EConDA
Economics of Chronic Diseases

Final technical report: EConDA

Contract number: 2012 12 13

DELIVERABLE 8

This report arises from the project EConDA which has received funding from the European Union in the framework of the Health Programme. Project number: 2012 12 13

Structure of this report

This report is structured as per the instructions on the Chafea website here: http://ec.europa.eu/chafea/documents/management/Financial_Workshop_27092012_Preparation_of_final_technical_reports.pdf

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Section 1: Declaration

The attached periodic report represents an accurate description of the work carried out in this project for this reporting period.

Signed…….. Date……

Laura Webber, Project Coordinator

Section 2: Checklist

Checklist

Please see the separate checklist (Checklist final payment.xls).

Please read the checklist and answer all respective questions in it.

√	Have you read and understood the "Guidelines for Request of Balance Payment"? http://ec.europa.eu/chafea/documents/management/chafea_Guidelines_for_request_of_balance_payment_25_09_2008.pdf
Technical Report	
√	Did you draft the final technical report using the Chafea template? *The template can be found at:* *2009 07 20 Final Technical report template.doc* It is not possible to open the above link, therefore the instructions here were followed as per the email exchange with Anne-Marie Yazbeck http://ec.europa.eu/chafea/documents/management/Financial_Workshop_27092012_Preparation_of_final_technical_reports.pdf
√	Does your technical and financial report cover the complete duration of the project?
√	Did you fill the Executive Summary?
√	Did you summarise the main outcomes and main recommendations of the project in 1-3 paragraphs?
	WP3 on Evaluation
√	Did you provide data for the indicators that are outlined in the Grant Agreement? *Remark: The Grant Agreement does contain indicators in its technical annex, which refer to process, output and outcomes. Please copy them into the final technical report and provide data and discussion for them.*
	Deliverables
√	Have you attached to the final report 2 hardcopies of each deliverable?
√	Do all published/printed deliverables contain the reference on EU funding? *Remark: The Grant Agreement states that all electronic or printed publications shall state the following sentence in conjunction with the EU logo: "This publication arises from the project "[Project Title]" which has received funding from the European Union in the framework of the Health Programme." (Please also refer to article I.11.3 of the grant agreement.) The EU logo can be found at the following page:* http://europa.eu/abc/symbols/emblem/download_en.htm

	Financial Report
√	Did you fill the final cost statement using the Chafea template? *The template can be found at:* Grants since 2006 - Balance Payment Financial Report Template.xls
	Detailed cost statement (Template 4)
√	Did you fill Template No. 4 with all details for each cost item?
√	Did you check the sums and calculations for correctness? *Remark: The template itself does not contain formulas for calculation yet. You need to add them yourself.*
√	If one or more partners are using currencies other than EURO, did you transform the amounts of these currencies as stated in the grant agreement? *Remark: Please refer to Article I.10.1 of the grant agreement: for the complete reporting period, the exchange rate established by the Commission for the first day of the month following the end of the reporting period shall be used.* The rates can be found here:
	Detailed cost statement (Template 4) - Travel
√	If you have travel outside EU Member States, please attach Chafea's prior approval (eg. copy of an email, letter)
√	Did you report under E2 travel and subsistance only of Staff that is mentioned under E1. *Remark: Travel and subsistance of non-staff shall be reported under E6-Other Costs. Travel and Subsistance of Subcontractors shall be included in the Subcontract.*
	Detailed cost statement (Template 4) - Equipment
√	Did you attach a copy for each cost item under E3 (Equipment)
√	Did you number these copies and link to the respective cost item? (See column M)
	Detailed cost statement (Template 4) - Subcontracting
√	Did you attach a copy for each cost item under E5 (Subcontracting)
√	Did you number these copies and link to the respective cost item? (See column M)

Section 3: Specification of the project

Foreword

About this project

The EConDA project was a 2.5 year project (April 2013-October 2015), led by the UK Health Forum together with sixteen partners, with the dual objective of assisting EU Member States to develop, select and implement a) more cost-effective policies to improve chronic disease prevention and b) policies to reduce health inequalities due to chronic diseases. The EConDA project was piloted in 8 countries: Bulgaria, Finland, Greece, Lithuania, the Netherlands, Poland, Portugal, and the United Kingdom.

Importance of the project

This project is important because it provides tools for measuring the cost-effectiveness of interventions for chronic disease prevention with a particular focus on diabetes, cardiovascular diseases or respiratory disease by:
- providing increased consensus on the best measures of cost-effectiveness
- developing demonstration computer simulation models to quantify the future burden and related costs of chronic disease with the inclusion of obesity and smoking as risk factors. Multi-stage computer models for type 2 diabetes, respiratory disease, and chronic kidney disease were developed. Lung cancer, coronary heart disease, stroke and hypertension were also included as single-stage diseases.
- testing prevention, screening and treatment interventions within the same model, providing the structural ability to test a range of integrated interventions by different social groups.

This is important because chronic non-communicable diseases are the leading cause of morbidity, disability and mortality in Europe, and are responsible for more than 86% of all deaths[1]. Chronic diseases also contribute to health inequalities and lower life expectancy. This chronic disease burden represents a major economic burden: 70-80% of health care budgets, an estimated €700 billion per year, are spent on treating chronic diseases in the EU alone, as well as result in widening social care and lost productivity costs.

Generally, but particularly in times of economic austerity and with ageing populations, economic evaluation in health is crucial to study the burden of disease and to assess which policies could best impact disease trends. Cost-effectiveness is vital if healthcare systems are to be sustained.

The project is important because it sought to address the 2nd EU health programme (2008-2013) priority on promoting health. It is a direct response to the Commission action on the preventing chronic diseases. The EconDA specifically examines the cost-effectiveness of integrated approaches for chronic disease prevention with a particular focus on diabetes, cardiovascular disease and COPD.

Key findings from the project

There are many outputs from this project which are presented in greater detail in the annexes. However, the following provides a list of the key findings:

[1] WHO Europe http://www.euro.who.int/en/health-topics/noncommunicable-diseases

Findings from the expert meeting

There was a consensus that:

- Various measures of cost-effectiveness should be used, these include: direct healthcare costs, indirect or non-healthcare costs (such as welfare costs), Quality Adjusted Life Years, incidence cases (i.e. new cases in a given time period) of chronic disease avoided, life years gained.

- A 'societal' perspective should be taken where possible. This means including costs of disease that are not just those related to healthcare, but also non-healthcare costs such as loss in productivity due to sickness, and changes in quality of life as a result of an intervention.

Findings from the obesity modelling

- Obesity is predicted to increase across the majority of the EConDA countries and across all levels of education by 2050.

- Increasing obesity will result in increases in chronic diseases over time, with widespread and serious effects on the economy of the health system and wider society.

- Significant health and economic gains can be achieved with small reductions in BMI.

- Multi-component behavioural change interventions implemented annually will substantially reduce obesity-related diseases.

- Maintaining weight loss is particularly beneficial.so that investment in weight loss maintenance interventions is an important additional step.

- By its nature, a sugar sweetened beverage (SSB) tax is more cost-effective than weight loss programmes, however both interventions were found to be cost-effective.

- Introducing a 20% SSB tax will have a significant impact on major chronic disease, such as CHD and type 2 diabetes.

Findings from the smoking modelling

- By 2050, smoking prevalence is forecast to decrease across all of the countries that were modelled.

- Data for smoking prevalence by education level were available for Finland, Lithuania, the Netherlands, and the UK only. Prevalence of smoking was projected to decrease across all education groups in these countries. However, the rate of decline was projected to be faster among males and females with tertiary education compared to those with less than tertiary education. For this reason, the gap in smoking prevalence between more and less advantaged groups was predicted to widen year on year until 2050 in the four countries.

- Across all countries the chronic diseases selected were predicted to rise by 2050

- Smoking cessation services (SCS) are cost-effective and have an important impact on reducing the future burden of smoking-related diseases.

- Of the interventions tested, SCS are projected to have the largest epidemiological impact on COPD and stroke in absolute terms.

- SCS are more cost-effective and result in greater gains in quality-adjusted life years when compared to treatment of a single smoking-related disease.

- Important policy measures such as tobacco taxation and bans on smoking in public places are likely to be responsible for the prevailing downward trends in smoking. Retaining these policies is imperative if the predicted trends are to be maintained.

General:

- The results illustrate the importance of chronic disease prevention to avoid health system and societal costs. In particular, primary prevention interventions are cost effective when a time horizon of more than 10 years is used.

- Economic analyses of chronic disease should take a societal perspective to account for costs beyond healthcare.

- We have produced a downloadable tool that can be used to test the effectiveness and cost-effectiveness of interventions in relation to the future burden of disease: www.econdaproject.eu/tools.php

Who might benefit from the outputs/outcomes

The outputs are of particular benefit to national governments highlighting the dynamic nature of trends in obesity and smoking over time and by social group, as well as quantifying the impact of these risk factors upon chronic diseases. The outputs also quantify both the cost burden of changing trends in these risk factors over time and the impact of interventions to prevent, screen or treat risk factor related diseases such as type 2 diabetes and cardiovascular disease. In a similar vein, the outputs are important to the wider society and business since they highlight the colossal indirect costs (e.g. losses in productivity) as a result of chronic disease.

The models and related tools provide a means of chronic disease resource planning and budget allocation into the future, which is of benefit not just to governments but to commissioners at a local, national and European level. In austere times it is even more imperative to know where resources are needed most, and should be prioritised. The work also highlighted the need for standardised surveillance data within countries, and also across Europe and identified where data are particularly scarce.

