Development of the Health economic assessment tools (HEAT) for walking and cycling
Physical Activity Through Sustainable Transport Approaches (PASTA)
5th Consensus meeting
Copenhagen, Denmark
28 - 29 March 2017

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Executive summary

Coordinated by WHO, steered by a core group of multi-disciplinary experts and supported by ad-hoc invited relevant international experts, the HEAT\(^1\) project holds regular core group and consensus meetings to discuss and agree upon methodological updates and new features of HEAT.

This consensus meeting was held to 1) achieve scientific consensus on the possibility to integrate changes to emissions of carbon dioxide and the influence of road crashes into HEAT; 2) achieve scientific consensus on options for developing new modules addressing emissions of carbon dioxide and road crashes in HEAT; 3) make recommendations for future improvements that could be considered for implementation in HEAT. The meeting was attended by 26 experts and members of the HEAT core group, 2 observers, 2 staff members of the United Nations Economic Commission for Europe and 6 staff members of the WHO Regional Office for Europe and Headquarters.

Based on information presented in a detailed background document and by lead experts at the meeting, participants discussed possible options for further HEAT modules. Integrating a carbon module and a crash module into the HEAT was supported by the consensus meeting. The different proposed options were discussed and guidance on the proposed approaches was given.

The consensus meeting also took note of options for future improvements and made recommendations for implementation in HEAT, in particular with regard to possibilities to consider morbidity and to further improve the appeal and usability of the HEAT.

Acknowledgments

The meeting was organized by the WHO Regional Office for Europe and supported by the project on “Physical activity through sustainable transport approaches” (PASTA), which is co-funded by the 7th Framework Programme (http://pastaproject.eu).

It was planned in close collaboration with the Transport, Health and Environment Pan-European Programme (THE PEP), jointly lead by the WHO Regional Office for Europe and the United Nations Economic Commission for Europe (UNECE).

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\(^1\) www.heatwalkingcycling.org

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1 Introduction and background

Physical inactivity is a significant public health problem in most regions of the world, which is unlikely to be solved by classical health promotion approaches alone, such as organized forms of sport or exercise, frequently during leisure time. Promoting regular cycling and walking is a promising route to more physical activity but requires effective partnerships with the transport and urban planning sectors, whose policies are key driving forces in providing appropriate and safe conditions for such behavioral changes to take place.

Economic appraisal is an established practice in transport planning. However, techniques for assessing the economic value of the benefits to health of cycling and walking have historically been applied less systematically than the approaches used for assessing the other costs and benefits of new transport interventions.

Coordinated by the WHO, steered by a core group of multi-disciplinary experts and supported by ad-hoc invited relevant international experts2, a project was started in 2005, aimed at developing guidance and practical tools for economic assessments of the health effects from cycling and from walking. The main goal of the project is the development of the Health Economic Assessment Tool (HEAT) for walking and cycling, a harmonized method for economic valuation of health effects of cycling and walking, based on best available evidence and international expert consensus. HEAT calculates: if x people cycle or walk y distance on most days, what is the economic value of all-cause mortality rate changes? (www.euro.who.int/HEAT).

HEAT is primarily aimed at transport planners, traffic engineers, economists and special interest groups. Since this audience may not necessarily have ready access to epidemiological and economic expertise and modelling tools, HEAT is intended to be scientifically robust, yet easy to use. It is not intended to be a comprehensive health impact assessment tool but aims at providing an estimate of the health effects of regular walking and cycling (currently mortality only) based on minimal data input for use in economic analyses in transport planning, such as cost-benefit analyses of different transport and land use developments options.

HEAT is developed through an iterative process, consisting of the following main steps: a) review of approaches to the inclusion of health effects into economic appraisals of transport interventions related to cycling and walking; b) critical evaluation of these approaches and indicators regarding their relevance, accuracy and feasibility; c) achievement of scientific consensus on how to apply this knowledge within the “HEAT environment”; and d) regular review and update of the approach in view of user-needs and scientific developments.

