Public Health Research Programme – Rapid Review Report

Evaluation of the impacts on health of the proposed UK industry levy on sugar sweetened beverages: developing a systems map and data platform, and collection of baseline and early impact data

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Plain English Summary

The Government plans to introduce a tax on industries that produce or import sugary soft drinks. This will become law in 2018 and the details have yet to be finalised. The purpose of the tax is to reduce the amount of sugary drinks that people drink. The tax could have many possible effects on many different areas of public life. These effects might be on jobs, how much soft drinks cost and how many of them people consume, as well as on public attitudes. Many of these immediate effects may later impact on health. We undertook work in this project to work out how best to evaluate the many effects of this tax.

First, we brought together scientists to discuss the tax and its possible effects and map these out in a diagram. We then consulted with other experts, from local and national government, the food industry and groups interested in health. We asked them to comment on the diagram and add to it. The final version was agreed by most people consulted.

We then looked for sources of information that could be used to measure changes in the possible effects of the tax set out in the diagram. We worked out whether the information was available in ways that would allow us to measure changes from before to after the introduction of the tax. We also worked out the cost of bringing together the information.

Lastly, we worked out how to measure a number of possible effects of the tax that were not available from existing sources of information. This work included bringing together information from all the main supermarkets on the cost and contents of all soft drinks. We developed a way to do this over time. We also worked out how to identify what people say in the news media and in trade press about the tax overtime. In addition, we developed a set of questions to track what the public thinks about soft drinks and the tax over time.

Based on all of this work, we developed a proposal to seek funding to undertake an evaluation of the health impacts of the tax, which was submitted to NIHR.

Scientific Summary

Background and aims

In 2016 the Chancellor announced a tiered soft drinks industry levy (SDIL) on industries importing or selling sugar sweetened beverages (SSBs) in the UK, with the explicit intention of reducing consumption of sugar from SSBs. The SDIL was subject to a public consultation during 2016, leading to the introduction of legislation, which will be considered in the Finance Bill 2017. It is anticipated this will be enacted in April 2018. We aimed to conduct formative research to underpin a proposed whole systems approach to the evaluation of the health-related impacts of the SDIL in the UK.

Methods and findings

Theory development and prioritisation of potential impacts. To describe the complex adaptive system on which the announcement and implementation of the UK industry levy on SSBs will have impacts, as well as the major outcome parameters and their likely direction of change, we undertook system-mapping. We held an expert workshop, followed by a Delphi exercise and qualitative interviews with stakeholders. This resulted in a final system map, supported by stakeholders from academia, industry, public sector and civil society groups.

Data platform for evaluation of prioritised impacts. To identify the feasibility of establishing a comprehensive data platform, including time series data on the key social, economic and health outcome parameters and potential mediating, moderating, confounding and distributional factors, we sought and costed viable data sources for key components of the systems map. These were catalogued and prioritised for the definitive evaluation

Exploring early impacts of the SDIL announcement on reformulation and method development. To collect time-sensitive qualitative and quantitative data on early impacts of the SDIL to provide a viable baseline and allow measurement of change in key outcomes over time, we developed a range of methods and collated data. These included data on supermarket soft drink product formulations and prices, qualitative data from interviews with stakeholders on perceived early impacts, and an exploration of news media data. In addition we conducted qualitative interviews with members of the public and reviewed literature to inform the development of questions to evaluate change in public attitudes to sugar consumption and the SDIL. Accessing and archiving supermarket data proved viable and baseline trends were established.

Building on this work, we developed a full proposal for a definitive, system-level evaluation of the SDIL. We also applied for a won an ESRC/PHE PhD studentship to evaluate changes in soft drink marketing associated with the introduction of the SDIL. Ongoing discussions with The Health Foundation should lead to the funding of regular surveys of public attitudes to sugar consumption and the SDIL, which will also complement the main evaluation.

Conclusions

A systems approach appears well suited to understanding how the SDIL might meet its aims and has allowed us to develop a strong scientific proposal for a definitive evaluation. A better understanding of the context of the SDIL was gleaned from in-depth interviews and these helped to refine our conceptual and theoretical work that led to the final systems map. Mapping data sources to the system map enabled us to determine the feasibility of a definitive evaluation. Further work is needed to finalise methods for some aspects, including surveys of public attitudes to sugar and the SDIL over time, which is the subject of a further funding application.

Background

In 2016 the Chancellor announced a tiered soft drinks industry levy (SDIL) on industries importing or selling SSBs in the UK with the explicit intention of reducing consumption of sugar from SSBs. The introduction of the SDIL is punctuated by three events:

i. the chancellor's announcement (April 2016, 2 years ahead of implementing the levy)

ii. the introduction of legislation within the Finance Bill 2017, which confirmed details of the levy

iii. the implementation of the Levy (anticipated April 2018)

Each of these events aims to prompt changes in industry behaviour – primarily reformulation to lower sugar content but also other changes, such as in marketing to persuade consumers to switch to lower sugar alternatives. Reformulation (e.g. by Tesco and Britvic) is already occurring. Moreover, each phase of the introduction of the SDIL is accompanied by media coverage influenced by HM Treasury, HM Revenue and Customs, the Department of Health and Public Health England, which may emphasize the health risks of SSB consumption. Introduction in April 2018 may be associated with a rise in the price of SSBs. All of these changes may impact SSB and total sugar consumption, with potential consequences for diet and health. The effects of these 'perturbations' in highly complex food and health systems are multiple and likely to interact dynamically.

The implementation of a fiscal policy is thus an intervention that is highly context dependent resulting in reactions by many stakeholders including government, civil society, industry, health sector and consumers, and the potential to affect a range of diet and health outcomes. The multifaceted nature of the SDIL necessitates consideration of the context (i.e. the system(s) of factors) that surrounds the levy to systematically guide empirical work. Our proposed evaluation will focus on aspects of this complex system, in addition to direct measures of reformulation, price, purchasing, consumption and potential health impacts

Study aims and objectives

We aimed to conduct formative research to underpin a proposed whole systems approach to the evaluation of the health-related impacts of the SDIL in the UK, and the mechanisms through which these impacts are generated. Specifically, this included three areas of work:

1. *System-map*: To describe components of the complex adaptive system on which the announcement and implementation of the UK industry levy on SSBs will have impacts, the major outcome parameters and their likely direction of change

2. *Data platform*: To identify the feasibility of establishing a comprehensive system-level evaluation data platform, including time series data on the key social, economic and health outcome parameters and potential mediating, moderating, confounding and distributional factors

3. *Early impacts:* To develop methods to collect time-sensitive qualitative and quantitative data on key early impacts of the announcement and implementation of the SDIL in order to provide a viable baseline and allow measurement of change in key outcomes over time

Methods

1. Theory development and prioritisation of potential impacts

A system map was developed in two phases. Firstly a concept mapping workshop involving the study team (eight content experts from a range of academic disciplines including epidemiology, public health, nutrition, geography, health economics and systems science) generated and structured an initial system map. This was guided by a draft conceptual model, a set of predefined questions and an iterative consensus building process (Appendix A). Secondly, a modified online Delphi survey was used to solicit perspectives from individuals representing five stakeholder groups: academia, public health professionals, government, civil society and the food industry.

The survey was conducted in two rounds. Firstly a set of questions identified research priorities and sought details on agreement or disagreement with the initial system map. Secondly, we asked respondents to signal their agreement with an updated system map based on their initial input (Appendix B). Survey respondents were asked to indicate their willingness to participate in follow-up in-depth interviews to seek insights into their perspective on the soft drinks industry levy, and examine in depth, the factors reflected in the system map. Of those who agreed to an interview, ten were purposively sampled to ensure representation from stakeholder groups and their current level engagement with issues directly relevant to the SDIL.

Analysis of Delphi responses included collating priorities of stakeholders and summarising percentage agreement with the system map factors and connections, synthesis of qualitative feedback related to disagreements and revision of the system map. Analysis of the in-depth interviews included reviewing interview transcripts for additional insights related to the map and making modifications as needed. A final version of the system map was developed to inform the definitive evaluation of the SDIL (Appendix B).