Health professionals, academics and anyone who seeks to promote a reduction in risk factors and their related chronic diseases will benefit from the outputs of the simulation model and use of the tool. The tool provides a way of testing the cost-effectiveness of a range of different interventions. Academics will particularly value the validation of the demonstration models against existing models drawing comparisons between other methods.

Ultimately, the potential beneficiaries are all EU citizens since the models highlight where resources are needed most both now and in the future and how even small changes in risk factors can have a significant impact on chronic diseases.

Acknowledgements

Primarily we would like to acknowledge all of the associate partners: UK Health Forum, European Heart Network, European Society of Cardiology, Health Equalities Group, International Diabetes Federation Europe, Lithuanian University of Health Sciences, National Institute of Health Doutor Ricardo Jorge, University of Groningen and to the collaborating Partners: World Health Organization, Organisation of Economic Cooperation and Development, European Society for Medical Oncology, European Cancer Organisation, European Respiratory Society, European Kidney Health Alliance, European Association for the Study of the Liver, University of Helsinki, Foundation of European Nurses in Diabetes.

We are indebted to the European Commission, for their support in supporting this work. In particular to Guy D'Argent and Anne-Marie Yazbeck, for their ongoing support.

We would like to thank all of the experts who took part in interviews and fed into the discussion on developing a consensus for measuring cost-effectiveness. In particular to Susanne Logstrup, Marleen Kestens and Jane Capon for coordinating the consensus meeting.

Our sincere gratitude goes to Dr. Martin Brown whose mathematical brilliance has steered much of the model development work for this project.

We would like to thank all of the scientists who provided expert advice on the development of the models. In particular our gratitude goes to Dr. Ron Gansevoort. Prof. John Yudkin. Prof. Peter Calverley, Prof. Peter Burney, Dr. Hugh Bethell, Prof. Klim McPherson, Leonor Guariguata, Dr. Lydia Makaroff and Dr. Joao Breda.

We would like to thank Mark Livermore for developing the website and for being on call with queries and updates when necessary.

We would like to acknowledge the kind work of Dr. Ron Gansevoort for his commitment in kind to the project and expert input into the development of the chronic kidney disease model. Also to Dr. Pepijn Vemer and Prof. Maarten Postma for their coordination and management of this collaboration.

We would like to thank all of the participants of the country workshops for contributing to the tool developments and improvements and to Emilia Miloiu for coordinating the workshops so effortlessly.

Also our sincere gratitude goes to our temporary researchers who have provided much needed support in the writing of reports and testing of models. In particular, thanks to Ketevan Rtveladze, Deepti Mishra, Max Coveney and Jennifer Saxton.

Keywords

1. Non-communicable diseases
2. Statistical Modelling
3. Chronic disease
4. Cost-effectiveness
5. Public health

Section 4: Final publishable Executive summary (3 pages)

Project scope and objectives

Chronic non-communicable diseases are the leading cause of mortality worldwide and in Europe, are responsible for more than 86% of all deaths[2]. Chronic diseases also represent a major economic burden: 70-80% of health care budgets, an estimated €700 billion per year, are spent on chronic diseases in the EU alone[3]. In times of economic austerity and ageing populations, economic evaluation in health is crucial to study the burden of disease and to assess which policies could best impact disease trends.

EConDA stands for 'Economics of chronic diseases'. The key aim of EConDA was to aid EU Member States to develop, select and implement more cost-effective policies to improve chronic disease prevention and impact upon populations with the highest rates of premature deaths from chronic diseases and reduce health inequalities.

The specific objectives of EConDA were to:

1. Achieve consensus among relevant experts on the methodology for measuring cost-effectiveness of interventions to prevent, screen and treat chronic diseases.
2. Develop a computer simulation model of the future burden of chronic diseases
3. Develop a demonstration model for integrated approaches to address cost-effectiveness of various interventions for chronic disease prevention
4. Implement the model in specific countries
5. Validate the model
6. Publish and disseminate an evaluation of the study

The countries studied in the EConDA project were: Bulgaria, Greece, Finland, Lithuania, Netherlands, Poland, Portugal and the UK

Activities and key findings of the project and their potential impact and use by the target group

Consensus on the best ways to measure cost-effectiveness (objective 1)
Consensus was achieved among key international organizations on methodology for measuring cost-effectiveness of interventions to prevent, screen and treat chronic diseases. Three reports were produced and are available for consultation from the website: A report on the literature review on cost-effectiveness of interventions for chronic diseases, a qualitative analysis of expert testimony on cost-effectiveness analysis and a report on the consensus meeting on best practice to measure cost-effectiveness in public health.

The **key findings** of the consensus meeting were:

- Various measures of cost-effectiveness should be used.
- A 'societal' perspective should be taken to account for costs beyond healthcare.
- Country-specific measures of cost-effectiveness should be included where possible.
- It is sometimes a challenge to source the necessary data to generate the most accurate estimates on cost-effectiveness of interventions.

Development of an epidemiological disease model (objective 2)

[2] WHO Europe http://www.euro.who.int/en/health-topics/noncommunicable-diseases
[3] EU Summit on Chronic Diseases Conclusions
http://ec.europa.eu/health/major_chronic_diseases/docs/ev_20140403_mi_en.pdf

Multi-stage computer models of several chronic diseases were developed to enable the testing of a range of interventions from policy and community level interventions to screening and treatment. The models incorporate two risk factors (smoking and BMI), and seven major chronic diseases (coronary heart disease, type 2 diabetes, chronic kidney disease and chronic obstructive pulmonary disease, stroke, lung cancer and hypertension). Risk factor prevalence was projected to 2050 based on current and historical trends.
Figure **1** illustrates multi-stage disease models using diabetes as an example. Multi-stages enable interventions to be tested at different stages of disease progression from prevention to treatment.

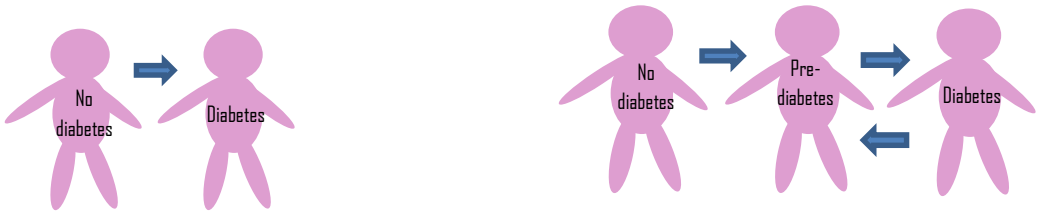

Figure 1: Possible transitions between different stages of diabetes used in the micro-simulation models

The **key findings** of the risk factor projections were:

Overweight and obesity model results	Smoking model results
• Obesity is predicted to increase across the majority of the EConDA countries and across all levels of education by 2050. • Increasing obesity is projected to result in increases in chronic diseases over time, with widespread effects on the economy.	• By 2050, smoking prevalence is forecast to decrease or remain stable across all of the countries that were modelled with the exception of Poland and Portugal where smoking prevalence is projected to increase. Within countries there were differences in the trends by age group and sex.
• Overweight and obesity predictions vary by education, but the pattern is not consistent between countries.	• There is a social gradient such that a greater number of individuals in the less educated group smoke. This is predicted to persist through to 2050.
• Across all countries the specified chronic diseases were predicted to rise by 2050	

Development of a cost-effectiveness simulation model and downloadable tool and their implementation in 8 EU countries (objectives 3 and 4)
The disease model described above was further developed to evaluate the economic burden of diseases in the future and the cost-effectiveness of potential interventions. A downloadable tool using the disease model was developed for use by policy makers and tested at the EConDA workshops. The effect of selected interventions on the health and economic burden of chronic diseases was modelled in 8 countries.

The **key findings** from the models were:

Overweight and obesity interventions	Smoking interventions
• Significant health and economic gains can be achieved with small reductions in BMI.	• Smoking cessation services (SCS) are cost-effective and have an important impact on reducing the future burden of smoking-related diseases.

• Multi-component behavioural change interventions [4] implemented annually substantially reduce obesity-related diseases. • Maintaining weight loss is more beneficial than if weight is regained after an intervention. Investment in weight loss maintenance interventions is important.	• SCS are projected to have the largest epidemiological impact on COPD and stroke in absolute terms. • SCS are more cost-effective and result in greater gains in quality-adjusted life years when compared to treatment of a single smoking-related disease.
• By its nature, a sugar sweetened beverage (SSB) tax is more cost-effective than weight loss programmes, but both interventions were found to be cost-effective. • Introducing a 20% SSB tax will have an important impact on major chronic disease, such as CHD and type 2 diabetes.	• Important policy measures such as tobacco taxation and bans on smoking in public places are likely to be responsible for downward trends in smoking. Retaining these policies is imperative if the predicted trends are to be maintained.
• The results show the importance of chronic disease prevention to save health system & societal costs.	
General findings	
• Primary prevention interventions are cost effective when a time horizon more than 10 years is used.	
• The EConDA tool can be downloaded so that users can test the effectiveness and cost-effectiveness of interventions in relation to the future burden of disease: www.econdaproject.eu/tools.php	

Other project activities

- Disease models are very data intensive and a large amount of time was dedicated to data collection. Poor data or the lack of it is a major limitation of the models in some countries.
- Disease models were validated against existing models (**objective 5**).
- Regular project meetings as well as a number of dissemination activities took place including publication of a leaflet, website, peer-reviewed article, conference presentations, and country workshops.
- The project has been evaluated on a yearly basis. As well as this, an evaluation of the country workshops, conference and downloadable tool was carried out (**objective 6**).

