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Supplement
Orthopaedics and traumatology
Communications and News

Whitebook Medical Care of the Severely Injured

2nd revised and updated edition

Recommendations on structure, organization, installations and equipment to promote quality, safety and reliability in the medical care of the severely injured in the Federal Republic of Germany

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Orthopaedics and traumatology

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the German Society for Trauma Surgery (registered association) and

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These recommendations have been agreed with the following specialist societies and associations:

German Association of Rescue Services,
German Society for Vascular Medicine and Surgery,
German Society for Cardiac, Thoracic and Vascular Surgery,
German Society for Paediatric Surgery,
German Society for Neurosurgery,
German Society for Orthopaedics and Orthopaedic Surgery,
German Society of Plastic, Reconstructive and Aesthetic Plastic Surgeons,
German Society for Thoracic Surgery,
German Society for Radiology,
German Society for Urology,
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German Society for Anaesthesia and Intensive Care,
German Society for General and Visceral Surgery,
German Society for Surgery

Preface to the 2nd revised and updated edition

The publication of the first Whitebook in autumn 2006 stimulated intense, long-term discussion of the organization and availability of medical care for the severely injured in Germany. To address the inadequacies that came to light and to implement the published recommendations, the German Society for Trauma Surgery initiated the project TraumaNetzwerk DGU® (TNW). The task of implementing the project was assigned to the Whitebook Implementation Group / TraumaNetzwerk (AKUT).

The aim of the TNW is to form a structured nationwide network of approved clinics qualified to deliver medical care to the severely injured in compliance with uniform care and quality standards. **This should guarantee that every severely injured person has the same chances of survival at all times and in all places in Germany.**

In 2007 the panel of experts monitoring changes in the health system adopted the recommendations set out in the Whitebook and recommended them to other medical disciplines as a model of structured and interlinked emergency care. In the meantime, the TNW project has been integrated into hospital planning requirements in a drive to ensure emergency medical care in the individual federal states.

The decision to publish a 2nd revised edition of the Whitebook was taken in response to changes in the health system environment, the experience acquired during implementation of the TNW project, and the insights gained during compilation of the interdisciplinary S3-Guidelines of the German Society of Trauma Surgery on the care of the severely injured..

The recommendations for the care of severely injured children and severe burn patients as well as a chapter on early rehabilitation and outpatient follow-up treatment are new in this edition.

Furthermore, representatives from numerous institutions, specialist societies and associations have collaborated on this 2nd edition of the Whitebook.

We express our sincere thanks to all those who contributed to the preparation and compilation and, in particular, we thank all the specialist societies, associations and experts listed in the front matter for their valuable comments and important contributions.

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President DGU

Hartmut Siebert
Secretary General DGU

Steffen Ruchholtz
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Berlin, May 5, 2012

Notes:

All official titles in these Recommendations, including titles of status and function that appear to be gender-specific are to be understood as referring to men and women alike.

Comments and suggestions with regard to clarity of meaning, misunderstandings or errors will be gratefully received. We ask you to direct your communications to the main office of the German Society for Orthopaedics and Trauma in Berlin.

This Whitebook will be updated at relevant intervals in response to changes in legal and economic regulations and conditions, medical developments and to reflect the ongoing practical experience being gained in the process of implementing these recommendations as part of the project TraumaNetzwerk DGU®.

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List of Abbreviations

ADAC	German Automobile Association
AHB	Follow-up Treatment
AIS	Abbreviated Injury Scale
AKUT	Whitebook Implementation Group / TraumaNetwork of the DGU
ÄLRD	Medical Director Rescue Services
ATLS	Advanced Trauma Life Support
AUC	Academy for Traumatology Ltd
BG	Trade Association (Industrial Liability and Accident Insurance)
BGSW	BG Inpatient Follow-up Treatment
CT	Computer tomography
D-Arzt	Accident Insurance Consultant
DGUV	German Statutory Accident Insurance
DICOM	Digital Imaging and Communications in Medicine
DIVI	German Interdisciplinary Association for Intensive Medical Care
DRG	Diagnosis Related Groups
DSO	German Foundation for Organ Transplant
DSTC	Definitive Surgical Trauma Care
EAP	Enhanced Outpatient Physiotherapy
EFL	Evaluation of Functional Performance
EKG	Electrocardiogram
ERGOS	Work simulation system
ETC	European Trauma Course
MS	Medical Specialist
GCS	Glasgow Coma Scale
GKV	Statutory Health Insurance (SHI)
GMG	Health Care Reform Act
GSG	Health Care Structure Act
GUV	Statutory Accident Insurance
HOTT	Hand Over Team Training
HNO	Ear, Nose and Throat Therapy

ICF	International Classification of Functionality, Disability and Health
INM	Institute for Emergency Medicine and Medical Management
ISS	Injury Severity Score
KTQ	Cooperation for Transparency and Quality in the Health System
KV	Health Insurance
LTZ	Local Trauma Centre
MRT	Magnetic Resonance Imaging
NIS	DGU Section for Emergency Medicine, Intensive Care and Care of the Severely Injured
OPS	Operations and Procedures Code
PHTLS	Pre Hospital Trauma Life Support
Reha	Rehabilitation
RTZ	Regional Trauma Centre
RV	Pension Insurance
SGB V	Social Security Code V
SHT	Craniocerebral Trauma
SP	Specialism
TNW	TraumaNetwork
TR	TraumaRegister
TZ	Trauma Centre
ÜRTZ	Supraregional Trauma Centre
WA	Specialty registrar
WHO	World Health Organization
ZMK	Dental, Oral and Maxillofacial Surgery

1 Introduction

Accidents can happen to anyone and are by definition unexpected. They can happen anywhere at any time. Accidents may involve one person or several people or may be heavy casualty events. Accident prevention, emergency treatment of the injured, restorative and corrective interventions, replacement of body parts and restoration of functional ability as well as rehabilitation with the aim of social and professional reintegration of the injured person are humanitarian, social and economic responsibilities of the highest order.

To ensure the nationwide long-term provision of high performance, quality-assured medical care of the severely injured around the clock, the new, revised and updated edition of the Whitebook sets out recommendations not only for infrastructure, installations, equipment, and organization, but also reliability and quality of care for severely injured patients of all ages.

“Quality and Reliability“ in the care of the severely injured can only be achieved through the nationwide provision of high-performance care facilities that can treat any injury to any person around the clock. This requires structured regional medical care systems within which there is a pre-planned, well coordinated close-knit cooperation of rescue services, clinics, rehabilitation facilities and doctors in independent practice. Trauma centres are pivotal elements that have proven to increase the quality of infrastructure, processes and treatment outcomes for the severely injured. The concept of networking was put into practice in 2007 in the form of the ongoing TraumaNetzwerk DGU® project.

In accordance with regionally defined requirements, adequate capacity and relevant specialists are to be provided in suitable medical care centres within each Trauma Network. Apart from orthopaedic and trauma experts, the many other requisite operative and non-operative specialisms include anaesthesiology and emergency medicine, radiology and interventional radiology, general and visceral surgery, neurosurgery and neurology, cardiac, vascular and thoracic surgery, plastic surgery, oral maxillofacial surgery, ear nose and throat therapy, paediatric surgery, ophthalmology, psychiatry and psychology, urology and gynaecology.

A smooth collaboration between preclinical rescue operations, emergency doctors, other institutions (e.g. the fire brigade) and the trauma centres within the network is as essential as the structured interaction between emergency clinics, rehabilitation centres and facilities for outpatient follow-up treatment.

Only clearly task-oriented networks can offer guaranteed accessibility to all the necessary specialists and optimal utilization of the available resources. Provision of adequate medical care facilities is a primary concern of those immediately involved and of the regional authorities legally responsible.

The endeavours presented here support the Decade of Action for Road Safety 2011–2020 (DARS) as called for by the World Health Organization as well as flanking programmes and projects of various national and international organizations and associations within the EU to optimize cross-border cooperation in the care of the severely injured.

The recommendations in the Whitebook serve

- to optimize the care chain from the scene of the accident to reintegration,
- to facilitate the gradual realization of a network for the medical care of the severely injured (TraumaNetzwerk DGU®),
- to ensure realistic, long-term regional and cross-border planning of hospital requirements,
- to promote definitive internal and external quality assurance and patient safety,
- to contribute to disaster prevention,
- to maximize utilization of resources on the basis of medical and economic necessity and developments.

In this endeavour the findings and insights of the following institutions and associations were taken into account:

- Federal Offices for Health and Safety at Work and Industrial Medicine,
- Federal Road and Transport Office (BaST),
- Federal Office for Quality Assurance (BQS),
- German Statutory Accident Insurance (DGUV),
- German Interdisciplinary Association for Intensive Medical Care (DIVI),
- Federal Health Reports,
- Institutes of the Lead Associations of the Statutory and Private Health Insurers (GKV, PKV),
- Institutes of the German Hospital Federation (DKGI),
- Robert Koch Institute (RKI),
- Federal and State Statistical Offices (StBA),
- DGU Guidelines for the Care of the Severely Injured,
- TraumaRegister DGU®,
- American College of Surgeons (ACS).

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2 Overview

2.1 Medical Care Infrastructure for the Severely Injured in Germany

Preclinical and clinical care of severely injured patients in Germany is of a high standard due to the immense dedication of all the participating professional groups and specialists [1].

That said, some specific accidents have led to intense public discussion and a number of scientific studies indicating that the quality of care for the severely injured in Germany is not yet homogeneous [2–4]. For example, reports from the Federal Statistics Office show that the incidence of fatal road accidents varies greatly across the different federal states. The statistics reveal that the mortality rate after road accidents involving personal injury in Mecklenburg-Vorpommern is 1.6% compared with 0.8% in North Rhine Westphalia (Federal Statistics Office 2010). However, it should be noted that a hospital in Mecklenburg-Vorpommern has a catchment area of 4634 km^2 compared with 541 km^2 in North Rhine Westphalia. Furthermore, detailed study of the data stored as part of the TraumaRegister of the German Society for Traumatology (DGU) has shown clear differences in mortality rates after severe trauma at their member hospitals [4].

There are two main reasons for these differences in quality:

- differences in geography and infrastructure between regions, and
- differences in professional expertise, care facilities and treatment concepts in the different hospitals.

Before the TraumaNetzwerk DGU® project started in 2006 the structures and processes for the care of the severely injured in Germany were guided by conditions laid down by the statutory accident insurance companies, state-specific political regulations and strategies for the professional development of all specialisms and professional groups involved in the care of the severely injured patient.

The TraumaNetzwerk DGU® project aims to improve the quality and reliability of care for the severely injured nationwide in Germany with the support of all specialist disciplines, professional groups and associations that participate in the care of the injured based on the recommendations of the Whitebook.

Since the start of the project in 2006 864 clinics in 53 regional Trauma Networks have participated in this quality initiative. 31 Trauma Networks with 413 participating clinics have already completed the certification process successfully. A further 132 clinics have successfully passed through the auditing procedure and are awaiting certification of their regional Trauma Network. Another 17 clinics in neighbouring countries are integrated into cross-border cooperation agreements (at the time of printing, up-to-date information on www.dgu-traumanetzwerk.de).

Parallel research projects have already found evidence of first improvements in the quality of infrastructure and processes in the regional Trauma Networks. This includes standardization of emergency room installations, implementation of interdisciplinary treatment guidelines and improved cooperation between centres [5]. Data on outcome quality are not currently available.

