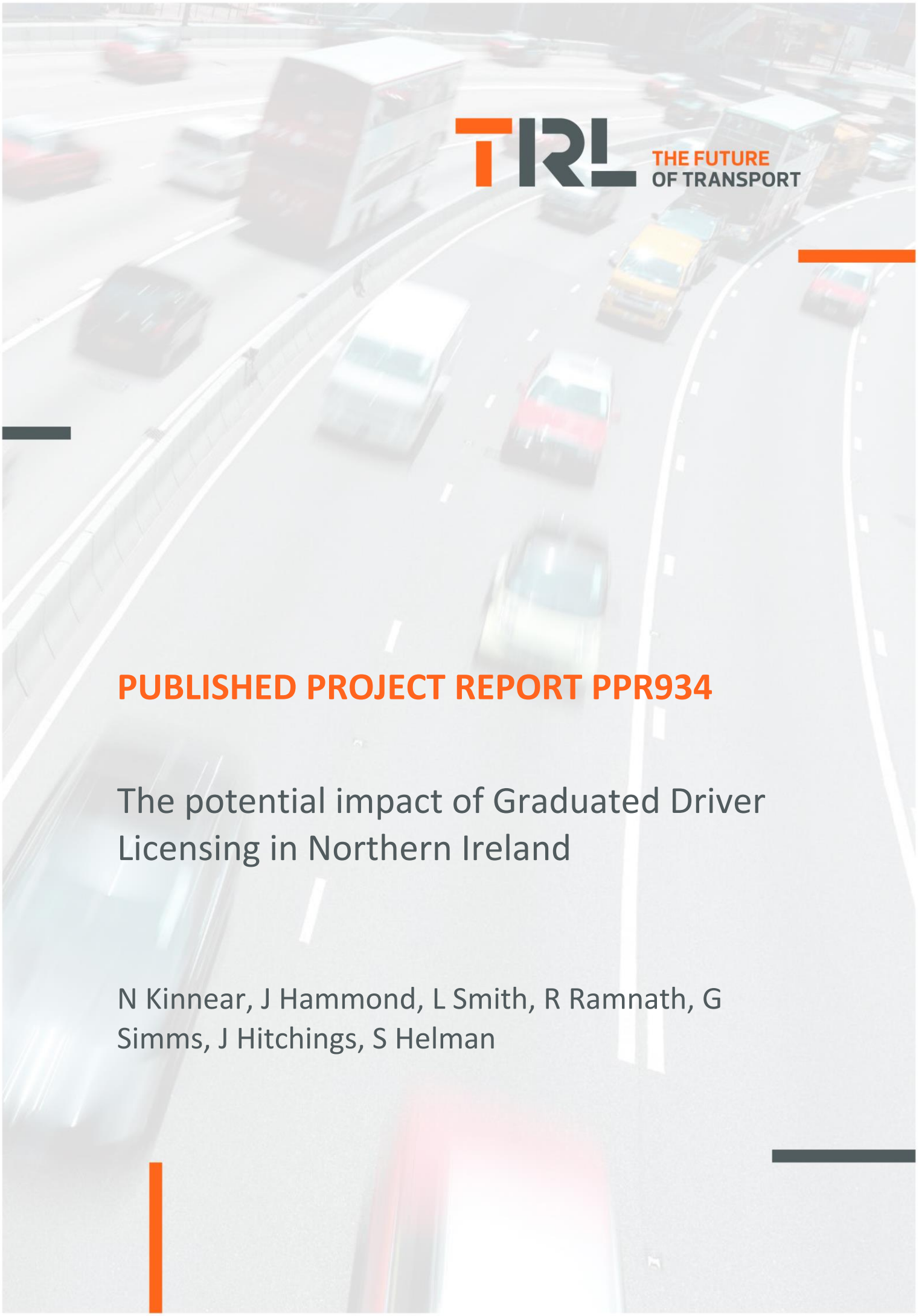

THE FUTURE OF TRANSPORT

PUBLISHED PROJECT REPORT PPR934

The potential impact of Graduated Driver Licensing in Northern Ireland

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Report details

Report prepared for:	Driver & Vehicle Agency (DVA), Northern Ireland		
Copyright:	© TRL Limited		
Report date:	26th March 2020		
Report status/version:	Final		
Quality approval:			
Su Buttress (Project Manager)		Shaun Helman (Technical Reviewer)	

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Contents amendment record

This report has been amended and issued as follows:

Version	Date	Description	Editor	Technical Reviewer
1	06/12/2019	First version for client review	NK/JH	SH
2	19/12/2019	Updated version following client feedback	NK/JH	SH
3	26/03/2019	Final published report	NK/JH	SH

Document last saved on:	26/03/2020 11:16
Document last saved by:	Neale Kinnear

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Executive summary

Background

In 2017 young (17-24 year old) drivers in Northern Ireland accounted for 10% of car licence holders but were deemed responsible for 27% of fatal and serious injury collisions (Irwin, 2019). To address this disproportionate collision risk, Northern Ireland has received Royal Assent that enables the introduction of Graduated Driver Licensing (GDL). GDL is a licencing system designed to promote on-road practice while protecting the novice driver from high-risk situations (as informed by collision analysis). A GDL licensing structure for Northern Ireland has been designed and approved and is expected to be introduced in 2020.

This report provides a review and analysis to predict the expected impact of the introduction of the proposed GDL system in Northern Ireland on road casualties and savings to society. It also sought to explore the impact that variants of the system could have.

GDL typically takes the form of a phased approach including a learner phase and probationary phase prior to full licensure. The evidence from the international literature continues to demonstrate that GDL is overwhelmingly the most effective approach for reducing road collisions involving young and novice drivers. No two GDL systems are the same and this results in a range of effectiveness being reported from a 5% to 40% reduction in young driver collisions. The difference in effectiveness is influenced by the baseline against which the changes are being applied and the strength of the GDL components being implemented.

There is no agreed 'best practice' GDL system although there is evidence of core components and thresholds that are considered to be the most effective. In the learner phase this includes a minimum learner period (12 months) and minimum number of supervised hours of on-road practice (120 hours). In the probationary phase this includes independent night-time (21:00 or 22:00 to 05:00) and young passenger restrictions. Supporting components might include a logbook during the learner phase, with requirements to encourage varied practice, and complementary education.

The proposed changes in Northern Ireland include a minimum six month learner period and a six month post-test passenger restriction (no passengers aged between 14-20 years) between 23:00 and 06:00. A post-test 'new driver period' of 2 years (to align with the New Drivers Order) will also be introduced during which novice drivers (and riders) will be subject to lower alcohol limits and must display a post-test identifier. Other reinforcing elements include a programme of driver training and a logbook. The existing licencing structure in Northern Ireland already supports other areas of good practice such as licensing age, hazard perception testing, a stringent practical test, stricter alcohol limits for new drivers and a lower penalty point threshold (for 12 months).

Findings

Northern Ireland collision data provided by PSNI for the years 2012-2018 were analysed to predict the effects of the proposed combined passenger at night-time restriction (traditionally the most effective components). Additional data sources were used to account for exposure and passenger carrying. A similar approach to that used for previous analyses of predicting the impact of GDL in Great Britain was utilised (Kinnear et al., 2013; Kinnear, Lloyd, Scoons & Helman, 2014).

The analysis revealed that the proposed combined passenger at night-time component is expected to result in a reduction of 30 casualties of all severities each year (including 6 killed or seriously injured (KSI)). This equates to an annual saving of costs to society of £3 million. Decoupling of the combined passenger at night-time restriction to create independent passenger and night-time restrictions would increase effectiveness to 241 fewer casualties and a saving to society of £16 million each year. Further strengthening the independent night-time component by bringing forward the start time from 23:00 to 21:00 would have a substantial effect, almost doubling the casualty savings (53 to 102) from that component alone. An independent passenger component based on the current restriction definitions (no carrying of passengers aged 14-20 years) would be highly impactful (saving 167 casualties per year) but further strengthening (i.e. no carrying of 14-24 year old passengers) would yield marginal benefit (an additional saving of 13 casualties). Extending the probationary period from 6 to 12 months enhances effectiveness in all scenarios.

There are a number of assumptions and limitations that are necessary when conducting predictive analysis, a full list of which can be found in the method section of this report. It was not possible to model all of the changes being introduced due to a lack of data (e.g. lower alcohol limit) and/or evidence for their effectiveness. While there is not the evidence to accurately predict the effectiveness of these components, it is feasible that the whole system effect (including the lower alcohol limit and concurrent additional restrictions on young motorcyclists) may be greater than that reported here. The predicted reductions can be considered conservative and likely to be an underestimate.

In summary, the analysis has indicated that GDL remains the most evidenced and impactful intervention to reduce casualties associated with young and novice driver road collisions. The predictive analysis suggests that the proposed GDL system in Northern Ireland is likely to prevent collisions and injuries and save lives. However, it also highlights that there is scope to build on the foundations being implemented and prevent significantly more casualties in future.