Impact and benefits by target group

The outputs of the project were aimed at policy-makers and stakeholders involved in preventing chronic diseases across Europe. EConDA has produced a wealth of information which can inform health policy decision making in the countries studied. For example, policy makers will be able to assess which risk factors and diseases should be given priority in their specific countries based on the model projections. Further, the downloadable tool enables stakeholders to test different interventions on the future burden of chronic diseases. The literature review and consensus report on cost-effectiveness is a valuable reference for public health professionals and policy makers.

The final reports are being disseminated through the website and networks via the European chronic disease alliance to Health policy planners, advocacy groups and NGOs. These parties, as well as commission officials were invited to attend the final conference. Country delegates were additionally invited to attend the workshops.

The strategic relevance and contribution to the EU Health Programme.

[4] These weight loss interventions include a diet, physical activity and cognitive component.

Given the epidemic of chronic diseases across Europe the EConDA project is of immense strategic importance to the EU Health programme. It has contributed to the key objectives of the 2008-2013 EU health programme by:

Relevance and contribution to the EU Health Programme
Quantifying the absolute and relative inequalities in obesity and smoking by 2050 illustrating the need for targeted preventive interventions in certain groups.
Predicting the future economic burden of chronic diseases in 8 EU countries to 2050.
Promoting health by making the economic case for prevention of chronic disease. The project measured the cost-effectiveness over time of prevention, screening and treatment interventions for chronic diseases illustrating that policy and preventions interventions are generally more cost-effective than treating a single chronic disease.
Providing estimates of the future burden of smoking and overweight by age, sex and education group.
Developed sophisticated modelling software to test the cost-effectiveness of integrated approaches to preventing, screening and treating chronic disease.

Conclusions and recommendations

The EConDA project illustrates the extent to which disease burden and related costs can be avoided with specified interventions and that even small changes in risk factors can have important impacts. The results provide evidence for the importance of disease prevention showing the impact of low cost interventions on the future burden of ill-health. Instead of treating a single disease, interventions that reduce a common risk factor can in turn have an important impact on a range of chronic diseases concurrently (1). Targeting less educated groups, especially with smoking cessation interventions is key to reducing the social inequalities in health. Given that 97% of health spending is on treatment, and only 3% on prevention with prevention bearing the brunt of austerity (2), our results show that investment in health to reduce disease onset and progression is cost-effective in the long-term.

Recommendations for the future include:
Taking a societal perspective in economic analysis is key to understanding the full economic impact of the chronic disease burden.
The microsimulation model is sophisticated in structure and should be used to develop additional multi-stage diseases such as dementia and cancers.
There is no silver bullet. An integrated set of interventions is necessary in order to get maximum benefit to health.
The EConDA models should be further developed to include additional and combined risk factors such as alcohol, and physical inactivity.
Encouraging countries to monitor risk factors by social group and chronic diseases over time is key. In particular, collection of data on incidence and cost by disease stage is imperative.

Section 5: Technical aspects of the project

Background and scope

EConDA was a 2.5 year project (April 2013-October 2015), led by the UK Health Forum together with sixteen partners, with the dual objective of assisting EU Member States to develop, select and implement more cost-effective policies to improve chronic disease prevention and to reduce health inequalities due to chronic diseases. The EConDA project focused on 8 countries: Bulgaria, Finland, Greece, Lithuania, the Netherlands, Poland, Portugal, and the United Kingdom.

The project was commissioned in recognition of the growing burden of chronic disease morbidity and mortality across Europe. Chronic diseases are the leading cause of death in Europe requiring action to determine the most effective and cost-effective to intervene. Therefore EConDA sought to demonstrate the use of computer simulation modelling to quantify the future burden of major chronic diseases by 2050 across 8 EU countries, and determine the impact of selected prevention, screening and treatment interventions taking account of differences between social groups.

General objectives

The general objectives of EConDA were to:

- Aid EU member states to develop, select, and implement more cost-effective policies to improve chronic disease prevention
- Reduce health inequalities in chronic disease prevalence

The use of modelling to predict future health outcomes of public health interventions is gaining increasing cogency. Trials are too expensive, take too long and are often subject to too many cofounding variables. The EConDA project used micro-simulation methods enables policy makers to test various interventions and outcomes.

The EConDA project has contributed to better informing policy making and provide direction, e.g. consensus on methodology, and developing a model that can be used to provide integrated approaches to address cost-effectiveness in linked avoidable chronic disease prevention. The project identified groups with the highest risk of obesity or smoking and as a result the highest risk of related chronic diseases. It was not possible to test interventions on particular groups due to the scarcity of data, however the model structure is such that this can be done when data become available.

The project has contributed to increasing the knowledge base for reducing a) early death and disease from chronic diseases; b) early death and disease from chronic diseases in the population groups most affected i.e. reducing inequalities in behavioural risk factors and subsequent chronic disease risk; c) reducing the wider externalities, i.e. the economic costs and losses from chronic diseases.

The project has provided demonstration models and tools to enable policy makers to address these issues.

Specific objectives

Table 1 Specific objectives

Number	Title	Indicator	WP
1	Achieve consensus among key international organizations on methodology for measuring cost-effectiveness of interventions to prevent, screen and treat chronic diseases.	Report on the review of literature, report on consensus meeting	4
2	Develop an epidemiological disease model.	Data collection Working disease models	5
3	Develop a demonstration model for integrated approaches to address cost-effectiveness of various interventions for chronic disease prevention.	Data collection of cost data Working models with interventions	6
4	Implementation of the model in specific countries.	Working model implemented in 7 countries	6
5	Validation of the model	Validation against other models	7
6	Publish and disseminate an evaluation of the study.	Scientific articles	2

Overview of Work Packages and deliverables

Table 2 Work packages and deliverables

D	Title	Relevant Milestone	Month planned	Month received	Comments e.g. any delay	Public (Y/N)
1	Review of cost-effectiveness methods and evidence for the chronic disease prevention	Draft review based on the literature review for circulation to partners	6	6		Y, on website
2	Development of a disease model	Final report	30	31	Some delay in data collection, vigorous testing and inclusion of additional diseases beyond contract put this WP back a little. In addition testing of the model. Lack of data meant complex algorithms were developed.	N, the model outputs are available on the website
3	Consensus on criteria that will allow standardisation and comparisons of cost-effective studies	Seek consensus on the best methodology for measuring cost-effectiveness of chronic disease interventions.	8	9	Consensus meeting took place in month 8 and final report of this meeting complete in month 9 - enabling time or delegates to comment on the final report	Y, on website
4	Develop a cost-effectiveness simulation model	Gather cost-effectiveness data	24	31	Data collection was held up, and development of the model in particular conceptualising intervention was more complex than originally planned.	Y, the tool is available on the website
5	Validation of the model		28	32	Validation and testing took place throughout the development phase and is an ongoing process. It highlighted the necessary changes to the model. This held up development somewhat but ensured more robust outputs.	Y, on website
6	Project leaflet	Write project leaflet	6	6		Y, on website

7	Final Evaluation report	Baseline evaluation report	6	6		Y, on website
		Annual evaluation report	12	12		Y, on website
8	Interim and final technical and financial reports.	Year one technical and financial reports submitted	14	14	The annual report was submitted in September 2014 The final report was submitted in month 30.	Y, on website once submitted
9	Dissemination (website, papers, conference)	Website Protocol paper, BMC public health Final conference	30	6 9 30		Y, on website
10	Final project report and layman's final project report.	Layman report Conference Papers	29 30 30	31 30 ongoing	Papers are being drafted and prepared for submission. Some delay in the lay report due to delays with the model outputs and final results.	Y, on website

Main activities carried out including methods and means

The project aimed to develop a consensus amongst experts about the best way to measure the cost-effectiveness of interventions for chronic diseases. The project brought together a group of international experts from the European Chronic Disease Alliance to debate these issues and establish a consensus on the best method/s to measure cost-effectiveness and impact on economies of integrated approaches to chronic disease prevention.

It also aimed to develop a simulation computer model to forecast the future burden of chronic diseases forward to 2050 and test the effectiveness and cost-effectiveness of interventions to reduce chronic diseases. The project used a microsimulation model initially developed by the UK Health Forum for the Tackling Obesities enquiry (Foresight, 2007). This model showed how the direct healthcare and indirect costs of chronic diseases in 8 EU countries currently and how they will alter by 2050 based on existing chronic disease trends. The project focused on coronary heart disease, type 2 diabetes, chronic obstructive pulmonary disease, lung cancer, stroke, hypertension and two risk factors: obesity and smoking. The model structure is sophisticated such that it can easily be adapted to include new multi-stage diseases, combined risk factors and testing of integrated interventions.

The specific objectives required different methods and means.

Objective 1: We conducted a literature review of the methodology used in assessing the cost-effectiveness of chronic disease interventions using online databases and information from European collaborators. In addition, we carried out qualitative interviews with European stakeholders and analysed these data using thematic framework analysis to form a consensus about the best method for measuring the cost-effectiveness of chronic disease interventions. We enriched this review by carrying out a qualitative study with experts about the methods of calculating cost-effectiveness and analysed the outputs using thematic framework analysis.

Annexes 4.1 to 4.3 provide the outputs from this objective.

Objective 2: Develop a chronic disease model to project future trends. The software for this programme is written in C++ by expert programmers on the UKHF team. A dual-module modelling process was developed by the UK Foresight working group (McPherson et al, 2007) which was has been applied and refined for analysis of obesity trends and chronic diseases in over 80 countries including each of the 53 WHO-Euro region countries. The model uses a multivariate, categorical regression model that was fitted to cross-sectional risk factor data to forecast trends forward to 2050 by age, sex and social group. These risk factor projections are fed into module 2, a sophisticated microsimulation model that produces longitudinal projections to 2050. This creates virtual country cohorts of a large number of individuals based on module one disease distributions from 2010 to 2050. Simulated individuals are at risk of getting a particular disease each year if he or she did not have the disease at the beginning of the year; they can continue living with the disease or die from it (if it is fatal).

