Section III

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11 Transport and Clinical Practice

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Whilst most of this book is about health at a population level and the policy measures that are needed for its enhancement, it is important to remember that at the root of any population health effect are real people experiencing specific biological impacts upon their personal health. It would therefore be remiss not to include a chapter written from this clinical perspective.

The purpose of this chapter is to provide a summary of the transport and health agenda for a general practitioner who wishes to understand how transport-related issues affect the treatment of patients. It is therefore a resource for general medical education. Sections of it may, of course, be useful in specialist training as well and it may be of value in the training of other health professionals such as nurses (it is has been particularly disappointing to see a major nursing journal campaigning for free hospital car parking).

This chapter includes information both on the impacts of transport on disease risk and also on the effects of disease on the need or ability to travel independently. It complements the

information provided in chapter 9 on disability and disadvantage in association with transport.

11.1 Diseases of physical inactivity

As described in chapter 2, physical inactivity causes obesity, and hence hypertension and type 2 diabetes. It also causes heart disease and osteoporosis. Physical activity improves mental well being and reduces the incidence of mental illness. Physical activity can be an effective treatment of depression.

Physical activity can be taken in many ways but many people find it difficult to find the time for organised sport or fitness programmes and it is easier for people to increase their physical activity if they can build it into their daily life. Using stairs rather than the lift is one simple measure but will not in itself be enough. Travel to and from work, school, or other daily activities is a good opportunity to build physical activity into the daily routine.

Walking and cycling are healthy means of transport. Cycling is especially useful as it is faster than walking and can therefore be used over greater distances. Some people are concerned about the safety of cycling. This is discussed fully in chapter 7. In summary, there is a slight increased risk relative to walking or driving but it is no greater than many other risks that people take in everyday life, such as driving on all purpose roads rather than motorways or driving instead of taking the train. For the population as a whole the risk is more than offset by the reduced risk (relative to driving) of injury to third parties whilst for the individual cyclist the small risk is far outweighed by the considerable health benefits. Cycling does not reduce the individual's life expectancy even slightly: it increases it considerably.

Inexperienced cyclists will often want to become familiar with cycling on quiet roads before mixing with heavy traffic. Assistance in route planning may help them with this. They could also be encouraged to take cycling proficiency courses. Walkers may also benefit from route planning – people prefer to walk along attractive routes and may be unaware of some of the routes available to them.

Many cyclists choose to wear cycle helmets. The evidence on the effectiveness of these helmets is summarised in chapter7.

For people whose journey to work is too long to cycle, public transport offers more physical activity opportunities than driving. Walking to and from the station, walking to and from a bus stop on a high frequency route, walking between stations, and getting off one stop before your destination and walking the rest of the way are all entirely viable approaches.

11.2 Mental health & transport

11.2.1 Stress related disease

The associations between transport and stress are given in chapter 5: section 5.1.1 Stress and anxiety; section 5.1.2 Stress and mental and physical health; section 5.1.3 Transport and the stress reaction; and section 5.1.4, Diseases of poor social support. We have therefore not repeated these sections here but those who are reading this chapter only should also refer to them.

11.2.2 Mental health and transport

The associations between mental health and transport are complex. Active transport is associated with improved mental health and may be recommended as a treatment for mental illness, but some mental illnesses may prevent travel either through fear or restrictions on use of vehicles. Lack of access to transport may also be associated with mental health disorders.

The benefits of active transport

There is a substantial body of evidence demonstrating that walking has significant benefits to mental health.[1] [2] [3] [4] [5] Physical activity and hence active transport is associated with improved subjective well-being, mood and emotions. These effects are seen within all age groups and are independent of socio-economic or health status.[6] Physical activity can also improve self-esteem[7] and can result in positive changes in certain aspects of physical self-perception, such as body image or self-worth. The effect is stronger for those with initially low self-esteem such as mental health patients and those with mild depression. Active individuals also report fewer symptoms of anxiety or emotional distress and improved sleep patterns. Inactive people are more likely to develop clinically defined depression.[8]

Physical activity is effective in reducing clinical symptoms in those diagnosed with severe, moderate or mild depression[9] and has been shown to be equally effective as traditional treatments such as psychotherapy.[10] Those who maintain physical activity for at least six months report less use of medication and are more likely to recover than those who rely solely on medication. T here is also strong evidence that physical activity has a positive effect on anxiety with the most notable effects among those who maintain physical activity programmes over several months.[11] Projects such as Bike Minded are aimed at encouraging mental health service users to cycle by offering organised rides, cycle training, bike maintenance courses and vocational activities.[12]

Restrictions on vehicular travel

A systematic review of the literature on motor vehicle crashes and mental illness found that motor vehicle collision rates were higher among certain driver sub-groups including those having the most severe degree of mental illness and those using specific psychotropic medications such as benzodiazepines.[13] In England the DVLA which is responsible for issuing motor vehicle licenses may not grant and may revoke a license to persons with severe uncontrolled anxiety, severe depression with marked psychomotor retardation and/or psychosis, bipolar disorders including hypomania or mania, acute psychotic disorder, schizophrenia or other chronic psychosis.

Fear of travel

Individuals with certain mental health disorders (esp. agoraphobia, obsessive compulsive disorder) may fear travel and there are other phobias specific to transport type (aerophobia – flying; siderophobia – trains). Persons with agoraphobia may either restrict travel or need a companion when away from home, or else endure agoraphobic situations despite intense anxiety.[14]

Access to transport

Persons who reported feeling isolated as a result of the lack of transport (public or private) were more than three times as likely as the sample as a whole to have a GHQ score (general health questionnaire score, which measures minor psychiatric morbidity) indicative of depression.[15]

11.3 Transport and external causes of ill health

11.3.1 Transport related poisoning

See table 3.2 in section 3.1 for the health effects of air pollution from transport emissions.

Other transport related chemical hazards include scrotal cancer due to oil, cervical cancer in women who work in oily occupations or whose partners work in such occupations (most cervical cancer is caused by HPV infection, but most of the small number of non-HPV cases

are occupational: most of those are due to oil, although some are due to work with biological materials), and asbestosis in shipbuilding and carriage-making.

11.3.2 Transport related violent injury

Carbon monoxide poisoning from vehicle exhausts and jumping in front of trains or off bridges are common forms of suicide. Some inexplicable single vehicle crashes may also be suicides.

Cars can be used as weapons to carry out violent attacks. Other forms of transport could also theoretically be used in this way but this is less common, although aircraft were the weapon in the horrific mass murders at the Twin Towers and people are sometimes pushed in front of trains.

Road rage – violence provoked by poor driving – is a recognised phenomenon.

11.3.3 Transport Related Crashes

For prevention of transport related crashes see chapters 4 and 18, and sections 7.1, 7.2, 7.3, and 9.2.

The treatment of the injuries resulting from transport-related crashes is a subject which is well covered in textbooks of emergency surgery and it would not be useful to repeat it or attempt to summarise it in this chapter.

One important transport related issue in relation to transport-related crashes is the centralisation of Accident & Emergency (A&E) Departments to produce larger departments with more expertise. The public are often concerned that such centralisation risks lives by making it necessary to take casualties further with consequent delay. The profession tends to believe that this risk is offset by greater expertise.

THSG would also be concerned that centralisation of A&E Departments tends to lead to centralisation of hospitals and hence more travel.

Another issue is the provision of immediate care at the crash site.

11.4 Disease and transport

11.4.1 Cardiovascular disease & transport

Heart disease is both a stress-related disease (chapter 5, section 5.1) and a disease of physical inactivity (chapter 2, section 2.2). Considerable links between heart disease and transport have therefore been described above under these headings.

Long term exposure to carbon monoxide increases arteriosclerosis and causes heart disease and stroke. Smoking is the commonest cause of this but high-mileage motorists may also experience this. Particulates also contribute to heart disease, both precipitating hospital admission and premature mortality (chapter 3, section 3.1).[16]

People who have a stroke, transient cerebral ischaemic attack (TIA) or acute coronary syndrome cannot drive for a month but do not have to inform the DVLA (Driving and Vehicle Licensing Authority) unless the symptoms last longer than this or their doctor says they should not drive for longer.[17 18] However, these events may lead to permanent loss of licence and therefore livelihood for HGV and PSV drivers.[17 18]

Following a stroke, some people may have hemi-inattention, visual field deficits or seizures which render them unfit to drive for longer, possibly permanently. Some of these people may also be unsafe as pedestrians or cyclists, because of a lack of awareness of traffic, obstructions, and other dangers.

Disability, such as a physical deficit following a stroke or significant angina that limits walking, often limits mobility. This is addressed in chapters 9 (Inequalities) and 13 (Reducing social exclusion).

11.4.2 Respiratory disease & transport

Motor vehicle emissions contribute to respiratory disease.[16] Particulates, nitrogen oxides and ozone all cause lung damage. At high concentrations nitrogen dioxide causes inflammation and irritation of lung tissue, increasing susceptibility to viral infection, bronchitis and pneumonia Particulates. especially those of less than 1µm, can be inhaled deep into the lungs where they can cause inflammation and a worsening of heart and lung diseases. Exposure to particulate matter is consistently associated with respiratory and cardiovascular illness and mortality. Ozone also reduces lung function: very high levels increase the symptoms of those suffering from airway diseases such as asthma and bronchitis, leading to increased incidence of respiratory hospital admissions and mortality. Polycyclic aromatic hydrocarbons in vehicle exhaust emissions cause lung cancer.

Traffic pollutants are either a major cause of asthma or a major exacerbator. It may be that it only exacerbates existing asthma by nitrogen oxides acting as sensitisers for other allergens such as pollens. It is probable, although not certain, that there may also be direct causal effects. The main effect is from fine particulates.[19] If there are direct effects traffic may cause asthma rather than merely exacerbate it. This is to some extent a matter of controversy but may not be a great clinical issue – whether traffic caused asthma or merely turned a minor problem into a serious one may be of little importance to the patient. Acute increases in air pollution trigger exacerbations of asthma in susceptible individuals, especially children.[20] Organic compounds and metals such as iron and vanadium bound to diesel particulates in traffic pollution increase the risk of asthma.[20] Early exposure to pollution from traffic increases the risk of developing symptoms in normal, healthy children.[21] Evidence in the UK, accepted by the Environmental Audit Committee of Parliament in 2010, is that previous estimates of extra deaths and deaths brought forward may be an underestimate. In June 2010 the Mayor of London published data which estimated that 4,267 premature deaths a years were due in part to long-term exposure to airborne particles.[22]

It can be seen therefore that it is sensible for those with early respiratory disease to be advised to reduce non-essential exposure to motor traffic. Walking and cycling along quiet roads or travelling by train is better than using main roads. On main roads, pedestrians, cyclists and public transport users experience less pollution than car users since in most circumstances, levels of most pollutants are highest in the centre of a roadway and least by the pavement, and are highest inside cars,[23] with exposure inside buses[24] [25] being intermediate between car occupants and pedestrians on the pavement.