1 Introduction

1.1 Background

Regardless of age, all newly licensed drivers are at greater risk of being involved in a collision than experienced drivers, as a result of their inexperience (Maycock, Lockwood & Lester, 1991; McCartt, Mayhew, Braitman, Ferguson & Simpson, 2009). However, the majority of newly licensed drivers are also young, and risks associated with youth exaggerate the risk associated with inexperience. This results in young and novice drivers being a particularly at-risk cohort. In 2017 young (17-24 year old) drivers in Northern Ireland accounted for 10% of car licence holders but were deemed responsible for 27% of fatal and serious injury collisions (Irwin, 2019).

Graduated Driver Licensing (GDL) is a phased licensing approach that was designed to mitigate risk factors known to be related to young and novice driver collisions. A GDL system takes a new driver from learner to fully licensed driver through at least one intermediate phase. Age and time based components are typically included at the learner and probationary[1] licence phases in order to increase the amount of safe on-road practice undertaken, and to protect the driver from known risks related to their age and inexperience when driving unsupervised. Common components include minimum learner periods, a restriction on carrying similar age passengers and a restriction on driving at night-time.

A review of the evidence for approaches to improve young and novice driver safety in Great Britain (GB) recommend that there was a compelling case for the introduction of GDL in GB and outlined a proposed structure. National and regional analysis by TRL in 2013 and 2014 for the Department for Transport and the RAC Foundation predicted a significant number of collisions could be prevented with the introduction of GDL in GB (Kinnear et al., 2013; Kinnear, Lloyd, Scoons & Helman, 2014). Overall it was predicted that a GDL system (at that time) would save 4,478 casualties (433 of these being KSI casualties – killed or seriously injured) and would deliver social and economic benefits valued at £200 million in GB every year. This analysis only included GDL applied to drivers aged between 17-19 years old. Northern Ireland was not included in this analysis due to differences in the licensing process and collision data.

While GB continues to debate the costs and benefits of GDL, the Road Traffic (Amendment) Act (NI) 2016 ('the Act') received Royal Assent in March 2016, making provision for the introduction of Graduated Driver Licensing (GDL) in Northern Ireland. A GDL licensing structure has since been designed and is expected to be introduced in 2020.

1.2 GDL in Northern Ireland

The GDL proposals for Northern Ireland will establish a revised training and testing regime for car drivers and motorcyclists and will introduce post-test restrictions for drivers/riders. The

[1] The intermediate phase is commonly referred to as the 'provisional' licence phase in international literature but due to potential confusion with the provisional learners licence in Great Britain and Northern Ireland it is referred to as the 'probationary' phase in this report.

aim is to reduce the over-representation of new – mainly young – drivers/riders in fatal and serious road collisions.

GDL will introduce:

- A programme of training for learner drivers/riders which must be evidenced in a compulsory logbook. The programme details the practical skills and knowledge the learner must know, and helps learners understand how factors such as their attitude, personality, behaviour and feelings impact on their driving style.
- A mandatory minimum learning period (MMLP) of six months (drivers only).
- A time bound passenger restriction for those new drivers under 24 years old for the first six months after passing their test (drivers only): no passengers aged between 14-20 years between 23:00 and 06:00[2].
- Extension of the current 12 month restriction period to a 24 month 'new driver/rider' period (six month passenger restriction; 24 month reduced alcohol level).
- A requirement to display a distinguishing (plate) on the vehicle for two years after receiving a full licence. (six month one colour R plate – 18 month new colour R plate).

Other changes are required to give effect to the Act, namely:

- Removal of the 45mph speed limit for learner and newly qualified drivers
- Allowing learner drivers and riders to take lessons on motorways, when accompanied by an approved driving / motorcycle instructor (ADI/AMI)

The Department for Infrastructure (NI) produces an annual GDL Monitoring Report to baseline collision, driving test and licence data, and public attitudes prior to the introduction of the changes (Irwin, 2019).

1.3 This report

The aim of this work was to predict potential collision and cost savings that might be expected from the introduction of GDL in Northern Ireland. This analysis complements the annual GDL Monitoring Report and informs how GDL may be developed further to maximise the safety benefits of the system. The analysis also explored how alternative application of GDL components (i.e. stronger variations of the passenger and night-time restriction) impacts on collisions.

The analysis was based on the approach employed in previous publications (Kinnear et al., 2013; 2014) but updated for use with Northern Ireland collision data. To inform the analysis, an up-to-date review of relevant literature was undertaken to ensure that levels of GDL

[2] The passenger restriction does not apply to immediate family members (of any age) or to passengers for whom the driver is entitled to receive carer's allowance. The passenger restriction will also not apply if an accompanying person is present in the front passenger seat aged 21 years or older, who has held a full licence for three years or more; or if the vehicle is being "used for emergency purposes" such as fire and rescue, ambulance and police.

effectiveness applied in the analysis were relevant and based on the most recent data and analyses.

Section 2 summarises the review of GDL effectiveness.

Section 3 details the analysis method undertaken.

Section 4 presents the results of the analysis.

Section 5 provides a summary and conclusions.

2 Review of GDL effectiveness

There are a number of previous reviews of GDL effectiveness including Kinnear et al. (2013) and Senserrick and Williams (2015). In order to inform and contextualise the analysis and results presented in Sections 3 and 4, a review of literature published since 2015 was conducted. A systematic approach was employed to ensure that the papers reviewed were both relevant and met minimum scientific quality standards.

2.1 Systematic approach

A list of search terms (see Appendix A) relevant to the project objectives was generated to run the literature search. Multiple searches were conducted within a variety of online research databases (Google Scholar, ScienceDirect, TRID[3] and BASE[4]) through an iterative process. Search terms were tested individually and in combination with each other to identify which terms generated relevant results.

Search terms that generated relevant results were merged into Boolean search expressions (an example of which can be seen in Appendix A) specific to each database. This allowed the search output to be refined to a manageable number of relevant texts. After conducting and refining the literature search, texts were then compiled for review. Search results that were clearly irrelevant were removed at this stage and 56 papers remained after this stage. The abstracts of these papers were reviewed and scored using a set of inclusion criteria (see Appendix A). Following this scoring, 18 papers were taken forward for full text review.

2.2 Overall effectiveness of GDL

2.2.1 The current focus

Most evaluation studies of GDL effectiveness appear to have been conducted and published pre-2015; only one paper from 2015 reported a new evaluation of GDL implementation. This is not wholly surprising given that GDL started in New Zealand in 1987 and was subsequently implemented across the USA, Canada and Australia through the 1990s and 2000s. The majority of recent GDL papers are instead focused on attempting to establish individual component effectiveness (see section 2.3) and secondary research questions. For example, Zhu, Zhao, Long and Curry (2016) examined whether GDL had an unintended consequence of increasing non-driver fatalities among adolescents. This could occur due to young drivers having to walk, cycle, be a passenger or use public transport during an extended learner phase or during restricted periods in the probationary phase. Longitudinal analysis of fatality data from across 50 US states and the District of Columbia between 1995-2012 did not find evidence of a shift in risk as a result of GDL. Among adolescents aged 16 years, GDL was not

[3] Transport Research International Documentation Database that covers a million records of references to books, technical reports, conference proceedings and journal articles within the field of transport research.

[4] Bielefeld Academic Search Engine is one of the world's most voluminous search engines especially for academic resources, providing more than 120 million documents from more than 6,000 sources.

associated with increased passenger, pedestrian or bicyclist fatalities, but was associated with an 11% reduction in total traffic fatalities.

Goldstick, Carter, Almani, Brines and Shope (2019) meanwhile analysed the spatial variation of the reduction in crashes following the implementation of GDL in Michigan. The researchers sought to identify whether GDL crash rate reduction was evenly spread or associated with specific urban or suburban environmental factors. GDL implementation corresponded to a 34% reduction in injury crashes among teen drivers (15-19 years old) overall. The magnitude of that reduction varied and was more pronounced in highly populated areas, and less pronounced in areas near schools. In particular, post-GDL crash rate reductions were larger in areas with more alcohol outlets and areas with cinema complexes also showed larger post-GDL crash rate reductions after dark. These findings appear to support that GDL is affecting the types of risks that it is intended to, limiting exposure for a new driver at times when young people are more likely to be socialising and potentially drinking alcohol with peers.

