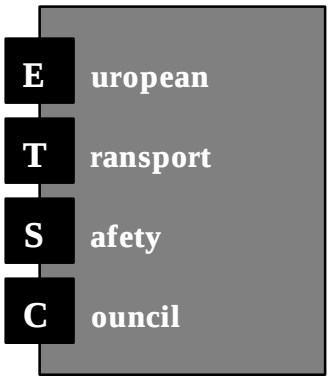

REDUCING THE SEVERITY OF ROAD INJURIES THROUGH POST IMPACT CARE

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The European Transport Safety Council

The European Transport Safety Council (ETSC) is an international non-governmental organisation which was formed in 1993 in response to the persistent and unacceptably high European road casualty toll and public concern about individual transport tragedies. Cutting across national and sectoral interests, ETSC provides an impartial source of advice on transport safety matters to the European Commission, the European Parliament and, where appropriate, to national governments and organisations concerned with safety throughout Europe.

The Council brings together experts of international reputation on its Working Parties, and representatives of a wide range of national and international organisations with transport safety interests and Parliamentarians of all parties on its Main Council to exchange experience and knowledge and to identify and promote research-based contributions to transport safety.

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Introduction

Morbidity and mortality due to injuries from road crashes contribute considerably to human suffering amongst victims and their relatives and lead to important socio-economic costs. Many victims belong to younger age groups resulting in many years of life either lost or threatened by severe disability. Despite the fact that the cost of road trauma is larger than from cancer and cardiovascular diseases, the attention and effort paid by health policymakers and by the medical community, to trauma-related care and research has been disproportionately small so far.

The health consequences of road crashes can be influenced by preventative actions before the crash (active or primary safety), during the crash (passive or secondary safety) and post crash (rescue, treatment and rehabilitation). The appropriate management of road casualties following the impact is a crucial determinant of the chance and quality of survival. The ultimate goal of post crash care is, on the one hand, to avoid preventable death and limit the severity of the injury and, on the other, to ensure optimal functioning of the crash victim and re-integration into the community.

This review has brought together medical experts from across the European Union to consider the state of the art of post impact care and the scope for further action. Following an examination of available statistics and epidemiological information, the review looks at the different aspects of post impact care which can be considered as a chain of help given to road crash victims. The review goes on to highlight evidence-based actions for the organisation of optimal trauma care which can be encouraged or undertaken by the European Union. Due to the sparseness of rigorous experimental evidence in trauma care, hard evidence is often lacking and recommendations for further research are made where there seems to be good potential for optimising equipment, procedures, or the organisation of services.

The scope for reducing casualties with post impact care

In EU countries, there are around 43,000 road traffic deaths annually and about 3.5 million casualties when underreporting is taken into account. Some road crash casualties sustain injuries which are unsurvivable in any circumstances and with any type of care. However, the vast majority of crashes are technically survivable.

About 50 per cent of deaths from road traffic collisions occur within minutes at the scene or in transit and before arrival at hospital. For those patients who are taken to hospital, some deaths occur between 1-4 hours after the crash (15 per cent) but the majority occur after 4 hours (35 per cent).

Numerous studies of avoidable trauma deaths have suggested that in both the pre-hospital and hospital phases, a proportion of blunt road trauma deaths could be avoided with optimal care. Variations in case fatality ratios for different Member States suggest there may be differences in the effectiveness of post-impact care between countries but it should be emphasised that the available data do not allow firm conclusions to be drawn. It is possible, therefore, that several thousand road traffic deaths in the EU could be prevented by optimal post-impact care. At the same time, poor post impact care could be leading to avoidable

injury and disability in survivors. A study conducted in the UK estimated that 12 per cent of patients who had sustained serious skeletal trauma went on to have significant preventable disability.

Detailed information on injury severity in EU countries is needed for a better understanding of the scope for savings through post crash care. It is recommended that:

- Data should be collected by Member States for auditing the performance of the Emergency Medical Services. The EU-financed European Home and Leisure Accident Surveillance System (EHLASS) would provide one appropriate and possible mechanism for carrying this out.
- Regulations for performing post mortems or radiological investigations in all road traffic fatalities should be formulated.
- The Abbreviated Injury Scale (AIS) should be used to record injury severity.
- The outcomes of road crash survivors need to be measured. Post-injury measures of disability (for example, the Glasgow Outcome Scale) need to be included in routine hospital statistics linked to national crash data.

Chain of help to patients injured in road crashes

The type of help needed by road traffic victims varies with the severity of their injuries. In cases of *minor* injury patients will often not be hospitalised but will treat themselves or seek the help of a general practitioner. Optimal medical and psychological follow-up care at this level is very important to alleviate pain and distress.

In *major* injuries the help provided to the victims can be viewed schematically as a chain consisting of different links.. Help starts with (1) action taken by the victims themselves or more often by lay witnesses or bystanders. The subsequent links in the chain are (2) access to the emergency medical system, (3) the help provided by emergency services rescuers, (4) the delivery of medical care before arrival at the hospital, (5) hospital trauma care and (6) rehabilitative psychosocial care. The chain will only be as strong as its weakest link.

Role of bystanders

There is no doubt that lay bystanders can play a crucial role: They can take immediate action by using a fire extinguisher if the vehicle is on fire. When the victim is in a dangerous situation bystanders should be able to take any necessary action to prevent further collisions or damage. Lay bystanders need to be able to recognise unconsciousness and the signs of failing vital functions. Securing a free airway in unconscious victims in a safe way is particularly important to reduce preventable deaths. The presence of gloves in the car to protect the bystander during these actions is desirable. The bystander should know how the emergency services function and especially how to contact them and to give correct and relevant information.

There is no evidence to suggest that first aid kits being made available in cars would help. Indeed, they might confuse bystanders and distract them from the essential action described above.

It is recommended that a description of the important steps to be taken by lay bystanders in the event of a road collision should be included in national Highway Codes and in car manufacturers' maintenance manuals.

Access to emergency medical system
The European emergency telephone number 112 should be applied by all European countries and publicised so that travellers within the EU are able to contact local emergency services. The time taken to answer emergency calls should be minimised and an EU standard should be devised for call receipt.

Efficient and well-organised emergency medical dispatch is necessary. Calls need to be transferred to a trained dispatcher able to make a layered response of the call using an appropriate dispatch system. The EU could assist in this process by encouraging information exchange on best practice concerning the functioning, type and operation of emergency medical dispatch systems as well as carrying out research.

Emergency services
Fire fighter rescuers and, in some areas, coastguards may arrive at the scene before emergency medical service personnel. It is important that fire fighters be trained in the provision of basic life support techniques and that there is training and close co-operation amongst professionals at the scene with regard to rescue from crash vehicles and safety at the scene. Again, the EU can assist in encouraging information exchange and carrying out research in this area.