2.2 Data on the mechanisms, frequency and consequences of accidents and factors affecting quality of care

Epidemiology of severe trauma

In Germany accidents are in fifth place in the statistics for cause of death and in first place as the cause of loss of potential life. From a socio-economic point of view death by accident is more relevant than malignant neoplasm or cardiovascular disease! Studies in the USA identified an average loss of 35 years of potential life after trauma, whereas malignant neoplasms led to 16 years and cardiovascular disease to 13 years loss of potential life [6].

Germany can expect up to 38,000 severely injured persons annually (i.e. persons with an Injury Severity Score [ISS] ≥ 16) [7]. In addition, at least an equal number of less severely injured persons are likely to present for treatment (ISS < 16). On the assumption of severe impact or due to a temporary disruption of vital signs, these patients initially place high demands on staff and resources (emergency room treatment and diagnostics, intensive care) at the clinic where they are admitted and treated [8].

According to the 2010 data entered in the TraumaRegister DGU® 15% of all severely injured persons (ISS ≥ 16) who reached a hospital died. The literature on health-related quality of life and functional disability is currently overwhelming [9–24]. Of those who survive 60% are still suffering from relevant disabilities two years after the accident, only 50% have returned to their former employment and 30% complain of constant pain. The incidence of posttraumatic stress disorder is given in the literature as 20–60% [9–23]. This condition leads to social isolation and impedes professional reintegration.

Possibly, prompt psychotherapeutic intervention in the early phases of rehabilitation might help reduce this late consequence [25].

Long-term studies by the statutory accident insurance companies show that even decades after a claim has been entered substantial sums of money are expended for pension payments and late treatment of accident-related disorders. Data from the insurance companies also show that the improved survival rate for the severely injured over the past ten years has led to a 6-fold increase in this patient group and that expenditure of more than one million Euros has often been necessary to cover the costs [26,27].

A study by the Swiss Accident Insurance Company (SUVA) followed up on 63 injured persons who scored an average ISS of 27 five years after the accident [28]. 22 were receiving a pension or benefits. The total cost came to CHF 780,980 on average. The cost of follow-up therapy is therefore higher than

the cost of primary treatment. Preclinical and clinical treatment accounted for 5% and follow-up treatment for 29% of the total costs. The remaining 66% is the result of loss of productivity.

Treatment outcomes for the severely injured

Clinical experience and scientific data suggest [3,29,32] that outcomes for the severely injured are decisively and lastingly affected by

- the treatment-free interval, the duration of preclinical care and the level of expertise applied (in the sense of the shortest possible rescue time),
- the 24-hour availability of comprehensive emergency diagnostics (e.g. CT, interventional radiology) and treatment (interdisciplinary emergency and OR management, special OR teams),
- excellent intensive care and immediate access to complementary surgical specialists (e.g. neurosurgery, visceral surgery, vascular and cardiac surgeons),
- early commencement of holistic rehabilitative therapies.

Studies carried out in the USA in the 1970s found that the quality of trauma care was better in specialized centres in the sense that less preventable deaths occurred [33,34]. This led to the introduction of designated and accredited trauma centres at different levels of care (Trauma levels 1–4). The idea behind this policy was that all persons with very serious injuries should be taken to a specialized trauma centre [35–42].

Scientific proof of the efficacy and benefit of introducing trauma centres is extensive and convincing. Celso undertook metaanalysis and found that establishing trauma systems had led to a reduction in trauma mortality in the USA [43]. This result has been confirmed by later studies [44–46]. Analysis of the National Trauma Data Bank also revealed better functional outcomes (based on the Functional Independence Measure, FIM) and a higher rate of long-term completely independent trauma survivors after treatment at a specialized centre [47].

In the literature there is controversial discussion as to whether a minimum number of cases improves outcomes for the severely injured [48–53].

In summary, current literature does not offer any evidence that a minimum case number is important or that there is a clear relationship between case number and outcome.

The most recent evaluation of the TraumaRegister DGU® (2010) in Germany concluded that on average 57 severely injured patients (ISS ≥ 16) were treated annually at a supraregional trauma centre, 28 at a regional trauma centre, and six at a local trauma centre [8].

A comparison of the international literature with the afore-mentioned data from the TraumaRegister (TR) also suggests that it is important to discuss greater centralization in Germany. If the number of severely injured is assumed to be 38,000 with an average stay of 11 days in the intensive care unit [8] then far more ICU beds are needed at the individual centres. Assuming 100 trauma centres in Germany this would mean that each of these centres would require 12 beds permanently set aside for

the intensive care of the severely injured. This would, in turn, mean radical restructuring of the hospital landscape. Therefore, the project TraumaNetzwerk DGU® gave preference to the alternative concept of integrating approved trauma centres for different levels of care into regionally coordinated networks.

This structure has provided a densely populated country with an integrated nationwide system of approved trauma centres, organized into networks and operating at a standardized and approved level.

Severely injured children

Statistics from the TraumaRegister DGU® (2006–2010) show that about 1500 patients aged between 0–15 years require treatment for severe injuries in Germany every year. The highest percentage of severely injured children and adolescents are aged 11 to 15 and account for almost 50%, 30% are aged 0 to 5 years, and 20% are 6 to 10 years.

The most frequently injured region is the head. Between 67 ands 78% of children (depending on age group) suffer cerebrocranial trauma (CCT) with an AIS ≥ 3. The number of severe cases of CCT is therefore much higher than for adults (58%). Injuries to the chest (32 to 45%) and to the extremities (21 to 34%) are less frequent than in adults (56%). Between 17 and 26% of affected children have suffered serious abdominal injuries in contrast to 22% of adults. Relevant pelvic and spine injuries (AIS ≥ 2) are likewise less than for adults (9–21%). Overall the mechanisms of injury and the injury patterns gradually approximate to those of adults as age increases [7,53].

Although no additional comparative data are available for Germany, findings from international studies suggest that the injured child will receive better care if the availability of the relevant experts is integrated into the special organization for the care of severely injured persons. In reality this means that paediatric trauma specialists need to be definitively linked into the system of approved trauma centres [55–79]. For this reason, this revised edition of the Whitebook includes the special infrastructure, organization and professional expertise required to treat these young patients.

Burn injuries

Every year about 1400 adults are treated for severe burns at special hospitals. The cost of treatment is high and can run to several hundred thousand Euros for one individual. Comprehensive expert treatment requires appropriate wound treatment at all stages and “state-of-the-art“ skin grafting to achieve best possible functional and aesthetic restoration as well as early social and professional rehabilitation and reintegration.

The severely burned patient needs qualified multidisciplinary and multiprofessional treatment in line with current standards clearly defined by national and international specialist societies [80–91].

In the Federal Republic of Germany the number of beds in specialized centres complies with international recommendations on adequate care standards (1 ICU bed per 1 Mio. inhabitants) (www.verbrennungsmedizin.de). A network of specialized burn centres is provided in Germany to

accommodate these special cases. Networking between the trauma centres and the centres for the severely burned is an essential part of the TraumaNetzwerk DGU® project.

2.3 Reformed Health Care Structure

Framework Law

The basic economic and section-related framework for the care of the injured is governed mainly by various statutory regulations such as

- the GKV/GHI Statutory Health Insurance and Health Care Structure Act (GKV-VSG) – 2011,
- German Diagnosis-Related Groups System (G-DRG-system),
- Social Security Code V (SGB V),
- Working Hours Act (ArbZG),
- Social Security Code VII (SGB VII) (special medical care of the German Statutory Accident Insurance (DGUV) with updated guidelines on the practice of medical care,
- Health Care Reform Act (GMG),
- Hospital Funding Act (KH-FiG),
- special federal state legislation (e.g. hospital requirement planning, rescue services)

These and other conditions such as limited government funding for the necessary investments, e.g. for heavy medical equipment and/or building projects, have led to increased concentration on specific, achievable services in the outpatient and inpatient sectors in an effort to minimize cost and optimize resources.

According to a study conducted in 2009 and 2010 the German Diagnosis-Related Groups System (G-DRG), which changes every year, only adequately covers ⅔ to ¾ of total expenditure on emergency treatment of the severely injured due to inconsistent allocation of a severely injured person to the diagnosis groups that determine income [95,96].

To optimize the G-DRG system there is a need to improve its allocation precision so that complex and heterogeneous groups of severely injured persons can be identified by the grouping mechanism.

Studies conducted by leading rescue organizations together with treatment data from some of the main casualty departments in specific regions of the Federal Republic of Germany, as presented at the DGOU Forum “Centralized Emergency Admissions“ in June 2010, indicate that modification or restructuring of in- and outpatient emergency care, especially outside normal working hours, leads to a tangible accumulation of emergency care needs at specialist centres so that the facilities are over-stretched and capacity for the severely injured is limited.

Continuous Professional Development in the Care of the Severely Injured

Constant progress in medicine and increasing specialization led to a change in the Model Regulations on Specialty Training (MWBO) in 2003. Surgery as a discipline is divided into 8 specialist qualifications combined with supplementary specialist qualifications based on general advanced surgical training ("common trunk"). Specialist qualification in orthopaedics and traumatology requires a 4-year advanced course and a 2-year basic surgery course. The in- and outpatient care of casualties is one of the core areas of orthopaedic and trauma surgery. This responsibility includes provision of comprehensive services for emergency care 24 hours a day on 365 days of the year, delivery of appropriate specialist care to the injured person and, in some cases, ensuring the delivery of such care by collaboration with other medical disciplines. The complexity of severe injury often requires joint multidisciplinary multi-stage treatment.

The treatment chain is made up of preclinical rescue, emergency room management, emergency care, surgical and non-surgical interventions to achieve definitive restoration, including rehabilitation to the level of professional and social reintegration. The advanced in-depth training course on "Special Trauma Surgery" lasts at least two years after qualification as a specialist and imparts specialist knowledge concerning the treatment of injury and its consequences, and includes insights and experiences in the care of the severely injured and management of the treatment processes.

It will not be possible in the long-term to have the right specialist on duty or on call at all times for all injuries, particularly as this often means several specialists for one patient. Advanced training as a specialist for orthopaedics and traumatology, especially the in-depth supplementary qualification in Special Trauma Surgery, is there to ensure that a broad knowledge is acquired as well as specialist training. This presupposes that generalists as well as specialists will be provided by the hospital structures to support and assist each other for the benefit of the patients. The generalists will learn continuously from the specialists and vice versa. This ensures that the generalists work at a high level and the view of the specialist does not become too narrow [97,98].

It also means that despite increasing specialization, "generalists", i.e. well qualified specialist doctors with broad-based advanced training who can take responsibility round the clock even within the specialism of orthopaedics and traumatology, should continuously receive up-to-date professional training.

The multiplicity of possible traumatopathies (e.g. abdominal trauma) highlights the necessity of imparting knowledge and experience through advanced training courses in "Special Trauma Surgery" not only in the area of orthopaedics and traumatology, but also in the related disciplines involved in the care of those requiring special surgery.

Communication of superior knowledge and experience in the context of process-steering and overall responsibility is the special task of the clinics authorized to teach orthopaedics and traumatology.

Experience gained in recent years during implementation of the TraumaNetzwerk DGU® has shown

that a regional network of clinics with different care specialisms, including facilities for early rehabilitation, constitutes an extension of the available opportunities for advanced training.

Within the organized network of competent care facilities and in the case of life-threatening body cavity injuries it is essential that the relevant expertise is available to diagnose and possibly deliver emergency treatment at very short notice in all hospitals qualified to care for the severely injured.