Annexes 5.1 to 5.5 provide the outputs from this objective.

Objective 3a: Data collection and processing of country-specific chronic disease data for entry into the model. A literature review was carried out using online databases and expert knowledge from partners and collaborators with access to good quality data. There were many limitations with the data collection. Frequently data on incidence were not available so we converted prevalence to incidence using standard tools. Incidence data by disease stage (e.g. COPD stage 1, 2, 3, 4) often did not exist, so complex algorithms were developed to calculate incidence by stage using the data that were available. Direct and indirect cost data by disease were also very difficult to come by therefore proxy data were used.

Supporting appendices A1 to A8 of annex 6.1 provide the data references which link to this objective.

Objective 3b: Develop a demonstration model to test the cost-effectiveness of various interventions for chronic disease prevention. A module of the microsimulation model described in objective 2 was developed using C++ software. Future costs of chronic diseases in each country were estimated to 2050 based upon current chronic disease trends in each country using micro-simulation modelling. To estimate the cost burden associated with the trends in chronic diseases, as well as the effect of prevention, screening or treatment interventions, future changes in the cost of chronic diseases were projected to 2050 using a number of different interventions. The interventions tested were:

- the impact of a 20% sugar-sweetened beverage tax
- a multi-component behavioural change intervention
- smoking cessation services
- treatment of COPD stage 3+
- screening for albuminuria (for chronic kidney disease).

Annex 6.1 and supporting appendices C1 to C4 provide the outputs from this objective.

Objective 4: The model was adapted and run for 8 EU countries using country specific data as far as possible. The 8 countries included were: Bulgaria, Finland, Greece, Lithuania, the Netherlands, Poland, Portugal, and the United Kingdom. In addition, a downloadable tool was created so that each country has a tool by which to test policy cost-effectiveness.

Annex 6.1 and supporting appendices D1 to D5 provide the outputs from this objective.

Objective 5: A validation of the model was carried out by comparing results with existing disease and risk factor models. There was some difficultly in directly comparing the results of models since parameters are frequently different. However, in this instance qualitative comparison was made or similar parameters compared.

Annex 7.1 provides the outputs from this objective.

Objective 6: The results have been disseminated across workshops in five of the EConDA countries as well as in Brussels at a final conference. A protocol paper has been written as well as a short report for the WHO and in Lithuanian for a Lithuanian medical magazine. A number of papers are currently in preparation for submission to peer-reviewed journals and will be disseminated at conferences. Information about EConDA and its results have been disseminated at a number of conferences and written up for publication in peer-reviewed journals and in presentations to policy makers within the countries and at an EU level.

Annexes 2.1 to 2.14 provide the outputs from this objective.

Target groups

The target groups of the project were those who have an impact on the reduction of chronic diseases across Europe, namely policy-makers and stakeholders.

These include:

• Health policy planners.

• Advocacy groups relevant to health promotion and chronic disease prevention, including European Chronic Disease Alliance members: this project involves all of the major European chronic disease NGOs and who have members throughout the EU. They will receive reports from all WPs; and were invited to the final conference and country specific workshops.

• European Commission: Commission officials were invited to conferences/meetings.

• World Health Organization (Europe) supported this project and helped provide data, feedback on model assumptions, and contacts.

• OECD provided input into work package 4 (consensus building) and the outputs will inform the ongoing work of the OECD's economics of prevention group who work with the UKHF modelling team.

• The populations of the selected countries who will benefit in the long-term from any policy changes and/or intervention provision as a result of the findings or use of the tools.

• Health professional organisations, in particular those representing medical doctors with a specialisation in one or several of the chronic diseases addressed in this project.

• Academic and research networks.

Evaluation

The project has been evaluated throughout, and a full evaluation of the project is provided in annex 3.3. More detail of achievement of each process, outcome and output indicator is presented below.

The evaluators concluded that 'In most cases, EConDA may be considered very effective. A consensus on methodology for measuring the cost-effectiveness of interventions was agreed as determined early in the life of the project. This set the agenda for both developing a disease and cost-effectiveness model. Dissemination of the project's results has been particularly effective with workshops held in five different countries with 73 participants attending from a range of disciplines together with a final conference held in Brussels with 24 participants.'

The conferences were hugely successful, engaging public health officials, health economists, individuals from academia and students. Overall, participants scored the conferences, on average, 8.3 / 10.

One participant summed up: *"If dissemination succeeds, it may significantly improve the relative status of health vs. finance in political and public discourse, as well as democratize this discussion by opening access to this data to all interested parties including youth and NGO actors."* Academic from the Brussels conference.

And another noted the importance of developing this demonstration project further *"Reaching consensus is a difficult task since different health systems / countries / modelling perspectives influence required outputs. Projects like this warrant more time to grow."* Researcher from the Brussels conference.

The final evaluation review concluded that:

'The process evaluation has shown that the project progressed well and there were few issues of concern. There are however continuing problems with data availability and suitable quality which have been noted. The cost effectiveness model is usable for each country, but can be significantly improved if local efforts are made to improve available data sources. The conference and country specific workshops in September 2015 were important elements of the dissemination of the project's results and drew EConDA to its conclusion.'

Results by process, output and outcome indictors

Specific objective 1. Achieve consensus among key international organizations on methodology measuring cost-effectiveness of interventions to prevent, screen and treat chronic diseases

Process indicators met

A team of researchers were brought together to complete the literature review which was completed on time. The report was disseminated online and to European chronic disease alliance members. An article is being prepared for publication in a peer-reviewed journal.

The outputs from the consensus meeting were disseminated on the EConDA project website and shared with key members of international organisations such as the OECD and WHO.

Output indicators met

The **outputs** included:
- weekly updates on progress of the reviews and interview study to ensure issues were resolved
- bringing together a team of international experts to decide on a consensus on cost-effectiveness methodology

Outcome indicators met

The **outcomes** correspond to **deliverables: 1**. A report on the literature review on cost-effectiveness of interventions to prevent, screen and treat chronic diseases and **3**. A report on the consensus meeting.

An additional outcome was that a qualitative study was carried out with experts. This further enriched the literature review.

The Final Report from the work package was sent to all participants of the consensus meeting on 28 January 2014 and is published on the EConDA website. These outcome indicators are presented in annexes 4.1 to 4.3.

Specific objective 2. Develop an epidemiological disease model

Process indicators met

A literature review was carried out to collect the necessary disease data using online databases as well as liaison with international experts. C++ was used to develop and host the epidemiological disease models. A report was drafted and meetings held with associate partners to discuss the direction, content and adjustments to the report.

Output indicators met

The **outputs** included:
- assessment and collection of relevant data
- testing of the model
- report of the projection of future risk factor burden and related disease burden to 2050

The outputs were expanded to include a larger range of diseases over and above what had been planned. Development of multi-stage diseases for T2DM, COPD and CKD, as

well as single stage diseases for CHD, stroke, lung cancer and hypertension were built. This required more data collection, processing and model coding, but provides a better picture of the future burden of risk-factor related chronic diseases.

Outcome indicators met

These **outcomes** correspond to deliverable 2, and resulted in an understanding of the best available disease and risk factor data available in the 8 EConDA countries. It also demonstrated the utility of a dynamic microsimulation model in quantifying the future burden of risk factor related diseases into the future.

Specific objective 3. Develop a demonstration model for integrated approaches to address cost-effectiveness of various interventions for chronic disease prevention

Process indicators met
Three researchers at the UKHF were trained on the types of cost-effectiveness data needed to run the microsimulation models. This training was based on the findings of deliverables 1 and 3.

C++ was used by the UKHF mathematical modellers to build the microsimulation model.

Output indicators met
As has been raised in different sections of this report, it was a challenge to find appropriate cost data for each country. The data needed for cost-effectiveness analysis of public health interventions is not routinely collected or available in many countries. When this was the case, proxy data was used. Supplementary appendices A1 to A8 of the WP 5 and 6 report (annex 6.1) details the sources of the cost data used and highlights where proxy data has been used.

The microsimulation model is efficient, running 5,000 simulation runs (i.e. a population of 5000 people) in less than a minute and 100million simulations in around 8 hours per intervention scenario. Due to the nature of the interventions tested in EConDA (small effect sizes at a population level), up to one hundred million runs were carried out.

A downloadable tool (supplementary appendices D1 to D5 of annex 6.1) was developed in addition to the main deliverables of this work package. This tool is very efficient and can run a cohort in under a minute. The time taken to develop the sophisticated microsimulation model for all diseases and interventions and the downloadable tool was slightly longer than planned however this was due to a number of factors:

- Additional disease models were developed requiring further coding, testing, data collection and manipulation as well as model runs and output interpretation. For example, 8 diseases were modelled (only 3 were proposed in contract). For three of these diseases, a more sophisticated multi-stage disease model was developed.

- Data scarcity meant that complex algorithms had to be built to deal with lack of data within the model to ensure demonstration of its utility was delivered.

- Development of a tool that required extensive additional coding, pilot testing in various countries through workshops that required unforeseen pilot testing, survey development, qualitative analysis.

- Deployment of tools on different platforms e.g. mac version.

