Finnish Transport and Communications Agency

Impacts of the eCall System in Finland

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Tiivistelmä

Tutkimuksessa arvioitiin automaattisen eCall-hätäpuhelujärjestelmän toteutuneita vaikutuksia Suomessa ajanjaksona 2019–2023 ja turvallisuuspotentiaalia vuoteen 2035 asti kattaen sekä yleiseurooppalaisen eCallin että kolmansien osapuolien palvelukeskusten TPS-eCallin. Lisäksi tarkasteltiin järjestelmän teknistä toimivuutta ja vaikutuksia hätäkeskuslaitoksen päivystäjien ja pelastustyöntekijöiden työhön. Tutkimus perustui Hätäkeskuslaitoksen, PRONTO-tilaston ja OTI:n aineistoihin sekä haastatteluihin.

Tulosten mukaan eCallin liikenneturvallisuusvaikutus vuosina 2019–2023 oli maltillinen: Automaattisen eCallin arvioitiin laskennallisesti pelastaneen Suomessa tarkastelujaksolla yhden ihmishengen. Tulokseen vaikutti mm. se, että useimmat vakavat liikenneonnettomuudet ilmoitetaan myös muilla keinoin pian onnettomuuden tapahtumisen jälkeen, ja eCall-järjestelmä ei ole vielä erityisen yleinen. Näin ollen eCallin lisäarvo korostuu harvinaisissa viiveisissä tapauksissa, joissa on osallisena eCallilla varustettu ajoneuvo.

Tulevaisuudessa NG-eCall tulee pakolliseksi uusissa henkilö- ja pakettiautoissa vuonna 2027, ja nykyinen 2G/3G-pohjainen eCall lakkaa toimimasta vuonna 2030. eCall-järjestelmien osuuden liikennekäytössä olevien henkilö- ja pakettiautojen kannasta arvioitiin kasvavan vuoden 2025 12,5 %:sta noin 27 %:iin vuonna 2035. eCallin arvioitiin säästävän vuosina 2019–2035 kumulatiivisesti noin 10 henkeä ja noin 13 muuten vakavasti loukkaantunutta loukkaantuisikin lievästi.

Moottoripyörissä ja raskaissa ajoneuvoissa ei ole tällä hetkellä eCall-järjestelmiä. Moottoripyörien eCall-järjestelmän arvioitiin voivan auttaa erityisesti harvaan asutuilla seuduilla ja yöaikoina, mutta järjestelmän toteutuksessa tulisi pyrkiä siihen, että aiheettomia ilmoituksia tulisi mahdollisimman vähän. Raskaan liikenteen eCallissa suurin lisäarvo liittyy MSD-viestin lastitiedon (esim. vaaralliset aineet) välittämiseen.

eCall-järjestelmän haasteena on suuri aiheettomien hätäilmoitusten osuus: kaikkiaan 80,6 % eCall-hätäilmoituksista oli aiheettomia, automaattisista 55,3 % ja manuaalisista 94,0 %. Kolmansien osapuolien palvelukeskukset suodattavat tehokkaasti aiheettomia ilmoituksia. Hätäkeskuksiin päätyneistä TPS-eCall-ilmoituksista aiheettomia oli vain 1,9 %. Kierto erillisen palvelukeskuksen kautta voi kuitenkin aiheuttaa viivettä.

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Sammandrag

I studien bedömdes de realiserade effekterna av det automatiska eCall-nödsamtalssystemet i Finland under perioden 2019–2023 samt säkerhetspotentialen fram till 2035. Studien omfattade både det paneuropeiska eCall och TPS eCall via tredje parters servicecentraler. Dessutom granskades systemets tekniska funktion och dess effekter på arbetet för Nödcentralsverkets (Hätäkeskuslaitos) operatörer och räddningspersonal. Studien baserades på material från Nödcentralsverket, PRONTO-statistiken och OTI samt på intervjuer.

Enligt resultaten var eCalls trafiksäkerhetseffekt 2019–2023 måttlig: automatiskt eCall bedömdes, baserat på beräkningar, ha räddat ett människoliv i Finland under granskningsperioden. Resultatet påverkades bland annat av att de flesta allvarliga trafikolyckor också anmäls på andra sätt kort efter att olyckan inträffat, och av att eCall-systemet ännu inte är särskilt utbrett. Därför framhävs eCalls mervärde i sällsynta fördröjda fall där ett eCall-utrustat fordon är inblandat.

Framöver blir NG eCall obligatoriskt i nya personbilar och paketbilar år 2027, och det nuvarande 2G/3G-baserade eCall kommer att sluta fungera år 2030. Andelen eCall-system i fordonsbeståndet av person- och paketbilar i trafik uppskattades öka från 12,5 % år 2025 till cirka 27 % år 2035. eCall bedömdes kumulativt rädda omkring 10 liv under 2019–2035, och i cirka 13 fall skulle en person som annars hade skadats svårt i stället skadas lindrigt.

För närvarande finns inga eCall-system i motorcyklar och tunga fordon. Ett eCall-system för motorcyklar bedömdes kunna vara till hjälp särskilt i glesbygdsområden och nattetid, men vid implementeringen bör man sträva efter att antalet obefogade anmälningar blir så litet som möjligt. För eCall i tung trafik är det största mervärdet kopplat till att lastinformation (t.ex. farliga ämnen) kan förmedlas i MSD-meddelandet.

En utmaning för eCall-systemet är den höga andelen obefogade nödanmälningar: totalt var 80,6 % av eCall-nödanmälningarna obefogade—55,3 % av de automatiska och 94,0 % av de manuella. Tredje parters servicecentraler filtrerar obefogade anmälningar effektivt. Av de TPS eCall-anmälningar som nådde nödcentralerna var endast 1,9 % obefogade. Omdirigering via en separat servicecentral kan dock orsaka fördröjning.

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eCall; effectiveness; impact assessment; road safety; impact potential; technical performance

Abstract
The study assessed the realised impacts of the automatic eCall emergency call system in Finland during 2019–2023 and its safety potential up to 2035, covering both the Pan-European eCall and third-party service centres' TPS eCall. In addition, the study examined the system's technical performance and its impacts on the work of Emergency Response Centre Agency dispatchers and rescue workers. The study was based on datasets from the Emergency Response Centre Agency (Hätäkeskuslaitos), the PRONTO statistics, and OTI, as well as interviews.

According to the results, the road safety effect of eCall in 2019–2023 was moderate: automatic eCall was estimated, based on calculations, to have saved one life in Finland during the review period. The result was influenced, among other factors, by the fact that most serious road traffic accidents are also reported by other means soon after the accident occurs, and that the eCall system is not yet particularly widespread. Thus, the added value of eCall is emphasised in rare, delayed cases involving a vehicle equipped with eCall.

In the future, NG eCall will become mandatory in new passenger cars and vans in 2027, and the current 2G/3G-based eCall will cease to function in 2030. The share of eCall systems in the fleet of passenger cars and vans in active traffic use was estimated to grow from 12.5% in 2025 to about 27% in 2035. eCall was estimated to save cumulatively about 10 lives over 2019–2035, and in about 13 cases a person who would otherwise have been seriously injured would instead sustain only slight injuries.

At present, motorcycles and heavy vehicles do not have eCall systems. A motorcycle eCall system was estimated to be potentially helpful especially in sparsely populated areas and at night, but its implementation should aim to minimise unnecessary notifications as far as possible. For heavy-vehicle eCall, the greatest added value is related to transmitting cargo information (e.g., dangerous goods) in the MSD message.

A challenge for the eCall system is the high share of unnecessary emergency notifications: overall, 80.6% of eCall emergency notifications were unnecessary—55.3% of automatic notifications and 94.0% of manual ones. Third-party service centres filter unnecessary notifications effectively: of the TPS eCall notifications that reached the emergency response centres, only 1.9% were unnecessary. However, routing via a separate service centre may cause delay.

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ALKUSANAT

Suomessa eCall otettiin käyttöön EU:n päätösten mukaisesti lokakuussa 2017. eCall-järjestelmän on oltava asennettuna Euroopassa kaikkiin 31.3.2018 jälkeen tyyppihyväksyttyihin henkilö- ja pakettiautoihin. Tulevina vuosina nykyinen, 2G- ja 3G-verkoissa toimiva eCall korvataan uuden sukupolven eCall-järjestelmällä, joka toimii 4G- ja 5G-verkoissa. Komissiolla on suunnitelmia laajentaa järjestelmä myös kaksipyöräisiin moottoriajoneuvoihin ja raskaisiin ajoneuvoihin.

eCallin turvallisuusvaikutuksia Suomessa arvioitiin vuosituhannen alkupuolella, jolloin eCall-järjestelmä oli vasta suunnitteilla. Turvallisuusvaikutusten lisäksi eCall-järjestelmän teknistä toimivuutta on selvitetty vuosien mittaan useissa hankkeissa. eCallin todellisia liikenneturvallisuusvaikutuksia ei ole arvioitu missään maassa, ja Suomessakin olosuhteet ovat 20 vuodessa muuttuneet.

Liikenne- ja viestintävirasto Traficom tilasi VTT:ltä tutkimuksen, jonka tavoitteena oli selvittää nykyisen eCall-järjestelmän toimivuutta, hyötyjä ja vaikutuksia sekä arvioida automaattisen hätäpuhelujärjestelmän hyötyjä uusille ajoneuvotyypeille. Tämä raportti on käännös alkuperäisestä, suomeksi julkaistusta raportista (Traficomin tutkimuksia ja selvityksiä 1/2026).

VTT:llä projektiryhmänä toimi Johannes Mesimäki, Henri Sintonen ja Satu Innamaa (projektipäällikkö) sekä Ida Maasalo (kesäkuuhun 2025 asti) ja Fanny Malin (joulukuuhun 2024 asti). Projektin ohjausryhmässä olivat Anna Schirokoff (puheenjohtaja), Risto Öörni, Heidi Himmanen, Timo Kärkkäinen ja Kari Hakuli Traficomista; Pertti Virtanen, Dan Berlin ja Jussi Uimaluoto Hätäkeskuslaitokselta; Esa Aaltonen ja Antti Paasilehto LVM:stä sekä Niina Sihvola Onnettomuustietoinstituutista.

Kiitos kaikille haastatelluille ja tutkimuksen käyttöön aineistoja luovuttaneille.

Helsinki, 16. maaliskuuta 2026

Anna Schirokoff
Johtava asiantuntija

Liikenne- ja viestintävirasto Traficom

FÖRORD

I Finland togs eCall i bruk i enlighet med EU:s beslut i oktober 2017. eCall-systemet måste vara installerat i Europa i alla person- och paketbilar som typgodkänts efter den 31 mars 2018. Under de kommande åren kommer det nuvarande eCall-systemet, som fungerar i 2G- och 3G-nät, att ersättas av en ny generation eCall-system som fungerar i 4G- och 5G-nät. Kommissionen har planer på att utvidga systemet även till tvåhjuliga motorfordon och tunga fordon.

Säkerhetseffekterna av eCall i Finland bedömdes i början av 2000-talet, då eCall-systemet fortfarande var under planering. Förutom säkerhetseffekterna har den tekniska funktionaliteten hos eCall-systemet utretts under årens lopp i flera projekt. De verkliga trafiksäkerhetseffekterna av eCall har inte bedömts i något land, och även i Finland har förhållandena förändrats under 20 år.

Transport- och kommunikationsverket Traficom beställde en studie från VTT med målet att undersöka det nuvarande eCall-systemets funktion, nyttor och effekter samt att bedöma fördelarna med automatiska nödanropssystem för nya fordonskategorier. Denna rapport är en översättning av den ursprungliga rapporten som publicerades på finska (Traficoms forskningsrapporter och utredningar 1/2026).

Projektgruppen hos VTT bestod av Johannes Mesimäki, Henri Sintonen och Satu Innamaa (projektledare) samt Ida Maasalo (fram till juni 2025) och Fanny Malin (fram till december 2024). Projektets styrgrupp bestod av Anna Schirokoff (ordförande), Risto Öörni, Heidi Himmanen, Timo Kärkkäinen och Kari Hakuli från Traficom; Pertti Virtanen, Dan Berlin och Jussi Uimaluoto från Nödcentralsverket; Esa Aaltonen och Antti Paasilehto från Kommunikationsministeriet samt Niina Sihvola från Institutet för Olycksinformation.

Tack till alla intervjuade och till dem som tillhandahöll material för studien.

Helsingfors, den 16 mars 2026

Anna Schirokoff
Ledande sakkunnig

Transport- och kommunikationsverket Traficom

FOREWORD

In Finland, eCall was introduced in accordance with EU decisions in October 2017. The eCall system must be installed in Europe in all passenger cars and light commercial vehicles that have been type-approved after 31 March 2018. In the coming years, the current eCall system, which operates on 2G and 3G networks, will be replaced by a next generation eCall system that operates on 4G and 5G networks. The Commission also has plans to extend the system to two-wheeled motor vehicles and heavy vehicles.

The safety impacts of eCall in Finland were assessed in the early 2000s, when the system was still in its development stage. In addition to safety impacts, the technical functionality of the eCall system has been examined over the years in several assessments. The actual road safety impacts of eCall have not been assessed in any country, and conditions in Finland have also changed over the past 20 years.

The Finnish Transport and Communications Agency Traficom commissioned a study from VTT with the aim of investigating the functionality, benefits and impacts of the current eCall system, as well as assessing the advantages of automatic emergency call systems for new vehicle categories. This report is a translation of the original report published in Finnish (Traficom Research Reports 1/2026).

The project team at VTT consisted of Johannes Mesimäki, Henri Sintonen and Satu Innamaa (project manager), as well as Ida Maasalo (until June 2025) and Fanny Malin (until December 2024). The project steering group included Anna Schirokoff (chair), Risto Öörni, Heidi Himmanen, Timo Kärkkäinen and Kari Hakuli from Traficom; Pertti Virtanen, Dan Berlin and Jussi Uimaluoto from the Emergency Response Centre Agency; Esa Aaltonen and Antti Paasilehto from the Ministry of Transport and Communications; and Niina Sihvola from The Finnish Crash Data Institute.

Thank you to all interviewees and to those who provided material for the study.

Helsinki, 16 March 2026

Anna Schirokoff
Chief specialist

Finnish Transport and Communications Agency Traficom

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Glossary

English (EN)	Finnish (FI)	Definition
112 app	112-sovellus	A mobile application that relays the location coordinates of an emergency call.
Valid eCall	Aiheellinen eCall	An eCall activation that led to dispatch or was classified as a real emergency.
False/invalid eCall	Aiheeton eCall	An eCall activation that requires no action or is classified as groundless.
Vehicle renewal rate	Ajoneuvokannan uusiutumisaste	The share of the vehicle fleet that is replaced annually.
eCall (in-vehicle emergency call)	eCall	A vehicle-integrated system that contacts the PSAP in the event of an accident, transmits the Minimum Set of Data (MSD) and facilitates voice communication between the persons in the vehicle and the dispatcher; mandatory in new type-approved passenger cars and vans since 2018.
eCall event	eCall-tapahtuma	In the PSAP information system, an event is an umbrella term for compiling all the information related to a specific emergency. It represents one real-world accident or incident. An eCall event is an event associated with at least one eCall emergency notification.
H task (advice & guidance)	H-koodit / H-tehtävä	A PSAP classification/process where an emergency call does not generate a forwardable task (e.g. advice and guidance) because the situation cannot be assessed according to the guidelines / risk assessment or it does not require dispatch.
Dispatched incident	Hälytystehtävä	An event where at least one unit is dispatched to the scene of an accident or similar incident.
Emergency call	Hätäilmoitus	Notification to the PSAP (eCall, phone call, 112 app) that initiates the processing of a task.
Public Safety Answering Point (PSAP)	Hätäkeskus	Receives emergency calls (phone call, 112 app, eCall), conducts a risk assessment and initiates a dispatch.
Call-taker / Dispatcher	Hätäkeskuspäivystäjä	A person working in an PSAP who handles emergency calls and dispatches units.
Notification time	Ilmoitusaika	Delay from accident to first emergency call.
Light investigation	Kevyttutkinta	A method developed by the Finnish Crash Data Institute for investigating road and off-road accidents resulting in injury. In a light investigation, an investigation team combines and refines information obtained from existing information sources.
Golden hour	Kultainen tunti	The principle that a seriously injured person needs to be admitted to a surgical hospital no later than within one hour of the accident.
Minimum Set of Data (MSD)	MSD	eCall's Minimum Set of Data, which includes details such as event coordinates and vehicle information.
Next-Generation eCall (NG eCall)	NG-eCall	eCall functioning in the 4G/5G network. Mandatory for all new type-approved passenger cars and vans as of 2026 and for all new cars as of 2027.
The Finnish Crash Data Institute	Onnettomuustietoinstituutti (OTI)	The Finnish Crash Data Institute coordinates the operations of road accident investigation teams and administers the investigative data collected on accidents.
PRONTO statistics	PRONTO-tilasto	Rescue services' resource and accident statistics: incl. notification method, task category, severity, times, location and units' departure and arrival times.
SOS button	SOS-painike	Button for starting a manual eCall inside the vehicle.

English (EN)	Finnish (FI)	Definition
Official Statistics of Finland	SVT (Suomen virallinen tilasto)	Official statistics series of Statistics Finland; the road accident statistics were used in this report.
In-depth investigation	Syvätutkinta	The investigative method used by investigation teams, including site investigation, vehicle and road environment investigations and interviews of the parties involved. In addition to fatal road and off-road accidents, investigation teams use the in-depth investigation method to carry out projects (as samples) where they investigate accidents that led to both injury and material damage.
Call processing time	Tehtävän käsittelyaika	Time from receiving an emergency call to generating a task, assigning an urgency category and dispatching a unit.
Third-Party Service eCall (TPS eCall)	TPS-eCall	An eCall activation transmitted through a vehicle manufacturer's service centre.
Response time	Vasteaika	Time from the reception of the first emergency call to the arrival of the first rescue unit.
Vehicle Identification Number (VIN)	VIN (valmistenumero)	Unique vehicle identifier; transmitted in the MSD, helps link the register data to the set of tasks.
Finnish Transport Infrastructure Agency crash data	Väyläviraston tieliikenneonnettomuus-aineisto	Open database for estimating the total number of accidents (including non-injury accidents).
Single-vehicle crash	Yksittäisonnettomuus	An accident involving only one vehicle.

1 Background and objective of the study

1.1 Background

1.1.1 Introduction

In the event of a road accident, the vehicle device of the eCall system automatically contacts a PSAP (Public Safety Answering Point) either directly (pan-European eCall) or via the vehicle manufacturer's service centre (TPS eCall). The system does not prevent traffic accidents; its purpose is to mitigate the consequences of accidents. Once a connection between the vehicle device and the PSAP has been established, the eCall system transmits the Minimum Set of Data (MSD) and facilitates voice communication between the persons inside the vehicle and the dispatcher. The MSD contains data such as the location of the accident and the type of vehicle, including its make and VIN. This means that eCall can shorten the time between the occurrence and notification of an accident and provide more detailed information on location.

The eCall system has been mandatory in European type-approved passenger cars and vans since 2018 (Tarkiainen et al., 2023). According to an estimate by Pilli et al. (2022), about 8% of Finland's passenger car fleet had an eCall system as standard equipment or as an accessory in 2022. The plan is to extend the system to include two-wheel motor vehicles and heavy vehicles.

The current eCall system is based on the technology of circuit-switched 2G and 3G networks. 3G networks have been decommissioned in Finland, and 2G networks will be operational according to licence terms until the end of 2029. As a result, the current eCall will no longer work as of 2030. In the next few years, the current eCall will be replaced by Next-Generation eCall (NG eCall), which operates in the 4G and 5G networks. NG eCall is mandatory for all new type-approved passenger cars and vans as of 2026 and for all new passenger cars and vans as of 2027. Authorities need information about the impact of these changes on road safety. It is also important to understand how the current eCall system has already impacted road safety in Finland and to assess the potential impact of the NG eCall system.

The aim of this study was to assess the impacts of the eCall system in Finland. In this report, "eCall" refers to both the pan-European eCall system and the TPS eCall system. In addition to automatic eCalls, the scope of this study includes manual emergency calls made with eCall.

1.1.2 Effectiveness of the eCall system

The actual impact of the eCall system on road safety has not been studied before, but some assessments of its potential impacts have been carried out. Most of these studies focus on how the time saved by eCall could prevent traffic fatalities. There are only a few assessments of the impact the system would have on alleviating serious injury.

The European Commission has estimated that, in the EU, eCall could speed up response times by 40% in urban areas and by 50% in rural areas. The Commission has also issued an estimate that eCall could reduce the number of road fatalities at the EU level by 4% and the number of serious injuries by 6% (Euroopan komissio, 2024).

Sihvola et al. (2009) assessed the potential impact of an automatic emergency call system on the consequences of road accidents in Finland. The analysis was based on fatal road accidents between 2001 and 2003 investigated by road accident investigation teams. The study assessed the delay between the time of an accident and the subsequent emergency call by comparing the times of emergency calls received by the Emergency Response Centre Agency with the investigation teams' estimates of the time of the accident. The data consisted of 1,192 deaths related to traffic accidents, of which 919 were motor vehicle passengers. The deaths were first filtered based on whether, according to the assessment of two physicians specialising in traffic accident traumatology, the injuries were so lethal that the person would have died even if help had been available immediately after the accident. The remaining cases were reviewed with a specialist in orthopaedics and traumatology based on the information in the investigation teams' files, and this material was used to estimate how many of the fatalities could very likely have been prevented if help had arrived more quickly. In addition, a survey directed at PSAP facilities was used to assess callers' ability to determine the location of an accident and the difficulties encountered by rescue units in trying to find the accident site.

According to the results of Sihvola et al. (2009), an automatic emergency call system could have very likely prevented 3.6% of the deaths included in the study. However, the type of the accident had a significant impact on effectiveness. The study estimated that the system would be most effective in accidents involving motor vehicles not covered by eCall, such as motorcycles and mopeds. The proportion of single-vehicle crashes was high in these accidents. In addition, the results indicate that eCall would probably not have prevented even a single pedestrian or cyclist death. The overall preventive effect of the system was estimated to be approximately 4–8% if all the deaths that the eCall system might have prevented were taken into account.

According to a study by Sihvola et al. (2009), approximately 20% of emergency calls were made more than five minutes after the accident. Long delays were especially prevalent on low-traffic roads, at night, in single-vehicle crashes and in animal collisions. In addition, accidents involving vehicles for which eCall is not available were prominent, for example due to the prevalence of single-vehicle crashes and animal collisions of the vehicle types in question. Overall, approximately 30% of fatal accidents were estimated to be such that the delay between the accidents and the subsequent emergency call would be shortened with the help of the eCall system. The study found that the greatest potential of the system for saving lives would be in cases where the emergency call would otherwise have been made more than five minutes after the accident. According to the results of the PSAP survey, callers are often unable to report the location accurately, and rescue units often have to ask for more detailed information on the location of the accident. Sihvola et al. recommended the extensive implementation of the eCall system in Finland.