It is not only the advance of diagnostic and special therapeutic methods for the treatment of injuries to the abdominal and thoracic cavities with attendant specialization and concentration on special treatment apparatus, but also a drop in the number of life-threatening cavity injuries in recent years that has sometimes led to a shortage in appropriate specialist care. According to calculations based on the TraumaRegister DGU® to determine frequency and management of abdominal and thoracic cavity injuries, the statistics show that a doctor will only be confronted with this sort of injury every six to ten weeks whether the patient presents at a hospital for primary and routine care or at a maximum care facility.

These developments underline the need for additional training courses at suitable clinics – making good use of the TraumaNetzwerk DGU® project – as well as the increased need for advanced courses in specialisms to impart specific knowledge related to the care of the severely injured and to prevent treatment errors, especially in emergency situations (u.a. ATLS®, ETC®, DSTC™, Hand over Team Training [HOTT®]).

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3 The concept of the TraumaNetzwerk DGU®

3.1 Preliminary Remarks

The treatment of the severely injured is medically demanding and timing is critical when life is threatened (“golden hour of shock“) [1,2]. Consequently, correct, nationwide expert treatment must be streamlined according to the following factors:

- the expected number of severely injured persons including regional and temporal peak periods, and
- access to clinical facilities with the relevant performance spectrum (treatment capacity and expertise).

The aim of the TraumaNetzwerk DGU® project is to ensure and continuously improve the quality and reliability of care for the severely injured nationwide in Germany with the support of all experts and groups involved in the care of the injured such as specialized professionals, associations and government institutions.

Every severely injured person should have the same chance of survival anywhere in Germany at any time.

This can be achieved by means of a tiered organization that is cross-linked and enhanced by networking structures connecting the approved facilities and requires:

- Definition of standards for structures, processes, outcome quality and patient safety in the care of the severely injured,
- Contractual agreements to optimize and harmonize treatment standards, advanced training and common strategies to improve outcome quality,
- Definition of criteria for expertise and capacity at the facilities linked into the networks according to their different treatment responsibilities,
- Definition of key criteria for referral of the injured person based on the type and severity of the injuries in cooperation with the leading medical rescue organizations (ÄLRD) and definition of the need for treatment in a supraregional or regional trauma centre based on the S3 guidelines of the DGU to facilitate decision-making for the emergency doctor on site (www.awmf.de) [3],
- Expansion and intensification of the defined communication channels between all partners, including use of telecommunication.

Hospital infrastructure has been divided into three care categories that have been catalogued according to special structure and process criteria and given codes:

- local trauma centres,
- regional trauma centres,
- supraregional trauma centres.

Consequently, not all the existing institutions at each level will participate in the TraumaNetzwerk DGU® project in large conurbations, whereas some of the facilities in less densely populated areas have to be upgraded to comply with the standards set by the TraumaNetzwerk DGU® and to fulfil the requirement of timely, expert emergency care.

Having secured the survival of the patient the next highest priority is the best possible restoration of the functional and psychological integrity of same. For this reason rehabilitation centres and outpatient treatment facilities must also be integrated into the concept of TraumaNetzwerk DGU®.

3.2 Components of a Trauma Network

The nationwide care of severely injured patients from the scene of the accident to the emergency clinic and then on to rehabilitation and follow-up treatment has to be guaranteed through a well coordinated collaboration between approved hospitals (emergency clinics and inpatient rehabilitation) and facilities for outpatient care in any given region. This includes establishing networks of clinics offering different levels of care in the form of local, regional and supraregional trauma centres (TC). The concept of regional Trauma Networks (TNW) and the inclusion of clinics takes the following aspects into consideration:

- regional peculiarities,
- complete coverage of a geographical region with beneficial overlap into the margins of the adjacent TNW, whereby clinics in any one region should belong to only one network,

- appropriate size of a TNW with a minimum requirement of one supraregional TC, two regional TCs and three local TCs.

All the clinics in a TNW are audited as part of a certification process (quality assurance) to evaluate the requirements for care of the severely injured and their role within the trauma network.

The clinics are linked to each other and to the rescue services through a clearly defined communication and cooperation system. Communication within the TNW is governed by contractual agreement and is an integral part of the network. Quality of care in the individual clinics and in the TNW is evaluated partly on the basis of the data recorded and entered into the TraumaRegister DGU® on every severely injured person receiving treatment within each TNW. The cornerstone is to assess essential structural and procedural parameters and risk-adjusted mortality in terms of achieving the relevant benchmark.

Well structured cross-linking of the individual Trauma Networks must be strictly established and regularly tested by conducting mock exercises involving all parties in order to ensure correct, expeditious, expert treatment in the case of a mass casualty event or a catastrophe.

The components of a Trauma Network are presented in detail in the next section.

3.3 Clinics in the Trauma Network

Local Trauma Centre (TC)

General Characteristics – Local TC

The essential function of Local Trauma Centres is the nationwide care of the most frequent isolated injuries. These centres also serve as the first point of contact, especially outside large conurbations, and fulfil the important task of adequate emergency care and best possible allocation of the severely injured person within their institution when primary transportation to a regional or supraregional trauma centre is not possible in the time available (obligation to admit). Their integration into a Trauma Network obligates them to join with the regional and supraregional trauma centres in taking responsibility for immediate and follow-up treatment of relevant injuries and to participate in all subsequent treatment phases in accordance with regional circumstances and their individual performance spectrum.

Responsibilities within a TNW – Local TC

The basic precondition for successful emergency care of the severely injured at a local trauma centre on 24-hour standby is the ability and experience to recognize and control life-threatening abdominal bleeding (emergency laparotomy), thorax (emergency thoracotomy), and pelvis (application of an external fixator or pelvic clamp) and to address serious injuries to the extremities. The task of the local trauma centre therefore consists of emergency treatment of life-threatening conditions (Damage Control Strategy) and reliable provision of transport to the next regional/supraregional trauma centre. The responsibilities can be detailed as follows:

- Guaranteed treatment of a severely injured person in the sense of emergency surgical intervention, especially recognition and management of body cavity injuries and severe injuries to the trunk and extremities,
- Obligation to participate jointly in care and follow-up treatment with the regional and supraregional trauma centres,
- Optional participation in clinical studies,
- Participation in basic and advanced specialist courses,
- Constant guarantee and improvement of care quality in the context of external and internal general and special quality assurance procedures for trauma surgery.

Quality standards for infrastructure and procedure – Local TC

- Clinic for Trauma Surgery, Clinic for Orthopaedics and Trauma Surgery or Clinic for Surgery with an orthopaedic/trauma expert,
- 24-hour standby for emergency admission of severely injured persons,
- 24-hour availability (on call, present within 20–30 minutes): Specialist for orthopaedics/trauma surgery with an additional qualification in special trauma surgery or consultant for surgery specialized in trauma surgery,
- 24-hour availability (on call, present within 20–30 minutes): Specialist for visceral or general surgery,
- 24-hour availability (on call, present within 20–30 minutes): Specialist for anaesthesiology,
- 24-hour standby for emergency admissions and emergency care of the severely injured,
- 24-hour functional operating room for emergencies.

Personnel Requirements – Local TC

Medical Management (Senior Consultant/Medical Director/Consultant) – Local TC

- Specialist for orthopaedics/trauma surgery with additional qualification in special trauma surgery, or
- Specialist for surgery with a main focus on trauma surgery

Basic team in the emergency room – Local TC

- 1 specialist for orthopaedics/trauma surgery or visceral or general surgery and/or specialty registrar* (MS-standard),
- 1 specialist for anaesthesiology and/or specialty registrar (MS-standard),
- 2 nurses for surgery,
- 1 nurse for anaesthesiology,

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* Of the trauma specialists responsible for emergency surgery (i.e. senior registrar and consultant) 50% must have an advanced qualification in emergency room management and a standard course in Advanced Trauma Life Support-(ATLS®). The DGU recommends participation in an ATLS® course or an ATLS® equivalent course (e.g. ETC®).

- 1 medical and technical radiology specialist (MTRA).

On-call emergency team (present within 20 minutes) – Local TC

- Specialist for orthopaedics/trauma surgery with additional qualification in special trauma surgery (consultant)*,
- Specialist for visceral surgery or general surgery (consultant),
- Specialist for anaesthesiology (consultant),
- Specialist for radiology (consultant),
- 2 OR nurses.

Infrastructure Requirements – Local TC

Emergency admissions – Local TC

A local TC must have an emergency room. The relevant imaging equipment must be available at all times for prompt diagnosis and treatment of injuries, including life-threatening body cavity injuries. The emergency room must contain imaging equipment based either on x-ray or ultrasound technology or CT. The emergency room must have its own independent heating system.

In the main interdisciplinary emergency centres there will be a jointly agreed protocol setting out responsibilities with regard to the emergency treatment of the severely injured.

Surgery Department – Local TC

An operating room must be held in constant readiness for emergency surgery to treat a severely injured person.

Required installations are listed on p. 30 of the Appendix.

Intensive Care Unit – Local TC

Provision must be made for temporary intensive medical care of the severely injured.

Regional Trauma Centre

General Characteristics – Regional TC

Regional trauma centres are responsible for comprehensive emergency and definitive care of the severely injured and maintain adequate intensive care and surgical facilities for this task. The necessary apparatus and human resources include the constant presence of specialists with advanced training in special trauma surgery, immediate access to consultants in other specialist disciplines (e.g. neurosurgery), diagnostic, therapeutic and surgical installations appropriate to this level of care, and participation in disaster control with provision of sufficient treatment capacity. It differs from a supraregional trauma centre in that capacity is limited (emergency treatment area) and there are limited specialists for extremely complex injuries (e.g. thoracic aortic lesions).

Responsibilities within the Trauma Network – Regional TC

In addition to the responsibilities of the local trauma centres a regional centre should be able to offer definitive treatment of the majority of injuries and their consequences. The responsibilities of a regional TC include:

- compulsory 24-hour admission and care of severely injured patients of any age, including very severe injuries,
- Constant presence of specified specialist consultants,
- Obligation to offer medical care and follow-up treatment in collaboration with the local TC and supraregional TC,
- Participation in specialist professional development and advanced training,
- Participation in clinical studies,
- Continuous improvements and guaranteed care quality in the context of external and internal general and special quality assurance procedures for trauma surgery.

Quality standards for infrastructure and procedure – Regional TC

- Clinic for Traumatology or Clinic for Orthopaedics and Trauma Surgery,
- 24-hour availability (on call, present within 20–30 minutes): Specialist for orthopaedics/trauma surgery with an additional qualification in special trauma surgery or specialist for surgery with a main focus on trauma surgery,
- 24-hour availability (on call, present within 20–30 minutes): Specialist for visceral or general surgery,
- 24-hour availability (on call, present within 20–30 minutes): Specialist for anaesthesiology,
- 24-hour availability (on call, present within 20–30 minutes): Specialist for radiology,
- 24-hour availability (on call, present within 20–30 minutes) neurotraumatology specialist (see special text),
- constant availability (on call, present within 20–30 minutes) of all specialist departments involved in the treatment of special injuries,
- 24-hour standby for emergency admissions to care for the severely injured,
- 24-hour functional operating room for the definitive treatment of at least one severely injured person,
- 24-hour availability of appropriate intensive care capacity,
- Participation in preclinical emergency rescue (rescue helicopter/clinicar).