Outcome indicators met

Cost-effectiveness data were processed successfully and entered into the model. The second outcome indicator of this objective corresponds to deliverable 4. Annexes 5.1 to 5.5, detail the technical aspects of the model. Supporting appendix B5 of annex 6.1 contains a description of the economic parameters used in the model.

Specific objective 4. Implementation of the model in specific countries

Process indicators met

The UKHF worked with all EConDA partners to gather the best available epidemiologic and cost data in participating countries. A particularly good relationship with partners and local researchers in Lithuania, Poland, Netherlands, Bulgaria and Portugal was built. This was crucial to the project since some of the necessary data were not available to the public or not published in English. Country partners were able to ratify when the necessary data were simply not available for their countries.

Output indicators met

The model was implemented in 8 countries: Bulgaria, Greece, Finland, Lithuania, Netherlands, Poland, Portugal and UK. However, the quality of the estimates varied due to the difference in data availability by country.

Outcome indicators met

This outcome corresponds to deliverable 4, the main report of WP5 and 6 (annex 6.1), which contains the results of the implementation of the model in the 8 countries listed above. Within this report, the future burden of a range of chronic diseases is quantified and the costs and QALYs avoided as a result of different interventions are presented, by country. The wealth of information in this report enables national governments, policy makers and other stakeholders to make the economic case for prevention of chronic diseases by selecting cost-effective interventions. It also provides evidence for the utility of microsimulation modelling as a policy lever in public health.

Specific objective 5. Validation of the model

Process indicators met

Cross validation, the comparison of our model outcomes with other published models, was undertaken using 19 models including DYNAMO-HIA. Cross validation was complex to implement for five reasons: differences in methodology between models, initialisation of models, in the implementation and conceptualisation of interventions, in the input data and in terms of format of outputs. Therefore, although comparing actual model

results was difficult because of model differences, the validation exercise was an important and useful process which highlighted the strengths and limitations of the EConDA model compared with other models. The full report can be found in WP7 annex 7.1.

Output indicators met

The EConDA model was validated against 19 different models including: DYNAMO-HIA, PREVENT, DPoRT, NICE tobacco ROI tool and CORE diabetes. The modelling process and results of the SSB tax intervention were compared against two published modelling studies (Food Active and Briggs & Wang).

Outcome indicators met

This outcome corresponds to deliverable 5 and resulted in a better understanding of the model's strengths and weaknesses. The full report can be found in annexe 7.1.

Specific objective 6 Publish and disseminate an evaluation of the study

Process indicators met

A dissemination plan (annex 2.1) was created which included a list of conferences where EConDA could be presented. A scientific paper on the EConDA protocol was drafted and published (annex 2.3) and a number of publications are currently being drafted.

The EConDA conference was organised by ESC and held in Brussels on September 22nd 2015, and delegates registered in advance. The list of attendants can be found in annex 2.11. The presentations given at this conference can be found in annex 2.12. In addition, 5 country workshops were held in Bulgaria, Lithuania, The Netherlands, Poland, and Portugal to launch the tool and receive feedback on the tool's utility and user-friendliness. The agendas and attendance list to workshops can be found in annex 2.8 and 2.9.

Output indicators met

Twenty four delegates attended the final project conference in Brussels. In addition to this, 73 delegates attended the 5 country workshops carried out to present the project findings.

Outcome indicators met

The project protocol was published in a peer reviewed journal (BMC Public Health) in 2014. The project has also been presented at several conferences and workshops. See project report for details (annex 2.14).

The conferences were hugely successful, engaging public health officials, health economists, individuals from academia and students. Overall, participants scored the conferences an average of 8.3 / 10.

General summary of results

There are many outputs from this project which are presented in greater detail in the annexes for each work package. However, the following provides a list of the key findings:

Findings from the expert meeting

- Various measures of cost-effectiveness should be used, these include: direct healthcare costs, indirect or non-healthcare costs (such as welfare costs), Quality Adjusted Life Years, incidence cases (i.e. new cases in a given time period) of chronic disease avoided, life years gained.

- A 'societal' perspective should be taken where possible. This means including costs of disease that are not just related to healthcare, but also non-healthcare costs such as loss in productivity due to sickness, and changes in quality of life as a result of an intervention.

Findings from the obesity modelling

- Obesity is predicted to increase across the majority of the EConDA countries and across all levels of education by 2050.

- Increasing obesity will result in increases in chronic diseases over time, with widespread and serious effects on the economy of the health system and wider society.

- Significant health and economic gains can be achieved with small reductions in BMI.

- Multi-component behavioural change interventions implemented annually will substantially reduce obesity-related diseases.

- Maintaining weight loss is particularly beneficial.so that investment in weight loss maintenance interventions is an important additional step.

- By its nature, a sugar sweetened beverage (SSB) tax is more cost-effective than weight loss programmes, however both interventions were found to be cost-effective.

- Introducing a 20% SSB tax will have a significant impact on major chronic disease, such as CHD and type 2 diabetes.

Findings from the smoking modelling

- By 2050, smoking prevalence is forecast to decrease across all of the countries that were modelled.

- Data of smoking prevalence by education level were available for Finland, Lithuania, the Netherlands, and the UK only. Prevalence of smoking was projected to decrease across all education groups in these countries. However, the rate of decline was projected to be faster among males and females with tertiary education compared to those with less than tertiary education. For this reason, the gap in smoking prevalence between more and less advantaged groups was predicted to widen year on year until 2050 in the four countries.

- Across all countries the chronic diseases selected were predicted to rise by 2050

- Smoking cessation services (SCS) are cost-effective and have an important impact on reducing the future burden of smoking-related diseases.
- Of the interventions tested, SCS are projected to have the largest epidemiological impact on COPD and stroke in absolute terms.
- SCS are more cost-effective and result in greater gains in quality-adjusted life years when compared to treatment of a single smoking-related disease.
- Important policy measures such as tobacco taxation and bans on smoking in public places are likely to be responsible for the prevailing downward trends in smoking. Retaining these policies is imperative if the predicted trends are to be maintained.

General:

- The results illustrate the importance of chronic disease prevention to avoid health system and societal costs. In particular, primary prevention interventions are cost effective when a time horizon of more than 10 years is used.
- Economic analyses of chronic disease should take a societal perspective to account for costs beyond healthcare.
- We have produced a downloadable tool that can be used to test the effectiveness and cost-effectiveness of interventions in relation to the future burden of disease: www.econdaproject.eu/tools.php

Section 6: Horizontal and specific work packages

Horizontal work packages

WP1: Coordination
Work package lead: UK Health Forum (formally the National Heart Forum)
Associated partners involved: All partners were involved in steering meetings, with UK Health Forum as coordinator.

Management structure

The EConDA project has been administered by the UK Health Forum (UKHF). The following organisations led on the different work packages:

WP2: European Society of Cardiology
WP3: Health Equalities Group
WP4: European Heart Network
WP5: UK Health Forum
WP6: University of Gröningen

The steering group was made up of Laura Webber (UKHF), Martin Brown (UKHF), Abbygail Jaccard/Lise Retat (UKHF), Susanne Logstrup (EHN), Marleen Kestens (EHN), Sophie O'Kelly/Ilaria Leggari (ESC), Vilma Kriaucioniene, (LUHS), Robin Ireland (HMP), Ana Rito (INSA), Maarten Postma (RUG), Pepijn Vemer (RUG), Sophie Peresson/Gaël Bassetto/Mayur Mandalia (IDF-Europe).

Activities undertaken

A kick-off meeting, four steering group meetings and two teleconferences were held over the course of the project (see Table 3 for details). Meetings involved participation by each partner. Agenda and minutes of each meeting can be found in annex 1.2.

Table 3 Project meetings

Meeting	Date	Place
Kick off meeting	25th April, 2013	Luxembourg
1st Steering group meeting	9th October, 2013	Brussels
2nd Steering group meeting	4th March, 2014	Brussels
Planning teleconference	17th July, 2014	n/a
3rd Steering group meeting	21st October, 2014	Brussels
4th Steering group meeting	10th March, 2015	Brussels
Planning teleconference	8th July, 2015	n/a

All reports and deliverables have been reviewed by the project team (e.g. website, leaflet, reviews) and key decisions were discussed and made. For example, we discussed and agreed the questions needed to steer the consensus meeting on cost-effectiveness and the interventions we were to test in each of the models.

Internal communication

The project coordinator communicated directly with Work Package leads and other members of the team on an ongoing basis and through their participation in relevant work package meetings and workshops.

Each associated partner received and signed a cooperation agreement between them and the project lead, UKHF outlining the general and specific tasks that they were to deliver (an example can be found in annex 1.1).

There were three teleconferences with European Heart Network (WP 4) during the planning stages of the consensus meeting and report writing.

Monitoring and supervision

As we have indicated, the primary mechanisms for this was through the steering meetings, teleconferences, minutes and regular meetings with work package lead and coordinator when necessary.

Advisory board

While there was no formal advisory board, the associate partners provided support and guidance throughout the project. They were an important point of contact for guidance and expert advice relating to health economics, intervention conceptualisation and disease model development. Where relevant associate partners provided external contacts to expert epidemiologists who provided additional advice on the disease model and intervention concepts.

WP2: Dissemination

Work package lead: European Society of Cardiology

Associated partners involved: All partners were involved in this WP

Key messages of the project

- The EConDA project illustrates the extent to which disease burden and related costs can be avoided with specified interventions and that even small changes in risk factors can have important impacts.
- The results provide evidence for the importance of disease prevention showing the impact of low cost interventions on the future burden of ill-health.
- Instead of treating a single disease, interventions that reduce a common risk factor such as smoking or obesity can in turn have an important impact on a range of chronic diseases concurrently (1).
- Targeting less educated groups, especially with smoking cessation interventions is key to reducing the social inequalities in health.
- Given that 97% of health spending is on treatment, and only 3% on prevention with prevention bearing the brunt of austerity (2), our results show that investment in health to reduce disease onset and progression is very cost-effective in the long-term.

