Public Health and Communities Leadership Team

Cover sheet

<table>
<tr><td>Report Title:</td><td colspan="3">Safe and active travel
Health Needs Assessment – Road Safety in Devon
(with note on active travel)</td></tr>
<tr><td colspan="2">Name of presenter: John Amosford</td><td colspan="2">Meeting Date: 27/11/2018</td></tr>
<tr><td rowspan="2">Purpose of report:
✓as appropriate</td><td>Information</td><td>Discussion</td><td>Decision</td></tr>
<tr><td></td><td>[Symbol]</td><td>[Symbol]</td></tr>
<tr><td>Key points to highlight:

Use this space to include key discussion or decision points and/or recommendations you wish to cover during the meeting.</td><td colspan="3">Discuss the adoption of a ‘Safe System’/system approach with specific reference to integrated working across CoPHEP, including support for:

• Further exploration around a positive approach to active travel in the built environment.

• Continued and developing community engagement in balanced transport environments.

• Integrated analysis of STATS19, HES, and NTS data with ‘Safe System’ approach.

• Influencing decisions around functional classification.

• Calling for a national approach for evidence base and transport advice guidance.</td></tr>
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Safe and Active Travel Health Needs Assessment

Road Safety in Devon (with note on active travel)

November 2018

Contents

Foreword

One in ten adults say they have been involved in a road collision in the last three years. Over the last ten years we have seen an increase in serious injuries on Devon's roads, with transport a leading cause of death for younger people. Concerns have been raised about the rising trend in serious injuries on our roads, with Devon's road safety performance falling behind the rest of the UK. These collisions in Devon have significant personal and economic costs, with over 45 people per 100,000 killed or seriously injured between 2014 and 2016, and an estimated cost of over one-hundred-and-sixty million pounds to the local economy each year.

Transport provides opportunities to access employment, leisure, and health services which improve quality of life. When people travel, they should be able to do so free from risk and harm, and able to use modes that support healthier lifestyles. Vulnerable road users, often using health travel options, are disproportionately affected by road collisions, as are younger drivers and those reaching older age. Those in more deprived areas, particularly child pedestrians, may suffer more harms through collisions, pollution, and restrictions on freedom, whilst benefitting least.

To address the issues, we face Devon County Council is adopting a 'Safe System' approach. This approach accepts that we all make mistakes when out on the roads, that there are limits to the collision forces we can withstand, and that a shared responsibility is required to ensure collisions do not lead to serious injury, or death. Our responsibility is to influence road user's behaviour through road infrastructure and education.

This report informs the development of a road safety strategy from a public health and safe system perspective.

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Safe and Active Travel
Health Needs Assessment
Road Safety in Devon
(with note on active travel)

1. Executive Summary

1.1. Road collisions present a significant health burden and are an important public health issue. In the UK road collisions are a leading cause of death for younger people between the ages of 5 and 35 years.

1.2. Devon's road safety performance has fallen behind that for the rest of the UK. The overall trend for serious injuries from road collisions has risen in Devon. The rise in rural areas has been greater and accounts for 70% of those killed or seriously injured on Devon's roads. In rural areas, child car occupant casualties are higher than other child-related travel casualties.

1.3. Car occupants are the largest proportion of casualties for all severities accounting for almost half (46%) of road deaths. Other main casualty groups are pedestrians 25%, motorcyclists 18% and cyclists 6%.

1.4. Casualty rates per mile reveal vulnerable road users as pedestrians, cyclists and motorcyclists. These vulnerable groups include forms of transport that are considered 'active' travel that promote health, contribute to general wellbeing, as well as having less impact on environments. Vulnerable road users account for 81% of urban, and 38% of rural, killed and seriously injured.

1.5. With higher injury rates, older pedestrians and drivers should also be considered a vulnerable group.

1.6. Devon is expecting the older population to increase significantly, with additional increases in younger age groups, both of which have higher population level casualty rates. Most recent rises for killed and serious injury are for car occupants, particularly older drivers.

1.7. At a population level, from reported casualty rates it can be seen that:

- Pedestrian accident rates appear more significant from all modes for children.
- Child pedestrian accident rates appear highest at secondary school transition age.
- Motorcycle rates appear highest during late teen and into the twenties (higher than the mid-teen walking rate).
- Rates for many factors appear higher in the late teens.
- The highest observed rate for drivers is in their twenties (higher than the mid-teen walking rate).
- The rate for drivers of both car and motorcycle are similar in the 40 to 60-year-old range.
- The rate for older pedestrians, drivers, and passengers appears to increase in older age, particularly at 80+.

1.8. The economic costs of collisions in Devon were estimated to be over £166 million per year.

1.9. It does not appear possible to identify any single or specific group of factors causing a rise in KSI figures in Devon, which although statistically significant, may be within a 'natural fluctuation'.

Interventions and a 'Safe System' Approach

1.10. Local Authority adoption of a Safe System approach to road safety has been set as a priority by Government. As the lead local authority on road safety, Devon County Council is developing a Safe System approach. This report informs the approach from a Public Health perspective.

1.11. A Safe System approach involves a paradigm shift from trying to prevent all collisions to preventing death and mitigating serious injury in road traffic collisions. The approach is based on the underlying principles that:

- Humans make frequent mistakes that lead to road collisions.
- The human body has a limited ability to sustain collision forces.
- A shared responsibility is required between road users, road managers and vehicle manufacturers to take appropriate actions to ensure that road collisions do not lead to serious or fatal injuries.

1.12. Although there appears to be no single model for a Safe System approach, the approach requires a shared responsibility for it to succeed. System-induced Exposure (SiE) needs to be managed through road infrastructure and regulations in relation to road skills, behaviour and vehicle design.

1.13. Rather than start with driver behaviour at the bottom, a Safe System approach starts from the top and looks at the system as to why a collision occurred and how systems can be developed to influence road users' behaviours to reduce collisions and collision severity.

1.14. Evidence appeared weak around school-based education programmes preventing injuries, including road injuries. Providing safe learning environments on road may be more productive. Stand-alone publicity campaigns have no effect and behaviours, such as speeding, difficult to change. Education, such as speed awareness courses, are more likely to be successful if used in conjunction with engineering and enforcement.

1.15. With the upward trend in serious injuries and adoption of a 'Safe System' approach, effective interventions to reduce harms to an acceptable level are required. Measures for older drivers, which may be applied to other, particularly younger, drivers have been suggested, these include:

- Road design adopted that reflects needs and capabilities of older drivers.
- Improve design to environments that older drivers experience difficulty with.

1.16. Improve infrastructure and land use to facilitate accessibility and availability of alternative transport options for seniors.

1.17. Devon data suggests that approaches and analysis should treat urban and rural environments differently. In urban areas, design and behaviour change would focus on prioritising accessibility and protection of all vulnerable road users. In rural areas, consideration will need to balancing access and mobility.

1.18. In Australia, behavioural risk factors such as speeding, drink driving and not wearing seatbelts were more prevalent in fatal collisions, whilst serious injury collisions were related to errors, mistakes and inattention. Analysis should consider looking at killed, seriously injured and minor injury locations causes and effects separately as well as in aggregate.

1.19. Differences between police STATS19, NHS Hospital Episode Statistics (HES) and Department for Transport National Travel Survey data require further exploration.

1.20. There is a distinction between a 'Safe System' approach and a 'systems approach', which appear to have differing antecedents and acceptability of levels of injury.

Observations

1.21. In adopting a 'Safe System' approach all 'five pillars' should be adopted as part of a strategic systems approach. Consideration should be given to a wider systems approach and injury levels, seeking to design a system that supports healthy environments, though this may be more achievable in urban environments, consideration needs to be given as to how this approach would work in rural areas of Devon.

1.22. Hospital Episode Statistics need to be considered alongside STATS19 data to reveal a fuller picture, together with information from the National Travel Survey. The expertise of the Road Safety Team and Public Health Intelligence Team could look to develop fuller models. Consideration should also be given to looking at data across a wider area to improve reliability.

1.23. Consideration should be given to specific strategic analysis to rural and urban roads environments though part of a wider system where 'functional classification' influences road safety emphasis based on a balance of communities, e.g. those driving, and communities being driven through.

1.24. Measures, such as reduction in speeds, should be considered where there is high accessibility potential, particularly for vulnerable road users such as child pedestrians.

1.25. Communities should be engaged in determining the type of environment they wish to live in, balancing access with mobility.

1.26. Further exploration of how to take a positive approach to active travel in relation to the built environment is carried out. This would include building on Public Health England's recent publication on spatial planning for health (Public Health England, 2017c). This would include a review of evidence to inform future planning decisions whilst considering wider determinants and adverse health impacts.

1.27. In line with Pillar 1, that Devon County Council supports a national approach to an evidenced-based Safe System whilst working through localism to understand the system at a community level.

Aims

1.28 To inform strategic direction with the adoption of a 'Safe Systems' approach (Department for Transport, 2015a) by reviewing road safety in the context of Public Health, the Public Health Profiles, and wider determinants of health. Wider issues affecting health and active travel are highlighted.

1.29 To consider Safe Systems based around the principle that no deaths or serious injuries are acceptable as a result of road transport, whilst seeking health improvements through continued support of active travel and reduction in negative impacts of transport on communities.

1.30 To reduce the impacts of road transport on all sectors of society, particularly the most vulnerable groups, whilst sharing the benefits. The Public Health Outcomes Framework's vision is to increase healthy life expectancy, reduce differences in life expectancy and healthy life expectancy between communities through greater improvements in more disadvantaged communities (Appendix A).

1.31 To open up discussions around balancing health promotion and risk prevention, in line with guidance such as 'Delivering healthy local transport plans':

- Supporting access and accessibility to maintain healthy and cohesive communities
- Encourage healthier lifestyles and promote physical activity as a key mode of transport and recreation
- To manage transport risks and support improvements in health throughout the community
- Reduce potential health risks to communities and commuters
- Support relative needs and support healthy improvements in all age groups
- Close the gaps in socio-economic and health inequality (Department for Transport, 2011a).

1.32 More detailed data and analysis on specific road safety issues is provided by the Council's Road Safety team; this report does not set out to reproduce the work of this team.

Objectives

1.33 This Health Needs Assessment (HNA) will primarily consider collisions and injuries, and broad health impacts in relation to road transport and surrounding environments. A need for wider consideration of road transport safety, particularly mental health and pollution, will be highlighted.

1.34 As road safety is a 'wicked' and complex problem with a vast research field this report aims to highlight some main factors. A rapid narrative review has been used to illustrate aspects of road safety to inform further actions.

1.35 Local Authority Public Health and Public Health England, as set up under the Health and Social Care 2012 Act, have no direct legal duties in relation to transport planning. However, transport has a major influence on protecting and improving the Nation's health and wellbeing. With the creation of the division of Communities, Public Health, Environment and Prosperity there is opportunity for specific expertise to work together on developing a Safe System approach with continued development of active travel initiatives.

Target Population

1.36 This Health Needs Assessment is for the whole population of the administrative area covered by Devon County Council (DCC), and transient populations using the Devon County road network and allied environments (14% of drivers involved in collisions were not from Devon, with highest involvement during the peak tourist season (Devon County Council, 2017a)).

1.37 Specific attention will be given to the most vulnerable groups in society; people with disabilities, older people, children and young people, and those affected by social deprivation.

1.38 Throughout various key modes of travel, active travel, and safety need to be considered in relation to 'functional classification', with a balance between mobility, accessibility, and wider safety for all. For example, in a city centre the accessibility for walking may be prioritised over wider mobility for other modes, whilst motorways will have significantly reduced (no) accessibility for non-motorised modes. Active travel modes include walking, cycling, and public transport, balanced with freight transport, and motorised private transport.

Part 1

2. What is a Safe System?

2.1 This section will introduce the principles of a Safe System approach, in relation to national road safety policies, before looking at issues in relation to roads and public health. Public Health England states that a rebalancing of transport systems is needed as the growth of road transport has been a major factor in reducing physical activity levels and increasing obesity (Public Health England, 2016). Urban design, land use, and transport systems that promote walking and cycling will help create active, healthier and more liveable communities (Public Health England, 2014b).

British Road Safety Statement

2.2 Government has stated that a key priority for road safety is to adopt a Safe System approach. It may be expected that within Devon (as nationally) road safety will now move in the direction of a Safe System approach, away from a reactive focus on spikes in data (Department for Transport, 2015a).

2.3 The British road safety statement, 'Working together to build a safer road system', recognises the current higher risk for vulnerable road users, whilst recognising that walking and cycling have clear health benefits. The safety statement sought to encourage active travel through behaviour change as well as safer and more suitable environments to improve health outcomes (Department for Transport, 2015a).

2.4 Accompanying the British road safety statement is guidance on road safety powers and devolution. This states that local authorities:

- are responsible for the management of local roads
- are required by statute to:
  - promote road safety
  - to undertake collision/casualty data analysis
  - to devise programmes, including engineering and road user education, training and publicity that will improve road safety (Department for Transport, 2015b).

2.5 A Safe System approach has evolved over many years and derives principally from the Swedish 'Vision Zero' (Kristianssen et al, 2018) and Dutch 'Sustainable Safety' strategies (PACTS, 2016). Although all are based on similar principles, there is no set interpretation of what a 'Safe System' looks like. Swedish and Dutch approaches are based around sets of principles, the Australian approach considers roads, vehicles, drivers and speed, whilst the UK approach focuses primarily on particular categories of road users (Hughes et al 2015, 2016).

2.6 The Safe System approach involves a paradigm shift from trying to prevent all collisions, to preventing death and mitigating serious injury in road traffic collisions (PACTS, 2016).

2.7 Safe System is based on the underlying principles that:

- Humans make frequent mistakes that lead to road collisions.
- The human body has a limited ability to sustain collision forces.
- A shared responsibility is required between, for example, road users, road managers and vehicle manufacturers to take appropriate actions to ensure that road collisions do not lead to serious or fatal injuries (PACTS, 2016)

2.8 A Safe System may be conceptualised as an approach that deals with human behaviour proactively by creating environments for safe behaviour (Wegman, 2017).

2.9 In adopting the 'Safe Systems' approach the Government has adopted the United Nations 'Five Pillars' (Table 1) strategic approach to managing road safety (Department for Transport, 2015a). A Safe System has five pillars of action (Figure 1) that require a shared multi-agency and societal response.