Pre-hospital medical care requirements

What treatment should be applied?
There are a range of Basic Life Support techniques (delivered by emergency medical technicians who staff the ambulance, by paramedics, by specialist 'critical care' nurses, or physicians in mobile care units) which can be applied at the scene and during transportation to hospital. The particular technique to be applied will depend upon the nature of the trauma. The old method of 'scoop and run' without any treatment may be obsolete, but to 'stay and play' at the scene before definitive surgical treatment can be started may also be detrimental for the prognosis of the patient. Scientific knowledge about the efficacy of a range of procedures, however, is still in evolution and the optimal approach for different types of trauma patient has yet to be determined. This is an important area for EU research.

Who should deliver the care?
It is not economically feasible to send paramedics, a nurse or a mobile intensive care unit (MICU) to every road collision. A two-tier system with, for example, emergency medical technicians as the first tier and a MICU team as the second has been set up in many European countries. However, the level of training and degree of professionalism varies widely. All too often, the job of emergency medical technician is under-valued. The EU could assist in encouraging greater professionalism and encouraging better standards of training. In addition, the standards for minimum requirements for physicians staffing MICU teams could be developed at EU level.

Who should transport the patients to hospital?
In the majority of road traffic collisions, the patient will be transported with land ambulances. It is recommended that standardised equipment is used in EU countries and guidelines drawn up concerning matters such as occupant restraint. Training standards need to be defined for ambulance drivers.

Helicopters are used widely throughout Europe. Although the small European literature is broadly supportive of claims for benefits such as improving response times, a review of evidence relevant to one Member State concluded that their effectiveness was doubtful. The evidence indicates that if helicopters are operated, this should be on a regional basis in a secondary responder role in response to the request of emergency personnel at the scene or at a primary receiving hospital.

Medical control of pre-hospital care

Since the links in the chain of pre-hospital care are very complex, medical control and medical direction of that care are essential components. Input from a qualified emergency physician is necessary throughout the planning, implementation and evaluation of the emergency medical service. The audit of trauma care should be organised and supervised by all emergency physicians responsible for medical control. The EU should encourage information exchange on best practice in this area.

Organisation of trauma care in major road disasters

The best possible way of providing for adequate medical treatment is through a national or regional trauma system which may include hospital-based mobile medical teams, trained to collaborate with ambulance, police and fire services.

Hospital trauma care

Guidelines need to be formulated at a national and European level in consultation with national scientific medical societies on hospital trauma centres and their organisation and co-ordination. For example, a minimum threshold of basic clinical capabilities for each trauma centre needs to be established and the nature of each hospital and its resources needs to be taken into consideration. Each region should have a list of hospitals with exact details of the services they provide and trauma care should be organised and resourced accordingly.

Trauma teams managing trauma care must have adequate training. The optimal standard is the ATLS course of the American College of Surgeons. In those countries where this course is not applicable each trauma centre must still have a protocol for both the prehospital and hospital phase and will need to organise education and training of the personnel to use such a protocol. The trauma team leader needs to have a specific background in trauma care with certified experience. This experience should include a period sufficient to have managed the treatment of at least 50 major trauma patients in Emergency Department level I/II level trauma centres.

Rehabilitation

Effective trauma care aims to return the injured individual to his or her place in the community. The importance of early rehabilitation in reducing disability has been demonstrated and there is a growing acceptance that rehabilitation specialists should be available as soon as patients are medically and surgically stabilised.

Patients who have sustained traumatic brain injury (TBI) will need additional specialised attention. There is increasing evidence that even relatively “mild TBI” is followed by prolonged disability in a high percentage of cases. Identification of those at special risk in this regard is not yet possible, so research is required in this area. Psychologists should be involved in the “discharge planning” of all patients with TBI and be consulted whenever there is concern about the integration of a patient back into the community.

Post traumatic stress disorder is recognised as a major obstacle to full recovery after injury. It is probable that early assessment and early referral to a psychologist will improve long term outcome and speed up the recovery process. Those care givers responsible for supporting

relatives of fatally injured crash victims must have special training and there must be adequate immediate help for these staff who will, in turn, often require support themselves.

Best practice should be identified in treatment programmemes in these areas and information exchange between different Member States be encouraged.

1 Introduction

Morbidity and mortality due to injuries from road crashes cause considerable human suffering of victims and their relatives and lead to important socio-economic costs. Many victims belong to younger age groups resulting in many years of life either lost or threatened by severe disability. Despite the fact that the cost in terms of years of life lost resulting from road trauma is larger than from cancer or cardiovascular diseases, the attention and effort paid by health policy makers and by the medical community, to trauma-related care and research has been disproportionately small so far.

The health consequences of road crashes can be influenced by preventative actions before the crash (active or primary safety), during the crash (passive or secondary safety) and post crash (rescue, treatment and rehabilitation). The appropriate management of road casualties following the impact is a crucial determinant of both the chance and quality of survival. The ultimate goal of post crash care is, on the one hand, to avoid preventable death and limit the severity of the injury and, on the other, to ensure optimal functioning of the crash victim and re-integration into the community.

This review has brought together medical experts from across the European Union in a working party to consider the state of the art of post impact care and the scope for further action. Starting with the examination of available statistics and epidemiological information, the review then looks at the different aspects of post impact care which can be considered as a chain of help given to road crash victims.

The working party scrutinized the scientific data and, wherever possible, based on available evidence, has made recommendations for appropriate European Union action concerning the organisation of optimal trauma care. Where doubts remained, the working party identified these as areas for further research. One general remark that should be made here is that due to the sparseness of rigorous experimental studies in trauma research, hard evidence is often lacking.

In order to facilitate the reading of this report which contains technical medical terms and abbreviations, a glossary is given in an appendix and items are labelled in the text with an asterisk.

2 Post Impact Care Casualty Statistics

Post-impact care provided by Emergency Medical Services (EMS) can affect the outcomes of patients injured in road crashes but not the number of casualties nor the immediate severity of their injuries. Consequently statistical information which is useful for exploring the epidemiology of road traffic collisions from the EMS perspective needs to include information on outcomes.

Whilst information on the frequency of road traffic fatalities is available from all countries, information on the health of survivors is lacking. This is a feature of trauma research generally and is not unique to road safety research. Some attempts to fill the gap have been made using ad-hoc studies, but there is no systematic information on outcomes in road collision survivors which is routinely available from EU member countries.

The information which is given below therefore focuses on death as the outcome. However, even this is not straightforward. There are two important issues in collecting and interpreting road fatality data from the point of view of post crash care.

2.1 Unsurvivable injuries

Firstly, some casualties sustain injuries which are unsurvivable in any circumstances and with any care. Often these patients die immediately at the scene or within a few minutes of the collision. The emergency services are rarely present at the time of death and they are unpreventable from the point of view of post impact care. This should not be taken as meaning that all deaths within a few minutes of a collision at the scene, and unattended by the emergency services, are unpreventable of course. It has been estimated that many of these deaths occur as a result of airway obstruction which could be corrected by lay bystanders trained in first-aid (Hussain and Redmond, 1994) (see section 3.1).

No distinction is made between preventable and unpreventable deaths in most road safety literature, because, when it comes to the primary prevention of crashes and the secondary prevention of injuries in crashes, there is no such thing as an unpreventable death. However, given that a collision has occurred and an injury such as massive destruction of the brain stem has resulted, death is unpreventable. From the point of view of post-impact care road safety research these cases could therefore be excluded from consideration. They can be identified, approximately, as those casualties with injuries with Abbreviated Injury Scale (AIS)* scores of 6 (which are usually described as leading to 'inevitable' death). Unfortunately, no routine data is available which includes AIS injury descriptions.