Severe respiratory disease can affect the pace of walking and the distance that can be walked.

Some transport-related industries such as shipbuilding and carriage-making have in the past provided asbestos exposure which, due to periods of latency, are still causing many new cases today.

11.4.3 Gastrointestinal disease & transport

Some gastrointestinal diseases, including minor gastrointestinal upset, are stress-related, which is dealt with in chapter 5, section 5.1.

People with certain gastro-intestinal diseases may have frequent and/or urgent need for a toilet, which can limit certain travel options.

Much food is consumed whilst travelling and food outlets specifically serving travellers are renowned, perhaps by caricature, as of low quality. There are also safety issues of eating or drinking while driving, both through taking hands away from the car's controls and also as a distraction from the road and traffic.

11.4.4 Infectious disease & transport

Susceptibility to infectious disease is increased by stress (see section 5.1)

The ready availability of international travel has increased the mixing between ecosystems. This has a number of effects. It means that infectious diseases spread by droplet, by sex or by blood-mixing will definitely spread more rapidly across the world once they have become established. Whether this will also happen to water-borne diseases or to vector-borne diseases depends upon the circumstances but the risk is certainly there. There is a theoretical risk of carrying a vector insect aboard an aircraft, ship or international train but this has not happened often. With a water/food-borne disease, such as typhoid, movement of a carrier or a case will not necessarily spread the disease unless there is also poor hygiene or employment in food preparation. With such infections international spread has often been by carriage of infected products.

As well as the spread of infectious diseases outside their normal ecosystem there is also the risk to people who intrude into ecosystems where they do not have immunity to local disease. A common cold is a frequent consequence of travel for this reason. More serious are diseases like yellow fever and malaria. Travellers should always be advised to take appropriate precautions.

Mixing of ecosystems may however also have a beneficial effect. The virulence of a disease is an obstacle to its spread and the tendency is for infectious diseases to become less virulent over time as natural selection favours both the more resistant hosts and the less virulent organisms. However if this happens in one ecosystem and the local population becomes immune to it, it may remain virulent in other ecosystems and yet at the same time become more transmissible creating a situation where it may be spread by travellers into an immunologically naive and therefore susceptible population. The most widely cited examples of such disasters – the spread of smallpox into Latin America,[26] measles into the Pacific Islands[27] and the 1918 flu pandemic with demobilising troops[28] all occurred either before international travel became normal or at a time when it was disrupted.

Respiratory diseases such as influenza can be transmitted from infected to susceptible individuals via four direct and indirect mechanisms, each of which modes could occur when on public transport, where people are regularly in closer contact with large numbers of people than they would otherwise be. However, the relative importance of these different modes of spread for influenza is disputed.[29]

Overcrowding can lead to direct physical contact between people, with direct transfer of infectious agents. Secondly, infected individuals produce large droplets that can travel up to 1m during sneezing, coughing or even talking, with deposition on susceptible individuals' mucosae. Droplet spread is therefore very likely in public transport, as passengers are frequently within 1m of each other. Thirdly, airborne spread can occur over longer distances, as small infectious particles remain suspended in the air for long periods. The enclosed nature of most public transport vehicles therefore facilitates airborne transmission. Finally, most public transport vehicles have many hard surfaces, such as door handles or button and hand rails, that are touched by large numbers of passengers. Influenza viruses can survive on hard surfaces for up to 2 hours,[30] so indirect contact through contamination of these surfaces is also a significant route for disease transmission. Despite these theoretical modes of transmission, no outbreaks of influenza have been reported in relation to public transport apart from aeroplanes.[31 32]

The UK pandemic plan advises the public to minimise leisure and social (i.e. non-essential) travel to reduce their personal risk but recommends that while public transport can continue

to be used for essential journeys, good personal hygiene measures are important.[33] Staggering journeys where possible would reduce overcrowding at rush hour but this may reduce only the direct person to person spread, given that the other three mechanisms described above are still likely to operate. Mathematical modelling to investigate the effect on spread of pandemic influenza of restricting travel to within 20km of the home in the UK and USA found that this would reduce spread of infection from one area to another only in conjunction with effective border control.[34] However, the authors viewed travel only as a means of moving infected individuals from an area of existing infection to another area where they could spread the infection; they did not consider the impact of travelling on public transport per se as an effective means of increasing transmission of infection.

11.4.5 Musculoskeletal Disease & Transport

Osteoporosis is a disease of physical inactivity (see section 11.1 above).

Many musculoskeletal diseases cause reduced and/or painful mobility that affects all modes of transport. Sufferers may be unable to stand for prolonged periods or use steps and may take longer to get on and off public transport. They may also have difficulty getting in and out of cars, whether as a driver or a passenger.

Those with marked arthritis of the hands, or with neurological disease, may be unable to hold onto handrails for support on public transport.

Cycling may be a useful form of transport for people with arthritis of weight-bearing joints, such as the knee, hip or ankle, in whom both speed and distance for walking are often limited by pain.

There has been a single research study associating rheumatoid arthritis with traffic.[35] Further studies are required to assess whether this was a chance (false) finding, was due to unmeasured confounding, or whether fine particulates or other traffic pollutants are truly associated with greater risk of developing rheumatoid arthritis.

11.4.6 Genitourinary tract disease & transport

Scrotal cancer and cervical cancer due to exposure to oil have been discussed in section 11.3.1 above.

Incontinence or an urgent or frequent need to use a toilet is often an obstacle to walking and cycling – indeed to going out at all – if people are not confident that there will be toilets readily available when they need them. This is an advantage of intercity travel by train or coach rather than car but does not yet apply to urban travel.

11.4.7 Neurological disease & transport

Mention has been made of stroke in section 11.4.1 above. Most neurological diseases have similar effects to those described for stroke and/or musculo-skeletal disease (section 11.4.5 above). Some neurological diseases, such as multiple sclerosis, can also affect balance,.

In addition, they can also affect bladder or bowel control, leading to problems of incontinence. As discussed in sections 11.4.3 and 11.4.6 above, these can be a substantial deterrent to travel and can severely limit the options available.

11.4.8 Cancer & transport

Cancer is in part a stress-related disease: this has been discussed in chapter 5, section 5.1. Scrotal cancer and cervical cancer due to exposure to oil have been discussed in section

11.3.1. Pleural mesothelioma is a consequence of asbestos exposure, which has been discussed as being associated with shipbuilding and carriage-making.

Benzene and 1,3-butadiene are carcinogens in vehicle exhaust emissions. They are particularly associated with leukaemia. 1,3-butadiene is also associated with lymphoma and cancer of lymphoid and blood-forming tissue. Polycyclic aromatic hydrocarbons in vehicle exhaust emissions are also carcinogenic. They cause lung cancer and may have other carcinogenic effects as well.

11.5 Effects of disability on transport

Aspects of impairment and transport which have already been covered in detail in chapter 9 are not discussed further in this chapter.

11.5.1 Old Age & Transport

Current knowledge and needs for research were summarised in a paper published in 2008.[36]

Short car journeys by elderly drivers are important for their continuing independence, although they cause substantial anxiety to their younger relatives. Crashes per mile are low and generally result in little injury,[37] except for those driving less than 3,000km annually.[38] Fatal crashes at night are lower in older people (aged 65+) than in young drivers (under 25), although they are higher than in adults aged 25-64.[39]

Loss of independence due to an inability to drive and then a further loss due to becoming too frail to use public transport are important factors in the decline into dependency. Research suggests that transport policy options to enable older people to maintain independent mobility are important especially such as those with dementia because even for older people with recourse to family and other support the 'burden' on carers as chauffeurs.[40] Past research has reported that both for those independent and dependent older people in rural areas they are unable to travel far and a minority housebound.[41] Although increased car ownership has increased mobility for older people in recent decades, this does not detract from the impact on health when license holding or car use has to be given up.

11.5.2 Driving impairment

Functional deterioration in vision, hearing, co-ordination, and mental processing of information can each lead to impaired ability to drive, particularly in the dark.

In addition to these endogenous causes of impairment, any alcohol, some prescribed medication, and some illegal drugs can affect an individual's ability to drive. The number of collisions in which these are a factor is described in chapter 4 section 4.5, while chapter 17, section 17.6.2 considers the evidence for what the legal limit for blood alcohol should be.

11.5.3 Legal issues

The General Medical Council's updated advice on Confidentiality, which came into effect on 12th October 2009, and its supplementary advice also covers reporting patients to the DVLA, even where that breaches confidentiality.[42]

> *"Personal information may be disclosed in the public interest, without patients' consent, and in exceptional cases where patients have withheld consent, if the benefits to an individual or to society of the disclosure outweigh both the public and the patient's interest in keeping the information confidential. You must weigh the harms that are likely to arise from non-disclosure of information against the possible harm, both to the patient and to the overall trust between doctors and patients, arising from the release of that information.*
>
> *"Disclosure of personal information about a patient without consent may be justified in the public interest if failure to disclose may expose others to a risk of death or serious*

harm. You should still seek the patient's consent to disclosure if practicable and consider any reasons given for refusal."[42]

It is the Driver and Vehicle Licensing Agency (DVLA) and Driver and Vehicle Agency (DVA) (Northern Ireland) that are legally responsible for deciding if a person is medically unfit to drive. They therefore need to know if a driving licence holder has a condition or is undergoing treatment that may now, or in the future, affect their safety as a driver.

Doctors are advised to seek advice from an experienced colleague or the DVLA or DVA's medical adviser if unsure whether a patient may be unfit to drive and to review any decision that they are fit, particularly if the patient's condition or treatments change. The DVLA has published information about a variety of disorders and conditions that can impair a patient's fitness to drive.[43]

Although it is the driver him/herself who is legally responsible for informing the DVLA or DVA about such a condition or treatment, it is the doctor's responsibility to explain to the patient both that the condition may affect their ability to drive, and that they have a legal duty to inform the DVLA or DVA about the condition.