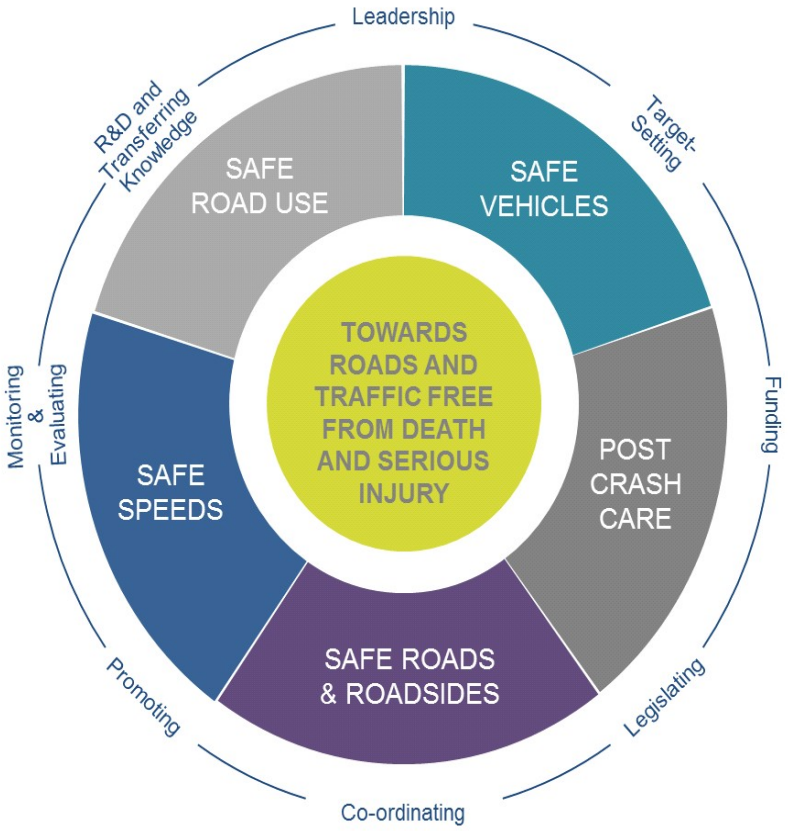
Table 1: **United Nations Five Pillars of Road Safety** (based on Department for Transport, 2015a, United Nations, 2010).

National activities	
Pillar 1 **Road safety management**	Road safety management encourages partnership working and lead agencies for the delivery of national[1] road safety strategies. This is underpinned by data and evidence-based research.
Pillar 2 **Safer roads and mobility**	Safer roads and mobility that shifts safety towards a protective quality of road networks for the benefit of all road users, particularly the most vulnerable (e.g. pedestrians, cyclists, and motorcyclists). This is through improved safety-conscious planning, design and operation of roads.
Pillar 3 **Safer vehicles**	Safer vehicles encourage improved vehicle safety technologies for both occupants and vulnerable road users.
Pillar 4 **Safer road users**	Safer road users seek to improve road user behaviour through education, awareness, and increased enforcement.
Pillar 5 **Post-collision response**	Post-collision response seeks to improve health systems response to emergency treatment and longer-term rehabilitation of collision victims.
International co-ordination of activities	

[1] The Government's devolution agenda supports local decision making rather than a centralised national approach (Department for Transport, 2015a).

2.10 The Parliamentary Advisory Council for Transport Safety (PACTS) also presents a visual representation for policy actions (Figure 1).

Figure 1: Safe System Wheel with Policy Actions (PACTS, 2016).



2.11 Further relevant Acts and legislation can be found in Appendix B.

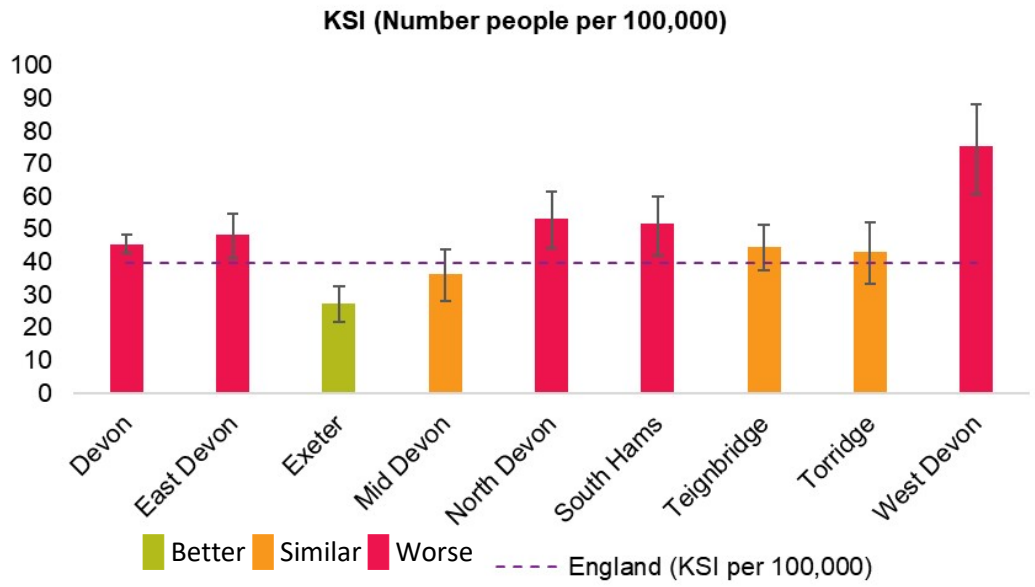
3. Why Are We Concerned About Collisions Resulting in Harm in Devon?

3.1 Concerns have been raised that the overall trend for serious injuries from road collisions is rising in Devon. This is of relevance at a time UK road safety policy adopts a 'Safe System' with the principle anyone being killed or seriously injured on the roads is unacceptable, given the controls available around road systems.

3.2 Devon's road safety performance is falling behind the rest of the UK. The County is currently ranked 74th out of 78 counties, with serious and fatal collisions increasing 20% between 2010-12 and 2014-15 (Road Safety Foundation, 2018).

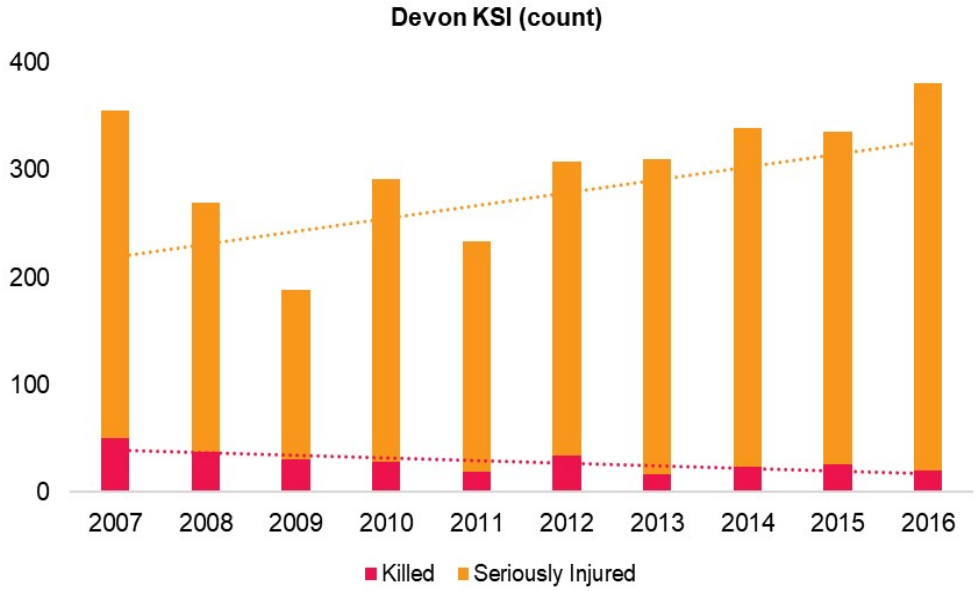
3.3 Devon is performing worse in relation to the number of people killed and seriously injured (KSI) on the County's roads compared to England as a whole. In 2014 to 2016 there were 45.5 people killed or seriously injured per 100,000 people, compared to England at 39.7. West Devon performed worse out of all districts with a KSI of 75.4 per 100,000 people (Figure 2).

Figure 2: KSI per 100,000 people (fingertips.phe.org.uk, 2018).



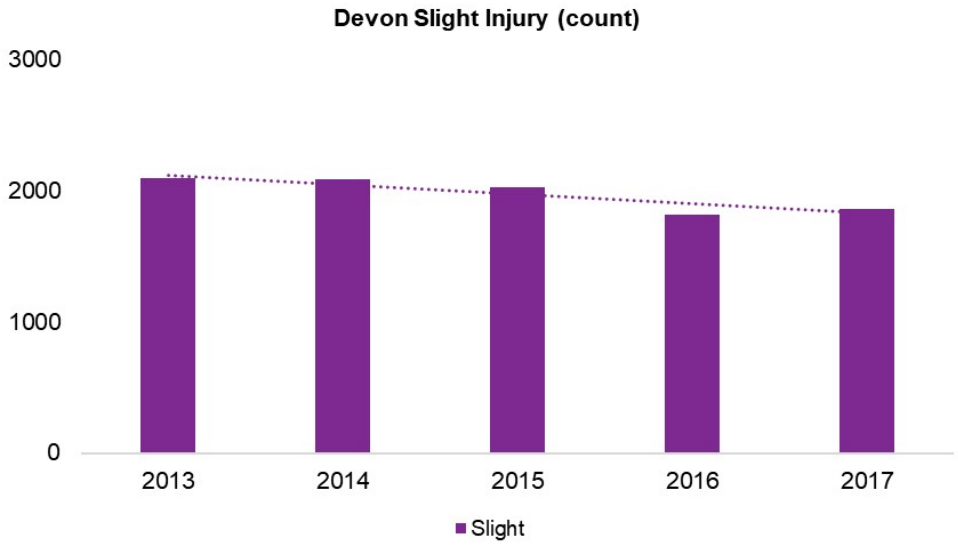
3.3 Over the last ten years the Killed or Seriously Injured trend appears to have increased. Although the "KSI together" events have increased, this trend appears to be due to a rise in serious injuries, whilst those killed has decreased (Devon County Council, 2017a). Serious injuries can have significant impacts on individuals and their families (Figure 3 below).

Figure 3: Killed and Serious Injured (KSI) Count for Devon
(Devon County Council, 2017a)



3.5 Minor injuries have decreased over the last five years (Figure 4), though these account for over four in every five accidents. The consequences of these 'minor' accidents need further consideration in relation to impact on those involved (almost 10,000 recorded in Devon over five years).

Figure 4: Slight Injury Count for Devon (new.devon.gov.uk, 2018)



3.6 According to the National Travel Survey for 2014 to 2017 around one in ten adults and one in 20 children say they have been involved in a road accident in the last three years (National Travel Survey, 2017). This suggests not all (minor) injuries are recorded and, potentially, a higher prevalence of injury than presented in data such as STATS19.

3.7 Prevalence of resulting injury in the population following collisions needs to be considered as well as incidence. Being killed in a road collision obviously has considerable impact on individuals, families and society. Non-fatal injuries can also have a significant impact on the quality, and length, of life of a collision survivor and their relatives. A study looking at six European countries, including England, found that 90% of serious injury resulted in lifelong consequences, with between 8.7 and 11.5 years lived with a disability (YLD) (Weijermars et al, 2018). Effects of minor injuries were difficult to determine with existing evidence.

3.8 Minor injuries account for over 80% of reported injuries (not all minor injuries may be reported). Looking through a 'public health lens' we may need to ask whether a minor injury is a predictor of a future, more serious event. Further to this we may apply the principle of Rose's (1985) 'population strategy' to control the determinants of incidence – what are the underlying causes that make the incidence of 'disease' (road collisions) common, particularly amongst younger drivers, what are the determinants? Looking at incidence and high-risk individuals (often only identified after the event) requires a sustained and continuous approach to identify 'risky' individuals or groups. A 'population strategy' would seek to reduce the exposure to the whole population and change the norms of what is socially acceptable (Rose, 1985). This should apply equally to road traffic collisions and other factors such as pollution.

3.9 A study in Australia found that 27% of work disability days resulting from a road collision were for those with no hospital stay, so therefore possibly some of the injuries classed as minor. Seventy one percent of sick days during their study period (17 months) were due to those with a week or less, or no hospital stay. These data were based around insurance claims with the cohort examined by an assessor (Berecki-Gisolf, Collie, and McClure, 2013). These disability work days resulting from road collisions will have costs to the individual and economy.

3.10 The economic costs of collisions in Devon, using 2017 data, were estimated to be over £166 million per year (Table 2). If a zero level of KSI was achieved, assuming same number of collisions but all slight, the reduction in casualty cost at current levels could be around £130 million per year.

Table 2: Devon Data Dashboard and DFT RAS60

Casualty type	Cost per casualty	Devon casualties	Total cost	Percentage of total cost
Killed	1,841,315	31	£57,080,765.00	34%
Serious	206,912	384	£79,454,208.00	48%
Slight	15,951	1866	£29,764,566.00	18%
All			**£166,299,539.00**	

3.11 In the UK, transport injuries are a leading cause of death for younger people between the ages of 5 and 35 years (ranked second ages five to 19 and third 20 to 34). After the age of 35, heart disease and stroke become leading causes which can be attributed to inactivity (Public Health England, 2017a). Over the ten-year period up to 2016, over 230,000 people (about the population of Plymouth) were killed or seriously injured in road collisions in the UK, from over 1.5 million injuries (Department for Transport, 2017). This is a significant public health issue affecting the population.

3.12 In considering 'road safety' we need to not only look at the 'acute' factors around road collisions, but also other preventable health outcomes. In managing the road environment, we need to consider the positive aspects of active travel, accessing work and leisure, and negative consequences such as the effect of pollution. The wider factors will be highlighted in Part 2.

3.13 With some evidence suggesting an upward trend in serious injuries together with the significant impact of acute and chronic effects of the road environment, this is an important public health issue. This report will look at these issues through a public health lens[2]. It should be noted that the Hospital Episode Statistics (HES) are showing a downward trend in Devon, though no explanation was immediately apparent (Devon County Council, 2017a).