2.2.2 Estimates of GDL effectiveness

With regard to the general effectiveness of GDL, reviews of individual evaluations have highlighted a wide range of effectiveness. For example, Russell, Vandermeer and Hartling (2011) found that while GDL was consistently effective in all jurisdictions (34 studies from the USA, Canada and New Zealand were reviewed) the level of effectiveness varied, with crash rate reductions among 16 year olds ranging from 8% to 27%. Shope (2007) similarly found that effectiveness ranged from ≥5.6% (Dee, Grabowski & Morrisey, 2005) to 38–40% (Baker, Chen & Li, 2007), although concluded that the effect of implementing GDL overall was a reduction in crash rates of between 20–40%. Elvik, Høye, Vaa, & Sørensen (2012) meanwhile estimated that GDL had a general effect of reducing the number of all accidents by 19%, injury accidents by 6% and fatal accidents by 26%.

This variability is unsurprising when it is considered that no two GDL systems around the world are the same. Variations in data collection (e.g. collision data) and analysis techniques also play a role, although systematic reviews like Russell et al. ensure only high-quality studies are considered. Licensing age is one of the major differences across jurisdictions with most states in the USA allowing drivers to become licensed from 15 or 16 years. Across the USA, GDL typically ceases to apply at 18 years old hence several US studies note that GDL is less effective for older-teens (e.g. Conner & Smith, 2017). What this demonstrates is that GDL is effective on the population with which it is targeted. In New Jersey (USA) and New South Wales (Australia), where the licensing age is 17 years, evaluation demonstrates similar results to those for 15 to 16 year olds in other states in the USA, indicating that the effectiveness of GDL is not limited to younger teens. Williams, Ali and Shults (2010) found a 14% reduction in all collisions and a 25% reduction in fatal collisions for 17 year olds in New Jersey. Senserrick and Williams (2015) meanwhile note that authorities in New South Wales have reported a 40% reduction in probationary driver fatal crashes since strengthening its GDL restrictions. In Victoria, Australia, drivers can learn from age 16 years but there is a minimum 12 month learner period and a probationary licence can only be gained at age 18 years. Healy, Harrison and Catchpole (2012) report a 23% reduction in all collisions for 18-20 year olds and a 31% reduction in 18-20 year old collisions.

In jurisdictions where GDL is applied to older 'young drivers' or all new drivers, reductions in novice driver collisions are reported for all age groups (Simpson, 2003). These findings are consistent with the large body of work showing that all new drivers, regardless of age, are at increased crash risk until they gain necessary on-road experience (Forsyth et al., 1995; Maycock et al., 1991; Mayhew, Simpson & Pak, 2003; Vlakveld, 2004).

2.2.3 Best practice

A GDL system aims to improve safety through the following mechanisms:

1. Increasing the amount of on-road driver training over an extended period of time
2. Reducing exposure to high-risk driving conditions while additional experience is accumulated
3. Delaying full licensure allowing newly-licensed drivers to benefit from greater maturity.

It has been argued that GDL is mainly effective because components, such as passenger and night-time restrictions, simply lower young and novice drivers' exposure – as opposed to improving driving competence (Karaca-Mandic & Ridgeway, 2010). Zhu, Cummings, Zhao and Rice (2016) estimated that 16 and 17 year olds who were licensed through GDL drove 20% fewer kilometres than those not licensed through GDL, suggesting that limiting exposure is one of the main routes to effectiveness. Zho, Cummings, Zhao, Coben & Smith (2015) nevertheless estimated that reducing exposure only accounted for half of the reduction in overall collision risk for 16 year old drivers and that the other half was due to a reduction in crash rate per mile driven. There is also evidence of longer term safety effects of GDL with studies in North Carolina indicating that those exposed to GDL were safer in the 3-5 years post-licensure than pre-GDL licenced drivers were (Masten & Foss, 2010; Foss, Masten & Martell, 2014). While implementation of GDL systems has been consistently effective, it is not entirely clear what the proportional impact of each of these mechanisms is.

Several authors have sought to develop a best practice GDL system (e.g. Mayhew, Williams & Robertson, 2016; IIHS, 2012; Vaa, Høye & Almqvist , 2015). Mayhew et al. (2016) conducted expert panel workshops in North America with researchers and stakeholders to reach agreement on making recommendations for which GDL features were core. They established minimum standards such as: a learner period of 12 months and more than 50 hours of supervised practice supported by a logbook; night driving restriction starting at 21:00 or 22:00; licence plate identifiers and driver education that supports the GDL process. Senserrick & Williams (2015) established a similar list although added peer passenger restrictions (a surprising omission from Mayhew et al.), a zero blood alcohol concentration (BAC) limit, 80-120 hours of supervised practice and inclusion of hazard perception testing at some stage. Vaa et al.'s conclusions replicate those of Senserrick & Williams' with some subtle additions. It is argued that passenger and night-time restrictions should be mutually exclusive and not combined (i.e. a passenger restriction only applying at night), exceptions should be avoided, and a lower penalty point threshold for violations should be applied.

McCartt, Teoh, Fields, Braitman and Hellinga (2010) conducted a national analysis of fatal collisions in the USA and established a grading of GDL systems as 'poor', 'marginal', 'fair' or 'good'. GDL systems rated as 'good' compared with those rated 'poor' were associated with

30% lower fatal collision rates among 15-17-year-olds; a rating of 'fair' was associated with 11% lower fatal collision rates than a rating of 'poor' (McCartt et al. 2010). Vaa et al. (2015) argue that the IIHS 'good' category is not 'excellent' and there is still room for improvement. They suggest edits such as requiring night-time and passenger restrictions rather than night-time or passenger restrictions and a minimum number of hours of on-road practice. While the categories are heavily culturally specific to US GDL systems, these analyses signify the importance of the strength of an overall GDL system for achieving desired impact and effectiveness.

2.3 Components

Establishing the relative contribution of specific components of a GDL system has become more of a focus as the search for the ideal GDL system intensifies. However, GDL components are rarely implemented on their own and many changes are often made simultaneously making it difficult to determine an appropriate control or comparison group (Senserrick & Williams, 2015). It could also be argued that GDL operates as a system and it is in some ways artificial to attempt to isolate the effectiveness of individual elements (Kinnear et al., 2013). Nevertheless, evaluations of GDL allow for consideration of some of the most common components such as changes to the learner phase and night-time and passenger restrictions in the probationary phase. A summary of evidence for these components is provided in the following sections along with an overview of the evidence for other components.

2.3.1 Learner phase

Common components in the learner phase are a minimum number of hours practice (50-120 hours) and/or a minimum duration (usually 6 or 12 months). Sometimes these are supported by the use of a logbook to monitor and verify progress. Both requirements aim to promote an increase in the amount and variation of supervised practice, and benefit from a delay in licensure (reduced exposure and greater maturity). The combination of both is complementary.

An updated GDL system in Victoria, Australia required a minimum learner period of 12 months and a minimum of 120 hours on-road supervised practice (including ten hours at night) during the learner phase for drivers under 21 years old. Results of before-and-after surveys found that the number of hours of practice increased substantially for 17 to 20 year olds and length of time a person is engaged with learning to drive increased for all age groups (Healy et al., 2012). The introduction of GDL in Victoria is associated with a significant reduction in young and novice driver collisions, although the effects of the requirements in the learner period have not been dissociated from the overall effect of the system (Senserrick & Williams, 2015).

With regard to the number of hours of practice, there are historically mixed results. Much of this is likely related to low level requirements (e.g. 30 hours) applied in many jurisdictions, particularly in the USA. If the minimum is set too low, for example 30-50 hours, it is possible that there is no opportunity to obtain a safety benefit if learners are already achieving this level of learner experience without any minimum. For example, in Great Britain, the Cohort II study determined that drivers had a mean of 52 hours of professional instruction and a mean of 19 hours of private instruction prior to taking the practical test (Wells et al., 2008). A review of US and Australasian practices suggest that the minimum requirements found in North

America are generally not sufficient (e.g. 30-50 hours) whereas those in Australia (e.g. 100-120 hours) are more effective. Through modelling of crash risk, Sagberg (2002) estimated that new drivers require 5,000-7,000 kilometres of learner experience to achieve the optimal balance of risk and experience that would result in the greatest safety benefit during the learner and first-year probationary period. This has been estimated to equate to between 80-140 hours of practice (Senserrick & Williams, 2015).

In New South Wales, the learner practice requirement was increased to 120 hours from 50 hours and a more difficult practical test was introduced. Comparison of the two cohorts suggest that the 120 hour group had increased pass rates (despite more complex task on the test) and evidence of superior driving skills (Senserrick & Williams, 2015). Recorded practice in complex driving situations was shown to increase after 110 hours of practice. The impact of this change alone cannot be identified as it was part of a number of changes, however, the combined changes resulted in a 40% reduction in fatal probationary driver crashes.