Key in the development of HEAT is the achievement of scientific consensus on the approach to be taken in the development of the different functionalities and components of the tools. This is achieved through the

2 See full lists at www.heatwalkingcycling.org
organization of consensus building meetings which, under the coordination of the WHO, bring the core group together with international advisors invited on the basis of their scientific expertise in the aspects of interest, and develop consensus-based recommendations on possible ways forward for the further development of the tool. Background to these meetings is provided by a review of relevant scientific evidence and preparation of proposed methods by invited experts, summarised in working papers distributed to the meeting participants in advance of the meeting. The most recent versions of the online tools for walking and cycling and of the user guide booklet were launched in 2014 [1]. The last consensus meeting was held in December 2014 to finalize the approach for a HEAT air pollution module, which is forthcoming.

The HEAT process is particularly designed to be open to continuous updating and further developing the tools. In previous HEAT meetings, the health effects from road traffic crashes as well as impact of active travel on morbidity have been identified as important topics for consideration. Including the impacts of active travel on carbon emissions could further enhance the appeal and relevance of the HEAT to transport planners by addressing climate change related issue. Options on possible approaches for the development of separate HEAT modules on carbon and traffic crashes for discussion by the HEAT core group were presented in a working paper [2]. The paper presented also a background for discussion on including morbidity into HEAT as well as insights into HEAT user needs.

The specific objectives of the meeting were to:

- achieve scientific consensus on the possibility to integrate changes to emissions of carbon dioxide and the influence of road crashes into HEAT;
- achieve scientific consensus on concrete options for developing new HEAT modules addressing emissions of carbon dioxide and road crashes;
- make recommendations for future improvements that could be considered for implementation in HEAT (e.g. regarding possibilities to consider morbidity, different metrics for the economic valuation; usability).

2 Welcome, election of the chair and rapporteur of the meeting, and introduction to the scope of the meeting

Francesca Racioppi welcomed the participants on behalf of the WHO Regional Office for Europe. The meeting was attended by 26 experts and members of the HEAT core group, 2 observers, 2 staff members of the United Nations Economic Commission for Europe and 6 staff members of the WHO Regional Office for Europe and Headquarters. Ms Racioppi recalled the HEAT principles, motivation and aim and also highlighted the history and formal process of its development, in which the consensus meetings have a key role. She also underlined that the possible options for additional HEAT modules were a foreseen key deliverable of the 7th Framework Programme project on “Physical activity through sustainable transport
approaches” (PASTA), (http://pastaproject.eu) but that selected modules shall only be implemented when the key features of HEAT are preserved, in particular withstand scientific scrutiny and any assumption made fully transparent while providing a maximum of user-friendliness and simplicity. Additional complexity should only be considered if no other option would provide a scientifically sound solution. Additional complexity should only be considered if no other option would provide a scientifically sound solution. Additional complexity should only be considered if no other option would provide a scientifically sound solution. Additional complexity should only be considered if no other option would provide a scientifically sound solution. Additional complexity should only be considered if no other option would provide a scientifically sound solution.

Ms. Racioppi also thanked the experts who prepared the background documents for their thorough work to prepare the meeting (Thomas Götschi, Alberto Castro and Sonja Kahlmeier, Epidemiology, Biostatistics and Prevention Institute (EBPI), University of Zurich, Christian Brand, Environmental Change Institute and Transport Studies Unit, University of Oxford, Nick Cavill, University of Oxford; David Rojas-Rueda, IS Global, Barcelona; Paul Kelly and Tessa Strain, University of Edinburgh, United Kingdom). Michal Krzyzanowski, consultant (formerly WHO Regional Office for Europe), Poland, was elected chair of the workshop, and Sonja Kahlmeier, University of Zurich, Switzerland, was elected as rapporteur.