2.2 Defining fatalities

The second reason why road fatality statistics are not straightforward is that not all EU countries use the same definition of a road traffic death. Most countries define a fatality due to a road crash as being one which occurs within 30 days of the accident. However, some European countries adopt a different definition (Greece - 3 days; Portugal - before hospital admission; Spain - 1 day), and fatality data between these countries is not directly comparable. Indirectly, the numbers from countries using these more restricted definitions could be inflated to account for the cases excluded by the restrictive definition (for example, +15 per cent in Greece, and + 30 per cent in Portugal). Whilst this can deal with the statistics, the epidemiological picture cannot, of course, be corrected by this means. The deaths which are excluded, (the 'late' deaths), are different in nature, cause, and 'epidemiology' from the early deaths - most obviously in terms of age, where late death can often follow traumatic injury in elderly people.

Studies of road traffic fatalities suggest that time till death varies considerably between patients and countries, and, for example, the modal peak has been found within the first hour at the scene (Wyatt, Beard, Gray, Busuttil and Robertson, 1996) or at 1 - 2 days post impact (Meislin, Criss, Judkins, Berger, Conroy, Parks, Spaite and Valenzuela, 1997).

However, roughly speaking about 50 per cent of deaths from road collisions occur within minutes at the scene or in transit and before arrival at hospital. For those patients who are taken to hospital the time of death distribution suggests that comparatively few deaths occur between 1-4 hours after the incident (15 per cent) and the majority occur after 4 hours (35 per cent).

2.3 Minor injuries

At the other end of the injury spectrum there are minor injuries which are self-limiting, the long-term outcomes of which are often independent of treatment. However, casualties with minor injuries should not be ignored because post-impact care may sometimes influence outcomes in the longer term, and may often influence short-term health in terms of pain, distress and disability.

Furthermore, the social and economic burden minor injuries place on the community may be large because they comprise the majority of road traffic casualties. For instance, in most countries only a small percentage of casualties are hospitalised, and indeed most patients are seen and treated outside hospital casualty departments. In a population survey in the Netherlands of road collisions resulting in any injury however minor (Harris, 1990), less than 1 per cent were fatally injured, 4 per cent were admitted to hospital, roughly a quarter were seen in a hospital casualty department (27 per cent), a quarter were treated by a doctor outside a hospital (24 per cent), a quarter received some other treatment (21 per cent), and a quarter received no treatment at all (23 per cent).

2.4 Accuracy of statistics

National road traffic collision statistics are usually compiled from reports made by the police who attend the incident scene, or to whom crashes are reported. Reporting requirements in EU countries do not show complete uniformity in the definitions of death and injury. However, a greater problem, revealed in numerous studies, is that not all injury crashes are notified to the police and of those that are, not all are included in statistical returns. Estimates of total under-reporting vary but it is estimated that about 30 per cent of serious injuries and around 60 per cent of slight injuries do not appear in police statistics (OECD-IRTAD, 1994).

Most police statistics also include some data on the severity of non-fatally injured casualties, but rarely in any more detail than whether or not the patient was ‘hospitalised’, which may mean being seen in a hospital Accident and Emergency casualty unit, or admitted to a bed in the hospital.

All the studies which have examined under-reporting have also found that it is related to injury severity. There is usually no under-reporting of fatally injured casualties (within the definition used by each country), under-reporting typically of the order of 10 per cent - 30 per cent of hospital inpatients, and much greater under-reporting rates in casualties with minor injuries (in some countries as high as 75 per cent). It has also been found that under-reporting varies with type of road user and collision. Thus, for example, single vehicle collisions and cyclist casualties have comparatively high levels of under-reporting by police. This may be partly to do with the injury severity distribution and partly to do with the circumstances of the collision.

There is little available information on the comparative degree of under-reporting between countries for different types of road user, and variability in this makes international

comparisons difficult. Thus, for example, such variability may be part of the reason why there is a fourfold difference between countries in the fatal to all casualty ratios. This is a particular problem for post impact care research where the case fatality ratio (that is the proportion of casualties who die) could be a useful measure of performance of an EMS. Since casualties with more severe injuries are comparatively well-recorded, one approach is to use as a measure of post-impact care performance the ratio of all fatalities to all non-fatal hospitalised road traffic casualties. It would, of course, be better still to be able to exclude the AIS 6 injury cases whose deaths are 'inevitable' but currently routine data systems do not allow this.

The fatalities to hospitalisation ratio is clearly related to a number of factors other than the effectiveness of the EMS in delivering post impact care. These include, for example, the split between types of road user, the age of casualties and the severity of their injuries, and the geographical environment as well as the availability and performance of services. Within road user types, the severity distribution is, of course, strongly related to vehicle speeds, and one means of partially controlling for this is to restrict attention to built-up areas. This also means that expected differences in outcomes between very rural and urbanised regions are controlled. Of course, for comparing trends or examining changes in post-impact care before and after changes to the EMS are introduced, geographical characteristics and other fixed factors do not matter. With these considerations in mind some comparisons between regions and over time are presented in Figures 1 and 2.

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Insert Figure 2 (Do figure titles in font size 11)

2.5 Data Sources

A number of statistical sources for road collision data in Europe exist. The four main sources worth mentioning are:

1. International Road Traffic Accident Database (IRTAD)
The German Federal Highway Research Institute (BASt) established an international road traffic and accident database in the mid-eighties. In 1988 BASt extended IRTAD, in co-operation with the EU. Since 1990 IRTAD has operated within the framework of the Organisation for European Economic and Development (OECD) road transport research programmeme, and now includes data from all OECD countries. IRTAD includes fatality and hospitalised casualties broken down by road user type, age, and type of area.

2. United Nations Economic Commission for Europe (UN/ECE)
Provides basic data on road traffic collisions and casualties, in European and some other countries. The scope of the statistics, which are compiled by the UN/ECE from replies to questionnaires supplied by member countries, comprises the number and type of collisions, alcohol-related collisions, and the number of persons killed or injured by category of road user and age group.

3. Community wide road accident data (CARE)
The CARE initiative is still being developed. When fully operational CARE will provide data for the EU which will differ from that available elsewhere in that it will be disaggregated. CARE will be an amalgam of the 15 national databases on road collisions and casualties. Work to date has not been to harmonise database variables but rather to provide a framework of transformation rules in CARE to increase database compatibility.

4. European Home and Leisure Accident Surveillance System (EHLASS)
EHLASS compiles sample statistics on hospital attendances from accidents. There is a proposal to extend EHLASS to include road collisions in the sample as well as home and leisure accidents. This would then provide a clinically based dataset with obvious potential usefulness for post-impact care research and safety initiatives.