Evaluations of learner periods as part of GDL systems have consistently found benefits of a 12 month learner period over six months, and six months over no requirement (Senserrick & Williams, 2015). Originally support for the implementation of a minimum learner period and minimum required levels of practice comes from changes in the licensing system in Sweden (Gregersen, 1997, Gregersen et al., 2000). In Sweden, the learner licensing age was reduced from 17.5 to 16 years old to create a two year learner period, with a full minimum licencing age of 18 years old. The aim was to encourage more practice in the learner period, although the minimum period for holding a learner permit was six months. The changes were associated with a net reduction in collisions of 15% (Gregersen et al., 2000). Those utilising the full two year learner period had a greater reduction in collision risk and accumulated an average of 118 hours of practice compared with those who learned to drive in the minimum six months and recorded an average of 48 hours of practice. The more recent research cited above appears to support the effect of these differences in practice hours and provides some consensus that 120 hours of practice could be considered best-practice.

2.3.2 Probationary phase: Night-time component

Williams (2017) notes that since 2012 there has been little published research on night driving GDL restrictions other than a 2016 study that noted that GDL was associated with wider societal benefit of reducing criminal activity among 16-17 year olds (Deza & Litwok, 2016). This may reflect an acceptance that a night-time restriction is considered to be one of the most effective components of a GDL system, even for 6 months only.

In New Jersey, where the licensing age is 17 years old, Williams et al. (2010) found that a midnight to 5am restriction for new drivers was associated with a 44% reduction in fatal collisions (40% for all collisions). A multi-jurisdiction US study meanwhile estimated that the net effect of night-time restrictions in the USA, when compared with an older control group, is a reduction in fatal collisions at night for 16 to 17 year olds of 10% (Fell, Todd & Voas, 2011). There are significant variations from jurisdiction to jurisdiction in relation to exemptions (e.g. for carrying work or family) and the time period restricted.

Several studies have all estimated the effects of start-time differences on the effectiveness of the night-time component. McCartt et al. (2010) found that restrictions starting at 21:00 cut fatal collision rates for 15-17 year olds by 18%, whereas those beginning at midnight resulted

in a 12% reduction. Another study found that a 21:00 restriction reduced collision claims by 12% for 16 year olds, with an 8% reduction when starting at midnight (Trempel, 2009). Masten, Foss and Marshall (2013) meanwhile note that night restrictions starting at 22:00 or earlier are associated with 19% lower crash rates for 16 year old drivers. No studies have looked at the differences between end times of night driving restrictions.

2.3.3 Passenger component

An extensive literature review by Ouimet et al. (2015) concluded that fatal crash risk for young and novice drivers is associated with carrying young, similar age passengers, and multiple young passengers increases this risk. It is for this reason that passenger restrictions are commonly found to be associated with crash rate reductions as part of a GDL system (Senserrick & Williams, 2015; Williams, 2017; Vaa et al., 2015). Williams, Tefft & Grabowski (2012) found that teenage driver collisions when carrying teenage passengers were more likely to involve speeding, alcohol consumption and at-fault contribution to the collision, when compared with teenage driver collisions without passengers.

The evidence for the effectiveness of passenger restrictions in directly reducing collision risk is well established. In New Zealand, Begg and Stephenson (2003) found a 9% reduction in collisions attributable to the introduction of a teenage passenger restriction for new drivers. Meanwhile, in a comparison of passenger restrictions across US jurisdictions, states allowing one passenger had a 7% lower fatal crash rate than those allowing two or more passengers. The fatal crash rate for 15 to 17 year old drivers was 21% lower when novice drivers were prohibited from carrying any teenage passengers than when two or more teenage passengers were allowed (McCartt et al., 2010).

In New Jersey, where the licensing age is 17 years old, Williams et al. (2010) found that a no more than one passenger restriction for new drivers was associated with a 23% reduction in fatal collisions. In New South Wales and Queensland, Australia, GDL systems have a passenger restriction that only applies at night, similar to the proposal in Northern Ireland. While the introduction of GDL systems in these states has been associated with large reductions in probationary driver collisions overall (40% in NSW and 30% in Queensland), the individual effect of the passenger component is unknown. Senserrick, Boufous, Olivier & Hatfield (2018) argue that despite positive reductions overall, further strengthening can achieve greater effectiveness by including distinct night-time and passenger restrictions.

2.3.4 Other components

As already noted, no two jurisdictions have the same GDL system and there are a number of additional components that can be applied within a GDL system. Based on reviews by Kinnear et al. (2013) and Senserrick and Williams (2015) and the literature found from this review, Table 1 provides an overview of other components and the state of evidence for their effectiveness. Driver testing (theory, hazard perception or practical) has not been considered as a component here as GDL in Northern Ireland will build on the existing licensing system.

Table 1: Summary of other GDL components

GDL component	Summary of component	Evidence of effectiveness
Identifiers	Identifiers as part of a GDL system are used in Canada, New Zealand and Australia but the effectiveness of their use has not been established through research, although it is assumed. Scott-Parker, Watson, King and Hyde (2012) note that while there is no clear evidence for the use of identifiers, it is logical that they improve compliance and enforcement by increasing the visibility of new drivers to the authorities and increase the perceived threat of detection for the new driver.	Curry et al. (2013; 2015) analysed New Jersey's state-level crash rate, licensing and citation data to determine the effect of a new law requiring novice drivers to carry identifiers. Among probationary licence drivers aged 17 to 20 years, there was an increase in the rate of GDL citations issued in the few months after implementation and a sustained decline in crash rates two years after the provision went into effect.
Formal education requirements	Education can take many forms and may look to raise awareness and/or improve knowledge or attitudes to safety related behaviours. Education as part of GDL is sometimes used to discount the time a driver stays within the GDL system, although this has been associated with reducing the effectiveness of the GDL system. Mayhew, Williams, Robertson and Vanlaar (2017) argue education is a reinforcing component that can be used to support the core components of a GDL system.	Numerous reviews have suggested no quantifiable effect of education on crash risk. However, some studies have shown early promise for some forms of specific educational approaches that complement the GDL system (e.g. hazard perception, attentional control, impulse control and resilience).
Mobile technologies	The effect of driver distraction on collision risk is well established but few jurisdictions have applied GDL specific restrictions. North Carolina, USA and Victoria, Australia include mobile phone bans as part of their probationary licence phase. The remainder of jurisdictions rely on routine enforcement of laws that apply to all drivers.	There is little evidence of effectiveness for this component, largely due to a lack of evaluation studies. Neither North Carolina nor Victoria have reported a reduction in mobile phone use as a result of the ban, nor any relationship to crash risk (Goodwin, O'Brien & Foss, 2012; Senserrick & Williams, 2015).
Vehicle power restrictions	Some states in Australia impose high performance vehicle restrictions as part of a GDL system, however, this impacts a very small proportion of the young driver population.	There is little evidence of effectiveness for this component and any predicted impact is thought to be minimal, if any.

Alcohol limits	According to ETSC (2012) the risk of a fatal road collision increases exponentially with the blood alcohol content (BAC) of the driver. Drivers with a BAC between 0.1g/l and 0.5g/l are 1 to 3 times more likely to be involved in a fatal collision than sober drivers. Drivers with a BAC between 0.5 and 0.8g/l are 20 times more likely to be involved in a fatal collision. For drivers with a BAC between 0.8 and 1.2g/l, the risk is 30 times higher than a sober driver (Le Lièvre, Adminaite, Jost and Podda, 2019). The impact of alcohol on novice driver collision risk is greater than for experienced drivers (Peck, Gebers, Voas & Romano, 2008). Analysis from Irwin (2019) indicates that impairment from alcohol or drugs was the second greatest contributory factor in KSI collisions in Northern Ireland where a young driver (17-24 years) was responsible. The current drink drive limit in Northern Ireland is 80mg of alcohol per 100ml of blood (i.e. 0.8g/l). This is applicable to all drivers, regardless of licence status. The Road Traffic (Amendment) Act 2016 makes provision for two new lower drink drive limits of 50mg for the typical driver and 20mg for a 'specified person'. A 'specified' person includes a learner driver who holds a provisional licence and a novice driver who is subject to the two year probationary period under the New Driver's Order 1998.	Evaluations of the effectiveness of lower alcohol limits as part of a GDL system have historically been difficult to isolate. Begg & Stephenson (2003) were unable to establish definitive results from New Zealand's lower alcohol limit of 0.3g/l for new drivers. However, a summary of subsequent literature found a range of effectiveness with a 9-24% reduction in alcohol-related fatal crashes for 15-19 year olds (4-17% for all severities) (Senserrick & Williams, 2015). Additional evidence based on studies in Australia and the USA suggests that a lowered alcohol limit of 20mg (as proposed in Northern Ireland) has been associated with a 17% reduction in night-time single vehicle fatalities (Zwerling & Jones, 1999). A zero alcohol limit was more effective and associated with a 22% reduction. However, it should be noted that this study is 20 years old and obviously does not take account of any recent changes in alcohol related collision trends. Recent trends may account for Haghpanahan et al. (2019) being unable to find any impact of the reduced alcohol limit (for all drivers) in Scotland (from 0.8g/l to 0.5g/l) on collision rates. The authors suggest that another explanation could be the change may not have been promoted or enforced effectively. The evaluation was based on only two years of post-change data and a longer time period for evaluation may be necessary.