Personnel Requirements – Regional TC

Medical Management (Senior Consultant/Medical Director/Consultant)

- Consultant for orthopaedics/trauma surgery with additional qualification in special trauma surgery or consultant for surgery specialized in trauma surgery, with at least 18-months experience in teaching special trauma surgery,

- Assistant: Specialist for orthopaedics/trauma surgery with additional qualification in special trauma surgery or consultant for surgery specialized in trauma surgery.

Basic team in the emergency room – Regional TC

- 1 specialist and/or specialty registrar for orthopaedics/trauma surgery* (MS-standard),
- 1 specialty registrar in orthopaedics/trauma surgery, or visceral or general surgery*,
- 1 specialist for anaesthesiology and/or specialty registrar (MS-standard),
- 1 specialist for radiology and/or specialty registrar (MS-standard),
- 2 nurses for surgery,
- 1 nurse for anaesthesiology,
- 1 medical and technical radiology specialist (MTRA).

To cope with all types of injuries it must be possible to supplement the medical team by additional specialists/consultants (extended emergency team):

On-call emergency team (present within 20–30 minutes – Regional TC

- Specialist for orthopaedics/trauma surgery with additional qualification in special trauma surgery (consultant)*,
- Specialist for visceral surgery or general surgery (consultant),
- Specialist for anaesthesiology (consultant),
- Specialist for radiology (consultant),
- Specialist for neurosurgery,
- Specialist for vascular surgery,
- 2 OR nurses.

Optional

- Specialist for ophthalmology,
- Specialist for gynaecology,
- Specialist for ENT,
- Specialist for paediatric surgery and/or specialist paediatrician,
- Specialist for oral maxillofacial surgery,
- Specialist for plastic surgery,
- Specialist for thoracic surgery,
- Specialist for urology,
- Specialist with additional qualifications in hand surgery (Specialist for orthopaedics and trauma surgery or specialist for plastic surgery).

Regional TC without its own neurosurgical clinic

Neurotraumatological emergency care must be guaranteed at all times at a regional TC. At hospitals without their own neurosurgery clinic/department neurotraumatological care is to be provided by one of the means given below. The efficiency of the arrangement will be evaluated in the context of a two-

stage certification and re-certification process based on data from the TraumaRegister DGU® (see 6.3. Evaluation of Outcome Quality).

A Neurotraumatology by Trauma Surgeons: Surgical intervention is performed by at least two trauma surgeons experienced in neurotraumatological surgery (with proof of relevant advanced qualifications) who guarantee their expertise 24 hours a day on 365 days a year. In addition, contractual agreements with an external neurosurgical clinic should be in place. Depending on the availability of neuro-monitoring in the Intensive Care Unit, subsequent treatment will be performed at a supraregional trauma centre.

B Treatment may also be provided by a neurosurgical consultancy service: Neurotraumatological treatment is performed at a regional TC by an external neurosurgeon with neurotraumatological expertise. A patient with severe CCT and indications for trepanation/ventriculometry does not need to be transferred. This model can only be realized under the following conditions:

- The neurosurgical back-up service must be on-call 24 hours/365 days and offer guaranteed consultancy standards.
- The entire infrastructure and installations necessary for surgical intervention and intensive care of these patients (intracerebral pressure monitoring) must be available at the clinic for trauma surgery.

C Cooperation with an external neurosurgical clinic/department: Neurosurgery is conducted at another hospital in the specialist department. This model can only be realized under the following conditions:

- Capabilities for telemedical cooperation (see Appendix p. 34) for analysis of neuroradiological imaging at the external neurosurgical department 24 h/365 days. The relevant recommendations on transfer times concerning data transmission are to be observed (see Appendix IV).
- Cooperation agreements between the two clinics with regard to prompt onward transfer of patients with severe CCT to the neurosurgical department. It is important to clarify procedure for patients with initial infaust prognosis (e.g. no primary referral) and procedure for transfer back to the referring clinic once the neurosurgical interventions have been completed. An additional neurosurgical facility should also be entered into the agreement/recommendations as an alternative in case basic capacity is exhausted.
- Additional agreements should be in place to ensure care of other traumatopathologies. It must be possible to treat extracranial injuries at the referral clinic, which must be attached to a regional or supraregional TC.

Infrastructure Requirements – Regional TC

Emergency Admissions – Regional TC

A regional TC maintains an emergency room with a surface area of at least 25 m^2 (better still: 40 m^2). The emergency room must have its own independent heating system.

In new buildings or during structural modifications a computed tomography facility is to be built in the immediate vicinity of the emergency room.

The emergency room should be physically close to the ambulance bay, helicopter landing pad, radiological department and surgical department.

The relevant imaging equipment must be available at all times for prompt diagnosis and treatment of injuries, including life-threatening body cavity injuries. The emergency room must contain imaging equipment based either on x-ray or ultrasound technology or CT.

In the main interdisciplinary emergency centres there will be a jointly agreed protocol setting out responsibilities with regard to the emergency treatment of the severely injured.

Immediately adjacent to the emergency room there should be a room where emergency surgery can be performed (separate anaesthesia unit, OR instrument sets for emergency trauma, general, neural and thoracic surgery).

The emergency room must contain all materials and instruments required for emergency surgery in all the sizes needed for children.

Surgery Department – Regional TC

An operating room must be held in constant readiness for emergency surgery to treat a severely injured person.

Required installations are listed on p. 30 of the Appendix.

Intensive Care Unit – Regional TC and supraregional TC

Provision must be made for the long-term intensive medical care of a severely injured person, including neuromonitoring. The personnel, structural and organizational requirements for intensive care units at regional or supraregional TCs are given on p. 19.

Supraregional Trauma Centre

General Characteristics – Supraregional TC

Supraregional trauma centres are located at maximum care hospitals and have specific tasks and responsibilities in the comprehensive care of the multiply and severely injured, especially those with exceptionally complex or rare injury patterns. In addition to uninterrupted provision of intensive care and operating room capacity for immediate admissions at all times, these centres guarantee the prompt availability of all necessary specialists for interdisciplinary treatment. Suitable locations for supraregional trauma centres are university hospitals, clinics of the Trade Associations, and comparable established clinics of the same kind. In addition to nursing and caring for the sick, these institutions also have special responsibilities in the areas of teaching and advanced training. In the case of university hospitals there are additional obligations to hold lectures and conduct research in trauma surgery, to participate in disaster control, and to provide sufficient treatment capacity.

If the clinics for maximum and specialized care are in close proximity, it is recommended that they should combine to form a supraregional trauma centre in order to optimize the benefits of the available resources as long as they fulfil all the requirements when taken together.

Responsibilities within the Trauma Network – Supraregional TC

At a supraregional TC all the qualified staff needed to manage all kinds of injuries in an emergency and to provide subsequent definitive treatment must be on hand round the clock – 24 h/365 days. Possible exceptions are injuries that need attention at special treatment centres (e.g. severe burns). The facility must be able to provide definitive treatment to a least two severely injured persons at the same time.

- Obligation to participate in immediate and follow up care (secondary referrals from other units) of any severely injured person as part of the integrated system of local and regional trauma centres,
- Patients with special injuries (e.g. burns, spinal lesions, injuries requiring pressure chamber, replantations) must be treated initially at the supraregional trauma centres and/or promptly transferred by them to the appropriate specialist facilities,
- Participation in disaster control with readiness to cope with heavy casualty admissions as a result of mass casualty events and catastrophes,
- Provision of teaching and advanced training across all specialist disciplines,
- Special obligation to take part in clinical studies,
- Constant guarantee and improvement of care quality in the context of external and internal general and special quality assurance procedures for trauma surgery,
- Guaranteed interhospital advanced training and quality assurance (quality circles) within the Trauma Network,
- Responsibility for specific non-patient-related obligations within the TNW (e.g. support in the areas of quality assurance, communication and organization).

Quality standards for infrastructure and procedure – Supraregional TC

- Clinic for Trauma Surgery or Clinic for Orthopaedics and Trauma Surgery,
- 24-hour availability: Specialist for orthopaedics and trauma surgery with an additional qualification in special surgery (on-call, present within 20–30 minutes) or consultant for surgery specialized in trauma surgery,
- 24-hour availability (on-call, present within 20–30 minutes): Specialist for visceral surgery,
- 24-hour availability (on-call, present within 20–30 minutes): Specialist for anaesthesiology,
- 24-hour availability (on-call, present within 20–30 minutes): Specialist for radiology,
- 24-hour availability (on call, present within 20–30 minutes): Specialist for neurosurgery,
- 24-hour availability (on call, present within 20–30 minutes) of all other specialist disciplines needed to treat the severely injured,
- 24-hour emergency room standby to accommodate and care for at least two severely injured persons,
- 24-hour emergency surgery capacity,
- 24-hour provision of sufficient intensive care capacity to treat at least two severely injured persons simultaneously,
- lead role in preclinical emergency rescue,
- clinical research.

Personnel Requirements – Supraregional TC

Personnel requirements (costs of provision) are unavoidably high given the tasks to be performed. The emergency team initially requires (for one severely injured person) at least five doctors and five practitioners (emergency team).

Medical Management – Supraregional TC (Senior Consultant/Medical Director)

- Specialist for orthopaedics and trauma surgery with an additional qualification in special trauma or consultant for surgery specialized in trauma surgery,
- Associate professorship or comparable scientific qualification,
- Fully licensed to teach on courses for the advanced qualification in special trauma surgery,
- Assistant: Specialist for orthopaedics/trauma surgery with additional qualification in special trauma surgery or consultant for surgery specialized in trauma surgery.

Basic team in the emergency room – supraregional TC

- 1 Specialist or specialty registrar for orthopaedics and trauma surgery*,
- 1 specialty registrar in orthopaedics and trauma surgery or registrar on the advanced course for special trauma surgery or specialty registrar for visceral or general surgery*,
- 1 Specialist for anaesthesiology and/or specialty registrar (MS-standard),
- 1 Specialist for radiology or specialty registrar (MS-standard),
- 2 nurses for surgery,
- 1 nurse for anaesthesiology,
- 1 medical and technical radiology specialist (MTRA),
- transport staff

On-call emergency team (present within 20–30 minutes) – supraregional TC

Depending on the type of injury it may be necessary to call upon specialists from other disciplines at short notice to supplement the emergency team.

- Specialist in orthopaedics and trauma surgery with an additional qualification in special trauma surgery or MS in surgery with special trauma (senior consultant)*,
- Specialist for visceral or general surgery (senior consultant),
- Specialist for anaesthesiology (senior consultant),
- Specialist for neurosurgery (senior consultant),
- Specialist for radiology (senior consultant) with expertise in interventional radiology,
- Specialist for vascular surgery,
- Specialist for cardiac and/or thoracic surgery,
- Specialist for oral maxillofacial surgery,
- Specialist for ENT,
- Specialist for ophthalmology,
- Specialist for urology,
- 2 OR nurses,
- other specialists on-call to facilitate simultaneous treatment of several severely injured persons.

Optional – Supraregional TC

- Specialist for gynaecology,
- Specialist with additional qualification in hand surgery (specialist for orthopaedics and trauma surgery or specialist for plastic surgery),
- Specialist for paediatric surgery or paediatrics.

Infrastructure Requirements – Supraregional TC

Emergency Admissions – supraregional TC

Supraregional trauma centres maintain an emergency room with a surface area of at least 50 m^2 for the simultaneous treatment of two severely injured persons or two separate fully equipped emergency rooms.

In new buildings or during structural modifications a computed tomography facility is to be built in the immediate vicinity of the emergency room.

The emergency room should be physically close to the ambulance bay, helicopter landing pad, radiological department and surgical department.

The relevant imaging equipment must be available at all times for prompt diagnosis and treatment of injuries, including life-threatening body cavity injuries. The emergency room must contain imaging equipment based either on x-ray or ultrasound technology or CT. There must be an interventional angiography unit on hand.

In the main interdisciplinary emergency centres there will be a jointly agreed protocol setting out responsibilities with regard to the emergency treatment of the severely injured.

Immediately adjacent to the emergency room there should be a room where emergency surgery can be performed (separate anaesthetic apparatus, OR instrument sets for emergency trauma, visceral, neural, thoracic and maxillofacial surgery).

The emergency room must contain all materials and instruments required for emergency surgery in all the sizes needed for children.

Surgery Department – Supraregional TC

To fulfil its responsibilities a supraregional trauma centre must maintain operating rooms in constant readiness to receive and treat two severely injured persons.

Required installations are listed on p. 30 of the Appendix.

Quality standards for infrastructure and procedure at an intensive care unit – Regional TC and Supraregional TC

For a regional or supraregional trauma centre to fulfil its responsibilities, the following infrastructure and procedural arrangements for intensive medical care must be in place [4–6].

The structure and installations of the intensive care unit must conform to the recommendations of the German Interdisciplinary Association for Intensive Medical Care (DIVI) of 30.11.2010 [4]. In addition, it is necessary to comply with the structural requirements set out in the relevant valid OPS catalogue for complex intensive medical care (Basic Procedure, Code 8-980) (www.dimdi.de). The intensive care unit is defined in the Recommendations from DIVI of 18.04.1989 (updated on 26.03.1999).

Personnel Requirements for the Intensive Care Unit

Doctor in charge of the ICU

Specialist with an additional qualification in intensive care working full-time at the ICU.

Head Nurse of the ICU

Nurse with additional specialist qualifications in anaesthesia and intensive care working full-time at the ICU.

Personnel at the intensive care unit

Medical Team

- 1 specialty registrar (MS-standard) present 24/365 in nonstop shifts (for up to 12 beds); 2 specialty registrars for more than 12 beds,
- 1 specialist with an additional qualification in intensive care (continuous presence during normal working hours: present within 20–30 minutes when on-call [in compliance with the Recommendations of DIVI (4)]).

Nursing Team

- 1 nurse for 2 care stations working shifts,
- 1 nurse for 1 care station in special situations: severe burns, extracorporal lung replacement procedures, > 60% patients with organ replacement procedures,
- physiotherapy,
- specialist psychological care

3.4 Care of severely injured children (up to 15 years of age)

In every TNW there should be a cooperation agreement with a supraregional trauma centre that has specialists in paediatric trauma (paediatric trauma referral centre). If none of the clinics in the TNW fulfil the requirements, agreements should be made with referral centres in an adjacent TNW.

The aim is to ensure that severely injured children receive treatment as soon as possible (30 minutes) at a regional or supraregional trauma centre. If it would take up too much preclinical time to transport an injured child to these centres (> 30 min), then emergency care becomes the task of the nearest local trauma centre. Once vital parameters have been reliably stabilized, the option of referral to a trauma centre with special paediatric trauma competence can be evaluated.

Referral and contact criteria

Given the following criteria it is essential to consider referral in consultation with the head of paediatric trauma at the referral centre (by telephone or telecommunication):

- GCS < 13 (moderate to severe CCT), impression fracture, neurological symptoms,
- Thoracic trauma with pulmonary contusion (AIS > 2),
- Abdominal trauma with organ injury (AIS > 2),
- Pelvic fracture or fracture of 2 long bones of the lower extremities,
- Intensive care > 24 h,
- ISS ≥ 15.

Paediatric trauma referral centre

Quality standards for infrastructure and procedure

The paediatric trauma referral centre of a TNW should comply with all the structural and procedural requirements of a supraregional trauma centre as well as the following additional requirements:

- Clinic for paediatric surgery with special paediatric trauma competence or clinic for orthopaedics and traumatology with special paediatric trauma competence,
- Clinic for paediatrics and care of adolescents,
- Paediatric Intensive Care Unit,
- Emergency admissions or central admissions with child-specific procedures in the emergency room protocol.

Personnel Requirements

Medical Management

- Specialist for paediatric surgery with special qualifications in paediatric trauma or specialist for orthopaedics and trauma surgery with an additional qualification in special trauma surgery and special qualifications in paediatric trauma

Basic team in the emergency room

The same requirements apply as for a supraregional trauma centre with the addition of:

- a paediatric surgeon experienced in trauma care or a traumatologist experienced in paediatric trauma,
- anaesthetist with paediatric experience.

Extended emergency room team (present within 20–30 minutes)

- neurosurgeon with paediatric experience or paediatric surgeon with experience in neurosurgery,
- paediatric intensive care specialist or intensive care specialist with experience in paediatric anaesthesia/traumatology,
- radiologist with paediatric experience.

3.5 Care of the severely burned in the TNW

Every clinic participating in the Trauma Network must care for the severely burned in accordance with the procedures set out by the DGV (German Society for Burn Medicine).

Indications for Treatment at a Centre for the Severely Burned

After primary care at a trauma centre the patient should be transferred as soon as possible to a centre for the severely burned.

Referral is managed by registering the patient with the “Central Agency for the Allocation of Hospital Beds for the Severely Burned“ (Tel.: 040/42851-3998 and 040/42851-3999, Fax: 040/42851-4269, E-Mail: leitstelle@feuerwehr.hamburg.de) in Hamburg and they will identify an available bed (38 clinics with 183 beds).

Indications for transfer to or treatment at a centre for the severely burned have been clearly defined by the German Society for Burn Medicine and depend on the extent and localization of the burn, concomitant injuries, and special patient-specific data:

- burns to the face/neck, hands, feet, anogenital region, armpits, areas covering the large joints,
- second degree burns to more than 15% body surface,
- third degree burns to more than 10% body surface,
- inhalation trauma,
- electrical injuries,
- (pre-existing morbidities or aged < 8 or > 60 years).

Further details are given on p. 31 of the Appendix.

3.6 References

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3.7 Rehabilitation of the Severely Injured within the TNW

Inpatient Rehabilitation

Responsibilities within the Trauma Network [1–5]

- To ensure early rehabilitative therapy of the severely injured within the context of emergency medical care,
- In collaboration with supraregional and regional TCs facilities for the early rehabilitation of the severely injured are under obligation to contribute to the treatment and follow-up care of these patients within their performance spectrum,
- Participation in clinical studies,
- Member institutions regularly involved in the early rehabilitative care of the severely injured must possess the necessary expertise in both emergency medicine and rehabilitative therapy and take responsibility for running the relevant subject-specific courses,
- Constant guarantee and improvement of care quality in the context of external and internal quality assurance procedures for trauma surgery (TraumaRegister DGU® Supplement on Rehabilitation).

Quality standards for infrastructure and procedure

Structural requirements are set out in the OPS code guidelines (www.dimdi.de).

In addition to the minimum OPS requirements, early rehabilitation of a severely injured person not only requires physio- and ergotherapeutic strategies, but also early psychological care of the patient and relatives, all of which must be provided. At the same time, social services must be involved to attend to the social and professional reintegration of the individual.

Personnel Requirements

Medical Management

- Specialist for orthopaedics and traumatology or specialist for orthopaedics or specialist for surgery specialized in trauma surgery and at least 3-years experience in rehabilitative medicine

Care Team

- Early rehabilitation team under specialist medical management,
- Psychologist,
- Social services.
- Provision of at least one of the following treatment facilities:
  - Physiotherapy/remedial gymnastics,
  - Physiotherapy,
  - Ergotherapy,
  - Electrotherapy,
  - Hydrotherapy,

- Mechanotherapy,
- Neuropsychology,
- Psychotherapy,
- Speech/facio-oral therapy, language therapy,
- Art and music therapy,
- Dysphagia therapy.

Special quality assurance measures

- standardized early rehabilitation assessment or application of disorder-specific scoring systems to document and evaluate functional deficits in at least five areas at the start of treatment
- weekly team meetings with weekly documentation of treatment outcomes to date and next treatment goals
- activity-generating treatment by specially trained nurses
- assessment prior to discharge
- final decision on follow-up treatment after hospital discharge

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Further information on organization and details of in- and outpatient rehabilitation procedures can be found on p. 32 and p. 33 of the Appendix.

3.8 Outpatient Follow-up Treatment within the TNW

Independent practice and care units attached to inpatient facilities must offer specific structural and procedural constituents of outpatient treatment to promote the goal of functional restoration and reintegration of the severely injured person into social and professional life.

Quality standards for infrastructure and procedure

Legislation and the requirements laid down by the professional societies on quality assurance and proper documentation in independent practice are an integral part of these recommendations. In particular, the structural and infrastructural conditions, barrier-free access to suitable treatment and

waiting rooms, and functional x-ray apparatus or access to the same are required to comply with the regulations of the German Statutory Accident Insurance.

Personnel Requirements

Medical Management

At least one of the full-time partners fulfils the following requirements:

- Specialist for orthopaedics and traumatology or specialist for surgery specialized in trauma surgery or specialist for orthopaedics and fully registered or auxiliary accident insurance consultant or proof of comparable experience in the treatment of the severely injured,
- Knowledge of approaches to physical and psychosocial rehabilitation and pain treatment.

One qualified specialist that fulfils the above criteria must be on standby at all times.

Qualification of Practitioners:

Experience and proof of knowledge in:

- bandaging techniques,
- wound cleaning and care,
- application of splints and postural supports.

Interaction between inpatient facilities and the recipient doctors

Cooperation between the treating clinics (emergency or rehabilitation clinic) should be structured according to the following points:

- proper consideration of the clinic's individually adapted treatment plan,
- prompt access to the images (x-ray, CT, MRI etc.) obtained during the course of treatment, preferrably in the form of an electronic case file (connection to the telemedicine network).

Continuation of the social reintegration process should include the following:

- Individually adapted treatment plan taking the previous programme at the referring clinic into account,
- Collaboration with the general practitioner or a specialist for orthopaedics and traumatology,
- Organization and monitoring of outpatient rehabilitative activities,
- Organization of professional rehabilitation in close cooperation with the social insurance companies and company doctor,
- Guaranteed psychological rehabilitation,
- If necessary, organization of additional inpatient treatments,
- Regular follow-up assessments as required,
- Prompt involvement of the doctors at the referring clinics in the case of disordered or delayed progress in the course of treatment,
- Documentation of all rehabilitative activities,
- Participation in the quality circle of the TNW and in all actions to promote the quality and reliability of the TNW.

4 Networking between clinics

4.1 Interaction of the clinics participating in the Trauma Network

A Trauma Network should be made up of at least two or three local trauma centres, one regional and one supraregional trauma centre. The combination of centres should take geographical and political divisions (e.g. federal state borders) into consideration and provide balanced and well organized coverage of a specific area. If there is no supraregional centre in the Trauma Network, then it should include at least two regional trauma centres. At the same time, cooperation agreements should be entered into with supraregional trauma centres in the adjacent Trauma Networks to ensure proper care of patients with highly complex injuries and treatment needs.

Every local and regional trauma centre must cooperate with a supraregional trauma centre through the networking system. Depending on regional circumstances (e.g. hospital density) cooperations with several supraregional trauma centres and SHI-accredited independent practices may be possible.