2.6 Epidemiology

In 1997 there were around 43,000 reported road traffic deaths in the fifteen EU Member States and 1.5 million reported casualties. Bearing in mind the earlier discussion of under-reporting of casualties in police statistics it is likely that the true number of casualties is more than twice this number, perhaps as many as 3.5 million. The majority of the deaths occur on country roads (59 per cent) and in daylight (55 per cent). The modal split between types of road user injured in collisions varies considerably between countries. For example, approximately 10 per cent of fatalities are pedestrians in the Netherlands, but 30 per cent in the UK.

The number of deaths declined by 12 per cent between 1985 and 1995. This change may of course reflect changes in exposure as well as changes in primary, secondary and tertiary prevention. However, on average over the 15 EU member states road fatality rates per 100,000 population declined by 22 per cent between 1970 and 1980 and a further 12 per cent between 1980 and 1990. More dramatically, for eight Member States for which national data

were available fatality rates per billion vehicle kilometres reduced on average by 48 per cent between 1970 and 1980 and by a further 48 per cent between 1980 and 1990.

Exposure adjusted fatality rates also vary considerably between member states, ranging by a factor of four for road user deaths per 10,000 motor vehicles, and by a factor of 7 for pedestrian deaths per 100,000 population.

2.7 The effect of post impact care

Can any of this variation over time or between Member States be attributed to changes or differences in the organisation and effectiveness of the EMS providing post-impact care? Figures 2a - 2d show the case fatality ratios (CFR)* for fatalities and hospitalised casualties from all collisions occurring in 1990 and 1996 for those Member States which contribute this data to IRTAD. Two facts are apparent which are confirmed by statistical analysis.

i) There is no evidence of an improvement in the CFR between 1990 and 1996.
ii) There is variation between countries in the CFR.

Although no conclusions can be drawn without further analysis, it is possible that there may be some differences in the effectiveness of post-impact care between countries which is contributing to these results.

2.8 Conclusions

1) It is surprising that detailed information relating to the post impact care of road traffic collisions remains unavailable in many EU countries. Data should be collected within countries which is useful for auditing the performance of the EMS.
2) For post-impact care analysis information is needed on injury severity preferably using the Abbreviated Injury Scale (AIS). This will enable a better description and understanding of the role of post impact care.
3) Variations exist between countries in case-fatality ratios. Certainly numerous studies of avoidable deaths in trauma care have suggested that both in the pre-hospital and hospital phases, a proportion of blunt road trauma deaths could be avoided with optimal care. It is possible that several thousand deaths in the EU could be prevented by optimal post-impact care. In order for better information to become available about such problems post-mortems or radiological investigations should be carried out on all crash fatalities in Europe.
4) Equally, poor quality post impact care could be leading to avoidable morbidity in survivors. A study carried out by the British Orthopaedic Association estimated that 12 per cent of patients who had sustained serious skeletal trauma went on to have significant preventable disability (McKibbin, Ackroyd, Colton, King, Smith, Staniforth, Templeton and West, 1992).
5) Outcomes of survivors need to be measured. Post-injury measures of disability, at least on discharge from hospital, or at 30 days post-impact need to be included in routine hospital statistics linked to police road traffic crash data. One such measure is the Glasgow Outcome Scale which has recently been updated. Despite its faults this might be a useful start until a better measure can be developed and introduced. A measure of general health such as the EQ-5D (The EuroQol Group, 1990) could also be usefully introduced on discharge from hospital.

3 Chain of help to patients injured in road collisions

The type of help needed by victims of road traffic collisions varies with the severity of their injuries. In cases of *minor* injury patients will often not be hospitalised and will treat themselves or seek the help of a general practitioner. As emphasised previously, optimal medical and psychological follow-up care at this level is very important to alleviate pain and distress.

In *major* injuries the help provided to the victims can be viewed scematically as a chain consisting of different links. This reminds us that the chain will be as strong as its weakest link. Help starts with (1) action taken by the victims themselves or more often by lay witnesses or bystanders. The subsequent links in the chain are (2) access to the emergency medical system, (3) the help provided by emergency services rescuers, (4) the delivery of medical care before arrival at the hospital, (5) hospital trauma care and (6) rehabilitative psychosocial care. These different aspects are discussed below.

3.1 Role of lay bystanders

There is no doubt that lay bystanders can play a crucial role. Bystanders should be able to stay calm and make an analysis of the situation of the road traffic collision. When vehicles are on fire they should be able to take immediate action and use a fire extinguisher. When the victim is in a dangerous situation bystanders should be able to take any necessary action to prevent further collisions or damage.

Lay bystanders must be able to recognise unconsciousness and the signs of failing vital functions. They should have the skill to apply basic life support and should be able to secure a free airway in unconscious victims in a safe way as this causes a considerable number of preventable deaths (see section 2.1). Campaigns to educate people on these most basic elements are useful for victims of medical emergencies in general. The presence of gloves in the car to protect the bystander during these actions is desirable as is the availability in the car of special blankets for prevention of hypothermia.

The bystander should know how the emergency services function and especially how to call the emergency services and give correct and relevant information. Instructions given by the dispatcher to be carried out before the arrival of the emergency services need to be understood.

With regard to first aid kits being made available in cars there is no evidence that this is of any help, and it should be emphasised that they may confuse bystanders and distract them from the really necessary action described above. It is recommended that a description of the important steps to be taken by lay bystanders in case of a road traffic collision should be included in national Highway Codes and in car manufacturers' maintenance manuals.

3.2 Access to the emergency medical system

The chain of survival in trauma care following injury in crashes includes a vital link between the patients or witnesses and the emergency services. Access to the EMS is almost always made by telephone, but how the telephone link operates varies between services.

Telephone number

Although there is a European emergency telephone number (112), most countries use their own number in addition or in preference to the European number. This diversity only matters to the extent that there are travellers in the EU who urgently need to contact the local emergency services but do not know the local number. There is no published information about this. It should be mentioned that false calls on '112' triggered by line faults in the telephone system have been reported in the UK. Whether this is also the case in other European countries needs to be explored.

Telephone answering

The time taken by the call-receiving service to answer the emergency call is wasted time - and it should be minimised. It is not known whether any countries have standards for call receipt. In some Member States calls are directly answered by the ambulance services or the emergency medical services, in others by other emergency services who then transfer appropriate calls to the EMS, and in others by an emergency call answering service who transfer all emergency calls to the appropriate services. This diversity of models has not been studied, but a priori direct contact over indirect contact is to be preferred.

Emergency medical dispatch

Calls received by the EMS may be handled in one of two ways. All calls may result in the automatic dispatch of an emergency ambulance. In this case the only requirements of the call-taker are to identify accurately the location of the incident and to mobilise the emergency response crew. Taking details about the nature of the collision, casualties, special circumstances, and so on may also be important.

The second way of handling calls is to make a selective response depending on the perceived nature and urgency of the incident. The process of doing this is known as emergency medical dispatch. All calls to EMS in Europe should be transferred as soon as possible to a trained dispatcher able to make a layered response using an appropriate dispatch system.