2.4 Summary

In summarising an extensive review of the literature, Kinnear et al. (2013) concluded that the impact of any GDL system depends on the number of components implemented, the strength of those components and the conviction with which the system is implemented by authorities. A review by the AAA Foundation for Traffic Safety in the US showed that states with more comprehensive GDL programs had more than double the reduction in injury collisions, and

more than triple the reduction in fatal crashes among 16 year old drivers relative to the overall reduction of crashes in states with less comprehensive GDL programs (Senserrick & Williams, 2015). In short, what evaluations to date have demonstrated is that there is a strong correlation between the strength of a GDL system and its effectiveness.

When considering a best practice approach, multiple reviews agree in the implementation of core components. In the learner phase this includes a minimum learner period (12 months) and minimum number of supervised hours (120 hours). In the probationary phase this includes mutually exclusive night-time (21:00 or 22:00 to 05:00) and young passenger restrictions. Supporting components might include a logbook during the learner phase, with requirements to encourage varied practice, and education. The existing and proposed licencing structure in Northern Ireland already supports other areas of good practice such as licensing age, hazard perception testing, a stringent practical test, stricter alcohol limits for new drivers and a lower penalty point threshold.

If appraising the proposed system in Northern Ireland against the international literature, it can be said that Northern Ireland is starting from a higher baseline of safety than many countries and states that have implemented GDL. This means that it is likely to be more challenging to reach the higher collision reduction percentages reported, with an expectation that reductions are likely to be more modest. With regard to the components being implemented, the minimum learner period, passenger restriction (at night) and the extension of the new driver period (including lower BAC limit) are supported by evidence of effectiveness. The role of identifiers, logbook and new training programme is difficult to quantify but act as reinforcing support to the system. Nevertheless, the evidence from the literature would suggest that the GDL system could be strengthened. For example, a learner phase of 12 months with a minimum number of hours of required practice would likely improve effectiveness, as would mutually exclusive night-time and passenger restrictions in the probationary phase.

The following sections describe analysis of Northern Ireland collision data to understand the predicted effect of the proposed GDL system, and the potential effect were components in the probationary phase (i.e. night-time and passenger restrictions) strengthened.

3 Method

This section describes the method used to calculate the potential casualty and cost savings from the core components of the GDL system currently being proposed in Northern Ireland. The analysis included casualties of all severities: killed, seriously injured and slightly injured. Alternative forms of implementing the core components (labelled scenarios) are also explored. Section 3.1 describes the different GDL scenarios considered in the analysis and section 3.2 explains how the casualty and cost savings were calculated for each scenario.

3.1 GDL Scenarios

In total, potential casualty savings have been calculated for 25 scenarios, comprising different combinations of passenger and night-time driving restrictions which apply for varying lengths of time after test pass. Table 2 describes the passenger and night-time restrictions for the different scenarios. Scenario 0 represents the status quo. Scenario 1 is the GDL currently proposed for Northern Ireland. Scenarios 2 and 3 (light blue shading) represent either the current night-time or passenger restriction operating exclusively (in the absence of the other). Scenario 4 (dark blue shading) represents both night-time and passenger restrictions being implemented exclusively. Scenarios 5-12 represent variations of scenarios 2, 3, and 4 but where the component is strengthened by being made stricter. Green shading here indicates where the component has been strengthened. Scenarios 1 to 12 have restrictions in place for the first six months after test pass and scenarios 13 to 24 have restrictions in place for 12 months after test pass.

Table 2: GDL scenario descriptions

Scenario 6 months (and 12 months)	Scenario description	Night-time definition	Young passenger definition
0	Baseline: No GDL	-	-
1 (and 13)	Proposed: No young passengers at night only	23:00-06:00	14-20 years
2 (and 14)	No young passengers at any time	-	14-20 years
3 (and 15)	No driving at night	23:00-06:00	-
4 (and 16)	No young passengers at any time AND No driving at night	23:00-06:00	14-20 years
5 (and 17)	No young passengers at any time	-	14-24 years
6 (and 18)	No driving at night	21:00-06:00	-
7 (and 19)	No young passengers at night only	21:00-06:00	14-20 years
8 (and 20)	No young passengers AND No driving at night	21:00-06:00	14-20 years
9 (and 21)	No young passengers at night only	23:00-06:00	14-24 years
10 (and 22)	No young passengers AND No driving at night	23:00-06:00	14-24 years
11 (and 23)	No young passengers at night only	21:00-06:00	14-24 years
12 (and 24)	No young passengers AND No driving at night	21:00-06:00	14-24 years

3.2 Data analysis

This section describes how the potential casualty and cost savings have been calculated for each of the scenarios in Table 2.

Northern Ireland collision data provided by PSNI for the years 2012-2018 were analysed to identify a target population for each scenario. The target population was defined as the number of casualties in collisions which 'met' the passenger and night-time criteria for the scenario and therefore would potentially have been avoided if the GDL restrictions were in place. For example, the target population for Scenario 1 includes all casualties in collisions which happened between 23:00 and 06:00 and involved a young driver who had passengers between the ages of 14 and 20 years old in their car.

The collision data does not include information about how long drivers have held their licence. Therefore, exposure data in the form of the number of young drivers in Northern Ireland with

full car licences and the total number of young drivers of each age who have held their licence for less than six months and for less than 12 months was provided by DVA.

This exposure data allowed the GDL scenario criteria about who restrictions apply to (e.g. drivers in their first six months or first 12 months) to be applied. Also, the addition of the exposure data meant that the number of casualties in the target populations could be factored to account for the risk of collision being different for novice and non-novice drivers and risk being higher for younger novice drivers than older ones. A detailed description of how the exposure data was used to factor the target populations can be found in Appendix B.

Another detail not recorded in the collision data is the presence of uninjured passengers in a collision. This meant that collisions in which a young driver had young passengers who were not injured would not be captured in the target populations at the collision data analysis stage. Therefore, the target populations for the scenarios with passenger restrictions were factored up by a proportion calculated using data from the RAIDS[5] project which collects information about all vehicle occupants involved in a collision, whether they are injured or not.

Once the target populations for each scenario had been identified and any necessary factoring completed, cost per casualty values were applied to give the potential cost savings for each scenario. Standard figures for the cost to society of a fatal, serious or slight casualty were not available for Northern Ireland so figures published by DfT were used instead[6]. These are shown in Table 3.

Table 3: Average value of prevention, 2018 (RAS60001 (DfT, 2019))

Casualty severity	Cost per casualty (£)
Fatal	1,958,303
Serious	220,058
Slight	16,964

3.2.1 Assumptions and limitations

The analysis in this report is constrained by the following assumptions and limitations.

- This analysis only covers young car drivers[7], motorcyclists to whom the GDL restrictions may also apply to have not been included.
- It is assumed that all young drivers are compliant with GDL regulations.
- It is assumed that a collision involving a young driver would not have happened had the young driver not been present.

[5] Road Accident In-Depth Study. A project for Department for Transport which involves detailed analysis and reconstruction of a sample of road traffic collisions.

[6] DfT average value of road casualty prevention based on an approach encompassing economic cost of lost output, emergency services costs and medical treatment, and human costs (reflecting pain, grief and suffering) associated with road traffic accident injuries.

[7] Car is defined here as car, taxi or light goods vehicles less than or equal to 3.5 tonnes

- No exemptions to the GDL restrictions have been accounted for, e.g. young passengers who are family members being permitted.
- It was only possible to account for the passenger and night-time components GDL in the casualty analysis. No other components, such as learning time of logbook requirements, have been included.
- Alcohol consumption of young drivers has not been accounted for.
- It has been assumed that uninjured passenger data from the RAIDS project which covers collisions in England is representative of Northern Ireland.

4 Results

This section presents potential casualty and cost savings for each GDL scenario, calculated using the method described in Section 3. The results are presented as expected reductions from the baseline (Scenario 0). The casualty numbers for Scenario 0 (all casualties in collisions involving a young driver) are shown in Table 4.

Table 4: Baseline annual casualty numbers (Scenario 0)

KSI casualties	Total casualties
214	2,495

Table 5 shows the expected reduction in number of casualties (total and KSI) and the expected proportional reduction in total annual casualties for each scenario, compared with the baseline (Scenario 0). The expected cost savings for each scenario are also shown.