4. Who Is at Risk of Harm from Road Injury?

4.1 This section will start to explore current literature from the Department for Transport and principal Public Health bodies in the UK around road safety. Who is more susceptible to harm from road injury, and whether there are factors that may explain an apparent increase in serious injuries, will be considered. An overview of the national picture followed by a summary of significant readily-available local data are presented.

[2] In considering public health benefits that seek to reduce barriers to implementing road safety measures we are working alongside the Road Safety team but may consider data in different ways to road safety reports produced by the Council.

Department for Transport

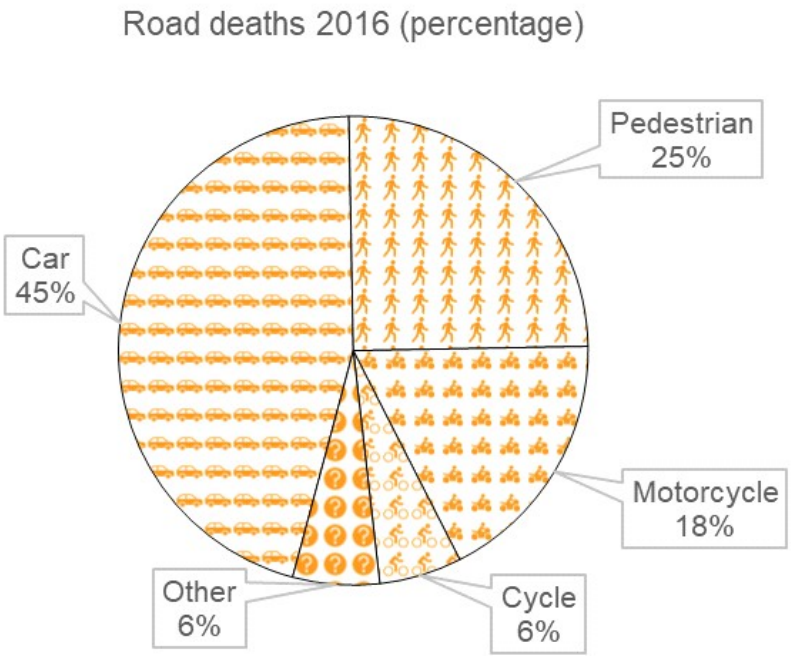
4.2 The Department for Transport (DfT) produces an annual statistical release on road casualties (usually around end of September each year) based on STATS19 collected by police forces.

4.3 Since 2010 the trend has been broadly static nationally in relation to fatalities. The 2016 annual report (Department for Transport, 2017) reported a 4%, not statistically significant, increase in road death nationally. Overall, there were 181,384 casualties of all severities; 3% lower than 2015 and lowest on record.

4.4 STATS19 only collects those injuries reported to police that occurred on a public highway. This means STATS19 do not represent the full range of accidents or casualties resulting from road or traffic accidents, which may explain some of the discrepancies with HES data. Additionally, the method of reporting severity has changed which influenced the serious injury category. The Department for Transport found no single factor or easily identifiable set of causes influencing road casualties based on available data (Department for Transport, 2017). The Transport Research Laboratory found that, even for some of the strongest relationships, there were only weak correlations (Pressley et al, 2016).

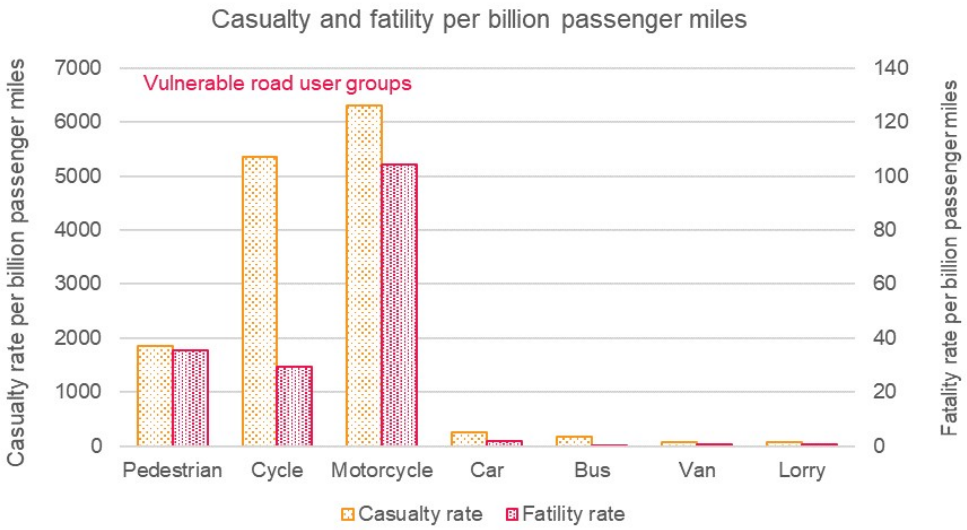
4.5 Overall, car occupants accounted for 46% of road deaths (80% of traffic), pedestrians 25%, motorcyclists 18% and cyclists 6% (Figure 5). Car occupants are the largest proportion of casualties for all severities (68% drivers, 32% passengers) so present a significant health burden.

Figure 5: Road Deaths by Mode (Department for Transport, 2017).



4.6 Casualty rates per mile travelled shows a different picture and reveals a group who have a much higher rate per mile which creates a class of ‘vulnerable road users’ (Figure 6). Vulnerable road groups are classified as pedestrians, cyclists and motorcyclists based on a vehicle mile rate. The vulnerable groups include forms of transport that are considered ‘active’ travel, that promote health and contribute to general wellbeing.

Figure 6: Casualty and Fatality Per Billion Passenger Miles and Vulnerable Road User Groups 2016 (Department for Transport, 2017).



4.7 Another way to consider the data is, as discussed earlier, at a population level. DfT produce data on population level rates. In Figure 7, the reported casualty rates for STATS19 have been broken down by age and principal mode of transport. From this it can be seen that:

- Pedestrian accidents rates appear more significant from all modes for children.
- Child pedestrian accident rates appear highest at secondary school transition age.
- Motorcycle rates appear highest during late teen and into the twenties (higher than the mid-teen walking rate).
- Rates for many factors appear higher in the late teens.
- The highest observed rate for drivers is in their twenties (higher than the mid-teen walking rate).
- The rate for drivers of both car and motorcycle are similar in the 40 to 60-year-old range.
- The rate for older pedestrians, drivers and passengers appears to increase in older age, particularly at 80+.

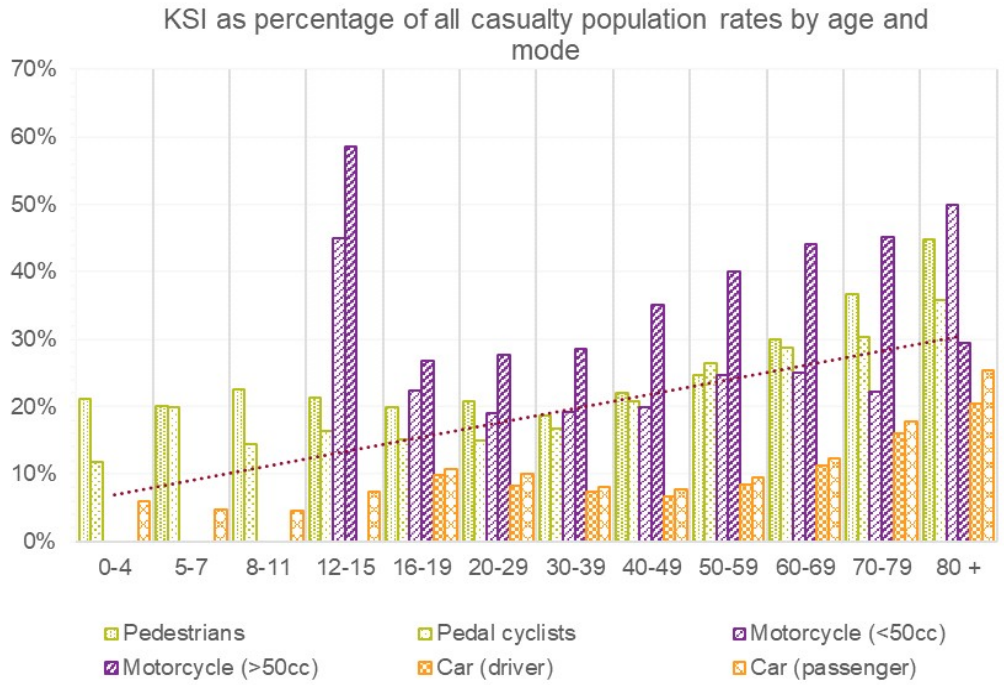
4.8 From relatively crude population rates and fatality per passenger miles it can be seen interventions may be targeted at specific groups and further exploration of these required.

4.9 If we consider KSI as a proportion of overall casualties, we can see that this increases with age (Figure 8). Hospital-based evidence has also found an increased mortality rate, particularly for older pedestrians and motorcyclists (Etehad et al, 2015). This suggests that, together with increasing rates to older pedestrians and remerging higher rate for older drivers and passengers, consideration should be given to older age as a vulnerable group.

4.10 Child pedestrians, older teenagers and those in their twenties may also be considered as a sub-group of vulnerable road users.

Figure 7: Reported Casualty Rates Per Million Population by Age Band, Transport Mode, and KSI From STATS19 for UK in 2019.

Figure 8: Based on STATS19 Data. Note high percentage at 12-14 ages range for motorcycles due to very low numbers involved.



4.11 As people age the prevalence of disability increases. STATS19 considers contributory factors in relation to the cause of the collision but does not appear to consider disability in relation to casualty rates to determine if there is increased vulnerability. The classification of disability being a contributory factor is down to the police officer attending a collision and are considered subjective (Department for Transport, 2017).

4.12 It appears that national databases, such as STATS19, still do not record disability as reported by the Transport Research Laboratory (TRL) in 2002 (Williams et al, 2002). The TRL reported that limited evidence appeared to indicate that vision or hearing impairments, and learning difficulties were associated with increased injury in road traffic collisions. Data did not appear to be available to inform road casualty risks in relation to other disabilities (Williams et al, 2002). Disability needs to be considered in relation to vulnerability and road collisions.

4.13 Being male appears to be a significant factor in road collisions, particularly in vulnerable groups such as motorcyclists (91% of casualties are male) and child casualties (58% male). Older casualties overall appear to be evenly split (Department for Transport, 2017).

Social Deprivation

4.14 Socio-economic groupings appear to influence road casualty rates nationally. Fatalities for male occupants in the 20 to 64 age group appeared to be double for more disadvantaged groups. Overall, 13% of the more disadvantaged groups accounted for 20% of casualties. Fatality rates for children appear to be higher for those whose parents worked in 'manual work'. Similarly, areas with higher deprivation appeared to have higher incidence of child pedestrian injuries, as well as for adults over 75, but less so on other groups (RoSPA, 2012). Public Health England data show that KSI for children is 23 per 100,000 for the most deprived decile, decreasing to 13 per 100,000 for the least deprived. This appears to reverse for overall KSI with 30 per 100,000 KSI for the second most deprived decile, increasing to almost 48 per 100,000 for the

second least deprived decile (fingertips.phe.org.uk). Fatality rates for walking, cycling and driving are higher for males and vary more by age and sex than mode of transport. Deprivation appears to increase walking and driving fatalities (Feleke et al, 2018).

National Institute for Clinical Evidence (NICE)

4.15 A Road Safety standard has been referred to the National Institute for Care and Excellence (NICE) in July 2018, however, this will not be considered and prioritised until after August 2018. A watching brief will look for developments around this.

4.16 NICE has published evidence around "Unintentional injuries on the road: interventions for under 15s" (NICE, 2010). This study highlights that unintentional injury is a leading cause of death among children and that nearly half of these are transport-related. In 2009, over 18,000 children were injured on UK roads (that is about equivalent to the number of people who live in Honiton).

4.17 The NICE evidence found that 65% of children injured were pedestrians, whilst 16% were car passengers and 16% cyclists. Around two thirds of those killed or seriously injured were boys. The majority of traffic accidents to children happened in urban areas on minor roads nearer home (NICE, 2010).

4.18 More than a quarter of child pedestrian injuries were found to come from the most deprived tenth of wards. The most significant factor was exposure to danger rather than behavior of the pedestrian (NICE, 2010).

4.19 It is noted that the most commonly used statistics based on STATS19 are detailed but not complete or perfect. It was found that estimates based on the National Travel Survey suggested a total number of casualties around three times those recorded in STATS19.

4.20 A report has also been published on "Reducing unintentional injuries on the roads among children and young people under 25 years" (Public Health England (PHE), 2018c). This report considers police STATS19 data together with Hospital Episode Statistics (HES). The key findings were:

- Three young males die for every young female who dies on the road.
- Highest rates of hospital and police data occur when young people legally start using cars and motorcycles.
- One in 1,349 young people aged 15 to 24 suffers a serious or fatal traffic injury.
- Half of young car occupant deaths occur between 8 pm and 4 am.
- Differences occur between local authority areas due to rurality and deprivation.
- Distribution of traffic injuries due to social inequalities are very significant in school-age children (with peak injury during school travel time).
- The majority of pedestrian, cyclist and motorcyclist fatalities occur on 30 mph roads.

4.21 This provides a useful way to model approaches to road safety, for example with predominance of pedestrian, cycle and motorcycle KSI in 30 mph areas, how countermeasures, e.g. Safe System speed controls, could influence KSI, as well as other indicators.

4.22 More recent local increase in serious injury and decrease in minor injuries may, in a small part, be due to Devon and Cornwall Police adopting a new data capture system (CRASH) in 2016. However, the apparent rising trend in KSI overall (Devon County Council, 2017a) preceded this.

4.23 Over £200 million of savings were required from Devon County Council (DCC) during the period 2010 to 2017. Expenditure on road safety in Devon County Council has been reduced following a 'Tough Choices' spending review. The Road Safety revenue budget was decreased by 60%, the capital budget cut and staffing levels reduced. Other initiatives, such as the Camera Safety Partnership, have seen similar drops in funding, as have Devon and Cornwall Police. In addition, public funding-supported bus services and street lighting have seen significant reductions in funding. No causal relationship between these reductions and KSI has been demonstrated.