1. THE FUNCTION OF THE SYSTEM

Emergency medical dispatch systems are usually required to have several functions. These are prioritisation by level of urgency (triage) to determine the speed of response; prioritisation by level of need to determine the type of response needed (for example, air ambulance; medical land ambulance; paramedic land ambulance; BLS* land ambulance; other first-responder); the provision of pre-ambulance-arrival instructions in first-aid and scene management, and communication with those on the scene and in the receiving hospital with regard to the appropriate reception of the patient.

2. THE TYPE OF SYSTEM

The system which is used to determine needs and priority may either be criteria based or protocol driven. Arguments and empirical evidence have been presented in favour of both approaches. In both systems, however, a computerised system which prompts the call taker, records responses, supports decision making, and provides the material for audit and quality assurance is considered essential (Nicholl, 1997).

3. THE OPERATORS OF THE SYSTEM

Operators of emergency medical dispatch systems vary in type and training between EMS in Europe. They range from physician based systems to lay telephone operators with no specific medical training. Another model is to employ nurses trained in the operation of the system as, for example, in the Netherlands, Norway, Italy. The appropriateness of the type of call handler clearly depends on the nature of the system in use and the contribution they are therefore expected to make to decisions and support. Most importantly, protocol driven systems impose fewer requirements for medical knowledge on their users than criteria-based systems. When telephone advice and first aid pre-arrival instructions are being frequently provided again some medical knowledge may be appropriate. For the purpose of dispatch, the call handler must follow a standard protocol. Whatever system is used, medical supervision, audit of operations and the training of the dispatchers is essential.

3.3 Emergency rescue services

Emergency rescue services, in many countries usually fire fighters, may arrive at the scene of a road traffic accident before emergency medical service personnel. Therefore it is recommended that fire fighters should be trained in the provision of basic life support techniques, so they can offer immediate first aid when necessary. The same recommendation applies to police personnel. Furthermore, close co-operation between fire fighters and health care providers is essential when victims are not readily accessible. For road collisions this is most often due to the entrapment of the victim in a vehicle but it may also be due to a fire resulting from the impact or to the submersion of the vehicle.

Early intervention by fire fighters and rescuers is important and will primarily depend upon the information given (either spontaneously or upon request to the emergency medical dispatcher).

In the case of submersed victims a team of well-trained and equipped divers will be necessary. Training of coast guards in the delivery of basic life support is to be recommended. For entrapped victims in wrecks after road collisions, desincarceration of the victim(s) should be carried out in the most efficient and safe way. Command should be taken by a fire fighter who is in close communication with the emergency health care providers (emergency medical technicians, paramedics, emergency nurses and physicians).

Defining working areas around the wreck, stabilisation of the wreck, prevention of secondary injuries by (broken) glass, use of protective materials (plastic foil, protective shields etc.) are essential for preventing further injuries to the patient or the health care providers. A first assessment and start of treatment of the victim is followed by creating space around the entrapped victim. The principle is to remove the wreck from the patient and not to extract the victim from the wreck. Repeated assessments of the medical condition of the victim should carried out and result in advice to the fire fighter/commander about how urgently he should proceed with the desincarceration

Special training of both emergency rescue services, usually fire fighters, and emergency medical health care providers is essential to obtain this goal. Such training sessions are organised in many Member States, for example, Germany, the Netherlands and France, and should be a requirement with regular retraining sessions.

3.4 Prehospital medical care requirements

Early provision of adequate medical care to victims of road traffic crashes is expected to save lives and limit disability in some patients. It is important to consider what type of care should be provided at the scene and during transportation to the hospital, and by whom this must be provided.

WHAT TREATMENTS ARE ESSENTIAL?

There is no doubt that measures protecting the victim from further injury, basic life support measures such as providing a free airway, and techniques used to support failing respiration with artificial respiration and administration of oxygen are essential. Basic techniques like mouth-to-mouth ventilation and mask-bag-valve ventilation must be applied, and advanced techniques like endotracheal intubation and ventilation and decompression of a tension pneumothorax may be necessary.

Circulatory failure due to blood loss can be corrected by basic techniques such as positioning of the patient and administration of oxygen or with more advanced techniques such as setting up an intravenous infusion of plasma expanders. Finally, necessary manoeuvres should be started for immobilising possible fractures of the vertebral column and fractured limbs to prevent further damage.

Our scientific knowledge of the efficacy of these techniques is still evolving. There is evidence that the nature of the trauma is important for the type of care that may be necessary. For example, the intravenous administration of fluids at the scene may not be efficacious and may even be harmful in patients with penetrating injuries (Bickell et al., 1994). Also patients in whom brain injury is predominant may require a specific approach. It is important to realise that only necessary treatments should be given so that there is no unnecessary waste of time. The old method of ‘scoop and run’ without any treatment is obsolete but to ‘stay and play’ at the scene with loss of time before definitive (surgical) treatment can be started in the hospital may also be detrimental for the prognosis of the patient. The optimal approach must be determined for different types of trauma patients, and well controlled prospective multicentre studies should be carried out to answer these questions.

WHO SHOULD DELIVER THE CARE?

The basic techniques described above can be delivered by emergency medical technicians who staff an ambulance with the necessary material equipment. Advanced techniques can only be provided by paramedics,* who are emergency medical technicians who have received an extended training (for example in the United Kingdom), by nurses specialised in critical care (for example in The Netherlands) or as in many countries now in Europe (for example in Belgium, Germany, France, Italy etc.) by physicians in mobile intensive care units (MICU). The integration of pre-hospital MICU-teams in the hospital emergency departments is the better option as this will both reduce costs and improve the quality of care (Council of the European Society for Emergency Medicine, 1998).

It may not be economically feasible to send paramedics, a nurse or a MICU-team to every road crash and may even be harmful as each crew would have too little exposure to develop their expertise. A two-tiered system with, for example, emergency medical technicians as the first tier and a MICU-team as the second tier has been set up in some countries in Europe. It is obvious that the emergency dispatch centre plays a critical role in the efficient use of these

systems especially in order not to lose time for adequate treatment of the severely injured patients where both tiers should be sent simultaneously (see section 3.2).

One important aspect of the different tiers is that their composition differs from country to country and that the level of training and the degree of professionalism involved can show wide variation (Chamberlain, 1998 and Huemer, Pernerstorfer & Mauritz, 1994). Too often the job of emergency medical technician is not well recognised, and the quality of care is compromised by the fact that this ambulance work is either seen as an accessory activity for fire department personnel or is even left to volunteers. The EU could encourage improvements in emergency medical technician training by setting out minimum standards.

Also, the regulations governing the training of physicians staffing the MICU-teams also differ from country to country. It is recommended that standards for minimum requirements be developed at EU level for the different tiers.

The level of professionalism and expertise of the different health care providers will clearly be influenced by the degree of exposure. It is recommended that when setting up a prehospital care system a balance will need to be maintained between the number of health care providers in each tier and the number of calls. Working with well-trained professionals obviously has economic consequences and society has to decide on the price it is willing to pay for good quality prehospital care.

HOW SHOULD PATIENTS BE TRANSPORTED TO HOSPITAL?

Patients are transported by land ambulances in the majority of road collisions. It is recommended that standardised equipment be available in ambulances in European countries. Moreover, the development of safety standards, for example for child restraint and adult seat belt use during transport are recommended. With regard to the safety of land ambulances and MICU-teams, attention should be paid to ambulance driver training. Recommendations at European level are needed in view of the considerable number of crashes involving ambulances.

Helicopters

Helicopters are widely used throughout Europe in post-impact care as emergency ambulances, and have been used in this role since the early 1970s in Germany. They are perceived as being able to contribute to the performance of an EMS in a number of different ways: improving response times to the scene; giving a more appropriate level of response; improving removal times from the scene to hospital particularly in cases of difficult access; providing access to appropriate rather than convenient primary receiving hospitals; and improving the performance of the whole EMS by providing flexibility.

Although the small European literature is broadly supportive of claims for benefits in all these areas, a review of evidence relevant to the UK concluded that the effectiveness of civilian helicopter emergency ambulance services in some environments is doubtful (Nicholl, 1997). The evidence indicates that if helicopters are operated, it should be on a regional basis in a secondary responder role in which they are called out at the request of emergency personnel at the scene or at a primary receiving hospital, and not in a primary responder role in which they are activated by Ambulance Service dispatchers acting on information from emergency calls from the public.

Some of the doubts arising in the review were related to the specific geography and demography of the UK, and it was acknowledged that as distances (measured in terms of

travel time) increase, or access becomes more difficult in other ways, the advantages of helicopters may quickly come to outweigh their disadvantages. Since the geography and demography of Europe is so variable it would not be possible to recommend a uniform European system. Any system has to be tailored to fit the local circumstances.

There are three other considerations which should be borne in mind:

Firstly, in whatever way an EMS is organised it is obviously not acceptable for it to be designed to be dependent for a successful performance on helicopter ambulance services unless they are available 24 hours a day. In some countries there are restrictions on night-time flying for civilian helicopters from non-designated landing sites such as the scene of accidents and helicopters cannot fly in bad weather. Thus the helicopter ambulance service should only be developed as an adjunct to a good land based ambulance system and should not be developed to replace that system.

Secondly, helicopters are expensive, they cost between 0.5 million euro and 1.5 million euro per annum to operate, and this cost has to be justified by the benefits they bring to post crash care.

Thirdly, there are concerns about the safety of helicopter ambulances particularly at night-time, and in bad weather. The fatal helicopter ambulance accident rates in the US have been alarming for several years, and during the 1980s was estimated to be 4.7 fatal crashes, and 11.7 crashes in total, per 100,000 flying hours (Rhee, Holmes et al., 1990), a rate twice that for other commercial helicopter operations (Low, Dunne et al., 1991). However, this collision experience is not unique with similar rates reported in Germany, and an even higher rate (1 per 5,000 missions) in Norway. Fatal crashes have also been reported in Italy, and the UK, although the rates have not been calculated. Despite these safety concerns there is no published evidence that the marginal risks associated with helicopter ambulances are worse than the risks that would be incurred using land ambulances to carry out the same missions.

TO WHICH HOSPITAL SHOULD THE PATIENT BE TRANSPORTED?

Patients with severe road injuries should receive adequate hospital trauma care promptly. The nearest and most convenient hospital may not be the most appropriate one for the type of care that is needed. Several factors must be taken into account such as the type of injuries, the services available at the hospital, the comparative distance (and time) to reach the nearest or the most appropriate hospital and any regulations concerning the transport of injured people restricting the choice of emergency health care providers.

The identification of patients who may have major trauma and need the services of a specialist hospital is based on a well-known 'check list' developed in the US that depends on the field triage criteria (The Study Group on Head Injury, 1996):

Check list to identify patients with major trauma

- Trauma Score (TS) = 13
- Prolonged extrication
- Falls > 15 feet
- Heavy damage to vehicle
- Ejection
- Two proximal extremity fractures
- Chest blunt trauma + RR > 35 + TS < 13

- Abdominal blunt trauma + TS < 13
- Penetrating injuries
- Severe burns
- Pedestrian + Chest / abdom. blunt trauma or 2 fractures
- Motor / bike + Chest / abdom. blunt trauma or 2 fractures
- Spinal injuries
- Fatality in the same car
- Flail chest
- Age: > 70, < 5 yrs.

These criteria are based on the mechanisms of injury, the anatomical location of injuries, and alterations to physiological parameters (Trauma score or RTS).

It is not clear whether this triage can be appropriately applied in European countries. Moreover the nature of the trauma and care needed may also make it difficult to apply generalised rules. It is recommended that rules for transport between hospitals in different regions in the EU should be decided locally.

NEED FOR MEDICAL CONTROL OF PREHOSPITAL CARE

It is clear that the links in the chain of prehospital care are very complex. Therefore medical control of the system is an essential component of a prehospital care system. It is a way of ensuring the accountability and the quality of the care provided and as such will influence morbidity and mortality. Prehospital care should not only be subjected to medical control, but should be under medical direction. Physician input is necessary throughout the planning, implementation, and evaluation of the EMS system.

This medical direction must be provided by a qualified emergency physician with an interest in prehospital care and EMS, and is an essential component in a successful prehospital system. It is strategically involved with protocol development, training and continuous quality improvement.

Quality control in trauma care, in general, and in individual cases is mandatory. Audit should be organised and supervised by the emergency physicians responsible for medical control. During the last two decades, much effort has been invested in this particular matter. The Major Trauma Outcome Study (MTOS), the development of different statistical models (for example, TRISS or ASCOT) to predict outcome, and the Abbreviated Injury Scale (AIS) provide the scientific basis. However, these methods have their limitations and are time consuming and costly.

Uniform registration of trauma cases using Utstein-style criteria is recommended.

ORGANISATION OF TRAUMA CARE IN MAJOR ROAD DISASTERS

Major road disasters principally occur in fog due to speed, and while large numbers of injured persons may also result from collisions involving buses or lorries carrying toxic, explosive and / or inflammable chemical products.

Once a major road disaster has occurred, the best possible way of providing for adequate medical treatment is a region-wide trauma system, including hospital based mobile medical teams, who are trained to collaborate with ambulance, police and the fire brigade. The medical rescue of the casualties needs three complementary organisations involving on site triage and immediate care, evacuation and hospital admission. The specific nature of a major

road disaster, however - as for any major disaster - requires a superstructure, co-ordinating the efforts of the various components involved and linking the local systems in the area to each other. Hospital based medical team physicians must be in charge; they must be specially trained in disaster management to be able to co-ordinate the whole chain of medical rescue from the site to the hospitals. A specific disaster plan is, therefore, essential in each region.

3.5 Trauma Care

The concept of hospital trauma care involves the provision of appropriate treatment to patients with either minor or major injuries.

Minor injury care
As discussed earlier, patients with minor injuries often treat themselves or are seen either by their general practitioner or in the emergency department of a hospital. General practitioners and physicians working in the emergency department should be adequately trained to correctly identify which injuries are to receive priority treatment. Correct treatment of injuries like head and neck trauma and adequate follow-up care is important to limit distress and pain and prevent adverse consequences.

Major injury care
Hospitals receiving patients with major injuries should offer a trauma care system incorporating the various facilities needed for the treatment of major trauma.