3 Approach to the inclusion of carbon effects into the HEAT

Christian Brand, University of Oxford, recalled that about one quarter of carbon emissions in the EU stem from the transport sector and that increased investments will be necessary to achieve the ambitious reduction targets adopted for 2050. Thus, even if the possible contributions from increased active travel seem modest, all contributions to closing the gap to target will be valuable. However, the currently available tools to assess such contributions from active transport have not been systematically included in decision making on active travel interventions yet. He then presented options for a possible approach for inclusion of the effect of cycling and walking on carbon emissions into HEAT (for details see [2]). There are 3 main assessment stages to address:

1. Assessing mode shift from motorised travel to active travel (or vice-versa) (passenger-km, trips)
2. Assessing the carbon emissions from displaced motorised travel (gCO₂e/passenger-km, gCO₂e/trip)
3. Assessing the economic value of the social impact of changes in carbon emissions (€/tCO₂e)

In general, the inclusion of a carbon module that users can choose to apply separately from the health-related parts of the tool was supported by the consensus meeting. It was underlined that it will be important to frame
the results appropriately, e.g. by comparing estimated CO2 reductions to those from using standard household appliances such as a washing machine, to avoid the impression of a potentially negligible contribution from active transport. It was also suggested to further look into possible scenarios where the contributions from active transport could lead to increased net emissions to address such scenarios appropriately in the introductory sections of the module.

Participants discussed the proposed approaches for each of the 3 stages. The following were adopted:

**Assessing mode shift from motorised travel to active travel (or vice-versa)**

For this step, the proposed approach to ask users for an estimation of the mode shift (or the avoided travel for “single-point-in-time” assessments) from/to motorized travel and from/to public transport was adopted. Users will be provided with similar guidance as in other HEAT modules to support the development of realistic scenarios to avoid inflated values.

This approach will include the following steps and questions:

- separating utility and recreation trips (as it can be assumed that the majority of new recreational walking and cycling will not have been shifted from motorized travel); as default value a 50:50 split was adopted and the same visualization as for the air pollution module shall be used (most likely circular sliders adding up to 100%);
- walking and cycling ‘diversion rates’ from/to other modes; here default values will also be provided, derived from the literature as described in [2] but applying different rates for walking and cycling. Detailed guidance will be developed for users on how to best derive realistic assumptions for their local (or national) situation. HEAT will then assume a 1:1 shift from other modes to walking/cycling\(^3\). The option to provide different defaults for national, regional, city level assessments will be considered;
- (In the case of before/after assessments) how much of the change in walking and cycling activity specified in HEAT is not due to mode shift but due to trip generation (induced trips that were not met by other modes before) and trip reassignment (i.e. same mode but destination or route shifting, based on existing question 9 of HEAT\(^4\)).

While the available background data usually focused on urban contexts, the HEAT module should also support national assessments.

\(^3\) This implies the assumption that some e.g. car trips diverted to other modes were longer (e.g. where a new piece of cycling infrastructure means the cycling trip is more direct) and some were shorter (e.g. where a new cycle trip is taking the scenic, less direct route) as a reasonable compromise.

\(^4\) This approach would also mean to re-formulate and re-interpret the current question 9 of HEAT, namely “When assessing the impact of an intervention it is prudent to assume that not all the cycling/walking, or increase in cycling/walking, observed is newly induced, that is directly attributable to the intervention. Estimate the proportion of cycling/walking which you would like to attribute to the intervention (i.e. you want to value) to the best of your knowledge”.

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Assessing the carbon emissions from displaced motorised travel (gCO$_2$/passenger-km, gCO$_2$/trip)

Overall, the proposed approach was supported by the consensus meeting (for details see [2]). It will be based on travel activity and emission factors, based on available data for each country and/or city in the WHO European region (including background data on country specific fuel splits, average speeds, trip lengths and ambient temperature informing the lookup tables). Speed-emissions dependency, real world uplift, cold start emissions and life cycle emissions will be included, making the module more realistic and defendable. It was also agreed to include one additional question on traffic conditions in the study area (including “heavily congested”, “some peak-time congestion”, “generally free flow”) to address average speed dependency of carbon emissions at the city level; examples of cities with a selected number of specific traffic situations will be provided as guidance.

