Future road safety risks of 2G/3G eCall systems

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TRANSPORT ANALYSIS

Transport Analysis
Address: Rosenlundsgatan 54 118 63 Stockholm
Phone: +46 10 414 42 00
E-mail: trafikanalys@trafa.se
Web address: www.trafa.se/en
Photo: Mostphotos
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Foreword

Transport Analysis has assisted the Swedish Transport Agency with an analysis of the future road safety risks associated with automatic vehicle alarms (112 eCall) that can be expected due to a complete shutdown of 2G/3G networks in 2028. This memorandum summarizes the results. The author is Tom Andersson.

Transport Analysis would like to thank the Swedish Transport Agency for good cooperation, as well as the Swedish Civil Contingencies Agency (MSB) for valuable support with national data on emergency operations in the event of road traffic accidents.

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Andreas Tapani

Head of department for Evaluation

Content

Summary

Transport Analysis estimates that, following a complete shutdown of 2G/3G networks in 2028, there will be 793,650-853,867 passenger cars and light trucks in Sweden with non-functioning automatic alarms systems (eCall). We estimate that a functioning eCall system in these vehicles would reduce the number of fatalities and serious injuries by 1-4 and 10-32, respectively, during the period 2028-2032.

The analysis is based on the following assumptions:
(1) non-functioning 2G/3G eCall systems in 13-15% of the vehicle fleet in 2028-2032,
(2) annual 1.1% phase-out rate of old systems,
(3) constant rates of traffic accidents, fatalities and injuries (since 2019-2023)
(4) uniform distribution of accidents and injuries across the vehicle fleet, and
(5) 2-4% alarm efficiency.

These assumptions represent a worst-case scenario.

Based on this, Transport Analysis considers the risk of fatalities and serious injuries due to non-functioning eCalls in 2028 as low, although not negligible. This assessment relies on previous and common assumptions in ex ante cost-benefit analyses of causal relationships between eCall systems, emergency response times and injuries, i.e., automatic alarms and calls resulting in shorter response times and less serious injuries.

To evaluate the commonly accepted assumptions about the effect of eCall, we carried out an ex post assessment of the effects of automatic alarms on emergency response times and the fatality rates in road traffic accidents during the period 2022-2023. The analysis shows no benefits of automatic calls: 14.0 minutes for automatic calls (CI95 13.5-14.5) and 11.9 minutes for conventional calls (CI95 11.8-12.1); 1.8% fatalities for automatic calls (CI95 0.7-3.0%) and 1.3% for conventional alarm chains (CI95 1.1-1.5%).

There is a lack of statistics and evidence-based studies of the effect of eCall. Several benefit and cost analyses of its potential effect preceded the entry into force of the EU regulation in 2018. Since then, we have not found any systematic follow-up study or evaluation. Thus, there are good reasons for further investigation and research in this area.

1 Introduction

112 eCall is an automatic alarm and emergency call system. The alarm can be triggered by sensors in the vehicle or manually by a driver or a passenger. The system will then open a communication channel with SOS Alarm (Sweden's Public Safety Answering Point, PSAP) and send an automatic text message containing information about the vehicle identity, its location and the time of the alert.

Since April 1, 2018, EU 2015/758 requires a 112 eCall system in new types of cars and light trucks (M1 and N1 vehicles). The current standard specifies communication in 2G/3G networks. After amendment (EU 2024/1180), new standards apply from 2026 requiring eCall communication in 4G/5G networks. Vehicle manufacturers may choose to implement 4G/5G systems in new types of vehicles already from 2025.

By 2028, we expect all 2G/3G networks to be shut down in Sweden. A certain number of cars and light trucks will then be equipped with non-functioning 2G/3G eCall systems. This raises the question of the road safety risks associated with the systems after the shutdown of 2G/3G networks? In this memorandum, we intend to highlight these risks.

Saving lives and mitigating serious road traffic injuries were the primary and main arguments in favour of eCall in vehicles in EU (ERSO, 2024). Expected outcomes varied widely in cost-benefit analyses before the regulation came into force in 2018. The most common estimates were 2-4 per cent fewer fatalities and serious injuries after a full implementation (Høye and Elvik, 2023). These figures also appeared in Swedish impact assessments (Swedish Transport Administration, 2014; Swedish Transport Agency, 2014).