2. Data platform for evaluation of prioritised impacts

An environmental scan was undertaken using the collective knowledge of the study team to inform searches for available data for each factor identified in the system map. Each data source was assessed based on suitability (i.e. availability over multiple time points, sample size, validity, reliability), access (i.e. publically available versus privately held) and cost in order to determine to optimal components of a data platform to be used in a definitive system level evaluation.

3. Exploring early impacts of the SDIL announcement on reformulation and method development

Pilot the use of online supermarket nutrition data to examine reformulation

Building on previous work, which explored the possibility of automatically extracting time-stamped data on the nutritional content of foods and drinks from UK online supermarkets and built a prototype for the collection of such data, we developed two datasets to examine reformulation of sugary drinks over time. One dataset – foodDB – is designed to be automatically updated over time with data from six online supermarkets (Tesco, Sainsbury's, Morrisons, Asda, Waitrose and Ocado) and to provide a platform for ongoing monitoring of sugar levels in soft drinks available for consumption in the UK. The second dataset used similar techniques to collect historical data on a subset of soft drinks from the Tesco online supermarket utilising www.archive.org – a project aiming to provide free access to archived websites. Using this, we automatically collected data on the nutritional content of all soft drinks on all Tesco pages from 2011 through to 2015. We used a 'last observation carried

forward' approach to deal with missing data (e.g. if a drink appeared in 2011 and 2013, but not in 2012, then the sugar content of the drink in 2011 was used for the level in 2012). We then calculated trends in the average sugar content of four categories of non-diet drinks: carbonated drinks, energy drinks, juice drinks, and milk-based drinks. Trends were estimated using linear regression with sugar (g per 100ml) as dependent and year as independent variable. Non-linear trends were also explored using likelihood ratio tests.

Additional data sources

In addition to exploring early impacts of the announcement of the SDIL on reformulation and piloting methods, additional factors on the system map were identified as important in a future evaluation – however, data and methods for their assessment were not immediately apparent. These covered two areas, where work was undertaken to progress future evaluation efforts.

Public attitudes and acceptability

A rapid review related to understanding attitudes toward sugar, soft drinks and public acceptability of the SDIL and development of survey questions.

Media discourse analysis

A review of current methods, identifying data sources for the UK and testing search, identification and screening procedures were undertaken for future media analysis (print newspapers, trade press and twitter).

4. Variations to protocol

We had planned to undertake initial surveys of public attitudes using the ONS Opinions and Lifestyle Survey. However, the extent of methodological work needed to develop the questions precluded the commissioning of any surveys during the short time period of this study. We instead used the time and resource to undertake (a) a rapid literature review of attitudinal work on sugar consumption, and (b) further interviews with members of the public to explore these issues in greater depth. We also undertook further review of survey platforms, identifying that Kantar World Panel's consumer panel offered the potential for multiple surveys of attitudes at lower cost than ONS, and had the advantage of allowing linkage to consumer purchasing data on soft drinks in the same households.

Results

1. Theory development and prioritisation of potential impacts

The concept mapping workshop, collation of qualitative data from the Delphi survey and input from in-depth interviews resulted in a final system map. This map includes factors with multiple connections and feedback loops, distributed across five sectors (consumer behaviour, industry and government actions, public acceptability and discourse, and actions of other sectors). It is also represented as a set of interrelated sub-systems. The initial and some intermediate system maps developed during the workshop are available in Appendix B.

2. Data platform for evaluation of prioritised impacts

The final map was then used to guide the development of a theoretically informed data platform and proposed analyses for future evaluation (Appendix C). This included a range of secondary data sources including the National Diet and Nutrition Survey, Kantar World Panel, online supermarket websites and primary data collection including focus groups.

3. Exploring early impacts of the SDIL announcement on reformulation and method development

Pilot the use of online supermarket nutrition data to examine reformulation

Automated data collection was conducted on six UK online supermarkets and transferred to foodDB at three time points: October 2016, December 2016 and April 2017. This provides proof of principle for regular time-stamped collection of online supermarket nutrition data for use in a definitive evaluation.

Using the www.archive.org website we collected data on 415 non-diet soft drinks consisting of 68 carbonated drinks, 76 energy drinks, 252 juice drinks and 19 milk-based drinks. For all the categories there was no evidence of non-linear trends in sugar levels. Carbonated drinks and energy drinks showed small non-significant downward trends in average sugar levels. For example, the average sugar level in carbonated drinks fell by 0.23g per 100ml per year ($p = 0.056$). Juice drinks showed a significant downward trend in sugar levels (average falls of 0.22g per 100ml, $p<0.001$). However, milk-based drinks showed little change in sugar levels over the six years of data collection. This provides a useful baseline for trends in sugar levels for soft drinks to compare with more recent trends that may be influenced by the SDIL.

Public attitudes and acceptability

Initial work was undertaken and resulted in a conceptual model to guide measurement of the acceptability of the SDIL and some of the potential determinants. These factors represented those reflected in the systems map. Each construct was then operationalised using measurement items from previous research and will be used in future research to examine how attitudes toward sugar, soft drinks and the acceptability of the SDIL change over time (Appendix D).

Media discourse analysis

Media discourse will be examined using a range of data sources, with different identification procedures and selection criteria. These will include 1) print news sources, 2) industry trade press sources and 3) social media (specifically twitter) sources. As part of this rapid funding project, we identified potential data sources and developed appropriate methods to identify data and review methods for searching, identification and selection of sources for a range of media analysis (Appendix E). Analysis of early changes in media discourse will form the subject of an MPhil thesis, to be completed in August 2017 (Dr Eleanor Turner-Moss, supervised by JA and TP)

4. Applications for funding of a definitive evaluation

In addition to the formative work, a grant proposal for a definitive evaluation of the SDIL taking a systems perspective was developed and submitted to NIHR PHR in December 2017 (See Appendix F for scientific summary). The final outcome of the application is awaited.

In addition, we applied successfully for a PhD studentship, jointly funded by ESRC and PHE, which will focus on the impact of the SDIL on marketing of soft drinks, commencing in October 2017. We anticipate the student (to be appointed) will be embedded in the definitive evaluation team and supervised by JA and MW with colleagues from PHE).

We are involved in ongoing discussions with The Health Foundation concerning the funding of tracking surveys to monitor changing public attitudes over time, based on the formative work undertaken in this project, which we anticipate will helpfully complement the definitive evaluation.

Discussion

1. Summary of main findings

Our overall aim was to work out how to undertake a systems level evaluation of the impacts of the SDIL. To achieve this, we theorised the intervention and developed a comprehensive systems map with input from key stakeholders, identified data sources that can be used to measure changes in key proximal, intermediate and distal outcomes of the SDIL identified on the systems map, developed methods to collect and analyse a range of data sources, and successfully applied for funding to conduct a definitive evaluation.

2. Strengths and limitations of the methods

This work was exploratory and undertaken rapidly (within six months), and thus required a high degree of flexibility. As a result, some changes were made during the course of the work to maximise the potential of the project. We involved a wide range of stakeholders in the Delphi exercise, but although we had good representation from most sectors, representatives of national government declined to participate. It is possible that their views might have shaped the systems map differently. Available data did not cover the entire system map, but efforts were made to expand the research to accommodate other areas of the map deemed important by the Delphi/interview participants (e.g. public discourse and public acceptability sub-system). We have piloted data collection and analysis methods where possible and refined methods in anticipation of the definitive evaluation. We have secured data on early impacts (e.g. data on reformulation using FoodDB, and data on industry, media and public discourse using Lexis Nexis and Twitter), but time has not permitted analysis of this data, which will be undertaken early in the definitive evaluation.

3. Interpretation and Conclusions

A systems approach appears well suited to understanding how the SDIL might meet its aims and has allowed us to develop a strong scientific proposal for a definitive evaluation. A better understanding of the context of the SDIL was gleaned from in-depth interviews and these helped to refine our conceptual and theoretical work that led to the final systems map. Mapping data sources to the system map enabled us to determine the feasibility of a definitive evaluation. Further work is needed to finalise methods for some aspects, including surveys of public attitudes to sugar and the SDIL over time, which is the subject of a further funding application.