Clinics in close proximity belong to one network for professional and organizational reasons

If several clinics for maximum care are situated in close geographical proximity and fulfil the criteria for a supraregional centre, each of these clinics can apply for categorization as a supraregional trauma centre. It must however be proven that these clinics work in close collaboration to optimize use of the available resources. Optimal utilization will be taken into consideration as part of certification of these clinics.

Management of the trauma networks in practice (cooperation, mutual support) is regulated by cooperation agreements that form an important part of certification.

4.2 Interhospital Communication

Apart from professional and technical shortcomings, avoidable adverse events are mainly due to deficits in communication, inadequate guidelines on documentation, and lack of due attention within the team [1–14]. These difficulties are most likely to arise when the patient's medical team changes. To avoid these kinds of events, the following steps should be followed when transferring a patient within the network:

- reliable, durable patient identification,
- documentation of findings, prescriptions and ongoing treatments (ideally in the form of a transfer protocol, e.g. similar to the example in the ATLS manual, DIVI emergency protocol – trauma module),
- clearly specified methods of communicating with the decision-makers, even outside normal working hours (emergency telephone, trauma mobile),
- direct communication between the attending doctor responsible for the patient at the primary care clinic and the doctor in charge at the referral centre,

- organization of rescue services with regard to responsibilities in the event of outbound transfer.

4.3 Telecommunication within the Trauma Network (Telecooperation)

It is a basic requirement that every trauma centre must make adequate arrangements for demand-oriented, modern, electronic, functionally reliable communication between the clinics of their trauma network and also with other clinics integrated into the TraumaNetzwerk DGU® project, e.g. special clinics or rehabilitation clinics. The options to meet these requirements are known as teleradiology (transfer of image data) or telemedicine (transfer of general data, e.g. physiological parameters).

Since cooperation is the essential foundation on which optimization of the care of the severely injured through interclinical communication takes place, the term telecooperation will also be used in the following texts.

Basically, every form of communication must comply entirely with valid data protection laws. The current rules as set out in the Regulations for Radiography should be applied to the individual scenario and transfer of x-ray images should adhere to the recommendations of the German Society for Radiology, e.g. with regard to resolution, as set out and approved at the Consensus Conference of 23.02.2008. The valid rules and standards for quality assurance of the procedure itself and quality of the communicated data are to be followed.

In telemedicine networking the following situations might be expected:

- transfer in the emergency phase (emergency room to emergency room),
- consultation with other specialists in the emergency phase (e.g. neurosurgery, OMF),
- consultation with colleagues at an affiliated trauma centre or with specialists from other specialist disciplines after the emergency phase to clarify questions of therapy planning, complication management and possible referral to another clinic,
- communication of findings to clinics providing follow-up care (Reha) and SHI-accredited doctors in independent practice who have been contracted into the network.

As part of the interdisciplinary project of the DGU – TeleKooperation TNW® – an appropriate system for nationwide, interhospital telemedicine communication across all sectors is being set up for the rapid transfer of imaging data and other information.

Further details on the requirements of telecooperation systems are given on p. 34 of the Appendix.

4.4 Criteria for onward transfer

In the case of very severe or special injuries primary care should be followed by prompt transfer to a higher level regional or supraregional trauma centre within the Trauma Network according to specific, defined criteria.

Transfer criteria must be set out in writing in the cooperation agreement of the Trauma Network and must be approved by all participating trauma centres. Before transfer the patient must be given

primary care at the level of the clinic receiving the emergency in accordance with ATLS® standards. This means that transfer within the network is not permitted if the patient's haemodynamic condition is unstable. Primary care must be delivered first.

Criteria for transfer to a supraregional trauma centre

The criteria given here are intended as a suggestion and require contractual agreement within the Trauma Network.

Severely injured patients with

Diagnoses:

- severe CCT*,
- penetrating cerebrocranial trauma or impression fractures*,
- neurological focal signs*,
- space-occupying haemorrhage*,
- maxillofacial injuries*,
- vascular injuries to the trunk*/**,
- unstable pelvic ring injuries with haemorrhaging,
- urogenital injuries*,
- spinal injuries with neurological deficit*,
- severe chest trauma with lung injury or cardiac involvement**,
- sepsis or multiple organ failure,

or for:

- interventional vascular management (e.g. aortic stent, coiling),
- conservative treatment of relevant abdominal parenchymatous organ injuries,
- installation of intracranial pressure monitoring,
- replantation, reconstruction or revascularization of complex injuries,
- complex respirator treatment,

and, possibly, comorbidities/concomitant states:

- pregnancy,
- age < 16 or > 55 years,
- immune suppression,
- anticoagulation,
- relevant pre-existing disorders (e.g. cardiac, respiratory or coagulation-physiological disorders).

* if a special department is not available 24 h/365 d at the primary clinic

** after haemodynamic stabilization within the capabilities of the primary centre

4.5 Networking between preclinical and clinical care facilities

Rapid and definitive treatment of a severely injured person at a trauma centre is only possible if there is close cooperation between the facilities for preclinical and clinical treatment.

Only intensive collaboration of the trauma centres with the rescue services within the Trauma Network will guarantee that a patient who has received emergency care at the scene of the accident will be taken to a suitable clinic and that transfer will be smooth [15,16].

Definitive procedures for communication can be established through the participation in quality assurance strategies (quality circle) of those responsible for preclinical care. Since the leading rescue units play a central role in patient referral, the heads of these units are to be included in these strategies (see quality circle) [13,17–23].

The DGU welcomes the nationwide quality assurance strategies that some rescue organizations already offer (e.g. ADAC air rescue, KTQ). Close interaction with the strategies described here is an important objective for the future.

Joint advanced training events within the Trauma Network and including emergency doctors and rescue personnel should also offer courses for preclinical trauma care (e.g. Pre Hospital Trauma Life Support – PHTLS) and the interface between the emergency room and the clinic (e.g. Hand Over Team Training – HOTT®).

Criteria for admission to the emergency room of a trauma centre with activation of the emergency room team

The degree of threat to the injured patient and, consequently, the indication for care in the emergency room of a trauma centre must be determined by the emergency doctor in the preclinical treatment phase. To guarantee high reliability of care underestimation of injury severity (undertriage) should not be more than 10% and overestimation (overtriage) not more than 50% [24–26]. Since the various scoring systems to determine the indication for emergency room care have not proven reliable [23], the rescue team should document:

- disorder of vital parameters,
- obvious injuries,
- possibly the cause of the accident

to determine the indication for treatment at a trauma centre.

Often the activation criteria cannot be determined conclusively at the scene of the accident. If in doubt, a higher level of severity should be assumed and the patient should be referred for emergency room treatment [10,27–36].

The combination of an acute event due to underlying disease and trauma may justify emergency room treatment (e.g. fall after cerebral or myocardial infarction). In these cases additional relevant

specialists must be involved as soon as possible according to the tentative diagnoses and this situation must be taken into account by the rescue services when selecting a primary care clinic.

Criteria for emergency treatment according to S3 Guidelines

Recommendation type A:

a) Disorder of vital parameters
- systolic blood pressure below 90 mmHg after trauma,
- GCS below 9 after trauma,
- disordered breathing/emergency intubation after trauma.

b) Obvious injuries
- penetrating injuries to the trunk/neck region,
- gunshot wounds to the trunk/neck region,
- fractures of more than two proximal bones,
- unstable thorax,
- unstable pelvic fracture,
- amputation injury proximal to the hands/feet,
- injuries with neurological signs of spinal cord transection,
- open cranial trauma,
- burn > 20% of ≥ 2b degrees.

Recommendation type B:

c) cause of accident or situation
- fall from a height of more than 3 metres,
- Road traffic accident (RTA),
- head-on collision with indentation of more than 50–75 cm,
- change of speed of delta > 30 km/h,
- pedestrian / two-wheeled vehicle collision,
- death of a passenger,
- ejection of a passenger.

If none of the criteria from a) or b) apply, the cause of accident c) determines the type of emergency care.

Handing over the injured person and documentation on preclinical treatment

The clinic's in-house procedures must include strategies for timely alert and arrival of the entire emergency room team (central crew-calling system). Transfer of the severely injured person from the attending emergency doctor to the recipient trauma leader takes place in the presence of the

emergency room team. The whole team must be able to follow the report of the emergency doctor in order to understand the initial situation and to avoid loss of time due to missing information.

The DIVI protocol (www.divi-org.de) together with the documentation of the TraumaRegister DGU® is to be utilized to record all preclinical findings, activities and treatments.

In addition, the rescue personnel must be permitted to submit an anonymous evaluation of the procedures for patient transfer (documentation form Customer Satisfaction Rescue Service).

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5 Quality and Reliability of Care for the Severely Injured

Quality and reliability of patient care are key concerns of medical activity. When the Health Care Structure Act 01.01.1993 came into force quality assurance was laid down as an indispensible, legally binding component of medical care (section 9, SGB V, §§ 135–139). § 135a SGB V regulates compulsory external and internal quality assurance.

Transparency and patient safety are laid down as the highest priorities in the statutes of the German Society of Trauma Surgery and the German Society for Orthopaedics and Traumatology.

The TraumaNetzwerk DGU® project aims to guarantee and improve the nationwide quality and reliability of specialist care at all times for the severely injured in Germany.

This Whitebook sets out standards for the structure, organization and installation of care facilities for the severely injured and includes recommendations to promote quality and reliability in this specialized area of care and also specifies indicators and key data for evaluation purposes. Existing terminology for quality and risk management is also used here to describe quality criteria – structure, procedure, and outcome quality – but is, however, especially and specifically directed towards “planning“, “implementation“ and “suitability“ of quality criteria for the care of the severely injured [3].

Outcomes of clinical studies, experience derived from implementing the TraumaNetzwerk DGU® project over the past 4 years [4,5] and evidence gathered separately by the participating specialist societies and associations involved in writing this edition of the Whitebook form the basis for the standards, quality criteria and key data.

The interdisciplinary S3 Guidelines for the care of the severely injured – published in 2012 – (http://www.awmf.org/leitlinien.html) [1] to address the emergency treatment of severely injured persons reflects the current status of scientific knowledge and includes procedures that have proven valuable in practice. It forms another important foundation on which to base standards for the three important phases of emergency treatment of the severely injured.

- Preclinical phase,
- Emergency room phase,
- first OR phase

5.1 Strategies to Promote Quality and Reliability

Trauma Centre

- Formalize interdisciplinary collaboration (Standard Operating Procedures) taking into account the S3 Guidelines for the care of the severely injured and regulations for those taking responsibility (team leadership) for emergency room care (see box),
- Establish the clinic's own quality circle for care of the severely injured and hold meetings at least every six months,
- regularly enter information on outcomes from all participating doctors and professional groups into the TraumaRegister DGU®,
- Organize risk management (e.g. CIRS) and send regular reports to all participating doctors and professional groups,
- Set up a trauma surgery or interdisciplinary Morbidity & Mortality conference,
- regular reports on nosocomial infections (Krankenhaus(Hospital) Infection Surveillance System [KISS]),
- Organize the clinic's own complaints management procedure for patients and relatives,
- Draw up in-house agreements for prompt identification of potential organ donors (see box).