4.24 Although an increase in KSI is being observed, there did not appear to be overall factor explaining this increase. All road user types appeared to have an increase, though mid-aged car drivers were the only category with a statistically significant increase. Although not statistically significant, an increase in child car passenger casualties was observed in 2016. Car passenger child casualties (someone up to 15 years old) are the most significant cause of child road casualties in rural areas, with the majority (72%) being driven by someone between the ages of 26 and 50 years old (Devon County Council, 2017b). East Devon, South Hams, Teignbridge and West Devon saw borderline/significant increases in road casualties (Devon County Council, 2017a).

4.25 The DCC Casualty Report states that the most recent rises in KSI are for car occupants, particularly older drivers. Vulnerable road users (motorcyclists, cyclists and pedestrians) account for 81% of urban and 38% of rural KSI's. As with national data, the 16 to 25-year-old group appeared most likely to be injured (Devon County Council, 2017b). There did not appear to be any single or easily identifiable cause and rise may be natural fluctuation within the number of KSI which makes trends harder to identify.

4.26 The annual KSI Casualty Report for DCC (2017b) indicated that there has been a rise in KSI rates in both urban and rural areas. Car and motorcycle KSI have increased significantly. The rise in rural areas has been greater, statistically significant and accounts for 70% of all KSI (Devon County Council, 2017a) Although cycle and pedestrian rates also increased, these were not statistically significant (Devon County Council, 2017a).

4.27 As with national data, the casualty rates are highest in late teens and through the twenties, with a higher rate for males. The road-based injury rate for young adults is 6.3 compared to a Devon average of 2.8 per thousand, and KSI casualties 0.97 for young adults compared to a Devon average of 0.5 per thousand. Young drivers represented 22% of driver casualties whilst accounting for 6% of car licence holders (Devon County Council, 2017a).

4.28 The rate of KSI casualties per million people has increased in Devon over the last few years and outweighed by the increase in population (Devon County Council, 2017a). In 2016, the road casualty rate per million people for Devon was 489, compared to 414 for England as a whole (Figure 8).

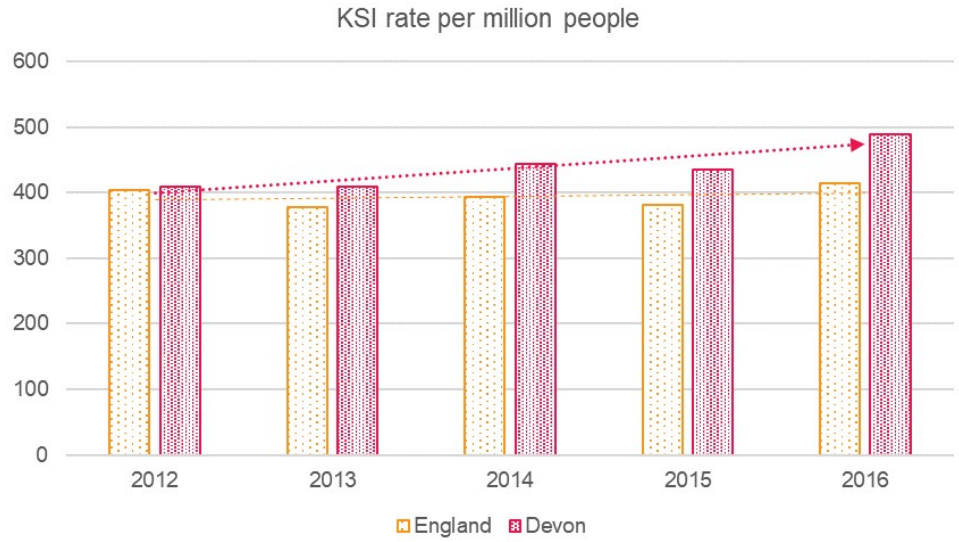
4.29 According to sub national population projections (ONS, 2014), between 2014 and 2016 there were an additional 7,000 people over 65 in Devon. In 2016 there were around 193,000 people over 65 years of age. By 2036 it is estimated that there will be 270,000 people over 65 living in Devon, with approximately 100,000 over the age of 80. Table 3 shows the increase in population for population groups, including the 15 to 29 age range:

Table 3: Population Projections (ONS, 2014)

Age group	Population projection (Thousands)		
	2016	2036	Change
5 to 15	80	89	9
15 to 29	129	136	7
30 to 64	334	329	-5
65 plus	193	274	81
80 plus	54	100	46

4.30 It can be seen from the above that Devon is expecting the older population to increase significantly, with additional increases in younger age groups, both of which have higher population level casualty rates.

Figure 9: KSI Rate Per Million People (Table RAS41004, DfT)



4.31 Many of the significant contributory factors (Table 4) reported, such as 'failed to look properly' may be classed as human error. Driver/rider error was attributed to 82% of factors contributing to rural collisions (Devon County Council, 2017b). Under 'Safe System' this will need to be looked at in relation to the environment if we accept that the 'host' (driver/pedestrian etc) is prone to error and environment needs to change to mitigate against this.

4.32 The information provided by national and local reporting can be used to identify some key areas where more immediate interventions may be considered. At a population level, there appears to be concern around young male drivers of both motorcycles and cars.

Table 4: KSI Contributory Factors (All) (Devon County Council, 2017a)

KSI contributory factors (All)		
Rank	Count	Description
1	132	Failed to look properly
2	73	Loss of control
3	63	Failed to judge another person's path
4	61	Poor turn or manoeuvre
5	57	Careless/reckless/in a hurry

Table 5: KSI Contributory Factors (Single Vehicle)
(Devon County Council, 2017a)

KSI contributory factors (Single vehicle – 99 in 2016)		
Rank	Count	Description
1	50	Loss of control
2	20	Impaired by alcohol
3	19	Travelling too fast for conditions
4	18	Poor turn or manoeuvre
5	17	Slippery road due to weather

Table 6: Epidemiology Triad Identifying Main Risk Groups Based on Available Reports (See Appendix C for information on this matrix).

Pillar 1: Road Safety Management			
		Environment	
Host Social determinants	**Agent** Pillar 3 safer vehicles	**Physical** Pillar 2 safer roads and mobility	**Social** Pillar 4 safer road users
Young People (8 to 19) (Males)	Pedestrian (Deprivation?)	Urban	Secondary transition
Young People 0 to 15 (Deprivation?)	Car (Passenger)	Rural	Parents
Young Males (16 to 29) (deprivation?)	Motorcycle	60mph (Rural) 30mph (Urban/Rural)	Novice and more confident rider
Young Males (16 to 29) (deprivation)	Car	60mph (Rural) 30mph (Urban/Rural)	New driver Impaired by alcohol
Older People (70+)	Car	Rural	Older driver
Older People (70+) (Deprivation?)	Pedestrian	Urban/Rural	No longer able to drive?
Male	Cycle	Urban/Rural	Active travel

5. Harm-Related Factors

5.1 This section will consider some of the issues around the main groups identified in the previous sections to highlight some of the issues involved. It appeared that much of the available research focuses on single issues, particularly around drivers and driver behaviour. Although systems-based approaches have been present in parts of the transport industry, these appear to be relatively sparse in road-based transport (Scott-Parker and Salmon, 2015).

5.2 Consideration will be given to some of the key issues identified in the Haddon-type matrix seen in Table 6. This will be used to illustrate some main factors in relation to road collisions. However, it should be borne in mind that these factors are inter-related in a complex system which, if using a 'Safe System' approach, should consider adopting a wider systems approach (Salmon, McClure, and Stanton, 2012).

Younger Drivers (Including Motorcycles)

5.3 Young drivers are a high risk group that may be considered a public health problem due their over representation in road collisions (Scott-Parker, Goode, and Salmon, 2015). One in five young drivers will have significant collision in the first six months of passing their driving test (Box and Wengraf, 2013). Previously, young drivers and collision risk may have been conceptualised as the 'young driver problem' or the 'problem young driver'. The former considers all young drivers' over-representations in collision statistics. The latter assumes a sub-group of young drivers representing a higher risk (Scott-Parker et al, 2013). Young, novice drivers engage in various risky behaviours, including speeding (Scott-Parker and Oviedo-Trespalacios, 2017). A Safe System looking at a wider approach needs to consider broad influences of road design, legislation and safer vehicles in relation to risky behaviours.

5.4 It is, perhaps, no surprise that novice drivers are more frequently involved in collisions and is a pattern repeated worldwide (WHO, 2015). The apparent difference between males and females needs some explanation to inform approaches to reduce the incidence of collisions and consequences.

5.5 A study in Sweden found a set of characteristics of collisions involving younger drivers (Table 7). In urban areas, there appears to be problems with negotiating turns and other people within the environment. In rural areas, speed appears to be a more significant factor.

Table 7: Main Factors in Relation to Young Person Collision (Sweden) (Hasselberg and Laflamme, 2009)

Significant Category	Cases
Urban areas (under 50kmh, turning, rear-end, hitting pedestrian/cyclist/object)	33%
Single vehicle in sparsely populated area (speed limits over 70kmh)	31%
Collisions at dawn or dusk (single collisions in sparsely populated areas)	14%
Turning collision (mainly speed limit under 50kmh and older vehicles	14%
Front-on collision (speed limits over 90kmh and older vehicles)	7%

5.6 **Safe Road User**: Research suggests that young drivers are more likely to overestimate their ability and underestimate the risk of being involved in a collision. From a questionnaire-based study across eight European countries (not UK), it was found that three attitudes appeared more prevalent in males (Cordellieri et al, 2016). These negative attitudes were around:

- Traffic rules and risky driving
- Drugs and alcohol
- Speeding

5.7 In relation to the negative attitude towards traffic rules and speeding, participants justified their unsafe behaviours in accordance with environmental situations (Cordellieri et at, 2016). Younger drivers, particularly those under 20, were significantly more likely to have caused a fatal accident than other groups – particularly loss of control accidents due to speeding or recklessness (Clarke et al, 2010). If a Safe System approach seeks to modify environments to control speed, then questions need to be asked how this relates to drivers' risk perception in relation to their perceived ability in a given environmental situation. Insight training around personal ability may not be successful and improved perception did not appear to translate to reduced collisions (Ivers et al, 2016). Cordellieri et al (2016) did not consider wider social determinants and whether these influenced attitudes towards traffic rules or other factors.

5.8 Alcohol was found to be a contributory factor to collisions (Devon County Council, 2017a). Males may be more prone to alcohol-related collisions (Cordellieri et al, 2016), with young drivers under the influence of alcohol more at risk of road traffic collisions when compared to older drivers under the influence of alcohol. Having a lower blood alcohol limit (BAC) for younger drivers has been demonstrated to reduce injuries and death (WHO, 2015).

5.9 Cordellieri et al (2016) backed up previous research that suggested that gender differences in collisions can be 'largely' explained by differences in alcohol consumption. This will need to be explored further with local data. It was also found that, although men and women have the same perception (and skills) around risky situations, females showed concerns about these risks and this may be an explanatory factor in differing behaviours. However, there was some evidence that riskier driving behaviour was becoming more aligned between the sexes within the younger population (Cordellieri et al, 2016). This perhaps indicates the highly socialised nature of driver attitudes and that 'fix the driver' behavioural approaches are fairly downstream.

5.10 Mobile phone usage has been found to be a strong predictor of collisions and may influence other collision categories, such as entering road in front of another vehicle (Scott-Parker and Oviedo-Trespalacios, 2017). Distraction within vehicles appeared to be less well researched and is an area to explore further. It was unclear how distraction may influence statistics, particularly where one party may have been killed or seriously injured.

5.11 The Royal Automobile Club (RAC) suggests increasing pre-test driving experience, with a minimum learning period, followed by a Graduated Driving Licence (GDL) scheme within a supportive road environment. This may include focusing on car handling skills and more around judgement, attitudes and behaviours (Box and Wengraf, 2013). A systematic review of motorcycle training was unable to establish firm evidence around the best type of training required to reduce collisions and injuries (Kardamanidis et al, 2010).

5.12 A group of road safety organisations including the Parliamentary Advisory Council for Transport Safety (PACTS) also consider the introduction of a Graduated Driving License. A GDL is based on restricting riskier behaviours until further experience is gained. Contrary to the RAC they see education playing an important role, including ensuring every child learning to cycle as part of learning to use the road (Feest, 2015).

5.13 Graduated Driving Licences can include measures such as restricting the type of passenger. Additional teenager passengers have been found to have either a moderating effect or heightened risk effect – which suggests peer influenced behaviour (Scott-Parker and Oviedo-Trespalacios, 2017). Attitudes and social reactions were also influenced by 'what I think others do' (Cestac, Paran, and Delhomme, 2011). This perhaps supports a population-level systems approach to behaviour change through infrastructure, training and enforcement. Graduated Driving Licences, would be Government-level intervention, though employer interventions can enable localised management of younger drivers.

5.14 A systematic review found that driver-based education in school led to earlier licensing and potential increase in teenagers involved in collisions (Roberts and Kwan, 2001). Another systematic review of post-licence driver education found no evidence as to effectiveness of practices on reducing collisions or injuries (Ker et al, 2003).

5.15 **Safe Speeds**: In a study carried out in France it was found that, given a scenario of a straight road, only 43% of young women and 26% of young men stated they would never speed. Sensation seeking appeared to be a significant factor for younger men and speeding intentions increased with driving experience. Lack of negative feedback following violations, e.g. penalties and collisions, appeared to reinforce behaviour, with past behaviour a predictor of speeding-intentions (Cestac, Paran, and Delhomme, 2011). Increased confidence in a driver's own skills may also increase transference of attribution of fault to other drivers (Ivers et al, 2016), which may add to lack of negative feedback. This demonstrates that engineering design and enforcement can impact on risky behaviour.

5.16 Risky behaviour may be influenced by social factors, including enforcement. A multi-country review found that Colombia had higher levels of risky driving behaviour when compared to countries such as Australia and New Zealand implementing greater enforcement (Scott-Parker and Oviedo-Trespalacios, 2017). It should also be borne in mind that Australia and New Zealand have also adopted a 'Safe System' approach. However, younger drivers may also be more prone to 'impulse' which suggests skills around impulse control may also be required (Hatfield et al, 2017).

5.17 As Cestac et al (2011) was survey-based, intention may not necessarily translate to behaviour. Additionally, people may have answered questions how they thought they should be answered - though this may tell us something about normalisation, as it was found that men perceived more social pressure to speed than women. Safe systems look to strategies, such as social marketing, to encourage safer use through questioning the perceptions around normalised behaviours.

5.18 Several studies have found that stand alone publicity campaigns have no effect, and speed behaviour difficult to change. Speeding may be classified as a habitual behaviour and influenced by perceptions of others' behaviours. Engineering and enforcement are more likely to be successful (Shagen et al, 2016). Further to this, roads with high speed limits were found to trigger

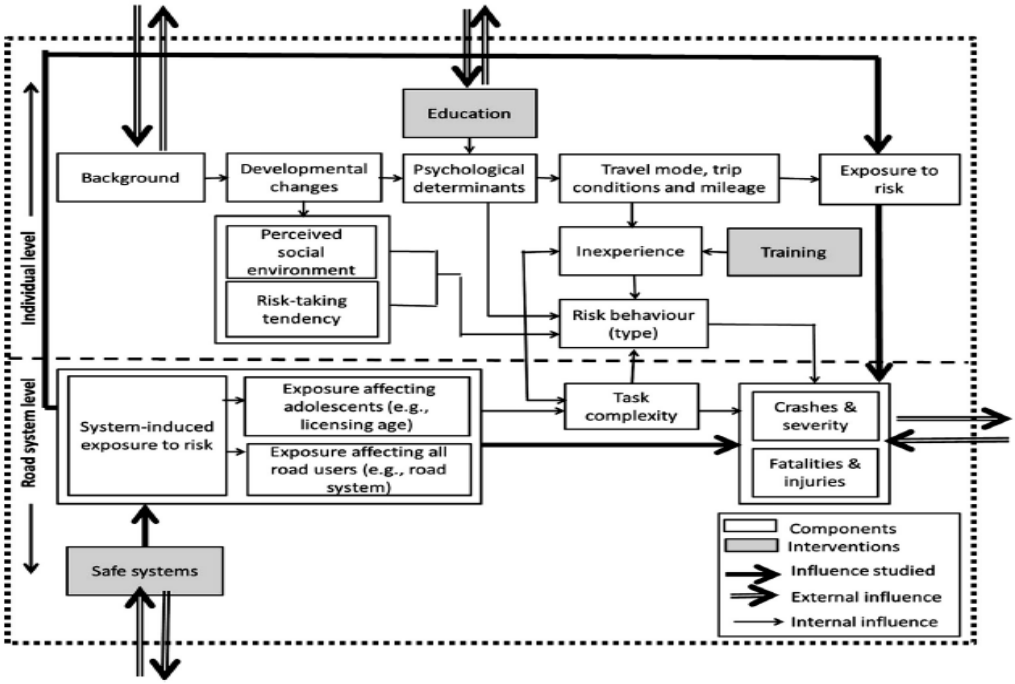
aggressive driving behaviour (Rajesh, Naveen, and Chandra, 2010). A Safe System approach would appear to require each of the five pillars to succeed.

5.19 An education programme that included road safety in the physics curriculum assessed driving-related risky behaviour. After six months there appeared to be positive effects on speeding and seat belt wearing, but no evidence of effects on drink driving (Martinez et al, 1993). However, a systematic review of school-based education programmes to prevent injuries, including road injuries, found weak evidence that school-based education improved students safety skills and behaviour (Orton et al, 2016).

5.20 The relationship to risk is not a straightforward one; we all take risks in learning something new. Risky behaviours may also be part of acquiring new skills and there is some evidence that risk behaviour is a result of structural changes in the adolescent brain. This means that simply trying to discourage risky behaviours through education may be counter-productive. Looking at ways to provide safe learning environments on road may be more productive (Twisk et al, 2015). If these risky behaviours continue through negative reinforcement, then a question arises whether such negative reinforcement creates a road environment not conducive to novice drivers developing faculties, or much older drivers if faculties decline.

5.21 **Safe Roads**: In order to consider safe roads, it is worth exploring some research around constructing a Safe System around adolescent, novice drivers. This goes further to not only accept that people make mistakes, but that adolescent risky behaviour can be influenced by the road system; this includes external influences including education, political agendas, cultural views and financial constraints. A model (Figure 10) presented by Twisk et al (2015) has been constructed around health behaviour and health behaviour change (after Bartholomew et al, 2011). This takes a view of looking at psychological determinants, road skills and exposure to risk, including risk-taking tendencies, and how road infrastructure and regulations relates to these, i.e. the System-induced Exposure (SiE).

Figure 10 Conceptual Model of Adolescent Road Risk Composed of Individual and System Level Components and Three Intervention Types (from Twisk et al, 2015).



5.22 The significant finding from Twisk et al (2015) was that countries, such as the Netherlands, with low System-induced Exposure had better safety records for young adolescents. Australia's Safe System has also reduced exposure through design features such as roundabouts (Marshall, 2018). Other factors, such as later licensing, were found to have a lesser effect. However, with the focus previously being on 'fixing the driver' not the system, there is considerable knowledge around factors relating to drivers, but little around the system components needed to shape, young driver behaviour (Scott-Parker, Goode, and Salmon, 2015). What this demonstrates is that fixing the system, e.g. through the Netherlands 'Sustainable Safety', to reduce risks has impact but, as yet, there is no agreed 'Safe System' approach.

5.23 Twisk et al (2015) mention psychological determinants and social environment, but do not appear to consider the social determinants that influence psychological development, the relationship to the social environment, nor how determinants affect exposure to risk.

5.24 **Post-Collision:** As part of Devon's 'Learn2Live,' a mobile app was developed to assist, particularly young people, prepare and respond to a car collision.

5.25 **Safe Vehicles:** The adoption of increasingly safe vehicles would appear, on the face-of-it, to have played a significant part in the reduction in the number of drivers and passengers killed in vehicular collisions. It may not always be assumed that vehicle technologies improve safety or behaviour of all drivers, and perhaps consideration needs to be given to how novice and young drivers may react to or adapt to such technologies. For example, young drivers may become over reliant on collision avoidance technologies in following vehicles more closely based on audible collision alert. However, this may be, in part, due to false warnings and adopting riskier behaviour with increased confidence. Having audible warnings were found to have some improvements on lane discipline and signal use (Jermakian, et al, 2017). Such technologies, e.g. lane discipline and lines, need to be supported by the road environment, e.g. lines painted to support technological guidance system.

5.26 If we start to consider an upstream approach, then a Safe System approach may help in achieving change in changing behaviour at a system and social level. In focusing on the driver there are significant factors that may remain unknown (Scott-Parker, Goode, and Salmon, 2015). This is not to say driver behaviour is to be ignored, for example, the recent rise in mobile phone usage appears to be a significant collision risk for young people (Scott-Parker and Oviedo-Trespalacios, 2017).

Older Drivers

5.27 This section will consider wider literature around factors relevant to older drivers (65 years and older) and road safety in relation to 'Safe System'. Older drivers account for 6% of both 'all severity' and 'killed or seriously injured' (KSI) casualties. Although older driver casualties had been gradually falling over time (statistically significant), the recent KSI trend is showing a steady increase. 2016 saw a 15% increase compared to the five year average, however, this was not statistically significant (Devon County Council, 2017a). A quarter (24.8%) of Devon's population in 2016 were 65 or over.

5.28 Before considering the risks, it is worth highlighting that transport can facilitate older people maintaining their mobility for as long as possible and

acknowledgement given that the car can provide important mobility (Oxley, Langford, and Charlton, 2010).

5.29 **Safe Road User:** Older drivers tend to cover a lower mileage per annum than average. When compared with younger drivers with similar driving exposure older drivers have a similar rate of collisions per distance driven. Lower mileage older drivers tend to do more driving on local, predominantly urban, roads with higher number of potential conflict points, so therefore their collision rate is higher per unit distance than those for longer-distance drivers, who tend to use primary routes and motorways (Langford and Oxley, 2006).

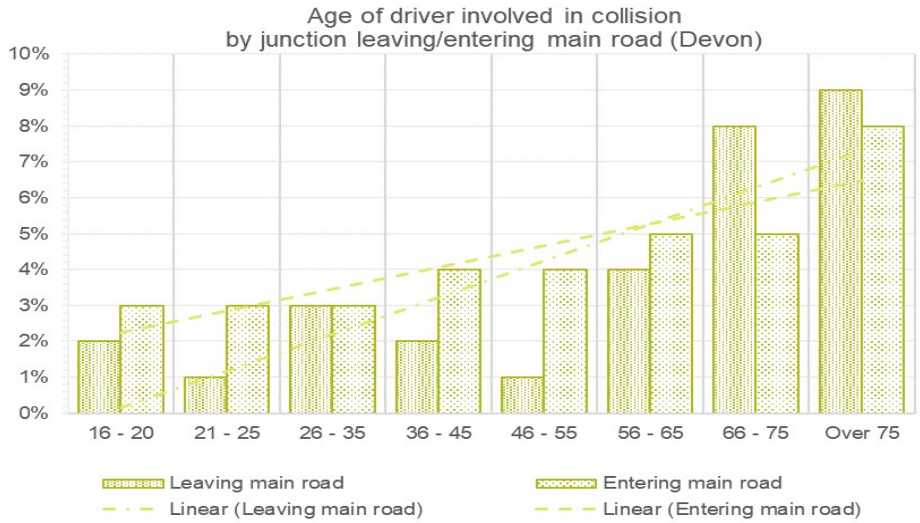
5.30 Women tend to stop or reduce driving earlier than needed, whereas males tend to leave it too long (Husband, 2010). KSI data shows that a male and female injury gap closes from 65 years onwards (Woltman and Martin, 2017). Blanket screening tests to determine fitness to drive may not reduce collision risk, whilst reducing mobility (Oxley, Langford, and Charlton, 2010).

5.31 Older drivers tend to have reduced visual acuity, night time vision, depth perception, muscle strength, reaction times, and ability to do multiple tasks. Age is also associated with numerous diseases, including diabetes, heart disease and dementia. Some evidence suggests that older drivers tend to be aware of their functional decline and many adjust their driving behaviour accordingly, which mitigates the associated higher risk (Langford and Oxley, 2006). Nothing was found on whether other drivers adjust behaviours to accommodate older drivers, if aware of their presence.

5.32 **Safe Speeds:** Frailty is an increasing issue with age, with reductions in bone strength and fracture tolerance. The amount of energy required to produce an injury decreases with age, so older drivers are more likely to experience serious injury in a collision. Reduced tolerance to collision forces results in overrepresentation of older drivers in road safety Killed and Seriously Injured (KSI) data. Fragility may account for a significant proportion of excess death rates in older drivers (Langford and Oxley, 2006). Consideration of speeds, particularly in urban environments, with higher junction interfaces should be given to reducing injuries in relation to this group (and others).

5.33 **Safe Roads:** With ability to negotiate intersections impaired by age, it has been found that older drivers have a predominance of intersection collisions (Langford and Oxley, 2006). Right of way errors also increase with age and found to be predominantly rural in relation to fatalities in the UK (Clarke et al, 2010). A look at available STATS19 data for 2016 shows that this type of relationship may be reproduced in Devon (Figure 11).

Figure 11: STATS19 Data For 2016 From Open Data Showing Higher Percentage of Collisions at Junction Turning Off or Onto Main Road For Older Drivers



5.34 The Australian Safe System approach has analysed data to find older driver blackspots and found problems around right turns against fast moving traffic. Measures, such as introducing additional right turn traffic signals, were put in place to reduce problems associated with 'gap-selection' (Oxley, Langford, and Charlton, 2010).

5.35 Oxley, Langford, and Charlton (2010) suggested three key measures for older drivers:

- Road design adopted that reflects needs and capabilities of older drivers.
- Improve design to environments that older drivers experience difficulty with.
- Improve infrastructure and land use to facilitate accessibility and availability of alternative transport options for seniors.

5.36 The question remains as to whether there is evidence as to effectiveness of a 'Safe System' to reduce collisions, particularly KSI, and acceptance that the road environment needs to be more accommodating for differing levels of ability, whether due to young age, novice or older age, due to changes in physiology.

5.37 **Post-collision:** Devon is a substantially rural county with around half of the population living in rural areas. More than two-thirds (69%) of KSI casualties occur in rural areas (Woltman and Martin, 2017). Increased injury fatality may be due, in part, to delayed access to care as a result of rurality (Zwerling et al, 2005).

5.38 **Safe Vehicles:** Vehicle safety is not just a consideration for motoring manufacturers, though an important component of the 'Safe System' approach. Older drivers may own older vehicles with less collision resistance than more up-to-date vehicles. Driver behaviour may also change with age; in an Australian study it was found that drivers over 75 reported discomfort from seat belts due to changes in their bodies due to ageing. This resulted in belt-repositioning (including placing behind the back) or using accessories (Brown et al, 2017). Although vehicle design may help, this shows guidelines and assistance for older drivers may be informed in relation to potential effects of ageing.

5.39 Collision incidence density (risk of collision) and fatality rates (risk of dying given a collision) increased dramatically from the age of 75 (Dellinger, Langlois, and Li, 2002).

Older Drivers – Cognitive Impairment and Dementia

5.40 The number of people, predominantly over 65, with dementia in Devon is projected to be just over 16,000 by 2020 and almost 22,000 by 2030. In 2015, the diagnosis rate was 56% (Devon County Council, 2015).

5.41 Dementia is a syndrome with many different causes so the different aetiologies have differing effects on fitness and ability to drive and change with time. People with dementia may experience different symptoms, such as reduced hazard perception or loss of motor functions (Piersma et al, 2015).

5.42 As suggested earlier, older drivers may self-regulate their reduction or stop in driving. Increased driving restriction in older drivers with cognitive impairment has been observed, though questions raised as to whether reported self-regulation translated into changes in risk behaviours (Festa et al, 2012).

5.43 Festa (2012) found at-risk drivers, i.e. still driving with cognitive impairment, in their study, twice as likely to be involved in a collision as non-at-risk drivers. Another study found the risk halved for those with cognitive impairment, possibly due to numbers of at-risk no longer driving (Fraade-Blanar, 2018). A Danish study (final results due December 2018) suggests limited studies into dementia and collisions, with no agreement in risk level (Petersen et al, 2016).