Appendices

Appendix A: Workshop questions and process
Appendix B: Survey questions for modified Delphi
Appendix C: Priority Data Sources identified from the SDIL Systems Map
Appendix D: Conceptual model and measurement items for public acceptability of the SDIL and potential psychosocial determinants
Appendix E: Media analysis methods
Appendix F: NIHR PHR Grant Funding Application – Scientific Summary

Appendix A: Workshop questions and process

Part 1: Introduction to method, and preparation work completed
We used a combination of concept mapping,[1] adapted for consensus building using an expert panel (i.e. nominal group method) including agreement of a majority of participants for acceptance of revisions without loss of that revision[2], followed by validation of the systems map using a Delphi process.[3] We used a variety of methods to capture an initial systems map to describe the potential effect of the SSB levy on SSB consumption and health (Figure 1 below). It was expected that by taking a systems approach to this work, we would be able to anticipate unintended consequences and complex or emergent aspects of the SSB levy.

Concept mapping is process that traditionally involves six steps, three relevant for this work:

- Preparation: a planning step where the focal areas are identified and criteria for participation are determined
- Generation: a participatory step where the group addresses the focal question and generates a list of items that will be used in subsequent analysis. Focal questions are designed to elicit information to address the primary research questions. Most often, data are obtained through data collection processes such as 'brain storming' sessions.
- Structuring: participants independently organise the list of generated items. They sort them into piles based on their perceived similarities or relationship to one another. Then each item is rated in terms of its importance or usefulness to the research question.

Consensus building for an expert panel includes firstly generating views on the research question that are listed and ranked in order of importance individually. This will then be used to make modifications to the system map iteratively until consensus, or near consensus is reached.

Part 2: Generation of potential factors and links
For this project, the focus will be on answering the question of *how, for whom and under what circumstance* the SSB levy might impact SSB consumption and health. Therefore, guiding the generation of different aspects of our system map will include the following probing questions for members to answer individually:

- What factors are involved in the wider context of the SSB levy?
- What might change as the result of the SSB levy?
- How could the SSB levy change consumption of SSBs?
    - What are possible pathways?
    - What might stop this from occurring?
    - What might influence this effect?
- Who is likely to be effected by the SSB levy?
    - Organisations?
    - Businesses?
    - Consumers?

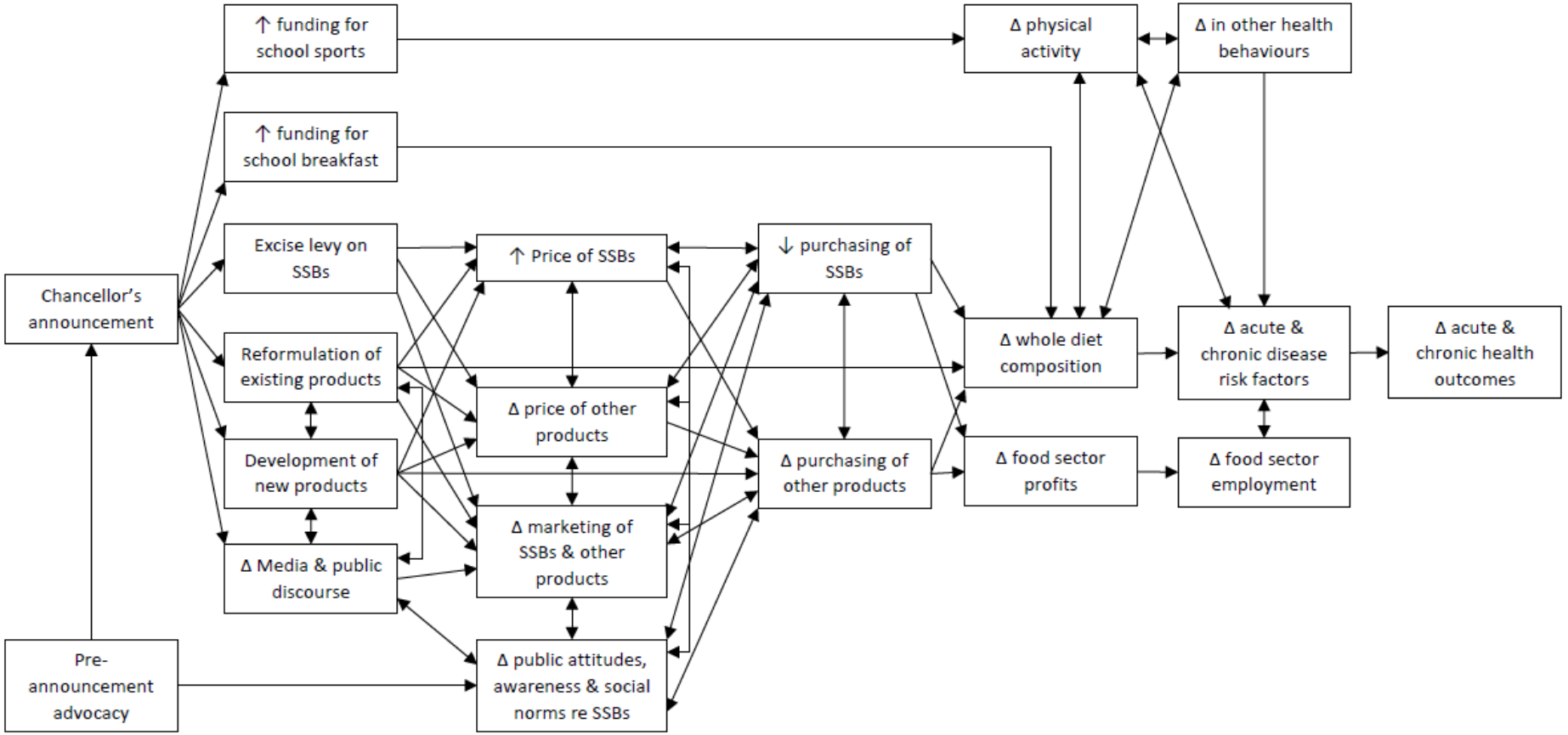
Part 3: Structuring the system map, reflection, revision and consensus

With a set of factors, links and notes related to different aspects of the systems map we will configure and modify the system map to accommodate these new possible links and associations. Each group member will have an opportunity to provide, in order of importance, the different factors and links generated during the previous session. Proposed modifications will then trigger discussion, and will require at least some consensus within the group. When all members have contributed their modifications, there will then be a process of reflection based on the map as a whole where each group member will suggest changes or parts of the map where there is disagreement – again requiring some group consensus. When suggestions are rejected, they will be noted; when suggestions are accepted the modification will be made. Periodic photos of progress will be taken throughout the structuring process to capture the evolution of the map and to allow for reflection on previously rejected ideas. This process will repeat until there is moderate (70% or more) to full consensus for the system map as a whole.

References

1. Burke JG. An Introduction to Concept Mapping as a Participatory Public Health Research Method. *Qual Health Res*. 2005;15(10):1392–1410. doi:10.1177/1049732305278876.
2. Fink A, Kosecoff J, Chassin M, Brook RH. Consensus methods: Characteristics and guidelines for use. *Am J Public Health*. 1984;74(9):979–983. doi:10.2105/AJPH.74.9.979.
3. Culley JM. Use of a Computer-Mediated Delphi Process to Validate a Mass Casualty Conceptual Model. *Comput Informatics, Nurs*. 2011;5(29):272–279. doi:10.1126/scisignal.2001449.Engineering.

Figure 1: Initial system map for the SDIL developed for the expert workshop



Possible individual-level effect modifiers: age, gender, socio-economic position, ethnicity, baseline adiposity, baseline diet (including SSB consumption), baseline disease risk

Appendix B: Survey questions for modified Delphi

Soft Drinks Industry Levy – Anticipated effects from your perspective
Thank you for agreeing to participate in our online survey. As described in your information sheet (**click to view the information sheet**) the UK Chancellor of the Exchequer announced an industry levy on soft drinks as part of the 2016 budget - to be introduced in April 2018. This will fall on drinks' producers and importers, and be higher for drinks with more sugar. The levy aims to encourage manufacturers to reduce the sugar in their drinks and direct money from the levy toward primary school breakfast clubs, sports and extended hours.
To help us better understand the wide range of potential impacts of the proposed levy, we are seeking input from a range of stakeholders. As someone with an interest, or role, in the development or implementation of the levy we would like to know what you anticipate will be **FIVE** effects of the soft drinks industry levy **from your perspective**, and how you would **RANK** these effects **from most to least important**.