Chauvel & Haviotte (2011) assessed the safety impacts of eCall in France by using a database of accidents reported by eCall. The database included 3,100 cases involving a Peugeot or Citroen car equipped with eCall. A total of 202 other cases that had been investigated in more detail were selected for a more detailed impact assessment. The accidents were classified based on type, and the effectiveness of the system was assessed by expert judgement. Based on the results, it was estimated that 119 of all the annual road traffic fatalities in France would have survived if the eCall system had been in use. This corresponds to 2.7% of road deaths in France in 2009.

The European eIMPACT project estimated that eCall could reduce road deaths by 5.8% [3.6%–7.3%] in the EU25 countries, assuming that the system was installed in all passenger vehicles (Francsics et al., 2009). The system was estimated to increase injuries by 0.1% since some of the otherwise fatal accidents would result in injury. The estimate was largely based on the proportions of different types of accidents where the eCall system could have impacted response time, which were investigated in a Master's thesis by Virtasen (2005). The proportions were applied to the different EU25 countries while taking into account the distribution of different types of accidents.

Ponte et al. (2016) assessed the potential impact of the eCall system on traffic fatalities in South Australia from 2008 to 2009. The study assessed the delay from the time of the accident to the emergency call by combining traffic accident data with data from emergency medical care units and cause-of-death investigations. Finally, by examining the cause-of-death investigation reports, the likelihood of survival was assessed in the case that there would have been no delay. Of the studied deaths, 25% (n=53) were associated with a delay of more than 10 minutes in the dispatch of paramedics. According to the results, five people could have survived an accident if an earlier emergency call had made it possible to start providing emergency medical care sooner. In addition, three more people would have potentially survived if surgical treatment had started earlier. The study estimates that the system could therefore have prevented 2.4–3.8% of all road fatalities during 2008–2009. That benefit would be 2.6–4.6% if only passenger vehicles were taken into account.

Kim et al. (2023) assessed the impact of having better location data from eCall on the consequences of accidents in South Korea by analysing 17,285 road accidents and 54,952 other types of accidents over the last 10 years. The study assessed the time it took for paramedics to arrive at the scene of an accident by comparing the actual times (from emergency call to the rescue department arriving at the scene of an accident) with an estimated driving time sourced from a routing app. It was estimated that the average time taken to arrive at road accidents was 16 minutes 26 seconds, which could be reduced by 3 minutes 38 seconds with the eCall system. The corresponding figures for accidents in non-road environments were 6 minutes 52 seconds and 3 minutes 10 seconds. The change in mortality rate was estimated by assuming a 2% reduction for each minute saved (Nasser et al., 2020). As a result, potentially saved lives were estimated to total 6.2%.

Andersson (2024) assessed the impact of the shutdown of 2G and 3G networks on road safety in Sweden between 2028 and 2032, which is when eCall will stop working since it uses these networks. The analysis estimated that 13–15% of the vehicle fleet would have a non-functioning eCall system during that period. The traffic safety impacts were then assessed based on the worst-case scenario, which assumed that 1.1% of the vehicles with a non-functioning eCall system would leave the vehicle fleet annually, and the accident rate remained constant (based on the average during 2019–2023). Based on previous studies, the impact of the eCall system was assumed to be 2–5%. With these assumptions, it was estimated that non-functioning eCall systems would cause a total of 1 to 4 deaths and 10 to 32 serious injuries during the period. However, the report mentions that there are uncertainties in the estimate since there are no reliable empirical impact assessments of eCall systems. The analysis also included a rough examination of there being no clear difference in response times for emergency calls related to traffic accidents based on whether the notification was automatic or not.

Estimates of the impact of the eCall system on the consequences of accidents resulting in injury have not been studied much. The European Commission’s 2011 cost-benefit analysis of eCall refers to a few publications assessing the impact of the system on accidents resulting in serious injury (Euroopan komissio, 2011). Considering the results of the studies, it was estimated that eCall could reduce serious injuries by 1.0–7.5% per year, depending on the country.

In the UK, two thirds of emergency calls made via eCall were estimated to be invalid (Reed, 2025). This aspect was determined according to whether the Public Safety Answering Point (PSAP) relayed the call to the authorities. Approximately 75% of manual eCall notifications were invalid, and the corresponding percentage for automatic eCall notifications was approximately 33% (66% for both). The report presented various reasons for invalid notifications, such as pressing the button for a manual eCall activation accidentally, demonstrating the function in car dealerships, and technical faults due to issues such as moisture damage. The report states that the ratio of automatic eCall activations to manual activations differs significantly from one car manufacturer to another. According to the report, this suggests that some manufacturers’ vehicles are more prone to invalid manual eCall activations, while others might be more prone to invalid automatic eCall activations. The report states that the high proportion of invalid eCall activations undermines the credibility of the expected road safety impacts of the system and negatively affects PSAP employees’ ability to respond to real accidents. The problem is expected to grow as the penetration rate of the eCall system increases.

To sum up, the international literature includes only a few studies on the impact of the eCall system on road safety, and none of these studies has assessed the actual impacts of the system. According to existing studies, the system is estimated to prevent approximately 3–8% of annual traffic fatalities. In the case of Finland, the latest estimate – which is already over 20 years old – states that eCall could prevent 3.6% of traffic fatalities per year if all passenger cars and vans had eCall. The impacts of the system on the reduction of serious injuries have barely been studied at all, but a literature review by the European Commission suggests that eCall could reduce serious injuries by between 1.0% and 7.5% depending on the country. According to the study conducted in the UK, the high rate of false alarms is significant (66%).

1.1.3 Road accidents in Finland

In Finland, there has been a decreasing rate of injuries in road transport in recent years. According to the road accident statistics of Statistics Finland, 6,408 injuries from road accidents were reported to the police in 2015, and the corresponding figure for 2023 was 3,642 (Figure 1) (SVT, 2025). Although the statistical decrease in the number of injuries is partly explained by the fact that accidents resulting in minor injuries are not reported to the police as comprehensively as in the past, the data on traffic fatalities is reliable, and consequently, the decrease in fatalities shows that traffic safety has improved over the years.

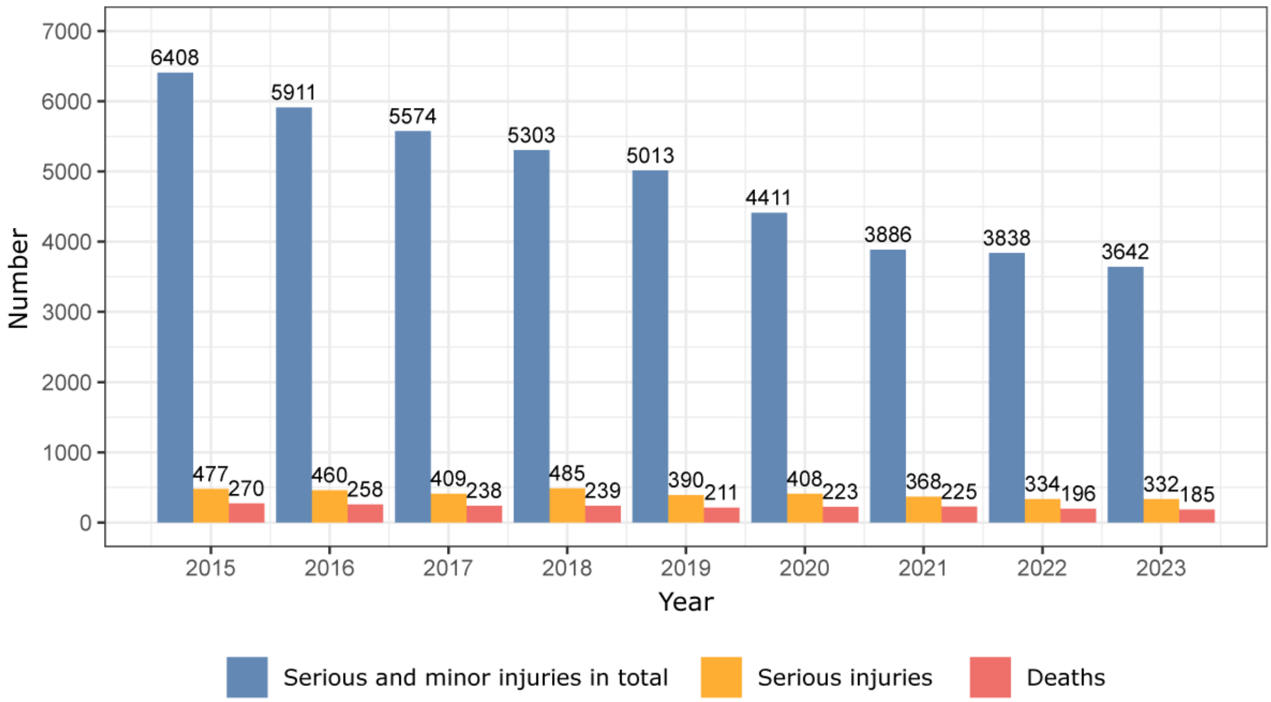

Figure 1. Number of fatalities, serious injuries and all injuries in the road accident statistics of Statistics Finland during 2015–2023 (SVT, 2025).

Most of the road traffic fatalities and serious injuries between 2015 and 2023 occurred in accidents involving a passenger car or van (Figure 2, 90.7%). Of the deaths and serious injuries, 24.0% occurred in accidents involving pedestrians, cyclists or mopeds. Heavy vehicles were involved in 19.7% of accidents, motorcycles in 13.7%, and animals in 2.3%.

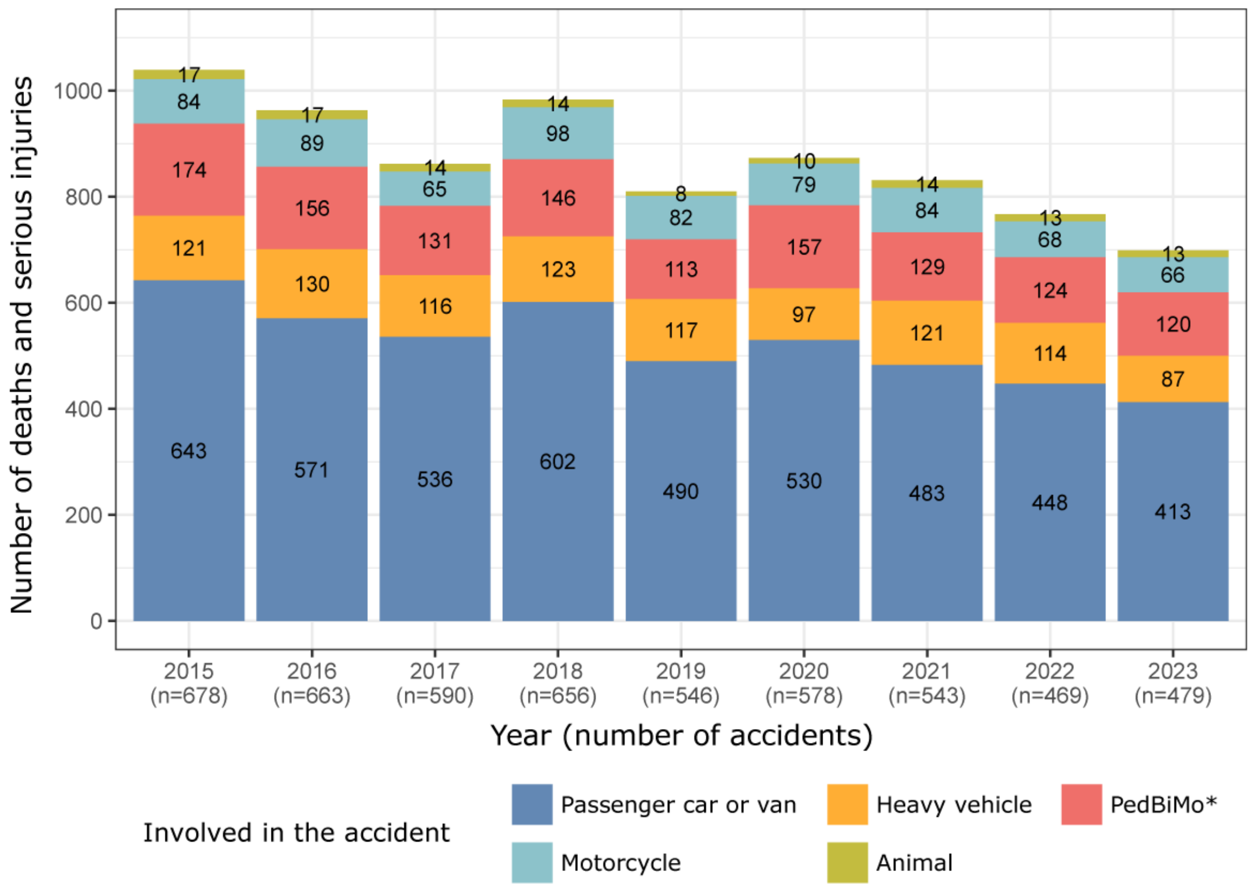

*Figure 2. Number of fatalities and serious injuries in road accidents according to the involvement of different vehicle types in Statistics Finland's road accident statistics during 2015–2023 (SVT, 2025). *Pedestrian, bicycle or moped. (**Note:** The same injury can occur in several categories).*

1.1.4 Rescue operations in road accidents

In road accidents, the course of events from the time of the accident to the start of rescue operations may proceed in different ways. The eCall system primarily affects the first stages of the rescue chain, especially the delay between the occurrence of the accident and the first emergency call, meaning the notification time (Figure 3).

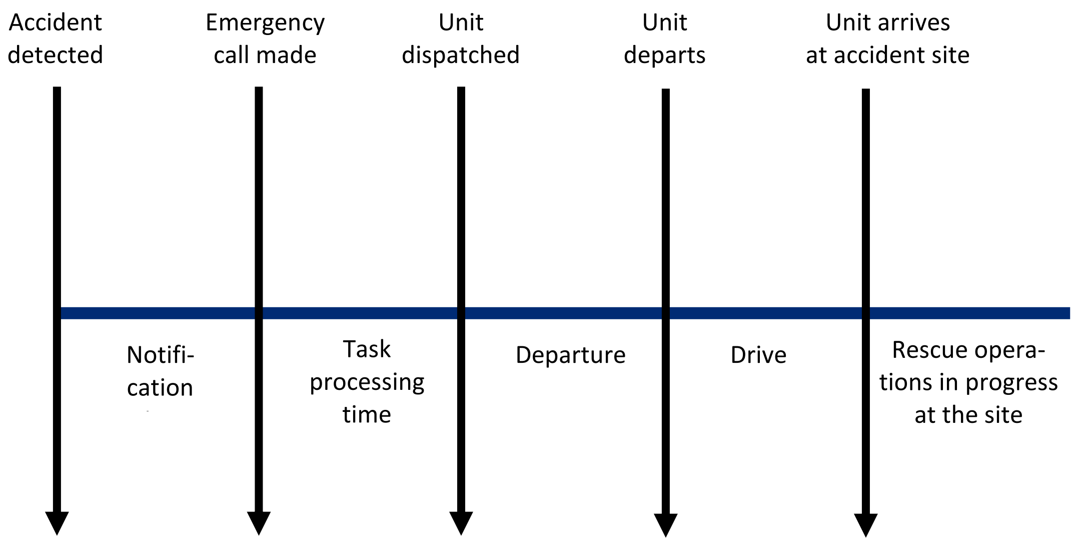

Figure 3. Operational readiness concepts (adapted from the Ministry of the Interior, 2025, p. 16)

After an accident occurs, the accident is notified to a PSAP with an emergency call if possible; the call can be made either by a person involved in the accident and/or by a bystander. There may be a delay between the accident and emergency call (notification time), depending on factors such as the functional capacity of the people in the accident and whether there are bystanders present, since the people who were in the accident may be unconscious and there may be few bystanders in sparsely populated areas. In the event of an accident involving a vehicle equipped with an eCall system, the system may make an emergency call automatically and open a voice connection to that vehicle with the PSAP (or third-party system service provider). In such a case, there is no delay between the occurrence of the accident and the emergency call.

The PSAP assesses the location of the accident after receiving an emergency call. If the emergency call was made with a phone, the caller is asked to explain the location. A notification made with the 112 app transmits the caller's coordinates when the GPS connection is operational. Similarly, the eCall MSD contains the event coordinates and an assessment of the reliability of the location data. Based on the information received about the accident, the PSAP assesses the urgency of the situation and determines an urgency category for the rescue mission. If necessary, the PSAP will then dispatch units to respond to the accident. The PSAP can also make a call back to the person who notified the accident if the connection is interrupted or additional information is required. Dispatched units are determined by factors such as the urgency category of the task and the availability of units. The units receive advance information on the accident from the PSAP. In the road accidents leading to injury that occurred in 2023, the time from receiving the emergency call to the arrival of the first rescue unit at the scene of the accident was 12 minutes 54 seconds on average (Mesimäki et al., 2025).

1.2 Research questions

The following research questions were set for this study:

Road safety impacts and potential

1. What were the safety impacts of eCall in Finland during 2019–2023?
2. In how many of the motorcycle accidents leading to death or serious injury in Finland would eCall have significantly accelerated the arrival of help at the scene of the accident? What about accidents involving a heavy vehicle?
3. What is the current safety potential of eCall in Finland, meaning how many serious traffic accidents occur in Finland where access to assistance is delayed because the PSAP does not receive information about the accident quickly enough?
4. What is the impact of automatic emergency call systems on road safety from 2027 onwards, considering that all new passenger cars and vans are required to have NG eCall as of 2027 and that the current eCall in passenger cars and vans will no longer work in 2030?
5. What would be the significance for road safety if the eCall for heavy vehicles included cargo information in the MSD message?

Technical functionality and experiences of the Emergency Response Centre Agency

6. How many of the automated and manual eCalls have led to a task carried out by an official body?
7. What kind of invalid eCalls have arrived at PSAPs? What are the reasons for invalid automatic eCall activations? Are some vehicle makes or models overrepresented?
8. What kind of delays or other problems have been caused by the emergency call being routed

through the vehicle manufacturer’s own centre to the PSAP?

9. What are the PSAP’s experiences of the technical functioning of eCall?

10. How has eCall affected the work of Emergency Response Centre Agency dispatchers and rescue workers? How has eCall contributed to determining the location of accident sites and to assessing the equipment needed there?

2 Data and methodology

2.1 Data

2.1.1 Emergency call data

The emergency call data used in the study consisted of events related to road accidents in the PSAP information system and their emergency calls between 1 April 2021 and 10 September 2025. The data did not contain any call recordings. The basic unit of the data is an event that describes one accident situation. One event can involve several emergency calls (such as eCall and calls made by bystanders). An eCall activation was associated with approximately 24.5% of all events in the data. These eCall events were further broken down into automatic and manual activations for analysis.

Permission for using the emergency call material and extracting it from the database was sought from each data controller: the Emergency Response Centre Agency, 21 wellbeing services counties and the City of Helsinki. The data was extracted from the PSAP information system. It was limited to include the information that was relevant to the analysis of events and related notifications. These included time stamps, the Minimum Set of Data (MSD), location and type of notification (automatic/manual eCall) and information on whether the event led to an official task or whether it was classified as invalid. The VIN contained in the MSD was used to retrieve the vehicle make and model. After this search, the VIN was removed from the dataset for the purpose of erasing personal data; as a result, the vehicle identification data was no longer available during the analysis of the emergency call data.

2.1.2 Rescue services' PRONTO statistics

The PRONTO statistics are the rescue services' resource and accident statistics that are used to monitor and develop rescue operations and investigate accident data. The statistics contain information on the departure and arrival times of units dispatched to accident sites as well as various accident details, such as category (e.g. road accident), severity, how the accident was notified (e.g. phone call, eCall), time and location. The statistics also include an assessment of the urgency of the task, the number of injured persons and the severity of the injuries. The statistics only contain information on accidents where the rescue department was involved. The received data covered the period of 2019 to 2023.

According to the training instructions of the PRONTO statistics (Pelastusopisto, 2013, s H-28), the deaths that are recorded as being caused by a traffic accident involve people who die immediately or during transport. Similarly, a seriously injured person is a person with

- "an injury that requires hospitalisation for more than 48 hours and treatment in hospital is started within a maximum of seven days of being injured
- a bone fracture (excluding simple fractures in fingers, toes or nose)
- severe bleeding or serious injuries to nerves, muscles or tendons
- injuries to internal organs
- second and third degree burns or burns where more than 5% of the skin is affected
- inflammation due to exposure to infectious substances
- radiation injury
- an injury resulting from exposure to corrosive or toxic substances."

2.1.3 Materials of the Finnish Crash Data Institute

Road accident investigation teams investigate all fatal road and off-road accidents in Finland. Fatal accidents are investigated with an in-depth investigation method where the investigation teams carry out an extensive investigation of the risk factors, consequences and circumstances of each accident. Investigated aspects include the course of events, the road and traffic environment and conditions at the accident site, the condition of and damage to the vehicles, injuries to persons, causes of injuries, the use of safety equipment and risk factors. In addition, based on their accident investigations, the investigation teams make proposals for improvements related to road safety. Comprehensive information on accidents is available from a numerical database managed by the Finnish Crash Data Institute (OTI).

OTI also collects information on accidents leading to serious injury. The in-depth investigation data on accidents resulting in serious injury consists of road and off-road accidents that have been investigated as special projects. As it consists of samples, the coverage of this special project data is not as comprehensive as the data on fatal accidents. In a light investigation, the investigation team combines and refines information obtained from existing information sources. The light investigation data also does not cover all accidents resulting in serious injury. This study was the first one to make use of the light investigation data. The data was important in this study because it contained more detailed information on serious accidents involving motorcyclists than was available from other sources.

From 2019 to 2023, the road accident investigation team data included a total of 923 road accidents involving a passenger car, van, heavy vehicle or motorcycle. For the same period, the data also included 293 accidents that resulted in serious injury investigated with the in-depth method, and from 2020 to 2023, it included 878 accidents that resulted in serious injury that were featured in the light investigation data.

The numbers of road traffic fatalities in the investigation team data do not fully match the figures from Statistics Finland. This is because traffic fatalities in the Statistics Finland figures include persons who died within 30 days of the accident, whereas the investigation teams mainly investigate accidents where the death occurred within three days of the accident. In addition, the Statistics Finland figures do not include deaths caused by sudden cases of illness during driving (OTI, 2025).

2.1.4 Interview material

Interview material was compiled from PSAP dispatchers' and rescue personnel's experiences of the eCall system. The interviews were semi-structured, meaning that the discussion progressed from one topic to another based on the interviewees' responses. The themes and questions of the interviews and the questions sent to the traumatology specialists are presented in Appendix 1.

2.2 Research methodology

2.2.1 Safety impacts in Finland during 2019–2023 (RQ 1)

The actual safety impacts of the eCall system in Finland in 2019–2023 were examined by estimating how many traffic fatalities were prevented by the system. The estimate was based on the accident notification time reduced by the eCall system and its impact on injuries (Figure 4). Safety impact assessments were carried out based on the emergency call data from the PSAP information system and the Finnish Rescue services' PRONTO statistics. It was estimated that the eCall system may have saved lives in traffic accidents where

- the emergency call was made with an automatic eCall activation
- the accident resulted in serious injury or death
- there would have been a significant delay in making the emergency call without eCall.