Table 5: Expected reduction in annual casualties for each GDL scenario

Scenario	Months	Scenario description	Expected reduction in annual casualties from baseline		Expected proportional reduction in annual total casualties	Expected annual cost savings (£million)
			KSI	Total		
1	6	No 14-20yo passengers between 23:00-06:00	6	30	1%	3
2	6	No 14-20yo passengers at any time	21	167	7%	10
3	6	No driving between 23:00-06:00	9	53	2%	4
4	6	No 14-20yo passengers AND no driving between 23:00-06:00	34	241	10%	16
5	6	No **14-24yo** passengers at any time	22	180	7%	11
6	6	No driving between **21:00-06:00**	15	102	4%	7
7	6	No 14-20yo passengers between **21:00-06:00** only	12	70	3%	5
8	6	No 14-20yo passengers AND no driving between **21:00-06:00**	42	311	12%	19
9	6	No **14-24yo** passengers between 23:00-06:00 only	7	34	1%	3
10	6	No **14-24yo** passengers AND no driving between 23:00-06:00	35	250	10%	17
11	6	No **14-24yo** passengers between **21:00-06:00** only	13	74	3%	5
12	6	No **14-24yo** passengers AND no driving between **21:00-06:00**	43	320	13%	20

Scenario	Months	Scenario description	Expected reduction in annual casualties from baseline		Expected proportional reduction in annual total casualties	Expected annual cost savings (£million)
			KSI	Total		
13	12	No 14-20yo passengers between 23:00-06:00 only	10	51	2%	4
14	12	No 14-20yo passengers at any time	34	291	12%	16
15	12	No driving between 23:00-06:00	16	95	4%	8
16	12	No 14-20yo passengers AND no driving between 23:00-06:00	55	421	17%	27
17	12	No **14-24yo** passengers at any time	37	318	13%	18
18	12	No driving between **21:00-06:00**	26	178	7%	12
19	12	No 14-20yo passengers between **21:00-06:00** only	19	116	5%	8
20	12	No 14-20yo passengers AND no driving between **21:00-06:00**	70	541	22%	33
21	12	No **14-24yo** passengers between 23:00-06:00 only	12	58	2%	5
22	12	No **14-24yo** passengers AND no driving between 23:00-06:00	58	443	18%	28
23	12	No **14-24yo** passengers between **21:00-06:00** only	20	125	5%	9
24	12	No **14-24yo** passengers AND no driving between **21:00-06:00**	72	563	23%	35

Table 5 shows that GDL restrictions proposed by Northern Ireland (Scenario 1: no 14-20yo passengers between 23:00-06:00 only for six months post-test) are expected to decrease the total casualties by 1%. Separating the current combined night-time and passenger restriction to create two independent restrictions (Scenario 4) would improve effectiveness and be expected to reduce casualties by 10%. This would also increase costs savings from £3 million to £16 million. The six-month scenario expected to reduce casualty numbers the most (by 13%) is Scenario 12 where independent and strong restrictions on young passengers (passengers aged 14-24 years old) and driving at night (between 21:00 and 06:00) both apply after test pass.

As would be expected, the casualty savings for each of scenarios 13-24 (where restrictions are in place for 12 months post-test) are higher than for the corresponding scenario where restrictions are only in place for six months.

Figure 1 shows the effect of separating combined night-time and passenger restrictions proposed in Scenario 1 and creating independent restrictions. The reduction in casualties when compared with the baseline is shown for each scenario.

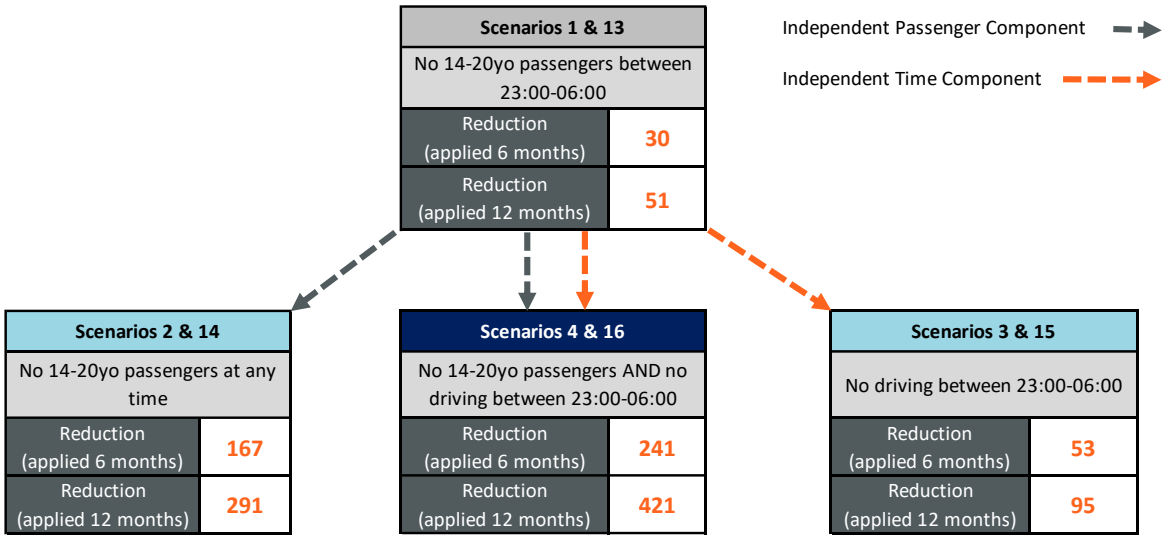

Figure 1: Relationship between GDL scenarios with combined or independent time and passenger components

As can be seen in Figure 1, independent passenger and night-time restrictions result in larger reductions in casualties than the combined restriction (Scenario 1). A passenger restriction (Scenarios 2 and 14) would save more casualties than a night-time restriction (Scenarios 3 and 15) but applying both independent restrictions as in Scenario 4 (and 16) would be the most effective.

Scenarios 2, 3 and 4 (independent passenger and night-time restrictions) as shown in Figure 1 have night-time and passenger restrictions as defined in the GDL system currently proposed for Northern Ireland (young passengers defined as 14-20 year olds and night-time defined as between 23:00 and 06:00). Figure 2 shows the effects of strengthening these definitions.

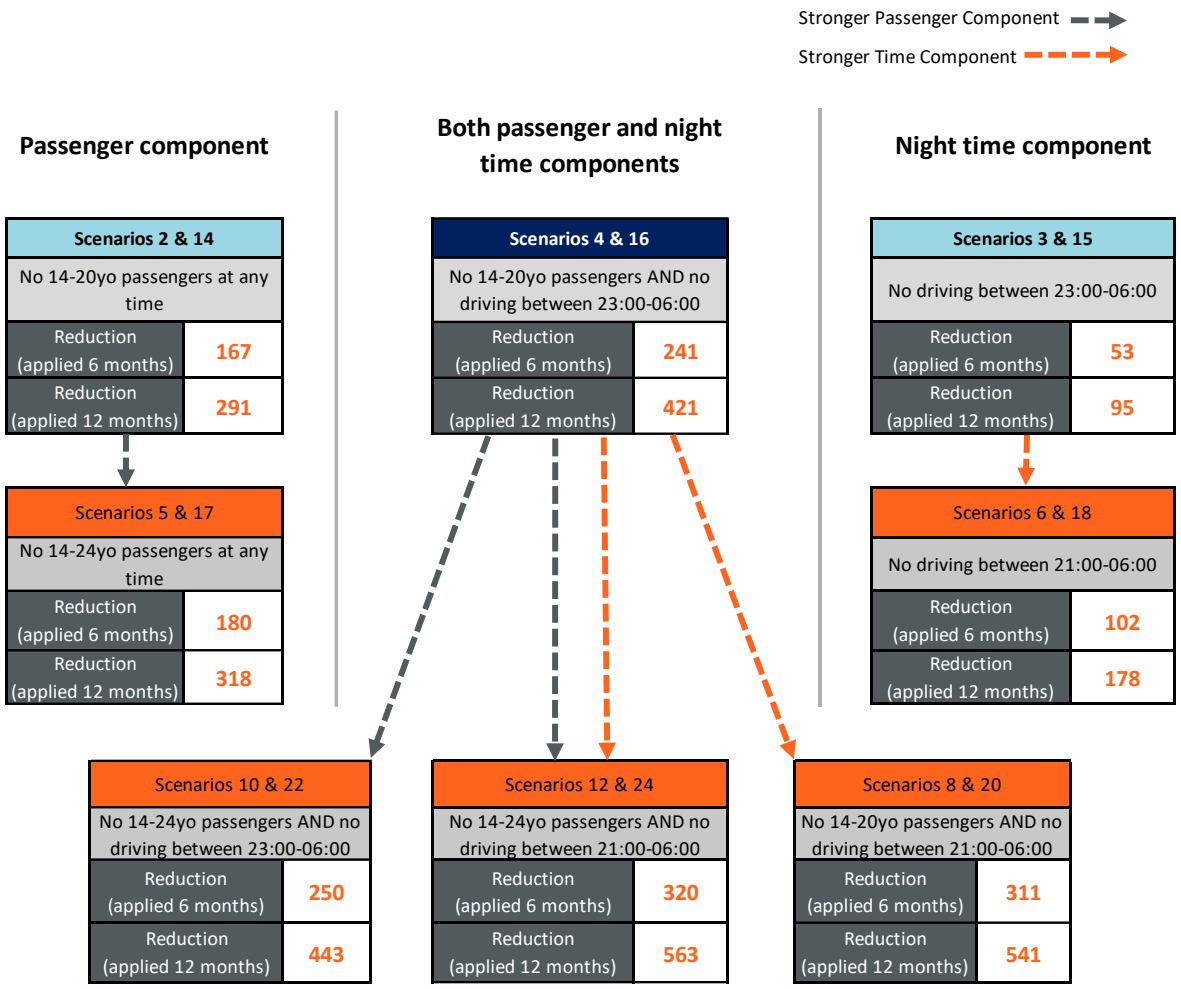

Figure 2: Effects of strengthening independent passenger (left) and night-time (right) components. Centre shows impact of strengthening both as independent components in a GDL system.