Project logo

EConDA
Economics of Chronic Diseases

Project website (deliverable 9)
http://econdaproject.eu/

Activities undertaken to ensure results have reached the target groups

Conference presentations

- Ana Rito, Mafalda Bourbon, Laura Webber, Tim Marsh, *Chronic diseases in Portugal – a review within the EU project EConDA,* poster presentation III World Congress of Public Health Nutrition, 2014, Gran Canarias, Spain
- Abbygail Jaccard, *The obesity epidemic and risk of hyperglycaemia: using a microsimulation approach to model multi-stage type 2 diabetes*, oral presentation at the fifth world congress of the international microsimulation association (IMA), Luxembourg 2-4 September 2015
- Abbygail Jaccard, *EConDA project results*, invited speaker to The future of research on obesogenic environments (Spotlight project), Brussels 19th November 2015
- Klim McPherson, Martin Brown, Laura Webber, et al. *Evaluating the costs of NCDs; The Nutritional Component. Foresight and beyond.* Invited speaker at the World Public Health Nutrition Association conference, Oxford, UK, September 2014
- EConDA Exhibition, at the European Congress on Obesity, Sofia, Bulgaria.May 2014
- Laura Webber, Martin Brown, *UKHF lecture on modelling including EConDA models*, University of York 18 September, 2014
- Laura Webber, *Hot debates in nutrition and globesity*, leaflet distribution and presentation. EuroPrevent 2014, Amsterdam, 8-10 May 2014
- Laura Webber. *Presentation on EConDA.* Chronic Diseases and Healthy Ageing Workshop. The Hague, February 2015.

- Vilma Kriaucioniene, *Projection of changes in the prevalence of obesity from 2012 to 2050 in Lithuania.* Obesity facts: 22nd European Congress on Obesity (ECO2015). Prague, Czech Republic, May 2015.
- Laura Webber, *EConDA and key findings* EU Joint Action on Nutrition and Physical Activity Launch, September 2015
  Vilma Kriaucioniene, *Past and future trends in the prevalence of overweight and obesity in Lithuania.* Obesitologia: 5th CECON. Budapest, Hungary, May 2015.
- Laura Webber**,** *Lessons learnt from the EConDA project: Gaps and priorities in the prevention of NCDs.* EU Parliament MEP Group for Kidney Health Presentation to the EU October 2015

Pending submission for 2016 conferences:

- Perez Ferrer C, Knuchel-Takano A, Bhimijiyani A, Jaccard A, Retat L, Brown M, Kriaucioniene V, Webber L, *Inequalities in smoking and obesity in Europe predicted to 2050: Findings from the EConDA project.*
- Webber L, Knuchel-Takano A, Postma M, Vemer P. Reaching a consensus on the best method for assessing the cost-effectiveness of chronic disease interventions: Results from, the EConDA project.
- Retat L, Bhimjiyani A, Baker A, Briggs A, Jaccard A, Knuchel-Takano A, Webber L. *Investigating the impact of sugar-sweetened beverages on the future chronic disease burden in seven European countries: Results from the EConDA project.*
- Perez Ferrer C, Knuchel-Takano A, Jaccard A, Retat L, Brown M, Webber L. Effectiveness and cost-effectiveness of policy and community level interventions for reducing obesity and related chronic diseases.

Peer reviewed articles (deliverable 9)

- Divajeva D, Marsh T, Logstrup S, Kestens M, Vemer P, Kriaucioniene V, et al. Economics of chronic diseases protocol: cost-effectiveness modelling and the future burden of non-communicable disease in Europe. BMC public health. 2014;14(1):456

- Vemer, P "Decision analytic modelling: The need for disease specific model standardization" Chapter in D Tordrup, L Stephan, A Attwill, S Karunaratna, R Bertollini "Research Agenda for Health Economic Evaluation" Health Economic Evidence Review, World Health Organization

Papers in preparation for submission to peer-reviewed journals

- Perez Ferrer C, Knuchel-Takano A, Bhimijiyani A, Jaccard A, Retat L, Brown M, Kriaucioniene V, Webber L, *Inequalities in smoking and obesity in Europe predicted to 2050: Findings from the EConDA project.* For submission to British Medical Journal
- Webber L, Knuchel-Takano A, Postma M, Vemer P. Reaching a consensus on the best method for assessing the cost-effectiveness of chronic disease interventions: Results from, the EConDA project.
- Retat L, Bhimjiyani A, Baker A, Briggs A, Jaccard A, Knuchel-Takano A, Webber L. *Investigating the impact of sugar-sweetened beverages on the future chronic disease burden in seven European countries: Results from the EConDA project.* For submission to *European Journal of Public Health*
- Perez Ferrer C, Knuchel-Takano A, Jaccard A, Retat L, Brown M, Webber L. Effectiveness and cost-effectiveness of policy and community level interventions for reducing obesity and related chronic diseases.

Reports and other information available to the public through the website

- EConDA project leaflet **(deliverable 6, annex 2.2)**
- Literature Review: Cost-effectiveness of interventions to prevent, screen and treat chronic diseases **(deliverable 1, annex 4.1)**
- Report: Qualitative analysis – expert testimony on the best methods for measuring cost-effectiveness of chronic diseases **(deliverable 1, annex 4.2)**
- Final report from expert consensus meeting on cost-effectiveness **(deliverable 3, annex 4.3)**
- Final report from implementing the model in 8 EU countries and testing a range of interventions integrated within the same model **(deliverable 4, annex 6.1 along with supporting appendices)**
- Downloadable modelling tool and user guide (**appendix D2 of annex 6.1**)
- Final project report (**deliverable 10 annexe 2.14)**
- Other non-peer reviewed articles **(annex 2.4 and 2.5)**

Country workshops and final conference (deliverable 9, annexes 2.8 to 2.12)

Five country workshops were carried out in September 2015. Workshops were organised by the ESC and were well attended by country stakeholders. The dates and location of workshops were as follows:

Bulgaria, 3 September 2015
Lithuania, 18 September 2015
Netherlands, 10 September 2015
Poland, 16 September 2015
Portugal, 14 September 2015

Sample agenda of the workshops

10:00-10:30 ***Registration & Welcome Coffee***

10:30-10:45 **Introduction to the project and participation of Bulgaria**

10:45-11:35 **Key findings:**

- **Review of cost effectiveness methods**
- **Consensus on standardisation of cost effective studies**
- **Presentation of the disease model**

11:35-12:00 **Presentations of the cost effectiveness tools & demonstration**

12:00-12:30 **Questions & Answers**

12:30-13:30 ***Lunch & Coffee Break***

13:30-14:20 **Interventions testing by participants with real data**

14:20-14:45 Feedback from participants

14:45-15:00 Wrap up & Conclusions

The final project conference took place in Brussels on the 22nd September. The presentations given at this conference are available to the public and can be downloaded from the website http://econdaproject.eu/presentations.php. The conference was covered by social media with hashtag #EConDAconf.

Country partners provided contacts for the selection of attendees who were invited to the workshops and final conference given their expert knowledge about the national context. This ensured that the target population, policy makers and other stakeholders involved in chronic disease prevention, attended and/or received relevant information on the project.

WP3: Evaluation

Work package lead: Health Equalities Group
Associated partners involved: IDF-Europe, UKHF, EHN, ESC

A process evaluation was undertaken annually and at the project's conclusion to understand what happened in the delivery of the project; whether each work package achieved its objectives; and whether there were any unexpected outcomes or learning during the project.

The process evaluation comprised email-based surveys with work package leaders; telephone and face to face interviews as appropriate. Questionnaires were circulated at the country dissemination workshops and at the final project conference in Brussels. In addition all key project documents and journal articles were monitored as well as the use of the EConDA website.

Section 5 described how the process, output and outcome indicators were met. A final evaluation report (**deliverable 7**) has been submitted with more details.

"In most cases, EConDA may be considered very effective. A consensus on methodology for measuring the cost-effectiveness of interventions was agreed as determined early in the life of the project. This set the agenda for both developing a disease and cost-effectiveness model. Dissemination of the project's results has been particularly effective with workshops held in five different countries with 73 participants attending from a range of disciplines together with a final conference held in Brussels with 24 participants.

The conferences were hugely successful, engaging public health officials, health economists, individuals from academia and students. Overall, participants scored the conferences, on average, 8.3 / 10".

Specific work packages

Please provide a concise overview of the progress of the work in line with the structure of Annex I of the grant agreement and its amendments including details for each task.

WP 4: Consensus on cost-effectiveness

Work package leader: EHN
Associated partners involved: EHN, NHF, INSA, ESC, IDF, RUG, HMP, LUHS/LSMU

This work package aimed to reach a consensus amongst experts on the best way to measure the cost-effectiveness of interventions for chronic diseases.

Consensus was achieved among key international organizations on methodology for measuring cost-effectiveness of interventions to prevent, screen and treat chronic diseases. Three reports were produced and are available for consultation from the website (http://www.econdaproject.eu/publications): A report on the literature review on cost-effectiveness of interventions for chronic diseases (**deliverable 1**), a qualitative analysis of expert testimony on cost-effectiveness analysis (not in contract but deemed necessary) and a report on the consensus meeting on best practice to measure cost-effectiveness in public health (**deliverable 3**).
The **key findings** of the consensus meeting were:

- Various measures of cost-effectiveness should be used including: direct healthcare costs, indirect or non-healthcare costs (such as welfare costs), Quality Adjusted Life Years, incidence cases (i.e. new cases in a given time period) of chronic disease avoided, life years gained

- A 'societal' perspective should be taken. This means including costs of disease that are not just related to healthcare, but also non-healthcare costs such as loss in productivity due to sickness, and changes in quality of life as a result of an intervention

- Include country-specific measures of cost-effectiveness where possible e.g. health costs of disease in a specified country.