It was assumed that manual eCall activations may not significantly speed up the process of making an emergency call compared to mobile phones or the 112 app. The scope was limited to serious injuries and deaths because it was assumed that if time saved by eCall prevented a death, the outcome would be serious injury.

Accidents reported by eCall were determined as situations where an emergency call led to a dispatched incident and the notification was made with the eCall system. The purpose of limiting the scope to accidents that were dispatched incidents was to minimise the inclusion of invalid eCall activations. These situations were generalised to represent traffic accidents of all severities.

It was not possible to obtain all of the emergency call material from the desired years (materials were obtained from months: April 2021–September 2025), so the number of accidents reported by eCall for 2019, 2020 and 2021 was obtained from the total number of eCall events that led to a dispatched incident in 2019–2021, sourced from the Emergency Response Centre Agency. The number of accidents in 2022 and 2023 was obtained from emergency call data. As it was not possible to fully combine the emergency call data with the PRONTO statistics, the distribution of accidents reported by eCall according to severity and the time savings generated by eCall was estimated based on the distributions of known cases. The MSD information in the emergency call data was used to distinguish between the type of eCall activation (automatic or manual), the time of the eCall emergency call and the time of other emergency calls made about an accident.

The severity of the accidents was assessed by examining how the accidents reported by eCall were distributed into different severity categories according to the type of eCall activation (no injury, minor injury, serious injury, fatality). The distribution was estimated from cases matched between the PRONTO statistics and emergency call data. The data was combined based on the notification ID. There were 600 combined accidents that were reported automatically. The emergency call data for 2021–2023 contained 629 corresponding accidents. This means that the cases combined reasonably well (95.4%). A total of 101 manually reported accidents could be combined. In the emergency call data, there were a total of 315 manually reported accidents between 2021 and 2023, which means that the combination rate was worse (32.1%). This may have been affected by the fact that there are more likely to be false alarms or very mild accidents among manually reported cases, and the rescue department was less likely to have been involved in those cases.

The impact of the eCall system on the reduction of notification time (under five minutes, 5–30 minutes, over 30 minutes) was assessed by examining accidents that had been reported in some other way in addition to the automatic eCall activation. In practice, the time was estimated by calculating the difference between the time of the automatic eCall activation and the time of the first other type of emergency call. It was assumed that, if the eCall system had not been in use, the time of this other emergency call would correspond to the time of the first emergency call of the accident. The distribution was estimated with cases which were matched between the emergency call data and PRONTO statistics, and calculated based on whether or not the accident resulted in injury. All accidents leading to injury were processed together in the delay distribution because the number of accidents leading to serious injury in the dataset was too small for a reliable estimation of the distribution (n=38).

According to the study by Sihvola et al. (2009), eCall would have the greatest potential to save lives in accidents that would otherwise be reported more than five minutes after the accident occurred. Therefore, the final estimate of the number of lives saved was obtained by examining the number of seriously injured victims in automatically reported accidents where the notification time without eCall would have been at least five minutes by estimate. The estimated number of injuries was calculated using general averages of injuries in accidents: On average, 1.05 people are seriously injured in accidents resulting in serious injury and 0.14 people are seriously injured in accidents resulting in death (Metsäranta et al., 2024). The persons who would have died without eCall were further separated from the group of seriously injured persons. Based on the fatal accidents investigated in depth by the investigation teams in 2019–2023, approximately 36% (312 people out of 865) of all persons who died in road accidents died later and not immediately when the accident occurred. This percentage was used to distinguish the persons who survived because of eCall.

It is possible that a manual eCall activation could also shorten the notification time and thus affect the severity of injury caused by an accident, for example thanks to the accurate location data generated by the eCall system. However, it is very challenging to quantify this impact, so the assessment of the actual safety impacts is only based on accidents that involved an automatic eCall activation.

In addition, the emergency call datasets contain numerous limitations related to Third-Party Service eCall (TPS eCall), which is why the quantitative assessment of the safety impacts of the eCall system presented in this report is based only on the data of the pan-European eCall. It is not possible to use the material to distinguish whether a TPS eCall activation was made automatically or manually. In addition, there is no information available on which accident calls recorded in the emergency call records are related to TPS eCalls. There is only information concerning when the PSAP recorded a task related to a contact from a foreign call centre. This prevents examination of TPS eCall activations with sufficient precision and means that they are not comparable to pan-European eCall activations. However, a later section of this report includes an estimate of how taking the TPS eCall system into account could affect the outcome.

Below is a summary of the methodology.

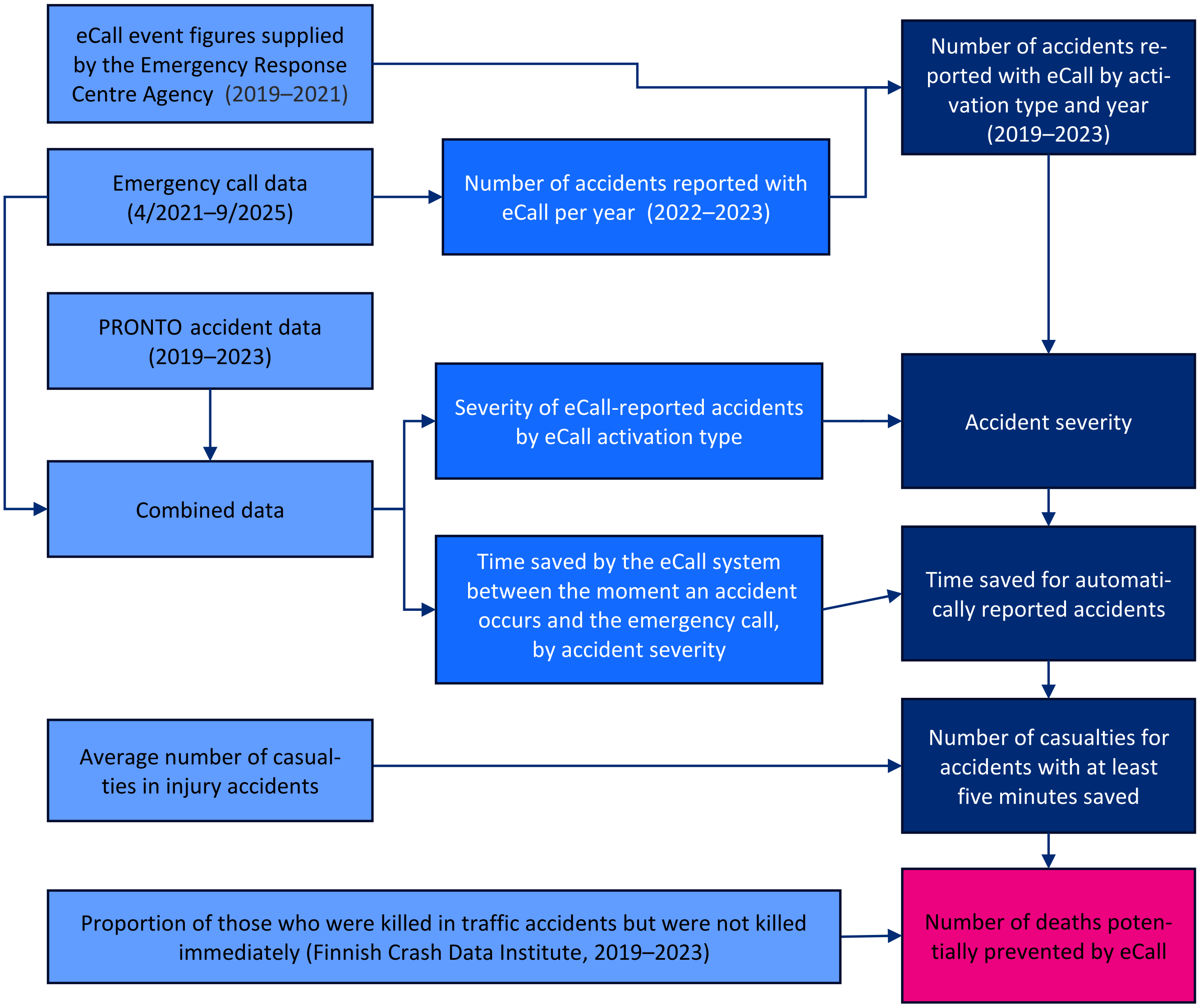

Figure 4. Process of assessing safety impacts (2019–2023).

2.2.2 *Delay between accident and notification in serious traffic accidents (RQs 2–3)*

The road safety potential of the eCall system was assessed by examining the proportion of accidents leading to death or serious injury (including motorcycles and heavy vehicles) where eCall could have significantly accelerated the arrival of assistance at the scene of the accident. To this end, the delays between the times of accidents and their emergency calls in 2019–2023 were examined for road accidents that were not reported with the eCall system. The results were examined based on whether the road accident involved a passenger car, van, heavy vehicle or motorcycle.

In fatal accidents, the delay between the occurrence of the accident and a conventional emergency call was assessed by combining the accident data in the PRONTO statistics with the accident data in the OTI investigation team data. The OTI investigation team data contained an estimate of the time when each accident had occurred. This time was considered the theoretical time of the eCall activation if the system were operational and functioning correctly. The PRONTO statistics, on the other hand, included the time of the first actual emergency call. Comparing the estimate of the time of the accident with the time of the emergency call provided an understanding of the time potentially saved by eCall in the first stage of the rescue chain. The data in the PRONTO statistics were also used to examine response times, or the time from receiving the first emergency call to the arrival of the first rescue unit at the scene of the accident.

Delays between the estimated time of the accident and the first emergency call were also assessed based on the data from accidents resulting in serious injury that had been investigated by investigation teams. The data on accidents resulting in serious injury consisted of accidents investigated with the in-depth and light investigation methods. The in-depth investigation data consisted of special projects concerning road accidents. These projects involve examining a sample of accidents from different themes. The coverage of the data is therefore less comprehensive than in the investigation of fatal accidents. The in-depth investigation data from 2019–2023 included a total of 223 passenger car and van accidents resulting in serious injury. The number is slightly below that of the average per year according to Statistics Finland’s road accident statistics (approximately 270 accidents resulting in serious injury (SVT, 2025)). In the in-depth investigation data, there were only 54 heavy vehicle accidents resulting in serious injury and only 33 such motorcycle accidents, so they were excluded from the examination. The OTI light investigation data included a large number of accidents involving a motorcycle from 2020 to 2023, and especially from 2022 and 2023 (n=397). In the period 2022–2023, motorcycle accidents were a special focus area of light investigations.

The accident data from the OTI materials and the PRONTO statistics were combined based on the time and coordinates of each accident. The data related to the location and time of accidents may be inaccurate in the datasets, so the search distance between the datasets was 7 kilometres and ±1 days from the accident time estimated by the OTI investigation teams. If this resulted in several potential accident matches between the datasets, the final dataset was supplemented by combining the cases where the time and location of the accident were closest to each other. Finally, a separate examination was carried out to ensure that the combined data points with considerable difference either in distance or accident time were likely to refer to the same accident.

2.2.3 Future traffic safety potential of automated emergency call systems in Finland (RQ 4)

The safety impacts of the eCall system from 2027 onwards were assessed by preparing a forecast of the system's prevalence in the vehicle fleet until 2035. The estimate consists of the following data:

- Estimated prevalence (penetration rate) of functional eCall systems in the fleet of passenger cars and vans until 2035.
- Estimate of the traffic accidents reported by eCall (automatically and manually) and their number in relation to the penetration rate of eCall in the fleet.
- Estimate of the annual number of serious accidents reported by eCall.
- Estimate of the proportion of serious accidents reported by eCall whose consequences could be affected by the time saved by the system.

The penetration rate of the eCall system in the Finnish car fleet until 2035 was estimated as part of the assessment of the traffic safety potential of the eCall system. The estimate took into account that NG eCall will be available from 2025 and will become mandatory for all new passenger cars and vans from 2027. It was also noted that eCall, which operates in the 2G network, will stop working in 2030 when the 2G network is shut down.

The results of a report on the prevalence of driver support systems published by Traficom (Pilli et al., 2022) were used to assess the penetration rate of the eCall system operating in the 2G network in the car fleet during 2017–2021, which was used in the eCall penetration rate forecast. The penetration rate in 2017–2021 was estimated using the percentages presented on page 20 of the report (Figure 5). The percentages refer to cars equipped with eCall that were taken into use during 2016–2022 and were still in use in July 2022. The number of eCall cars taken into use in 2016–2021 was estimated based on these percentages by multiplying the percentage of cars equipped with the eCall system in the year in question by the number of cars registered for the first time in the year in question. The penetration rate of the eCall system was estimated by calculating the annual accumulation of these cars and dividing it by the number of vehicles in traffic use in the corresponding years. It should be noted that the proportions presented in Pilli et al. (2022) are not based on data on cars that had been decommissioned from traffic before summer 2022. However, it is likely that only a small percentage of the cars taken into use after 2016 had already been decommissioned from traffic at that time, so the resulting error is probably minor. The percentage for 2022 was not used because it only corresponded to the first half of the year. The future projection of eCall penetration rate was assessed with linear regression and vehicle renewal rates.

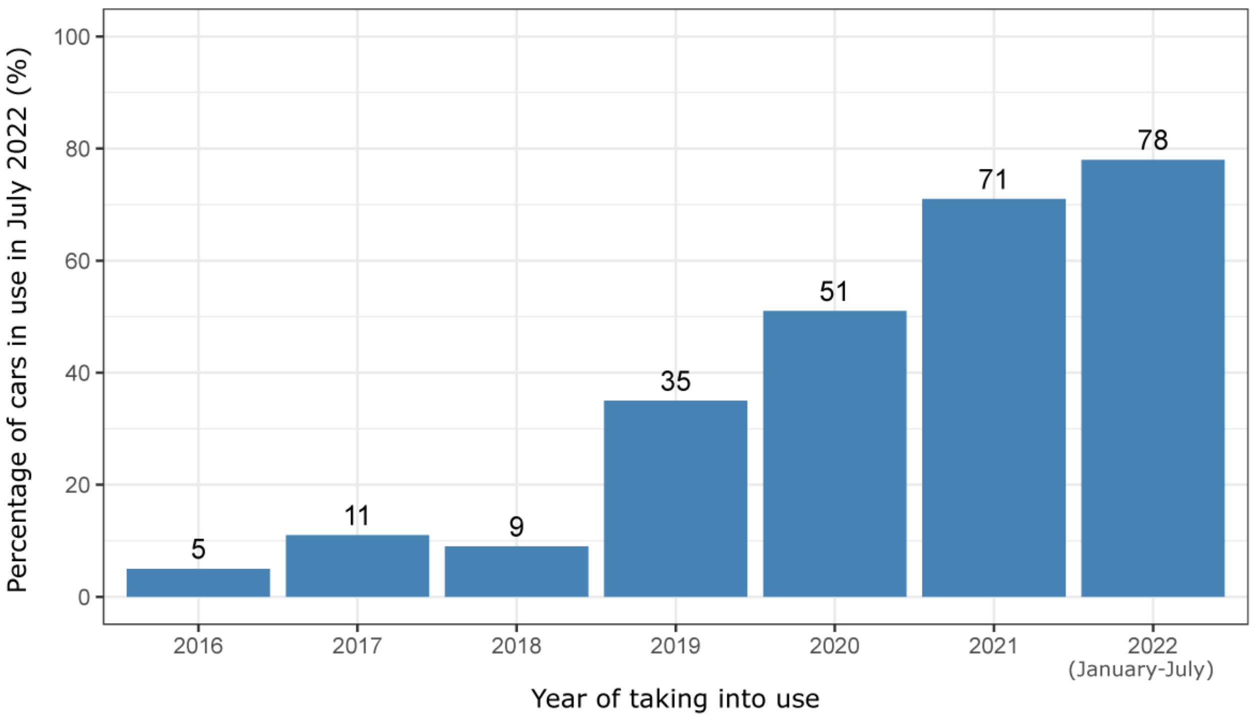

Figure 5. Penetration rate of the eCall system in cars of different ages in Finland that were still in traffic use in July 2022. (Adapted from Pilli et al. 2022, p. 20).

Linear regression was used to estimate the number of accidents that would be reported by eCall in the future based on the estimated penetration rate of eCall. These accidents were divided into accidents resulting in serious injury and death according to a severity distribution based on road accident statistics. The databases of open statistics on road accidents of the Finnish Transport Infrastructure Agency and Statistics Finland (FTIA) (SVT 2025; Väylävirasto, 2025) were used to estimate the percentage of passenger car and van accidents that would result in serious injury and death. The statistics are based on accidents reported to the police. FTIA's crash data was used to estimate the total number of accidents, as it also contains information on accidents that only led to property damage (Lehtonen, 2020). The statistics include a total of 46,517 accidents between 2019 and 2023 involving a passenger car or van. In the statistics, 1.6% of passenger car and van accidents resulted in death (n=759). FTIA's open statistics on road accidents do not contain information on accidents resulting in serious injuries, which is why that number was obtained from the open database of Statistics Finland's road accident statistics. Based on the figures, approximately 2.9% (n = 1350) of accidents resulted in serious injury (MAIS3+). On average, fatal accidents resulted in the death of 1.11 persons on average and caused serious injury to an average of 0.14 persons (Metsäranta et al., 2024). An average of 1.05 persons were seriously injured in accidents resulting in serious injury between 2018 and 2022 (Metsäranta et al., 2024).

The impact of the eCall system on the future reporting times of these accidents and the severity of injuries was assessed based on the combined accident data of the PRONTO statistics and OTI data (combined as described in chapter 0) and on the basis of literature. The quantitative estimates presented in this report are based on the figures from the pan-European eCall system.

2.2.4 Technical functionality and experiences of the Emergency Response Centre Agency (RQs 6–7)

The methodology was divided into a qualitative and quantitative section. In the qualitative section, dispatchers and rescue workers were interviewed on their experiences of the technical functioning of the eCall system and its impacts on their work. The interview methodology is described in more detail in chapter 2.2.5.

The quantitative analysis of the technical functionality of eCall utilised emergency call data containing information on conventional emergency calls and automatic and manual eCall activations. The analysis focused on differences in processing times and technical quality factors when the emergency call is routed through the vehicle manufacturer's own service centre before arriving at the PSAP (so-called TPS eCall). In addition, the causes and prevalence of invalid eCalls were investigated as well as whether certain vehicle makes or models were overrepresented among such false alarms.

In order to analyse the delays in TPS eCalls, the timestamps of calls made via the vehicle manufacturer's centre and calls made directly to the PSAP were examined. These timestamps were used to calculate and compare the average delays. It was also examined whether there were any other problems related to these calls that emerged from the data.

In the case of invalid eCall activations, the type of call (automatic or manual) and the task classification issued by the PSAP were analysed. The classification was used to identify cases that did not lead to an official task and to determine their causes (such as mistakes, requests for advice or technical issues). The aim was to find out how the causes of invalid eCall activations are divided between automatic and manual activations.

The study examined whether certain vehicle makes or models are overrepresented as causes of invalid eCall activations. The data was divided according to the method of activation (automatic or manual) and the vehicle's make and model identified based on the VIN (from the MSD). This data was compared with Traficom's vehicle fleet statistics in order to calculate the relative notification frequencies (notifications per 1,000 vehicles) and to identify deviations.

Finally, a summary of the quantitative and qualitative results was compiled to form an understanding of the technical functioning of the eCall system and its impact on PSAP operations.

2.2.5 Interviews (RQs 5, 8–10)

The study included interviews with five Emergency Response Centre Agency dispatchers and four rescue workers. In addition, two traumatology specialists were asked by email to provide information on the impact the duration of the rescue period has on the consequences of injuries. No response was received from one of the traumatology specialists, while the other responded very comprehensively to the questions that were sent out.

The interviews were used to determine what benefits could be gained if the eCall MSD message included information on the cargo of a heavy vehicle. In addition, the interviewees were asked to assess what road safety impacts an eCall system for motorcycles could have.

The interviewed dispatchers worked at the Emergency Response Centre Agency facilities in Kerava, Vaasa, Oulu, Kuopio and Pori. The dispatchers' work experience ranged between two and 15 years.

Two of the rescue workers were from the wellbeing services county of Central Finland, one from Satakunta and one from the City of Helsinki Rescue Department. The interviewed rescue workers had an average of 20 years of work experience in emergency medical services and rescue services. Their work experience in rescue services covered a wide range of tasks, such as ambulance driver, emergency medical care supervisor and educator. In addition, the interviewees had experience in firefighting duties and acting as a firefighter supervisor and on-call firefighter. Almost every interviewee said that they had talked with their colleagues about the topic before the interviews. This brought a broader perspective to the interviews.

Before starting the interview, the interviewees were informed of the objective of the study and the processing of the interview material. The interviewees were told that participation was voluntary, and they were asked for permission to record the interview.

The interviews were conducted between the week starting on 18 November2024 and the week starting on 6 January 2025 in Microsoft Teams. When processing the interview material, the transcripts produced automatically by Microsoft Teams were initially cleaned up by removing extra repetitions and fixing essential mistakes. After this, the material was grouped by theme with qualitative content analysis methods to obtain answers to research questions.

3 Research results

3.1 Safety impacts in Finland during 2019–2023 (RQ 1)

3.1.1 Estimated safety impacts of the eCall system in Finland during 2019–2023

Table 1 presents the annual number of road accidents reported with the eCall system. The numbers for the period 2019–2021 originated from the total number of eCall events that led to a dispatched incident, sourced from the Emergency Response Centre Agency, while the numbers for 2022 and 2023 originated from emergency call data. The figures in the table were generalised to refer to traffic accidents of all levels of severity and reported by eCall.

Table 1. Estimate of road accidents reported by eCall during 2019–2023.

Year	Automatic eCall activation	Manual eCall activation	Total
2019	35	34	69
2020	56	51	107
2021	109	90	199
2022	222	134	356
2023	329	141	470
Total	**751**	**450**	**1201**

The severity level of the accident numbers was estimated with a severity distribution based on the eCall activation type. The severity distribution was estimated based on accidents combined between the PRONTO statistics and emergency call data. Accidents reported with automated eCall activations had more serious consequences than those reported with manual eCall activations (Table 2).

Table 2. Severity distribution of road accidents based on eCall activation type. Based on the accidents combined between the PRONTO statistics (2019–2023) and the emergency call data (4/2021–9/2025) where an emergency call was made with the eCall system.

eCall activation	Non-injury accident	Slight injury accident	Serious injury accident	Fatal accident
Automatic (n=600)	45.2%	49.3%	4.5%	1.0%
Manual (n=101)	89.1%	8.9%	2.0%	0.0%

In 2019–2023, there were an estimated 43 accidents resulting in serious injury. Of these, 33 were reported by automatic eCall activation and 10 by manual activation (Table 3). It was estimated that there were approximately eight fatal accidents, all of which were reported with an automatic eCall activation.

Table 3. Estimated number of road accidents reported by eCall by year, type of activation and severity of the accident.