Where a doctor does not manage to persuade the patient to stop driving, the patient is incapable of understanding the doctor's advice, for example, because of dementia, or the doctor discovers that the patient is continuing to drive against medical advice, the doctor must contact the DVLA or DVA immediately and disclose any relevant medical information, in confidence, to the medical adviser. However, the doctor should try to inform the patient of their decision to disclose personal information before contacting the DVLA or DVA, and should also inform the patient in writing once the DVLA or DVA has been informed. [42]

11.6 Health Promotion In General Practice

It is now a recognised role of general practice to conduct health promotion in the practice population. It is important that the role of walking and cycling in physical activity should be incorporated into the physical activity elements of such programmes and that physical activity should be given at least equal prominence to food when discussing obesity, given that the obesity epidemic is predominantly associated with falling activity levels. General practitioners might wish to familiarise themselves with pleasant walking routes in their vicinity so that they can advise patients to build them into their daily lives.

General practitioners who involve themselves in their local community might wish to make known their support for living streets, walking and cycling networks and improved public transport. Provision of cycle parking for staff and the many patients who could cycle would be a good start, as has been done by some – but few – health centres. Some GPs have set excellent example of practicing what they preach by walking and cycling to visit patients.

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12 Health Lessons for Transport Planners and Their Implications

J Cohen and S. Watkins

The purpose of this chapter is to summarise the scientific conclusions of this book where they are likely to be significant for transport professionals and yet unfamiliar to them. The chapter also explores the implications for professional practice in certain areas where this is necessitated by the promotion of walking and cycling, the new discoveries concerning the harmful impact of traffic in residential streets, or advancing understanding of congestion and the impact of saturation.

12.1 Introduction: Transport, Health, and Sustainability

The term 'sustainability' is a byword for 'sustainable development,' a term coined by the 1987 UN Report 'Our Common Future[1]', commonly known as the Brundtland Report. The term was defined as:

> *"development which meets the needs of the present without compromising the ability of future generations to meet their own needs."*

The corollary of this definition is the 'triple bottom line' – the recognition that for development to be sustainable it must consider and provide for economic, social, and environmental wellbeing.

The idea of sustainable development was originally developed to tackle the concern that economics trumped all other concerns when development decisions were made. Considering the way that 'sustainability' has now become a byword for 'environmentally friendly' or 'green', it is vital to keep in mind that economic and socio-economic considerations are equal partners in sustainability.

This is of particular importance for transport professionals, as transport impacts extend well beyond the environment into both economic and socio-economic spheres. For example, intensified development without proper transport links is economically unsustainable, and masterplanning new developments without proper consideration of walkability and access to services is socially unsustainable.

The discussion of sustainability and health should also, however, note that climate change will increasingly impact directly on health (chapter 3). This applies not only overseas but also in the UK, where more frequent heatwaves will present a serious risk,[2] and increased overall temperatures will increase the incidence of food poisoning and bacterial outbreaks in water supplies, as well as making possible occasional outbreaks of diseases such as malaria.[3]

The most important conclusion for transport professionals to take from *Health on the Move 2* is that when considering the sustainability credentials of a policy, a travel plan, or a development, the subject matter should not be limited to the environment. It is a fortunate coincidence that policies that are good for the environment are frequently also good for health, which in turn benefits society and the economy. Thus, efforts to promote sustainable policies should not focus only on the environment, but should seek to engage a wider group of stakeholders and demonstrate a wider set of benefits, in order to promote the business case.

12.2 Principles of Transport, Physical Activity and Health

Physical inactivity is one of the ten leading causes of death in developed countries.[4] It is associated with increased risks of developing many of chronic diseases such as type 2 diabetes, obesity, cardiovascular diseases, certain cancers, depression, osteoporosis and anxiety.

Physically active adults have a 20-30% reduced risk of premature death.[5] Taking up physical activity in middle age leads to a reduction in death rate comparable with stopping smoking.[6] The government currently recommends that adults should undertake at least 30 minutes of moderate intensity activity at least five times a week; this activity can be accrued in bouts of at least 10 minutes.[5] Walking two one-mile journeys or cycling two three-mile journeys daily satisfies this physical activity recommendation.

A Finnish study illustrated the extent of the benefits of exercise, finding that 55-year-olds who were physically active had the aerobic fitness of average people 30 years younger. A Dutch study found that those who cycle to work take fewer days sickness leave compared with those who do not cycle.[7]

12.2.1 Physical health

In England, nearly a quarter of adults are classified as obese,[8] and two-thirds are obese or overweight.[9] The increase in obesity over the past 30 years is mainly due to a significant decline in energy expenditure, rather than an increase in energy intake[10]: 25% of the British population do not walk for 20 minutes or more even once a year.[11] Government guidance recommends that 45-60 minutes of moderate intensity physical activity on most days is required for weight management. Each additional kilometre walked per day is associated with a 4.8% reduction in the likelihood of obesity, whereas each additional hour spent in a car per day is associated with a 6% increase in the likelihood of obesity.[12]

The WHO estimated that physical inactivity is responsible for 22-23% of coronary heart disease, 16-17% of colon cancers, 15% of diabetes, 12-13% of strokes, and 11% of breast cancers.[4] Men who walk or cycle to work have a lower rate of death from heart disease than men who travel to work by car, with public transport users having in-between rates.[13]

Particulate pollution from traffic is a major cause of premature death and early or additional hospital admissions from circulatory and respiratory diseases, particularly among the very old, the very young, and the frail. It can also cause asthma attacks, partly because nitrogen oxides act as sensitisers for other allergens such as pollen and also by direct effects of particulates.[14] In the elderly, long-term physical activity is associated with reduced memory loss,[15] reduced risk of osteoporosis,[16] and reduced deterioration of physical ability.[17]

12.2.2 Mental illness and stress

Physical activity is as effective an anti-depressant as psychotherapy and is more effective than relaxation and enjoyable activities. Exercise, including walking and/or jogging can reduce depression by half, whether clinical or not.[18]

Exercise has long been prescribed as a treatment for stress. Because the stress hormones prepare the body for action by putting the digestive and immune systems on hold, it is thought that physical activity can mop up the hormones, removing the physical effects of stress, which can include gastric conditions, cancer and infection, and heart disease. In addition, exercise provides contemplation time which can tackle the mental effects of stress. Walking and cycling for transport both therefore provide opportunities to treat stress.

Studies have found stress-related illness to be caused by a wide range of life changes such as moving house, or searching for a job, being trapped in an unsatisfactory situation, and even by the perception of inequality and being excluded from opportunities offered to others. Many of these situations can be caused, exacerbated, or improved by transport. Uncertainty and delays in transit, difficulties mastering driving skills, constant traffic noise outside the home, and inability to access social services and support can all contribute to stress. Conversely, good urban design incorporating slow traffic speeds, good walking permeability, and an aesthetically pleasing environment can reduce stress by facilitating community support networks and creating a pleasant living environment.

12.3 Promoting Active Travel: The Role of Highway Engineers

The promotion of walking and cycling is a fundamental public health goal of lifesaving significance. Transferring car journeys under five miles onto foot or cycle has a potential for saving heart disease deaths equal to all non-physical-activity heart disease prevention programmes put together. The decline in active travel has played an important role in the emerging obesity epidemic. This is often seen as due to changing patterns of food consumption but this is only part of the story. The obesity epidemic is predominantly an epidemic of declining physical activity and active transport has a key role to play. The adoption of a pedestrian impermeable street design (a loop and lollipop cul de sac design without cross linkages, for example) can add 6lbs to mean population weight, equivalent to an extra death rate of 1 per 1,000 or one extra death every ten years for every 100 people (perhaps as few as 30 houses) affected. The promotion of walking and cycling saves lives from heart disease, diabetes, low bone density, high blood pressure, and respiratory problems. It is therefore important that highways engineers consider the role that a road plays as part of a walking and cycling network and the potential that the road has for severing such networks and wider policy goals such as health.

- NICE guidance published in 2010 for government, local government, the NHS, and others whose actions influence the population's cardiovascular health[19] has two policy goals for physically active travel. The first is to ensure government funding supports physically active modes of travel. The second was to consider the following evidence-based measures: Ensure guidance for local transport plans supports physically active travel, such as allocating a percentage of the LTP block allocation fund to promote walking, cycling and other forms of travel that include physical activity.
- Create an environment and incentives which promote physical activity, including active travel to and at work. This includes prioritising the needs of pedestrians and cyclists over motorists when developing or redeveloping highways. It also includes developing public

sector workplace travel plans that incorporate physical activity and encouraging and supporting employers in other sectors to do the same.

- Consider and address factors which discourage physical activity, including active travel to and at work, such as subsidised parking.

A recent review concluded that the evidence supports the crucial role of public policy in encouraging cycling. Substantial increases in cycling require a raft of complementary measures, including infrastructure provision and pro-bicycle programmes, supportive land use planning, and restrictions on car use.[20]

12.3.1 The Use of Roads for Cycling

Some high speed roads may not need to be used by cyclists but if a road is to be used by cyclists we recommend the following measures:

Measures welcomed by novice and established cyclists alike

- Long quiet routes formed by closing rat runs
- Long quiet routes formed by cycle paths to link quiet streets
- Long quiet routes formed by establishing traffic lights or other safe crossings across major roads to link quiet streets
- Cycle lanes or paths where a short length of such provision creates long quiet routes by linking quiet streets
- High quality off-road routes where opportunities exist to create these
- Cycle lanes or parallel cycle tracks on roads which carry such heavy high speed traffic that cycling cannot be made safe except by segregation, and where no effective alternative parallel route can be constructed at reasonable cost or designated

Measures welcomed by established cyclists but less likely to meet the concerns of novice cyclists

- Traffic reduction overall, through for instance road charging
- Speed reduction treatments
- Junction treatment, hazard site treatment, traffic management

Measures welcomed by novice cyclists but often seen as fussy and segregating by established cyclists

- Other reallocation of carriageway space: bus lanes, widened nearside lanes, cycle lanes
- Other cycle tracks independent of road network
- Other conversion of footways/footpaths to shared use cycle tracks for pedestrians and cyclists

Established cyclists are particularly concerned that the design of cycle lanes or segregated cycle networks often leads to cyclists losing the priority at junctions which they would have had if they had used the main road. This can lead to cyclists repeatedly dismounting to cross quite minor roads. There is no basis for a presumption that motor traffic should have priority over cycles: where an important cycle route crosses a minor road, the cycle route is the major route and should have priority.