Similar to Figure 1, Figure 2 shows that independent passenger restrictions (Scenarios 2 & 14 and 5 & 17) give a larger reduction in casualties than night-time restriction (Scenarios 3 & 15 and 6 & 18). However, Figure 2 also shows that strengthening the independent time component results in a bigger increase in the expected reduction in casualties than strengthening the independent passenger component. When comparing Scenarios 3 & 15 with Scenarios 6 & 18, it can be seen that the expected reduction in number of casualties approximately doubles when the night-time definition is widened from starting at 23:00 to 21:00. However, when Scenarios 2 & 14 are compared with Scenarios 5 & 17 it shows that when the passenger restriction is strengthened (i.e. the definition of young passenger is widened from 14-20yo to 17-24yo) the reduction in casualties increases only slightly.

The casualty reduction economic savings associated with implementing each scenario are displayed in Figure 3. The scenarios are shown grouped by restrictions and colour-coded according to how long the restrictions apply for.

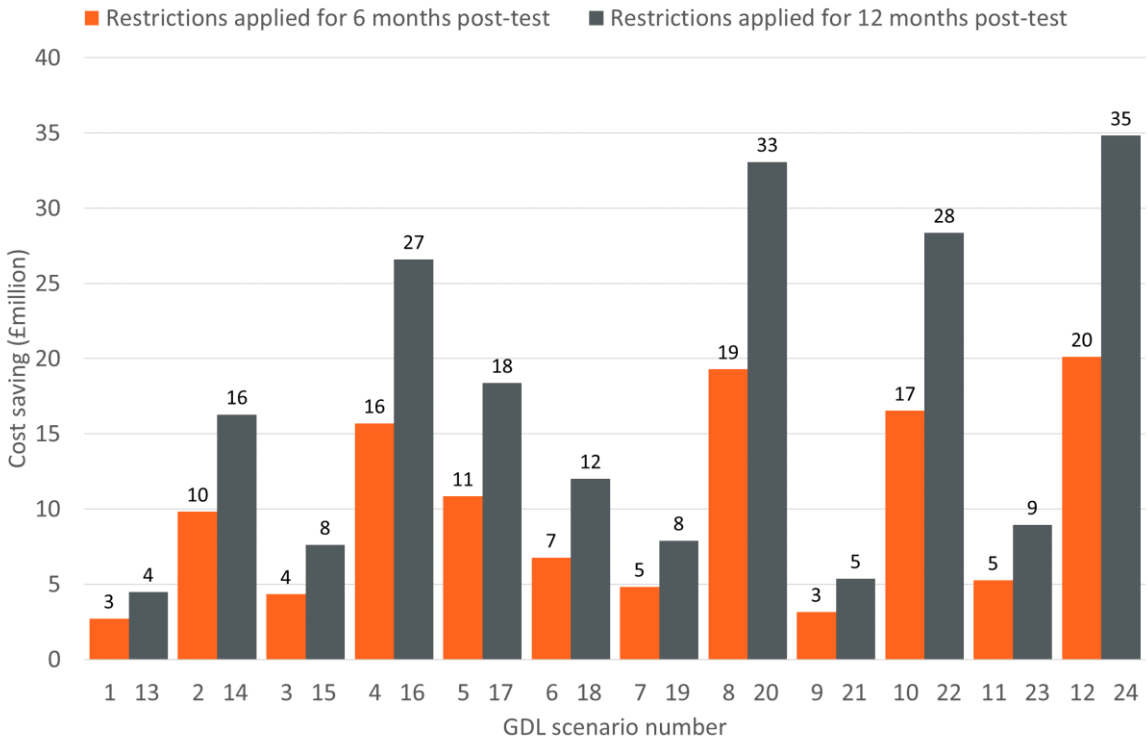

Figure 3: GDL new driver post-test scenarios – casualty economic savings (£million)

Figure 3 shows that the proposed GDL scenario would result in an expected annual saving of £3 million. Uncoupling the combined passenger and night-time restriction (scenario 4 and 16) would save £16 million with a six month probationary licence period and £27 million with a 12 month period. The largest economic saving achievable is through the implementation of Scenario 24 (independent and strengthened passenger and night-time restrictions in a 12 month period), resulting in £35 million of annual casualty savings. Scenario 20 achieves only slightly less (£33 million) by strengthening the night-time restriction over 12 months but without strengthening the passenger restriction.

5 Summary

Young and novice drivers are overrepresented in road collisions in Northern Ireland, posing a disproportionate risk to themselves and other road users. The most effective intervention for reducing the number of collisions and injuries in which young and novice drivers are involved is through Graduated Driver Licensing (Kinnear et al., 2013). The basic premise of GDL is to allow young and novice drivers to develop on-road driving experience under relatively safe and secure conditions by protecting them from more demanding and risky conditions.

Northern Ireland has received Royal Assent to implement a GDL system with the proposed system introducing a minimum six month learner period and a six month post-test passenger restriction (no passengers aged between 14-20 years) between 23:00 and 06:00. A post-test 'new driver period' of 2 years (to align with the New Drivers Order) will also be introduced during which novice drivers (and riders) will be subject to lower alcohol limits and must display a post-test identifier. Other reinforcing elements include a programme of driver training and a logbook.

An update and review of the literature confirms that GDL remains the most effective intervention for improving the safety of young and novice drivers. Almost all jurisdictions that have implemented GDL have eventually gone on to reinforce it by enhancing the strength of the system. As such, much of the recent research has focused on understanding nuanced secondary effects of GDL and attempting to distinguish what the most effective combination of components is. While there is no clear cut answer to this question, it is clear that core components in the learner phase include a minimum learner period and minimum number of hours of practice (12 months and 120 hours would be considered best practice). In the probationary phase, a night-time driving restriction and passenger restriction are considered as the core components. The effectiveness of these components is directly correlated to the extent to which they impact exposure and opportunity. For example, the earlier a night-time restriction starts (e.g. 21:00 or 22:00 rather than midnight), the more effective it will be. The fewer peer-passengers permitted, the more effective the passenger restriction. Of course, in such circumstances, independent and mutually exclusively restrictions are more effective than a combined restriction (i.e. passenger restriction that only applies at night, and consequently a night restriction that only applies if carrying a passenger).

All of the proposed changes in Northern Ireland are supported by evidence in the literature. However, the analysis reveals the impact on effectiveness from a weakening of the two core probationary components by combining them. The reduction of 30 casualties per year and £3 million saving from the proposed joint night and passenger restriction could be significantly more effective if these restrictions were independent. Such a change would increase effectiveness to prevent 241 fewer casualties and a saving to society of £16 million each year. Implementing these restrictions independently highlights that the passenger restriction would be more effective than the night-time component (167 and 53 casualties saved each year respectively). Strengthening either component reveals that the gains from strengthening the night-time component far outweigh changes to the passenger component. As a significant number of young driver collisions occur between 21:00 and 23:00, starting the night-time restriction at 21:00 would almost double the number of casualties saved (from 53 to 102 per year). Strengthening the passenger component (from no carrying of 14-20 year olds to 14-24 year olds) would marginally increase casualty savings from 167 to 180 per year.

International evaluations have found the introduction of GDL to result in collision reductions of between 5%-40%. Several factors will affect this but baseline licensing systems and the strength of the GDL implemented are two of the most important factors. The existing licensing framework in Northern Ireland provides a good basis for implementing GDL. The licensing age is higher than many jurisdictions that have implemented GDL, the driving test (including theory and hazard perception elements) is relatively stringent and the New Drivers Order enforces a lower penalty point threshold. With this already in place, the areas for impact are in the core learner and probationary phase components. The analysis demonstrates that with the strongest passenger and night-time components GDL in Northern Ireland could reduce casualties by 23%, in line with international estimates.