A prerequisite for optimal trauma care in hospital emergency departments is the delivery by health policymakers of a strategy for the organisation and provision of a national trauma system. This will entail effort by professionals involved in the provision and delivery of medical care at national and European level to provide research-based guidelines, standards and general advice about the treatment of trauma victims. The allocation of economic resources and facilities will depend upon the type of admitting hospital and the specialist human resources available locally.

A system for the care of trauma in Europe
In several European countries a hierarchy of hospitals with general emergency departments has been drawn up, but not specifically for trauma care. This means that there is not always a direct correlation between ‘hospital level’ and capability in treating severe trauma cases. One solution to this is to introduce a centralised system such that patients requiring trauma care for major injuries are taken to hospitals which have the necessary trained expertise and appropriate facilities. The centres selected need a combination of well-trained personnel together with appropriate facilities aimed at the stabilisation and definitive care of polytraumatised patients. It is suggested that the catchment population of these hospitals should be around 1,000,000 inhabitants, depending on geographical environment, infrastructure and demography, to get best value for money. Every local hospital receiving trauma cases should meet a minimum standard of trauma care.

During the pre-hospital phase an “exclusive trauma system” can ensure the dispatch of major trauma patients towards an appropriate trauma centre by scoring patients in terms of severity and priority by an appropriate check list.

For the patient referred from a local hospital, the Injury Severity Score (ISS)* (threshold value = 16) may be a useful measure to define major trauma together with the need for specialist

treatment (e.g. complex surgery, intensive care, or interventional radiology). However, different regions will need to determine their referring protocol based on the hospital hierarchy of the region. It should also be stressed that optimal medical care during transport from a local hospital to a trauma centre is essential.

The Trauma Team

The trauma service should be organised by a group of medical staff with the task of organising the care system within the hospital and ensuring that personnel receive appropriate training. This is a multi-disciplinary group (anaesthesiologists, surgeons, radiologists, emergency physicians etc.) which must take care of every major trauma patient admitted to hospital.

The creation of a trauma team and the appointment of a trauma team leader, is the first duty of the in-hospital trauma service. The qualifications, specialisation, training and the complement of medical and nursing staff on the trauma team will be determined by the type of admitting hospital.

One of the key issues for the trauma service is the identification of the trauma team leader to direct the multi-specialist care of each patient. In Europe, these leaders tend to be either emergency physicians, surgeons (orthopaedic surgeons, neurosurgeons, general surgeons) or anaesthesiologists and specialists in intensive care. It is essential that a person well-trained and qualified in medical trauma care is chosen to lead the team in-house and is available 24 hours a day. The trauma leader must be able to interpret, apply, and decide about all the priorities for the primary and secondary survey of the polytrauma as well as being able to offer team training.

Education, training and audit

Today the global standard for trauma team leader training is the ATLS course of the American College of Surgeons. However, this course is not always applicable in Europe which tends to see more blunt than penetrating trauma injuries to which the course is biased. Each trauma centre which has a protocol for the pre-hospital and hospital phase, as is the case in some European countries e.g. Germany, needs to organise the education and training of the trauma team members to use the protocol. Good practice suggests that the leader's previous experience in trauma care should include a period sufficient to have been involved in the treatment of at least 50 major trauma patients in a level I/II trauma centre emergency department (in Europe, such a department would be expected to admit more than 150-180 major trauma cases every year).

The education and training of team personnel is generally organised by a committee of trauma centre team leaders who must bear in mind the logistics of the hospital, the type and availability of the in-house specialities and the available facilities, as well as the number of severely acute patients admitted every year.

The group of trauma team leaders, together with the trauma co-ordinator must also take responsibility for the audit of the care and outcomes of all major trauma patients. This requires that every trauma service should set up a trauma registry to measure and record details about all patients (including ISS, TRISS, admission GCS*, etc.) for the programmeme of quality control and improvement.

Clinical services to be provided by the Trauma Service

The following represents current best practice arrangements in Europe with regard to the composition and availability of clinical care.

Minimum threshold of basic clinical capabilities to be provided by trauma centre

In-house 24 hours a day:
Emergency Medicine
Anaesthesiology
General Surgery and any life saving surgery (such as urgent external fixation for pelvic fractures, vascular surgery)
Radiology: a mobile X-ray apparatus should be located in the resuscitation room and the other X-ray facilities such as CT-scan should located near the emergency department

On call promptly available:
ESSENTIAL:
Anesthesiology (2nd team)
General Surgery (2nd team)
Neurosurgery (2nd team)
Orthopaedic Surgery
Maxillo facial Surgery
Interventional Radiology

DESIRABLE :
Pediatric Surgery
Vascular Surgery
Urologic Surgery
Plastic Surgery
Thoracic surgery

Facilities and resources: available in-house 24 hours a day:
X-ray and Ultrasonography
CT-scan
Trauma operating room with staffed personnel
Clinical laboratory service
Blood bank with adequate storage facilities
Rehabilitation team for the acute trauma phase

The facilities and medical instruments for every clinical procedure must be recorded on dedicated checklists which are monitored every day by trained nursing staff overseen by the trauma co-ordinator.

Integrated hospital trauma care in Europe

In Europe most trauma patients are treated in Emergency Departments which also manage all other medical and surgical emergencies. In such departments, the adoption and use of protocols or guidelines for the management of trauma patients is a potentially life-saving intervention, but co-ordination between the pre-hospital and hospital phases of care is also important and often lacking (Bartlet et al., 1998; Bullock et al., 1996; Maas et al., 1997 and The Study Group on Head Injury, 1996). Furthermore, there is a need for acute intensive rehabilitation treatment for trauma patients and for the patient's referral to rehabilitation

units once medical and surgical stabilisation has been achieved. Consequently good co-ordination between the acute treatment phase and the necessary subsequent rehabilitation is also important.

Protocols or guidelines governing co-ordinated care may be different in various European countries or even within the same country but must be based on locally available resources to ensure they are directly applicable.

3.6 Rehabilitation

Psychological aspects of trauma care

It is important to emphasise that an effective trauma system aims to return the injured individual to his or her place in the community. This requires the integration not only of initial 'high tech' medicine but also of rehabilitation services and attention to the psychological needs of the patient.

Staff must be trained to be sensitive to these needs although it is not necessary to have immediate psychological input in the first few hours in most cases. Those responsible for supporting relatives of people who have died also need special training. Long lasting psychological and social suffering of relatives may result from the way they are approached by emergency care givers (European Federation of Road Traffic Victims, 1997). There must also be adequate immediate help for these staff who will, in turn, often require support themselves.

Patients who have sustained traumatic brain injury will need additional specialised attention. There is increasing evidence that even relatively 'mild TBI' is followed by prolonged disability in a high percentage of cases. Identification of those at special risk in this regard is not yet possible, so research is required in this area.

Psychologists should be involved in the 'discharge planning' of all patients with TBI and be consulted whenever there is concern about the integration of a patient back into the community.

Post traumatic stress disorder is recognised as a major obstacle to full recovery after injury. It is probable that early assessment and early referral for rehabilitation will improve long term outcome and speed up the recovery process.