Year	eCall activation	Non-injury accident	Slight injury accident	Serious injury accident	Fatal accident	Total
2019	Automatic	15.8	17.3	1.6	0.4	35.0
	Manual	30.3	3.0	0.7	0.0	34.0
2020	Automatic	25.3	27.6	2.5	0.6	56.0
	Manual	45.4	4.5	1.0	0.0	51.0
2021	Automatic	49.2	53.8	4.9	1.1	109.0
	Manual	80.2	8.0	1.8	0.0	90.0
2022	Automatic	100.3	109.5	10.0	2.2	222.0
	Manual	119.4	11.9	2.7	0.0	134.0
2023	Automatic	148.6	162.3	14.8	3.3	329.0
	Manual	125.6	12.6	2.8	0.0	141.0
Total		740.2	410.6	42.7	7.5	**1201**

For accidents automatically reported by eCall, the time savings achieved by the system between the occurrence of the accident and its notification were estimated (Table 4, Figure 6). The time savings were estimated by comparing the delay between automatic eCall activations and the emergency calls that were made after the activation. It was assumed that, without eCall, this delay would correspond to the time from the accident to the first emergency call. The estimated delay was less than five minutes in the majority of the accidents; this length of delay is proportionally higher in accidents that led to injury.

Table 4. Breakdown of the estimated delay between the automatic eCall activation and conventional notification made after an activation. The estimate is based on the accidents combined between the PRONTO statistics (2019–2023) and emergency call data (4/2021–9/2025).

Delay (min)	Non-injury accident (n=167)	Accident resulting in injury or death (n=251)
Less than 5	86.8%	92.0%
5–30	10.8%	6.4%
Over 30	2.4%	1.6%

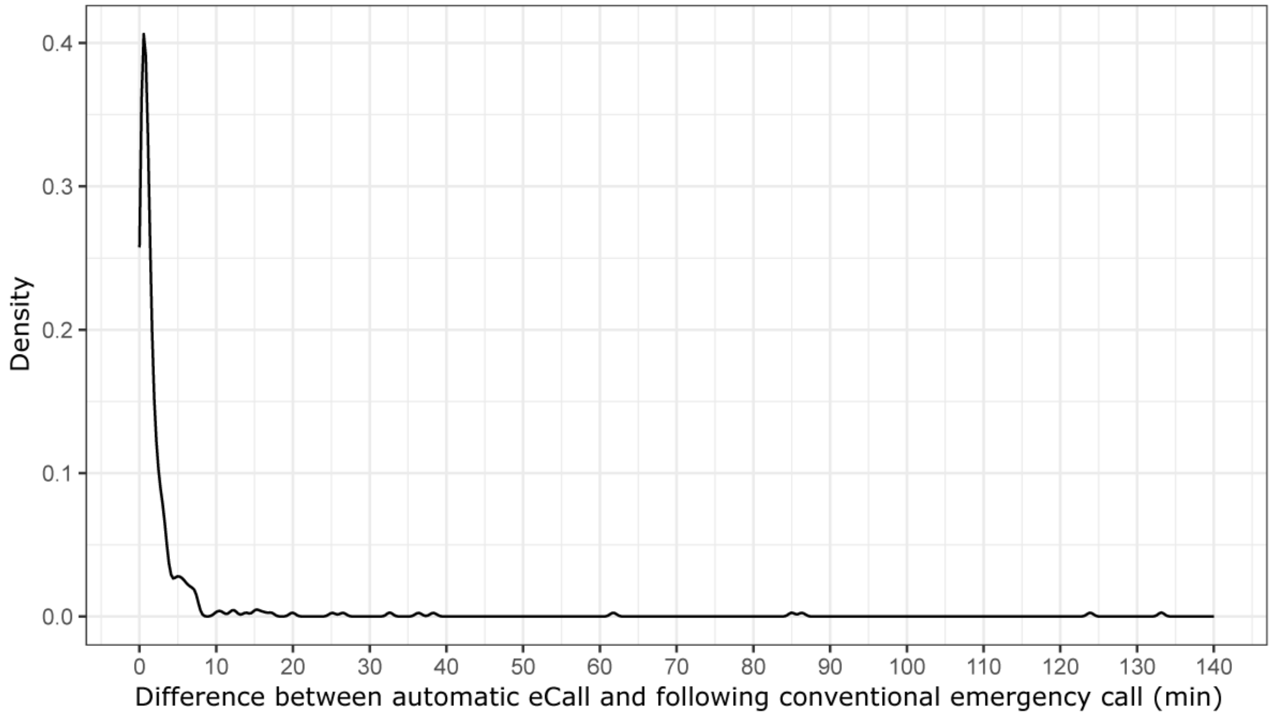

Figure 6. Distribution of delay in road accidents where a conventional notification was made in addition to the automatic eCall activation.

The delay distribution was used to estimate the number of accidents reported automatically based on the year, delay and severity of the incident (Table 5). It was assumed that the eCall system could have had an impact on the consequences of the accident if it saved at least an estimated five minutes of the accident notification time and the accident resulted in serious injury or death. According to the examination, an estimated 2.7 accidents resulting in serious injury occurred between 2019 and 2023 where the automatic eCall activation saved at least five minutes of the delay between the accident to the emergency call. The corresponding figure for fatal accidents is 0.6. On average, 1.05 people are seriously injured in accidents resulting in serious injury and 0.14 people are seriously injured in fatal accidents (Metsäranta et al., 2024), so the number of seriously injured persons in these accidents was estimated to be 2.9. This figure includes the persons whose death could have been prevented by the eCall system.

Table 5. Estimated number of road accidents reported by eCall by year, type of activation, estimated delay shortened by the eCall system, and severity of the accident.

Year	Type	Delay (min)	Non-injury accident	Slight injury accident	Serious injury accident	Fatal accident	Total
2019	Autom.	Less than 5	13.7	15.9	1.4	0.3	31.4
2019	Autom.	5–30	1.7	1.1	0.1	0.0	2.9
2019	Autom.	Over 30	0.4	0.3	0.0	0.0	0.7
2020	Autom.	Less than 5	22.0	25.4	2.3	0.5	50.2
2020	Autom.	5–30	2.7	1.8	0.2	0.0	4.7
2020	Autom.	Over 30	0.6	0.4	0.0	0.0	1.1
2021	Autom.	Less than 5	42.7	49.5	4.5	1.0	97.8
2021	Autom.	5–30	5.3	3.4	0.3	0.1	9.1
2021	Autom.	Over 30	1.2	0.9	0.1	0.0	2.1
2022	Autom.	Less than 5	87.1	100.8	9.2	2.0	199.1
2022	Autom.	5–30	10.8	7.0	0.6	0.1	18.6
2022	Autom.	Over 30	2.4	1.7	0.2	0.0	4.3
2023	Autom.	Less than 5	129.0	149.4	13.6	3.0	295.0
2023	Autom.	5–30	16.0	10.3	0.9	0.2	27.5
2023	Autom.	Over 30	3.6	2.6	0.2	0.1	6.4

Of the above group, it is still necessary to separate the persons who would have been seriously injured regardless of whether the accident was reported with the eCall system or not. Based on the fatal accidents investigated in depth by the investigation teams in 2019–2023, approximately 36% of all persons who died in road accidents died later and not immediately when the accident occurred. On this basis, it was calculated that around 36% of those seriously injured could have survived thanks to the eCall system if assistance had arrived more quickly. The result is approximately **1.0** lives saved.

The above results are based only on information concerning the pan-European eCall system. However, according to the entire emergency call dataset, the number of accidents reported with TPS eCall is approximately 80% of the number of accidents reported with pan-European eCall (TPS eCall = 1,584 accidents, pan-European eCall = 1,988 accidents). The severity distribution of accidents reported with TPS eCall combined with the PRONTO statistics is also very close to the corresponding distribution of accidents reported with pan-European eCall (Table 6). This makes it possible to estimate that, if accidents reported with the TPS eCall system are also taken into account, the safety impacts for 2019–2023 could be at most 1.8 times as high as those estimated above. However, the number is likely smaller in reality, as TPS eCall activations are routed through the vehicle manufacturer's call centre before information on the accident is transferred to the Finnish Emergency Response Centre Agency, which may affect the time saved by the system in a way that is difficult to predict. For this reason, the effectiveness of TPS eCall activations cannot be assumed to be at the level of pan-European eCall.

Table 6. Severity in road accidents involving a TPS eCall activation. The estimate is based on the accidents combined between the PRONTO statistics (2019–2023) and emergency call data (4/2021–9/2025).

eCall activation	Non-injury accident	Slight injury accident	Serious injury accident	Fatal accident
TPS eCall (n=666)	49.2%	45.3%	4.4%	1.1%

3.1.2 Factors affecting rescue time from rescue workers' perspective

In the interviews with rescue workers, the location of the accident was found to be one of the most significant factors affecting rescue time. If an accident occurs more than 200 kilometres from a hospital, rescue time will increase significantly in relation to accidents closer to hospitals, which may reduce the patient's chances of survival. In situations where the exact location of the site is not known at first, incorrect or incomplete information may slow rescue operations. This challenge may be especially emphasised in sparsely populated areas. The interviewees also highlighted vehicle extractions and vehicle structures as a significant factor affecting rescue time.

In general, it was noted that the PSAP's risk assessment usually facilitates good response planning, which helps to dispatch appropriate resources to accident sites. In other words, dispatching to an accident site because of insufficient initial information was not perceived as a common issue.

The interviewees emphasised that the sufficiency of resources and challenges related to rescue operations vary by region. Based on the interviews, rescue services aim to dispatch enough units right away. When the first unit reaches the site, the response is scaled back if necessary. This operating model was considered particularly important for safety on busy road sections where considerations include the occupational safety of rescue personnel and the rapid clearing of the accident site, even when there has been a less serious traffic accident, in order to avoid further accidents. The interviewees explained that one way to protect an accident site during accident tasks is to block it with a tanker.

In rural areas and sparsely populated areas, the insufficiency of resources can be a problem when a serious accident occurs and several patients need urgent treatment at the same time. For example, in a situation where three or more patients need urgent care, the lack of resources may be concretely reflected in the fact that not all patients can be immediately transported to the hospital. In these situations, rescue services are forced to prioritise patients and focus on treating those in the most critical condition.

Although the interviewed rescue workers reported that the initial information is usually sufficient, they felt that more detailed preliminary information on matters such as collision speed, the number of passengers and the use of safety belts would help to estimate the amount of resources. For example, if it is known that the collision speed was high and the vehicle is on its roof or wrapped around a light post, it can be ensured that enough rescue units and appropriate equipment are dispatched to the site. On the other hand, if information is received that can be used to estimate that the vehicle's structures have been damaged and passengers may be trapped, it is possible to anticipate serious injuries and the need for certain types of rescue equipment.

On the other hand, the interviewees mentioned that the required rescue measures can sometimes extend the rescue time when measures are taken to ensure patient safety. For example, stabilising a patient's injuries and protecting them from additional injuries may take time, but it is sometimes necessary to prevent the injuries from getting worse. For this reason, the rescue time cannot always be reduced to the absolute shortest; instead, the quality of the measures is a priority.

3.1.3 *Impact of rescue time on the consequences of injuries*

The interviewees listed the following as critical injuries in terms of the length of rescue time:

- Brain injuries: A severe brain injury may require rapid surgery in the case of a cerebral haemorrhage that is bleeding profusely inside the skull, causing an increase in cranial pressure. This type of injury poses a widespread threat to brain function, and the pressure must be relieved quickly. Even a mild brain injury may cause loss of consciousness, which causes a risk of airway obstruction and makes it essential that emergency care workers can get there quickly to secure an unobstructed airway.

- Chest injury causing lung injury and lung collapse (pneumothorax): In this case, there is a risk that the patient will stop breathing, so the condition may be life-threatening. Especially pneumothorax, which is a condition where the lung leaks air into the chest cavity when inhaling but the air does not escape during exhalation, will lead to death unless the internal pressure in the chest can be reduced.

- Injury due to severe internal organ haemorrhage: e.g. liver, spleen, intestines or large blood vessel.

- Haemorrhage caused by severe external injury: e.g. a severe open injury in the upper thigh or severe soft tissue injury in the neck area.

Other critical accident factors include an injured patient being left in a position where their airway is not secured or being exposed to the cold.

Based on the interview responses, it can be concluded that, in the event of serious injuries, it is critical that rescuers arrive quickly, assess the situation promptly and transport the patient without delay to a place where a comprehensive diagnosis can be made and treatment can be started. Before more information is available on injuries, any person who has been in a traffic accident is considered a multi-trauma patient.

A general guideline is that if a person has stopped breathing due to an injury, there is about 10 minutes before a risk of permanent brain damage due to lack of oxygen. In general, the interviewees stated that it is difficult to give precise time limits, but every minute counts – especially in cases of serious brain injuries and internal bleeding.

The interviewed rescue workers said that the so-called “golden hour” is a central concept in their field. It refers to the fact that a seriously injured patient needs to get to a surgical hospital within one hour of the accident at the latest. This time limit is based on observations that the likelihood of patient survival and the prevention of secondary injuries is significantly reduced if treatment is delayed beyond this period. The golden hour puts time pressure on rescue services as a whole, especially when an accident occurs far away from a surgical hospital.

The interviewed rescue workers mentioned that serious injuries for which the duration of the rescue period is decisive often happen in collisions and cars driving off the road, which are usually high-force accidents. These include situations where cars and motorcycles drive off the road at high speed and collide with obstacles such as bridge piers, rock cuts, poles or trees. Serious injuries also occur in head-on collisions of motor vehicles, especially to people travelling with more lightweight vehicles (e.g. small passenger cars, motorcycles, mopeds). Similarly, when a motor vehicle collides with a cyclist or pedestrian, serious injuries may occur even at city speeds.

According to the interviewed rescue workers, one challenge that modern vehicles present in rescue operations is the fact that car bodies are very strong and it is difficult for laypersons to identify the true nature of an incident. Nowadays, rescue operations aim to remove the patient as quickly as possible with very simple measures.

In older vehicles, it has been easier for laypersons to notice serious injuries if someone has become physically trapped. The bodies of modern vehicles are usually so durable that the passenger space does not collapse and the doors function normally. Becoming pinched is also less frequent. This may lead to a misjudgement by a layperson that no serious injury has occurred, even though the driver and passengers may have been subjected to high forces in the collision. At worst, this may result in the person being removed from the vehicle before professionals arrive, which may cause significant additional injuries.

3.2 Duration of delay between accident and emergency call in serious traffic accidents (RQ 3)

3.2.1 Fatal accidents

The data on fatal accidents investigated by investigation teams were combined with the data in the PRONTO statistics in accordance with the methodology in chapter 0. Of the accidents investigated by investigation teams, 915 had not been reported by eCall. Of these, 92.6% could be combined with PRONTO statistics. The accidents not combined are likely ones where the rescue department did not participate. The report by Virtanen (2005) also found that approximately 7% of the fatal accidents investigated by investigation teams could not be combined with PRONTO statistics.

Accidents were classified based on the duration of delay into categories of less than five minutes, 5–30 minutes and over 30 minutes. Approximately half (46.4%) of the accidents in the category of less than five minutes were those in which the estimated time of the accident was later than the time when the emergency call had arrived at the PSAP. This is likely due to the fact that the estimated time of accidents is often recorded to the nearest five-minute mark (the last digit of the incident time is zero or five, Table 7), so there is slight inaccuracy in the time estimate. In reality, the emergency calls of these accidents have likely been made within five minutes of the incident. Almost half of the event times have been recorded to minutes not falling within the five-minute intervals, so recording accuracy does not fully explain the time error.

Table 7. The last digit of the estimated accident time in OTI's investigation team data on passenger car and van accidents (2019–2023).

The last digit of estimated accident time	Number	Percentage (%)
0	259	33
5	153	19
7	56	7
2	54	7
8	54	7
9	51	6
6	44	6
4	43	5
3	42	5
1	39	5

Of the fatal accidents that were not reported by eCall and where it was possible to estimate the delay (i.e. the data on the accidents investigated by investigation teams could be combined with the PRONTO statistics), they were usually reported within an estimated five minutes of their occurrence (85.3%, Figure 7). An estimated 14.7% of the accidents involved a delay of over five minutes. In terms of the vehicles involved in the accidents, the distributions are roughly the same, except for heavy vehicle accidents, where the category of delays of less than five minutes is larger than the other distributions and there were no delays of over 30 minutes.

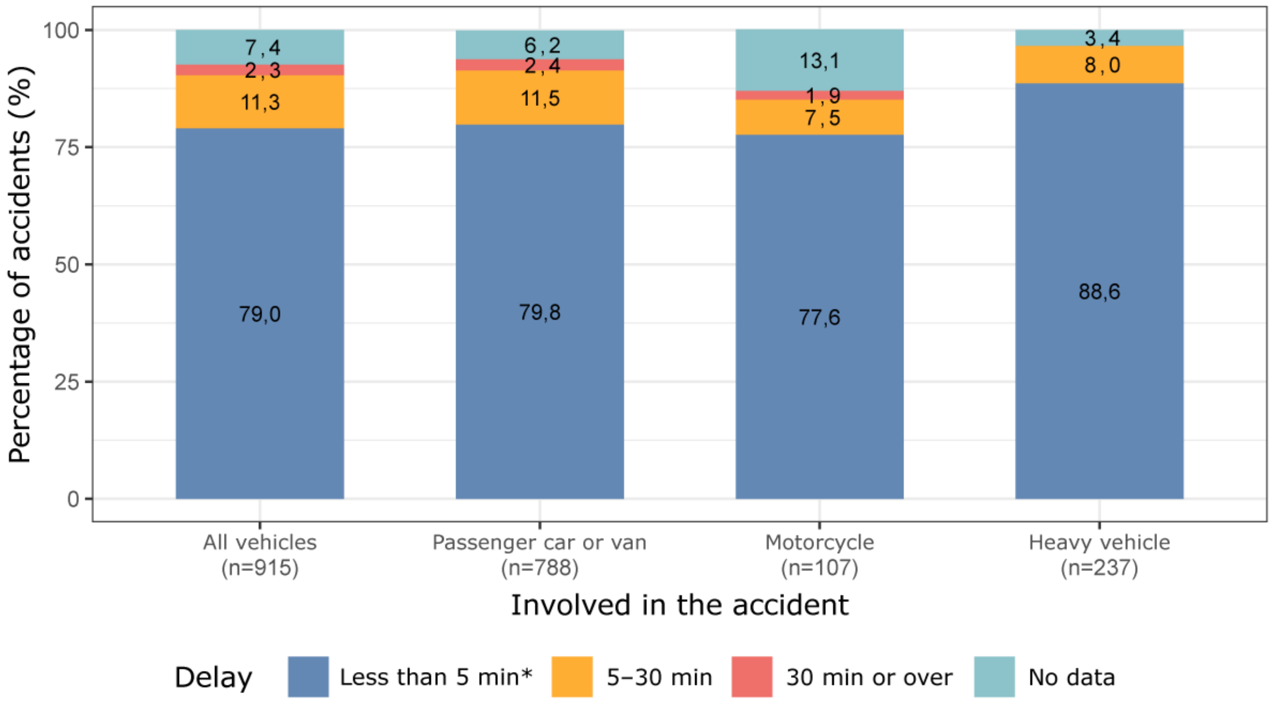

*Figure 7. The delay between the estimated time of an accident and the first emergency call in fatal accidents. *Also includes accidents where an emergency call had arrived before the estimated time of the accident.*

Of the fatal passenger car and van accidents not reported with the eCall system (n=788), 93.8% could be combined with the PRONTO statistics. In most of the passenger car and van accidents where it was possible to estimate the delay, the duration of the delay for making an emergency call was estimated to be less than five minutes (85.1%). Of the accidents, 14.9% were estimated to have a delay of over five minutes. The distribution is similar to that in Virtanen's (2005) study.

An estimated 86.9% of the fatal motorcycle accidents not reported with the eCall system (n=107) could be combined with the PRONTO statistics. This percentage was lower than in other accident categories, which was probably affected by the fact that motorcycle accidents, especially single-vehicle crashes, may not require the participation of rescue services as often as accidents involving passenger cars and heavy vehicles. In most of the motorcycle accidents where it was possible to estimate the delay, the delay in making an emergency call was estimated to be less than five minutes (89.3%). An estimated 10.8% of the accidents involved a delay of over five minutes.

Of the fatal heavy vehicle accidents (truck, bus) not reported with the eCall system (n=237), an estimated 96.6% could be combined with the PRONTO statistics. In most of the heavy vehicle accidents where it was possible to estimate the delay, the delay in making an emergency call was less than five minutes (91.7%). An estimated 8.3% of the accidents involved a delay of over five minutes.

The response time of the accidents, or the time from receiving the first emergency call until the first rescue unit arrived at the accident site, was less than 10 minutes in an estimated 44.0% of all fatal accidents that could be combined with the PRONTO statistics. Similarly, the response time was 10–15 minutes in an estimated 34.7% of the cases, 15–20 minutes in 11.8% of the cases and over 20 minutes in 9.6% of the cases. The response time was generally estimated to be less than 15 minutes, regardless of the delay between the occurrence of the accident and its notification and the types of vehicles involved (Figure 8). However, accidents involving heavy vehicles accounted for the largest share of accidents with an estimated response time of no more than 15 minutes.

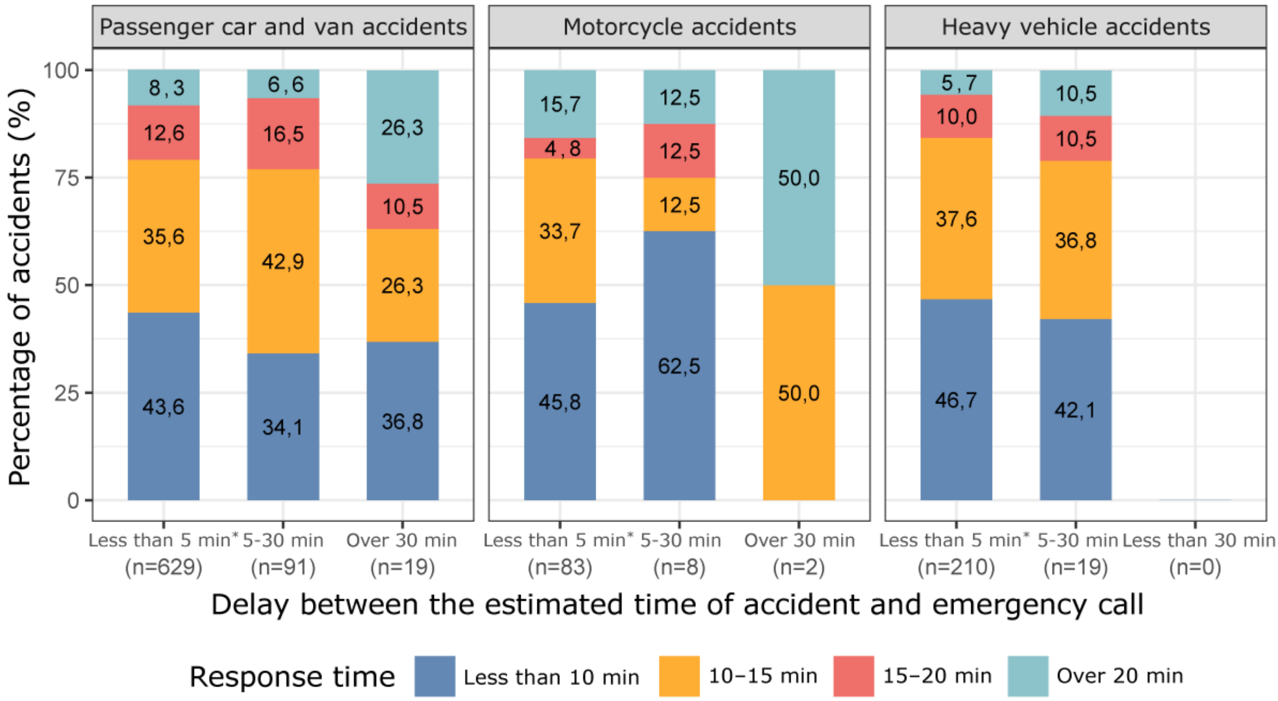

*Figure 8. The delay between the estimated time of fatal accidents and the reception of the emergency call and the response time from the reception of the emergency call to the arrival of the first rescue unit at the scene of the accident. The figure only includes the accidents that could be combined with PRONTO statistics. *Also includes accidents where an emergency call had arrived before the estimated time of the accident.*

3.2.2 Accidents resulting in serious injury

In the in-depth data, 87.9% of the fatal passenger car and van accidents not reported with the eCall system could be combined with the PRONTO statistics. Approximately 86.2% of the accidents for which it was possible to estimate the delay were reported within five minutes of the incident (Figure 9). Similarly, an estimated 13.7% of accidents involved a delay of over five minutes. Only 58.1% of the motorcycle accidents in the light investigation data could be combined with PRONTO statistics. An estimated 74.9% of these were reported in less than five minutes.