The analysis clearly relies on assumptions and is limited by the data available, for example, it was unable to account for the impact on alcohol related collisions. Nevertheless, it provides indicative values of the potential impact of GDL in Northern Ireland. These estimates are primarily the resultant outcome of the probationary phase components only (i.e. night-time and passenger restrictions). It does not, therefore, consider the impact of the six month minimum learner period, lower alcohol limit or the reinforcing components (e.g. learner driver programme, logbook and identifiers). While there is not the evidence to accurately predict the effectiveness of these components, it is feasible that the whole system effect (including concurrent additional restrictions on young motorcyclists) may be greater than that reported here. The predicted reductions can be considered conservative and likely to be an underestimate.

5.1.1 Conclusion

Northern Ireland is taking the lead on GDL in the United Kingdom. The evidence for GDL to reduce collisions and casualties on the roads is overwhelmingly consistent. The proposed changes in Northern Ireland at this time are also expected to result in casualty reductions, albeit modest in its current format. The constraint on effectiveness is the result of core restrictions being limited in impact through being combined rather than applied independently. It is notable that almost all jurisdictions that have implemented GDL have gone on to strengthen the system. The analysis here reveals that there is scope for Northern Ireland to significantly enhance and strengthen the system in both the learner and probationary phases, and such changes are likely to result in significant further casualty savings.

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Appendix A Search terms and scoring criteria

Table 6: List of search terms

1st Level		2nd Level
GDL* OR "Graduated driver licen*" OR "Graduated licen*" OR "Structured licen*" OR Restrict* OR Probation*	AND	Component* OR Factor* OR Review* OR Evaluat* OR Assess* OR Apprais* OR Evidence* OR Effective* OR Impact* OR Crash* OR Injur* OR KSI

** indicates a wild card operator. For example, "licen*" would search for licence, license, licencing, licensing, licenced, licensed and licensure.*

Example Boolean expression: "graduated driver licensing" AND (component OR factor* OR review*)*

Table 7: Scoring criteria

	Score = 1	Score = 2	Score = 3
Relevance	Not relevant to the objectives of the review	Some indirect relevance to the objectives of the review	Directly relevant to the objectives of the review
Quality	Fact sheet, newspaper type article	Scientific article, not peer-reviewed	Peer-reviewed scientific article

Appendix B Method for accounting for relative risk of novice/non-novice drivers

This appendix describes in detail the approach used to apply data about how long drivers have had their licence for to the GDL scenario target populations, as mentioned in section 3.2.

B.1 Calculating risk of novice/non-novice drivers

Maycock et al. (1991) devised a model which calculates expected annual accident frequency based on driver age, experience and mileage using the following equation.

$$F = 0.00212M^{0.38}e^{\frac{20}{A}+\frac{2.5}{X+2.2}}$$

Where

F = Expected annual accident frequency

M = annual mileage (assume to be 7,500 as done by Maycock et al)

A = drivers age

X = number of years since passing driving test.

This equation was used to estimate the expected accident frequency for novice and non-novice drivers in each age group. As the annual mileage has been assumed to be the same for all age groups, this expected accident frequency can be considered equivalent to risk.

Figure 4 illustrates the equation above. It shows the expected annual accident frequency by driver age for different aged novice drivers (grey lines) and for novice drivers of different ages (orange dotted line). The grey lines show that risk decreases with experience, e.g. a 17 year old novice driver has an expected annual accident frequency of just over 0.6 but by the time that driver is 24 (and therefore have 7 years' experience) this has decreased to around 0.2. The orange line shows that the risk for a novice driver is lower the older the novice driver is.

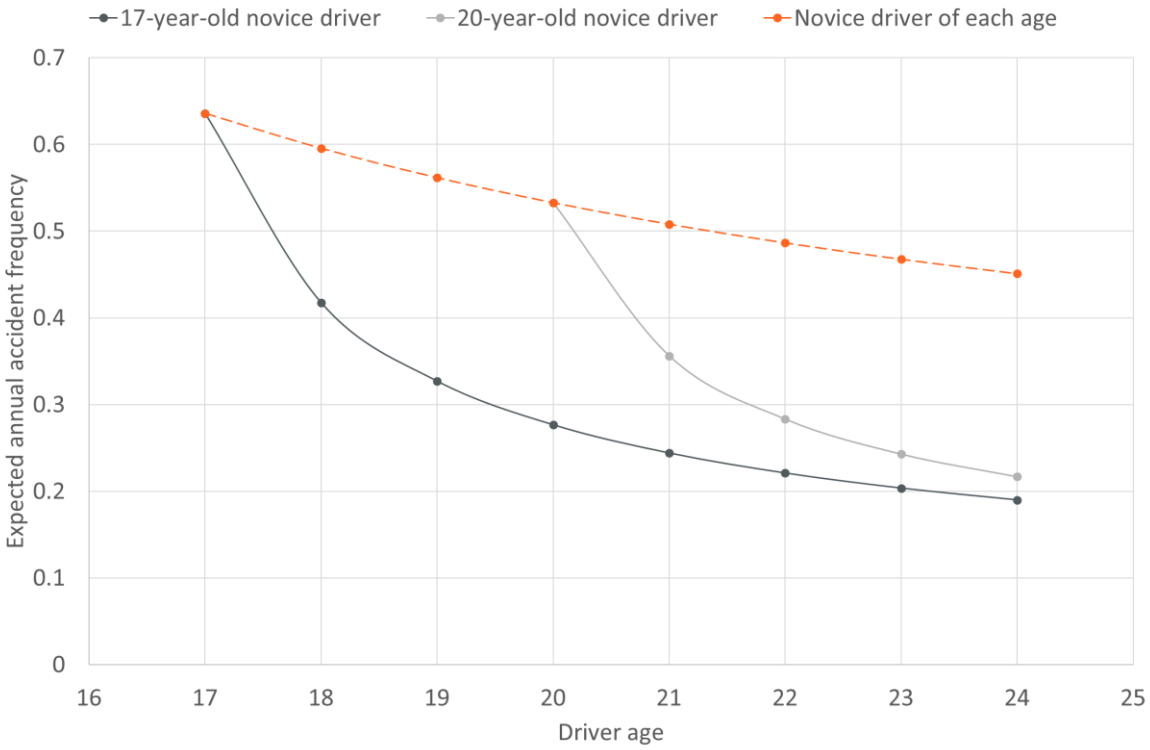

Figure 4: Expected annual accident frequency by driver age for different aged novice drivers (17 and 20 years old) and for novice drivers of different ages

B.2 Application to target populations

Exposure data provided by the DVA gave the proportion of drivers/riders of each age who have held their full licence for less than six months or for between 6 and 12 months.

The target population for each scenario was split by age of young driver (if two young drivers were involved in a collision, the lowest age was used). Then, the casualties from collisions in each young driver age group were factored as shown in Figure 5.

In Figure 5, 'Risk' is the expected accident frequency for the age group as calculated in the previous section and 'Proportion' is the proportion of drivers in the age group which have held their licence for the specified number of months. For example, $Proportion_{<6mths}$ is the proportion of drivers in the age group who have held their licences for less than six months and $Risk_{<6mths}$ is the expected accident frequency for these drivers.

Figure 5: Process for applying novice/non-novice driver risk to target population (this process is applied separately to each young driver age group)

The process in Figure 5 resulted in three different target populations for each scenario:

- TPa estimates all casualties in collisions where the young driver has passed their test less than six months ago
- TPb estimates all casualties in collisions where the young driver has passed their test between six and 12 months ago
- TPc estimates all casualties in collisions where the young driver has passed their test more than 12 months ago

The relevant sub-categories were then summed according to the criteria for the GDL scenario to give the updated target populations.

The potential impact of Graduated Driver Licensing in Northern Ireland

In order to address the overrepresentation of young and novice drivers in road collisions, Northern Ireland is set to implement a Graduated Driver Licensing (GDL) system. The system will include a minimum six month learner period, a six month post-test passenger restriction (no passengers aged between 14-20 years) between 23:00 and 06:00, and a 24 month new driver period incorporating a lower alcohol limit. Reinforcing elements such as a programme of driver training and a logbook, and identifiers to be carried during the probationary phase are also being implemented. This report details a review of the international literature which was used to inform and contextualise a predictive analysis of the expected impact of GDL in Northern Ireland using police reported collision data from 2012-2018. Analysis revealed that the proposed combined passenger at night-time component is expected to result in a reduction of 30 casualties of all severities each year (including 6 killed or seriously injured (KSI)). This equates to an annual saving of costs to society of £3 million. Decoupling of the combined passenger at night-time restriction to create independent passenger and night-time restrictions would increase effectiveness to 241 fewer casualties and a saving to society of £16 million each year. Further strengthening of the independent effects of night-time and passenger restrictions was also explored. This suggested that bringing forward the start time of a night-time restriction from 23:00 to 21:00 would almost double the casualty savings from this component. Strengthening of an independent passenger component had a more moderate impact.

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ISSN 2514-9652

ISBN 978-1-913246-20-4

PPR934