Excerpt from the S3 Guidelines for the care of the severely injured / polytraumatized [1]

- The care of the severely injured is an interdisciplinary task. Consequently, clear agreements adapted to the structure of the institution have to be in place in the form of treatment protocols that regulate interdisciplinary cooperation. These guidelines can be modified to accommodate local circumstances. However, the general basis for the care of the severely injured remains the interdisciplinary S3 Guidelines of the German Society for Traumatology.
- Responsibilities of the team management are to:
  - document the (medical) findings of the individual specialist team members and ensure that decisions are made,
  - take charge of communications (with each other) and determine next steps in diagnostics and therapy.

  Ideally it is the task of the trauma leader to identify the "best" decision based on consultation. In this context, it is also important to remember that, in terms of liability and responsibility, one person must take the final decision.

  There is no internal or external evidence to contradict the recommendation of the German Society for Traumatology that this responsibility lies with a broadly educated, well trained, experienced traumatologist with advanced qualifications.

In the context of care of critically injured patients and when all attempts to save life have failed, the possibility of organ donation is to be evaluated. The regulations set out in transplantation legislation are to be taken into account and potential organ donors must be registered with the German Foundation for Organ Transplantation (DSO).

Trauma Network

In a Trauma Network a quality circle is set up and meets at least twice a year [2].

Participants:

- Heads of Trauma Centres,
- Medical Director of Rescue Services,
- Heads of leading rescue units,
- Representatives from rescue services within the region of the TNW,
- Heads of rehabilitation facilities,
- Doctors in independent practice contracted to conduct outpatient follow-up treatment.

Optional:

- representatives of other specific disciplines involved in trauma care to deal with specific issues (anaesthesiology, neurosurgery, paediatric surgery, radiology),
- representatives of the medical and non-medical staff involved in the care of the severely injured.

Tasks of the Quality Circle:

- Discussion of the outcomes to be entered into the TraumaRegister DGU®,
- Evaluation of outcomes reported by the rescue services,
- Suggestions for improvement of regional and supraregional systems for the care of the severely injured including procedures to cope with heavy casualties and catastrophes,
- Resolution of “interface difficulties“ in interhospital communication,
- Organization of special advanced training courses at least once a year,
- Evaluation of agreements and obligations (e.g. continuous standby for the admission of severely injured patients at regional and supraregional trauma centres).

5.2 Evaluation of outcome quality – TraumaRegister DGU®

The basis for documentation of outcome quality is the TraumaRegister DGU®.

All clinics participating in the TNW are obliged to document every injured patient who is admitted to the ICU from the emergency room or who dies beforehand (in the emergency room or operating theatre) in the TraumaRegister DGU® as soon as possible (criteria for entering patient data in the TraumaRegister DGU®).

Outcomes in the TraumaRegister DGU® can be called up by the clinics online with regard to benchmarking of the procedural parameters or the risk-adjusted outcome analysis. An essential part of

this quality report is the comparison of individual clinic data with data from the same network and data from all member clinics. The quality of data entry into the TraumaRegister DGU® is evaluated as part of a re-auditing process which involves aligning the data with clinic documentation.

The number of patients in the TraumaRegister DGU® functions as a general indicator for the categorization of clinics in the Trauma Network. In accordance with data analyses based on the TraumaRegister DGU®, treatment of at least 20 severely injured patients per year is required to qualify as a regional trauma centre and 40 per year for a supraregional centre.

The future utilization of routine data by the statutory health insurance companies for quality assurance purposes as laid down in the Health Care Structure and Insurance Act – GKV 2011 will promote completeness of data sets and the quality of outcome reporting of the TraumaRegister.

5.3 Evaluation of neurotraumatological outcome quality

In accordance with the quality standards agreed with the presidency of the German Society for Neurosurgery, a regional trauma centre without its own neurosurgery department must be able to perform trepanation less than four hours after the accident taking into account the following timeframes:

- preclinical care
  approx. 70 minutes,
- Treatment and diagnostics at a regional TC (without neurotraumatological expertise)
  approx. 60 minutes,
- Onward transport
  approx. 30 minutes,
- Trepanation at a neurosurgery clinic
  approx. 60 minutes.

5.4 Organization of the Implementation of the TraumaNetzwerk DGU® Project

The conceptualization and development of the Trauma Network project was the task of the Whitebook Implementation Group for the Whitebook for the Care of the Severely Injured and Trauma Network (AKUT), supported by the committees and working platforms of the DGU taking into account health care politics and professional development.

Members of AKUT are “moderators“ entrusted with the coordination of 53 Trauma Networks (at the time of print – May 2012) in the German federal states. These state moderators together with the spokesperson of the TNW jointly assess the ability of the clinics (after audit has been completed) to qualify for categorization as a regional or supraregional trauma centre (TC).

AKUT is guided by the spokesperson. The spokesperson reports as specialist advisor to the Board and to the presidency of the DGU.

To ensure prompt processing of the wide range of questions that arise with regard to establishing a TNW, an AKUT steering committee has been formed.

The AKUT steering committee is made up of one member of the DGU Board and the Heads/Spokespersons of the organizations responsible for the implementation of the TNW and is entrusted with the following responsibilities:

- further development of the project nationally and internationally,
- professional consultation on the categorization of individual clinics by an external certification company,
- organization and moderation of the objection and conciliation process together with external certification agencies according to the procedures laid down in the TNW project,
- continuous professional training of the auditors at the certification company,
- professional development of codes and standards to promote quality and reliability of care for the severely injured,
- evaluation of the professional efficiency of the project together with the federal state moderators based on the outcomes of evaluation and experience in implementing the project.

With regard to scientific inquiries AKUT and/or the AKUT steering committee is supported by the section for emergency medicine, intensive care and care of the severely injured (NIS) of the DGU. The TNW Advisory Board was established to deal appropriately with issues over and above the professional and specialist aspects. This Board is an open forum for all those with immediate or less immediate involvement in the care of the severely injured and supports the ongoing development of the project. Currently, the Advisory Board is made up of representatives from the various medical disciplines, rescue organizations and emergency doctors, funding bodies, Ministry for Social Welfare, health care companies and patient associations. Moderation of the Advisory Board resides with the Secretary General and the main office of the DGU.

The Academy of Traumatology of the DGU (AUC) takes responsibility for the organizational and economic aspects of the project.

The AUC supports the TraumaRegister DGU® as a vehicle of external quality assurance within the TNW, the database of the TNW project, the TNW interactive homepage and the project TeleKooperation TNW®. The AUC works closely with the following business partners to run the project:

- AKUT main office organizes the project and supports the clinics during implementation. The AKUT main office and the main office of the DGU are jointly responsible for holding the TNW Annual Congress. The DGU office trains the auditors from the external certification companies.
- DIOcert Ltd, Mainz, is an independent external certification company. It is responsible for all strategies pertaining to quality assurance (auditing and certification) and advises AKUT on the development of the project.

5.5 Auditing and Certification

The quality standards and key data relevant to approval as described above are evaluated and guaranteed through a two-stage auditing and certification process. Evaluation of special strategies to ensure care quality and reliability at each clinic is part of the auditing procedure. The aim is to ensure that all clinics involved in the care of the severely injured – according to their care level – have fulfilled the same requirements with regard to equipment, personnel, infrastructure and procedures. The strategies agreed within any one Trauma Network to avoid bottlenecks, inappropriate admissions, and time delays in the care of the severely injured and to ensure cooperation (agreements) are evaluated in a second step. After successful conclusion of the evaluation and auditing process, the audited clinics participating in the TNW and the TNW are awarded certification for three years.

Re-auditing of individual clinics and re-certification of the network takes place every three years based on the guidelines set out in the Whitebook and on key data and criteria that reflect quality and reliability. More detailed information on these agreements and on the two-stage certification procedure can be found on the homepage of the TraumaNetzwerk DGU® (www.dgu-traumanetzwerk.de).

To guarantee the continuous advancement and support of strategies that ensure quality and optimize patient safety (such as documentation, supervision of quality circles), strategic models of peer-to-peer procedure as already applied in other areas are being revised and prepared for this project.

5.6 Clinical research and health care research

Establishing the TraumaNetzwerk DGU® has provided science and research with new impulses and opportunities and, in particular, a better overview of care reality (too much, too little, misdirected). In cooperation with the institutions of various funding bodies and insurance companies, independent of the maintenance and growth of data being entered into the TraumaRegister DGU®, it is possible to utilize routine data in accordance with SGB-V and the information on data transfer set out in the draft of the Health Care Structure and Insurance Act – GKV to plan and conduct clinical studies with clearly defined hypotheses and large sample size.

Strict adherence to Good Clinical Practice (GCP) and Good Epidemiological Practice (GEP) as well as registration of studies and professional coordination and analysis is an obligation in this endeavour.

Scientific evaluation of the TraumaNetzwerk DGU® project is the responsibility of a Working Group (WG Medical Care Research in the Trauma Network) of the Section “Emergency medicine, intensive care, and care of the severely injured“ (NIS) of the DGU. This group collates, designs and coordinates the research projects of individual research groups. These groups work on various open questions that arise from establishing the Trauma Networks. A detailed presentation of the “WG Medical Care Research in the TNW“ and the opportunity to participate and conduct studies can be found on the homepage of the TraumaNetzwerk DGU® (www.dgu-traumanetzwerk.de).

5.7 References

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6 International Cooperations

6.1 Decade of Action for Road Safety 2011–2020 announced by the WHO

The DGU together with national and international partners participates in the campaign led by the WHO on behalf of the UNO to improve road safety within the framework of their existing projects such as the TraumaRegister, TraumaNetwork and other endeavours with the aim of preventing road traffic accidents.

The recommendations presented here will also be appropriately modified to accommodate the situation in partner countries and will form part of the project programme.

6.2 Cross-border Trauma Networks

The DGU considers itself bound to participate in cross-border care of the severely injured in Europe.

Having gained experience in establishing cross-border Trauma Networks, it is essential to take into account the different structures and organizations of the relevant health systems when building these networks.

Appendix

I. Required facilities and installations for local, regional, and supraregional TCs (emergency admissions and operating rooms)

Tab. A I

Infrastructure/equipment (D: desirable E: essential)	SRTC	RegTC	LoTC
Emergency Admissions			
Blood donor service/blood bank	E	E	E
Laboratory*	E	E	E
Microbiology	E	E	D
Helicopter landing pad			
- 24 hour operation	E	E	D
Artificial respiration	E	E	E
Pulsoxymetry	E	E	E
Secretion suction unit	E	E	E
Capnography	E	E	E
Blood gas analyzer (BGA unit)*	E	E	E
Rapid infusion system	E	E	E
ECG monitor	E	E	E
Defibrillator	E	E	E
Invasive tonometry	E	E	E
Emergency OR sets			
- laparotomy	E	E	E
- external pelvic stabilizor	E	E	E
- craniotomy	E	E	E
- thoracotomy	E	E	E
- Bülau drainage	E	E	E
- Pericardial puncture	E	E	E
- suprapubic urinary drainage	E	E	E
- Bronchoscopy	E	E	E
- Emergency care for maximum severity burns	E	E	E
Emergency medication	E	E	E
Diagnostic imaging			
- ultrasound scanner, doppler sonography	E	E	E
- conventional radiography	E	E	E
- CT	E	E	E
- Angiography unit with intervention	E	D	–
- MRI	E	E	–
Splinting and traction systems	E	E	E
Constant temperature circulators			
- for patients	E	E	E

Tab. A I			
Infrastructure/equipment (D: desirable E: essential)	**SRTC**	**RegTC**	**LoTC**
- for infusions and blood	E	E	E
OR area			
OR installations			
Constant temperature circulators			
- for patients	E	E	E
- for infusions and blood	E	E	E
Cell saver	E	E	E
Image intensifier	E	E	E
* Recommendation: A unit should be available for blood gas analysis to facilitate documentation and transmission of findings more reliably.			