Please add five anticipated effects, you can then drag and drop the list to rank by importance until you are happy with the ranking.

Anticipated effect of levy and then drag and drop to rank (1 = the most important, 5 the least important)

_____
_____
_____
_____
_____

To help us better understand a range of perspectives relating to the soft drinks industry levy, we are conducting short phone interviews. Would you be interested in learning more about the phone interview?

[yes, please email me an information sheet]
[no, please don't follow-up with me regarding the interviews]

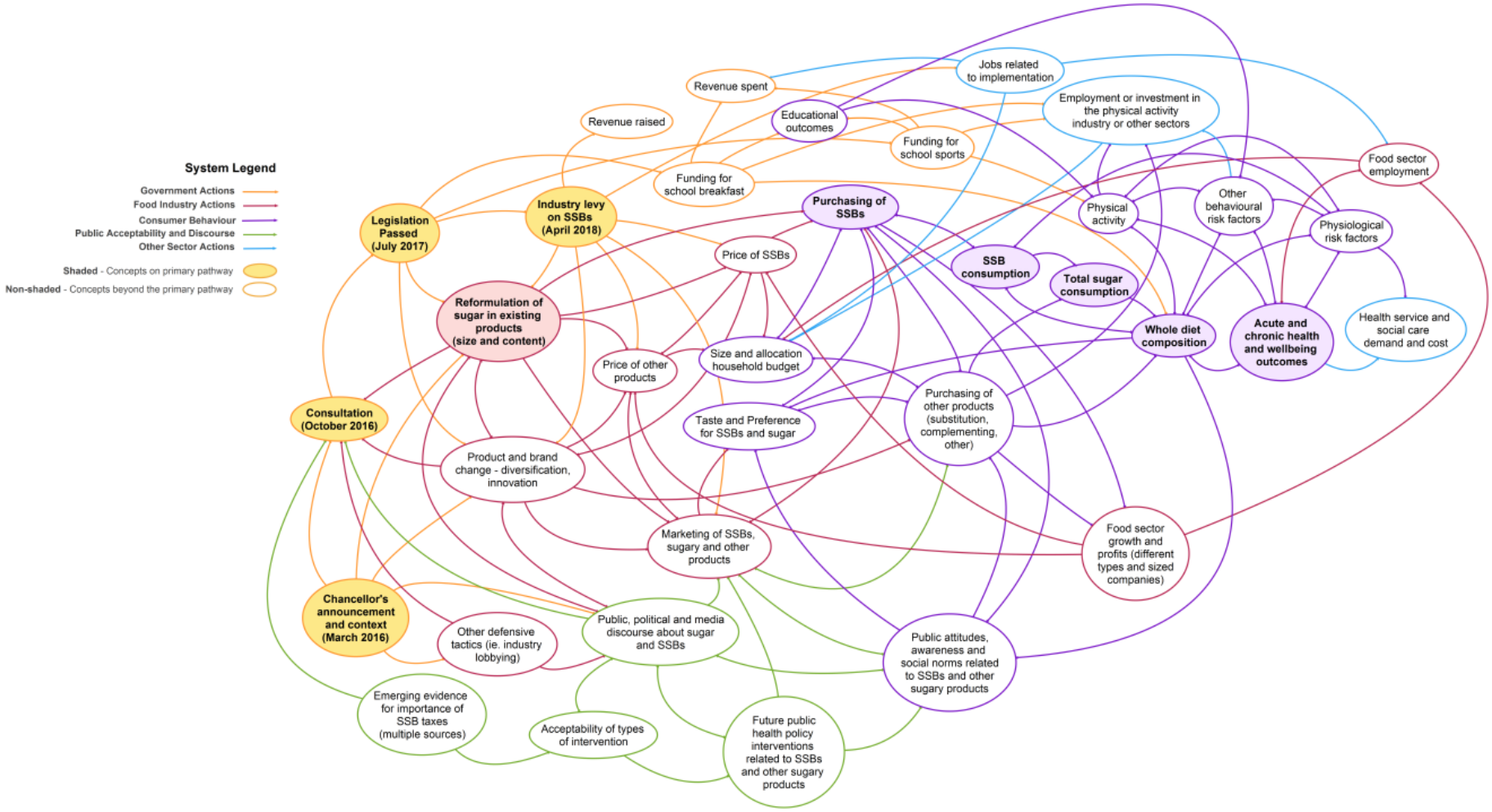
Soft Drinks Industry Levy – A systems map

As you might anticipate, the 'system map' developed by the study team is complex. It represents **multiple concepts** related to theorised effects of the Chancellors announcement, the consultation, legislation and implementation of the levy (Ovals) **along with connections and links between concepts** (arrows) that go beyond the development of the proposed 'pathway' stated in the announcement alone. This initial pathway suggested the levy would encourage reformulation, and the reduction of sugar intake based on consumption of soft drinks that have reduced sugar content by the population. In order to help simplify the map, and guide the collection of your feedback, we have:

1. Highlighted the proposed 'pathway' based on the announcement in the 2016 budget using **shaded circles**

2. Coloured the map to represented different domains of action or sub-systems, including:
    a. actions that **government** might take - **orange**
    b. actions that the **food industry** might take – **red**
    c. role of **media and other information** – **green**
    d. actions that **consumers** may take and the behavioural and health outcomes - **purple**
    e. role of **other sectors** – **blue**

3. Removed factors that modify potential effects including age, gender or socioeconomic position and other social and political context to focus exclusively on the wider system.


System Legend
Government Actions
Food Industry Actions
Consumer Behaviour
Public Acceptability and Discourse
Other Sector Actions
Shaded - Concepts on primary pathway
Non-shaded - Concepts beyond the primary pathway
Revenue spent
Revenue raised
Jobs related to implementation
Employment or investment in the physical activity industry or other sectors
Educational outcomes
Funding for school sports
Funding for school breakfast
Food sector employment
Legislation Passed (July 2017)
Industry levy on SSBs (April 2018)
Purchasing of SSBs
Physical activity
Other behavioural risk factors
Physiological risk factors
Price of SSBs
SSB consumption
Total sugar consumption
Reformulation of sugar in existing products (size and content)
Whole diet composition
Acute and chronic health and wellbeing outcomes
Health service and social care demand and cost
Price of other products
Size and allocation household budget
Consultation (October 2016)
Taste and Preference for SSBs and sugar
Purchasing of other products (substitution, complementing, other)
Product and brand change - diversification, innovation
Marketing of SSBs, sugary and other products
Food sector growth and profits (different types and sized companies)
Chancellor's announcement and context (March 2016)
Other defensive tactics (ie. industry lobbying)
Public, political and media discourse about sugar and SSBs
Public attitudes, awareness and social norms related to SSBs and other sugary products
Emerging evidence for importance of SSB taxes (multiple sources)
Acceptability of types of intervention
Future public health policy interventions related to SSBs and other sugary products

As the system can be a lot to take in as a whole, we have five smaller maps that focus on different pathways and domains where you will have the opportunity to add anything you feel is **MISSING**, and comment on anything you would **CHANGE** in the map. That will be followed by the map as a whole again, where you can provide any outstanding **COMMENTS**.