Secondary Transition Pedestrians

5.44 Transition to secondary school is a period when child pedestrians may be a heightened risk as they gain more freedoms to travel more, further and alone. Child pedestrians are a vulnerable group, who are over represented from age 11, when comparing modes of travel in Devon.

5.45 Although child pedestrian casualties in Devon are experiencing a downward trend, this may be reflected in the increase of child car occupant casualties. In urban areas, child pedestrian casualties are only slightly above the number of child car occupant casualties, but the largest share of urban children killed or seriously injured. In rural areas, child car occupant casualties are far higher than any other child groups (Devon County Council, 2017b). In Devon, child KSI's are higher in rural areas (55%) than urban (45%), whereas, nationally, 76% of KSI's occur in urban areas (Devon County Council, 2017b).

5.46 **Safe Road User:** In considering child pedestrians in relation to 'safe road users', we need to consider the nature of being a 'child'. A combined development of cognitive processes around attention and decision-making, for example where and when to cross, are required for 'safe' pedestrian behaviour. Some research suggests ability to judge speed may not form until around the age of 12 (Schwebel, Davis, and O'Neal, 2012).

5.47 Even if cognitive processes are developed, distraction may pose significant risk. Research has considered the significant increase in risk around talking on the phone, though research in this area is not well developed. Being amongst peers may also increase risks (Schwebel, Davis, and O'Neal, 2012). Sensation seeking behaviour may rise after the age of 9. As Safe System approach is

based around people making errors, this raises questions around responsibility and how far the system actually accounts for children.

5.48 As children develop they may find they are given greater freedoms by their parents. Parental 'licence' is one way of conceptualising when children are granted increasing freedoms with age in relation to travel, e.g. going out by foot on their own or crossing roads. The number of 'licences' increases, particularly with seniors around the age of 11, with the move to secondary school (Hillman, Adams, and Whitelegg, 1990). The benefits of independent mobility around improved health and wellbeing, which have long-term benefits, may be outweighed by parental concerns around traffic danger, stranger danger and bullying. Delay in granting 'licences' pose a greater risk with the transition to secondary school with often longer and more complex journeys (Shaw et al, 2015).

5.49 Guiding parents how to train their children in pedestrian safety appeared to be effective with improving safety of young children (Schwebel, Davis, and O'Neal, 2012). A systematic review found education could improve road crossing behaviour, but no evidence as to whether this reduced deaths and injuries (Duperrex, Roberts, and Bunn, 2002). It is perhaps unrealistic to expect children and young people to reach 'adult' levels of functioning, which should be accommodated in any Safe System approach. As identified earlier, NICE (2010) suggested exposure rather than behaviour was the greater risk. This means weighing children's freedom of access against adult mobility.

5.50 Deprivation of location and casualty has been found in some studies around road collision, though not replicated in others (Department for Transport, 2011b). Links have been found between increasing deprivation and child pedestrian road casualties in Devon (Hewson, 2004). A more recent report found that children in more deprived Mosaic groups were overrepresented in child pedestrian casualty data (Devon County Council, 2017b). This raises questions around how road environments 'fit' with child development and social setting. As highlighted before, there is only weak evidence that school-based education improved students safety skills and behaviour (Orton et al, 2016), and may be linked to wider social determinants which need to be explored in relation to exposure to risk.

5.51 Cohort studies have found that disability, such as hearing, and behavioural problems had significant influence on young people and road traffic injuries (Department for Transport, 2011b). Other cohort studies found being involved in a road collision as a young person accounted for almost a third of accident related disabilities (Barker and Power, 1993).

5.52 **Safe Speeds:** It is well known that speed is a significant contributor in relation to serious injury and fatality in road traffic collisions, particularly in relation to child pedestrians. A study in New Zealand considered drivers perceived and actual reduction in speed when faced with a child playing with a ball on a footpath or waiting to cross the road. When faced with child waiting to cross road drivers thought they were travelling at around 34 kph, when speed was actually nearer 53 kph, showing little or no adjustment accounting for children being present (Harré, 2003). This raises questions around what measures are effective at reducing speeds, particularly urban or residential settings, that are appropriate for those living in the setting.

5.53 **Safe Roads:** Road design measures need to be considered in relation to child pedestrian injuries, particularly in relation to speed. Measures such as speed humps have been found to have significant reduction numbers of children being

struck or injured (60% reduction in odds of injury or death) by a vehicle, particularly when in close proximity to their home (Tester et al, 2004). A systematic review found area-wide traffic calming, including seven UK schemes, as 'promising' in reducing traffic injuries and deaths, though results for pedestrian vehicle collisions was less certain (Bunn et al, 2003). Design can include lowering vehicle speeds, improving awareness through street design and siting of facilities, such as parks, where children may walk to them (Ferenchak and Marshall, 2016). In other words, make the environment fit for all users.

5.54 The Safe System approach advocates use of design features, such as roundabouts which may reduce the impact velocities, but further analysis and discussion with colleagues in road engineering will be required as the type and design of roundabout in countries adopting Safe System approaches (e.g. Netherlands) appears different to those currently generally found in the UK.

5.55 **Post-collision:** Once any emergency response has been enacted following a road traffic collision consideration needs to be given to post-collision outcomes. There appears to be considerable research around physical trauma, though perhaps more consideration required around psychological effects. Trauma, both physical and psychological, forms a significant component of prevalence of road collision injuries in the population. In relation to psychological trauma, in one study it was found that just over one in three young victims (7 to 18 years old) were found to be suffering from Post-traumatic Stress Disorder (PTSD) a month after the accident. It was suggested that PTSD in children following road traffic accidents may not have been properly addressed (Charitaki et al, 2017). A systematic review suggested that there was no evidence for effective psychosocial interventions following significant physical injury, with some evidence for these being detrimental to mental health (De Silva et al, 2009). Their review recognised that a physical injury may affect physical, mental and social functioning, but did not look at mental health where no physical injury had occurred, nor was it limited to road trauma.

5.56 Studies in the US found that drivers under 40 with existing driving offences were more likely to be involved in collisions with child pedestrians (American Academy of Pediatrics, 2009). Part of a Safe System approach should consider effective enforcement and penalties weighted towards the victim.

5.57 **Safe vehicles:** Vehicle design can influence the effects on the pedestrian with injury severity linked more to initial impact rather than contact with the ground. Sport utility vehicles (SUV) and similar have been demonstrated to increase pedestrian fatality by 46% for eight to 15 year olds (87% for younger children) (American Academy of Pediatrics, 2009). EuroNCAP requires some testing for pedestrian safety (www.euroncap.com) which includes bumper height, impact forces and deformation, but the forces acceptable to still pass the test is significant, particularly for child pedestrians.

6. How Do We Reduce Harms to an Acceptable Level?

6.1 The previous section demonstrates that factors affecting collisions are complex and a problem as the result of numerous factors. Problems need to be addressed systemically by considering all of the 'five pillars' (Department for Transport, 2015a).

6.2 With the upward trend in serious injuries and adoption of a 'Safe System' approach, we need to consider what interventions may be effective to reduce harms to an acceptable level.

6.3 The systems approach to accidents is not new, having first emerged in the early twentieth century (Scott-Parker, Goode, and Salmon, 2015) and further developed, in public health terms, including in relation to road accidents, by the work of people such as William Haddon (1968). More recently the Government has included a 'Safe System' approach in transport strategy. However, there is a distinction between a 'Safe System' approach and a 'systems approach' which appear to have differing antecedents and forms.

6.4 It should be noted that there are many different approaches to 'systems thinking' and that 'Safe System' approach appears to be more of a philosophy that accepts people makes mistakes and that the roads, vehicles and speeds should be designed to protect people in event of a collision. A systems approach would seek to look at factors across the system that influence the behaviours to control known risks and less tolerant of harms (Scott-Parker, Goode, and Salmon, 2015). It should be noted that Scott-Parker's work is grounded in Australia, however, there do appear to be similarities in overarching systems. From a public health perspective, it would appear that, at a population level, we would seek to address and mitigate the factors and interactions that create the adverse behaviours and situations upstream, whilst also mitigating for additional outcomes. A Safe System approach accepts that collisions occur and mitigates for these.

6.5 In comparing a systems approach to a Safe Systems approach questions are raised about the acceptability of risk. A Safe Systems approach acknowledges collisions happen and reduce the risk of serious injury or death, whereas a systems approach may take a tougher stance on reducing the likelihood of collision and risk of injury. A 'minor' injury to a child on the road may not be acceptable in other settings.

6.6 There did not appear to be significant research around looking at the higher social technical and system approaches (Scott-Parker, Goode, and Salmon, 2015) whilst much research appears to focus on specific incidents, behaviours or individuals. This report has highlighted some of the available research focusing around specific aspects. Wider issues need to be considered as part of a wider systems approach (Larsson, Dekker, and Tingvall, 2010).

6.7 It has been proposed that a truer systems approach should consider six socio-technical levels (Table 8) which *de facto* occur to a greater or lesser extent already. The main point here is that, rather than start with driver behaviour at the bottom, to start from the top and look at the system as to why a collision occurred and how systems can be developed to influence road users' behaviours to reduce collisions and collision severity.

Table 8 (based on Scott-Parker and Salmon, 2015):

Level	Category	What
1	Government	Policy, including laws, and regulations e.g. GDL, funding and further policy development.
2	Regulatory bodies	Informing legislation and research organisations.
3	Local Government	Planning and budgeting, as well as parents conceptualized as local governance of their children
4	Technical and operational management	Other bodies and organisations with direct influence on driver behaviour and decision making.
5	Physical processes	The drivers themselves and psychosocial influences on behaviour.
6	Equipment and surroundings	The physical environment and surroundings in which drivers find themselves, including vehicles.

6.8 Scott-Parker and Salmon (2015) created an 'actor map' of young driver safety in Queensland, Australia. Although the top two tiers, Government and regulatory bodies, are made of up different bodies, overall, the system is similar. An initial recreation of this model in the context of how Devon County Council currently fits with this, and any future adaptations, is presented in Appendix D.

6.9 The Safe Systems principles in Australia found that behavioural risk factors, such as speeding, drink driving and not wearing seatbelts, were more prevalent in fatal collisions, whilst serious injury collisions were related to errors, mistakes and inattention; hence the requirement for a rounded approach to all aspects of road behaviour (Organisation for Economic Co-operation and Development, 2016 (OECD)). In Devon, it was found that loss of control (the main factor), poor turn, exceeding the speed limit and driver impaired by alcohol featured more in KSI collisions (analysed together), though these also appeared to feature in relation to single vehicles collisions (Devon County Council, 2017a). Not all factors appeared to be available for analysis from accessible Devon-based data, such as seat belt in use.

6.10 A recent review by the Transport Research Laboratory (TRL) (Pressley et al, 2016) carried out an assessment of interventions which sought to increase the safety of young drivers. Part of this review was a structured evaluation of available literature which found little good quality evidence. It is also notable that Safe Systems type approaches are not mentioned in the report. The TRL report did not go into interventions that sought to limit exposure to risky situations and focused on equipping learners to become a 'safer driver'. The report was substantially informed by current stakeholders. This perhaps suggests there needs to be a fundamental paradigm shift in the field if the principles of a Safe System approach are to be adopted[3]. However, the report included a set of risk factors which will be combined with others found in this report and Scott-Parker's (et al, 2015) 'AcciMap' for (young) drivers (adapted in Appendix E).

6.11 The needs, limitations, and capacities of road users need to be integrated into the traffic system (Shinar, 2007 cited in OECD, 2016). As we have seen from

[3] Devon County Council's Road Safety Team are currently exploring 'Safe Systems' approaches.

the research on differing accident risk groups, there is often a mix of issues, some of which are intrinsic to the nature of the groups in question, i.e. being young or being old, though risk is also associated with other groups. Collisions are not exclusively linked to a specific group.

7. Where Are the Gaps in Effective Interventions?

7.1 Road safety is a problem with very wide influences, which perhaps explains why research has been focused on specific definable problems. This would appear to be a perennial problem with risk factors around young drivers known for about and explored for over 50 years.

7.2 The fundamental gap appears to be one of approaches appearing to look at driver behaviour, education and 'fixing the driver'. A Safe System approach would provide an overall perspective through the 'five pillar' approach.

7.3 There is some work demonstrating that more deprived groupings, particularly child pedestrians, are more susceptible to road collisions and outcomes, though, in Devon, we have seen that, like national data, particularly in rural areas, this may be less true. (It should be borne in mind that Mosaic and other data may be susceptible to ecological fallacy where pockets of deprivation may be masked within a larger group).

7.4 Another unanswered question appeared to be, "how do young drivers become socialised into a group behaviour?", where communication between actors is largely within a vehicular carapace; a private space within a public sphere. In learning to fit within the current environment, there appears to be significant risks. Trying to fix the driver when there are wider issues around social attitudes, social deprivation and system design would appear to have limitations. The system needs to fit all users better; accommodating capabilities of young and old alike.

7.5 Further to this, the OECD suggests that road safety has, until now, dealt with aggregated level data, looking at collisions and numbers of fatalities/injuries and present initial consideration to risks and road users. This needs to be developed to a deeper level of understanding of contributory mechanisms around collisions and their consequences, using a variety of both quantitative and qualitative data (OECD, 2016).

7.6 Although some literature on built environment was revealed in the literature search, there did not appear to be substantial work evidencing Safe System and effectiveness on outcomes. Further work is required to explore this area.

7.7 It has also been difficult to find information around prevalence to quantify the 'disease burden' of disability or illness in the population resulting from road collisions. This will need to be explored further, though even initial exploration of data found difficulties with ICD-10 coding, which is not mandatory for some fields. Mapping a patient journey may be problematic – a quick look at primary diagnosis by attendance type at national level found only just over 100 cases for vehicle related codes (data from digital.nhs.uk).