Rehabilitation of brain injuries

Due to the complexity of brain injury and the effects not only on the brain-injured person's own life, but also on the life of the family, neuropsychological treatment should be available to all victims with a brain injury caused by a road crash. Even patients who are not in need of hospitalisation after the crash should be referred for a systematic follow-up. The rehabilitation process can be perceived as a chain of different treatment levels. It is, however, not necessary that each person should pass each level in this chain. Depending on the initial level of functioning and on the speed of recovery there should be flexibility in referring to the appropriate level of rehabilitation in order to accommodate different needs.

In hospital trauma care a neuropsychologist should take part in the acute rehabilitation phase. Assessment of mental state, cognitive functions, and performance possibilities should take place as soon as the physical condition of the patient allows. The purpose is to provide a baseline of the patient's functioning and advise the interdisciplinary team (at this stage the

doctors, the nurses and the physiotherapists involved in the rehabilitation process). Providing support to family members is also a task for the neuropsychologist. It is well known that information given by health care workers at this stage to family members who are in shock is often not understood by them. It needs special knowledge and an extended amount of time to communicate about the victim's state and prognosis.

In order to effectively structure the rehabilitation process, information from the family can be obtained at the same time about the patient's specific life situation in as much detail as possible.

The aim of early rehabilitation in-hospital trauma care should most often be to calm the patient's anxiety, to prevent catastrophic anxiety and behavioural problems. The patient is in need of information at a level that is easily understood and in need of support to perform ordinary daily activities with the help of occupational therapists. Later training should be directed towards the functions most often affected by a traumatic brain injury: lack of awareness, concentration difficulties, and lack of control.

At the time of transferral from hospital trauma care to in-hospital rehabilitation or to a post-acute rehabilitation programme depending on severity, a report of the initial assessment and the patient's progress should accompany the patient.
Due to the various levels of severity of brain injury it is important that rehabilitation plans are made for the individual patient based on the early and thorough assessment. Different levels of rehabilitation programmes and programmes stressing various kinds of training have to be followed.

For in-hospital treatment it is important that further complications, such as contractures and malnutrition should be prevented. Since it takes a long time to treat patients with the most severe levels of brain injury, the interdisciplinary team working together in these places and to be well trained. Some programmes in Europe have been established for the rehabilitation of these very severely brain-injured persons and such programmes need to be established in other countries within the EU. Individually tailored programmes, that ensure a social milieu, where the brain-injured person can feel secure, where responsibility and learning are emphasised, have proven to be successful in moderately to severely injured persons. In these programmes training is individual and rehabilitative tasks are meaningful to the individual person's life and return to work. A cost-effectiveness study conducted by an independent research group for a post-acute programme with this approach has indicated that participation was followed by reduced expenditure in the management of brain-injured individuals for both public and private sectors and that there was a reduced dependence on health and social services.

The rehabilitation programmes that have proven most effective with respect to work integration offer treatment to groups usually with around 15 members; the programmes last for 3-5 months with attendance 4-5 days per week (Ben-Yishay and Diller, 1993). The costs amount to around 30,367 euro. The percentage of work reintegration varies from 60-75 per cent, with around 20-25 per cent to the same kind of jobs, the rest to part-time or supplemented jobs. Some of these programmes have been described in detail but further research following scientific standards is needed to make the results convincing.

Going through this chain may take at least two years and most often more time. However, if the initial treatment plan is followed an optimal outcome can be the result.

A prerequisite for comprehensive rehabilitation after brain injury is a competent group of rehabilitation specialists working in an interdisciplinary manner, each contributing their special knowledge in close collaboration. Training in this kind of rehabilitative work has to be promoted in all European countries.

In summary, all brain injured patients need treatment as early as possible - starting in the acute care phase as intensively as possible in order to obtain medical stability. The training should be medical and physical, but psychological support and evaluation is also needed. In planning for post-acute treatment special programmes should be developed for the various levels of injury securing the best possible sequence of rehabilitation which has been considered a right by the European Society (VDR, 1995). The goal today is to provide programmes that ensure prospects for life after brain injury composed of elements that encourage growth, responsibility and enjoyment, attachment to others and to work: to provide treatment that corresponds to the complexity of the brain and to our present scientific knowledge.

Rehabilitation of other injuries

Other injuries e.g. of the spine and extremities can be very debilitating and rehabilitation of these patients should also receive the necessary attention.

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Appendix: Glossary of terms

Abbreviated Injury Scale (AIS)
A score from 1-6, for anatomically different injuries, indicating the chance that such injuries lead to death. AIS 6 injuries are usually considered to lead to inevitable death, AIS 5 to probable death, AIS 4 to possible death and other grades rarely.

Advanced Life Support (ALS)
Medical care given by medical doctors and nurses trained in critical care medicine with the use of specialized technical equipment, infusion of fluids and drugs aimed to stabilize or restore vital functions.
Advanced life support is an integral part of a system of emergency medical services that needs adequate medical supervision

Advanced Trauma Life Support (ATLS)
A formal programmeme of training in ALS techniques that relate to trauma patients developed in the US

Basic Life Support (BLS)
Consists of emergency medical care to restore or sustain vital functions (airway, respiration, circulation) without specialized medical equipment and to limit further damage in the period preceding the arrival of specialized, advanced emergency medical care

Case Fatality Ratio (CFR)
Ratio between the number of fatalities and the total number of cases (victims) involved

Emergency medical dispatch system
This is the part of the emergency medical services system that takes incoming calls for emergency care. The person who receives and handles the calls is the emergency medical dispatcher.

Emergency medical technician
A person who received a training in emergency medical care for sick or injured patients in need of transportation to a hospital. This training includes basic life support and the ability to assist doctors and nurses in the delivery of advanced life support.

Glasgow Outcome Score (GOS)
A crude 5 point scale of functioning made at the time of hospital discharge.

Injury Severity Score (ISS)
A score based on the AIS (i.e. sum of the squares of the highest AIS grades in each of the three most severely injured body regions) which accounts for multiple injuries in one patient.
The ISS to some extent predicts the chance of death in multiply injured patients.

International Classification of Diseases (ICD)
An international classification system using codes for different diseases and injuries.

Mobile Intensive Care Unit (MICU)
A medical doctor and a nurse transported to the scene of the accident with the knowledge, skills and equipment necessary for performing advanced life support. A Mobile Intensive Care Unit is part of the emergency medical services in some European countries.

Paramedic
An emergency medical technician (EMT) who received further training for the delivery of some aspects of advanced life support (ALS) care.

Prehospital scoring
Scores primarily based on physiological functions (cardiovascular, respiratory, central nervous system etc.). These scores try to assess the severity of the trauma based on findings that can be made at the scene by emergency medical care personnel (EMT, paramedics, physicians etc.). The most widely used score is the Revised Trauma Score .

Utstein Style
Utstein is the place where a uniform reporting system for victims of out-of-hospital cardiac arrest was developed. The term Utstein Style is used here to allude to the fact that at present a group of experts is developing a uniform reporting system for trauma patients.