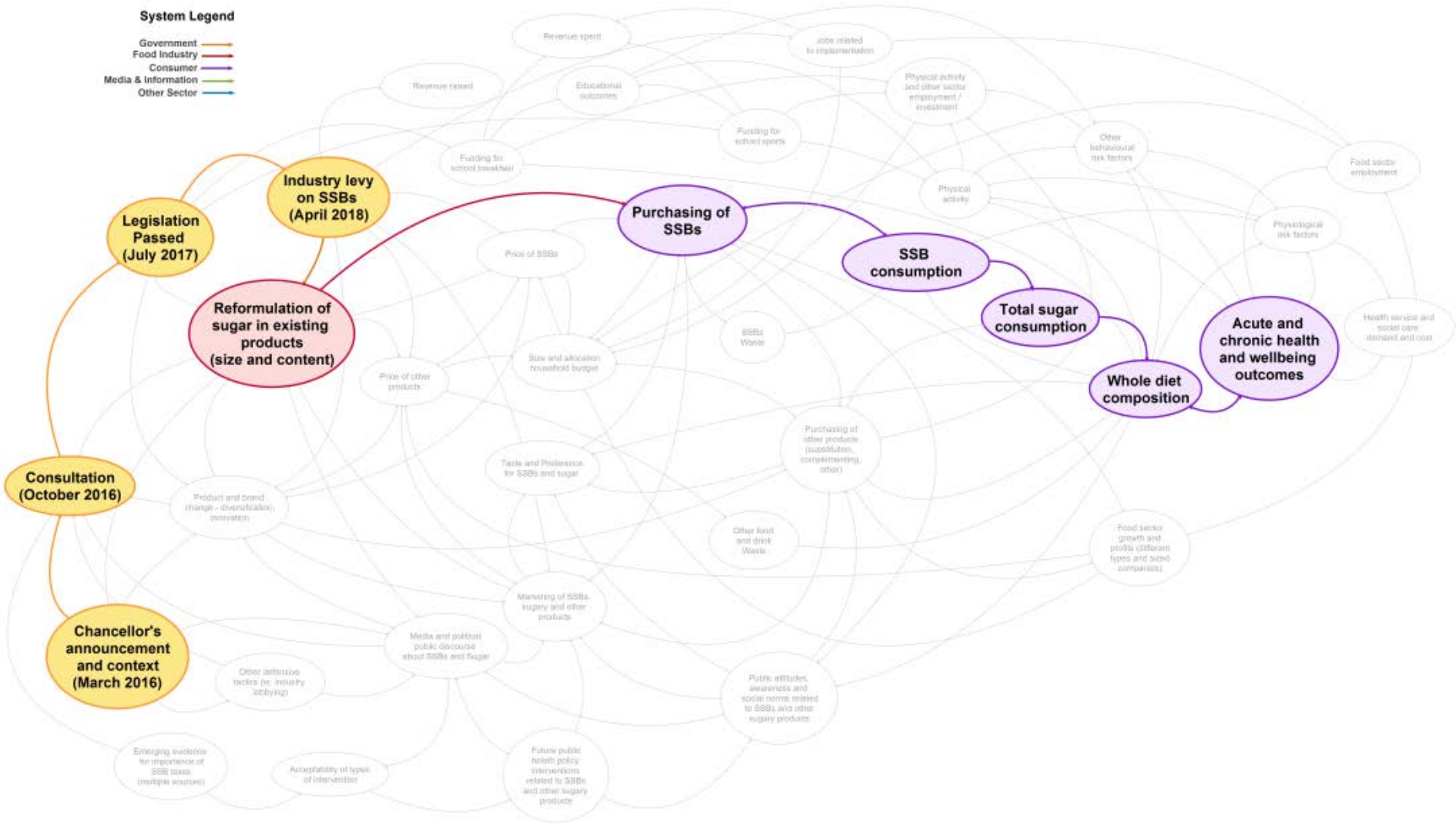
Soft Drinks Industry Levy – Input on proposed 'pathway' stated in 2016 Budget

As mentioned previously, the study team used the Chancellors announcement as a starting point (quote below) to develop a systems map representing **a set of 'reasonable connections or links' that can be tested in future analyses** (**click for large view of the map**). This was done based on the statement below from the 2016 budget announcement.

The 2016 budget announcement:

Budget 2016 announces a new soft drinks industry levy targeted at producers and importers of soft drinks that contain added sugar. The levy will be designed to encourage companies to reformulate by reducing the amount of added sugar in the drinks they sell, moving consumers towards lower sugar alternatives, and reducing portion sizes.

Under this levy, if producers change their behaviour, they will pay less tax. The levy is expected to raise £520 million in the first year. The OBR expect that this number will fall over time as the total consumption of soft drinks in scope of the levy drops, in part as a result of producers changing their behaviour and helping consumers to make healthier choices.

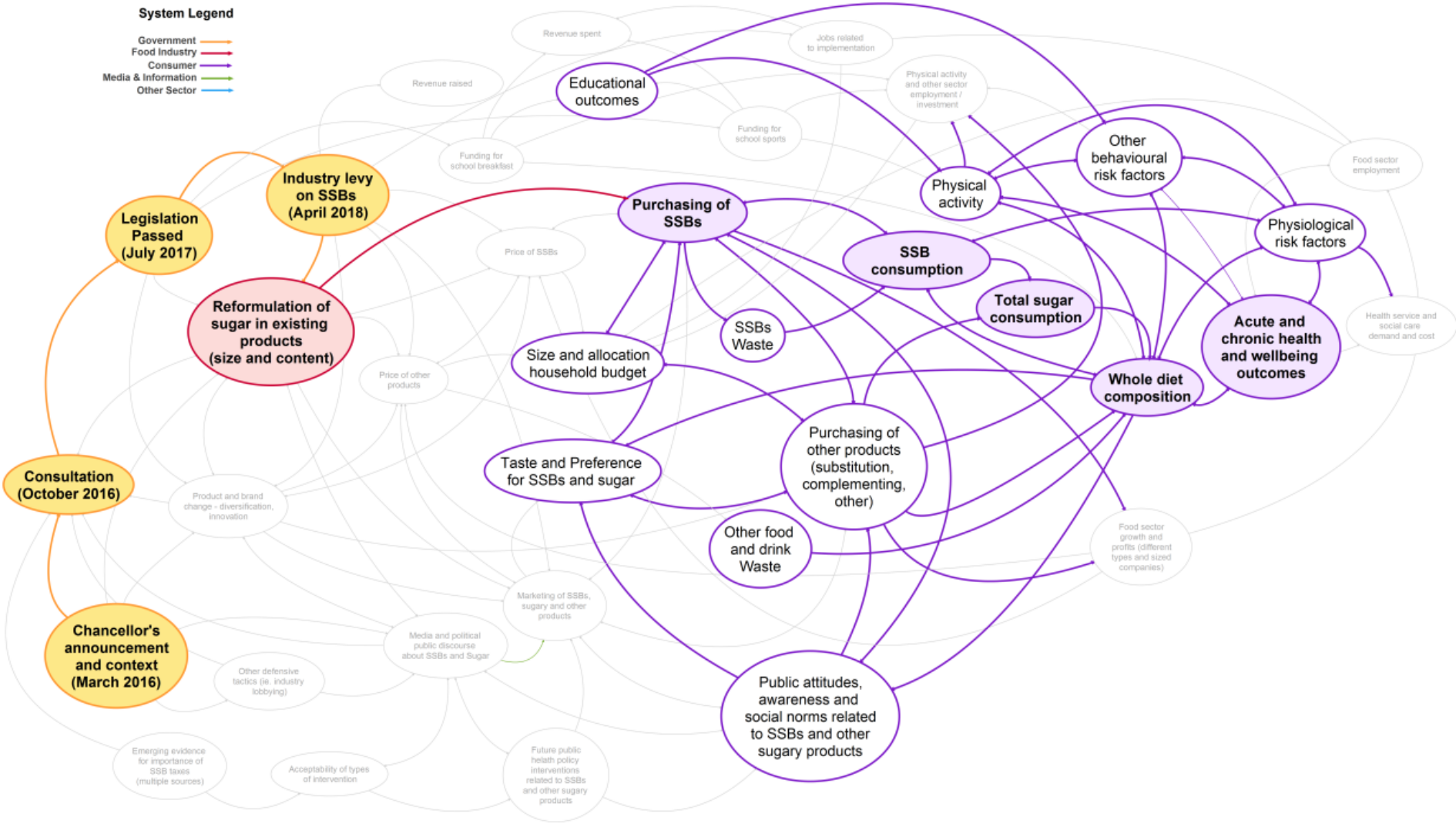

System Legend
Government
Food Industry
Consumer
Media & Information
Other Sector
Legislation Passed (July 2017)
Industry levy on SSBs (April 2018)
Reformulation of sugar in existing products (size and content)
Consultation (October 2016)
Chancellor's announcement and context (March 2016)
Purchasing of SSBs
SSB consumption
Total sugar consumption
Whole diet composition
Acute and chronic health and wellbeing outcomes
Revenue spent
Jobs related to implementation
Revenue raised
Educational outcomes
Physical activity and other sector employment / investment
Funding for school sports
Funding for school breakfast
Other behavioural risk factors
Food sector employment
Physical activity
Physiological risk factors
Price of SSBs
SSBs Waste
Health service and social care demand and cost
Price of other products
Size and allocation household budget
Purchasing of other products (substitution, complementing, other)
Taste and Preference for SSBs and sugar
Product and brand change - diversification, innovation
Other food and drink Waste
Food sector growth and profits (different types and sized companies)
Marketing of SSBs, sugary and other products
Media and political public discourse about SSBs and Sugar
Other defensive tactics (ie. industry lobbying)
Public attitudes, awareness and social norms related to SSBs and other sugary products
Emerging evidence for importance of SSB taxes (multiple sources)
Acceptability of types of intervention
Future public health policy interventions related to SSBs and other sugary products

Do you feel anything is **MISSING, or would you CHANGE** anything about this main pathway provided in the 2016 budget?