7.8 In relation to incidence, there has been little linkage made between HES data, STATS19/20 or the National Travel Survey. Methodologies have been developed in the Netherlands to reconcile HES and police data which may be explored further. Of interest is the apparently higher incidence expressed in NTS data, though open to recall bias. This report has only looked at 2016 data

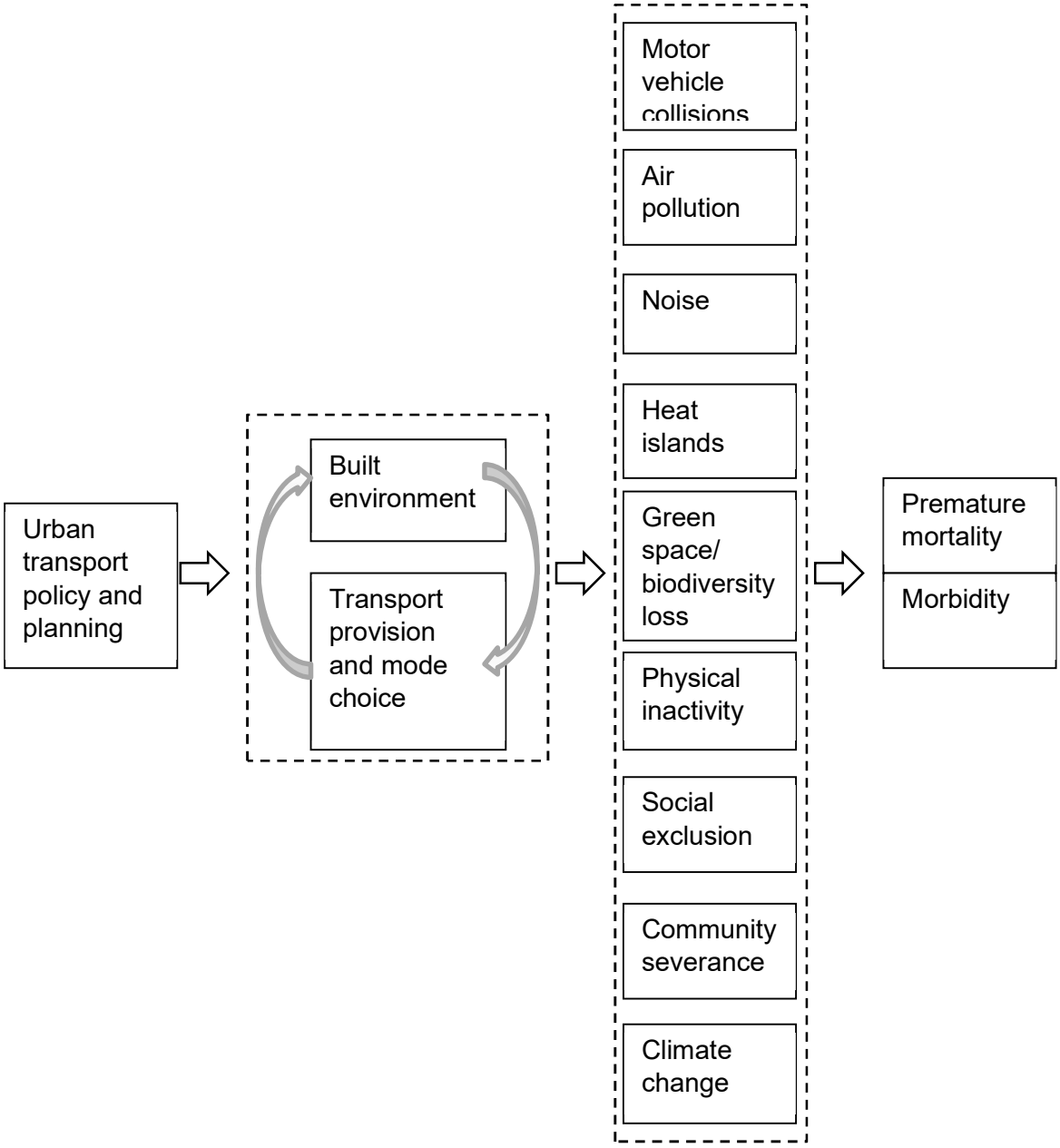
available from DfT (2016); further analysis is required to look at specific issues using existing expertise in the Road Safety and Public Health Intelligence Teams.

7.9 There appears to be a tension between mobility and safety, and differing expectations for the private (e.g. private cars, delivery and goods vehicles) and public spheres (e.g. plane travel, rail travel or public service vehicles).

8. What Are the Problems of 'Road Safety' and Wider Public Health?

8.1 Part 2 will take 'road safety' in the wider context of the effects of road transport and infrastructure on the health and wellbeing of populations. The following provide some examples of the types of issues to be considered.

Figure 12: Linkages Between Transport and Adverse Health Impacts (Khreis et al, 2017)

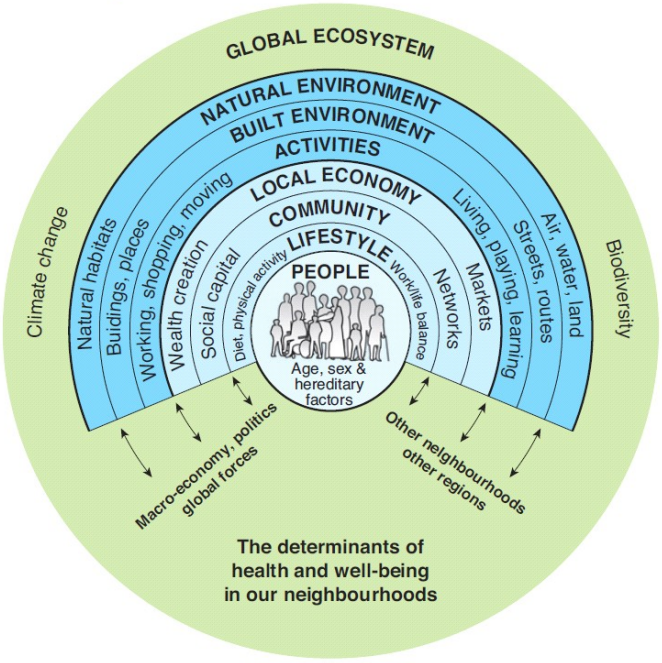


8.2 Consideration needs to be given to the linkages between transport and adverse health impacts with particular emphasis on implementing a Safe System approach.

8.3 The interactions with road environments are complex which influences and is influenced by the built environment and socio-economic factors. A health map developed by Barton and Grant (2006) helps to situate populations within the

complexities of this ecosystem. The Barton and Grant (2006) ecological model has been considered in relation to factors affecting road safety in Appendix E.

Figure 13: The Health Map (Barton and Grant, 2006).



8.4 This model supports the collaboration of transport planning, air quality management, economic development and community development. The built environment, particularly road environment, affects patterns of activity and travel behaviour (Barton and Grant, 2006). The way the road environment is planned has a strong moral component as this determines who fits and who does not. Limiting fit can have serious health consequences.

8.5 A 'public health lens' needs to look at upstream prevention and measures, e.g. what street design is appropriate for the locale, to look at the beginning of the causal chain and the wider consequences on communities, not just collisions (Christie, 2018).

8.6 **Collision and injuries:** As highlighted in Part 1, the number of incidents involving serious injury is continuing to rise in Devon with considerable human costs to victims and their families (Devon County Council, 2017a). Vulnerable road users are more susceptible to collision forces and the perceived risk may be a reason for people choosing one mode over another or not travelling.

8.7 **Pollution (air):** Public Health England estimated that, in Devon, 314 (4%) of deaths annually for people 25 or over was due to anthropogenic particulate ($PM_{2.5}$) air pollution. These deaths resulted in a total of 2,994 life-years lost (Public Health England, 2014a). The cost to the NHS and social care for England due to $PM_{2.5}$ is estimated at between £1.54 and £2.18 billion (Public Health England, 2018a).

8.8 This is only one measure of pollutants - other main exhaust pollutants known to affect health include PM_{10}, nitrogen dioxide (NO_2), sulphur dioxide (SO_2), Volatile Organic Compounds (VOCs), Ammonia (NH_3) and Ozone (O_3) (Department for Environment, Food, and Rural Affairs, 2017). Particulates also originate from wear and tear, particularly from tyres and brakes.

8.9 Public Health England produced a briefing (116 pages) for Directors of Public Health on Air Quality in 2017, putting air pollution clearly on the public health agenda (Public Health England, 2017b) and the Department for Transport 'The Road to Zero' strategy for cleaner road transport (Department for Transport, 2018).

8.10 **Pollution (noise):** There appears to be conflicting evidence around health effects of noise pollution on health issues such as heart disease or stroke, but stronger evidence around mental health (see below). However, given the prevalence of road traffic noise pollution and other combining factors, small effects from noise pollution from traffic may pose a significant public health risk in the UK (Cai et al, 2018).

8.11 **Physical inactivity** is responsible for one in six deaths in the UK at an estimated cost of £7.4 billion. Part of this is the cost to the NHS at around £0.9 billion (Public Health England, 2018b). Around one in two women and a third of men damage their physical and mental health through lack of physical activity. Regular activity can guard against diabetes, cancers and depression. Over-reliance on cars is a factor influencing inactivity (Public Health England, 2014b).

8.12 **Physical activity:** Switching from private motor transport to active travel has been associated with significant reductions in Body Mass Index (BMI), whilst switching from active travel to private motor transport is associated with a significant increase in BMI (Martin et al, 2015).

8.13 **Community severance:** It appears likely that community severance impacts on health with potential effects such as reduced social contact impacting on morbidity and mortality. Community severance occurs when road traffic creates a physical barrier which affects how communities interact. However, further research needs to establish evidence around this type of effect in relation to transport (Mindell and Karlsen, 2012).

8.14 **Climate change:** In 2004, Devon County Council signed up to the Nottingham Declaration on Climate Change and committed to work with Government to deliver the UK Climate Change Programme at a local level (Devon County Council, 2004). Following this, "A warm response our climate change challenge" strategy was produced. Consideration given to initiatives on effects on carbon emissions and other pollutants in reducing direct health impacts should also contribute to reducing negative effects on climate change.

8.15 **Mental health:** Air and noise pollution, together with traffic hazards in current built environments reduces use of active travel options resulting in decreased physical activity and knock on mental health issues (Mueller, 2015). Road traffic noise has been significantly associated with mental health problems (Stefanie, 2015). Post-traumatic Stress Disorder (PTSD) is prevalent among survivors of road traffic collisions (Lin et al, 2018).

8.16 **Economic costs** of collisions in Devon for 2017 were estimated to be over £166 million per year (Part 1).

8.17 **Social determinants and inequality:** People who are socially excluded tend to have poorer access to transport whilst living in areas impacted by negative effects (Mackett and Thoreau, 2015). There are links between increasing deprivation and child pedestrian road casualties in Devon (Hewson, 2004). It has also been found that more deprived Mosaic groups are overrepresented

in both child pedestrian and car passenger casualty rates (Devon County Council, 2017b).

8.18 **Freedoms of children:** Children have had decreasing levels of independent mobility over recent decades, with restrictions greatest for children under 11 (primary school age). Parents have significant concerns about letting children go out alone, with traffic the strongest factor which have effects on physical, social, and mental development of children (Shaw et al, 2015).

8.19 **Benefits of transport:** Transport provides opportunities to access employment, leisure and health services which improve quality of life. Transport road projects may have some positive effects on incomes and productivity, though they may have differing effects on local economies (What Works Centre for Local Economic Growth, 2015). Road transport plays a significant role in the movement of goods and services. The economic benefits of walking and cycling interventions have been estimated at a cost benefit of 19:1 for the UK (BMA, 2012).

8.20 **Behaviour change**: Safe System approaches seek to design in safety, rather than only trying to influence individual behaviours, through techniques such as social marketing. Similarly, we should continue to look to design in active travel. Issues such as 'car dependence' need to be looked on as societal and political issues, rather than individual or personal (Douglas et al, 2011) and require infrastructural support.

8.21 The act of the individual may be influenced by the state of the system, where personal utility can have significant impact when combined with others within the finite resources available – a 'tragedy of the commons' (Hardin, 1968). Looking to behaviour change initiatives when there are systemic issues faced by individuals may shift the blame, but not the problem. An example of this may be when parents consider letting their children walk to school, faced by the issues of traffic danger in a system designed around motorised traffic flow. Trying to change behaviour, without changing the system, will have limited effect.

8.22 **Boomerang effect**: We need to consider that measures to improve road safety and active travel may cause inadvertent consequences. Where possible, we need to determine, measure and mitigate against these should they arise. An example would be looking to current evidence around reducing speed limits and effects on traffic flow and pollution levels.

9. Discussion

9.1 It does not appear possible to identify any single or specific group of factors causing a rise in KSI figures in Devon, which may be within a 'natural fluctuation' due to uncertainties caused by low numbers.

9.2 Questions may be raised around the validity of definitions of 'seriously injured' and an apparent assumption that a minor injury is not part of the 'disease' of road traffic collisions. Additionally, questions need to be addressed around relationship of minor injury as a symptom leading to more serious outcome variables.

9.3 The current programmes of Safe System adopted use the premise that it aims to reduce fatal and serious injuries in collisions. Using a public health approach questions remain around what the impact of the significant number of minor collisions are on the population, and the relationship to more serious collisions, and how acceptable these are.

9.4 The data suggest that approaches and analysis should treat urban and rural environments differently. In urban areas, design and behaviour change would focus on prioritising accessibility and protection of all vulnerable road users. In rural areas, consideration will need to balance access and mobility together with the 'trinity' of speed, alcohol, and safety restraint.

9.5 In adopting the 'Safe System' approach we need to map the system in question. It may be contended that speed and speeding are key public health issues related to the transport environment. Issues around distraction appear to need further exploration. With mobile phone technology, design of digital driver consoles and behaviours of peers, more focus perhaps needs to be in this area.

9.6 By 2030, it is predicted that 43% (362,000) of Devon's population will be over 55 years of age, and 5% (45,000) over 85. Although we cannot, at present, predict the effect of self-driving cars or changes in social attitudes, we may assume that a significant proportion of these, given current driving patterns, will be active drivers and more vulnerable pedestrians. Other changes, such as electric vehicles, may alter the nature and distribution of pollutants.

9.7 If we are to take a (safe) systems approach which encompasses active travel, we need to consider the impacts of decisions across the system. For example; if young drivers are particularly prone to effects of alcohol, with a high incidence of collisions at night, with passengers, then what alternative provisions are provided, e.g. public transport (not necessarily a scheduled bus service) to access 'night life'.