The purpose here is to assess the road safety risks of non-functioning 2G/3G eCall systems after a complete shutdown of 2G/3G networks in 2028. The risks are framed in terms of the previous potential benefits of a functioning system. We apply common model estimates of 2-4% reductions in fatalities and serious injuries in traffic accidents involving cars and light trucks equipped with 2G/3G eCall systems.

To verify model estimates of eCall benefits, we have searched for reviews and evaluations of the effects of eCall systems. However, like the Transport Economics Institute in Norway (Høye and Elvik, 2023), we note a lack of evidence-based studies. Nor can we find any up-to-date statistics or empirical studies of the effect of eCall in the EU on the European Commission's road safety website (ERSO, 2024).

2 Method

The analysis consists of three parts: (1) estimation of the number of vehicles (M1/N1) with 2G/3G eCall systems in 2028 and 2032, (2) estimation of the loss of benefits due to non-functioning systems in 2028 and 2032, the number of fatalities and serious injuries, and (3) causal analysis of emergency response times and fatality rates in road traffic accidents, i.e., whether automatic alarms correspond to shorter response times and lower fatality rates compared with manual emergency calls. This causal chain is often the basis for estimate eCall effectiveness by means of modelling.

The first part of the analysis is based on two data sources, (1) a survey by Mobility Sweden (2024) and (2) time series data on car registrations in the road traffic registry maintained by the Swedish Transport Agency. The survey of Mobility Sweden was addressed to its members, Swedish manufacturers and importers of cars and light trucks, and asked for information on how many of their vehicles had 2G/3G eCall systems installed before and after April 1, 2018, until October 31, 2023.

The registry data was used to estimate the renewal rate of vehicles, i.e., annual rate of newly registered vehicles of new types. The calculation was based on the number of vehicles falling under the revised regulation for type approvals (EU, 2018/858) during the period September 1, 2020–July 31, 2024. We get the expected number of vehicles with 2G/3G eCall by multiplying the renewal rate with the length of time. If the number is comparable to Mobility Sweden's estimate, we treat the renewal rate as a constant and use it to estimate the number of vehicles with 2G/3G-systems for other time periods by means of extrapolation.

The number of vehicles with 2G/3G eCall in 2028–2032 is estimated in an interval, between a minimum and a maximum, representing two endpoints of extrapolation: December 31, 2024, and December 31, 2025. These dates correspond to times when type-approval of 4G/5G eCall becomes *authorised* and *mandatory* respectively (EU 2024/1180). From January 1, 2026, we apply a phase-out rate of vehicles with 2G/3G eCall equal to the renewal rate.

Furthermore, we assume that the size of the whole Swedish fleet of M1 and N1 vehicles is constant, as well as constant rates of traffic accidents, fatalities, and injuries among vehicle drivers and passengers. The constants are based on average figures for the period 2019–2023: 5,6 million cars and light trucks, and 124 fatalities and 948 serious injuries per year (Transport Analysis, 2024a). The previous long-term trend of declining fatality rates in road traffic, in Sweden and the EU, is assumed to be broken (ERSO, 2024), which is consistent with a worst-case scenario. In addition, we apply a uniform distribution of fatalities and injuries across the vehicle fleet, and we use the most common model estimate of eCall effectiveness, i.e., 2–4 per cent reduction of fatalities and serious injuries.

The third and final part is a causal analysis of Swedish emergency response times and fatality rates in road traffic accidents 2022–2023. The Swedish Civil Contingencies Agency (MSB) compiles national data collected from local emergency services. The data includes information on the type of emergency call, automatic or manual, and the response time, i.e., time from the incoming call to SOS Alarm, to the arrival of first responders. For each accident, there is also information on the number of people taken into care and fatalities. It allows us to calculate the proportion of fatalities and compare it between automatic and manual calls.

In previous cost-benefit analyses, eCall benefits have primarily been described in terms of simpler, faster and more efficient emergency calls, rescue operations, and care, i.e. shorter response times. This is believed to result in lower rates of fatal outcomes and serious injuries

in road traffic accidents.[1] Several factors can impact on the response time, e.g., weather, geography, and traffic situation. eCall is expected to be most useful when and where there are no alternative means of alarms and emergency calls, e.g., single accidents in sparsely populated areas, on low-traffic roads, involving a seriously injured driver. To take this into account, to some extent, we limited our causal analysis of response times and fatal outcomes to the seven counties in Sweden with the lowest population densities: Norrbotten, Jämtland, Västerbotten, Dalarna, Västernorrland, Gävleborg and Värmland.