- No [next page]
- Yes
    - Please provide your feedback in the comment box, listing any factors you feel are missing, and/or associations you would add or change. [comment box]

Soft Drinks Industry Levy – Input on Consumer sub-system

The map below is a sub-map of the full system (**click for large view of the map**) you saw on the previous page along with the pathway defined using the Chancellors statement for you to refer to. This map is focused on the actions **consumers** may take and the outcomes – (**purple**). In particular, we are interested in what you feel is **MISSING** or would **CHANGE** about any part of this pathway or domain.


System Legend
Government
Food Industry
Consumer
Media & Information
Other Sector
Revenue spent
Jobs related to implementation
Revenue raised
Educational outcomes
Physical activity and other sector employment / investment
Funding for school sports
Funding for school breakfast
Other behavioural risk factors
Food sector employment
Industry levy on SSBs (April 2018)
Physical activity
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Purchasing of SSBs
Physiological risk factors
Price of SSBs
SSB consumption
Reformulation of sugar in existing products (size and content)
Total sugar consumption
SSBs Waste
Acute and chronic health and wellbeing outcomes
Health service and social care demand and cost
Size and allocation household budget
Price of other products
Whole diet composition
Purchasing of other products (substitution, complementing, other)
Taste and Preference for SSBs and sugar
Consultation (October 2016)
Product and brand change - diversification, innovation
Other food and drink Waste
Food sector growth and profits (different types and sized companies)
Marketing of SSBs, sugary and other products
Chancellor's announcement and context (March 2016)
Media and political public discourse about SSBs and Sugar
Other defensive tactics (ie. industry lobbying)
Public attitudes, awareness and social norms related to SSBs and other sugary products
Emerging evidence for importance of SSB taxes (multiple sources)
Acceptability of types of intervention
Future public helath policy interventions related to SSBs and other sugary products

Do you feel anything is MISSING, or would you CHANGE anything about this map?

- No [next page]
- Yes
    - Please provide your feedback in the comment box, listing any factors you feel are missing, and/or associations you would add or change. [comment box]

***Continued for each sub-system, and then repeated for a second round.**

Appendix C: Priority Data Sources identified from the SDIL Systems Map

	System map factor with measurement available	Data type	Data source	Cost for access	Cost for collection
Industry Actions	Reformulation of sugar in existing products *and* role of retailers	Commercial sales data	Kantar WorldPanel	Yes	No
	Product and brand change - diversification, innovation	Supermarket inventory data	Online supermarket websites	No	Yes
	Price of other products	Supermarket inventory data	Online supermarket websites	No	Yes
	Price of SSBs	Supermarket inventory data	Online supermarket websites	No	Yes
	Other defensive tactics (i.e. industry lobbying)	Industry communications and interviews	Industry online publications and stakeholders	No	No
Consumer Behaviour	Purchasing of SSBs	Commercial sales data	Kantar WorldPanel	Yes	No
	Purchasing of other products (substitution, complementing, other)	Commercial sales data	Kantar WorldPanel	Yes	No
	Taste and preference *and* public attitudes for SSBs and sugar	Commercial sales data	Kantar WorldPanel	Yes	No
	SSB consumption	National Survey	National Diet and Nutrition Survey	No	No
	Total sugar consumption	National Survey	National Diet and Nutrition Survey	No	No
	Whole diet composition	National Survey	National Diet and Nutrition Survey	No	No
	Acute and chronic health and wellbeing outcomes	Administrative data, national study and PRIMEtime model	Hospital Episode Statistics (dental caries); National Child Measurement Programme (childhood adiposity); Office for National Statistics and the General Register Offices for Scotland and Northern Ireland and Hospital Episode Statistics (model)	No	No
Public Acceptability and Discourse	Media and political public discourse about SSBs and sugar	News media coverage, social media, documentation and online sources	LexisNexis, Twitter, Parliamentary records and documents and online media	No	No
	Acceptability of types of intervention	Focus groups and surveys	General public including parents, children and young adults	No	Yes
	Emerging evidence for importance of SSB taxes	Interviews	Stakeholders		
Government Actions	Chancellor's announcement	Documentation	UK Treasury	No	No
	Consultation	Documentation	UK Treasury	No	No
	Legislation passed	Documentation	UK Treasury	No	No
	Industry levy	Documentation	UK Treasury	No	No
Other Sectoral Actions	Health service and social care demand and cost	Micro (PRIMEtime) and Macro (Computable general Equilibrium) model	Office for National Statistics and the General Register Offices for Scotland and Northern Ireland and Hospital Episode Statistics (micro), Global Trade Analysis Project and UK Treasury (macro)	No	No

Appendix D: Conceptual model and measurement items for public acceptability of the SDIL and potential psychosocial determinants

Proposed research question and measures

Understanding how the SDIL changes a number of important parameters related to knowledge and acceptability over time, starting as soon as possible and ending in 2020 or later would complement the wide range of outcomes in our definitive evaluation and offer important policy-relevant data in its own right. The following are proposed questions, based on previous research where possible. These include five domains and represent measurements of public acceptability of the SDIL and potential predictors of acceptability with definitions and measurements below:

- Knowledge of the effects of sugar, sugary drinks and the proposed levy,
- The public acceptability of the SDIL and fiscal policies to improve health more generally,
- Descriptive social norms related to sugar and sugary drinks,
- Attitudes related to sugar and sugary drinks,
- Public trust in relevant institutions and health experts.

The following questions are provided in the order they should be used for surveying the public, for instance knowledge asked first so as not to influence responses to questions about acceptability of the SDIL.

1) Knowledge of health effects of sugar and soft drinks, and details of the levy

Indicator(s)	Question / Items	Scale	Label	Source/ Informed by
Knowledge preamble	"Please answer true and false to the following statements"			(Rivard et al., 2012)
Knowledge of sugar and health	Eating food high in sugar increases my risk of: • Obesity • Diabetes • Tooth decay'	None	• True • False	
Knowledge of sugary drinks and health	Frequently drinking sugary drinks increases my risk of: • Obesity • Diabetes • Tooth decay'	None	• True • False	
Knowledge of soft drinks industry levy	The sugary drinks tax includes: • A tax directed at industry to encourage reformulation of soft drinks • A tax directed at consumers intended to increase prices of sugary drinks	None	• True • False	

2) Public acceptability of the Soft Drinks Industry Levy and fiscal policies for health more generally

Indicator(s)	Question / Items	Scale	Label	Source/ Informed by
Fiscal policy preamble	"Taxes and subsidies may be one way to encourage people to eat healthier foods and discourage them from eating less healthy foods"			(Petrescu et al., 2016)
Support for fiscal policies	• 'Do you support or oppose these kinds of policies?'	4 point	• Strongly support • Support • Oppose • Strongly Oppose	
Perceived effectiveness of fiscal policies	• 'How effective do you think these kinds of policies would be?'	4 point	• Not at all effective • Somewhat effective • Mostly effective • Very effective	
SDIL specific preamble	"In 2018 a new tax on soft drinks will be introduced in the UK. This aims to encourage manufacturers to reduce the sugar in drinks. The money will be sent on breakfast clubs, and sports in primary schools"			(Petrescu et al., 2016)
Support for the soft drinks industry levy	• 'Do you support or oppose this policy?'	4 point	• Strongly support • Support • Oppose • Strongly Oppose	
Perceived effectiveness for the soft drinks industry levy	• 'How effective do you think this policy will be?'	4 point	• Not at all effective • Somewhat effective • Mostly effective • Very effective	

3) Descriptive social norms toward sugar and sugary drinks

Indicator(s)	Question / Items	Scale	Label	Source/ Informed by
Social norms preamble	"Please rate your agreement from 1 (completely agree) to 7 (completely disagree) with the following:"			(Smith et al., 2008)
Social norms for sugar	• People important to me try not to eat foods high in sugar • People important to me think I should not eat foods high in sugar	7 point	• Completely agree • Completely disagree	
Social norms for sugary drinks	• People important to me try not to drink sugary drinks • People important to me think I shouldn't drink sugary drinks	7 point	• Completely agree • Completely disagree	

4) Attitudes toward sugar and soft drinks

Indicator(s)	Question / Items	Scale	Label	Source/ Informed by
Attitudes preamble	"Please rate your agreement from 1 (completely agree) to 7 (completely disagree) with the following:"			(Roefs & Jansen, 2002)
Attitudes toward sugar	• Sugary foods taste good • High sugar foods are healthy • I should not eat high sugar foods • In our household, we try not to eat foods high in sugar • I eat a lot of high sugar foods'	7 point	• Completely agree • Completely disagree	
Attitudes toward sugary drinks	• Sugary drinks taste good • High sugar drinks are healthy • I should not drink sugary drinks • In our household, we try not to drink sugary drinks • I buy a lot of sugary drinks'	7 point	• Completely agree • Completely disagree	

5) Public trust related to the government, food industry and health experts.

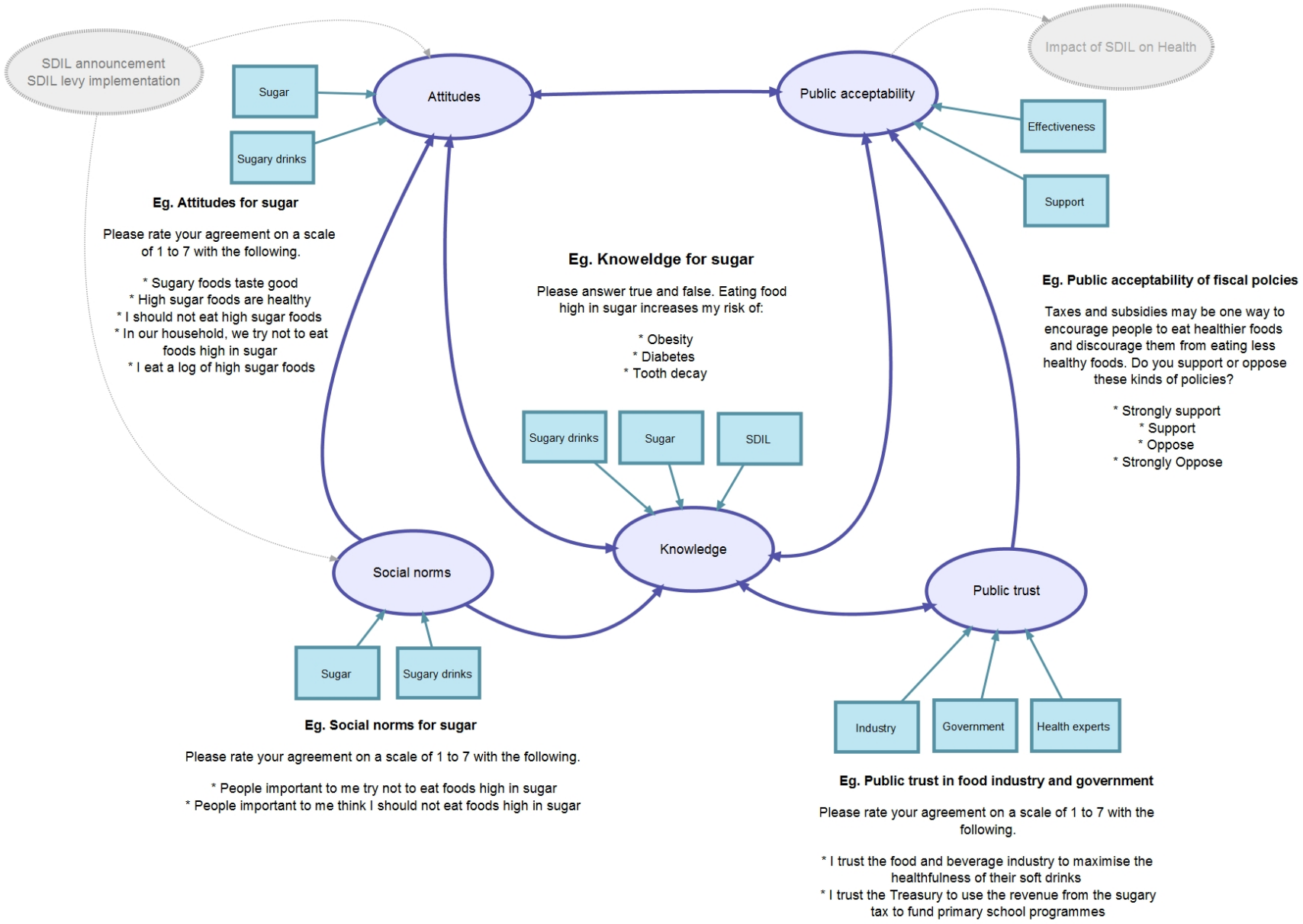
Indicator(s)	Question / Items	Scale	Label	Source/ Informed by
Trust preamble	'Please rate your agreement from 1 (completely agree) to 7 (completely disagree) with the following:			(Diepeveen et al., 2013; Somerville et al., 2015)
Trust in the food and beverage industry, government and health experts	• I trust the food and beverage industry to maximise the healthfulness of their soft drinks • I trust the Treasury to use the revenue from the sugary tax to fund primary school programmes • I trust health experts when they tell me about the benefits and harms of sugar • I trust health experts when they tell me about the benefits and harms of sugary drinks • I trust health experts when they tell me about the benefits and harms of artificial sweeteners	7 point	• Completely agree • Completely disagree	

How could the data be collected?

There are two key options that we believe are worth considering. The first is to include questions in the ONS Opinions and Lifestyle survey, a rolling (monthly) survey of a representative sample of adults in the UK. This is relatively expensive for repeated surveys, includes ample social and demographic data, but does not offer other data on food consumption which can be explored in relation to attitudes.

The alternative would be to include questions in Kantar World Panel's (KWP) household consumer panel (n=30,000), regularly surveyed across the UK since 1991. Households are recruited to the panel to provide data on their day-to-day purchases for consumption at home, including all foods and beverages. KWP regularly conducts market research surveys among the panel for their own research and when commissioned by clients. When questions are identified, KWP can be approached for access to their panel and to explore options for longitudinal repeated measures (within same households) at intervals to be decided. A key advantage of this option is that attitudes can be examined in relation to food and beverage purchasing. We will be acquiring such purchasing data as a part of our definitive evaluation of the SDIL.

Conceptual (purple) and Measurement (blue) model for understanding public acceptability and its potential predictors



Appendix E: Media analysis methods

Media discourse will be examined using a range of data sources, with different identification procedures and selection criteria. These will include 1) print news sources, 2) industry trade press sources and 3) social media (specifically twitter) sources.

Print news sources

Identification

Print news sources will be identified by interrogating the LexisNexis database, which has a comprehensive list of UK print newspapers that are published in print or online (See appendix for full list). The following field selections and search strategy (Table 1) will be applied to all available article headlines. Duplicate records will be removed; however similar records (i.e. articles that were modified for publication in print vs online) will be included to capture the full volume of coverage.

Table 1: Details on search procedure for LexisNexis

Field	Selection / terms
Library	• News
Search terms	• sugar*, sweet*, fizz*, soda* • In the Headline • Separate searches for each keyword to allow for manageable (<3,000 per search) records
Index terms - Industry	• Food and beverage, • Manufacturing, • Marketing & advertising, • Media - broadcasting, • Media – publishing, • Medical and healthcare, • Public relations, • Retail and wholesale trade, • Travel and tourism
Index terms - Subject	• Include all
Index terms - Country/Region	• UK
Sources	• UK newspapers
Duplication	• Off
Dates(s)	• Between: March 2000 – March 2017 (3 year intervals)

The purpose of the strategy is to identify all articles related to the topics of interest (sugar, sugary drinks, health and the levy). Searching begins approximately 15 years prior to the announcement of the WHO guidelines around sugar, considered a major step forward in recognising the importance of limiting sugar consumption in the population. In the year 2000 Dr Tom Marshall published one of the first peer-reviewed papers exploring fiscal food policies to improve health outcomes.[1] This 17 year window (from March 2000 to March 2017) will allow the development of a comprehensive timeline of major events to guide the

exploration of discourse culminating in the announcement of the Soft Drinks Industry Levy (SDIL) and immediately following.

Selection

Inclusion criteria for articles will be those that relate to a tax (or levy) on sugar or sugar containing products, any UK publication even if that publication is discussing these topics regarding other countries, sugar within a health context (for example, excluding an agricultural context) (Table 2). Using the inclusion criteria each title will be screened by two independent researchers (one researchers will review all title, two other researchers will divide titles between them). All titles that were identified as included by at least one researcher will be move into full text review. Full text review will be completed by all three researchers, and texts will require consensus for final selection to be included for analysis.

Table 2 Inclusion criteria

Field	Selection / terms
Date of Publication	• March 2000 – March 2017
Place of Publication	• UK newspaper covered in LexisNexis
Main topic of article	• Sugar or sugary drinks in health context • Taxing of sugar or sugary drinks
Restriction	• Published in UK print news source
Language	• English

Trade press sources

Identification

Industry trade press publications will be identified by using search engines looking for possible publications that include a range of food and beverage industries including food and drink retailing, food manufacturing and leisure and tourism, using a method piloted to search for grey literature and information.[2] The search strategy will include key words to identify relevant publications, for example: "food and beverage" AND "publication or magazine or press or news". The inclusion criteria will include the purpose of the publication, for example: a focus on trade press in "food and drink manufacturing", "food and drink retailing", "leisure and hospitality", "relevance to the UK".

Example Trade press publications include:

1. The Grocer – www.thegrocer.co.uk
2. Confectionery News – www.confectionerynews.com
3. Convenience Store – www.conveniencestore.co.uk
4. Food Manufacture – www.foodmanufacture.co.uk
5. Innovations in Food Processing and Packaging; Food Legislation; Food Finance; Industry and Consumer Trends etc – www.foodnavigator.com
6. Food and Drink Europe – www.foodanddrinkeurope.com
7. Food Production Daily – www.foodproductiondaily.com

Once a full list of publications has been identified, each publication will be assessed for an appropriate access model. For example, some publications are online only and will require a subscription to access articles within the publication. Others might be available via the British Library. Each procedure for identification of publications, and subsequent access models for published articles will be documented throughout the process.

Selection

Trade press sources are often subscription based online publications. Access to these sources will require a subscription and hand searching within each publication in order to collect necessary articles. Searching of these publications will be restricted to a meaningful timeline informed by the print news timeline development.

Once access is granted, inclusion criteria for articles will be those that relate to a tax (or levy) on sugar or sugar containing products, any UK publication even if that publication is discussing these topics regarding other countries, sugar within a health context (for example, excluding an agricultural context) (Table 3). Using the inclusion criteria articles will be screened in duplicate.

Table 3 Inclusion criteria

Field	**Selection / terms**
Date of Publication	• TBD
Place of Publication	• UK Trade press as defined above
Main topic of article	• Sugar or sugary drinks in health context • Taxing of sugar or sugary drinks
Restriction	• Published in UK source
Language	• English

Social media sources

Sources will be identified, and tweets will be selected, using two approaches:

All available tweets: identification of tweets will be done by using specific keywords (see example below) designed to capture the topic of SSBs and health, and the SDIL from a pool of tweets from a given time period. To select relevant tweets, a data driven method will be explored to deal with high volume of data, including machine learning and an iterative process to develop and validate a data driven typology and timeline that emerges from the collected tweets.[3] Through this process, criteria will be developed and applied to the data to exclude tweets that are not relevant for further analysis.

Example Twitter keyword search strategy

Tweets containing: (drink (and derivatives) OR beverage (and derivatives) OR sugar (and derivatives) OR SSB) AND (tax OR levy OR cost OR price OR £ OR $) AND not retweets AND (in English OR in language not identified)

Targeted tweets: In addition to an unbounded search of all available tweets over a given time period, tweets will be identified by specific twitter accounts of key stakeholder organisations and individuals involved in all aspects of SSBs and the SDIL. From these tweets, specific exclusion (see Table 4) will be applied to ensure the most relevant data.

Table 4 Initial criteria

Topic	**Criteria**
Date of Publication	• To be informed by print news analysis

Main topic of Tweet	• Sugar or sugary drinks in health context • Taxing of sugar or sugary drinks
Restriction	• Relevant to the UK context
Language	• English

References

1. Marshall T. Exploring a fiscal food policy: the case of diet and ischaemic heart disease Commentary: Alternative nutrition outcomes using a fiscal food policy. *Bmj*. 2000;320(7230):301-305. doi:10.1136/bmj.320.7230.301.
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3. Cheong F, Cheong C. Social Media Data Mining: A Social Network Analysis Of Tweets During The 2010–2011 Australian Floods. *PACIS 2011 Proc*. 2011:Paper 46. http://aisel.aisnet.org/pacis2011/46.

Appendix F: NIHR PHR fast-track grant funding application – Evaluation of the health impacts of the UK Treasury Soft Drinks Industry Levy (SDIL) (White M, *et al*)

Scientific Summary

We will conduct a natural experimental evaluation of proximal, intermediate & distal outcomes (work package (WP) 1), micro & macro-economic evaluation (WP3), & qualitative process evaluation (WP4) over 3 2-year time periods (2014-20). Simulation modelling of health & economic outcomes will focus on longer time horizons (WP2). In WP5, findings from WP1-4 will be synthesised and interpreted to refine intervention theory, and stakeholders engaged in dissemination.

WP1 – will use interrupted time series & regression analyses to evaluate impacts of the SDIL on:

1. Soft drink product diversification, formulation & price by brand, category & product size (volume) using data from 6 leading supermarket chains
2. Purchases of SSBs, all other drinks, confectionary & toiletries overall & by age, sex & socioeconomic position (SEP), using household purchasing data from Kantar World Panel
3. Consumption of SSBs & confectionary overall & by age, sex & SEP using data from the National Diet & Nutrition Survey
4. Prevalence of childhood obesity using data from the National Child Measurement Programme & hospital admissions for severe dental caries using data from Hospital Episode Statistics (HES) overall & by age, sex & SEP.

WP2 – will adapt an existing life table model (PRIMEtime) for proportional multistate life table analyses. Data from WP1 will be used to estimate the effect sizes for SSB consumption & free sugars from drinks. We will estimate the impact of these changes on health outcomes over the short (5 years), medium (5-10 years) & long term (>10 years). Disease outcomes of interest will include dental caries, T2DM, cardiovascular & kidney disease, & obesity-related cancers (e.g. colon, kidney, liver, breast & pancreas).

WP3 – will involve: (i) a micro-economic evaluation, modelling (using PRIMEtime) the health & social care cost impacts & health outcomes (QALYs gained); & (ii) a macro-economic evaluation, to assess the wider impacts of SDIL on industry, households, Treasury and UK economy. In (i) NHS costs will be estimated using programme-budgeting & HES data. Social care & wider societal costs will be assessed overall & by age, sex, utility score & ICD10 codes. Data on dental caries & associated health care costs will be incorporated & we will extend the cost estimates to cover children & adolescents. In (ii) we will use a Computable General Equilibrium (CGE) model of the whole economy that includes the cost minimising & profit maximising behaviour of producers, consumption & saving behaviour of households & government, taxation mechanisms & the use of labour, capital & other factors in order to produce goods & services for investment or consumption, & includes trade across international borders.

WP4 – will use qualitative methods to determine the perceived acceptability & impacts of the SDIL. We will conduct thematic Framework analysis of interviews with professionals &

focus groups with the public, thematic content analysis of newspapers articles & social media (twitter) output & analysis of survey questions on consumer attitudes to SSBs collected by Kantar in their household purchasing panel.

WP5 – will involve synthesis of the findings from WPs1-4 using our systems map & refinement of intervention theory. Triangulation of evidence generated using different methods from WPs1-4 will facilitate corroboration of findings, supported by techniques such as pattern matching. We will engage stakeholders in dissemination.