care pathway appraised.

Assurance:

Further guidance on assurance can be found in the Product Standard [(1)] and Sector Guidance [(2)]. If assurance is sought, then the following should be included in the reporting recommendations:

- a short assurance statement that includes:
  - whether the assurance was performed by a first or third party;
  - the level of assurance achieved (limited or reasonable) and an assurance opinion or the critical review findings;
  - a summary of the assurance process;
  - the relevant competencies of the assurance providers; and
  - how any potential conflicts of interests were avoided for first party assurance.

(1) GHG Protocol Product Life Cycle Accounting and Reporting Standard, 2011, http://www.ghgprotocol.org/standards/product-standard

(2) GHG Accounting Sector Guidance for Pharmaceutical Products and Medical Devices, 2012, http://www.ghgprotocol.org/feature/pharmaceutical-and-medical-device-sector-guidance-product-life-cycle-accounting

Annex A

Development of the Guidance and Contributors

1 DEVELOPMENT OF THE GUIDANCE

1.1 TIMELINE AND MILESTONES

A summary of the tasks and milestones completed to deliver the care pathways guidance is below.

Project initiation	Kickoff at CSPM meeting on 25th November 2014
Workshops	Workshops with invited experts to determine scope of guidance on 21st and 22nd January 2015
1st draft	First draft of guidance written by ERM in February and March 2015
1st consultation	CSPM members and invited experts provided comments on draft in April 2015
2nd draft	Second draft of guidance written and data collection by Trucost in May to August 2015
2nd consultation	CSPM members provided further comments on second draft in August 2015
Final draft	Final guidance document completed in September 2015
Launch	Launch and publication of the guidance in London on 20th October 2015

1.2 STAKEHOLDER WORKSHOPS

Workshops were run on the 21st and 22nd January 2015 in London for the purpose of scoping the care pathways guidance document. A public call for interested and relevant experts was placed in the Sustainable Development Unit monthly newsletter, in addition to those experts directly approached to contribute to the development of the guidance.

Prior to the workshops, the CSPM had discussed and agreed the six modules to include within the guidance, as well as the environmental impacts to consider. The purpose of the workshops was then to collaborate with experts in order to identify the scope of services to be included in each module and what consumables and equipment are required to provide the services.

Each module was considered separately, with stakeholders breaking into groups and reporting back their definition and scope of the module. The output from each session was a map defining the services and activities required by the module and a list of likely resources, consumables and equipment required and emissions and waste released. This information formed the first draft of the guidance.

1.3 *FIRST CONSULTATION PROCESS*

The consultation of the first guidance draft ran in April 2015 and included CSPM members and the stakeholder expert group.

Consultees provided their comments by editing the draft version of the guidance in track changes format and adding comments where necessary. The comments from each participant reviewing the document were then consolidated to a single list. ERM updated the guidance with those comments that did not require member agreement.

The remaining comments were discussed and changes agreed at the CSPM meeting in London on the 7th of May 2015. Following this, ERM updated the guidance and produced the second draft version ready for a further review.

1.4 *DATA COLLECTION*

Once the first draft of the guidance was agreed, the process of data collection, needed to underpin the calculation of the environmental impacts of each module, began. Trucost provided support in undertaking this task by working with a range of NHS representatives who provided data from their Trust. A list of supporting organisation that provided data for the guidance is included in *Section 3.6*.

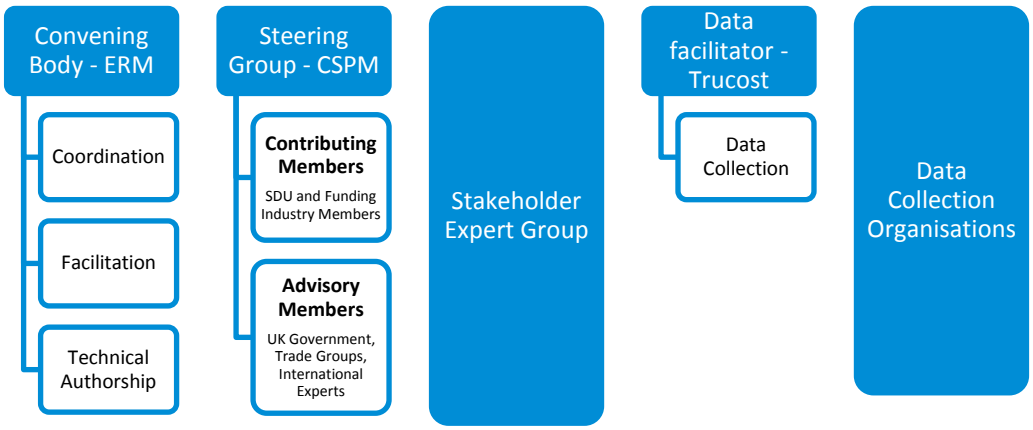
1.5 *SECOND CONSULTATION PROCESS*

A second and final consultation process was undertaken for two weeks in September 2015 in order to finalise the guidance. This consultation was completed by the CSPM members and served as final signoff and approval of the guidance. A teleconference was held to discuss and agree final changes to the guidance. Following this, ERM created the final guidance document.

2 ROLES AND RESPONSIBILITIES

The governance process to oversee and develop this guidance consists of four groups:

1. convening body and technical author (ERM);
2. steering group (CSPM);
3. stakeholder expert group ;
4. data collection facilitator (Trucost); and
5. data collection organisations.



2.1 ROLE OF CONVENING BODY AND TECHNICAL AUTHOR

The technical author's role has been to convene and facilitate the guidance development process. The technical author organisation has provided secretarial support to the process, responsible for convening meetings, for chairing the steering group, for preparing the agenda for meetings, and for writing the minutes of meetings.

The technical author has also been responsible for the production of each draft of the guidance document, and for collating and responding to comments. In doing so, the technical author has had an overarching role to provide consistency in the method and approach.

Responsibilities

- Facilitation and coordination of meetings of the Steering Group and Stakeholder Expert Group, as required.
- Review of relevant existing standards and methods, consolidation of issues and challenges and development of consensus around the content of the guidance.
- Development of chapters and draft text as appropriate.
- Development of inputs to inform, explain and/or justify provisions to the Steering Group, and Stakeholder Expert Group and support decision making processes.

- Receipt and response to feedback on draft chapters following consultation and review periods.
- Management of data collection, as required.
- Production of final chapters, taking into account feedback received.

2.2 *THE COMPOSITION AND ROLE OF THE STEERING GROUP*

The Steering Group has provided strategic guidance and built consensus during the development of the Sector Guidance.

The Steering Group is comprised of contributing members who funded the guidance and advisory members who provide additional technical input. A list of these members is below.

Steering Group meetings were attended by both Contributing Members and Advisory Members (either in person or remotely).

Decision Making Processes

The guidance has been developed through an open, transparent, inclusive, multi-stakeholder process. Decisions have been facilitated by building consensus, and the document is subject to review by stakeholders. As the Convening Body, ERM has made every effort to achieve consensus within the Steering Group on each aspect of the guidance. On the occasion that the wider Steering Group has been unable to reach a consensus, the majority vote by Contributing Members was the authority with regard to final decisions.

The Steering Group's Responsibilities

- Provision of advice and guidance on strategy, objectives and scope of the guidance documents.
- Provision of guidance on the structure of the document (including content, level of detail, etc.) based on agreed objectives.
- Provision of technical support, data and materials to support the drafting process.
- Resolution of disagreements on technical issues.
- Review of document drafts for technical accuracy, consistency and completeness.
- Recruitment of pilot testers.
- Support to the broad adoption and use of the guidance.

2.3 *STAKEHOLDER EXPERT GROUP*

The role of the Stakeholder Expert Group has been to provide feedback and technical input to the draft guidance.

The group consists of any interested stakeholders from government, industry, NGOs and academia. An application for parties was advertised publically through the Sustainable Development Unit website and newsletter. The SDU and steering group

also approached a number of parties directly, due to their relevant technical experience.

The Stakeholder Expert Group attended two days of workshops at the beginning of the guidance development process. The Stakeholder Expert Group reviewed and discussed each of the modules over the two day period to identify the scope, boundaries and what should be included and excluded within each module, based on their technical experience.

Information gathered through the workshops was summarised and incorporated into the first draft of the guidance. Incorporation of comments from the Stakeholder Expert Group was at the discretion of the Steering Group.

Stakeholders who contributed to the content of the guidance document are acknowledged and recognised below.

2.4 *DATA COLLECTION FACILITATOR*

Each module contains information describing the GHG emissions, water and waste associated with the module activities. Data were required describing the module activities for the purposes of calculating these environmental impacts.

The role of the data collection facilitator was to work with the organisations providing data to collect relevant data for each module, review and address data gaps then summarise the data into a format for inclusion in the guidance.

2.5 *DATA COLLECTION ORGANISATIONS*

A number of organisations volunteered to provide data for activities described in the module. The majority of these were organisations that provide the module services, such as hospitals.

These organisations worked with the data collection facilitator to provide detailed data for use in calculating the environmental impacts of each module.

3 CONTRIBUTORS

3.1 CSPM LEADERSHIP MEMBERS

- AstraZeneca: Keith Moore and Wesley White.
- Baxter Healthcare: Julie Aspin and Margaret Enos.
- Becton Dickinson: Ivan Welvaert.
- Boehringer Ingelheim: Richard Pitt.
- GlaxoSmithKline: Mark Rhodes and Matt Wilson.
- Johnson & Johnson: Phil Dahlin, Dominika Domanska and Erol Odabasi.
- Medtronic: Sarah Hill and Silvia Montisci.
- Novo Nordisk: Anne Gadegaard and Nanja Hedal Kløverpris.
- Sustainable Development Unit: Sonia Roschnik.

3.2 CONVENING BODY AND TECHNICAL AUTHOR

- Environmental Resources Management Limited (ERM): Tom Penny, Michael Collins, Andy Whiting and Simon Aumônier.

3.3 CSPM ADVISORY MEMBERS

- Association of British Healthcare Industries: Andy Vaughan.
- Association of British Pharmaceutical Industries: Mike Murray.
- AstraZeneca: Keith Moore and Wesley White.
- Barts Health NHS Trust: Fiona Daly.
- Baxter Healthcare: Julie Aspin and Margaret Enos.
- Becton Dickinson: Ivan Welvaert.
- Boehringer Ingelheim: Richard Pitt.
- British Generic Manufacturers Association: Paul Fleming.
- Environmental Resources Management Limited (ERM): Tom Penny, Michael Collins and Simon Aumônier.
- GlaxoSmithKline: Mark Rhodes and Matt Wilson.
- Guys & St Thomas trust: Alex Hammond.
- Hull and East Yorkshire NHS Trust: Marc Beaumont.
- International Sustainability Unit: Laura Partridge.
- Johnson & Johnson: Phil Dahlin, Dominika Domanska and Erol Odabasi.
- Medicines and Healthcare products Regulatory Agency: Ian Harwood.
- Medtronic: Sarah Hill and Silvia Montisci.
- National Institute for Health and Clinical Excellence: Jennifer Watts.
- Novo Nordisk: Anne Gadegaard and Nanja Hedal Kløverpris.
- Pharmaceutical Market Support Group: Kevan Wind.
- Royal Pharmaceutical Society: Helen Gordon, Howard Duff and Jamie Woodward.
- Sustainable Development Unit: Sonia Roschnik.
- UK Department of Health: David Wathey and Danny Palnoch.

- United Nations Development Programme (UNDP) Europe and Central Asia: Christoph Hamelmann.

3.4 *Stakeholder Expert Group*

- Airedale Hospital NHS Foundation Trust: Frank Swinton.
- AstraZeneca: Keith Moore and Wesley White.
- Baxter Healthcare: Julie Aspin.
- Becton Dickinson: Ivan Welvaert.
- Cambridge University Hospitals NHS Foundation Trust: Richard Hales.
- Centre for Sustainable Healthcare: Rachel Stancliffe and Allen Jones.
- Environmental Resources Management: Tom Penny, Michael Collins and Andy Whiting.
- GlaxoSmithKline: Mark Rhodes.
- Global Climate and Health Alliance: Isobel Braithwaite.
- Gloucestershire Care Services NHS Trust: Georgina Smith.
- Guys & St Thomas Trust: Alex Hammond.
- Hull and East Yorkshire Hospitals NHS Trust: Marc Beaumont.
- Johnson & Johnson: Phi Dahlin, Dominika Domanska and Erol Odabasi.
- London NHS Travel Network: Gemma Hagen.
- National Institute for Health and Clinical Excellence: Jennifer Watts.
- NHS England (South): Caroline Jessel.
- Northern Lincolnshire & Goole NHS Trust: Jug Johal.
- Public Health England: Brett Duane.
- Royal College of Nursing: Mark Platt.
- Royal College of Psychiatrists: Daniel Maughan.
- St George's Healthcare NHS Trust: Wilfred Carneiro.
- Sussex Community NHS Trust: Susie Vernon.
- Sustainable Development Unit: Sonia Roschnik and Imogen Tennison.

3.5 *Data Collection Support*

- Trucost: Julie Raynaud, Angela Rose, Miriam Tarin, Rick Lord and Tom Barnett.

3.6 *Data Collection Organisations*

- Airedale Hospital NHS Foundation Trust: Frank Swinton.
- Barts Health NHS Trust: Fiona Daly.
- Cambridge University Hospitals NHS Foundation Trust: Richard Hales.
- Centre for Sustainable Healthcare: Frances Mortimer.
- Guy's and St Thomas' NHS Foundation Trust: William Holden.
- Hull and East Yorkshire Hospitals NHS Trust: Marc Beaumont.
- Leicester General Hospital: Bernie Stribling.
- Northampton General Hospital NHS Trust: Clare Topping.
- Royal College of Nursing: Mark Platt.
- South East Coast Ambulance Service NHS Foundation Trust: Julia Brown.

- North East Ambulance Service NHS Foundation Trust: Clare Swift.
- Northern Lincolnshire and Goole NHS Foundation Trust: Sally Yates and Johal Jug.
- St. George's Healthcare NHS Trust: Wilfred Carneiro.
- Sustainable Development Unit: Imogen Tennison and Sonia Roschnik.

A particular mention is made of Richard Hales and Frank Swinton. Without their efforts in providing data, calculating the environmental impacts would not have been possible.

Annex B

Areas for Further Research and Limitations

1 AREAS FOR FURTHER RESEARCH

A list of modules already appraised and those where guidance would be beneficial is presented below. This list will be reviewed and amended as the document evolves.

1.1 LIST OF MODULES

Module number	Module	Description	Guidance Written?
1	GP Consultation		Yes
2	Patient Travel		Yes
3	Emergency Department Visit		Yes
4	Inpatient / Bed Day		Yes
5	Surgical Procedure		Yes
6	Condition Self-Management		Yes
	Outpatient		No
	Diagnostics	eg laboratory testing, medical scans, etc	No
	Community care	eg district nursing, palliative care, etc	No
	Prevention	eg nutrition, physical activity, education, built environment factors, air quality, etc	No
	Mental health services	eg counselling, etc	No
	Rehabilitation	eg physiotherapy, etc	No
	Dentistry	eg examination, hygienist, etc	No
	Others to be considered		

2 LIMITATIONS

2.1 MODULES

The guidance is focused on a limited number of care pathway modules. It is expected that further modules will be added over time in order to allow more detailed sustainable care pathway appraisals to be undertaken. When a care pathway is being appraised and it becomes clear that modules should be included that have not yet been defined in this guidance, the general guidance in the main document shall be applied.

2.2 ENVIRONMENTAL METRICS

Currently, this guidance accounts only for GHG emissions, water use and waste generated.

A limitation is that potential trade-offs with environmental impacts, other than those appraised across a care pathway, can be missed. This is also the case for economic and social impacts. The results of a GHG, water and waste footprint exercise should not be used in isolation to communicate the overall sustainability performance of a care pathway.

It is anticipated that additional metrics, including those that reflect social and financial objectives, will be included in future versions of the guidance.

2.3 DATA AND CALCULATIONS

Activity data and environmental metrics calculations are provided for each module. They are intended for use in the appraisal of care pathways. Where a module case study has been used and found to be material to the care pathway being appraised, more specific data shall be collected. These values are based on data collected for specific activities from a single hospital. There are noted gaps in the data provided for some modules (as described in the module chapters) and the calculations should be used as a guide only.

2.4 MODEL UNCERTAINTY

There will be variability in the inventory calculated for any care pathway and uncertainty associated with the data it contains. Inevitably, there will be errors and inaccuracies in standard emission factors used, data collected, knowledge gaps filled by assumptions and global warming potentials used.

It is important to understand the uncertainties associated with the results of an appraisal and the sources of those uncertainties. The Product Standard [33] requires that *"Companies shall report a qualitative statement on sources of inventory uncertainty and methodological choices."*

The Product Standard [34] (*Chapter 10*) describes three types of uncertainty within a GHG inventory:

Parameter Uncertainty: Uncertainty arising from the accuracy of direct emissions data, activity data, emission factors or global warming potentials. Typically, uncertainty can be represented by a range or probability distribution. Further quantitative analysis may then be undertaken using methods such as Monte Carlo Analysis (this may be done in common LCA modelling packages such as *SimaPro* or *GaBi*) or Taylor Series expansion.

Scenario uncertainty: Uncertainty arising from methodological choices such as allocation methods, product use assumptions or end of life assumptions. Analysis of these uncertainties may be undertaken by changing the assumptions made and comparing the results. This may also commonly be called sensitivity analysis.

Model Uncertainty: Uncertainty arising from limitations in the ability of modelling approaches to reflect the real world.

Wherever possible, the qualitative or quantitative uncertainty results should be included in the inventory report. Knowledge of this uncertainty will allow for a better assessment of the results when making decisions on hotspot prioritisation, material choices, process choices, etc.

(33) GHG Protocol Product Life Cycle Accounting and Reporting Standard, 2011, http://www.ghgprotocol.org/standards/product-standard

(34) GHG Protocol Product Life Cycle Accounting and Reporting Standard, 2011, http://www.ghgprotocol.org/standards/product-standard

Annex C

Emission Factor List

1 EMISSION FACTORS

A list of emission factors that may be useful when appraising a care pathway or individual module is provided. These emission factors are calculated by using the ELCD database and applying the impact assessment method described in *Annex D* within the SimaPro LCA software.

The ELCD life cycle inventory data is copyrighted to the ELCD to the individual data providers. The ELCD version 3.1 database has been used to source the life cycle inventory data. The most recent update of the ELCD can be found here: http://eplca.jrc.ec.europa.eu/?page_id=126

Other sources of data exist and some of these are documented in the main care pathways document. It is anticipated that this list of emission factors will be updated as the guidance evolves.

1.1 *ENERGY*

Name	Unit	GHG emission (kg CO_2e / unit)	Fresh water use - indirect (m^3 / unit)	ELCD name
Austria electricity	kWh	0.32	0.00045	Electricity mix, AC, consumption mix, at consumer, 1kV - 60kV AT S
Belgium electricity	kWh	0.4	0.0017	Electricity mix, AC, consumption mix, at consumer, 1kV - 60kV BE S
Bulgaria electricity	kWh	0.78	0.0019	Electricity mix, AC, consumption mix, at consumer, 1kV - 60kV BG S
Cyprus electricity	kWh	0.98	0.0017	Electricity mix, AC, consumption mix, at consumer, 1kV - 60kV CY S
Czech Republic electricity	kWh	0.76	0.0015	Electricity mix, AC, consumption mix, at consumer, 1kV - 60kV CZ S
Denmark electricity	kWh	0.76	0.00096	Electricity mix, AC, consumption mix, at consumer, 1kV - 60kV DK S
Estonia electricity	kWh	1.4	0.0019	Electricity mix, AC, consumption mix, at consumer, 1kV - 60kV EE S
Europe electricity	kWh	0.56	0.0015	Electricity mix, AC, consumption mix, at consumer, 1kV - 60kV EU-27 S
Finland electricity	kWh	0.5	0.0012	Electricity mix, AC, consumption mix, at consumer, 1kV - 60kV FI S
France electricity	kWh	0.15	0.0017	Electricity mix, AC, consumption mix, at consumer, 1kV - 60kV FR S
Germany electricity	kWh	0.69	0.0016	Electricity mix, AC, consumption mix, at consumer, 1kV - 60kV DE S
Greece electricity	kWh	1.1	0.0016	Electricity mix, AC, consumption mix, at consumer, 1kV - 60kV GR S
Heat from light fuel oil	kWh	0.34	0.0000001	Heat, from resid. heating systems from LFO, consumption mix, at consumer, temperature of 55°C EU-27 S
Heat from natural gas	kWh	0.25	-0.00007	Heat, from resid. heating systems from NG, consumption mix, at consumer, temperature of 55°C EU-27 S
Hungary electricity	kWh	0.62	0.0016	Electricity mix, AC, consumption mix, at consumer, 1kV - 60kV HU S
Iceland electricity	kWh	0.022	0.000013	Electricity mix, AC, consumption mix, at consumer, 1kV - 60kV IS S
Ireland electricity	kWh	0.82	0.0014	Electricity mix, AC, consumption mix, at consumer, 1kV - 60kV IE S
Italy electricity	kWh	0.68	0.0014	Electricity mix, AC, consumption mix, at consumer, 1kV - 60kV IT S
Latvia electricity	kWh	0.52	0.00085	Electricity mix, AC, consumption mix, at consumer, 1kV - 60kV LV S
Lithuania electricity	kWh	0.18	0.0018	Electricity mix, AC, consumption mix, at consumer, 1kV - 60kV LT S
Luxembourg electricity	kWh	0.59	0.0014	Electricity mix, AC, consumption mix, at consumer, 1kV - 60kV LU S
Malta electricity	kWh	0.97	0.0017	Electricity mix, AC, consumption mix, at consumer, 1kV - 60kV MT S
Netherlands electricity	kWh	0.71	0.0013	Electricity mix, AC, consumption mix, at consumer, 1kV - 60kV NL S
Norway electricity	kWh	0.029	0.000041	Electricity mix, AC, consumption mix, at consumer, 1kV - 60kV NO S
Poland electricity	kWh	1.1	0.0012	Electricity mix, AC, consumption mix, at consumer, 1kV - 60kV PL S
Portugal electricity	kWh	0.76	0.0013	Electricity mix, AC, consumption mix, at consumer, 1kV - 60kV PT S
Romania electricity	kWh	0.97	0.0011	Electricity mix, AC, consumption mix, at consumer, 1kV - 60kV RO S
Slovakia electricity	kWh	0.35	0.0014	Electricity mix, AC, consumption mix, at consumer, 1kV - 60kV SK S
Slovenia electricity	kWh	0.59	0.0013	Electricity mix, AC, consumption mix, at consumer, 1kV - 60kV SI S
Spain electricity	kWh	0.63	0.0015	Electricity mix, AC, consumption mix, at consumer, 1kV - 60kV ES S

Steam from heavy fuel oil	kWh	0.35	0.000017	Process steam from heavy fuel oil, heat plant, consumption mix, at plant, MJ EU-27 S
Steam from light fuel oil	kWh	0.33	0.000024	Process steam from light fuel oil, heat plant, consumption mix, at plant, MJ EU-27 S
Steam from natural gas	kWh	0.26	0.000011	Process steam from natural gas, heat plant, consumption mix, at plant, MJ EU-27 S
Sweden electricity	kWh	0.11	0.00093	Electricity mix, AC, consumption mix, at consumer, 1kV - 60kV SE S
Switzerland electricity	kWh	0.081	0.00094	Electricity mix, AC, consumption mix, at consumer, 1kV - 60kV CH S
United Kingdom electricity	kWh	0.62	0.0015	Electricity mix, AC, consumption mix, at consumer, 1kV - 60kV GB S

Note: water for turbine use in electricity generation is not included in the ELCD inventories

1.2 *WATER*

Name	Unit	GHG emission (kg CO_2e / unit)	Fresh water use - indirect (m^3 / unit)	ELCD name
Tap water - from ground water	m3	0.58	1.0	Drinking water, water purification treatment, production mix, at plant, from groundwater RER S
Tap water - from surface water	m3	0.63	1.0	Drinking water, water purification treatment, production mix, at plant, from surface water RER S

1.3 *WASTE*

Name	Unit	GHG emission (kg CO_2e / unit)	Fresh water use - indirect (m^3 / unit)	ELCD name
Incineration - municipal solid waste	kg	0.33	0.0037	Waste incineration of municipal solid waste (MSW), EU-27
Incineration - paper	kg	0.04	0.0036	Waste incineration of paper fraction in municipal solid waste (MSW), EU-27
Incineration - plastics	kg	2.28	0.0055	Waste incineration of plastics (unspecified) fraction in municipal solid waste (MSW) EU-27
Incineration - textiles	kg	0.41	0.0042	Waste incineration of textile fraction in municipal solid waste (MSW), EU-27
Landfill - biodegradable	kg	0.51	0.00022	Landfill of biodegradable waste EU-27
Landfill - inert waste	kg	0.012	0.000015	Landfill of glass/inert waste EU-27
Landfill - metals	kg	0.014	0.000012	Landfill of ferrous metals EU-27
Landfill - municipal solid waste	kg	0.7	0.00024	MSW deposition, landfill incl. landfill gas utilisation and leachate treatment, FR,GB,IE,FI,NO mix

				EU-27
Landfill - paper	kg	0.87	0.00029	Landfill of paper waste EU-27
Landfill - plastics	kg	0.07	0.0001	Landfill of plastic waste EU-27
Landfill - textiles	kg	0.9	0.0003	Landfill of textiles EU-27
Landfill - wood	kg	1.4	0.00039	Landfill of untreated wood EU-27

1.4 *TRANSPORT*

Name	Unit	GHG emission (kg CO_2e / unit)	Fresh water use - indirect (m^3 / unit)	ELCD name
Air freight	tkm	2.1	0.0002	Plane, technology mix, cargo, 68 t payload RER S
Barge sea transport	tkm	0.028	0.0000022	Barge, technology mix, 1.228 t pay load capacity RER S
Bulk carrier ocean transport	tkm	0.0024	0.00000018	Bulk carrier ocean, technology mix, 100.000-200.000 dwt RER S
Container ship ocean transport	tkm	0.013	0.00000098	Container ship ocean, technology mix, 27.500 dwt pay load capacity RER S
Lorry - medium	tkm	0.066	0.0000059	Lorry transport, Euro 0, 1, 2, 3, 4 mix, 22 t total weight, 17,3t max payload RER S
Lorry - large	tkm	0.05	0.0000045	Articulated lorry transport, Euro 0, 1, 2, 3, 4 mix, 40 t total weight, 27 t max payload RER S
Lorry - small	tkm	0.14	0.000012	Small lorry transport, Euro 0, 1, 2, 3, 4 mix, 7,5 t total weight, 3,3 t max payload RER S
Rail transport - diesel	tkm	0.027	0.0000022	Rail transport, technology mix, diesel driven, cargo RER S
Rail transport - electric	tkm	0.026	0.000069	Rail transport, technology mix, electricity driven, cargo RER S

1.5 *PACKAGING*

Name	Unit	GHG emission (kg CO_2e / unit)	Fresh water use - indirect (m^3 / unit)	ELCD name
Cardboard box	kg	1.2	0.009	Corrugated board boxes, technology mix, prod. mix, 16,6 % primary fibre, 83,4 % recycled fibre EU-25 S
Glass packaging	kg	0.78	0.0011	Container glass (delivered to the end user of the contained product, reuse rate: 7%), technology mix, production mix at plant RER S
Liquid packaging board	kg	0.46	0.082	Liquid Packaging Board (LPB) production, production, production mix, at plant, mineral coated LPB (n=4), basis weight: 266 g/m2 EU-27 S

1.6 *MATERIALS (CRADLE TO GATE ONLY)*

Name	Unit	GHG emission (kg CO_2e / unit)	Fresh water use - indirect (m^3 / unit)	ELCD name
ABS plastic	kg	3.8	0.12	Acrylonitrile-butadiene-styrene granulate (ABS), production mix, at plant RER
Aluminium	kg	3.2	0.0065	Aluminium sheet, primary prod., prod. mix, aluminium semi-finished sheet product RER S
Copper	kg	0.79	0.03	Copper wire, technology mix, consumption mix, at plant, cross section 1 mm^2 EU-15 S
Ethene	kg	1.4	0.00051	Ethene (ethylene), from steam cracking, production mix, at plant, gaseous EU-27 S
HDPE plastic	kg	1.9	0.019	Polyethylene high density granulate (PE-HD), production mix, at plant RER
LDPE plastic	kg	2.1	0.034	Polyethylene low density granulate (PE-LD), production mix, at plant RER
Nitrogen gas	kg	0.088	0.00023	Nitrogen, via cryogenic air separation, production mix, at plant, gaseous EU-27 S
Nitrous oxide	kg	2.78	0.00692	Nitrous oxide {GLO}| market for | Alloc Def, U
Nylon 6 plastic	kg	9.2	0.16	Nylon 6 granulate (PA 6), production mix, at plant RER
Oxygen gas	kg	0.15	0.00042	Oxygen, via cryogenic air separation, production mix, at plant, gaseous EU-27 S
Particle board	kg	0.88	0.0025	Particle board, P2 (Standard FPY), production mix, at plant, 7,8% water content EU-27 S
PET plastic	kg	3.4	0.059	Polyethylene terephthalate (PET) granulate, production mix, at plant, bottle grade RER
Polycarbonate plastic	kg	7.7	0.076	Polycarbonate granulate (PC), production mix, at plant RER
Polypropylene plastic	kg	2	0.034	Polypropylene granulate (PP), production mix, at plant RER
Polystyrene (expanded) plastic	kg	3.4	0.16	Polystyrene expandable granulate (EPS), production mix, at plant RER
Polystyrene (general) plastic	kg	3.5	0.13	Polystyrene (general purpose) granulate (GPPS), prod. mix, RER
Propene	kg	1.3	0.00049	Propene (propylene), from steam cracking, production mix, at plant, gaseous EU-27 S
PVC resin	kg	1.6	0.022	Polyvinylchloride resin (B-PVC), bulk polymerisation, production mix, at plant RER
Sodium chloride	kg	0.17	0.0027	Sodium chloride, production mix, at plant, dissolved RER
Sodium hydroxide	kg	1.4	0.0096	Sodium hydroxide, production mix for PVC production, at plant, 100% NaOH RER
Steel	kg	1.1	0.0035	Steel hot rolled section, blast furnace and electric arc furnace route, production mix, at plant GLO S

Annex D

Impact Assessment Methods

1 INDICATOR ASSESSMENT METHODS

1.1 GHG INVENTORY

Greenhouse gases are atmospheric gases that absorb and emit radiation within the thermal infrared range and contribute to the natural greenhouse effect and global climate change.

Gases in the atmosphere can exert a direct and indirect radiative forcing. Direct forcing occurs when the gas has been identified as a GHG. Indirect forcing occurs when gases emitted to the atmosphere are transformed into GHGs.

A GHG inventory accounts for emissions of greenhouse gases and aggregates these emissions into a single measure of radiative forcing relative to carbon dioxide over a specified time horizon. It is reported in 'kg CO_2 equivalents'.

The Greenhouse Protocol specifies that the most recent Intergovernmental Panel on Climate Change (IPCC) global warming potential (GWP) factors for GHG emissions over a 100 year time horizon should be used. A table of the most recent GWP values is available on the GHG Protocol website (1) and the full list can be found in the IPCC AR5 report (2).

Global warming potentials are updated periodically as a result of relative radiative forcing being sensitive to contemporary atmospheric concentrations.

Biogenic carbon dioxide emissions, if included within the aggregated GHG inventory, should be reported separately.

Release of sequestered carbon through previous land use change (within the last twenty years) should be accounted for where applicable, based upon recommendations provided in Appendix B of the Product Standard.

As with biogenic carbon dioxide, where relevant land use change impacts should be reported separately, as specified in the Product Standard.

(1) GHG Protocol, http://ghgprotocol.org/sites/default/files/ghgp/Global-Warming-Potential-Values.pdf

(2)Myhre, G., D. Shindell, F.-M. Bréon, W. Collins, J. Fuglestvedt, J. Huang, D. Koch, J.-F. Lamarque, D. Lee, B. Mendoza, T. Nakajima, A. Robock, G. Stephens, T. Takemura and H. Zhang, 2013: Anthropogenic and Natural Radiative Forcing. In: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.
https://www.ipcc.ch/pdf/assessment-report/ar5/wg1/WG1AR5_Chapter08_FINAL.pdf (last accessed June2015)

1.2 *WATER*

Fresh Water Consumption

Water consumption quantifies in volumetric terms fresh water consumed by the activity of concern and refers to both direct water use (eg water used by the health care activity) and indirect water use from activities upstream of care pathway modules (eg the water used in the production of pharmaceuticals), sometimes referred to as embodied water. Fresh water consumption includes the abstraction of cooling water and turbine water. Direct and indirect water consumption should be reported separately.

Fresh water consumption includes:

- fresh surface water, including water from wetlands, rivers & lakes;
- ground water;
- rainwater collected directly and used;
- waste water from another organisation; and
- municipal water supplies or other water utilities.

Water consumption is measured in m^3.

Direct Water Consumption

The direct water consumption metric reported shall quantify the total volume of water either withdrawn from a water source directly and the water delivered by a third party.

Direct water consumption is measured in m^3.

Water consumption data can be sourced from water meters or water bills. Direct water consumption, if not metered, can be estimated by water pump ratings and hours of operation.

Indirect Water

Indirect water consumption refers to the water consumed up or down stream of the module of concern, eg in the production of pharmaceuticals, generation and supply of utilities or the treatment of wastes. This includes the abstraction of cooling water and turbine water used in electricity generation.

Indirect water consumption is measured in m^3.

It is important to ensure that double-counting is avoided when combining indirect with direct water consumption, eg water consumed in supplying fresh water.

Water Environmental Impact Methods

The water consumption volumetric indicator does not address the impact of water consumption (such as biodiversity loss) or take account of factors such as resource

stress, based on geographic region and water quality. Examples of further standards and guidance that address scarcity and the impact of water consumption include ISO 14046 (1) and the Global Water Footprint Standard (2).

1.3 *WASTE*

The definition of waste employed in this guidance is "any substance or object which the holder discards or intends or is required to discard" (3).

Waste generation (all forms of solid or liquid waste excluding wastewater and excluding gaseous emissions) shall be calculated for direct waste (ie waste generated from an activity in the care pathway boundaries, eg waste from an emergency department).

Waste is to be reported in kg. Where waste data is obtained in volumetric terms, it should be converted into a mass using the density of the waste stream or if not known an estimate of density.

Indirect waste generation, from activities upstream of care pathway modules (eg from the production of materials and energy) can be excluded, as there is a lack of consistent secondary emission factors for waste. If indirect waste generation is to be included, it should be reported separately.

The following categories of waste generated shall be reported:

- hazardous waste (as defined by national legislation at the point of generation);
- non-hazardous waste (all other forms of solid or liquid waste excluding wastewater); and
- the total amount of waste generated as a sum of hazardous waste and non-hazardous waste.

Typically, disposal of sharps will be included within the hazardous waste definition. However, if relevant to the study, this may be reported separately. Other categories that it may be beneficial to report separately include clinical waste, unused pharmaceuticals, waste electrical and electronic equipment (WEEE) and others.

Where known, it may be useful also to report the waste treatment route of each waste type (eg recycling, incineration with or without energy recovery and landfill).

Waste Impacts

The waste indicator does not address the environmental impacts of waste management or disposal or address resource scarcity, resource consumption or conservation (through reuse, recycling).

(1) ISO 14046, http://www.iso.org/iso/catalogue_detail?csnumber=43263
(2) Water Footprint Network, Global Water Footprint Standard, http://waterfootprint.org/en/standard/global-water-footprint-standard/
(3) EC Waste Framework Directive, Directive 2008/98/EC

Annex E

Case Study Template

1 CASE STUDY REPORTING INFORMATION

1.1 BACKGROUND

The purpose of providing a list of reporting requirements when undertaking care pathway sustainability appraisals is both to ensure consistency between appraisals and to encourage the publication of new studies.

An example case study of a care pathway is published alongside the guidance. All case studies developed using the guidance and following this reporting template can be published alongside the guidance on the Sustainable Development Unit website.

In addition to the guidelines below, reporting requirements in the communications section of the guidance and reporting requirements in the Product Standard shall be used.

An organisation may publish a case study using its own formatting template provided the information below is included.

1.2 INFORMATION TO INCLUDE IN A CASE STUDY

The headings in red text below shall be included in a care pathways appraisal that is in conformance with the guidance. Text in [orange square brackets] is for information purposes and describes the information that should be included in each section.

1. Background

Title:	[name of care pathway appraised]
Organisation completing study:	[organisations that provided data and/or calculated and reported findings]
Contact details:	[name and email address]
Completion date:	[data published]
Assurance:	[level of assurance achieved and conformance with the guidance]
Supporting information:	[any key sources of information used in the study]

2. Summary

2.1 Introduction

[a brief description of the care pathway and alternative scenarios if a comparison is included]

2.2 *Reason for study*

[why is the appraisal being undertaken?]

2.3 *Conclusion*

[what are the headline results?]
[what do the results show?]
[are the findings conclusive or is more investigation needed?]

2.4 *Learnings*

[what has been learnt from the appraisal?]
[how can the findings be applied?]
[how can the appraisal be improved]
[are there any recommendations for action to be taken within the studied care pathway to reduce impact?]

3. Scope

3.1 *Description of pathway*

[detailed description of the care pathway]
[discussion of scope applied such as location, condition severity, patient type]
[description of the condition/illness]

3.2 *Description of patient*

[describe the patient profile applied in the appraisal including location, condition type and severity and any other relevant patient related information]

3.3 *Impacts appraised*

[identify which sustainability impacts are considered in the appraisal and whether the same impacts have been used that are described in the guidance]

3.4 *Unit of analysis*

[clearly state the unit of analysis of the appraisal]
[describe the time period that is considered and the geographic representativeness of the appraisal]

3.5 *Care pathway map*

[include a process map describing the care pathway included within the appraisal]
[provide a description of the process map]
[list the modules included in the appraisal]
[where possible list the activities, resources and emissions included within each key module]

3.6 *Exclusions and limitations*

[list and justify the exclusion of any modules or activities from the care pathway]
[describe the limitations of the study]

4. Data

4.1 Activity data

[describe the process of collecting activity data]
[include source and age of activity data]
[provide the activity data used, subject to confidentiality issues]

4.2 Emission factors

[describe the process of collecting emission factors]
[include sources of where emission factors are from]
[where able provide the key emission factors used]

4.3 Data requirements

[document where any secondary data had to be used to represent modules or activities]
[document where modules or activities have been excluded and provide justification]
[specify whether allocation was undertaken and if so where]
[describe data quality, including what level was achieved and what approach to data quality was taken]
[discuss uncertainty and include the method used to appraise uncertainty]

5. Results

5.1 Overall results

[headline results from the appraisal for each sustainability impact for the unit of analysis]

5.2 Breakdown

[breakdown of overall results per care pathway module]
[identify key contributors for each sustainability metric]

5.3 Comparisons

[if a comparison is undertaken, what are the findings?]
[discussion of what might make the results of the comparison different and whether these are material]
[inclusion of any sensitivity analysis if undertaken]

6. Conclusions

6.1 Key findings

[summary of key findings and conclusions from the appraisal, including any conclusions drawn from comparisons]
[implications of conclusions and how they might be applied elsewhere]

6.2 Recommendations and improvements

[discuss how the findings of the study might be used to improve the sustainability of the care pathway being appraised]

[describe how the study could be improved with regards to quality, accuracy and uncertainty]

[discuss the limitation of the study and whether they might influence the conclusions drawn]

For further information or to provide feedback please visit:
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