Major Roads

After asking the question "Is this road saturated or at risk of being saturated?" (Section 12.6.1), the next question that needs to be asked of a major road is "Does it need to be used by cyclists?" If there are parallel routes on off-road routes or on parallel quiet roads, the answer may be "No" (although this may require attention to the means of cycle access to buildings and settlements along the major road). The answer may also be "No" on interurban roads which cross remote areas with a gap between settlements greater than cyclists are likely to attempt for a serious interurban journey (more than 20 miles, say). However, there then arises the possibility that recreational cyclists will be attracted to the road because of the beauty of the remoteness unless there are more attractive access routes to the countryside in question. Accordingly, a good general rule is that if there is no alternative route, the road should be designed on the basis that cyclists need to use it. If the road carries fast motor traffic expecting free passage, then a separate cycle lane is needed.

Major Urban Roads

Unless an alternative direct high quality direct cycle route exists, for example on a parallel quiet road, the presumption should be that roads within the urban envelope will carry cyclists making short journeys. Appropriate measures need therefore to be put in place.

Rural Roads

Unless an alternative direct high quality direct cycle route exists, for example on a parallel quiet road, the presumption should be that roads linking villages and small towns will carry cyclists. Cycling will be an appropriate means of making utility journeys unless the distance is too great, but areas which are so remote that utility cycling ceases to be viable are usually so beautiful that recreational cyclists are attracted. Where these roads are carrying traffic at high speeds and on narrow carriageways, appropriate cycle facilities must be provided to enable safe cycling.

Quiet lanes offer considerable potential for providing high quality pedestrian and cycle routes away from the main flows of motorised traffic. They also offer considerable recreational benefit. These benefits often depend on them seeming to be remnants of a slow bygone age and are adversely affected by road improvements which destroy the bucolic tranquillity. The problem for a highways engineer is how to safely combine this key role of quiet lanes with their role as the end linkages in the rural street system providing access to homes, farms and businesses. If a quiet lane is disrupted by significant through vehicular use where there are main road alternatives (a rural rat run), the lane should be closed to all motor vehicles other than for access. Rural rat runs often exist for a different reason than urban ones – drivers may use them to experience their bucolic quality rather than to save time. In this situation, provision could be made for drivers to park and walk along the lane, or traffic could be kept within acceptable (very limited) levels by rationing through use to, say, one vehicle very 15 minutes, or by imposing road charges on through traffic. If through traffic is permitted on quiet lanes, a 20mph speed limit (or even less) should be imposed.

12.3.2 The Use of Roads for Walking

Any road which is to be used by pedestrians requires:

- a footway
- or a wide highways verge maintained so that it is easy to walk on
- or measures allowing traffic and pedestrians to mix safely by restricting traffic flow, improving mutual visibility of pedestrians and traffic so that they are visible to each other

within the stopping distance and slowing traffic down. This requires 20mph speed limits or potentially lower speeds driven to enable such shared space to be used with freedom from fear of injury.

Roads for walking also require regular, high-quality, and accessible crossing points located on desire lines, as described further on page 12-18.

Directness matters – pedestrians are very sensitive to deviation, and counting jaywalkers has been suggested as an indicator of where pedestrian improvements are required.[21] Link and Place[22] recommends counting the number of interruptions to pedestrian flows per km as a measure of the (in)efficiency of a pedestrian link.

People will walk further if the route is attractive, so in urban settings it is important to maintain a network of aesthetically attractive pedestrian routes. In such networks, aesthetic measures such as trees, floral displays, green verges and green patches, public art and attractive views should be seen as part of the design of the road rather than as something ancillary. Quality of place around a pedestrian link can be measured by comparing the ratio of people engaged in necessary activities to people engaging in optional activities such as strolling, chatting, or window shopping.[21 22]

Other matters to which attention needs to be paid if pedestrians are to be encouraged include ensuring the route feels safe and secure, is well surfaced, is free of litter and dog mess, is wide enough, and is well-maintained to prevent overhanging and encroaching vegetation.

In the past, major roads have often been built with little attention to their impact on walking routes. As a result some quite dangerous situations exist, such as the point where the Wainwright Coast to Coast Path crosses the A66 unassisted. Such situations should not be allowed to come into being in the future and those that have been created in the past should be progressively removed. Pedestrians have a right to cross roads and safe crossing points should be created without long diversions that disrupt the pedestrian network

Paths and Minor Urban Roads

The THSG advocates a fundamental rethink of the way that highways engineers think of paths and minor urban roads. They should be seen as the centre of a walking and cycling network rather than as peripheral to the road network. In the case of adopted streets their dual role as the core of the walking and cycling network and the periphery of the road network needs careful attention to balance. The role of streets as community facilities rather than just as passages also needs to be drawn into this balance. T he traditional distinction between adopted highways and unadopted highways is less important than a classification based on the role the highway plays.

Traditionally the first question a highways engineer has asked about a minor urban highway is whether it is adopted. If it is adopted this leads to an obligation to maintain and an assumption that it will be maintained in accordance with traditional standards and design assumptions. If however it is not adopted this often leads to responsibility passing to rights of way officers whose concern will be limited to ensuring that it provides free passage, generally with little concern for how surfacing and maintenance for example will affect usability, particularly for cyclists who are very sensitive to poor surfacing.

However this distinction pays little attention to the actual role of the route. Footpaths and bridleways may be important routes in a cycle or pedestrian network which not only supports the key obligation to promote walking and cycling but may also provide alternatives to adopted highways on which it may be more difficult to make adequate provision. Adopted highways may

also be more important in their pedestrian or cycle role than they are as a vehicle route and residential streets need to be considered first and foremost as community facilities.

It is also necessary to be aware that the attractiveness of a walking route will affect the distance people are prepared to walk. A diversion from a tree-lined, green (eg through fields or parks, or past greenspace or open plan gardens) or waterside path onto a route lacking equivalent attractive features is likely to seriously affect the walking route. So is diversion from a quiet route to a pavement alongside heavy traffic. Highways engineers have traditionally thought only in terms of the width and availability of the highway but on walking routes they need also to think in terms of its aesthetics. Green infrastructure is as important as surfacing and lighting.

12.4 Road Safety

12.4.1 Road safety and (mis)perceptions of danger

The safety of active travel has improved. In 2006, the fatality rate for pedestrians was 54% lower than the 1980 level and for pedal cyclists it was 46% lower.[23] However, the perceived safety when walking and cycling has not improved. Rather, perceptions of danger from rising motor traffic levels has increased.

Children and elderly people dying from road injuries are most likely to be pedestrians, while other adults are most likely to be car occupants. Pedestrian death rates are highest for children and elderly people, while car occupant and motor-cyclist death rates are particularly high for young adults.[24] Motorcyclists represent 20% of road fatalities but just 1% of traffic.[25] Rural areas also have their own particular risks including speed limits and visibility on country roads. In addition to the picture painted by road safety statistics, it is telling that 65% of respondents in a 1999 survey[26] reported feeling threatened some or all of the time when walking, cycling or riding on country lanes.

12.4.2 Danger aversion

Changing behaviour to avoid danger may be stressful or may be restricting (e.g. keeping children indoors instead of allowing them to play). The side-effects of danger aversion may also be hidden from standard transport statistics. For example, a busy main road in an urban area may have very few pedestrian injuries because pedestrians perceive it, correctly, to be so dangerous that they avoid crossing it as much as possible and take great care when doing so. A new approach within road safety to augment casualty reduction is required and this is road danger reduction, to place greater emphasis on the threat rather than the victims.

12.4.3 Road danger reduction

It is worth stating that a more accurate gauge of safety is whether pedestrian and/or cyclists use increases and this needs to be central to understanding perceived and real danger posed by motor traffic and the inequitable burden on injury among those mode users which are least carbon intensive and most health promoting. Much of the emphasis within traffic management to date has been upon getting the vulnerable road users to bear the burden of responsibility for their own safety and through the promotion of secondary safety measures, largely focused on improving safety within vehicles.[27] To achieve a substantive change would require a road danger reduction approach which tackles danger at source as illustrated perhaps most clearly through the Dutch national Sustainable Safety Programme. The idea behind the programme

has been to make the Dutch road network inherently safe. In many cases this means slowing down motor traffic in any settlements.[28]

12.4.4 Driver behaviour

90% of crashes are attributable to driver behaviour,[29] such as excessive speed or alcohol consumption. Excessive speed was recorded as a contributory factor in 26% of road fatalities in 2007.[25] In collisions between cars and pedestrians at 20mph only 5% of pedestrians are killed, whereas at 30mph about half are killed, and at 40mph only 5% survive.[30] The reason for this is that kinetic energy increases in proportion to the square of vehicle speed – therefore there is a steep increase in fatality risk with increased speed.

In addition to promoting good driver behaviour, drivers also need to be trained in what to do in unforeseen circumstances, such as when hit by another vehicle or skidding on ice. If driving is compared with the extensive worst case scenario training given to pilots or train drivers, it is clear there is a long way to go in this area.

12.4.5 Walking

Pedestrians admitted to hospital are more severely injured and their treatment costs twice as much as motor vehicle drivers and passengers.[31] It is therefore paramount to understand how pedestrians are injured and tackle the source of these injuries.

Collisions between pedestrians and motor vehicles during road crossing occur either due to a failure of the driver and the pedestrian to detect each other, or to anticipate each others' movements. Measures to reduce these risks include reducing road speeds to increase the time available to react, reducing crossing distances to reduce the area to be assessed by the pedestrian, and improving visibility by providing clear zones around junctions and crossings. Failures of anticipation may result from both parties assuming precedence. While speed reduction can mitigate the effects of this, it is also important to avoid measures that imply motor vehicle precedence, particularly in areas where pedestrians may want to cross the road or where children may run out.

