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Committee on Emergency Medicine, Intensive Care and
Trauma Management of the German Trauma Society (DGU)

AUC - Academy for Trauma Surgery

Annual Report 2023

TraumaRegister DGU®

General Annual Report

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Annual Report 2023 - TraumaRegister DGU®

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Content

Preface

Dear readers,

We are pleased to send you the TraumaRegister DGU® general **2023 annual report**.

This edition includes data for the seriously injured in 2022 (basic group), which were documented by the participating hospitals through the end of March 2023. In 2022, this basic group is comprised of 30,806 cases, according to the TraumaRegister DGU® definition of a seriously injured person.

Contrary to previous years, the number of cases has increased (5.6 % cases more than in the previous year). In primary diagnostics in the shock room, the use of chest radiographs continued to decline and was performed in just under 17 % of patients in 2022. In contrast, this was documented in 19 % of cases in 2021 and 24.5 % in 2019. Since 2017, the use of pelvic straps for unstable pelvic fractures has been steadily increasing. This trend continued in 2022, reaching 50 %. The approximately 24,900 primary care patients had a mean injury severity score according to ISS of 17.5 points, and 70 % were male. Of these patients, 7.5 % died in the hospital. The mortality prognosis for these patients was 7.9% (RISC II).

At the end of 2022, a total of 694 hospitals were participating in the TraumaRegister DGU®. In addition to the 622 hospitals from Germany, hospitals from from eight other countries are also participating in the registry. This includes 19 hospitals from Austria, 33 from Belgium and 9 from Switzerland.

We sincerely hope that the 2023 annual report will again provide you with findings that contribute to the further improvement of care for severely injured patients, in regards to quality assurance and health services research. In 2022, 10 scientific papers were prepared using data from the TraumaRegister DGU®. We would like to thank the authors, reviewers and all contributing clinicians for their commitment.

Sincerely yours,

Sebastian Imach   Heiko Trentzsch   Rolf Lefering

Christine Höfer   Stefan Huber

1 Number of cases

Inclusion criteria for documenting a patient in the TraumaRegister DGU® (TR-DGU) are admission via the emergency room and the need for intensive care. Patients who died before ICU admission should also be included. This pragmatic criterion was chosen to avoid complicated score calculations in the emergency room and to limit the documentation to patients with relevant, serious injuries.

However, the number of documented patients with only minor injuries has continuously increased over the years. This is not only unnecessary work for the hospitals, but more importantly it makes it difficult to draw comparisons both between hospitals and over time. Therefore, in 2015 a **basic group** was defined and nearly all analyses presented in this report refer to this patient group only (i.e. not to all documented patients).

The severity of each injury is described using the Abbreviated Injury Scale (**AIS**), which classifies severity from 1 (minor) to 6 (maximal). Using these severity grades, more sophisticated measures like the maximum AIS (**MAIS**), the Injury Severity Score (**ISS**) or the New ISS (**NISS**) can be derived.The **basic group** of the TR-DGU is defined as:

All patients with MAIS ≥ 3 AND all MAIS 2 patients who died or were treated in the intensive care unit.

The following flowchart gives an overview of the composition of the basic group.

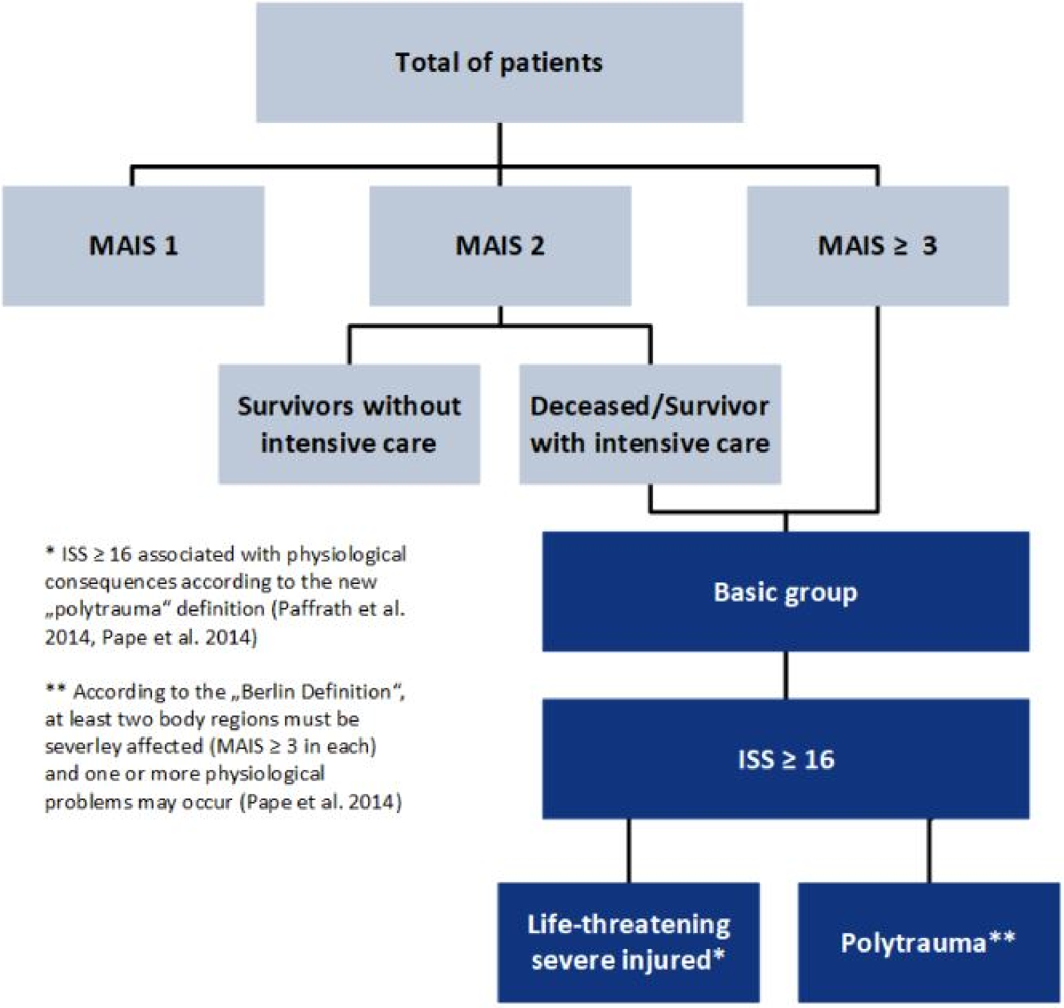


Figure 1: Flowchart describing the composition of the basic group

The following table shows the data of groups as defined in figure 1. The table is broken down by the MAIS criteria as well as the basic group and selected subgroups.

Table 1: Number of cases in 2022 from the TR-DGU

	TR-DGU 2022	Primary admitted	Transfer in	Early transfer out
Total number of documented patients.	**38,545**	33,641	2,468	2,436
MAIS 1 For these patients, the most severe injury was AIS grade 1 (MAIS = 1). Thus, they were not severely injured. Furthermore, the RISC II prognostic score has not been validated for these cases and they were excluded from all further analyses (except chapter 5.3).	**4,715** (12 %)	4,548	26	141
MAIS 2 survivors without intensive care The most severe injury was of AIS grade 2. These patients survived and did not receive intensive care.	**3,021** (8 %)	4,641	192	162
MAIS 2 deceased or survivors needing intensive care The most severe injury was of AIS grade 2. The patients died or survived but required intensive care.	**5,108** (13 %)	24,563	2,223	825
MAIS ≥ 3 The most severe injury was of AIS grade 3 or more (MAIS 3+). This criteria is also used by the EU as an internationally agreed to definition of a „*serious injury*" in the context of road accidents.	**25,698** (67 %)	21,734	2,199	1,765
Non-basic group Patients with MAIS 1 as well as patients with MAIS 2 that survived without intensive care.	**7,739** (20 %)	7,168	62	509
From this point onward all absolute numbers and percentages refer only to the basic group				
Basic group This definition includes all MAIS ≥ 3 patients and MAIS 2 patients who died or were treated on the intensive care unit. Patient age must also be documented.	**30,806**	**26,473**	**2,406**	**1,927**
Intensive care Patients admitted to the ICU.	**25,894** (84 %)	22,924	2,198	772
Deceased Patients who died in the acute care hospital.	**3,771** (12 %)	3,448	323	0
ISS 16+ The definition ISS ≥ 16 (or > 15) is commonly used to define a serious injury.	**16,866** (55 %)	13,991	1,695	1,180
Life-threatening severe injury Injury severity of ISS ≥ 16 in conjunction with physiological problems according to the „polytrauma" definition (Paffrath et al. 2014, Pape et al. 2014).	**9,707** (32 %)	8,309	810	588
Polytrauma According to the „Berlin Definition", two body regions are severly affected and one or more physiological problems are present (Pape et al. 2014).	**4,591** (15 %)	4,054	287	250

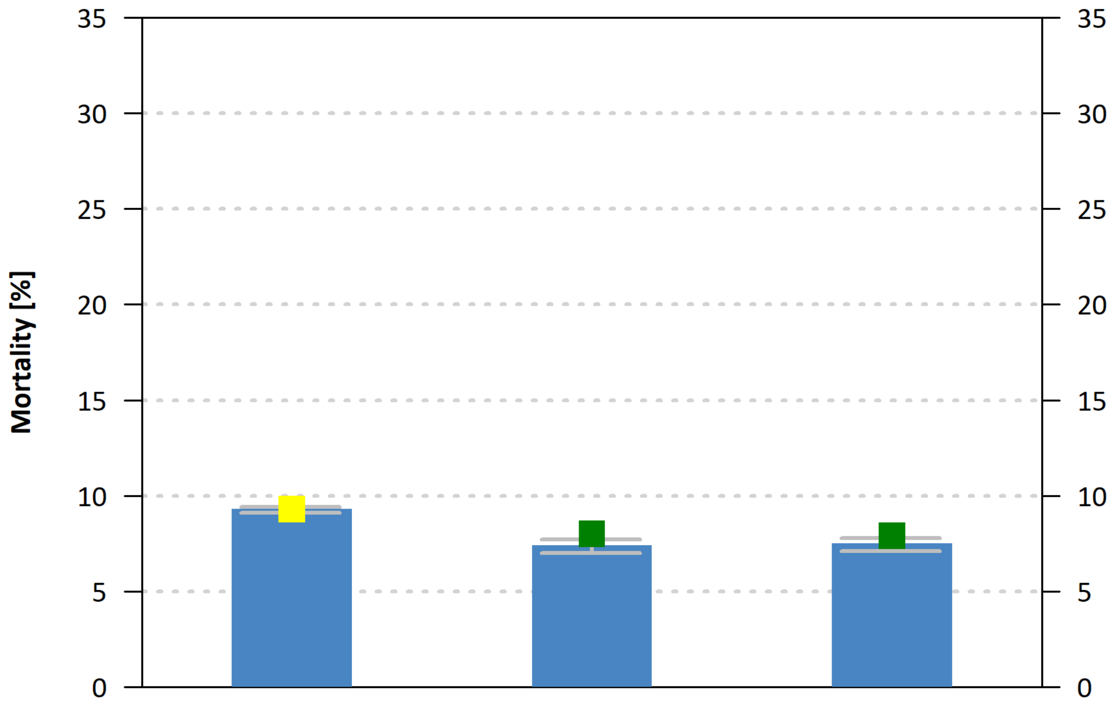
2 Observed mortality and prognosis

Comparing the observed **mortality** of severely injured trauma patients with their **prognosis** is a central element of quality assessment in the TraumaRegister DGU®. Here, the risk of death prognosis is derived using the **RISC II** prognostic score (Revised Injury Severity Classification; Lefering et al. 2014). This score can be calculated for all primarily admitted patients. The analysis in chapter 2 is confined to the **basic group** as defined on page 5.

No. of basic group patients documented in the TR-DGU in the last 10 years (2013-2022)	n = **317,846**
- of these, documented last year (2022)	n = **30,806**
- of these, only primary cases (no transfer in; no early transfer out; no patients deceased within the first week with a patient's volition)	n = **24,879**

Comparisons of mortality and risk of death prognosis will be performed for **primary admitted patients** only (Figure 2). For patients **transferred in** from another hospital (n = 2,406 in 2022), the initial status from primary admission is missing; for patients **transferred out early** (within 48 hours after admission; n = 1,927 in 2022), no final outcome is documented. Additionally, patients deceased within the first week with a patient's volition (n = 1,594 in 2022) are excluded from this analysis to ensure a correct presentation of the quality of treatment in a hospital.

The mean age of the remaining 24,879 patients was 53.1 years and 70 % were male. The mean ISS was 17.5 points. Of these patients 1,854 died in hospital, which is **7.5 %** (95 % CI: 7.1 - 7.8). The risk of death prognosis based on RISC II is **7.9 %**. You find these values for the TR-DGU in figure 2.



	TR-DGU 10 years	TR-DGU 2021	TR-DGU 2022
No. of pat. (n):	262,254	23,627	24,879
Mortality [%]:	9.3	7.4	7.5
RISC II [%]:	9.3	8.0	7.9

Figure 2: Observed mortality and risk of death prognosis (RISC II)

Expanded information for Figure 2:
The bars represent the observed mortality rate; percentages are given in the table at the bottom of each bar. The predicted mortality rate, RISC II, is given as a yellow **box**. This box turns to green or red in case that the observed mortality is significantly lower (= better) or higher (= worse) than expected, respectively. For the interpretation of the results, it must be considered that these findings depend on statistical uncertainty. Therefore, the 95 % confidence interval (CI) for the observed mortality rate is given as well (grey vertical error bars). The 95 %-CI describes a range of values which covers the „true" value with a high probability (95 %). The more patients a value is based on, the narrower the CI.

Data quality for the risk of death prognosis

The validity of a prognosis depends on the quality and the completeness of the variables required for its calculation. In the TR-DGU two different documentation types are used, the standard and the QM dataset. The standard dataset includes all parameters that are recorded by the registry. The QM dataset is a reduced version of the standard dataset. The risk of death prognosis **RISC II score**, developed for the TraumaRegister DGU®, is based on 13 different variables. Since the revision of the dataset in 2015, all 13 required variables are recorded by both datasets. Even though the only mandatory components are age and injury severity, every additional piece of information increases the accuracy of the outcome prediction.

Therefore, additional information on the data quality of the variables used for the prognosis is provided here. If all data required for calculation of the RISC II score were recorded, or if only one value was missing, then this patient was considered as a **„well documented"** case. The percentage of well documented patients (per hospital) is then used to quantify the data quality of outcome prediction. The following applies:

- (green) **more than 95 %** of cases were well documented,
- (yellow) **80 - 94 %** of cases were well documented,
- (red) **less than 80 %** of cases were well documented.

Table 2: Data quality for the calculation of the RISC II score

	TR-DGU 10 years	TR-DGU 2021	TR-DGU 2022
Total cases (n)	262,254	23,627	24,879
„Well documented" (n)	209,066	19,389	20,416
„Well documented" (%)	80	82	82
Data quality colour code	(yellow)	(yellow)	(yellow)
Average number of missing values per patient for the calculation of the RISC II	0.9	0.8	0.8

Mortality *vs.* risk of death prognosis

Figure 3 compares the **observed mortality** of each hospital with their respective **RISC II prognosis for all the hospitals participating in the TR-DGU in 2022**. The **deviation** of the observed mortality from the expected prognosis is plotted against the number of patients. Negative values correspond to mortality rates lower than expected. The grey lines represent the 95 % confidence interval. Hospitals with **fewer than 5 patients** are not included due to the large statistical uncertainty.

TR-DGU 2022:	Patients in the basic group:	**24,879**	primary admitted cases
	Deviation between mortality and prognosis:	**-0.4 %**	

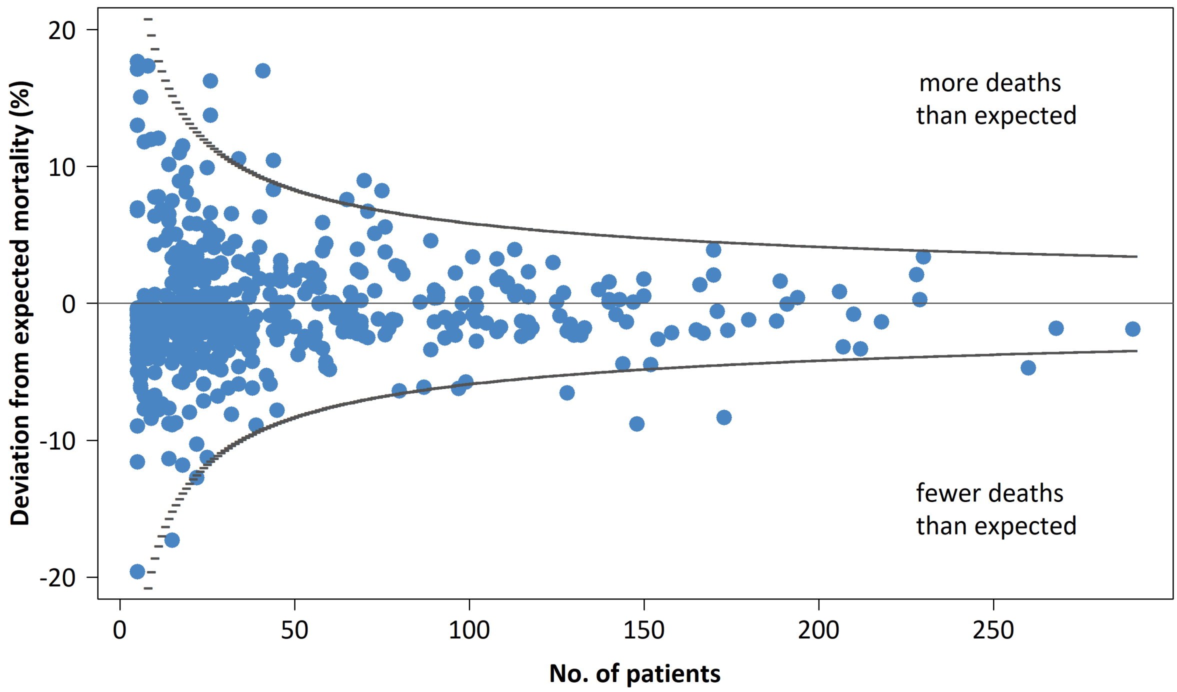


Figure 3: Deviation between the observed mortality and the risk of death prognosis (RISC II) of every hospital participating in the TR-DGU with more than 5 cases in the year 2022

3 Basic data from the last 3 years

The results in table 3 refer to the **basic group** only excluding patients with minor injuries and survivors without intensive care treatment. Attention: Results should be interpreted with caution when the number of patients is < 5!

Table 3: Overview of the data from the TR-DGU in the basic group from the last 3 years

		TR-DGU			
		10 years	2020	2021	**2022**
Total number of patients	(n)	317,846	29,494	29,196	**30,806**
Primary admitted and treated patients	(n)	269,285	25,378	24,987	**26,473**
Patients transferred out early	(n)	20,543	1,774	1,732	**1,927**
All primary admissions	(n)	289,828	27,152	26,719	**28,400**
Patients transferred in	(n)	28,018	2,342	2,477	**2,406**

Table 3 continuation:

		TR-DGU			
		10 years	2020	2021	**2022**
Demography (all patients in the basic group)					
Mean age	[years]	52.4	54.2	54.3	**54.3**
70 years or older	[%]	27.2	29.0	29.8	**29.2**
Proportion male	[%]	69.7	70.0	68.9	**69.6**
Trauma (all patients in the basic group)					
Blunt trauma	[%]	96.0	96.3	95.9	**95.9**
Mean ISS	[points]	18.3	18.3	18.0	**18.4**
ISS ≥ 16	[%]	54.1	54.2	53.6	**54.7**
TBI (AIS head ≥ 3)	[%]	36.7	36.3	36.2	**37.1**
Prehospital care (only primary admissions)					
Intubation by emergency physician	[%]	20.1	18.8	18.1	**18.8**
Unconscious (GCS ≤ 8)	[%]	16.3	15.6	14.7	**15.4**
Shock (RR ≤ 90 mmHg)	[%]	8.5	7.9	7.6	**8.1**
Average amount of volume	[ml]	624	595	587	**583**
Emergency room care (only primary admissions)					
Whole-body CT	[%]	76.2	75.5	73.5	**74.9**
X-ray of thorax	[%]	28.7	21.5	18.8	**16.8**
Patients with blood transfusion	[%]	7.4	7.3	7.7	**7.7**
Treatment in hospital (all patients in the basic group)					
Patients with surgery [1)]	[%]	66.4	67.8	67.3	**65.4**
if yes, no. of pat. with surgery [2)]	[n]	3.4	3.3	3.5	**2.9**
Patients treated in the ICU	[%]	86.2	85.5	83.2	**84.1**
Length of stay in the ICU [3)]	[days]	6.3	6.0	5.9	**6.0**
Intubated/ventilated patients in the ICU [3)]	[%]	36.9	35.2	34.4	**34.0**
Length of intubation [3)]	[days]	7.3	6.9	6.8	**6.9**
Outcome (all patients in the basic group)					
Length of stay in hospital [4)]	[days]	15.5	14.6	14.4	**14.5**
Hospital mortality [4)]	[n]	34,737	3,501	3,414	**3,771**
	[%]	11.7	12.6	12.4	**13.1**
Multiple organ failure [2) 4)]	[%]	18.5	17.2	15.4	**15.6**
Discharge to other hospital	[%]	17.3	16.9	16.7	**16.6**

[1)] years where less than 20 % patients underwent surgery are excluded

[2)] not available in the reduced QM dataset

[3)] only ICU patients

[4)] excludes patients transferred out early

4 Indicators of process quality

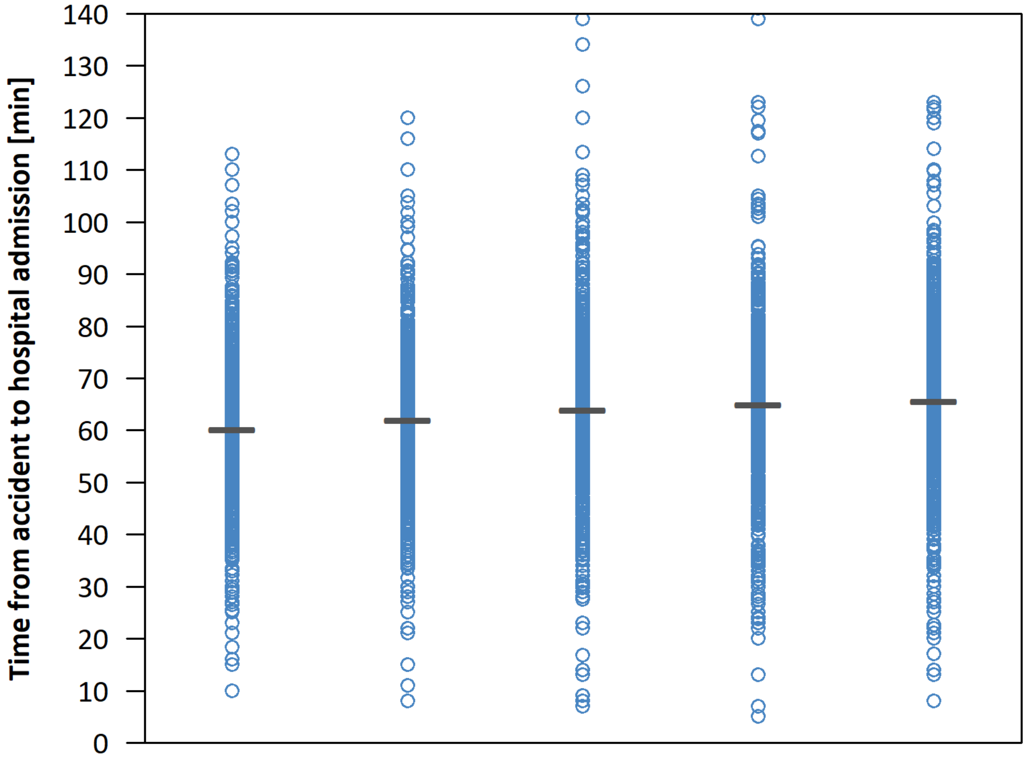
Quality indicators are measurements which are presumed to be associated with the quality of care and outcome. All results presented here are based on **primary admitted cases only from the basic group in 2022** with valid data or respective subgroups thereof. This includes early transfer out cases.

For each indicator, the distribution of the values of all participating hospitals is presented graphically over time. The light blue circles present the individual hospital values. The grey horizontal line is the mean across all hospitals for that year.

4.1 Prehospital indicators

4.1.1 Prehospital time

The sooner a patient reaches a trauma centre, the earlier life-saving interventions can be performed. Only patients with ISS ≥ 16 are included here. The time period from accident until hospital admission is presented as an average value in minutes. Implausible time values < 5 minutes and > 4 hours are excluded.

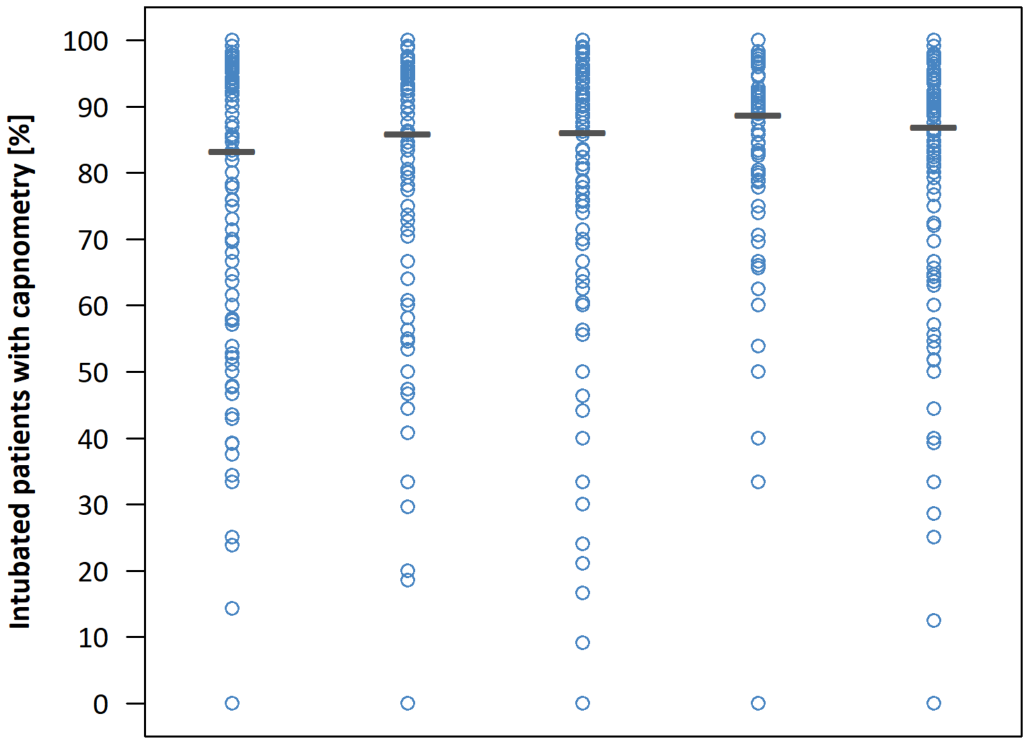


Year:	2018	2019	2020	2021	2022
TR-DGU:	60 [min]	62 [min]	64 [min]	65 [min]	66 [min]
n:	12,263	10,891	11,043	10,446	11,104
Min-Max:	5-240 [min]	5-240 [min]	5-240 [min]	5-240 [min]	5-240 [min]

Figure 4: Distribution of the mean duration from accident until hospital admission of patients with mit ISS ≥ 16 over all hospitals, 2018-2022, — TR-DGU, o single hospital value

4.1.2 Capnometry in intubated patients

Capnometry helps to assess the effectiveness of intubation in intubated patients. Only patients with a prehospital endotracheal intubation with valid data for capnometry are considered here. Intubated patients without information regarding capnometry cannot be analysed (n = 1,509).

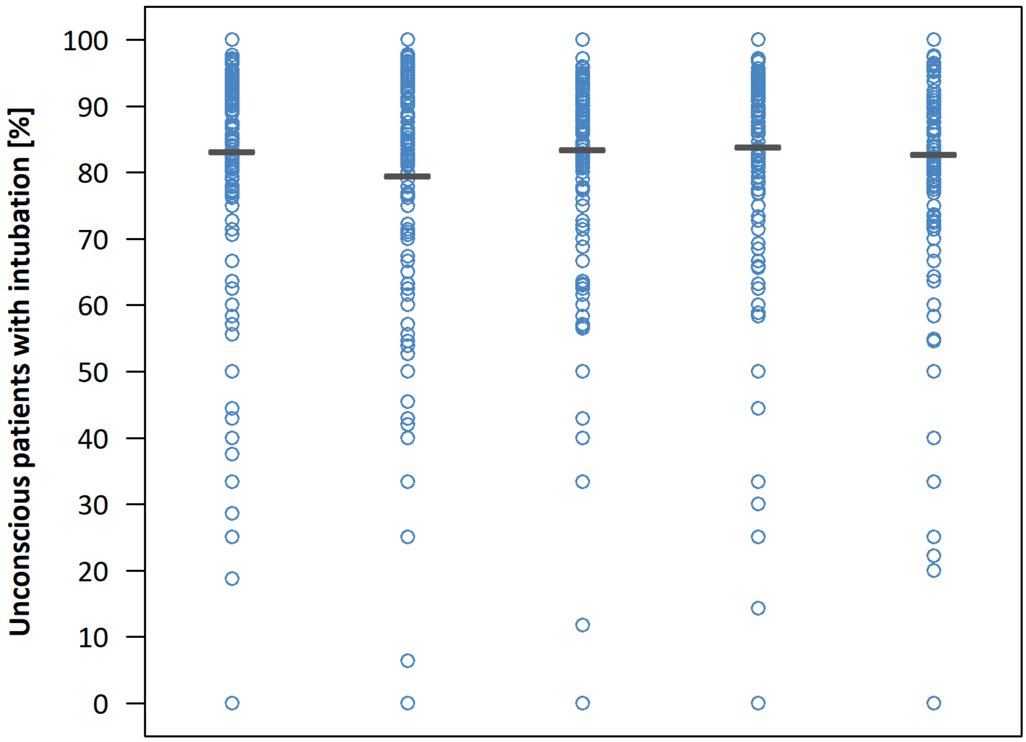


Year:	2018	2019	2020	2021	2022
TR-DGU:	83 %	86 %	86 %	89 %	87 %
Capnometry (n):	3,398	3,186	3,019	3,052	3,325
Intubated (N):	4,081	3,708	3,506	3,437	3,827

Figure 5: Distribution of the capnometry rate in prehospital intubated patients over all hospitals, 2018-2022, — TR-DGU, o single hospital value

4.1.3 Intubation of unconscious patients

The prehospital intubation of unconscious patients guarantees an oxygen supply until the hospital is reached. Only patients with a prehospital documented GCS ