Impacts of an automatic emergency call system on accident consequences

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Abstract

eCall is an automatic in-vehicle emergency call service developed in the European Union. The benefits of the eCall system are primarily based on the faster relaying of essential initial accident information, such as the type of accident and the precise accident location. The aim of this study was to estimate the impacts of an automatic emergency call system on accident consequences in Finland. The main results indicated that eCall could very probably have prevented 4.6% of the fatalities in accidents involving motor-vehicle occupants. The percentage was higher for accidents involving no vehicles in which the current eCall could be installed. This is probably because the emergency call delays were also longer in these accidents. The results of the case study, case study + phone log and questionnaire show that, in most accidents involving motor-vehicle occupants, the emergency call had been made less than five minutes after the accident. In 4% of the cases the emergency call had been made more than thirty minutes after the accident.
Introduction

eCall is an automatic in-vehicle emergency call service developed in the European Union. An eCall-equipped vehicle has a terminal with satellite positioning, wireless communications and sensors for detecting crash, rollover and fire. When an accident has occurred, the terminal dials the emergency response centre and sends the information on vehicle position and type of accident to the centre. It also opens a voice connection between the vehicle occupants and the operator of the emergency response centre.

The pan-European eCall system has received widespread support both from the EU member states and the car manufacturers. The objective is to equip all new cars with eCall terminals starting from the year 2009. Finland has been active in promoting eCall. The nationwide implementation of the eCall system has been under way in Finland since the spring of 2004.

The eCall system itself will not reduce the number of accidents. The benefits of the eCall system are primarily based on the faster relaying of essential initial accident information, such as the type of accident and the precise accident location. Some estimations about the impacts of the eCall system have been made, for example by the EU, but these estimations are not, however, necessarily applicable to Finnish emergency response centre processes or traffic accident statistics, so a more detailed evaluation was needed.

The aim of this study was to estimate the impacts of an eCall system on accident consequences in Finland. More specifically, its objectives were to estimate the annual number of fatalities that could be avoided using the eCall system, the effects of eCall on emergency response times, and the effects of real-time information about the vehicle location and accident type on the consequences of the accident.

Method

Fatality estimates

In Finland, all fatal accidents are investigated by road accident investigation teams. In 2004, the teams investigated a total of 331 fatal accidents, in which 384 persons were killed. The teams consist of a police officer, a road specialist, a vehicle specialist, a physician, a psychologist and other experts. The teams investigate what happened, why the accident happened, which factors affected the risk of the accident and what were the reasons for the consequences of the accident. The data includes, for example, the following information: description of the event, the location and situation related information, use of safety devices, general information about the user and the vehicle, a police report of the accident, description of injuries and the total extent of the injuries. In every case the investigation team also investigates whether alcohol was involved in the accident.

The studied data covered the period 2001–2003, containing a total of 797 accidents involving 929 fatally injured motor-vehicle occupants. Accidents were divided to two groups: accidents, where there was at least one vehicle in which the eCall could be installed, and to accidents, where there were no vehicles in which the current eCall system could be installed. The latter were mainly single motorcycle and snowmobile accidents.

First, the patients with fatal injuries were excluded. These were typically large head, chest, aorta or heart injuries, which result in immediate death. The remaining cases were analysed by a medical doctor and categorised into three groups: (a) eCall could very probably have prevented the fatality; (b) the very probable impact of eCall could not be validated and (c) unclear because of insufficient data.
Delay estimates

Emergency response times were divided to emergency call delays (time interval between the accident and notification of the emergency response centre) and to rescue chain delays. Three methods were used to analyse the emergency call delays.

First, information was gathered from the case reports of the road accident investigation teams. Second, the estimated time of the accident was compared with the phone log of the emergency response centres. Third, information was gathered with a questionnaire from the operators of emergency response centres. Emergency call delay estimates were categorised as follows: less than 5 min, 5–30 min, more than 30 min. All cases were again divided by the possibility of installing the current eCall at least on one vehicle.

Besides the emergency call delays, the operators of response centres were also asked to estimate other reasons for the delays in the rescue chain. The following questions were asked:

1. How often is the emergency caller not able to tell the exact location of the accident at the beginning of the call?
2. How often does the emergency caller give a wrong location?
3. How often does the rescue unit or police ask for correction of the accident site location?
4. How often does the rescue unit or police go to a wrong place or get lost?
5. How often is the arrival of the rescue unit delayed because of inexact or wrong location information?

TENTATIVE Results

Fatalities

eCall could very probably have prevented 4.6% of the fatalities in accidents involving motor-vehicle occupants (Table 1). The percentage of cases where eCall could very probably have helped is slightly larger in single two-wheel cases than in accidents including four-wheel vehicles. However, eCall can not be installed in these vehicles at the moment.

It was also evaluated after the examination of investigation team case studies that some of the accidents in the “the very probable impact of eCall could not be validated” category were such that they may have been avoided with the eCall system. The number was estimated as 5% of all studied traffic fatalities. The very probable and possible safety impacts were in total 5–10%.

In all of these cases, only those with realistic treatment resources were included, for instance rural areas were disclosed in most of the cases due to long distances even if the alarm were immediate.
Table 1. The number of fatalities that could be avoided by the eCall system in accidents involving motor-vehicle occupants.

<table>
<thead>
<tr>
<th>Influence on traffic accidents' consequences</th>
<th>Fatalities with eCall possibility</th>
<th>Fatalities without eCall possibility</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
<td>n</td>
</tr>
<tr>
<td>eCall could very probably have prevented the fatality</td>
<td>39</td>
<td>4,4</td>
<td>4</td>
</tr>
<tr>
<td>the very probable impact of eCall could not be validated</td>
<td>831</td>
<td>93,5</td>
<td>32</td>
</tr>
<tr>
<td>Unclear cases (not enough data)</td>
<td>19</td>
<td>2,1</td>
<td>4</td>
</tr>
<tr>
<td>Total</td>
<td>889</td>
<td>100</td>
<td>40</td>
</tr>
</tbody>
</table>

Fatalities that could very probably have been prevented by eCall included for instance hypoxia, alcohol abuse, severe attacks and submersion.

In many cases there were no such traumas that could have explained the death if the help had been available in reasonable time. These cases included fractures of ribs with slowly proceeding haematoma, mild initial brain contusions in combination with difficulties to breathe leading to severe brain oedema. Many of the deceased people had had a minor heart ischemia or non-traumatic brain bleeding or another severe disease, which could have been treated in some of the cases if information and alarm had been sent automatically. In alcoholic abuse cases, one or two passengers died because passengers with no trauma were so drunk that they were sleeping or they were not able to realise the severity of the situation. In several cases, a vehicle had turned around in shallow water or had driven directly into water and passengers were not able to leave the vehicle.

Delays

The results of the case study, case study + phone log and questionnaire showed that, in most accidents involving motor-vehicle occupants, the emergency call had been made within five minutes of the accident (Table 2). In about 14% of the cases the emergency call had been made 5–30 minutes after the accident and in about 4% of the cases more than thirty minutes after the accident. Delays seem to be longer in accidents, where there were no vehicles in which the current eCall system could be installed than in accidents including at least one vehicle in which the eCall could be installed.

Table 2. Emergency call delays in accidents involving motor-vehicle occupants.

<table>
<thead>
<tr>
<th>Emergency call delays</th>
<th>Case Study</th>
<th>Case Study + Phone Log</th>
<th>Questionnaire</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>accidents with eCall possibility (n=795)</td>
<td>accidents without eCall possibility (n=37)</td>
<td>Total (n=795)</td>
</tr>
<tr>
<td></td>
<td>n</td>
<td>%</td>
<td>n</td>
</tr>
<tr>
<td>Less than 5 min</td>
<td>87.5</td>
<td>56.9</td>
<td>86.1</td>
</tr>
<tr>
<td>5-30 min</td>
<td>8.6</td>
<td>26.9</td>
<td>9.5</td>
</tr>
<tr>
<td>More than 30 min</td>
<td>3.8</td>
<td>16.2</td>
<td>4.4</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

Most of the long delays occurred in single accidents and in moose accidents. Long delays were also typical for cases, where there were no eyewitnesses and where all occupants had died.
According to the questionnaire, the accident location is quite often unclear in the beginning of the emergency call (Figure 1). Sometimes the accident site is also mislocated by the emergency caller. Correction of the accident site location is needed very often, but it is rare that the rescuers get lost. Only rarely is the aid delayed due to inexact location information.

**Figure 1.** Results of the questionnaire sent to emergency response centres.

### Discussion

The study was the first in Europe in which the accurate and reliable estimates of fatalities that could be avoided by the eCall system have been estimated. Analyses of accidents were done case by case studying what was happened after the crash in a minute’s accuracy.

The study showed that eCall could have prevented 5–10% of the fatalities in accidents involving motor-vehicle occupants. This means a total of 14–29 fatalities per year in Finland. The percentage was higher in accidents, where there were no vehicles in which the current eCall could be installed. This is probably because the emergency call delays were also longer in these accidents. These were mainly single accidents of motorcycles.

The results do not take into account that accurate accident site location information given by the eCall system would be likely to have an effect on response times. The questionnaire showed that sometimes location information is too inaccurate. Therefore the fatality prevention influence of the eCall system could be even higher than showed in this study. On the other hand it was assumed that a workable eCall system would be installed in every vehicle in Finland. If this is not the case, then the effects of the eCall system will be lower. The results of the case studies are thought to be reliable, because of the small percentage of unclear cases.

The results showed that the eCall system could have greatest potential of saving lives in those cases where the emergency call would, without eCall, be done more than 5 minutes after the accident. Based on the results, eCall is expected to have the biggest effect at minor rural roads, at nighttime in off-peak traffic.
Recommendations

Based on the main findings of this study, the eCall system is recommended for immediate and widespread implementation in Finland.

Also based on the results there is a need for an eCall system, which could be installed in two-wheel vehicles. The situation could also be improved by ruling a positioning device as a compulsory equipment for motorcyclists and drivers of the snowmobile.

This study concentrated on fatalities and not injuries that could be avoided by the eCall system. The reason for this was that data concerning the severely injured wasn’t available. Hence the study also indicated a need for developing statistics on severely injured accident casualties in Finland.

Acknowledgements

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