II. Additional information on the care of the severely burned within the TNW

36 centres provide for adults and children.

Two centres treat children and adults and have a capacity of

- 128 beds mainly for adults,
- 46 beds mainly for children (21 beds for children or adults)

Most of these facilities are funded by university hospitals, Trade Associations, and local government, and there are also children's hospitals funded by the German armed forces and other sources.

Quality standards for infrastructure and procedure

The German Society for Burn Medicine (reg. assoc.) (DGV) and the German-speaking Association for Burn Treatment (DAV) consistently ensure and advance standards. The DGV has developed its own structural, personnel and medical guidelines, which are combined with an internal quality assurance system at all participating centres. The Association for Burn Centres conducts an annual analysis of the number of cases, demographic data, concomitant diseases, causes of injury, depth and extent of burns and survival rates. There is no other comparable collection of data from burn centres anywhere in the world.

The Trade Associations have advanced the establishment of burn centres offering the highest level of treatment to ensure optimal early treatment and the rehabilitation of persons with burn injuries. To guarantee excellent rehabilitation services in the long-term, specially designed buildings with the relevant installations and equipment as well as an adequate supply of beds and a pool of human and material resources must be on hand to supplement sufficient rapid response and primary care.

In particular, the following installations and care facilities are required:

- emergency admission and treatment rooms with heating,
- reanimation and emergency intensive care,
- integrated intensive care and monitoring unit with at least four beds,

- air-conditioned single room equipped for maximum intensive care,
- Microbiology for continuous bacteriological monitoring,
- access to artificial skin (biotechnological tissue engineering).

Qualification

Medical Management

- Specialist for plastic and aesthetic plastic surgery with knowledge of special plastic surgery intensive care

Personnel

- one doctor for every two patients,
- one nurse per patient and shift,
- qualified physio and ergo therapists,
- psychological care by properly qualified specialists,
- social services.

Tab. A II Current number of beds and centres for the treatment of severe burns in the Federal Republic of Germany (12/2011).

Institution	Beds for adults	Beds for children	Number of centres
Trade Association	62 (12 for adults and children)	0	9
University Hospital	18	21	10
Local government clinic, Children's Hospital, Private Clinic	44 (9 for adults and children)	25	17
Total	128	46	36

III. Detailed information and comments on the rehabilitation of the severely injured

Introductory remarks and definitions

The rehabilitation of the severely injured is to be distinguished from long-term curative or follow-up treatment. The main objectives of rehabilitation after accident are the restoration or substantial improvement of functional health. This definition is based on the biopsychosocial model of the World Health Organization (WHO) that is set out in the international classification of functional ability, disability and health (ICF). The reintegration of the severely injured into their social and professional environments is the highest priority of rehabilitation and is especially challenging.

Medical rehabilitation of the severely injured is divided into the following phases:

- early or immediate rehabilitation,
- post-emergency rehabilitation (e.g. complex inpatient rehabilitation),
- continued rehabilitation,

- rehabilitation geared towards professional re-integration.

Early or immediate rehabilitation

This type of rehabilitation requires the earliest possible commencement of combined emergency and rehabilitative medical care and is the responsibility of specialized departments or teams in the first phase of illness in which there is still a need for emergency inpatient care and must be differentiated from later inpatient rehabilitative strategies.

The following must be taken into account

- the transition phase from emergency care to rehabilitation of patients “not yet ready for rehabilitation“,
- the often essential decision of whether the patient should be transferred to an “orthopaedic“ or a “neurological“ rehabilitation unit, and
- the change of funding body at certain stages provided the accident did not happen on the way to work or at school (General Jurisdiction – Statutory Accident Insurance).

Early rehabilitation of the severely injured is especially well set out in Procedure 8-559 on “interdisciplinary and other forms of early rehabilitation“.

Specialized post-emergency rehabilitation

Post-emergency rehabilitation immediately follows emergency care or is scheduled to be in step with emergency care. The time to transfer the patient from the emergency to the rehabilitation facility depends on the type of injury, the type of surgery performed, the internal and external context of the individual case and the declared next intermediate goal. In terms of human and structural resources, technology and equipment the rehabilitation facility must be in a position to offer the patient optimal rehabilitative treatment in the situational context.

In the period prior to admission to the rehabilitation facility (in- or outpatient) adequate weight-bearing as part of biological fracture healing is absolutely indispensible. In these cases curative measures appropriate to the clinical picture and to the programme of weight-bearing are to be prescribed if post-emergency rehabilitation cannot immediately follow emergency care.

In the post-emergency rehabilitation phase the best possible integration and participation in work and sociocultural situations should be a main focus of attention based on comprehensive biopsychosocial treatment strategies. This type of multidimensional treatment approach requires the involvement of various specialized groups of professionals (multimodality), whereby these specialists do not just work “alongside“ each other but also as a combined network in interdisciplinary consultation. The phase model of neurological rehabilitation appears to be an exemplary approach in these situations.

In the early post-emergency rehabilitation phase, complications or planned repeat surgeries often require evaluation of possible alternative conservative or surgical treatment options. Rapid access to various specialists in emergency medicine and a wide range of diagnostic methods is therefore a precondition for rehabilitative emergency surgery. The close interaction or trauma surgery with rehabilitative medicine can optimize and shorten the rehabilitation process. This close collaboration, if

not under one roof, can be facilitated by close collaboration of personnel and the geographical proximity of the trauma centre and the rehabilitation facility.

If not otherwise possible, an evaluation of work therapy should take place in this rehabilitation phase to identify the patient's specific deficits in relation to the requirements of their workplace and to tailor rehabilitation towards the elimination of these deficits.

Continued rehabilitation of the severely injured

Immediately following the post-emergency phase, special in- or outpatient longer term rehabilitative strategies may be necessary. The following are given as examples:

- multimodal, complex rehabilitative therapy of the locomotor system (e.g. follow-up treatment provided by the Trade Associations or outpatient rehabilitation funded by SHI or pension insurance or enhanced outpatient physiotherapy),
- interdisciplinary pain therapy,
- rehabilitation to address psychiatric, psychological and psychosomatic processes as well as reactive depression or post-traumatic coping disorders.

In this rehabilitation phase professional reintegration should be commenced with special attention to the specific workplace requirements. If and when possible, the company doctor should be involved in the process at an early stage. The requirement profile of the patient's workplace is an indispensable prerequisite.

Aims in this phase are

- best possible restoration of structure/function,
- remedy of activity disorders/restoration of fitness for daily life,
- best possible pain reduction/improved pain control abilities,
- optimized ability to deal with the accident and consequent ill-health,
- pave the way for social and professional re-integration,
- put in place a sound, long-term follow-up concept.

Patients with relevant risk and context factors may need close long-term supervision by a team of trauma surgeons, social workers, physiotherapists and psychologists, sometimes for a period of several years to ensure that the consequences of trauma are kept to a minimum. Injured persons often need adequate information from experienced therapists for a long time as well as adequate pain management after discharge from inpatient care.

Rehabilitation geared towards professional reintegration

The aim of rehabilitation towards professional reintegration while medical rehabilitation is still ongoing is not only to remedy functional and structural deficits or to compensate for them, but much more to integrate the specific, essential, work-related functional processes into therapy to facilitate return to the workplace. This is specifically oriented towards the patient's work situation and aims to achieve sufficient functional ability to permit full-time return to the (previous) place of work when rehabilitation

has been completed. For this to take place the patient's general medical condition must be sufficient to train critical physical skills relevant to the workplace.

By the end of therapy comparison of the patients ability with the workplace profile should ideally show minimal deficits or none at all.

Rehabilitation for professional reintegration implies that statements/recommendations have to be made about the possible necessity of modifications at the place of work and/or compilation of a positive/negative performance chart based on full or screening tests to identify functional ability (EFL, ERGOS among others) to facilitate rapid, long-term re-integration of the patient into the world of work.

Prompt and comprehensive rehabilitation of the severely injured person often requires ongoing medical rehabilitative care. In addition, expert psychosocial support must be guaranteed. The amount of physical space needed by these facilities, which serve practically all clinical disciplines, depends on the size of the particular unit. The range of its services is to be defined in accordance with the in-house care strategies.

Early and immediate rehabilitation is conducted either in interdisciplinary collaboration or relative to the most predominant injury as neurological early rehabilitation or complex therapy in the case of spinal injuries.

Early rehabilitation procedures that place the patient in an early rehabilitation DRG conform to the approach of the DRG system. However, in many trauma surgery DRGs the early rehabilitative services provided are currently irrelevant in terms of reimbursement (8-559 "interdisciplinary and other forms of early rehabilitation").

References

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IV. Remarks on Telecommunication (Telecooperation) within the TNW

Special demands on telecooperation systems

Images have to be transmitted as quickly and completely as possible. It should be possible to view images within 15 minutes of completing the CT scan. Discussion of the transmitted images should generally be possible within 30 minutes. The images must be transmitted in standardized, previously agreed format promptly and in diagnostic quality.

A regional or supraregional centre should ensure that the transmission speed (cable and device capacity) permits sending and receiving of data on several cases at the same time. Electronic online data exchange is one preferred method based on specific standards (e.g. HL7, DICOM, IHE). The contact person has to be informed and the consultant's findings have to be recorded and documented. It is recommended that the communication options also guarantee the transmission of other data, for example, data on clinical parameters or the existing protocols (emergency room protocol or other such protocols) including the technology to hold a video conference.

Guarantee of data protection

The telecooperation system and its utilization must fulfil the requirements of data protection and medical confidentiality, in particular. The positive expert opinion of the data protection officer in charge must be available. For example, general standards include coded data transmission, 2-factor authentication and non-transferable user rights administration. Up-to-date information and recommendations, e.g. Federal Office for Security in Information Technology or the State Data Protection Commissioner, should be noted.

Technical and process-related quality assurance

Telecooperation requires technical quality assurance. This consists of a specification test (e.g. based on a sample set of image data and an assessment form, also see current information on the website of the TraumaNetzwerk DGU®) and the continuous or regular and, if possible, automated monitoring of:

- availability (recommendation: within minutes or hours)
- functional capacity (recommendation: daily)
- data transfer speed and times (recommendation: daily to monthly, at different times of day)
- data integrity including maintenance of diagnostic imaging quality (recommendation: monthly)

Agreements with the companies operating a telecooperation network should incorporate the creation, transmission, and possibly storage of the lists and statistics that derive from the information being handled.

A person should be nominated to take charge not only of coordination but also the network and the hospital's own internal monitoring of telecooperation quality assurance, e.g. a telecooperation officer in the TNW or a clinic administrator (see also documents on the website for the DGU project TeleKooperation TNW®, www.telekooperation-tnw.de). A concept agreed on by the participating clinics to deal with system failure, i.e. planned alternative methods of image transmission, will ensure good patient care even when the telecooperation system is disrupted. This should be documented together with a description of the technical telecommunication structures in operation, the relevant standards, and the agreed procedures and data protection strategies.

For external quality assurance it is important to consult the assessments of the medical authorities on teleradiology and operational x-ray facilities as well as conducting in-house analyses to evaluate radiological examinations in terms of radiation exposure and to identify opportunities for improvement.

The strategies and results of quality assurance form an important basis for re-auditing.

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