The proposed ‘well-to-tank’ (WTT) approach for transport fuels (gasoline, diesel, electricity, hydrogen, etc.) was also adopted. Based on approaches of previous studies [3,4,5] and assumptions regarding additional calories burnt through increased physical activity from cycling or walking more, it was also proposed to estimating the related additional carbon emission effect, compared to using a car or public transport (details see [2]). While there is some evidence that increases in exercise can lead to increased dietary intake [6,8] this seems to be mostly related to high intensity exercise and to date there is insufficient epidemiological evidence on the impact of taking up or increasing active transport on dietary intake. As including this aspect would also imply a number of additional assumptions (e.g. an average body weight of the related participants and the type of diet), the consensus meeting concluded that a more detailed analysis of the evidence would be necessary before this aspect could be included into the HEAT.

The proposed standard lifecycle inventory approach was adopted, applying embedded carbon emissions factors for vehicle production only to calculate vehicle lifecycle emissions. While it was acknowledged that the module would be highly sensitive to some of these aspects (e.g. lifetime mileage of a car or a bike), the available evidence shows comparable similar figures across different contexts.

To reflect that average emissions factors evolve over time as more efficient and cleaner vehicles enter the fleet, a trajectory over time will be used, based on a conservative assessment of available sources (e.g. modelling exercises and projections based on the mandatory new car CO$_2$ emissions standards for the EU, in line with the HEAT approach of dealing with uncertainty of future developments). Applying a linear trajectory would also agree with a conservative approach in view of the likely increase in the use of renewables and alternative propulsion systems. A possible rebound effect (e.g. people driving further because vehicles become more efficient and use less fuel) would not be included in these background values but users could be prompted to take such effects into account in their input values.

5 An explanatory note will be added that future fleet improvements have been taking into account, subject to the inherent uncertainty of such projections.
Assessing the economic value of the social impact of changes in carbon emissions (€/tCO$_2$e)

For this last step, the consensus meeting adopted the proposed “Social Cost of Carbon” (SCC) approach. The user can either default SCC values based on international evidence or averages (details see [2]), country specific values (if they exist) or his/her own preferred values. A caveat will be provided to the user outlining the large uncertainties in valuing carbon emissions impacts, reflecting regional socioeconomic realities such as time preference rates and equity-weighting. It will also be explained that these values represent the societal costs of climate change and while they include health aspects, they do not overlap with the societal value of reducing premature mortality through physical activity from cycling and walking that the HEAT physical activity module derives.

4 Approach to the inclusion of traffic crashes into the HEAT

Thomas Götschi and Alberto Castro, University of Zurich, presented options for inclusion of traffic crashes into HEAT. They recalled that safety concerns are a key barrier to active transport, in particular cycling. For this area, health impact assessments are considerably less developed than for other areas and it is confronted with additional challenges. For example, while for physical activity, the same relative risks apply more or less everywhere, the equivalent of a “background crash risk” is strongly dependent on local circumstances (e.g. traffic mix and infrastructure, speed limit enforcement, existing level of cycling, etc.)

For all HEAT modules but even more so for a crash module, the use case is of particular relevance, determined for example by:

- geographic scope (e.g. national, city-wide, specific piece of infrastructure)
- temporality (status quo vs. before-and-after scenarios).

Additional criteria to consider could be: type of data sources, cyclist attributes, infrastructure type (e.g. mixed with traffic vs. separated), types of cycling, mode shift scenarios, etc.