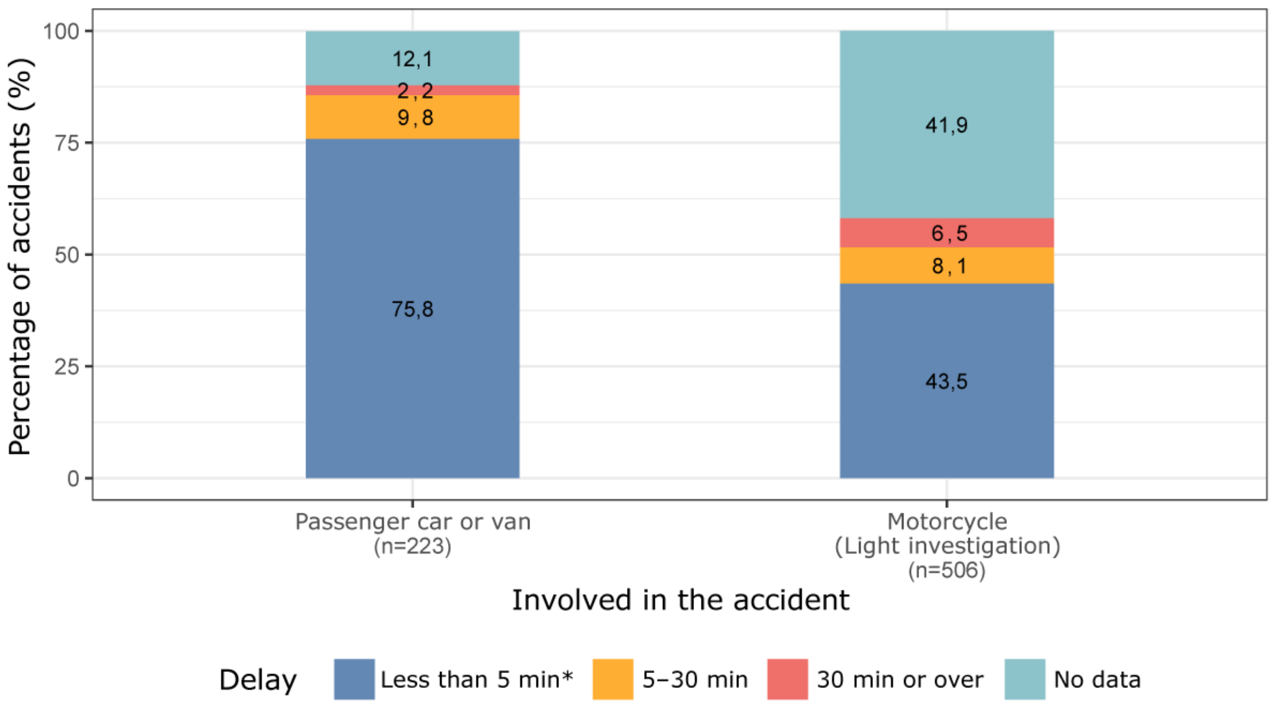

*Figure 9. The delay between the estimated time of an accident and receiving the first emergency call in accidents resulting in serious injury. *Also includes accidents where an emergency call arrived before the estimated time of the accident.*

In accidents leading to serious injury, the response time was generally estimated to be less than 15 minutes, regardless of the delay between the occurrence of the accident and its notification and the vehicles involved (Figure 10). An exception to this were accidents where the delay between the estimated time of the accident and the first received emergency call was estimated to be over 30 minutes. On the other hand, only 10 such cases were included, so it is not possible to draw general conclusions on their response times.

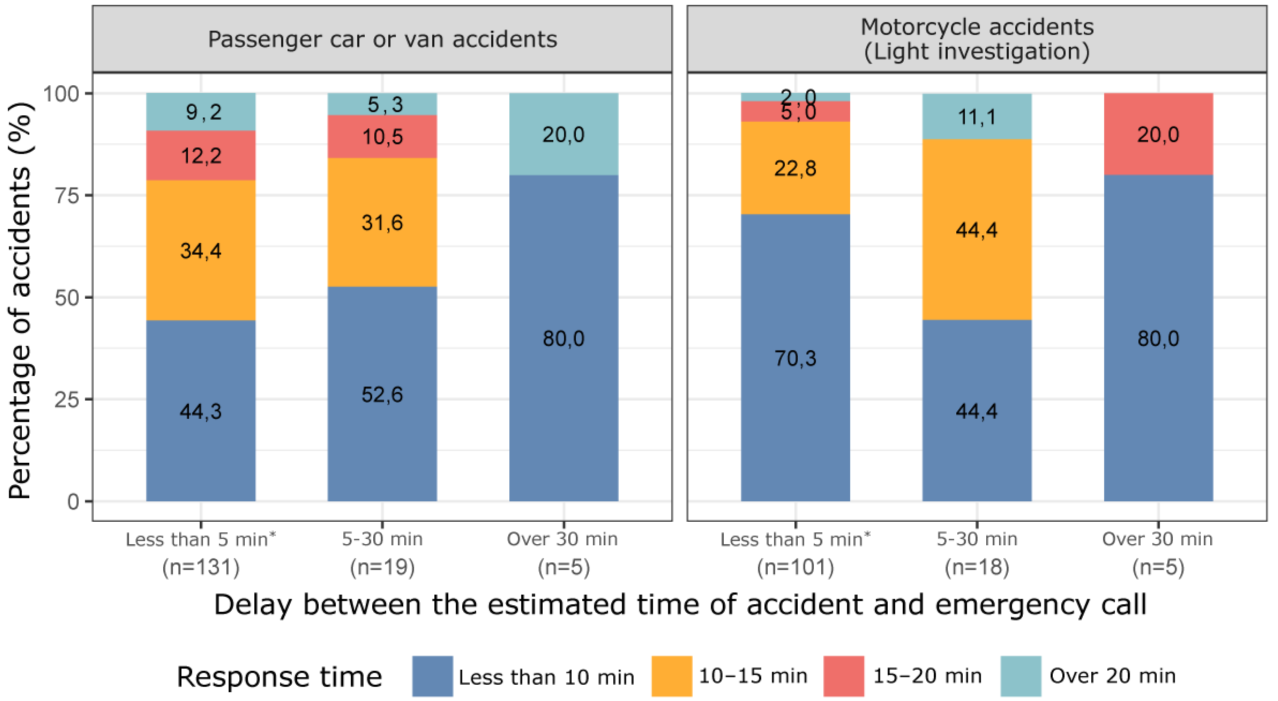

*Figure 10. Delay between the estimated time of occurrence of accidents resulting in serious injury and receiving an emergency call and the response time. The figure only includes the accidents that could be combined with PRONTO statistics. *Also includes accidents where an emergency call arrived before the estimated time of the accident.*

The majority (approximately 67%) of motorcycle accidents that resulted in serious injury and were included in the light investigation data but could not be combined were either single-vehicle crashes or animal collisions. It is possible that the rescue department did not participate in these cases, so data on the events did not end up in the PRONTO statistics either. However, such accidents are those in which the eCall system could have an impact, especially if a single-vehicle crash or animal collision occurs in an isolated area or outside busy traffic hours, in which case the accident is less likely to have eyewitnesses. According to the road accident statistics of Statistics Finland, an average of 1.5 motor-cycle accidents resulting in death and 2.8 similar accidents resulting in serious injuries occur outside urban areas at night each year (Table 8).

Table 8. Distribution of motorcycle accidents in the road accident statistics of Statistics Finland at night and during the day in urban areas and outside urban areas in 2019–2023 (SVT, 2025).

Time	Urban area	Severity	2019–2023 average /y.	2019–2023 total
Day	Outside urban area	Fatal single-vehicle crash (MC)	6.4	32
Night			1.5	6
Day	In urban area		2.0	10
Night			1.5	6
Day	Outside urban area	Serious injury single-vehicle crash (MC)	14.4	72
Night			2.8	14
Day	In urban area		3.6	18
Night			1.8	7

3.3 Future traffic safety potential of automated emergency call systems in Finland (RQ 4)

3.3.1 Penetration rate of eCall systems in the car fleet until 2035

The safety impacts of the eCall system until 2035 were assessed by preparing forecasts concerning the penetration rate of the system in the car fleet (passenger cars and vans used in traffic), the number of accidents reported by eCall and related injuries. The quantitative estimates presented in this chapter are based on figures from the pan-European eCall system, but the end of this chapter includes an estimation of how the consideration of TPS eCall could affect the outcome.

In Figure 11, the bars show the predicted penetration rate of the eCall system in the car fleet in 2017–2021. The blue line in the figure shows the estimated penetration rate of functional eCall systems in the car fleet in 2017–2035. The grey dashed line shows the penetration rate of the system operating in the 2G network, and the green dashed line indicates the penetration rate of NG eCall. The penetration rate of eCall in the car fleet increased in a fairly linear way between 2017 and 2021, so the penetration rate of 2017–2026 was estimated with a regression line.

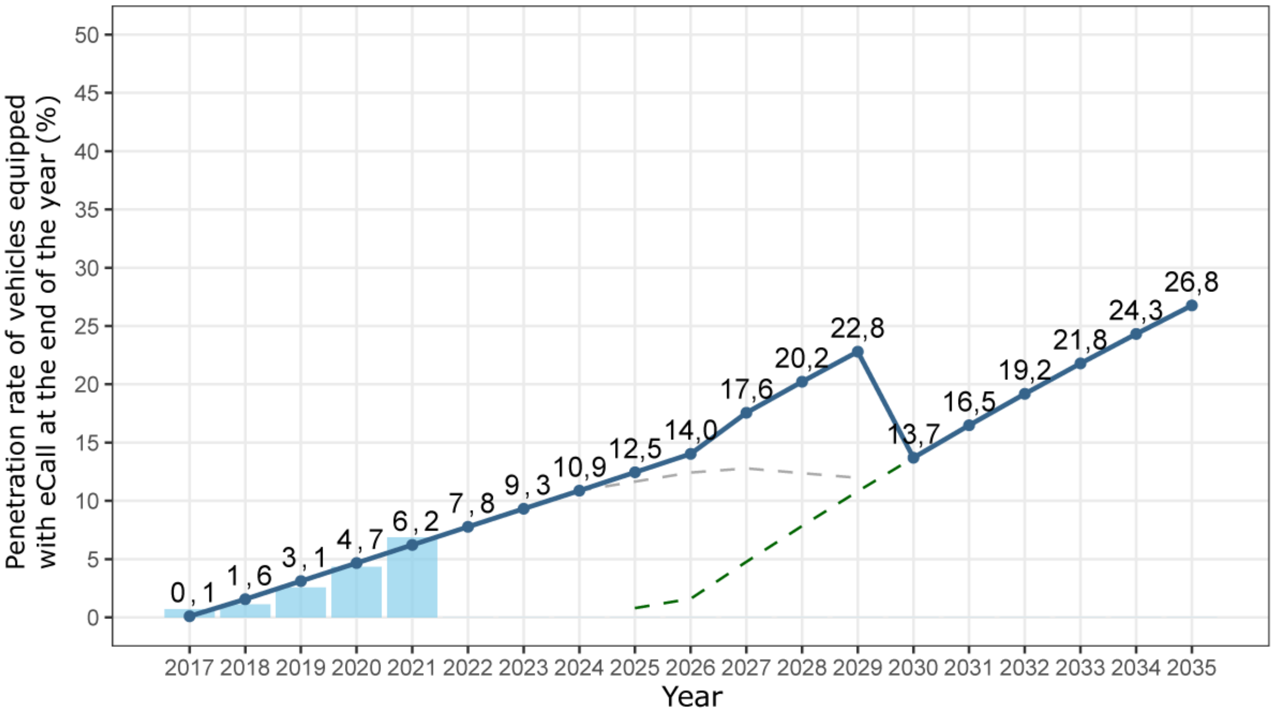

Figure 11. Estimated penetration rate of eCall systems in the Finnish car fleet (passenger cars and vans in traffic use). The bars for 2017–2021 are based on data from the report by Pilli et al. (2022, s. 20). The blue line shows the penetration rate of functional eCall systems. The grey dashed line shows the prevalence of eCall systems operating in the 3G and 2G network. The green dashed line shows the penetration rate of NG eCall systems.

Vehicles equipped with NG eCall were expected to be available from 2025 onwards. In this report, it was assumed that half of the cars that are in use and equipped with eCall in 2025 and 2026 are equipped with 2G eCall and the remainder with NG eCall.

From 2027, all new passenger cars and vans must be equipped with the NG eCall system. In other words, the increase in the penetration rate of the system was assumed to correspond to the percentage of first-time registered passenger cars and vans in the vehicle fleet. The percentage used was the average for 2020–2024, which was approximately 3.2% per year. At the same time, it was assumed that old eCall cars would exit from the vehicle fleet at the same pace. Old eCall cars are likely to leave the fleet more slowly than this, but there is no information available on how many cars removed from the fleet would have eCall. First-time registrations include imported cars in addition to new cars.

Imported vehicles without eCall may slightly distort the estimation of the penetration rate of NG eCall. However, the magnitude of the error is difficult to estimate.

Between 2027 and 2029, both the 2G eCall and NG eCall will be in use at the same time. The blue line indicating the penetration fate of eCall systems in these years corresponds to the sum of the grey and green dashed lines. The eCall system operating in the 2G network will stop working in 2030, which is reflected as a reduced penetration rate of eCall systems in the figure, falling to the level of NG eCall systems.

3.3.2 Estimate of the annual number of accidents reported by eCall

Figure 12 presents an estimate of the number of road accidents reported with automatic and manual eCall activations in 2019–2035. The estimate is based on the above estimate of the penetration rate of functioning eCall systems and the numbers presented in chapter 3.1.1 on accidents of all levels of severity reported by the pan-European eCall system in 2019–2023. The estimate presented in the figure was achieved by using the method of least squares to adjust the regression lines to the annual number of accidents reported by eCall in relation to the annual penetration rate of functioning eCall systems presented above. During the time period, approximately 70% of accidents reported with eCall were reported with an automatic eCall activation.

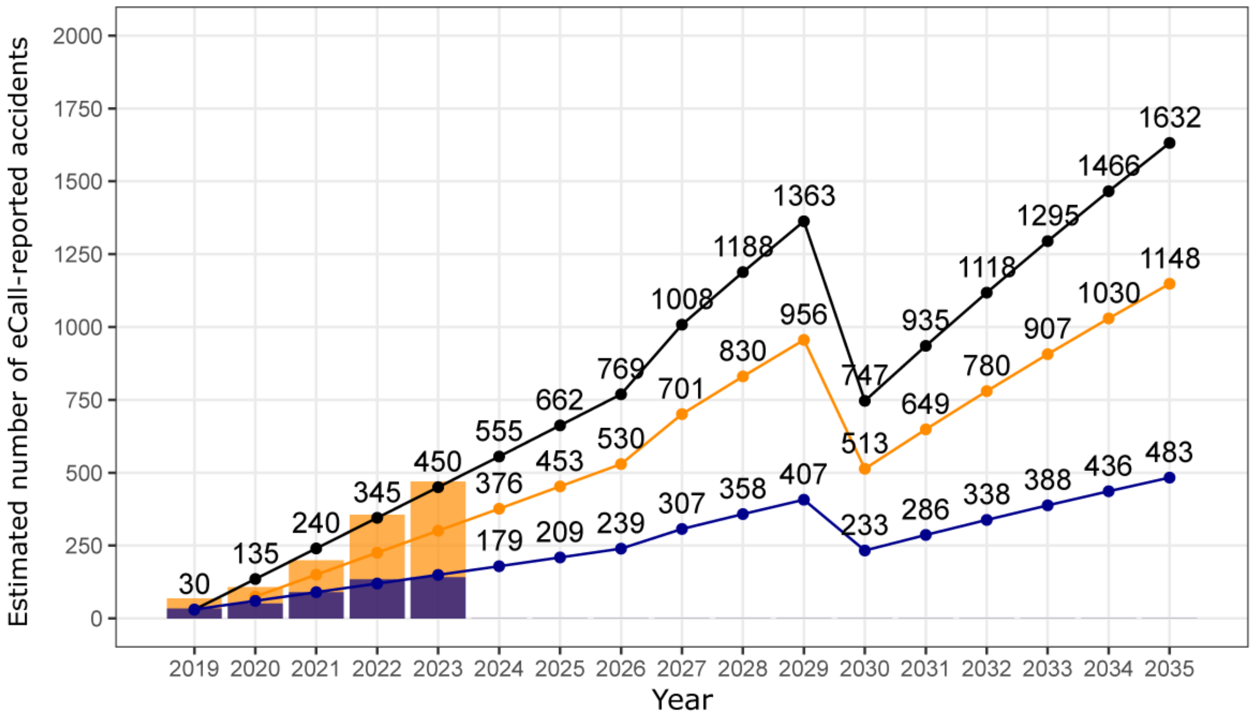

Figure 12. Estimated number of road accidents reported with eCall annually. The black line represents the forecasted total number of accidents, the yellow line represents the forecasted accidents reported with automatic eCall activations and the blue line the forecasted accidents reported with manual eCall activations. The bars indicate the estimated numbers of eCall accidents in 2019–2023 presented in chapter 3.1.1. The figures refer to the figures of the regression lines.

3.3.3 Estimate of the number of serious accidents reported by eCall whose consequences could have been affected by eCall

The final step involved investigating the percentage of accidents leading to serious injury or death reported by eCall whose consequences could have been affected by the time saved by the eCall system. This was assessed by examining the proportion of fatal passenger car and van accidents investigated by OTI investigation teams (excluding accidents reported by the eCall system), where the delay between the estimated time of the accident and the first emergency call was at least five minutes and where the OTI investigation team assessed that all the persons who were killed did not die immediately after the accident. In other words, there was a significant delay between the occurrence of the accident and the emergency call, and at least one of the persons who died in the accident might have been in a post-accident state where faster arrival of help might have affected their survival. In 2019–2023, there were a total of 44 such cases, which corresponds to approximately 6.0% of all fatal passenger car and van accidents in the dataset that were not reported with eCall and for which it was possible to estimate the delay between the incident and the first emergency call (n=739).

It is not possible to estimate the corresponding percentage of accidents resulting in serious injury by using the available data. However, previous estimates discussed in the literature review indicate that the percentage is estimated to be between 1.0% and 7.5%. In this report, it was assumed that about 4.0% of the accidents reported with eCall leading to serious injury would have consequences that could be affected by the time saved by the eCall system. This percentage is at approximately the midpoint of the assessment that is based on past literature. It was estimated that its impact would be that an otherwise serious injury would remain a minor one.

Figure 13 and Figure 14 present an estimate of the annual number of seriously killed or injured victims in accidents reported with an automated eCall activation, as well as estimates of the number of victims who could benefit from the time saved by the eCall system in 2019–2035, based on the figures above. The blue line represents the estimated number of victims of serious accidents reported with eCall annually. It is based on the numbers in Figure 12, multiplied by the total percentage of serious accidents (1.6% + 2.9% = 4.5%) and the average number of fatalities and injuries in such accidents. The red line represents the estimated number of fatalities in fatal accidents reported with an automatic eCall system, the consequences of which could have been affected by the time saved by the system (number of automatically reported eCall accidents * 1.6% * 6.0% * 1.11 people) (Figure 13). Similarly, the green line represents the estimated number of seriously injured persons in the case of accidents leading to serious injury reported with eCall, the consequences of which could have been affected by the time saved by the system ([number of eCall accidents reported automatically * 2,9 % * 4.0% * 1.05 people] + [number of eCall accidents reported automatically * 1.6% * 4.0% * 0.14 people]) (Figure 14). It is estimated that, by 2036, the eCall system could potentially save a total of about 10 lives and result in less severe injuries for about 13 people (Figure 15).

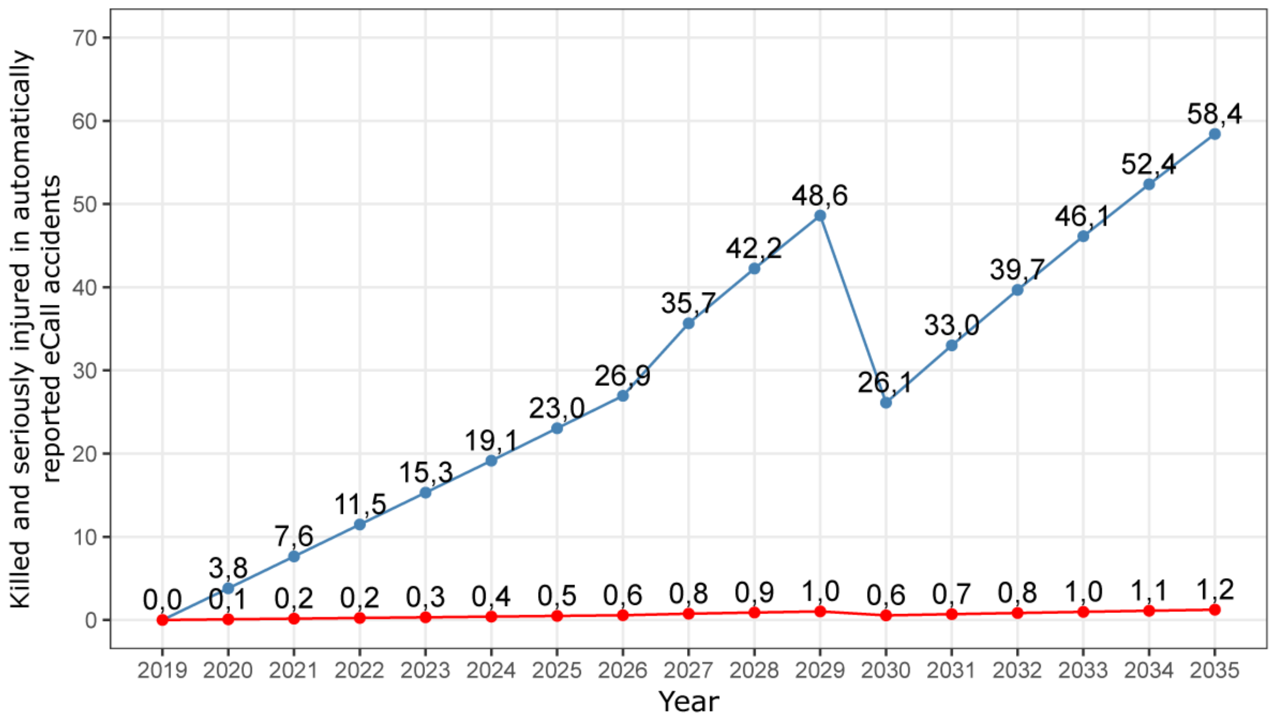

Figure 13. Estimated number of victims in serious accidents where the eCall activation was automatic. The red line indicates the number of fatalities in accidents reported automatically with eCall where the consequences could have been affected by the time saved by the system.