[1] Shorter response time of emergency services is also believed to reduce the duration of traffic disruptions (Høje and Elvik, 2023, Swedish Transport Administration, 2014; Swedish Transport Agency, 2014). However, we lack systematic data on this issue, for which reason, it is omitted in the risk analysis.

3 Results

Prevalence of 2G/3G eCall 2028–2032

Mobility Sweden's survey of 2G/3G eCall systems is addressed to vehicle manufacturers and importers of newly registered M1 and N1 vehicles between April 1, 2018, and October 31, 2023, 1,972,669 vehicles in total. The respondents are asked to provide information on the number of vehicles equipped with 2G/3G eCall systems before and since April 1, 2018. The numbers sum to 690,176 vehicles, of which 323,176 are registered since April 1, 2018.

The non-responses to the survey represent 142,321 vehicles (7.2 per cent). Mobility Sweden does not see any obvious and strong reason for the vehicle fleet of non-responses to deviate from the characteristics of the fleet of respondents. Thus, we recalculate the vehicle fleet size with 2G/3G eCall by increasing it by 7.2 percent, the non-response rate. It results in 743,724 vehicles on October 31, 2023, of which 348,250 are registered since 1 April 2018.

Registry data on type approvals of M1 and N1 vehicles includes information on the date and the number of vehicles type approved according to EU 2018/858. It is the basis for calculating the renewal rate of vehicles with 2G/3G eCall during September 2020–August 2024: 61,605 vehicles per year (1,1 per cent of the entire fleet of M1 and N1 vehicles). By extrapolation, we get 343,909 vehicles during April 1, 2018–October 31, 2023. This figure is in line with Mobility Sweden's survey, minus 4,341 vehicles (-1.2 per cent).

To estimate the number of M1 and N1 vehicles with 2G/3G eCall during 2025–2026, the period of transition to 4G/5G eCall standards, we use the vehicle count of Mobility Sweden before April 1, 2018, and add our minimum and maximum vehicle fleet estimates based on the renewal rate and extrapolation for the periods April 1, 2018-December 31, 2024, and April 1, 2018-December 31, 2025, respectively. From January 1, 2026, we apply a phase-out rate of the 2G/3G eCall systems equal to the renewal rate.

We get 793,650-853,867 vehicles with 2G/3G eCall systems on January 1, 2028, of which 406,830-467,046 are newly registered since April 1, 2018.

Five years later, on December 31, 2032, we still have 750,949-807,927 vehicles with 2G/3G eCall systems, of which 384,941-441,917 are newly registered since April 1, 2018.

Road safety risks 2028–2032

Given a constant fleet of M1 and N1 vehicles, 5.6 million vehicles (Transport Analysis, 2024b), the share of vehicles with non-functioning 2G/3G eCall systems will be 14–15% on January 1, 2028, and 13–14% on January 1, 2033, provided that no further action is taken by authorities or companies before then.

To calculate traffic safety risks, we assume a worst-case scenario 2028-2032 involving the following assumptions: (1) 13-15% vehicles with non-functioning 2G/3G eCall systems, (2) 1.1% phase-out rate per year of old systems, (3) constant accident rates, including fatalities and injuries, based on average figures for the period 2019-2023, (4) uniform distribution of accidents and injuries across the vehicle fleet; and (5) 2–4 percent eCall efficiency.

Based on this scenario, the road safety risks sum to 1–4 fatalities and 10–32 serious injuries due to non-functioning eCall systems during the entire period (five years).

Ex post assessment

The risk analysis is subject to uncertainty due to several non-validated assumptions. Firstly, there is uncertainty about the effectiveness of eCall. Existing data sources are not rich enough to disentangle causal relationships and temporal associations between the timing of road traffic accidents, levels of injuries, emergency calls, rescue operations, medical interventions, and health outcomes. Secondly, road safety risks depend on several factors in addition to the emergency response time, e.g., weather, geography, and traffic intensity.