The consensus meeting agreed with the proposed so called “basic” approach based on multiplying a HEAT-provided generic crash risk estimate with a user-provided measure of exposure for the studied use case (for details see [2]). Users would be instructed that at the current stage, the crash module is only applicable to national use cases and does not cover sub-national and even less so project- or infrastructure-specific applications. Applicability to city-level use cases was supported as a further future development. The consensus meeting supported to initially focus on cycling, assuming that the impact of traffic safety on modal choice and the complexity and cost of implementing dedicated infrastructure is higher for cycling interventions than for pedestrian ones, and therefore the provision of information on the implications of policy and investments into cycling might result in better-informed decisions. However, the consensus meeting strongly supported prioritizing the development of a similar module for walking, in particular in
view of the universal relevance of walking, as well as the higher burden of traffic-accident related mortality in pedestrians and lower prevalence of cycling in some parts of the European region (and globally).

An initial focus on mortality as health outcome was also supported by the consensus meeting. Some concerns were raised that not including health effects and costs from injuries (which, as some studies show, can be substantial [8,9]) would mean that the HEAT would not yet fully take into account all negative health effects from road crashes. However, it was acknowledged that the currently available data sources and the lack of internationally standardized approaches to definitions and to collecting information on traffic injuries do not yet allow inclusion of non-fatal outcomes. Underreporting, which is particularly relevant for injuries [9] was also mentioned as an additional challenge. Further investigations will be done on possible approaches to including injuries into HEAT at a later stage, in particular when positive health effects from reducing morbidities would be considered for inclusion (see also chapter 5.1). As a possible approach, recent guidance of the US Department of Transport was mentioned that proposed a method to derive coefficients for groups of injuries of different severity that can be applied to VSL to assign each injury class a value corresponding to a fraction of a fatality [10]. However, this approach may not be directly transferable to other countries that don’t use the same grouping of injury severities.

The consensus meeting also discussed the option to include mode shifts into the crash module, which have been adopted for the carbon module (see chapter 3). As the necessary background crash rates for the other modes (i.e. car, public transport and possible motorbikes with particularly high accident rates) stem from the same data sources that need to be searched for cycling and walking, it might be cost-effective to consider collecting them in parallel with developing the cycling (and possibly walking) option. As mode shifts are currently not being addressed in the HEAT core module on physical activity benefits, it was decided to further consider this option but not to pursue it as the first priority. Not including mode shift effects would likely lead to overestimating crash risks for mode shift scenarios but this was considered leading a conservative approach, in agreement with the HEAT principles.

Finally, the consensus meeting adopted the proposal to include a non-linear (“safety-in-numbers”) approach as an option for pre-post-assessments, based on user input regarding changes in crash rates over time. A default value will be provided, based on a recent systematic review and meta-analysis [11], along with guidance on how to best derive a locally sensible value. Further investigations will be made to determine if such a risk reduction should extend to very low levels of cycling as well or whether a minimum threshold (e.g. a 5% or 10% modal share of cycling) should be applied.

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8 For example, in this Swedish study, 41% of the DALYs were due to injuries (YLD) and the remaining 59% due to fatalities (YLL), see Table S4, Additional file 1.
9 In this Swiss study, the costs related to deaths from cycling accidents amounted to only 4% of total costs; i.e. over 90% of the costs were due to injuries from traffic crashes.
8 In the same Swiss study, for example, it was shown that while for bikes, 2,271 accidents were recorded in police records in 2010 (of which 28 involving deaths, 606 serious and 1,532 light injuries), a more complete assessment based on accident insurance reports includes 23’883 light injuries involving bikes (graphs 13-5 and 13-9, chapter 13.3).
It was also noted that the concept of “safety-in-numbers” is not universally accepted and thus HEAT needs to appropriately frame inclusion of this option, for example proposing it as part of a stated goal to improve transport safety, rather than a law of nature. It was also suggested not to use this phrasing in HEAT, as the causal direction of effects (safety-in-numbers or numbers-in-safety, or both) is unclear; a possibility could be for example “safety improvement effects option”.

4.1 Data sources
Participants welcomed the thorough assessment of the presented data sources [2]. The possibility that additional data could be available from the WHO Global Health Observatory will be followed-up after the meeting. In this regard, the importance of having several years of data to alleviate fluctuations as well as having the most recent data was underlined. As an alternative source in case the WHO data would prove not to be available, the Global Burden of Disease (GBD) study was also discussed [12]. However, it would be important to understand the approach used by the GBD study and variables in detail with regard to any implications for HEAT.