12.4.6 Cycling

Studies have found a substantial decrease in the risk of death among those who spent three hours per week commuting to work by bicycle compared with those who did not commute by bicycle.[32] Overall, studies show that the life-extending health benefits of cycling are about 20 times greater than the life years lost in road crashes.[33]

It is a popular myth that cycle crashes are under reported by police. This is because more KSI (Killed or Seriously Injured) incidents are reported in Hospital Episode Statistics (HES) which is based on hospital admissions than in the STATS19 database maintained by the Department for Transport (DfT) which is based on police reports. The difference between the two arises because while STATS19 reports only genuine road traffic collisions, HES includes all hospital admissions involving a cyclist – even if the cyclist simply fell of a bicycle in their own front drive. In the same way as a pedestrian tripping over is not a traffic incident, neither is a cyclist falling off their bike with no external influence, either on or off the highway. It is calculated that by including falls in the highway or in an 'unspecified place' within cycle casualty figures, the figures are inflated by approximately 3.2 times.

Road casualty trends show that cycling has experienced a greater relative increase in safety since 1970 than the car.[34] Considering the improvements to vehicle safety technology in the

intervening period, such as seatbelts, airbags, and crumple zones, the improvements in cycle safety are striking.

12.5 Children's travel & safe routes to school

Nationally, 46% of children walk to school.[35] Travel to school by car increased from 16% in 1985/87 to 32% in 2006.[36] The biggest growth in trip types nationally between 1975/76[37] and 2008[11] was escort trips made by a person to take someone else. The statistics show that children's independent mobility has been curtailed, with an increase in the average age at which they are allowed to travel unescorted by foot, bicycle or bus.[38] Parents restrict their children's movements or escort them because of fear of traffic[11] and fear of attack by strangers.[39]

Driving children to school reduces social interaction. Accompanying children on the journey to school, particularly when it involves sitting in a car rather than walking to school, can adversely affect children's development, due to reduced opportunity for exploration and social and motor skill development.[4041] The consequence of the increased trend for children to be driven to school has led to high proportion being insufficiently active, partly through reduced walking and cycling leading to high obesity levels.[42] For comparison, the average number of trips cycled per child in the UK is 18 per year, compared with 530 for a Dutch child.[43]

The 2008 National Travel Survey[11] showed that the greatest reason for children to be accompanied to school, accounting for 58% of 7-10 year olds and 34% of 11-13 year olds, was fear of traffic. Although Great Britain has one of the lowest mortality rates for all road injuries in Europe, the best figures for child pedestrians in Sweden are a third of the UK figures.[44] Child cyclists and pedestrians together account for almost 80% of serious injuries to children from motor traffic.

Measures to improve child safety and perceptions of safety will therefore be key to encouraging parents to let their children walk to school. Road safety education and cycling proficiency should be integrated into the usual school and PE curriculum to teach good habits from an early age, and the requirement to provide these lessons should be built into school travel plans. Because of the increased risk of children behaving unpredictably in or near the road, speeds on roads outside schools should be limited to 20mph at the beginning and end of the school day as standard, to ensure that drivers are moving slow enough to react. Visibility is also important: a high density of kerbside parking is associated with increased risk of injury to children.[45] Visibility provided by 'school keep clear' markings will only be provided if they are policed effectively; many parents see them as a convenient drop-off zone. The ideal situation is one in which the roads outside the school is as free of motor-traffic as possible. Moreover, residential streets should have speed limits no higher than 20mph. There are no significant time penalties nor changes in vehicle emissions or noise, rather there is reduced danger and increased quality of life for residents.

12.6 Demand Management

12.6.1 Saturation vs. Congestion

Everyone has a certain 'time budget' that they are willing to spend travelling each day. Through major changes in transport conditions, this has remained fairly static since 1952 at around an hour.[46] However, over time the distance that an individual can travel in one hour has increased substantially due to higher car ownership and a more fine-grained and high speed road network. This means that whereas in the 1970s a person may have chosen to live five miles from their

work and spend half an hour each way cycling, the same person in 2010 could live 20-30 miles from their workplace on a motorway corridor.

It follows, therefore, that if the average speed of the roads is 40mph, then the person would be willing to live 20 miles from their place of work. If those roads are improved so that the average speed increases to 60mph, the person might decide to move to a more pleasant location another 10 miles away from their place of work – keeping the journey time at 30 minutes each way. However, they will not be the only person having the same idea, and over time the average mileage increases, which means the number of vehicles on the network increases, increasing congestion and reducing driving speeds to something like their original levels. Road building has been shown to increase road use by as much as 8-10% per year between the improvement being opened and returning to a state of congestion.[47] This state of being, where there is a dense enough travelling population that journey time benefits from road improvements, is referred to as saturation, and is considered in more detail in Chapter 10.

In the 1950s people might have expected an uncongested journey on a trunk road to average 30 to 40mph. Now they might expect an uncongested motorway journey to average 60 to 80mph. The radius of a circle is proportional to the square of its radius so a doubling of speed increases fourfold the area that can be visited in a given time. Metcalfe's Law predicts that the number of potential connections in an area is proportional to the square of its size so a fourfold increase in the area that can be visited is a sixteen fold increase in journey opportunities. Accordingly, a two lane trunk road that was at capacity in the 1950s would need to be replaced by a 32-lane motorway to avoid congestion - even before making provision for increase in car ownership.

There are two potential ways of tackling congestion in a saturated system: managing demand by reducing the incentives to travel, either by increasing the cost or providing benefits to staying local, or by providing parallel networks that do not result in an additional load on the existing saturated network.

12.5.5 The Implications of Saturation for Highways Engineers

Highways engineers have been slow to grasp the significance of Mogridge's work,[50] of Pigou's Theorem and of the SACTRA study.[48] There is still inadequate understanding of the differences between highways engineering in saturated and unsaturated road systems.

Many traditional methods of highways planning, including traffic prediction methodologies, plans for removing bottlenecks to get traffic to flow more freely, and increasing capacity to ease congestion are inappropriate on saturated roads. They are not wrong – on unsaturated road systems they are as valid as they ever were. It is simply that less and less of our road system is unsaturated. The distinction between a saturated and an unsaturated road network is therefore a fundamental one as it points to one or other of two entirely different mathematical analyses of congestion, each of them valid where its own preconditions are met and each of them wholly unhelpful in the opposite setting.

To understand the concept of saturation we need to think of a motorway system in the absence of congestion as being technically capable of conveying traffic at 80mph. Since large numbers of people are prepared to commute for up to an hour this means that Manchester, Liverpool, Teesside and Sheffield are within commuting distance of Leeds. Once this situation arises and starts to feed itself into life choices the range of possible home to work linkages becomes unplannable and the potential traffic flows exceed any possibility of being accommodated on the road system. Congestion is the factor which corrects this situation – it limits the speed of traffic and hence the number of potential linkages and the consequent traffic flows.

In this situation we need to learn a new approach in which new roads do not ease congestion – it returns to equilibrium levels with more people exposed to it. Removing bottlenecks does not ease traffic flow – it simply exposes to congestion areas which were previously protected by the bottleneck. No longer can traffic flow be predicted by projection from past trends – it can only by predicted by calculating the flow which will occur at the present equilibrium congestion speed along any enhanced or reduced road capacity.

The choices which drive the tendency to equilibrium congestion speeds are not choices on a day to day basis about individual journeys. They are life choices made by individuals choosing where they can live and work. As a result the old methods will still achieve a temporary relief even in a saturated system. These effects however will be temporary and when the equilibrium levels of congestion reassert themselves those who chose lifestyles dependent on a freer flow of traffic will be left high and dry. Highways engineers who have not learned the concept of saturation create human misery for those who succumb to the chimera they transiently create.

One of the first questions that a highways engineer ought therefore to ask is "Is this road system saturated?" This is a fundamental question which leads to completely different predictive and design approaches. Unfortunately the question has not been analysed as extensively as it should have been. There are no clearly defined criteria for answering it. However from theoretical first principles it seems that it will occur when:

- the distance between major settlements is less than the distance which can be covered in the time people are willing to commute at the speed attainable in an uncongested system.
- one practical symptom of saturation is "spreading of the peak" whereby people alter the times of their journeys to avoid maximum congestion and the traffic levels rise to a more even level at all times (reflecting the tendency to equilibrium congestion)
- evidence that congestion is general across a wide network rather than occurring only at a few points would also suggest saturation
- so would evidence that road improvements lead to traffic rising until congestion re-emerges

Major Intercity and Interurban Roads

Inverness is the only city in Great Britain which is more than 80 miles from another city (although Penzance is almost 80 miles from Plymouth). It is therefore only in such lightly populated areas as the Highlands of Scotland or in Cornwall that the question "is this congested intercity road saturated?" is even worth asking. If congestion exists on most of the British motorway or trunk road system it is because of saturation. Plans to widen such roads or to build relief roads are therefore doomed to failure. Bypassing bottlenecks is pointless unless it is to ease quality of life in a settlement affected by heavy traffic and even then the bypass should be designed so that it does not enhance road capacity – it should be no wider or faster than the existing road and the existing road should simultaneously cease to be a through vehicular route.

Congestion on the motorway system will be eased only by investing in high capacity public transport alternatives or in alternatives to travel. High speed trains can easily exceed the speed of motorways and it is probably only the lack of a comprehensive network, fare levels and inadequacy of feeder systems that prevent the rail system competitively increasing the trade off point that creates the equilibrium congestion speed.

The development of rolling motorways (trains carrying road vehicles) as part of a service on reinstated railway lines may be worth consideration in some circumstances (the Woodhead route is much talked about). In mopping up some of the road traffic, it is open to the same criticism as other means of enhancing road capacity, in that the traffic removed will in theory be replaced. However if other trains also use the route, it simultaneously creates rail capacity which may increase equilibrium congestion speed and thus prevent the freed road capacity from

filling up. The conversion of motorways into automated highways with the road space released being given up to rail use has the same dual characteristic.

A similar analysis applies to most interurban roads although there are some parts of the country where roads linking relatively dispersed relatively small towns may not yet be saturated. Sometimes however this unsaturated situation exists only because the roads are not fast enough for 80 miles to be a theoretically viable commuting distance and that if they were improved the result would be traffic generation which would saturate them and create congestion.

Urban Network Roads

Most congestion on urban network roads is due to saturation and therefore it will be exceptional for it to be possible to address it by road improvements. It will require improvements of the alternatives (cycling and public transport) so as to raise the trade off point. Taking road space away from general traffic and giving it to buses, trams and cyclists ought counterintuitively to improve congestion if it takes place across a wide enough area to impact on the quality of the cycle network and public transport network thus raising the trade off point. This may not happen however if it is limited to a short isolated stretch and more traditional assessments of its impact may need to be made.