Despite these uncertainties, and the fact that the regulatory framework came into force 2018, we still lack evidence-based studies of eCall (Høye and Elvik, 2023). Thus, we need more and better ex post assessments of health outcomes of road traffic accidents. Our first contribution to this future body of knowledge is a causal analysis of data on Swedish road accidents 2022–2023, provided by The Swedish Civil Contingencies Agency (MSB). Since 2022, the data set includes information on the source of incoming emergency calls, manual or automatic alarms. It allows for the analysis of response times and fatality rates with respect to alarm type, which are central to previous ex ante effect analyses of eCall.

In 2022–2023, the emergency services reported 28,702 traffic accidents involving passenger cars and/or light trucks. In 789 cases (2.7%), the emergency call was triggered automatically. The number is slightly lower than the number of eCalls to SOS Alarm during the same period, 942 (SOS Alarm, 2024). The lower number is consistent with the fact that there are more call-outs of emergency services than real accidents on site.

The share of 2.7 per cent automatic alarms is the same as the share of road traffic accidents alerted with eCall in Norway in 2023 (DHS, 2024). The share is lower than the share of road accidents that can be expected to involve vehicles with 2G/3G eCall systems, but we do not expect all road traffic accidents to trigger eCall alerts.

Average response times and fatality rates do not show any advantage of automatic alarms: 14.0 minutes with automatic alarms (CI95 13.5–14.5) and 11.9 minutes without automatic alarms (CI95 11.8–12.1);[2] 1.8 per cent fatalities with automatic alarms (CI95: 0.7–3.0 per cent) and 1.3 per cent without automatic alarms (CI95: 1.1–1.5 per cent).

The result is the same in an analysis of average response times and fatality rates limited to the seven counties with the lowest population density: 16.7 minutes with automatic alarms (CI95 18.1–15.3) and 14.1 minutes without automatic alarms (CI95 14.3–13.9); 2.3 per cent fatalities with automatic alarms (CI95: 0.0–4.9 per cent) and 2.4 per cent without automatic alarms (CI95: 1.9–2.9 per cent).

[2] We have excluded an outlier when calculating the statistics on response times.

4 Discussion

There is considerable uncertainty in our analysis of road safety risks of non-functioning 2G/3G eCall systems in 2028–2032. There is a lack of evidence-based studies of cause-and-effect relationship between eCall and road safety. We also lack detailed insight into all the means of communication that road users have access to and can use to alert emergency services. Furthermore, there are geographical differences in the renewal rates of vehicles, with lower rates in sparsely populated areas. Thus, both the spread and updating of eCall systems take longer time in these areas.

Despite the uncertainty, our analysis indicates a low but not insignificant road safety risk with non-functioning 2G/3G eCall in 2028–2032. It is valid to the same extent as previous model estimates of 2-4 per cent efficiency. Thus, it is likely that there will be a few fatalities and serious injuries that could have been avoided with functioning eCall systems.

At the same time, it should be emphasised that there is a lack of evidence-based studies on the effectiveness of eCall. Our analyses of emergency response times and fatalities in road traffic accidents 2022–2023 show no support for the widely spread model estimates of eCall efficiency, i.e., reductions of fatalities and serious injuries by 2–4 per cent.

The conclusion is first and foremost that there is a need for more and better evaluations of eCall systems and other measures of intelligent transport systems (ITS). To conduct detailed causal analysis of eCall systems, we need systematic time series data on road traffic accidents and their outcomes, including conditions and interventions, e.g., type of vehicle alarms and emergency call.

Finally, we would like to draw attention to the fact that the EU eCall regulation is technology-specific. On January 1, 2026, the required communication standard for eCall changes from 2G/3G to 4G/5G networks. Given generation cycles for communication networks in the order of 10 years, there is a risk that the regulatory framework will never reach its goal.

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Transport Analysis is a Swedish agency for transport policy analysis. We analyse and evaluate proposed and implemented measures within the sphere of transport policy. We are also responsible for official statistics in the transport and communication sectors. Transport Analysis was established in 2010 with its head office in Stockholm and a branch office in Östersund.

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Transport Analysis
Rosenlundsgatan 54
118 63 Stockholm

Phone +46 10 414 42 00
trafikanalys@trafa.se
www.trafa.se/en