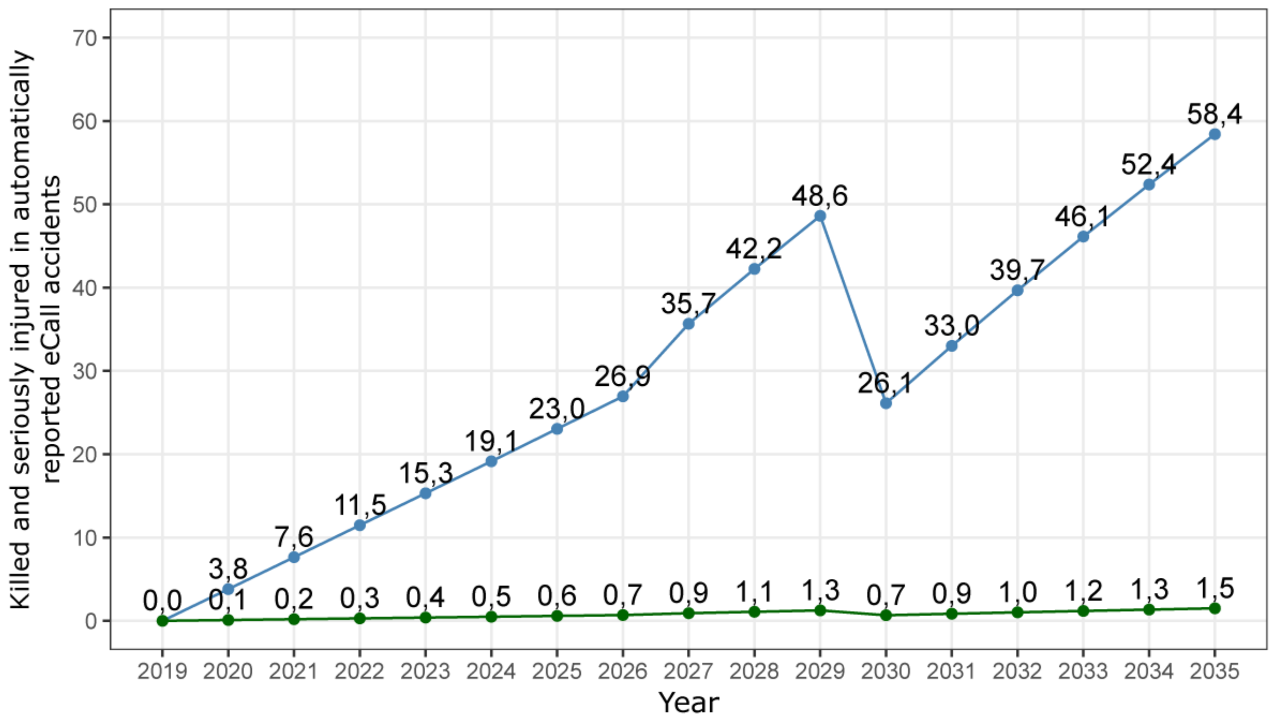

Figure 14. Estimated number of victims in serious accidents where the eCall activation was automatic. The green line indicates the number of seriously injured persons in accidents reported automatically with eCall where the consequences could have been affected by the time saved by the system.

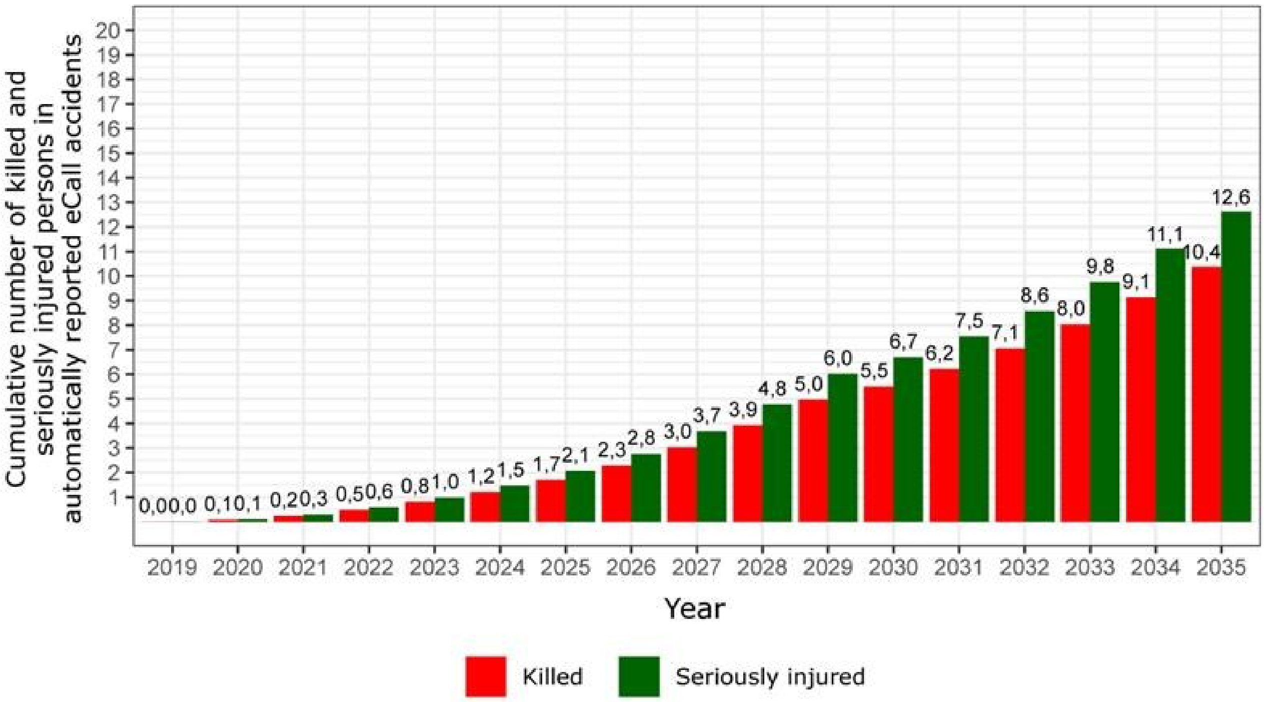

Figure 15. Accumulation of victims in serious accidents reported with eCall who will benefit from the time saved by the eCall system by 2035.

Similarly to the assessment of realised safety impacts, the above quantitative assessment of safety potential is only based on data from the pan-European eCall system. According to the emergency call data, the number of accidents reported with TPS eCall notifications is approximately 80% of the number of accidents reported with the pan-European eCall. In addition, the severity distribution of accidents reported with TPS eCall is similar to the corresponding distribution of accidents reported automatically with the pan-European eCall (see chapter 3.1.1). In other words, as in the estimation of the realised safety impacts, it can also be estimated that, when the accidents reported with the TPS eCall system are taken into account, future safety impacts could be up to 1.8 times as high as estimated in this report, assuming that its penetration rate in the car fleet corresponds to the penetration rate of the pan-European eCall. However, the impact is likely smaller in reality, as notifications made with TPS eCall are first routed through the vehicle manufacturer's service centre before information on the accident is relayed to the PSAP, which affects the time saved by the system in a way that is difficult to predict. In addition, the penetration rate of the TPS eCall system is difficult to assess and determine. Therefore, the impact of TPS eCall cannot be expected to be at the same level as that of the pan-European eCall.

3.4 Road safety potential of the eCall system for motorcycles and heavy vehicles in Finland (RQ 2 & 5)

3.4.1 eCall system for motorcycles

Both the interviewed PSAP dispatchers and rescue workers generally stated that an eCall system for motorcycles could speed up calling for help and finding the scene of an accident, especially in remote areas. The interviewed rescue workers mentioned that motorcyclists' high speeds often lead to serious injuries. The interviewees estimated that even if the system does not necessarily change the outcome of the most serious accidents, it could significantly improve the efficiency and speed of rescue operations.

The interviewees also explained that a motorcyclist may experience a high level of adrenaline after an accident, which may lead to dangerous behaviour, such as walking on the roadway. These situations may endanger both the people involved in the accident and the rescue personnel.

One interviewed rescue worker brought up two situations from the past summer where the eCall system could have been useful: In one, a motorcyclist had not arrived at their destination and could not be found on the road despite searches. It was later discovered that the motorcyclist had veered off the road on a curve and ended up in bushes where they were not noticed at first. In this case, the eCall system could have aided in getting help faster and possibly saved the motorcyclist's life. In the second accident, a motorcyclist went off the road and became incapacitated. However, the motorcyclist had an iPhone crash detection system that automatically reported an alert and relayed the location. Rescue personnel were able to find the motorcyclist quickly due to the location data, and the motorcyclist survived the accident.

A few of the PSAP dispatchers pointed out that extending the eCall system to motorcycles could increase the number of false alarms. eCall notifications might be activated when parked motorcycles fell over or were involved in minor collisions if it is not possible to adjust the system precisely enough to prevent invalid activations in these cases. Such false alarms would unnecessarily waste dispatchers' time and take up rescue resources. One interviewee emphasised that the sensitivity of the system would have to be improved before the widespread introduction of eCall for motorcycles.

3.4.2 eCall system for heavy vehicles

The interviewed PSAP dispatchers and rescue workers reported that heavy vehicle accidents have several special features that need to be taken into account in rescue operations, such as the size and structures of the vehicle and the content and quantity of cargo.

According to the interviewees, cargo-related information – such as content and quantity – is important for the planning and safety of rescue operations. Information on dangerous goods is usually available from the vehicle markings if the person making the emergency call has been able to detect them and the information cannot be obtained from the driver. Interviews with the dispatchers revealed that the driver is not always able to provide information on the cargo or other details related to the accident because of shock. For example, one interviewee described a situation where a passenger car had collided with a truck and the truck remained upright. The truck driver was very distressed, and it was difficult to get the driver to even look at what had happened to the other driver. In such situations, the dispatcher does not necessarily remember or want to prioritise asking questions about the cargo. The interviews also revealed that it is sometimes difficult to obtain information from foreign heavy vehicles due to the language barrier.

In addition to the contents of the load, failures in cargo fastenings are one potential hazard that can lead to uncontrolled movement of loose items and thus endanger rescue personnel. The interviewed rescue workers explained that there is usually no advance information available on how cargo has been secured. The interviewees said that it is sometimes necessary to investigate the situation at the site before rescue operations can start, which takes up some time, and this may increase the rescue time.

The interviewees considered an eCall system for heavy vehicles potentially useful, especially in situations where it could relay information on dangerous substances or about a vehicle's cargo. For example, information about the weight of the vehicle, the cargo it is carrying or other special features could help in planning rescue operations even before arrival at the site. One interviewee mentioned that tasks such as finding out information about the cargo always takes time in any case, even though their primary task is to determine whether any persons were injured in the accident.

3.5 Impact of the eCall system on the work of the Emergency Response Centre Agency in rescue operations (RQs 8–10)

3.5.1 Dispatchers' experiences of eCall

Based on the interviews with the dispatchers, eCall notifications are still a fairly rare type of emergency call in PSAP work. For this reason, dispatchers may not yet have enough repetitions of processing these notifications to make it a routine part of their work.

The dispatchers estimated that the eCall system could be useful in determining location, especially in situations where no other emergency calls have been made. The eCall notification also includes other useful information, which would otherwise have to be obtained the person reporting the accident. However, the interviewees mentioned that they still try to verify the information by asking. The dispatchers also found the system useful in situations where the caller is unable to speak or does not know their location.

The interviewees generally expressed that the MSD package contains not only location information but also other useful information, such as the VIN (Vehicle Identification Number) and the number of persons that were in the vehicle. The dispatcher uses the VIN to check the vehicle's registration information, and this information is attached to the information package provided by the PSAP to the rescue department. One interviewee pointed out that whether a vehicle is gas or electric is one of the most important pieces of information in the MSD package due to the increase in electric vehicles.

However, the interviewees also highlighted challenges in using the eCall system:

- Routing through vehicle manufacturers: Many interviewees had experiences of the TPS eCall notification being transmitted from abroad via the vehicle manufacturer. This was perceived as causing delays that were sometimes even significant. In these situations, the PSAP had often already received other emergency calls about the same accident, and there might already be an ongoing task. In this case, another challenge involves the need to determine whether the notification is an overlapping one or concerns some other accident. On the other hand, the interviewees estimated that routing notifications through the vehicle manufacturer filters out at least some of the invalid notifications, which reduces the number of false alarms.

- Several notifications of the same accident: One interviewee who works in the Helsinki Metropolitan Area explained that the first notification of an accident is usually the eCall notification. After that, a number of normal emergency calls are received about the accident, usually within minutes. Dispatchers process each emergency call as a new notification, regardless of whether it is an eCall or an emergency call. There is an information system to manage overlaps, but challenges may arise when a large number of notifications are received within a short time.

- Format of coordinate data: One interviewee explained that the eCall coordinates are in a format that is incompatible with the system used by the PSAP. Making use of the coordinates takes time, which is not ideal in urgent situations. Since the PSAP information system is compatible with the coordinate formats used in the MSDs of eCall notifications, this apparently referred to certain car makes' systems or coordinates sent by them.

- Disruptiveness: One interviewee mentioned that an eCall notification might sometimes be disruptive because it repeats the location coordinates continuously. This may interfere with the dispatcher's ability to hear the caller's responses during a voice connection and assess other relevant information.

- Invalid eCall notifications: The dispatchers reported that they receive a lot of invalid eCall notifications. The interviewees pointed out that invalid eCall activations may be caused by a variety of reasons. One typical situation is where a person has bought a new car and accidentally presses the eCall button or wants to test it. They had also received invalid eCall notifications caused by children and tourists. The interviewees also mentioned that eCall notifications may be received about situations where a vehicle has been standing completely unused outside for a long time and no one has touched it for days. For example, one interviewee mentioned that snow ploughs can cause eCall activations in parked cars. False alarms have also come from freight terminals where imported vehicles are handled. These vehicles do not have registration numbers yet, which makes it difficult to locate and identify them. For example, notifications might be activated when vehicles are loaded onto trucks and transferred to local car dealerships for selling. eCall notifications had also been received about minor fender benders. However, the dispatchers did not view the number of invalid eCall notifications as a problem – at least not yet – but some were concerned about the number of invalid eCall notifications continuing to increase from the current level. Interviewees mentioned that they also receive a large number of other unnecessary notifications and prank calls.

If voice communication with the driver or passengers of a vehicle cannot be established after an eCall notification, the task is relayed forward. Based on the interviews, there was no established practice for how long a dispatcher would try to determine whether there was a real emergency behind an eCall notification. The interviewees mentioned that eCall notifications always take up a certain amount of the dispatcher's time, for example when searching for vehicle information based on the VIN and recording required entries.

3.5.2 Impacts of the eCall system on rescue operations

Based on the interviewed rescue workers' experiences, they rarely receive eCall notifications in their region: annual numbers ranged from 10 to a few dozen. Based on the interviews, there seemed to be more eCall notifications in Helsinki than in many other regions, probably due to busier traffic and a larger number of vehicles. However, one of the interviewed rescue workers mentioned that it was not always clear to them whether a notification originated from the eCall system or from other sources. The interviewees said that various smart devices nowadays also often send out automatic emergency calls.

Based on the interviews, it can be concluded that almost all eCall activations that the interviewees had encountered had been invalid. eCall might have been useful in only a few cases. In any case, rescue workers will dispatch a unit to check the situation for all the notifications relayed by the PSAP if they cannot confirm that it is not an emergency.

The interviewees pointed out that invalid eCall activations take up rescue units' resources that could be kept available for an actual emergency happening at the same time. For example, one interviewee described a case where their unit tried to locate a vehicle on a busy city street based on an eCall activation, but it became clear only later that the vehicle was in motion and not involved in an emergency. Another interviewee described a case where an eCall activation was caused by a motorcycle falling over in a parking lot. When a unit is dispatched based on this kind of notification, it is tied to the task until the situation has been investigated and verified. In the worst case, this may reduce safety. One of the interviewees mentioned that invalid notifications may sometimes make it necessary for rescue units to engage in emergency driving for long distances, which exposes both the rescue personnel and other road users to unnecessary additional risks.

When rescue units engage in emergency driving, it poses significant safety risks because of the unexpected driving behaviour of other road users. The interviewees explained that noticing an emergency vehicle in traffic – sometimes at the last second – causes unpredictable reactions in many motorists.

The interviewees reported that some road users act in an illogical manner, such as braking hard while driving or yielding in an unexpected manner. One interviewee mentioned that if a heavy-duty firefighting vehicle engaged in emergency driving encounters a situation where a passenger car in front of it brakes suddenly, it could cause a hazardous situation – especially at high speeds. The emergency vehicle driver is responsible for minimising risks, but the reactions of other road users are difficult to predict. One interviewee said that drivers in their region participate in driving training every three years, where they practise safe emergency driving in particular. Despite the training, the interviewees stated that dangerous situations in traffic cannot be completely eliminated.

The interviewees noted that invalid notifications by the eCall system increase the amount of emergency driving and thus also the likelihood of near misses and actual accidents. Although the system has significant potential to improve the speed and efficiency of rescue operations, invalid notifications cause unnecessary risks in traffic. However, the interviewees saw potential in the eCall system, as it can reduce the delay related to emergency calls and provide accurate location information. They also thought it was useful that it shares the registration number, which allows rescue personnel to obtain technical information about a vehicle – such as the locations of batteries or safety equipment – while in transit to the location. This helps to plan rescue operations in advance. Identifying whether a vehicle is gas or electric at the scene of an accident was also considered challenging at times.

3.5.3 Determining the location of an accident and producing a risk assessment in PSAPs

According to the interviewed dispatchers, the location of an accident site is primarily determined based on the location data generated automatically by the caller’s phone. In addition, they always make an effort to ask the caller for additional information, such as road names, landmarks or other location-specific information if a voice connection can be established to the scene of the accident. It became apparent in the interviews that current positioning systems significantly support this process, especially with smartphones that have GPS-based location turned on.

This means that the majority of emergency calls now produce accurate GPS positioning, with an accuracy of up to a few metres. If no GPS signal is available, the location is based on cellular access point data. However, this method is less precise, especially in sparsely populated areas where distances between base stations are long.

The interviewed dispatchers described several situations where it may be challenging to determine the location:

- The caller does not know their location: The importance of automatic positioning becomes highlighted in situations where the caller does not know where the accident has taken place.
- Language barrier: Determining the location may be more difficult when the caller and dispatcher do not share a common language.
- Limitations of positioning technology: When the GPS signal does not work, for example because of interference reported near the eastern Finnish border, it may prevent accurate positioning. Older phones or devices with limitations in settings also have lower positioning accuracy.
- Complicated traffic environment: It may be challenging to determine the right ramp or lane in environments such as ring roads and motorways.
- Base station positioning: Errors can lead to data that is off by even kilometres. This may result in situations where units need to be dispatched in different directions in order to find the accident site.

The PSAP's risk assessment is carried out during the emergency call and it is based on several predetermined steps and guidelines specified by authorities. In other words, during an emergency call, the dispatcher follows official guidelines for the task, including procedures that are determined according to the situation, such as what questions are asked and what information is collected. However, the more detailed guidelines for processing tasks are confidential.

In recent years, dispatchers' discretion has been increased, and the number of questions asked automatically has been reduced. In other words, the dispatcher uses their professional skills and guidelines to carry out the risk assessment. The technical PSAP system will then produce a task type and urgency classification. The interviewees reported that the type of response may vary between different rescue departments – a certain kind of case will lead to one rescue unit being dispatched in some regions while some other region might send out three units.

3.5.4 Other factors for developing the eCall system brought up in the interviews

The interviews revealed that the dispatchers preferred the current practice where the information sent by eCall is based on text and a verbal description, both in terms of efficiency and the dispatchers' coping. The dispatchers felt that adding visual information to the notifications, such as images of the accident site, could increase workload and make the work less efficient. One interviewee mentioned that interpreting images might be difficult, time-consuming, and it would not necessarily be easy to understand the entire situation based on them.

3.6 Technical functionality of eCall (RQs 6 & 7)

3.6.1 Notification amounts and distributions of notification methods

The research data included a total of 81,200 incidents related to road accidents between 1 April 2021 and 10 September 2025. Of these, 19,886 (24.5%) events involved at least one eCall notification received by the PSAP. The remaining 61,314 events were initiated based on other notification channels, such as ordinary 112 calls made by bystanders.

The eCall notifications were divided into automatic and manual activations. In addition, the activation method of the notification remains unknown in some cases due to the lack of data. The data included a total of 2,905 automatic notifications (14.6%), 14,024 manual notifications (70.5%) and 2,957 cases (14.9%) where the activation method was unknown.

The vehicle fleet data used as the basis for comparing individual car makes and models included 171 different car makes and 1,799 different models[1]. It covers virtually all new vehicles in the Finnish car fleet that were taken into use in 2018 or later. The analysis therefore extends to nearly the entire fleet covered by the eCall obligation.

It is important to distinguish between the entire fleet and the vehicles that have been involved in eCall activations. During the review period, eCall notifications were only received from 46 different car makes (26.9% of all makes) and 262 different car models (14.6% of all models). This means that the majority of car models have not produced any eCall notifications so far, which is to be expected since accidents are rare and there are very small numbers of many models in traffic.

[1] The figures are based on raw data from Traficom's fleet data. For car makes, the data has been cleaned up by combining obvious spelling errors, different spellings (e.g. VW -> Volkswagen) and combinations of make and body manufacturer. In this respect, the figures are close to the truth, but they may include minor inaccuracies due to possible undetected deviations. The exact division of car models in the register (e.g. specified into different engine versions) was maintained, and they have not been combined into larger model families. This choice was made in order to identify technical problems as accurately as possible.

A single accident often produces several notifications. Conventional (non-eCall) accident events produce an average of 1.5 notifications per event. The average of all eCall events is lower (1.3), but this number is distorted due to the high number of false alarms. When only examining valid events, the number of notifications for eCall events increases to 2.2, while for conventional accidents the figure remains the same (1.5). This demonstrates that a valid eCall event generates more notifications than a conventional accident on average. The median number of notifications in both groups is 1.0, but the number of events with more than one notification was 12.7% in eCall cases and 29.8% in other cases. This difference may be partly explained by the fact that the eCall system typically generates one automatic notification, while serious accidents on busy roads may generate several emergency calls from bystanders.

Of all eCall events, 18.0% led to a dispatched incident where at least one unit was dispatched to the scene. This figure is low compared to conventional emergency calls, but the difference is almost entirely explained by the invalid notifications generated by the eCall system.

When looking only at the valid events, the effectiveness of the eCall system is extremely high: 92.3% of the valid eCall events resulted in a dispatched incident. In the reference group (road accidents not reported by eCall), the corresponding figure was 96.0%[2]. This shows that when an eCall notification is valid, it will lead to official action almost as surely as a normal emergency call.

3.6.2 Quality and classification of notifications

The task classifications determined by the PSAP were used to divide the eCall events into two main categories:

1. Valid events: events that led to an official task or were classified as real emergencies (task categories 200–500 series).
2. Invalid activations: events that did not require action or were classified as invalid. This category is based on the H categories of the PSAP information system and cases where the task category is completely missing (e.g. a technical fault or disconnection).

Overall, 80.6% (16,033) of all eCall activations were classified as invalid and 19.4% (3,853) were classified as valid, which is slightly different from the number of the notifications that led to a dispatched incident (18.0%). The proportion of invalid notifications remained relatively constant throughout the period under review. It should be noted that a valid eCall event is not exactly the same as a dispatched incident, as the validity is determined based on the task classification (200–500 series), while an emergency dispatch is a situation where at least one unit has been dispatched.

It should be noted that the conventional emergency calls (non-eCall) used as a control group are of a different nature: they consist almost exclusively of valid events (relevance rate 99.9%).

The subcategories used in the analysis were formed by combining the more detailed task categories (H codes) of the PSAP information system as follows:

- Advice/info: categories H31 (information, rescue), H32 (information received or relayed, rescue), H61 (information, PSAP) and H62 (information received or relayed, PSAP).
- Malicious/inappropriate: category H12 (inappropriate or malicious call).
- TPS/service: categories H637 (Contacted from abroad / car manufacturers, other control centres),

[2] The high percentage of events leading to an emergency response task is specific to the emergency calls made for road accidents in this material. For example, the Emergency Response Centre Agency received 2,729,620 emergency calls in 2024, of which 568,500 or approximately 21% were “false” (incl. unintentional, inappropriate and malicious) (Hätäkeskuslaitos, 2025).

H638 and H639.

- Unclassified/technical: cases where the task category is missing.

The analysis demonstrated that a significant proportion of invalid notifications are related to the accidental activation of eCall or technical problems. The most common causes of invalid notifications (16,033) were:

- Unclassified/technical: 13,029 (81.3%)
- Advice/info: 2,974 (18.5%)
- TPS/service: 28 (0.2%)
- Malicious/inappropriate: 2 (0.0%)

The broad category of “Unclassified/technical” includes calls that do not have a clear task category (e.g. mute calls, disconnected connections, or purely data messages without voice connection).

The proportion of invalid notifications was also examined according to the activation method, which revealed a clear difference:

- Automatic activations: percentage of invalid notifications is 55.3% (valid: 1,298, invalid: 1,607).
- Manual notifications: percentage of invalid notifications is 94.0% (valid: 840, invalid: 13,184).
- Notifications with unknown activation method: percentage of invalid notifications is 42.0% (valid: 1,715, invalid: 1,242).

The high proportion of invalid notifications in manual activations (94.0%) is especially noteworthy. When a vehicle sends a confirmed manual eCall activation, there is a high likelihood that the notification is invalid. In the analysis, these cases were categorised as invalid mainly because of the missing task category. A more detailed examination confirmed that this assumption was correct: the majority (88.1%) of these cases had been recorded as invalid (“Groundless”) by the PSAP, in which case a task category is not recorded. The median duration of these cases was only 18.1 seconds, which suggests accidental presses that were noticed quickly. A smaller proportion (11.9%) were recorded as “Handled”, which also means that a task would not be created, but the situation did apparently require some sort of processing. The median duration of these cases is longer, 48.3 seconds.

3.6.3 Comparison of TPS eCall and pan-European eCall

A distinction was made between TPS eCall notifications transmitted through the vehicle manufacturer’s own service centre and notifications sent directly to the PSAP with pan-European eCall.

Only 8.1% of all eCall activations received by PSAPs (including invalid notifications) were TPS eCall activations. However, because TPS effectively filters out invalid notifications, their role in actual accident situations is considerably greater: as many as 45% of the eCall events leading to a dispatched incident came through TPS.

TPS appears to be widely used in various car makes: 21.7% of makes that produced at least one eCall activation (10 makes in total) relayed at least some of their notifications through TPS.

In notifications received through TPS, the share of invalid notifications was 1.9% (valid: 1,585, invalid: 31). In pan-European eCall activations, the corresponding percentage was 87.6% (valid: 2,268, invalid: 16,002).

Although TPS eCall activations account for only 8.1% of all eCall activations, their small percentage of invalid notifications lowers the average percentage of invalid notifications across the eCall system to 80.6%. This suggests that service centres are able to filter out a significant share of invalid notifications before they reach the PSAP. However, there can be large variation between manufacturers, and the difference may not be equal between all makes.

Standard EN 16102 (CEN, 2011) obliges TPS providers to relay at least the information contained in the MSD to the PSAP. In practice, however, the data demonstrates that the MSD is usually not transmitted directly to the PSAP information system in notifications received via TPS. This is typically because the technical interfaces for transmitting the data are not yet comprehensively in use. As a result, the PSAP does not have technical data on how the notification was activated (automatic/manual) in most cases.

The data contained 35 identified TPS events (2.2%) where information on the automatic activation of the notification had been relayed. The number of confirmed manual activations was four (0.2%). The majority of TPS cases (1,577 activations, 97.6%) fall into the category of “Unknown” because the MSD is missing. By comparison, the percentage of automated activations was 15.7% in the pan-European eCall, where the MSD had been relayed more reliably, and 76.7% for manual activations. The share of unknown activations was 7.6%.

Invalid notifications drain PSAP resources even though their processing time is shorter. The first call of an invalid eCall event lasted 35.8 seconds on average, and the total duration of the event (including all calls related to the same notification) was 39.5 seconds. The first call in a valid eCall event lasted 263.1 seconds on average, and the total duration was 495.1 seconds. By comparison, the first conventional (non-eCall) emergency call in a road accident lasted on average 233.2 seconds, and the total duration was 301.5 seconds. The comparison number is calculated using only valid tasks so that it is comparable to valid eCall events. The longer duration of eCalls is partly explained by the fact that the vehicle sends the MSD over the audio channel at the beginning of the call, which takes some time before the voice connection can be established.

Table 9 describes the percentages of TPS with different vehicle models.

Table 9. Percentage of TPS in eCall activations by vehicle models (top 15). Non-TPS events reflect pan-European eCall activations.

Vehicle model	Events	TPS events	TPS %
Vehicle model 72	32	2	6.2
Vehicle model 69	35	2	5.7
Vehicle model 54	45	2	4.4
Vehicle model 38	80	3	3.8
Vehicle model 49	52	1	1.9
Vehicle model 40	79	1	1.3
Vehicle model 35	94	1	1.1
Vehicle model 32	98	1	1.0
Vehicle model 33	98	1	1.0
Vehicle model 16	214	2	0.9
Vehicle model 29	125	1	0.8
Vehicle model 27	137	1	0.7
Vehicle model 20	198	1	0.5
Vehicle model 6	689	3	0.4
Vehicle model 11	326	1	0.3

3.6.4 Analysis per vehicle model

To identify possible technical problems that are specific to a vehicle model, the eCall activation volumes were set in proportion to Traficom's vehicle fleet statistics. The result was used to calculate the relative activation frequency (activations per 1,000 registered vehicles).

Table 10 lists the vehicle models that are overrepresented in eCall activations in relation to their share in the vehicle fleet. The table also presents the absolute number of activations, since a high relative activation frequency for a model with a low-volume car fleet does not necessarily indicate a widespread problem. Instead, even a small deviation may be significant in the case of high-volume models. In addition, the analysis could not distinguish whether the activations came from a large or small number of vehicles, as the data only contained information on the car make and model without unique identifiers (VINs had been removed from the data to protect personal data). Even a single vehicle making repeated emergency calls may cause a statistical deviation, which is particularly emphasised in low-volume vehicle fleet models.

Table 10. Vehicle models with the highest relative number of eCall activations.

Vehicle model	Fleet size	Events	Event frequency /1,000	Valid frequency /1,000	Invalid %	TPS %
34	159	97	610.1	69.2	88.7	0.0
37	222	87	391.9	4.5	98.9	0.0
2	3941	1336	339.0	21.8	93.6	0.0
4	3230	942	291.6	19.8	93.2	0.1
3	5028	1117	222.2	8.9	96.0	0.0
31	504	106	210.3	9.9	95.3	0.0
14	1478	272	184.0	13.5	92.6	0.0
76	177	30	169.5	33.9	80.0	0.0
63	236	38	161.0	8.5	94.7	0.0
46	359	56	156.0	5.6	96.4	0.0
61	273	40	146.5	0.0	100.0	0.0
39	564	79	140.1	8.9	93.7	0.0
13	1998	273	136.6	10.0	92.7	0.0
83	181	24	132.6	0.0	100.0	0.0
60	314	41	130.6	3.2	97.6	0.0

The scatter plot below (Figure 16) illustrates the relationship between the total activation frequency and the proportion of invalid activations. Models located in the upper right corner of the plot are activated often, and the activations are mostly invalid. These "problematic models" put a disproportionate burden on the PSAP system compared to their share of the vehicle fleet. The models in the lower left corner work more reliably.

For example, problematic models can be defined as those in which the activation frequency exceeds 10 activations / 1,000 vehicles and the percentage of invalid activations exceeds 80%. These criteria would identify 88 car models where both the activation frequency and the proportion of invalid activations were that high.

The median activation frequency for all car models was 0.0 notifications per 1,000 vehicles and the median for invalid activations was 91.8%. This means that more than half of the vehicle models had not produced any eCall activations during the period under review, and the majority of events are invalid in many individual models.

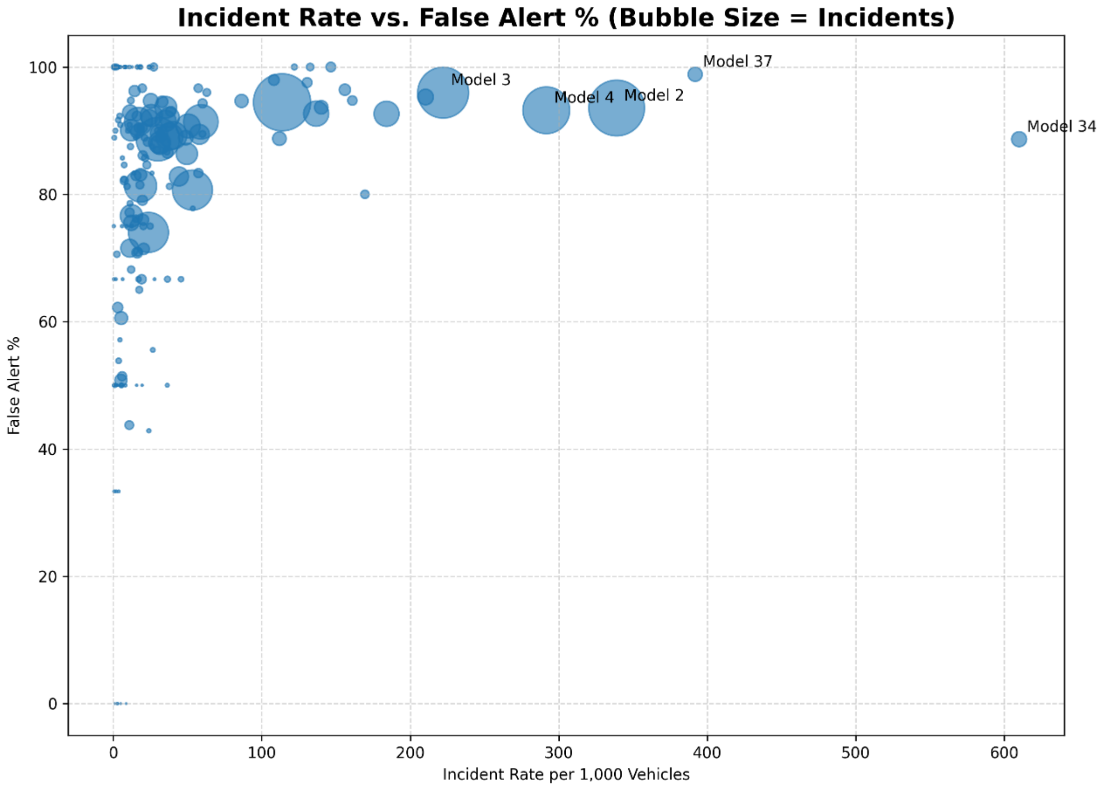

Figure 16. Placement of vehicle models according to activation frequency and the proportion of invalid activations.

The distribution of notifications into automatic and manual activations was examined in more detail using the overrepresented models. This breakdown helps identify the root causes of the problems:

- The high percentage of manual invalid activations could suggest challenges in user interface design, such as placing the SOS button in a location where it is prone to accidental presses.
- A high proportion of automatic invalid activations indicates technical faults or sensor hyper-sensitivity.

Figure 17 presents the distribution of the activation frequency according to how the notification is activated and the validity of the activation on the 15 most overrepresented vehicle models.

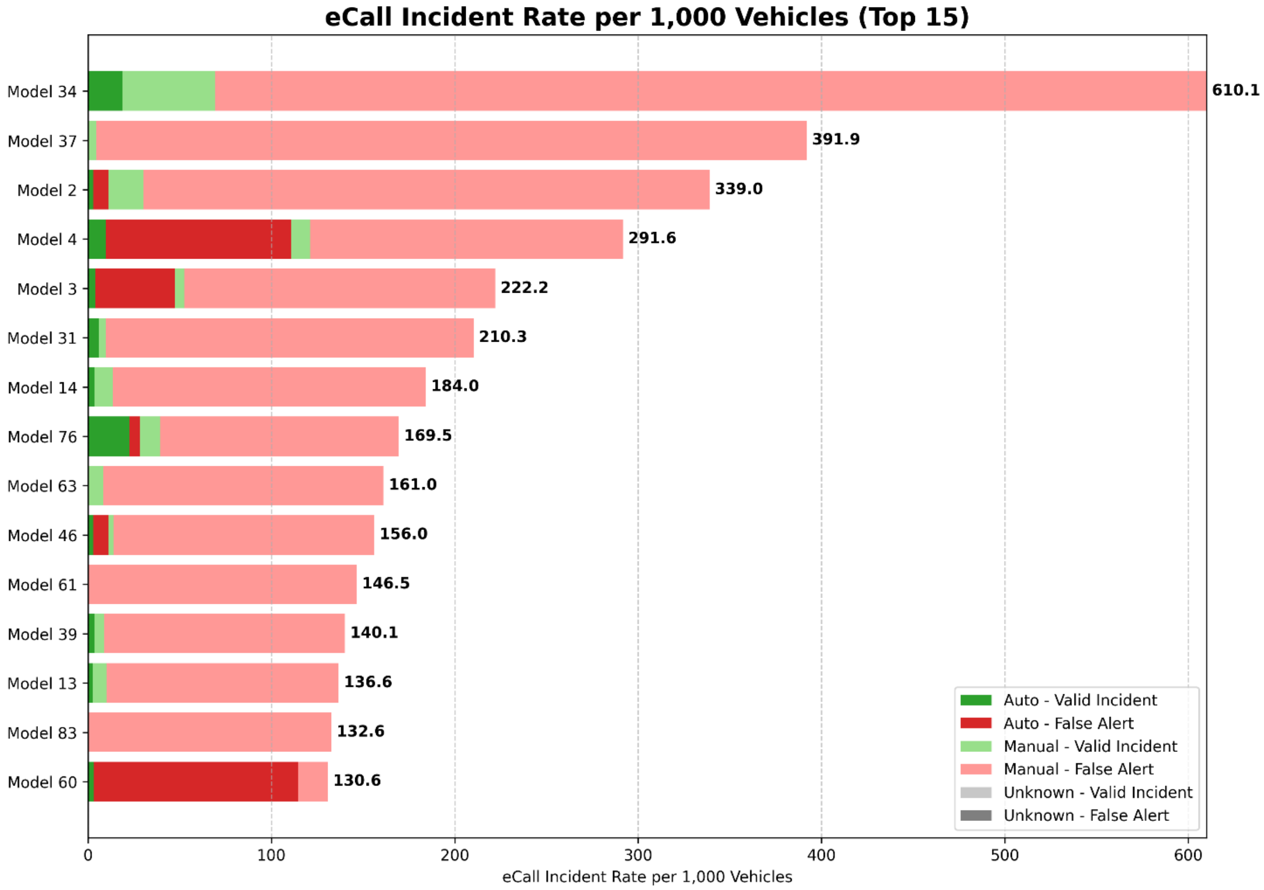

Figure 17. Activation frequency distribution into valid vs. invalid, automatic and manual activations.

As a whole, the eCall system produces an average of approximately 4.0 invalid eCall activations per 1,000 eCall-equipped vehicles per year (converted to the annual level based on the reviewed period of 1 April 2021–10 September 2025).

In addition, the year in which the vehicle was taken into use was taken into account, which helps to identify whether the problem is limited to certain annual models. A more detailed breakdown by model and annual model is presented in Table 11.

Table 11. eCall activation volumes and percentages by vehicle model and year of taking into use.

Vehicle model	Taken into use in	Fleet size	Events	Event frequency /1,000	Valid frequency /1,000	Invalid %	Autom. frequency /1,000	Manual frequency /1,000
2	2021	695	398	572.7	37.4	93.5	27.3	545.3
4	2019	558	290	519.7	23.3	95.5	306.5	213.3
4	2020	899	415	461.6	37.8	91.8	190.2	271.4
3	2020	1157	451	389.8	16.4	95.8	159.0	230.8
2	2022	396	150	378.8	25.3	93.3	2.5	376.3
2	2023	209	79	378.0	23.9	93.7	0.0	378.0
2	2020	1107	401	362.2	19.9	94.5	14.5	347.8
14	2021	219	79	360.7	22.8	93.7	9.1	351.6
14	2022	420	141	335.7	23.8	92.9	7.1	328.6
2	2019	816	253	310.0	27.0	91.3	9.8	300.2
1	2020	1979	605	305.7	17.2	94.4	131.4	174.3
17	2023	252	70	277.8	0.0	100.0	0.0	277.8
39	2022	162	45	277.8	24.7	91.1	6.2	271.6
14	2023	177	47	265.5	28.2	89.4	0.0	265.5
31	2024	158	39	246.8	12.7	94.9	12.7	234.2

Figure 18 presents activation frequencies by model and year of taking into use. This examination reveals individual “bad vintages” that might not stand out in an overall review. For example, a single year’s model can generate multiple activations compared to the same model from other years. The values shown in this graph may differ from the values in the overall review (Figure 17) for two reasons:

1. The year-specific examination distinguishes the years that have exceptionally high activation frequency, while the overall review shows the average for all years.

2. Only the annual models with a fleet of more than 100 vehicles are included in the analysis. For this reason, some low-volume models shown in the overall analysis may not be reflected in the annual breakdown if their fleet is divided over several years so that the fleet of an individual year falls below the threshold.

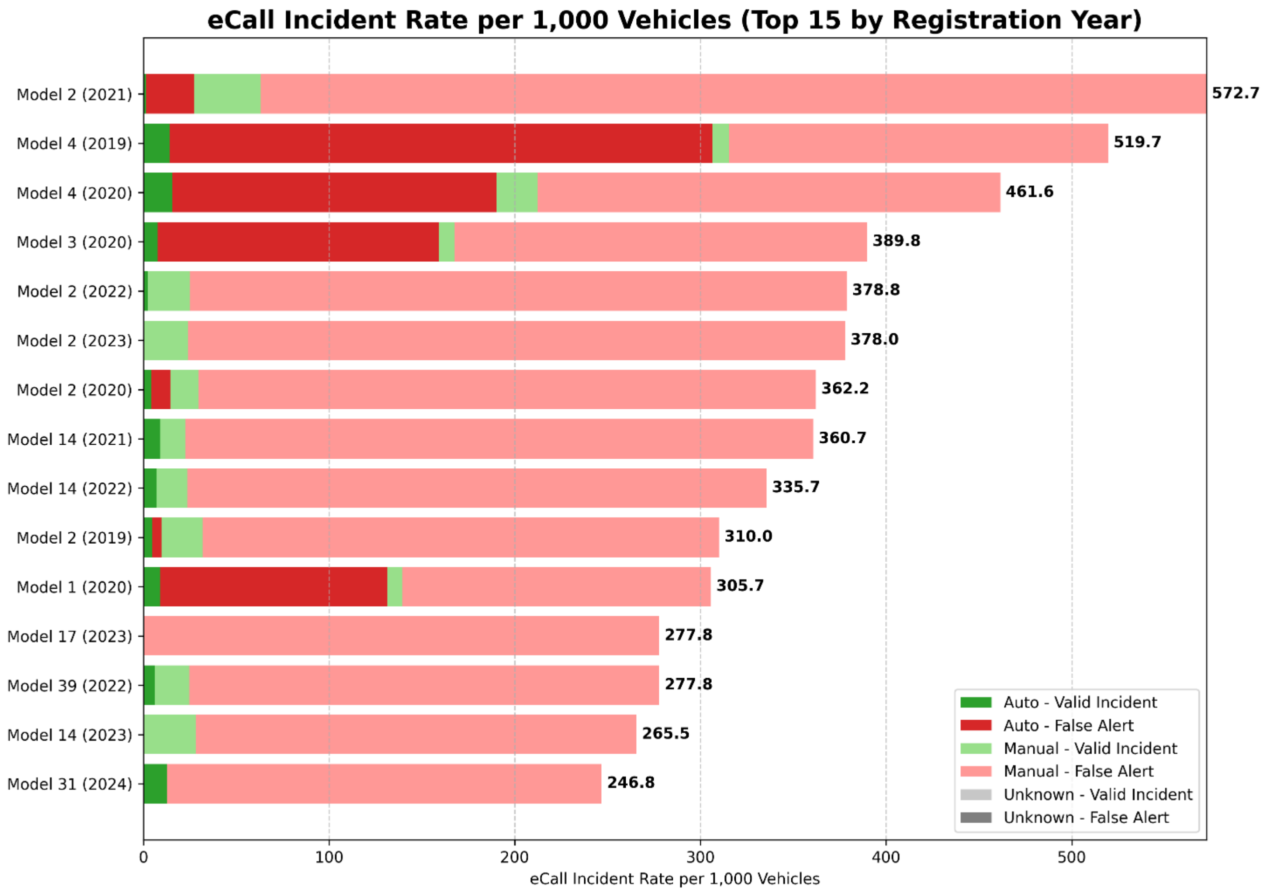

Figure 18. eCall event frequency per 1,000 vehicles (top 15 by the year of taking into use).

4 Discussion

This study examined the traffic safety impacts and potential of the eCall system as well as the technical functionality of the pan-European eCall system and related experiences of the Emergency Response Centre Agency. The results of the study are based on emergency call data from the PSAP information system, the investigation team data from the Finnish Crash Data Institute and the Finnish Rescue Services' PRONTO statistics. In addition, some of the research questions were investigated by interviewing employees of the Emergency Response Centre Agency and the Finnish Rescue Services as well as one traumatology specialist. The results are examined below by research question.

4.1 Answers to the research questions

4.1.1 Road safety impacts and potential

RQ 1: What have been the safety impacts of eCall in Finland in 2019–2023?

The automatic pan-European eCall system was estimated to have had a moderate impact on road safety in 2019–2023. By estimate, 1.0 people in Finland survived a road accident due to the automated eCall system during the entire reviewed period. The number of accidents reported by the eCall system remained relatively low at that time, and the majority of serious accidents are also reported fairly soon after their occurrence by other means, which partly explains the moderate impacts.

It is possible that a manual eCall activation could also speed up the arrival of help and thus affect the severity of injury caused by an accident, for example thanks to better location data. However, it was not possible to assess the extent of this impact.

Data for assessing the road safety impacts of TPS eCall were also not available. According to emergency call data, the number of accidents reported with TPS eCall was approximately 80% of the number of accidents reported with the pan-European eCall, and the severity distributions of these accidents are similar. In other words, if the accidents reported with TPS eCall are also taken into account, the safety impacts for 2019–2023 could be at most 1.8 times as high as those assessed for the pan-European eCall. However, the number is likely smaller in reality, as TPS eCall activations are routed through the vehicle manufacturer's service centre before information on the accident is transferred to the PSAP. This may affect the time saved by the system in a way that is difficult to predict.

RQ 2: In how many of the motorcycle accidents leading to death or serious injury in Finland would eCall have significantly accelerated the arrival of help at the scene of the accident? What about accidents involving a heavy vehicle?

In most fatal motorcycle accidents, the delay in making an emergency call was estimated to be less than five minutes (89.3%). An estimated 10.8% of the accidents involved a delay of over five minutes. Approximately 74.9% of motorcycle accidents resulting in serious injury where it was possible to estimate the delay and that were not reported by eCall were reported in less than five minutes. It should be noted that only 58.1% of the motorcycle accidents that had been the subject of a light investigation could be combined with PRONTO statistics, so there is uncertainty about how generalisable the estimate is.

In the majority of fatal heavy vehicle accidents where it was possible to estimate the delay and that were not reported by eCall, the delay in making an emergency call was less than five minutes (91.7%). An estimated 8.3% of the accidents involved a delay of over five minutes. The number of heavy vehicle accidents resulting in serious injury investigated by the investigation teams was too low for a representative assessment of delays, so these accidents were excluded from examination.

RQ 3: What is the current safety potential of eCall in Finland, meaning how many serious traffic accidents occur in Finland where access to assistance is delayed because the PSAP does not receive information about the accident quickly enough?

In the fatal road accidents of 2019–2023 where it was possible to assess the delay and that were not reported by eCall, the delay in making an emergency call was typically less than five minutes from their occurrence (85.3%). More than five minutes passed in 14.7% of the accidents. Similarly, the duration of the delay from the estimated time of the accident to the first emergency call was more than five minutes in 14.9% of fatal passenger car and van accidents. The corresponding percentage for motorcycle accidents was 10.8% and for heavy vehicle accidents 8.3%.

Accidents resulting in serious injury are also usually reported within about five minutes of the accident occurring. In the in-depth investigation data, a total of 86.2% of passenger car and van accidents resulting in serious injury that were not reported with the eCall system were reported within five minutes of the incident. An estimated 13.8% of the accidents involved a delay of over five minutes.

RQ 4: What is the impact of automatic emergency call systems on road safety from 2027 onwards, considering that all new passenger cars and vans are required to have NG eCall as of 2027 and that the current eCall in passenger cars and vans will no longer work in 2030?

The penetration rate of the eCall system in the vehicle fleet has a significant impact on its potential safety impacts, as it can only be useful in the event of an accident if a vehicle equipped with eCall is involved. The penetration rate of working eCall systems was estimated to be approximately 23% of the passenger car and van fleet by the end of 2029. At that point, both systems utilising the 2G network and NG eCall systems utilising the 4G and 5G would be operational. The penetration rate of functional eCall systems will fall to the penetration rate of NG eCall in 2030, which was estimated to be approximately 14%. In 2035, approximately 27% of passenger cars and vans are estimated to be equipped with the eCall system. However, this estimate includes some uncertainty, as the penetration rate of eCall is affected by many factors that are difficult to predict. In the light of the results, it is still unlikely that the majority of passenger cars and vans will be equipped with the eCall system in the near future, which will also affect its potential safety impacts.

The number of accidents reported with the eCall system was estimated to increase relatively faster than the increase in the penetration rate of the system in the car fleet. This is probably linked to the fact that only one vehicle equipped with eCall needs to be involved in an accident in order for eCall to report the accident as an emergency. According to the results, there would be an estimated 1,363 accidents reported with eCall in 2029 (including accidents that do not lead to injuries) and the corresponding figure in 2035 would be 1,632.

According to the results, it can be calculated that the eCall system could save less than or about one life per year. Similarly, it was estimated that the system could prevent a slightly larger number of serious injuries so that the resulting injuries would be minor. Estimated as a whole, eCall could prevent a total of about 10 traffic fatalities in 2019–2035, and about 13 seriously injured persons would only receive minor injuries. Overall, the estimated impacts on traffic safety are moderate. Ultimately, it is also a matter of coincidence whether an eCall vehicle is involved in an accident, whether the system speeds up access to treatment, and whether injuries are such that faster access to help would have an impact on the consequences of the accident.

The estimate of future safety potential is only based on data concerning the pan-European eCall system. According to the emergency call data, the number of accidents reported with TPS eCall has been approximately 80% of the number of accidents reported with the pan-European eCall. In addition, the severity distributions of accidents reported with TPS eCall are similar to the corresponding distribution of accidents reported with the pan-European eCall (see chapter 3.1.1). When taking into account the accidents reported with the TPS eCall system, this means that the future safety impact could be at most 1.8 times as high as that estimated for the pan-European eCall, assuming that the penetration rate of TPS eCall in the fleet corresponds to the penetration rate of the pan-European eCall. However, the impact is likely smaller in reality, as TPS eCall activations pass through the vehicle manufacturer's service centre before information on the accident is transferred to the PSAP. This may affect the time saved by the system in a way that is difficult to predict. The effectiveness of TPS eCall activations cannot be assumed to be at the level of pan-European eCall activations, and there is no comprehensive data on its penetration rate in the car fleet.

The safety benefits of eCall are also affected by a large proportion of invalid eCall activations. An official response unit is still usually dispatched to check the situations where the validity of the received notification could not be ascertained. According to the interview results, these situations often cause dangerous situations during emergency driving. Therefore, it is possible that a separate traffic accident happens during emergency driving when responding to an invalid eCall activation, which would reduce the potential of the system's traffic safety impact. As the penetration rate of the eCall system increases, it is likely that the number of invalid calls will increase as well. At worst, this could overload PSAPs and affect the rescue operations for non-traffic accidents if a large amount of resources have to be used to respond to invalid eCall activations. Reducing the number of invalid emergency calls is therefore a key challenge for ensuring the positive safety impacts of eCall.

RQ 5: What would be the significance for road safety if the eCall for heavy vehicles included cargo information in the MSD message?

The interviewees considered an eCall system for heavy vehicles potentially useful, especially in situations where it could relay information on dangerous substances or about a vehicle's cargo. For example, information about the weight of the vehicle, the cargo it is carrying or other special features could help in planning rescue operations even before arrival at the site. In the current situation, finding cargo details takes up time, even though the PSAP's responsibility is primarily to determine whether any persons were injured in the accident.

4.1.2 Technical functionality and experiences of the Emergency Response Centre Agency

RQ 6: How many of the automated and manual eCalls have led to a task carried out by an official body?

Of all eCall events, 18.0% led to a dispatched incident (compared to conventional 112 calls at 96.0%). Of all eCall activations, 19.4% were valid (specified as: led to an official task or were classified as a real emergency). In automatic eCalls, the percentage of invalid activations was 55.3% (1,298 valid / 2,905), so the proportion of valid activations was 44.7%; in manual activations, the percentage of invalid activations was 94.0% (840 valid / 14,024), so the proportion of valid activations was 6.0%. In addition, the percentage of invalid activations was 42% in the group where the activation method of the notification remained unknown. This means that automatic eCall activations were valid far more often than manual activations.

RQ 7: What kind of invalid eCalls have arrived at PSAPs? What are the reasons for invalid automatic eCall activations? Are some vehicle makes or models overrepresented?

Of all the eCall activations, 80.6% were categorised as invalid and 19.4% as valid. The main categories of invalid activations were "Unclassified/technical" 81.3%, (e.g. mute calls, disconnected connections, purely data messages), "Advice/info" 18.5%, "TPS/service" 0.2% and "Malicious/inappropriate" 0% in practice. The proportion of invalid notifications was 55.3% (valid 44.7%) in automatic eCall activations and 85.0% (valid 15.0%) in manual activations. According to the interviewees, invalid activations are caused by accidental presses (SOS button in a new car, children playing), tourists' tests, vehicles that have been stationary for a long time, environmental factors (e.g. snow ploughs), vehicles being moved in cargo terminals before registration, and small fender benders. In notifications received via vehicle manufacturers' service centres (TPS eCall), the percentage of invalid notifications was 1.9% (vs. the pan-European eCall at 87.6%), which points to the excellent filtering effect of invalid notifications in service centres. The downside is the potential notification delay in the TPS route.

When using the criterion of "notification frequency > 10 eCall activations / 1,000 vehicles and percentage of invalid > 80%", there were 88 vehicle models that stood out from the group. In the entire vehicle fleet, the median notification frequency was 0.0 / 1,000 vehicles, and the median for the percentage of invalid notifications was 91.8%. This means that more than half of the models did not produce any eCall activations during the period under review, but the majority of events were invalid in many individual models. These observations support targeted action (e.g. sensor sensitivity adjustment, SOS button placement and verifications of the user interface) especially for overrepresented models.

RQ 8: What kind of delays or other problems have been caused by the emergency call being routed through the vehicle manufacturer's own centre to the PSAP?

According to the interviewed Emergency Response Centre Agency employees, directing the eCall activations produced by third-party devices through the vehicle manufacturers' own service centres was considered to cause significant delays in reporting accidents. In these cases, the PSAP had often already received a conventional notification of the accident. On the other hand, it was also noted that there may be less invalid notifications among the notifications routed through vehicle manufacturers. Based on the emergency call data, only 1.9% of eCall activations relayed via the TPS were classified as invalid, while the corresponding percentage of pan-European eCall activations sent directly to the PSAP was 87.6%.

RQ 9: What are the PSAP's experiences of the technical functioning of eCall?

The dispatchers emphasised that they received a large number of invalid eCall notifications and stated that they could be caused by a variety of reasons. For example, the owner of a new car might press the eCall button unnecessarily when testing the car, or the button might be pressed by a child playing in the car. The interviewees even mentioned situations where cars that had been standing unused for a long time had sent an automatic eCall notification. Reed's (2025) report also discovered a variety of reasons for invalid eCall notifications. However, the Emergency Response Centre Agency dispatchers did not view the number of invalid eCall notifications as a problem – at least not yet – but some were concerned about the number continuing to increase from the current level.

RQ 10: How has eCall affected the work of Emergency Response Centre Agency dispatchers and rescue workers? How has eCall contributed to determining the location of accident sites and to assessing the equipment needed there?

The interviewed rescue workers and the Emergency Response Centre Agency dispatchers said that eCall could reduce the delay related to emergency calls and provide better location information on accidents. Better location information would be particularly useful when no other emergency calls have come in or the person reporting the accident is unable to describe the location for some reason. In addition, the interviewees found it useful that eCall's MSD message includes information on the VIN, vehicle registration number, whether the car is gas or electric, the location of batteries and the number of persons in the vehicle.

4.2 Conclusions

So far, the safety impact of the eCall system has been moderate in Finland. Based on the impact assessment carried out between 2019 and 2023, automatic eCalls have probably saved about one human life during this period, while the quantitative impact of manual eCalls could not be assessed reliably.

The rescue chain typically functions quickly in road accidents. In fatal and serious injury accidents, the first emergency call is most often made within five minutes of the incident, and the first dispatched unit usually arrives in less than 15 minutes. The importance of eCall is therefore particularly highlighted in the few cases where the emergency call is delayed.

The percentage of invalid eCall activations is high, which puts a burden on operators. Overall, 80.6% of eCall activations were classified as invalid; the share of invalid notifications was 55.3% for automatic activations, and that figure was 94.0% for manual activations. Invalid notifications take up the resources of PSAPS and rescue services and increase the risks of emergency driving.

In notifications received through vehicle manufacturers' service centres (TPS eCall), the proportion of invalid notifications is very small, which points to a filtering effect. On the other hand, the interviewees felt that the TPS route increased delay, which reduces its potential safety impact.

As the eCall system becomes more prevalent, the number of invalid emergency calls may also increase. The interviews with PSAP dispatchers confirmed that this development is seen as a challenge. As the system expands, it must be ensured that invalid eCall activations do not put an excessive burden on PSAPs and thus also weaken rescue operations in situations that do not involve traffic accidents.

The potential for future safety impacts will remain limited without a marked increase in the system's penetration rate and the management of the extra work caused by invalid calls. The transition to NG eCall (compulsory for new passenger cars and vans as of 2027; 2G eCall will stop working in 2030) will increase the share of functional eCall systems to approximately 27% in 2035. As a result, eCall can cumulatively prevent an estimated 10 deaths and mitigate a slightly larger number of serious injuries by 2035. The overall impact remains moderate.

Special areas: according to the interviewees, there is clear potential in eCall for motorcycles in remote areas where there are few bystanders. With heavy vehicles, the greatest added value is related to the transmission of cargo information in the MSD message, which supports risk assessment and resource allocation, even though the impact on delays remains limited.

Key development requirements to strengthen the net benefit of eCall:

- Reducing invalid notifications: controlling sensor sensitivity, user interface and SOS button design, and targeted monitoring for overrepresented car models.
- Developing the TPS route process to minimise delays in the information relayed to the PSAP.
- Uniform and systematic utilisation of MSD content (e.g. VIN, gas or electric, possible cargo data) in the processes of PSAPs and rescue services.

4.3 Limitations of the study

The limitations of this study included the following:

- Severity distribution: When estimating the future potential, it was assumed that the distribution of accident severity in eCall accidents was the same as in all accidents.
- Generalisability of realised impacts: The safety situation changes over time. In the calculation, it was assumed that average severity distributions will remain the same, which may lead to over- or underestimations.
- Prediction: It is difficult to make predictions far into the future. For this reason, the estimate of the penetration rate of eCall and the number of eCall events is naturally uncertain. Uncertainty increases the further predictions are made. Uncertainty of future projections: estimation of eCall penetration rate is based on regression and fleet renewal assumptions (~3.2%/y), regulation on NG eCall (mandatory in 2027) and the shutdown of 2G networks (in 2030). The share of imported cars in first-time registrations may affect the reliability of the NG eCall penetration rate assessment, as the impact depends on the age of the imported cars. The assessment of the prevalence of NG eCall is likely to be a slight overestimate, but it is difficult to estimate the exact amount of the error. In addition, Pilli et al. (2022) does not include vehicles that have already been decommissioned from traffic, which may distort the penetration rate estimate for the early years.
- Future trends: The safety situation is likely to improve in the future, which is why the predicted number of eCall events may be overestimated.
- Data coverage: The emergency call data covered the period from 1 April 2021 to 10 September 2025; the data for 2019–2021 are based on the total numbers of eCall events provided by the Emergency Response Centre Agency, not on detailed cases.
- Combination of datasets: The combination of PRONTO statistics with emergency call data was not a full match; the combination rate was high in automatic eCall cases (~95%) but significantly lower in manual cases (~32%), which may lead to selection bias. In addition, the combination percentage between the PRONTO statistics and OTI data was not the same for all vehicle categories.
- TPS eCall measurement restrictions: It was not possible to distinguish between automatic and manual TPS eCalls, and linking them to individual emergency calls was not reliable; therefore, the number estimates are mainly based on pan-European eCall data.
- Estimating the delay distribution: there were few automatic eCall events leading to serious injuries (n≈38), so the delay distribution had to be estimated based on the combined distribution of all accidents leading to injuries.
- Methodology assumptions in the estimation of lives saved: This report used average injury coefficients for accidents and made the assumption that approximately 36% of deaths are not immediate; these assumptions were used to derive an estimate of the number of lives saved.
- Accident time and location: Event times in the OTI data were often rounded to the nearest five minutes; the PRONTO combination used a search window of ±1 day and ±7 km, which may cause timing and location errors.
- Limitations in vehicle categories: In the OTI light investigation data, the combination of

motorcycle accident data with PRONTO statistics was poor, especially for single-vehicle crashes and animal collisions. There was limited data related to heavy vehicles and serious injuries.

4.4 Proposed further measures

The complexity of obtaining emergency call data was a challenge in this study. Permission for using the emergency call material and extracting it from the database was obtained separately from each data controller: the Emergency Response Centre Agency, 21 wellbeing services counties and the City of Helsinki. The permission processes varied between the different controllers. Harmonisation of the process would facilitate research based on emergency call data.

In this study, the following were identified as necessary topics for further research:

- Impact, quality and delays of TPS eCall (deep analysis)
- Safety impacts of the eCall system starting from 2030 if systems operating in 2G and 3G networks could be used after all
- Root causes and reduction of invalid eCall activations (vehicle model and annual model)
- Closer analysis of the impact of eCall on the response time of accidents (time from receiving the emergency call to arrival of the first unit at the scene of the accident)
- The value of eCall in rare cases involving delay
- Interoperability and disruptions of GNSS positioning (e.g. border regions)
- Automatic notifications from smart device ecosystems (phone/watch) vs. eCall
- eCall for motorcycles (equipment, sensitivity, data content)
- eCall for heavy vehicles: cargo information and risk profile
- Processing times in the rescue chain: end-to-end and bottlenecks
- Medical impact: Injury mechanisms vs. time saved by eCall
- Traffic safety risks of invalid notifications (emergency driving)
- Managing overlaps in emergency calls
- NG eCall deployment follow-up study and impact of 2G/3G decommissioning
- Enriching location/environment data in the MSD (such as collision context)
- Personnel operating models and training (PSAP & rescue)
- Benefit-cost analysis for establishing a filtering service in Finland
- VIN study: specific equipment faults vs. model/series deviations
- Impact of foreign cars and SIM cards, roaming & borders
- Seasonal variations in the number of automatic eCall activations not explained by the random distribution of notifications over the months of the year and the increase in the number of vehicles equipped with eCall.

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Appendix 1: Themes and questions of the interviews and questions sent to the traumatology specialist

Emergency Response Centre Agency dispatchers

Background questions

- Which Emergency Response Centre Agency facility do you work in?
- How long have you worked as a PSAP dispatcher?

Interview questions

Determining the location of a traffic accident site

- How does the PSAP determine the location of an accident?
- In what kinds of situations has it been difficult to determine the location?

Assessment of factors affecting resource needs

- How do you assess the factors affecting the amount of resources dispatched to the scene of an accident (equipment, personnel, etc.)?

Experiences of the eCall system

- In what kinds of accidents is eCall useful? Are there situations where it has been detrimental?
    - How has the eCall system affected determining the location of an accident?
    - How has the eCall system contributed to assessing the resources needed at the scene of an accident?
- Usability of the MSD package? Are the data useful?
- Have you received manual or automatic eCalls about situations where there has been no road accident?
    - How often do they happen and what have they been like?
- Experiences of the emergency call passing through the vehicle manufacturer's centre to the PSAP?
    - How often does it happen and has it caused problems?
- How often do you get an eCall and a conventional emergency call about the same accident?
    - What is your understanding of the average notification delay between eCall and a conventional emergency call?

eCall system for heavy vehicles

- Are there currently any specific challenges or features in rescue operations concerning heavy vehicle accidents?
- Does cargo affect the rescue operations in heavy vehicle accidents? In what way?
    - In the case of heavy goods vehicle accidents, do you usually get sufficient information about the cargo in the emergency call?
- How could an eCall system for heavy vehicles affect the rescue operations in heavy vehicle accidents?

eCall system for motorcycles

- Are there currently any particular challenges in the rescue operations involving motorcycle accidents? What kind?
- How could an eCall system for motorcycles affect the rescue operations in motorcycle accidents?

Rescue workers

Background questions

- In which organisation and which region do you work?
- How long have you worked as a rescue worker and in what kind of role?

Interview questions

Rescue time

- In what kind of traffic accidents and which road users do you often see injuries where the duration of the rescue period is critical?
    - What kinds of injuries are those in which the duration of the rescue time is particularly critical? What is the duration of the rescue time in that case?

Correct resource allocation

- In what kinds of accidents is correct resource allocation (equipment, personnel, competence, etc.) the most important thing in terms of the duration of the rescue time and the success of the rescue mission?

Impacts of the eCall system on rescue operations

- In your opinion, has the eCall system affected the accuracy of information on the accident location or the rescue time?
    - Has the saved time affected injuries or their severity? In what way?
- Has the eCall system caused unnecessary dispatches to rescue operations? What impacts has this had?

eCall system for heavy vehicles

- Are there currently any specific challenges in rescue operations concerning heavy vehicle accidents? What kind?
- Does cargo affect the rescue operations in heavy vehicle accidents? In what way?
    - In the case of heavy goods vehicle accidents, do you usually get sufficient information about the cargo before arriving at the scene of the accident?
    - Has the lack of information on cargo led to challenges in rescue operations?
- How could an eCall system for heavy vehicles affect the rescue operations in heavy vehicle accidents?

eCall system for motorcycles

- Are there currently any particular challenges in the rescue operations involving motorcycle accidents? What kind?
- How could an eCall system for motorcycles affect the rescue operations in motorcycle accidents?

Questions for traumatology specialists

1. In what kind of traffic accidents and which road users do you typically see injuries where the duration of the rescue period is significant in terms of the consequences of injuries?

2. What kinds of injuries are those in which the duration of the rescue time is particularly critical? What kind of decrease in the duration of rescue time would be significant for the consequences of these injuries?

3. What kind of literature sources would you also recommend when looking for answers to questions 1 and 2?

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