Rural Roads Linking Villages and Small Towns

These roads may well be unsaturated, especially some distance away from large towns, and traditional approaches to congestion and road improvement may be appropriate. However closer to large towns care needs to be taken that speeding up traffic with road improvements doesn't encourage commuting and draw the road into the saturated urban network.

12.6.2 Road user charging

Road user charging is a way of getting over the economic problems of roads encompassed by Pigou's Theorem. Pigou's Theorem points out that when a system is expensive to set up but then cheap to expand, it is common sense to attract as many users as possible to offset the setup costs. However, if the setup costs are so great that they can never be recovered from the users at a price the majority are willing to pay, then the options are either to subsidise use, or to price the system so that only those who can pay the high price necessary to fund the setup costs will use it, and leave the rest of the capacity empty.

The road system, being free at the point of use, is therefore effectively subsidised. However this has resulted in a situation where demand exceeds capacity. Because roads are free at the point of use, they also exhibit a classic 'tragedy of the commons' scenario. This occurs where everybody tries to buy an advantage and as a result destroys the very advantage they were trying to buy, while making things worse for everybody else.

While the cost of travel by all modes has increased more slowly than growth in disposable income, the cost of motoring proportionate to disposable income has fallen more in the last ten years than has the cost of public transport. Indeed the cost of motoring has fallen in real terms to approximately 85% of 1997 costs, whereas that of public transport has increased (although by less than disposable income).[49] The fall in the cost of motoring has been a result of reduced setup costs – the cost of purchasing a vehicle in 2008 was half the 1997 cost, whereas running costs have increased by almost 25%.

Road user charging makes it economically efficient to have a level of unused capacity, and is therefore both a useful way of managing demand to de-saturate the network, and internalising the external costs of each additional user, to combat the tragedy of the commons situation.

12.6.3 Alternative networks

If an entirely alternative network is provided, it is possible to remove people, and therefore congestion, *en masse* from a saturated system. For this to happen, the alternative network must be comprehensive enough to be able to cater to whole trips, rather than just individual routes. In practical terms, this means that providing a bus route from A to B is not enough to remove cars from the saturated road system if what travellers really want is to travel from A to B and then on to C before travelling back to A.

This theory was tested by Mogridge using data from London. The analysis showed that congestion in London was affected more by the quality of rail services than by anything done to the roads[50]. In the UK there is four times as much road traffic as public transport traffic, so to overcome saturation by providing alternative networks it will be necessary to increase public transport use by four times the desired proportionate road traffic reduction.

A key action is ensuring that public transport operators and planners are consulted when new road schemes are proposed, to ensure that new roads do not diminish opportunities to expand the public transport network. Although it seems counter-intuitive, reallocating road space to public transport should over the long term reduce congestion, if the public transport is part of a sufficiently comprehensive and efficient network.

12.6.4 Land use planning

Land use planning has a role to play in managing the need to travel and enabling alternative networks to be used. The shift towards mixed use development has intended to increase the extent to which services and employment are provided within a short distance of homes, minimising the distance travelled. Simultaneously, increasing development concentration increases the viability of public transport networks by creating a situation where fewer routes are needed to provided the same level of service, or a greater level of service can be provided on an existing route.

12.7 Reducing car dependency: public transport networks

In addition to the well-known environmental effects of car dependency, car dependency is detrimental to the viability of public transport networks, and exacerbates social inequalities by creating a society whose spatial layout assumes car ownership: in the lowest income quintile, fewer than half the households own a car, whereas in the top quintile only 11% have no car – and half own two or more (Chapter 9).

12.7.1 Suppressed demand

Demand suppression results from potential users travelling by another mode because the network only caters to part of their travel requirements. This can occur on either a spatial or a temporal level. Spatially, if a user could get the bus from A to B but then needs to travel on to C where there is no public transport route, they will either drive the entire route, or avoid travelling to C.

Temporally, a similar situation occurs with the last bus. Many people are not prepared to risk missing the last bus so catch the one before it; the bus operator notices that the last bus runs empty and so cancels it. The penultimate bus then becomes the last bus, and passengers shift to the one before it – and so on, until the system completely fails to serve late evening travellers and they drive or avoid travelling instead.

Both of these can only be tackled by a spatially and temporally comprehensive transport web, and raises the question of the aim of providing public transport. If it is to make a profit, then suppressing demand is a short-term gain that in the long run will make the mode as a whole less viable. If it is to achieve mode shift, then comprehensive networks need to be provided to stimulate mode shift, rather than modal shift stimulating additional provision. Either way, suppressed demand needs to be considered more widely when planning public transport provision and operations.

12.7.2 Safety and attractiveness

The perception of public transport is key to its uptake. A comparison of European cities shows that bus travel is greater in cities with rail-based travel than in those with bus-based public transport.[51] The explanation proposed is that the perceived quality and greater reliability of the rail network is better at attracting people out of cars. Once they are out of their cars, rail users then may consider other modes of public transport.

Safety is also a key consideration on public transport. A DfT survey found that 27% of bus users had seen someone being insulted, pestered, harassed, threatened or spat at in the last 12 months; 10% had seen someone assaulted, mugged or robbed.[52] A measure to improve safety on trains is to designate a 'safe coach' on late evening services, allowing passengers to group together in the same part of the train rather than being dispersed alone in separate carriages. Open or walk-through carriages achieve the same aim of ensuring no-one is trapped with someone threatening in a carriage between stations.

12.7.3 The cycle-train combination

The only way that the public transport system can compete with the car in terms of flexibility is to combine it with a personal transit system to create a speedy link between the origin/destination and the nearest public transport stop. The bicycle is the ideal way of doing this.

The cycle-train combination is currently under-developed in the UK compared with best practice elsewhere. 50% of the population own a bike and 60% live within 15 minutes ride from a train station, but only 2% of train passengers travel to the station by bike. In contrast, 40% of passengers in the Netherlands cycle to the station.[53] There is apparently suppressed demand for cycling to stations; 70% of respondents to a London Assembly Transport Committee survey considered that cycle facilities at Tube stations are inadequate, and 62% considered cited National Rail stations as providing inadequate facilities.[54]

Another approach that has been successful internationally is on-train bicycle carriage. Cal Train in California provides at least one cycle van on every train, and two vans on the most popular commuter trains, creating capacity for 80 cycles. Cal Train measures the success of its promotion not in terms of the percentage increase in cyclists carried but in terms of the percentage increase in total ridership attributable to cyclists: from 2003 to 2006, walk-on passengers increased 16%, whereas bicycle passengers increased 41%.[55] Using this measure, Cal Train has experienced payback times of just six months.[56]

12.8 Urban design: home zones, walkability and social support

The replication by Hart of the earlier study by Appleyard & Lintell now makes it clear that motor traffic in residential streets diminishes social support networks amongst residents and also leads to a lack of sense of possession over large areas of the street. The implications of this are very serious – social support is a major factor reducing mortality while areas of street over which

residents do not feel possession will increase crime, disorder and vandalism. It should now be regarded as unacceptable for a residential street to have a steady flow of traffic and development control must prevent any further such situations on new developments.

A major rethink of the street system is necessitated by the recognition of the high public health priority attached to walking and cycling coupled with the recognition from Appleyard/Lintell/Hart's work that steady traffic flows in streets have a serious impact on the health of residents. The urban street system needs to be seen as fulfilling three roles. It is the final link in the urban road system allowing vehicles to reach homes, shops, workplaces and businesses. It is the gap between houses – a community open space with important functions in maintaining social networks and community interaction. It is a set of routes that can be used to make provision for walkers and cyclists away from main roads. The problem for the highways engineer is how to balance these three roles. This balance may not be achieved by unthinkingly applying traditional design approaches which give pre-eminence to its role as a passage for local traffic.

12.8.1 Walkability: permeability and pedestrian priority

According to the DfT National Travel Survey 2007, the majority of adults agreed everyone should be encouraged to walk for their health (97%), the environment (94%) and to ease congestion (92%).[57] However, only 41% of men and 33% of women questioned in a general population survey reported walking 'brisk or fast' for ten minutes in the previous four weeks.[42] Nationally, 11% of commuters walk to work.[58]

Residents in a high walkable neighbourhood are likely to take more steps per day and walk more for transport than residents in a low walkable neighbourhood.[59] This is particularly pronounced for adults who previously had a preference for non-active transport and/or a low intention to walk or cycle. Pedestrian-permeable street designs are associated with 6lb lower mean population weight than pedestrian-impermeable environments.[60] This difference in weight is equivalent to an annual death rate of 1 per 1000 – which means one extra death every ten years in a population of 100, which could be as few as 25-30 houses. Walking more slowly than needed to increase fitness still aids weight control, as the same amount of energy is used up almost independent of the speed walked.[61]

The key elements of a walkable neighbourhood are small block sizes and low, slow traffic flows. Block size is usually determined by architects, so a key role of transport professionals is to influence designs at an early stage, referring to best practice such as the Urban Design Compendium.[62]

Slow traffic flows means traffic should move at 20mph or less. Driving two miles at 20mph takes 6 minutes, as opposed to 4 minutes at 30mph or 3 minutes at 40mph. There is little to be gained by driving faster than 20mph in residential side streets or streets outside schools, and therefore the safety of pedestrians in these areas should be the clear priority. 20mph zones should therefore be the standard in residential areas and outside schools at the beginning and end of the school day. Manual for Streets[63] provides the key design guidance on how to create these.

Where closure or diversion is proposed of minor urban roads (eg alleys) or rights of way used for utility walking it is important to be aware of the fact that utility walking is very distance sensitive. Any diversion of more than about 50 metres needs to be thought of very carefully and diversions of more than 100 metres should be seen as seriously affecting a walking route.

This is important when alleygating proposals are concerned. Alleygating of a back alley which is no more attractive than the parallel main street may well be acceptable. This cannot be said for gating of cross alleys, link passages or routes that are more attractive than the proposed

alternative. Other solutions must be found to security problems. If 30 houses suffer loss of pedestrian permeability then, if there are on average just over 3 residents per house, there will be one extra death every ten years. We cannot solve problems of minor antisocial behaviour by killing people.

12.8.2 Social support

Research has shown that strength of social support is associated with a four-fold difference in all-cause mortality – a difference comparable in magnitude to the effects of poverty. The effect was so striking that the researchers initially refused to believe it, and undertook extensive further studies which confirmed the effect.

Studies by Appleyard & Lintell in San Francisco, repeated more recently in Bristol by Joshua Hart, show that motor traffic levels in streets are a key determinant of the strength of social support – the greater the traffic levels, the less likely people were to know and interact with their neighbours. However, street design can also promote community networks, by providing space to interact and play.

Access to state social support such as health services requires there to be relevant transport services. Hospitals with poor public transport access or located at the top of a hill will not provide as good a level of social support to people without access to cars as they would if provided with comprehensive public transport and a good walking environment.

12.8.3 Severance

Severance was defined in the late 1970s as: *"the sum of the divisive effects a major urban road has on the inhabitants on either side of it."*[64] Severance results in: *"pedestrian delay, trip diversion and suppression, pollution, perceived danger and overall unpleasantness."*[65]

Because severance disproportionately affects pedestrians and cyclists, it also encourages modal shift towards the car, or trip suppression where people do not have access to a car. Severance by major roads or train lines also creates noise, pollution and frequently leads to visual blight. Community severance can give rise to stress and isolation, by increasing the effective distance to places of employment and health promoting facilities such as schools, parks, shops, leisure centres, and health services. This means that community severance is linked to social exclusion[66] [67] and its associated health disbenefits. In addition to causing stress, noise can also impair health by causing a lack of sleep. A 2006 survey found that half a million Britons move house each year because of noise,[68] although it is not clear to what extent traffic is the cause. However noise effects can to some extent be designed out – quieter road surfaces such as porous asphalt can reduce noise by 4-8 decibels, equivalent to almost halving the volume of traffic.

Community severance cannot be quantified effectively at present. Valuable indicators of community severance that could be empirically assessed include traffic volume, noise levels and pedestrian delay in crossing roads.[69] [70] [71] In 1969, the Urban Motorways Committee proposed pedestrian delay as the most important indicator of severance by major urban roads,[72] and pedestrian delay was used in the willingness to pay study of traffic calming by Garrod and colleagues.[73] In San Francisco, 94% of pedestrians on the light traffic street reported waiting not at all or only a few seconds, compared with 49% on the street with medium, 25% heavy and 19% very heavy traffic[74]. The Kensington Environmental Management Study considered that a peak figure of 300 vehicles/hr provided an appropriate standard.[75] However the amount of traffic is mediated by the road layout: the Buchanan report *'Traffic in Towns'* showed that the wider the road, the lower the volume of traffic required to cause the same pedestrian delay.[69]

The Standing Advisory Committee on Trunk Road Assessment (SACTRA) and the Transport and Road Research Laboratory (TRRL) proposed that vulnerable groups be identified, the facilities (such as post office or health centre) they are likely to use be listed, and the catchment areas of those facilities be delineated.[65] The number of people living within this catchment area but separated from these facilities by major roads would form a measure of severance. Unfortunately, however, decisions regarding the critical delineation of these catchment areas remain arbitrary. The TRRL approach specifically involved creating a severance index which considered how many people (especially vulnerable people) have impaired access to their nearest facilities, together with traffic density and a mitigation factor representing the presence and acceptability of crossing facilities.

Although there is not yet a widely accepted methodology for assessing, quantifying, and monetarising severance, there is an assessment of severance in DfT transport analysis guidance (WebTAG), meaning that new infrastructure that would sever communities should be avoided. Where existing infrastructure or physical features such as rivers exist, the priority should be increasing the density of pleasant, safe, and universally accessible crossing points. These crossing points should be at grade, since steps and ramps add distance and time to walking and cycling trips, and can be insurmountable barriers to less mobile people. Subways and bridges can also be dangerous and unpleasant for users.

The Crossing of Roads by Pedestrians: minimising physical severance

Roads on which traffic creates a steady flow without many gaps or on which traffic is fast require safe crossing points. It is essential that these crossing points are located on pedestrian desire lines and do not require deviation – because each step is noticed, pedestrians are highly sensitive to deviation from their intended direction and will often take unsafe routes where a direct crossing is not provided.

It is tempting to provide crossing points on the basis of observed flows of pedestrians. However this approach is open to the very powerful criticism that there may seem to be no demand to cross the road simply because it is too dangerous for people to attempt it and hence the pedestrian cross flow is small. Such assessments should be replaced by a deliberate planning of pedestrian flows based on an assessment of local trip generators and attractors, and the desire lines between them. These should be provided in such a way as to minimise pedestrian deviation when accessing key destinations along the road (e.g. bus stop, school entrance) and destinations past the road (e.g. hospital or train station one block back from a main road). Where there are no ‘stand-out’ trip attractors, crossings should be provided at regular intervals to ensure that pedestrians are not deviated unacceptably from their desire line.

Where pedestrian networks are carefully designed so as to provide flows of pedestrians separate from flows of motor traffic a safe crossing point should be provided wherever a pedestrian route crosses a road with steady or fast traffic. This same principle can be followed for allowing walkers on rural footpaths to cross the main road – wherever a footpath crosses a road there should be a safe crossing and wherever a footpath ends on a road there should be a safe crossing before the next footpath on the other side of the road.

On roads with speeds above 40mph only signalised or grade-separated crossings will suffice for this purpose. At-grade crossings are preferred whenever they are feasible due to a myriad of problems with grade-separated problems: not only are they often unattractive and leave pedestrians vulnerable to attack, they are also difficult for people with mobility difficulties to access, whether it is stick-users for whom flights of stairs are a major barrier, wheelchair users for whom extensive ramps are too large a challenge, or scooter users who can frequently have their path blocked by barriers intended to prevent cycle access.

On roads where visibility is greater than sight stopping distance at the actual traffic speed, zebra crossings can be a satisfactory alternative to signalised crossings, although it is important to note that a study of elderly pedestrians and scooter users found that feeling in control of traffic (using signalised or zebra crossings) was key to a feeling of safety on crossings.[76] On such roads central refuges may suffice if the traffic flow is small enough that gaps in the traffic will occur every minute or so even if only in one direction. When speed falls to less than 20mph and cars and pedestrians mix more as equals, the majority of crossings are likely to be at informal locations. However even in these areas, regular formal crossings should be provided with raised tables and tactile pavings, to ensure that people who need these facilities are adequately catered for.

12.8.4 Aesthetics

Studies have shown that aesthetically attractive settings, particularly those including greenspace or water features, may diminish physical ill health.[77] [78] Conversely, traffic impacts that preclude tranquillity such as heavy traffic or aircraft noise have been shown to have negative impacts on health. These are discussed further in Chapter 5.

Traffic, whether moving, stationary or parked, reduces the visual amenity of streets. A 2007 survey by the Commission for Architecture and the Built Environment (CABE) found that 31% of residents in new developments thought that roads and car parking dominated their development. Aesthetics are also key to establishing the priority on a street – whether it is a place for people or a link for vehicles. In streets where the majority of gardens have been converted into parking bays the width of the road is effectively trebled, leading to increased traffic speeds and increased risk and occurrence of accidents.[79] Conversely, streets where trees, benches, and grassed areas are used instead of chicanes or road humps as natural obstacles to slow traffic benefit from an attractive public realm and better traffic control.

12.8.5 Urban Residential Streets

Hart's replication in Bristol of Appleyard & Lintell's San Francisco study about the effect of traffic in streets on social networks has far reaching consequences for design of residential streets. It should now be regarded as unacceptable for a residential street to have a steady flow of motor traffic that interferes with its use for community networking.

The first impact of this should be on the attitude taken to rat runs – streets which are not intended to be major roads but have come to have heavy traffic flows because they form short cuts. Such rat runs should be closed to through motor traffic. This has two benefits; the residents are given back their lifesaving tranquillity and if a passage is retained for cyclists a new cycle route is created. The closing of rat runs has in the past often been a last resort, partly because of technical difficulties and partly out of a sense that motorists have the right to use the highway system. In future it should be the first and immediate professional response to steady traffic building up in a residential street due to a through traffic flow developing on what was meant to be only a local road. Rising bollards can be used as the obstruction if there is a wish to allow selected traffic (eg residents, buses, refuse vehicles, emergency vehicles, delivery vehicles).

The second impact should be on the advice highways engineers give in relation to planning applications which route traffic along residential streets as their means of access or which create a risk of such a route being chosen. Highways engineers should strenuously object to any development which will create a steady traffic flow along a residential street for a significant part of the day (there may perhaps be a balance to strike if it is only for a very limited part of each day). If this means that car parking must be remote from the development and access on foot

then so be it. Where the development is accessed by a proper access road, but there is a risk of traffic ignoring that and taking short cuts along a residential street, highways engineers should ask that the developer is required to fund the closure of the potential rat runs.

The third impact should be to render out of date the traditional design of the street as consisting only of carriageway and footway. The aim in future should be to carve areas for community interaction from the street– perhaps a tree with a seat around it, perhaps a picnic table for residents to chat, perhaps a play space, perhaps a communal garden to be maintained together, perhaps extensions to private gardens to be maintained privately but to be walked through and enjoyed together, or perhaps zanier ideas like a swimming pool. A residential street is the gap between houses. It needs to be possible to walk along it and move vehicles along it and there needs to be space to park vehicles but there can and should be other things as well. The carriageway may in the end be merely the gap between obstacles and in this context parking spaces can be arranged so as to serve as obstacles and to provide chicanes to slow traffic down and barriers to protect gardens or communal areas.

12.8.6 Urban Shopping Streets

Just as we must now think of urban residential streets as primarily for community interaction so we should think of shopping streets as being primarily for shopping. Studies conducted in Austria 10 years ago and in the UK recently found that retailers greatly overestimated the importance of the car and how far their customers travelled and underestimated how many of their customers walked, cycled or used public transport and how many shops they each visited.[80]

The passage of heavy traffic between rows of shops served from narrow pavements is unpleasant to shoppers. It removes spontaneity from crossing and recrossing the street, which becomes a barrier. It is dangerous in enticing people into dangerous crossing movements.

Where the street can be pedestrianised (except for cycles, buses and access) this should be the norm. It may be, however, that this is impossible without routeing through traffic along residential streets, which need protection even more.

A “high street” design with wide pavements, frequent crossing points, and controlled traffic speeds is the solution to such situations. Traffic should be slowed both for safety and also to increase the capacity of constrained road space so that the traffic flows freely but slowly.

12.9 Inclusive Transport

The people who experience the least benefit and the most disbenefit from transport are those who are disadvantaged in many other ways: women, children, people who are old, ill or have a disability, or are on a low income, or belong to a disadvantaged ethnic minority. The transport literature identifies these groups that are affected more as those who are more dependent on walking for transport.[65]

12.9.1 Women

Women tend to have different employment patterns, different time use patterns, and fewer financial resources than men.[81] They are more likely to be travelling encumbered by children or shopping, have greater safety fears, and wear different clothes. Women’s time is under greater pressure than men’s; women working full time have on average 23 fewer minutes per day leisure time than men working full time.[65]

Much of the transport system has been designed by men around the needs of the domestically inactive. Emphasis is given to journeys to work and long journeys, rather than to journeys for childminding or shopping. This can be seen in the radial layout of most cities' public transport systems, where the journey to work is catered for by rapid metro-type transit, whereas journeys to schools and shops are catered to by less reliable and often infrequent bus services, if at all. Because of the greater time pressure on women, public transport reliability is more important – yet local off-peak travel is largely by buses, which are markedly less reliable than peak time commuter transport.

Figures on car use assume that if a household has a car, all members of the household are thereby mobile. However, in 2003, only 61% of adult females had a driver's license, compared with 81% of adult males.[65] The possibility that the male partner may have taken the car to work or that some members of the family may be unable to drive is disregarded – yet can be vital in terms of informing design or service provision.

Women are a significant target audience for cycling to work, as their journeys to work tend to be shorter than men's so a higher proportion commute within the 3 mile distance that the British Medical Association suggested the majority of the population could cycle.[82] However, women are twice as likely as men to fear for their safety while cycling[83]. Data show that female commuter cyclists are more likely to prefer using off-road paths; a phenomenon which should be noted and acted upon by designers and travel planners hoping to increase female participation in cycling.[84]

12.9.2 Mobility difficulties

Fourteen percent of the general population has mobility difficulties, defined as anybody who has a disability or long standing illness or condition that makes it difficult either to go out on foot or to use local buses.[35] 45% of people aged 70 and over experience mobility difficulties, compared with 5% of those aged 16 to 49. Around one in four disabled people have difficulties using transport related to their health condition or disability.[85]

Restricted mobility may also occur on a temporary or intermittent basis when people are travelling with children, buggies, or luggage or shopping. Transport solutions aimed at those with disabilities will also improve mobility for these individuals. The 2005 Disability Discrimination Act has gone some way towards improving

12.9.3 Rural issues

Planners frequently assume that those choosing to live in rural areas make the decision in full knowledge that accessibility will be more difficult and they must compensate accordingly, usually by car ownership.[86] This assumption fails to consider those for whom living in an inaccessible location was not a choice. This may include those who are tied to a rural livelihood, elderly people and others unable to move away from rural areas, people who become disable din such a way as to prevent driving, and children not yet old enough to drive. In addition, there are those who have chosen a rural lifestyle but would inherently prefer not to be dependent on the car, whether for reasons of health, the environment, or cost. Even for households with a car, if the car is in use, other household members can be left unable to travel.[81] To fulfil the considerations of accessibility set out in the 1998 White Paper 'A New Deal for Transport' and Planning Policy Guidance 13: Transport (PPG13), it is essential to take into account all these groups and their different needs when considering rural transport.

12.10 Scheme appraisal

Reducing noise, improving air quality, reducing greenhouse gas emissions, and improving physical fitness are currently assessed within the Environment objective of DfT Transport Analysis Guidance (WebTAG) used in England. The Safety objective covers 'accidents' and personal security.

Best practice as expressed in WebTAG is to monetarise the health benefits referred to above. For example, for the physical fitness sub-objective, as set out in WebTAG unit 3.3.12,[87] the method is to calculate the change in all-cause mortality rates, translate that into lives saved or lost as a result of the scheme, and monetarise the cost/benefit using the standard economic value of a life.[88]

Health Impact Assessment is a mandatory requirement included within the Welsh Transport Planning and Appraisal Guidance[89] (WelTAG). However there is no set methodology, nor is there guidance on monetarising impacts. The Scottish Transport Assessment Guidance (STAG) does not cover health benefits of physical fitness. Although they could be included as part of 'wider economic benefits', this would rely on an individual planner's technical knowledge in the area or willingness to refer to the English guidance. This is a key issue in appraisal because standard appraisal software such as COBA and TUBA do not monetarise health benefits and so correct appraisal of health benefits/costs is overly reliant on the knowledge of the individual or organisation undertaking the study.

The accuracy of monetary estimations relies on the availability of information. Whereas improvements in physical fitness are relatively well documented and can be monetarised relatively easily, it is more difficult to estimate issues like reduction/increase in injuries as a result of a new walking/cycling facility: this relies on an estimate of the change in demand for walking or cycling and an estimate of the combined effect the new facility and the change in demand will have on injury rates, in order to calculate the value of injuries caused/prevented.

A major update to WebTAG currently in draft will place more emphasis on health benefits, establishing a new Safety, Security & Health objective, which will include sub-objectives assessing the extent to which a scheme will reduce the risk of death or injury, improve health through physical activity, and reduce air quality health costs. While these costs/benefits are monetarised, other issues such as severance and access to the transport system are not yet monetarised, which means they are easy to leave out of cost:benefit analysis. Furthermore, the health costs of stress caused by severance, noise, and inaccessibility are not currently considered in any way. While there has been progress, there is a long way to go. It is also important to note that all appraisal guidance is subject to overall government direction and is therefore under review following the formation of a new government.

There is an important difference between WebTAG and the approach public health professionals would advocate to Health Impact Assessment (HIA).[90] While WebTAG focuses on monetarising benefits public health focuses on identifying ways to maximise benefits and mitigate disbenefits. Thus HIA is not just about evaluating the scheme but also about shaping it. For that reason it should take place early before design is frozen. The NICE guidance referred to in section 12.3 above[19] has two policy goals for HIA:

1. Ensure government policy is assessed for its impact on cardiovascular disease (CVD); and
2. Ensure any such assessments are adequately incorporated into the policy making process.

It is important that any health impact assessment should address all the key transport determinants of health. The following is an appropriate list

- Crashes and injuries
- Impact on traffic levels
- Impact on walking and cycling
- Impact on public transport use
- Community severance
- Air quality and noise
- Impact on the number of houses experiencing constant traffic in their street
- Impact on access to facilities for car users and for others
- Impact on social support and stress
- Impact on availability of patches of tranquillity
- Impact on inequalities

12.11 Spatial & Transport Planning

12.11.1 The Role of Integrated Land Use & Transport Planning

There is now considerable evidence that congestion is a limiting factor in transport usage and therefore it cannot be eliminated – it will increase until it reaches the point at which it is unacceptable. This arises once the road system becomes saturated and although there is no research as to the criteria which lead to the conclusion that a road system is saturated, it seems from first principles that it will occur when the distance between major settlements is less than the distance which can be covered in the time people are willing to commute at the speed attainable in an uncongested system. Except in some remote areas, the UK road system is well past that point. The Downs-Thompson Corollary of Pigou's Theorem shows that once the road system is saturated road congestion will be influenced most by the availability of public transport as this provides an additional alternative to using a car or not travelling and therefore raises the equilibrium speed at which congestion leads people to make a decision not to travel. It should be noted that the decision not to travel is not on the whole a decision which is made journey by journey but is made in terms of life choices – what is the travel to work area of a particular employment site, how far will people travel to shop, will they restructure their lives to avoid travel at peak periods etc The Downs-Thompson Corollary however only addresses part of the problem because it assumes available capacity on the public transport system. When the road system and the rail system are both congested, or where reserved track public transport is not available, some other solution is called for. Walking and cycling provide alternatives to the car for short journeys and not travelling provides an alternative to the car and train for longer journeys.

Spatial planning has three major contributions to make to the avoidance of congestion. The first is that in those remote rural areas where the road system has not yet become saturated, it should avoid developments which will lead to it becoming saturated. This requires the maintenance of a rural economy which will avoid the rural area becoming dependent on the city, and it requires recognition of striking a balance between the development necessary to create

such an economy and developing the rural area to such an extent that it creates its own saturation.

The second is that in both urban and rural settings, spatial planners should aim to minimise the need to travel to access key facilities. This will further increase the options when choices are to be made and will therefore raise equilibrium congestion speed and reduce rail overcrowding. In the first instance this simply requires the maintenance of local facilities and restraints on the creation of facilities with excessive large catchments. However most areas of the UK have long passed the point at which a dispersed pattern of land usage can be avoided. Reversing the trend is therefore likely to include re-establishing local facilities, increasing working from home (which may require attention to broadband speed and capacity), promoting local multi-employer neighbourhood work stations (a largely new idea but probably one whose time is soon to come) and encouraging centralised facilities to have local outposts (eg shopping cooperatives to order from out of town shopping centres, tele-health to make some of the facilities of the large centralised hospital accessible in local health centres).

The third is that it needs to ensure that facilities are accessible by walking, cycling and public transport and that centralisation without such facilities is absolutely prohibited.

Although congestion alone would dictate such a strategy, reduced travel also addresses the problem of climate change, the promotion of walking and cycling addresses the problem of obesity, and the promotion of local facilities encourages the maintenance of strong local communities which will contribute to social support. Social support is a strong positive factor in reduced mortality.

12.11.2 International Transport Network Planning

Local transport planning is addressed in chapter 20, section 20.1.

An international high speed rail network needs to be developed if we are to curb the growth of air transport. Although in the first instance this needs to be developed by individual EU nations and linked on an EU basis, ultimately the EU needs to cooperate with other parts of the world to create an intercontinental network.

12.11.3 Development Control

We have discussed above in section 12.8.5 the role of development control in protecting residential streets from steady flows of through traffic. Development control officers are used to residents objecting to development on the basis of traffic creation and have tended to regard this as a relative factor to weigh in the balance. The discovery that a steady flow of traffic in streets causes serious health damage raises the significance of such objections. Development Control officers should be prepared to insist on separate access roads (with the developer paying to close the potential rat run along the existing street) or even car parks some distance from the development, with a walking route from the car park to the development. Development Control officers should ask for living streets design in all new residential developments.

Development control is one of the ultimate enforcement mechanisms for the roles we ascribe above to spatial planning. Development Control officers need the support of proper policies and development frameworks – this issue is discussed in chapter 20.

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