While the overall approach to describing the reliability of the different data sources was appreciated, it was suggested to simplify the proposed scaling. In addition, it was suggested to carry out additional sensitivity analyses to understand the impact of different aspects in more detail (e.g. 4 versus 3 cycling trips per day). It was also suggested to derive the background crash rate for those 17 countries where the highest quality (national) data is available with the approximation method used for the other countries to determine the level of precision of that approach. The presentation of the proposed approach and initial results at two international conferences in June 2017 will provide further feedback and a sense for its scientific credibility. A sub-group of experts was formed to provide further input and feedback on the final approach, as needed (including Rune Elvik, Audrey de Nazelle, Alexandre Santacreu and Michal Krzyzanowski).

5 Areas of possible future improvements of HEAT

5.1 Morbidity
David Rojas, IS Global, Barcelona, Spain, presented 3 different options for developing a HEAT morbidity module (see [2] for details). The participants appreciated the overview of these different options and the pros and cons related to the different approaches. The main issue encountered related to a lack of clear guidance on which of the possible metrics (cases of disease, health costs, DALYs or costs) would be most requested by which target audiences, and thus had the most chances to further increase the impact of HEAT on transport policy decisions, and possible relevant policies in other areas (e.g. NCDs, energy, air pollution etc.). Thus, it was supported to further investigate the usability of these approaches in direct interaction with
representatives of the HEAT target audience, as proposed. In further discussions on this topic the different approaches to economically valuate the results will need strong representation as well.

Participants also discussed an additional consideration with regard to possible approaches to including morbidity into the HEAT: while physical activity has shown positive effects on a range of diseases, it could be argued that in an economic assessment, not only the reduced number of cases of disease but also the possibility of a potentially higher number of people surviving with a certain disease and overall increased longevity would need to be considered. This could eventually lead to a higher number of people living with a certain disease within a given population, assuming that all the additional life years would not be lived in good health. So, as some authors found [13], under certain circumstances increasing physical activity could even lead to higher costs to society. More likely there would be a reduction in burden and hence costs but by a smaller amount than a simple approach would expect [14]. In addition, some of the related studies have not considered the impact or cost of the reduction in disease severity resulting from the increased physical activity, nor the cumulative health expenditures, which have shown no differences between healthier and less healthy elderly persons, despite their greater longevity [15,16,17]. Though of relevance in the broader context of an ethical and scientific debate on the effects of risk reductions on the health quality of extended life expectancy, and the related costs and gains to society, there was no consensus of how this debate could be addressed within the current HEAT context.

A further discussion is needed regarding the relative risks used for all-cause mortality (as with HEAT) when applied to risk assessment models produce larger reductions in mortality than do models that sum impacts from disease specific relative risks (e.g. [15]). However, this would also depend on the underlying assumptions and thus also requires further consideration and discussion.

### 5.2 User needs and expectations

Nick Cavill, University of Oxford, presented insights on what HEAT user needs and expectations, based on a range of sources, including Emails to the WHO, feedback from trainings, discussions and informal feedback and the results from a recent study [12]. He also outlined plans to consult with actual and potential users of the HEAT in order to develop a better understanding of their needs, and provide input to the further development of the tool, to:

- determine which most preferred morbidity output (cases of disease; health costs; QALYs; DALYs; costs; or another metric);
- gain further insight on barriers to use and presentational issues;
- assess the demand for and relative priority of different versions of the HEAT (e.g. Excel; online; version using ‘R’);
explore users’ ideas for strategic development of the HEAT (including further HEAT modules; changes to user interfaces; definition of target audiences; age groups; tutorials, products and dissemination).

The consensus meeting warmly supported further investments into understanding and responding to the most important user needs. It was suggested to focus on understanding the maximum leverage point in transport planning across a range of countries, in particular those where active transport and/or economic assessments have been less prevalent. Several suggestions were made on how e.g. central and Eastern European countries could be reached to give input. It might also be helpful to bear in mind that even transport planners might not be a homogenous group but that e.g. traffic engineers might have different views from urban planners. Also, not starting the conversation with HEAT but focusing on their needs in terms of advocating the inclusion of cycling and walking into transport planning decision processes might be useful to understand how HEAT could fit in.

In addition, the development of a tool to collect feedback on HEAT in a more standardized and sustainable way was called for. This should facilitate collecting, discussing, addressing, and archiving all sorts of feedbacks members of the core group (and possibly others) obtain through various means, including formal support requests, email exchanges, conversations at events, or issues the identify themselves. Also the provision of different language versions was acknowledged as a key element for further uptake of HEAT, in particular on sub-national level where most transport appraisals are carried out. Participants were also invited to send additional feedback and suggestions directly to Mr. Cavill.

6 Conclusions, next steps and closing

In conclusion, the consensus meeting endorsed the development of a carbon module and a crash module and decided on next steps for the development of a possible future module for morbidity. Further activities for a more in-depths understanding of user needs and preferences were also supported.

Francesca Racioppi closed the meeting with warm thanks to the experts who prepared the background work to guide the discussions, the chair for excellent guidance through the meeting and to Sonja Kahlmeier for coordinating and facilitating background work and preparations. Finally, she expressed appreciation on behalf of the WHO to all participants for the valuable support and inputs provided to the HEAT process.
References


### Annex 1  Meeting programme

**Tuesday, 28 March 2017**

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<td>09:00 – 09:30</td>
<td>Registration and coffee</td>
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| 09:30 – 09:45| Welcome, introduction of the core group and election of the chair and rapporteur of the meeting  
Francesca Racioppi, WHO/Europe                  |
| 09:45 – 10:15| Introduction to HEAT for walking and cycling and lessons learnt since 2008: scope of the proposed update  
Francesca Racioppi, WHO/Europe               |
| 10:15 – 10:30| Methodology and proposed way of working for the consensus meeting  
Chair                                         |
| 10:30 – 11:00| Proposed approach to the inclusion of carbon effects into the HEAT  
Christian Brand, University of Oxford               |
| 11:00 – 11:30| Coffee/tea break                                                      |
| 11:30 – 12:30| Discussion of proposed approach to the inclusion of carbon effects  
Chair                                         |
| 12:30 – 13:30| Lunch                                                                 |
| 13:30 – 15:30| Discussion of proposed approach (continued)  
Chair                                         |
| 15:30 – 15:45| Conclusions on the proposed approach to the inclusion of carbon effects  
Chair                                         |
| 15:45 – 16:15| Coffee/tea break                                                      |
| 16:15 – 16:45| Proposed approach to the inclusion of traffic crashes into the HEAT  
Thomas Götschi & Alberto Castro, University of Zurich                |
| 16:45 – 18:00| Discussion of proposed approach to the inclusion of traffic crashes  
Chair                                         |

**Wednesday, 29 March 2017**

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<tr>
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| 09:30 – 09:45| Welcome and summary of day one  
Chair & Francesca Racioppi                                      |
| 09:45 – 11:45| Discussion of proposed approach to the inclusion of traffic crashes – cont’d  
Chair                                         |
| 11:45 – 12:00| Conclusions on the proposed approach to the inclusion of traffic crashes  
Chair                                         |
| 12:00 – 13:00| Lunch                                                                 |
| 13:00 – 14:00| Areas of possible future improvements of HEAT  
- Morbidity – David Rojas, IS Global, Barcelona  
- User needs and expectations – Nick Cavill, Cavill Associates |
| 14:00 – 14:45| Discussion of possible future improvements of HEAT                   |
| 14:45 – 15:00| Next steps and other items                                            |
| 15:00        | Closure Francesca Racioppi, WHO/Europe                               |
Annex 2  List of participants

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