9.8 A Safe System needs to be built around vulnerable road users with particular consideration around the socialisation and protection of younger and older drivers.

9.9 If the Safe System approach seeks to address speed there appears to be a question around how 'thrill seeking' behaviours may adapt to roads designed to be safer. There would appear to be a need to gain a population level support for Safe Systems to change social attitudes and facilitate further development of active travel.

9.10 Enforcement measures also need to be considered as part of Safe Systems. For example, in relation to alcohol, increased police patrols may reduce traffic collisions and fatalities (Goss et al, 2008). Media campaigns related to

increased patrols aimed to increase acceptance of enforcement laws and belief that may get caught (Elder, 2004 cited in Goss et al, 2008).

9.11 One of the obvious problems with adopting a Safe System approach is the size of network existing within Devon. With the principal city of Exeter, street layout developed as an organic mix through the centuries, from Roman through Saxon, the mid-twentieth limits choices. The Netherlands had similar problems, and has achieved a more sustainable Safe System to reduce system-induced exposure through conscious decision-making. Devon can consider introducing safe systems in new schemes, and consider specific controls such as speed reduction through a strategic approach.

9.12 Some measures, such as approaches to speed management, graduated driving licences, zero blood alcohol levels (particularly novice drivers) need to be discussed at Governmental level and go beyo==========d the 'localism' agenda. For example, in speed limit setting, one criterion is to consider current use; this may be influenced by current traffic environment, not the potential use if accessibility increased. There is also perhaps some concern that, through localism, differing areas set different criteria, which may be confusing to those travelling across systems (such as appears to be happening in London - for example comparing the City of Westminster to the City of London – both of which serve more than the 'local' population).

10. Observations

10.1 In adopting a 'Safe System' approach, all 'five pillars' need to be adopted as part of a systems approach. Consideration should be given to a wider systems approach that supports healthier environments, for example looking at work on Healthy Streets carried out in London.

10.2 That Hospital Episode Statistics are considered alongside STATS19 data in order to reveal a fuller picture, together with information from the National Travel Survey. The expertise of the Road Safety Team and Public Health Intelligence Team could look to develop fuller models. Consideration should also be given to looking at data across a wider area to improve reliability.

10.3 Consideration should be given to specific strategic analysis to rural and urban roads environments, though part of a wider system where 'functional classification' influences road safety emphasis based on a balance of communities, e.g. those driving and communities being driven through.

10.4 Measures, such as reduction in speeds, as part of a healthy streets approach, should be considered where there is high accessibility potential, particularly for vulnerable road users such as child pedestrians.

10.5 Communities should be engaged in determining the type of environment they wish to live in, balancing access with mobility.

10.6 Further exploration of how to take a positive approach to active travel in relation to the built environment is carried out. This would include reviewing Public Health England's recent publication on spatial planning for health (Public Health England, 2017c) and building on our current approach. This would include a

review of evidence to inform future planning decisions, whilst considering wider determinants and adverse health impacts.

10.7 In line with Pillar 1, Devon County Council supports a national approach to an evidenced-based Safe System, whilst working through localism to understand the system at a community level.

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APPENDIX A

Public Health Outcomes Framework

OUTCOMES

Vision: To improve and protect the nation's health and wellbeing and improve the health of the poorest fastest.

Outcome 1	**Increased healthy life expectancy** Taking account of the health quality as well as the length of life
Outcome 2	**Reduced differences in life expectancy and healthy life expectancy between communities** Through greater improvements in more disadvantaged communities

(Note: These two measures would work as a package covering both morbidity and mortality, addressing within-area differences and between area differences)

↑ ↑ DOMAINS ↑ ↑

DOMAIN 1:	**DOMAIN 2:**	**DOMAIN 3:**	**DOMAIN 4:**
Improving the wider determinants of health	Health improvement	Health protection	Healthcare public health and preventing premature mortality
Objective: Improvements against wider factors that affect health and wellbeing, and health inequalities	**Objective:** People are helped to live healthy lifestyles, make healthy choices and reduce health inequalities	**Objective:** The population's health is protected from major incidents and other threats, while reducing health inequalities	**Objective:** Reduced numbers of people living with preventable ill health and people dying prematurely, while reducing the gap between communities
} Indicators Across the life course	} Indicators Across the life course	} Indicators Across the life course	} Indicators Across the life course

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/216159/dh_132362.pdf

APPENDIX B

Helping You Stay Safe on Britain's Roads

Helping you stay safe on Britain's roads (DVSA, 2017) is split into three themes:

- Helping drivers through a lifetime of safe driving
- Keeping vehicles safe to drive
- Protection from unsafe drivers and vehicles

Transport Investment Strategy (Moving Britain Ahead): The Government's Transport Investment Strategy sets out a commitment to invest in technologies and upgrades to networks that improve safety, including cycle and pedestrian networks. Spending priorities will include schemes contributing to safety and health, with a safety formula that considers road length and population (Department for Transport, 2017). This could cause anomalies where a few accidents in a sparsely populated area creates a higher ratio.

WebTAG: The Department for Transport (DfT) currently includes determinants of health in its Transport Analysis Guidance (WebTAG). In assessing transport schemes the guidance sets out approaches to encouraging physical activity, improving air quality, and reducing noise (Department for Transport, 2013a).

The Traffic Management Act 2004 (Section 16) requires local authorities in England and Wales to manage and maintain their road networks to:

- secure the expeditious movement of traffic on, and the efficient use of, their road networks
- avoid, eliminate or reduce road congestion or other disruption to the movement of traffic.

The Road Traffic Act 1988 (Section 39) requires local authorities in Great Britain to:

- take steps both to reduce and prevent accidents
- prepare and carry out a programme of measures designed to promote road safety
- carry out studies into accidents arising out of the use of vehicles on roads or part of roads, other than trunk roads, within their area
- take such measures as appear to the authority to be appropriate to prevent such accidents.

The Road Traffic Regulation Act 1984 (Section 122) requires local authorities in Great Britain to secure the expeditious, convenient and safe movement of vehicular and other traffic (including pedestrians).

Department for Transport Circular 01/2013 (Department for Transport, 2013b)

Local speed limits are set by traffic authorities following guidance issued by the Department for Transport. One priority for action was for authorities to keep their speed limits under review and consider the introduction of more 20 mph limits in urban areas (including residential village streets) to ensure greater safety for pedestrians and cyclists. Consideration in setting speed limits should be given to:

- History of collisions
- Road engineering
- Road function
- Composition of road users
- Existing traffic speeds
- Road environment

Process Evaluation of the Safer Roads Fund: phase 1 report [Online] Available at https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/715797/process-evaluation-of-the-safer-roads-fund-phase-1.pdf

The Health and Social Care Act 2012 requires Local Authorities in England to assess the current and future health and social care needs of the local community and produce a Joint Health and Wellbeing Strategy to meet the needs identified. As road safety is a key public health issue as identified in the previous sections, and additional factors (discussed in Part 2) then this should form a key part of a health and wellbeing strategy.

Local Transport Plan: Devon and Torbay strategy 2011-2026 [Online] Available at http://www.devon.gov.uk/dtltp2011-2026strategydoc.pdf

Previous Assessments

DCC Collision data
https://new.devon.gov.uk/roadsandtransport/safe-travel/road-safety/collision-data/

Cycling Demonstration Towns
http://webarchive.nationalarchives.gov.uk/20101007121133/http:/www.dft.gov.uk/cyclingengland/cycling-cities-towns/results/

https://www.sustrans.org.uk/sites/default/files/file_content_type/cycling_demonstration_towns_exeter.pdf

Home Zones (Wonford)
http://www.playengland.net/wp-content/uploads/2015/09/places-to-go-research-summary.pdf

APPENDIX C

Haddon Matrix

1. Safe System and Public Health

1.1 In considering the origins of the Safe System approach one of the primary foundations is the work of William Haddon who created a methodology and strategy to reduce 'harmful interactions' in the road environment (Organisation for Economic Co-operation and Development, 2016). This framework, as modified by Carol Runyan, is still considered relevant to public health today (British Medical Journal, 2015) and will be used to explore current issues in Devon.

The Haddon Matrix

1.2 Haddon's (1968) methodology is rooted in determining the causation and that road safety is primarily about mechanical energy interacting with people above their injury threshold. In considering causation, and challenging descriptive notions of accident, the implication is that interactions can be manipulated and controlled.

1.3 Haddon (1968) put forward three phases (of social concern) during which countermeasures may be undertaken (Table C1).

Table C1 (Haddon, 1968)

Event Phase	Concept	Description
Pre-crash	Prevention of the etiologic agent reaching the susceptible host	Measures to prevent mechanical forces above injury thresholds from reaching vehicle and people
Crash	Interaction between etiologic agents and susceptible structures	The point at which mechanical forces in excess of those the vehicle and people can tolerate begin to exert themselves on vehicles and people
Post-crash	Damage done to susceptible structures	Maximising salvage once damage has been done to reduce likelihood of death and progression of condition (if not reversal)

1.4 Haddon took the event phases and combined these into a matrix of human, vehicle, and environmental influences. These equate to the 'epidemiologic triad' of agent, host, and environment. This produces a conceptual framework, that can be adapted to a 'Haddon Matrix' similar to Table C2. Haddon (1972) suggested that the matrix could be adapted to given situations as required, rather than being fixed.

Table C2 (based on Haddon, 1972)

	Host	Agent	Physical Environment	Social Environment
Pre-crash				
Crash				
Post-crash				

1.5 In Table C2 the host column refers to the person at risk of injury. The agent of injury is energy transmitted to the host, which in the case of road safety is a vehicle. The physical environment covers the roadway and surrounding environs. Social environments are the norms and practices of a culture, for example drink driving (Runyan, 1998).

1.6 The epidemiological triad is limiting when considering the ecological models presented by Bronfenbrenner (1979) or models of determinants of health such as those presented by Dahlgren and Whitehead (2007). These postulate that the root causes (determinants) need to be understood before effective countermeasures can be put in place.

1.7 Social determinants may be considered in relation to selection of host, or alternatively within an expansion of the Haddon Matrix proposed by Runyan (1998). Runyan's approach introduces a policy decision making process that considers aspects such as effectiveness, cost, equity, and feasibility (Appendix A).

Safe System

1.8 Central to the 'British road safety statement' (Department for Transport, 2015a) is the principle of the 'Safe Systems' approach. The 'Safe Systems' approach acknowledges that:

- There will always be a degree of human error.
- The human body is inherently vulnerable to death or injury.
- Because of this, we should manage our infrastructure, vehicles, and speeds to reduce collision energies to levels that can be tolerated by the human body.

1.9 In adopting the Government's adoption of the United Nations 'five pillars' it is worth revisiting some of the earlier work by Haddon (1968).

1.10 Perhaps simplistic, but to enable a conceptualization and prioritization process, considering the Haddon Matrix together with the five pillars and wider social determinants may assist in determining areas to then widen into public health policy evaluation.

Table C3 (mash up of Haddon, Social Determinants, and 5 Pillars)

Pillar 1 Road safety management				
	Host	**Agent**	**Physical**	**Social**
			Environment	
Pre-crash	Social determinants	Pillar 3 safer vehicles	Pillar 2 safer roads and mobility	Pillar 4 safer road users
Crash				
Post-crash	Pillar 5 (Post-collision response)			

1.11 The 'Safe System' approach has fundamental differences to 'traditional' approaches to road safety. These differences have been laid out by the Organisation for Economic Co-operation and Development (2016) and presented in Table C4.

Table C4 (based on OECD, 2016)		
	Traditional	**Safe System**
Problem	Try to prevent all collisions	Prevent collisions from resulting in fatalities or serious injury
Goal	Reduce number of KSI	Zero fatalities and serious injuries
Approach	React to incidents Incremental approach	Target and treat risk Systematic approach to safe road system
Cause	Non-compliant road users	People make mistakes and are fragile. Varying quality and design of infrastructure provides guidance to users as to what is safe use behaviour
Responsibility	Individual road users	Share responsibility by individuals with system designers
System	Isolated interventions	Combined elements of Safe System greater than whole with each element supporting others

APPENDIX D

Main Actors in Young Driver Road Safety

Government policy and budgeting	Driver and Vehicle Licensing Agency	Driver and Vehicle Standards Agency	Vehicle Certification Agency	Home Office	Ministry of Justice	Department for Transport	Highways Agency	Westminster Government	Health and Safety Executive	Public Health England		
Regulatory bodies, and associations	Association of British Insurers	Road Safety Observatory	Approved Driving Instructors	Association of Chief Police Officers	Traffic Commissioners	Transport Safety Commission	Parliamentary Advisory Council for Transport Safety	Advertising Standards Agency	Ofcom			
Local area government	Parents	Corporate parenting	County Council	District and Parish Councils	Police and Crime Commissioner							
Technical and operational management	Family	Peers	School College University	Employers	Driving instructors	Youth clubs	Sports clubs	Charities and community organisations	Car industry	Entertainment venues	Media	Social media and apps
Physical processes and actor activities	Young drivers	Young passengers	Other passengers	Other road users	Social context	Cultural context						
Equipment and surroundings	Vehicles	Road infrastructure	Road environment	Euro NCAP	Intervention Utilizing Technology							

Actor map (young drivers) based on Scott-Parker and Salmon (2015) adapted for England with additions from Public Health perspective (e.g. social and cultural context).

APPENDIX E

Ecological Mapping of Inter-Related Factors in Road Safety

Global ecosystem	Air pollution											
Natural environment	Air pollution	Water pollution	Asset	Resource	Night time	Hard objects						
Built environment	Urban Rural	Speed	Road design	Access Mobility	Connect Sever	Street layout	Vehicle design	Hard objects	Distraction (focus)			
Activities	Physical activity	Leisure	Work	Education	Goods	Mobile technology						
Local economy	Healthy people	Journey purpose	Leisure	Work	Education	Goods						
Community	Parents	Peers	Passenger	Other road users	Driver expectancy	Drug and alcohol	Distraction	Penalties	Seat belt use	Speeding	Access Mobility	
Lifestyle	Learner driving exposure	Driving exposure	'Licence-holding' (Hillman)	Active travel	Social capital							
People	Age	Sex	Experience	Deprivation	Ethnicity	Psychology	Optimism bias	Distraction	Hazard Perception	Seat belt use	Speeding	Gap distance