This consensus was used to inform the development of the cost-effectiveness model in work package 6. The major challenge was to source the necessary data to generate the most accurate estimates.

WP 5 Develop a disease model

Work package leader: UK Health Forum

Associated partners involved: UKHF, RUG, HMP

This work package involved the development of a computer microsimulation model of seven chronic diseases (COPD, Type 2 diabetes, CHD, stroke, lung cancer, hypertension, chronic kidney disease), three of which included multiple stages of disease (T2DM, CKD, COPD) **(deliverable 2)**. The work package more than delivered by creating an additional three disease models beyond that expected in the grant agreement (CKD, hypertension, lung cancer). Diseases were projected into the future based on two risk factors: obesity and smoking. The UKHF microsimulation model, originally developed for the Foresight: Tackling Obesities report[5] was substantially refined and further developed for this project. Each disease can impact on heart disease independent of each risk factor.

Each risk factor was projected forward to 2050 and the impact of these risk factor trends on the future burden of chronic diseases was quantified. We tested interventions such as

[5] McPherson et al, 2007. Foresight, Tackling Obesities: future choices Future Trends in Obesity & Their Impact on Healthhttps://www.gov.uk/government/uploads/system/uploads/attachment_data/file/295149/07-1662-obesity-modelling-trends.pdf

a sugar-sweetened beverage tax, smoking cessation services, screening for chronic kidney disease and COPD treatment.

As part of this work package the necessary disease data were collected and the model was tested to ensure internal validity.

Results from the BMI model

Obesity is predicted to increase across the majority of the EConDA countries and across all levels of education by 2050.

Increasing obesity is projected to result in increases in chronic diseases over time, with widespread effects on the economy of the health system and wider society.

Overweight and obesity predictions vary by education, but the pattern is not consistent between countries. For example, 35% of Polish men with higher education are predicted to become obese by 2050 compared to 49% with lower education.

In contrast, 51% of Portuguese women with higher education are predicted to become obese by 2050 compared to 39% with lower education; Portuguese women with lower education are also predicted to have lower levels of overweight.

Results from the smoking model

By 2050, smoking prevalence is forecast to decrease or remain stable across all of the countries that were modelled with the exception of Poland and Portugal where smoking prevalence is projected to increase. Within countries there were differences in the trends by age group and sex.

Data on smoking prevalence by education level were available for Finland, Lithuania, the Netherlands, and the UK only. Prevalence of smoking was projected to decrease across all education groups in these countries. However, the rate of decline is projected to be faster among males and females with tertiary education compared to those with less than tertiary education. For this reason, the gap in smoking prevalence between more and less advantaged groups is predicted to widen year on year until 2050 in the four countries.

Across all countries the specified chronic diseases were predicted to rise by 2050

Data availability was problematic, with no incidence data by disease stage available. This meant that complex algorithms had to be built to deal with data scarcity. In addition cost of intervention and disease cost by stage were difficult to find. Proxy data were used where no data were available for a country. This resulted in some delay in the deliverable.

WP 6 Develop a model of cost-effectiveness

Work package leader: University of Groningen

Associated partners involved: UKHF, INSA, LUHS/LSMU

The disease model described above was further developed to evaluate the economic burden of chronic diseases into the future and the cost-effectiveness of potential

interventions (**deliverable 4, annex 6.1**). In addition, a downloadable tool using the disease model was developed for use by policy makers and tested at the EConDA workshops (supporting appendix D3 of annex 6.1). The effect of selected interventions on the health and economic burden of chronic diseases was modelled in 8 countries.

As part of this WP, cost-effectiveness data were gathered, interventions were conceptualised through literature reviews and coded into the model. These interventions were then implemented in 8 EU member states to assess the cost-effectiveness of interventions to prevent, screen and treat chronic diseases.

The key findings from the BMI and smoking models are as follows:

Results from the BMI model

Significant health and economic gains can be achieved with small reductions in BMI.

Multi-component behavioural change interventions implemented annually substantially reduce obesity-related diseases.

Maintaining weight loss is more beneficial than if weight is regained after an intervention. Investment in weight loss maintenance interventions is therefore important.

By its nature, a sugar sweetened beverage (SSB) tax is more cost-effective than weight loss programmes, but both interventions were found to be cost-effective.

Introducing a 20% SSB tax will have an important impact on major chronic disease, such as CHD and type 2 diabetes.

Results from the Smoking model

Smoking cessation services (SCS) are cost-effective and have an important impact on reducing the future burden of smoking-related diseases.

SCS are projected to have the largest epidemiological impact on COPD and stroke in absolute terms.

SCS are more cost-effective and result in greater gains in quality-adjusted life years when compared to treatment of a single smoking-related disease.

Important policy measures such as tobacco taxation and bans on smoking in public places are likely to be responsible for downward trends in smoking. Retaining these policies is imperative if the predicted trends are to be maintained.

General results

The results show the importance of chronic disease prevention to save health system & societal costs.

Primary prevention interventions are cost effective when a time horizon more than 10 years is used.

Economic analyses of chronic disease should take a societal perspective to account for costs beyond healthcare.

The EConDA tool can be downloaded so that users can test the effectiveness and cost-effectiveness of interventions in relation to the future burden of disease: www.econdaproject.eu/tools.php

WP7 Validation of the model

Work package 7 leader: UKHF

Associated partners: UKHF only

Cross validation, the comparison of the model outcomes with other published models, was undertaken using 13 models including DYNAMO-HIA **(deliverable 5, annex 7.1)**. Cross validation was complex to implement for five reasons: differences in terms of methods between models, initialisation of models, interventions tested, the input data used and the format of outputs presented. Although comparing actual model results was difficult because of model differences, the validation exercise was an important and useful process because it highlighted the strengths and limitations of the EConDA model compared with other models.

Strengths of the EConDA microsimulation models include:

Allowing the testing of the potential impacts of policies and practices, through —'what if' scenarios and the related costs of implementation e.g. what is the expected impact on CVD incidence following the implementation of a tobacco escalator tax

Time, cost and ethical advantages of using simulation models vs experiments, which are not possible with population level policy interventions

Enabling a wide set of comparisons to identify the most promising combinations of prevention (including policy interventions), screening and treatment approaches for different types of patients

Going beyond the follow-up periods of typical clinical trials so that long-term outcomes can be compared and predicted 20, 30 and 50 years into the future

Going beyond narrow definitions of study outcomes to outcomes in real-world settings where patients are complex and remain at risk of developing a wide range of disease conditions (i.e. accounting for comorbidities)

Help inform and persuade decision makers to make the best choices possible

Limitations of the models include:

Data intensive model simulations. Data describing the disease, risk factor and population are required by age, sex and social group stratification. However, the model is built in such a way that it can easily be updated when new data become available.

The requirement of large computing power. However, the UKHF model has been developed with a modular architecture such that a population of several million can be run on a desktop computer in a couple of hours

Improvements which could be made to the current EConDA model based on the methods used by comparison models in the validation work package include:

The use of multiple risk factors. In some of the models multiple risk factors were used in the simulation of disease risk. For example Grover *et al* used both smoking and BMI as risk factors for analysing the risk of diabetes.

The inclusion of additional risk factors to determine more accurately prevalence of diseases of interest such as CHD. Risk factors such as hypertension (Rosella, Manuel, Burchill, & Stukel, 2011), waist circumference (Grover et al., 2015) and cholesterol (total and HDL) (Grover et al., 2015) were used to analyse the risk of diabetes.

The inclusion of variables related to complications, history and family history to better determine the estimates of interest.

The inclusion of more health economic parameters such as Return On Investment or Net Present Value to capture the economic environment of interventions

Section 7: Annexes

Annexes are presented by work package in order to 'tell the story' of EConDA. Each file is labelled according to the EU file naming structure and these are indicated below each annex label.. Note that the results from running the models developed for deliverables 02 (development of a disease model) and 04 (Develop a cost-effectiveness simulation model) are presented in the same project report since these results are intertwined, we have therefore submitted this report twice. For each country we present the outputs from the risk factor and disease projections (Work package 5, deliverable 02) and then the results of the economic modelling (Work package 6, deliverable 04). This creates a better flow to the reporting of the results and enables interested parties to read a single complete report by country. This also prevented comparison across countries since data were so heterogeneous comparison is not appropriate and provided a more lay style report than the technical documents. Therefore, this report is submitted twice for deliverable 02 and 04.

However, an in depth technical document about the development of the disease model is a stand alone submission of deliverable 02 while an in depth technical document about the development of the cost-effectiveness model is a stand alone submission of deliverable 04.

Work package 1 annexes

1.1. Cooperation agreement

File name: 20121213 OTH-1 GB PS WP1_1.1 Coop agreement

1.2. Kick off meeting agenda and minutes

File name: 20121213 OTH-2 GB PS WP1_1.2 Kick off meeting agenda and minutes

1.3. Annual review

File name: 20121213 D08-00 FIR GB PS WP1_1.3 Annual review_Year 1

1.4 Final financial report

File name: *20121213 D08-01 FFR GB PS WP1_1.5 Final financial report*

Work package 2 annexes

2.1 Dissemination plan

File name: 20121213 OTH-3 GB PS WP2_2.1 Dissemination plan

2.2 Project leaflet **(deliverable 6)**

File name: 20121213 D06-00 LFT GB PS WP2_2.2 Project leaflet

2.3 Protocol papers **(deliverable 9)**

File name: 20121213 D09-00 OTH-1 GB PS WP2_2.3 Protocol paper

2.4 Lithuania paper

File name: 20121213 D09-01 OTH-2 LT PS WP2_2.4 Kriauciouniene paper

2.5 Rahee report EConDA excerpt

File name: 20121213 D09-02 OTH-3 GB PS WP2_2.5 Rahee report EConDA excerpt

2.6 Exhibition posters

File name: 20121213 D09-03 POS GB PS WP2_2.6 Exhibition poster

2.7 EConDA press release

File name: 20121213 D09-04 PRR GB PS WP2_2.7 EConDA_press release_22 09 2015

2.8 Workshop agendas **(deliverable 9)**

File name: 20121213 D09-05 OTH-3 GB PS WP2_2.8 EConDA dissem events agendas

2.9 Workshop attendance list

File name: 20121213 D09-06 OTH-4 GP PS WP2_2.9 Workshop attendance list

2.10 Conference agenda **(deliverable 9)**

File name: 20121213 D09-07 OTH-5 GP PS WP2_2.10 Final conference agenda

2.11 Conference attendance list **(deliverable 9)**

File name: 20121213 D09-08 OTH-6 GP PS WP2_2.11 Final conference attendance list

2.12 Conference slides **(deliverable 9)**

File name: 20121213 D09-09 OTH-7 GP PS WP2_2.12 Final conference slides

2.13 Lay person report **(deliverable 10)**

File name: 20121213 D10-00 LAY-1 GB PS WP2_2.13 EConDA lay person report

2.14 Final project report **(deliverable 10)**

File name: 20121213 D10-01 FFR GB PS WP2_2.14 Final project report

Work package 3 annexes

3.1 Baseline evaluation report

File name: 20121213 OTH-4 GB PS WP3_3.1 ECONDA baseline Evaluation Report October 13

3.2 Annual evaluation report

File name: 20121213 OTH-5 GB PS WP3_3.2 EConDA 1st Annual Evaluation Report April 14

3.3 Final evaluation report **(deliverable 7)**

File name: 20121213 D07-00_FFR-1 GB PS WP3_3.3 EConDA Final Evaluation Report Nov 15

Work package 4 annexes

4.1. Literature review **(deliverable 1)**

File name: 20121213 D01-00 FFR GB PS WP4_4.1 Literature review

4.2. Qualitative study (over deliverable)

File name: 20121213 D01-01 OTH-1 GB PS WP4_4.2 Expert testimony Qualitative

4.3. Consensus meeting report **(deliverable 3)**

File name: 20121213 D03-00 FFR GB PS WP4_4.3 Consensus meeting report

Work package 5 annexes[6]

5.1 Detailed Methodology_TechnicalDocument **(deliverable 2)**

File name: 20121213 D02-00 FFR GB PS WP5_5.1 Detailed Methodology_TechnicalDocument

5.2 DiabetesModel_TechnicalDocument **(deliverable 2)**

File name: 20121213 D02-01 OTH-1 GB PS WP5_5.2 DiabetesModel_TechnicalDocument

5.3 COPDModel_TechnicalDocument **(deliverable 2)**

File name: 20121213 D02-02 OTH-2 GB PS WP5_5.3 COPDModel_TechnicalDocument

5.4 CKDModel_TechnicalDocument **(deliverable 2)**

File name: 20121213 D02-03 OTH-3 GB PS WP5_5.4 CKDModel_TechnicalDocument

[6] Note that the WP5 and 6 results were combined to make separate country reports and provide more easy reading.

5.5 WP5 and WP6 report **(deliverable 2)** (note supporting annexes are outlined in WP6 annexes)

File name: 20121213 D02-04 OTH-4 GB PS WP5_5.5 Project report WP5_6

Work package 6 annexes[1]

6.1 WP5 and WP6 report **(deliverable 4)**

File name: 20121213 D04-00 FFR GB PS WP5_5.5 Project report WP5_6

Supporting appendices to project report WP5_6

Appendix A – input data references (WP5)

1. Bulgaria disease references

   File name: 20121213 D02-05_OTH-5 GB PS Appendix A1_Bulgaria disease reference list
2. Finland disease references

   File name: 20121213 D02-06_OTH-6 GB PS Appendix A2_Finland disease reference list
3. Greece disease references

   File name: 20121213 D02-07_OTH-7 GB PS Appendix A3_Greece disease reference list
4. Lithuania disease references

   File name: 20121213 D02-08_OTH-8 GB PS Appendix A4_Lithuania disease reference list
5. Netherlands disease references

   File name: 20121213 D02-09_OTH-9 GB PS Appendix A5_Netherlands disease reference list
6. Poland disease references

   File name: 20121213 D02-10_OTH-10 GB PS Appendix A6_Poland disease reference list
7. Portugal disease references

   File name: 20121213 D02-11_OTH-11 GB PS Appendix A7_Portugal disease reference list
8. UK disease references

   File name: 20121213 D02-12_OTH-12 GB PS Appendix A8_UK disease reference list

Appendix B – Technical methods

1. DiabetesModel_TechnicalDocument (WP 5)

   File name: 20121213 D02-13 OTH-13 GB PS Appendix B1_DiabetesModel_TechnicalDocument
2. COPDModel_TechnicalDocument (WP 5)

   File name: 20121213 D02-14 OTH-14 GB PS Appendix B2_COPDModel_TechnicalDocument
3. CKDModel_TechnicalDocument (WP 5)

   File name: 20121213 D02-15 OTH-15 GB PS Appendix B3_CKDModel_TechnicalDocument
4. Detailed Methodology_TechnicalDocument (WP 5)

   File name: 20121213 D02-16 OTH-16 GB PS Appendix B4_Detailed Methodology_TechnicalDocument
5. Economic parameters (WP6)

   File name: 20121213 D04-00_OTH-1 GB PS Appendix B5_Economic parameters
6. Methodology of WP6_CE model (WP6)

File name: 20121213 D04-01_OTH-2 GB PS Appendix B6_Methodology of WP6_CE model

7. Differences between microsimulation and tool (WP6)

   File name: 20121213 D04-02_OTH-3 GB PS Appendix B7_Differences between microsimulation and tool

Appendix C – Scenario Development

1. Multi-component lifestyle interventions results matrix (WP6)

   File name: 20121213 D04-03_OTH-4 GB PS Appendix C1_Multicomponent lifestyle intervention results Matrix

2. MCLI methods and assumptions (WP6)

   File name: 20121213 D04-04_OTH-5 GB PS Appendix C2_MCLI methods and assumptions

3. SSB tax intervention methods and assumptions (WP6)

   File name: 20121213 D04-05_OTH-6 GB PS Appendix C3_SSB tax methods and assumptions

4. Smoking cessation services methods and assumptions (WP6)

   File name: 20121213 D04-06_OTH-7 GB PS Appendix C4_Smoking cessation services model

Appendix D – EConDA Tool (WP6)

1. EConDA Tool Development

   File name: 20121213 D04-07_OTH-8 GB PS Appendix D1_EConDA Tool Development

2. EConDA Tool user guide

   File name: 20121213 D04-08_OTH-9 GB PS Appendix D2_EConDA Tool user guide

3. EConDA downloadable Tool

   File name: 20121213 D04-09_OTH-10 GB PS Appendix D3_EConDA_Tool_Setup

4. EConDA Tool Evaluation Survey

   File name: 20121213 D04-10_OTH-11 GB PS Appendix D4_EConDA Tool Evaluation Survey

5. EConDA Tool Feedback

   File name: 20121213 D04-11_OTH-12 GB PS Appendix D5_EConDA Tool Feedback

Appendix E – Results

1. MCLI not annual_no regain100M (WP6)

   File name: 20121213 D04-12_OTH-13 GB PS Appendix E1_MCLI not annual_no regain100M

2. Netherlands BMI-group and smoking projections by education (WP5)

   File name: 20121213 D02-17_OTH-17 GB PS Appendix E2_Netherlands BMI-group and smoking projections by education

3. Finland BMI-group and smoking projections by education (WP5)

   File name: 20121213 D02-18_OTH-18 GB PS Appendix E3_Finland BMI-group and smoking projections by education

4. Lithuania BMI-group and smoking projections by education (WP5)

   File name: 20121213 D02-19_OTH-19 GB PS Appendix E4_Lithuania BMI-group and smoking projections by education

5. 5. Poland BMI-group projections by education (WP5)

   File name: 20121213 D02-20_OTH-20 GB PS Appendix E5_Poland BMI-group projections by education

6. Portugal BMI-group and smoking projections by education (WP5)
   File name: 20121213 D02-21_OTH-21 GB PS Appendix E6_Portugal BMI-group by educ
7. UK BMI-group and smoking projections by education (WP5)
   File name: 20121213 D02-22_OTH-22 GB PS Appendix E7_UK BMI-group and smoking projections by education
8. Population Distribution 60+ (WP5)
   File name: 20121213 D02-23_OTH-23 GB PS Appendix E9_Population Distribution 60+
9. PersonEditor Smoking examples (WP6)
   File name: 20121213 D02-24_OTH-24 GB PS Person editor smoking examples

Work package 7 annexes

7.1 Validation of the model **(deliverable 7)**
File name 20121213 D05-00 FFR GB PS WP7_7.1 Validation of the model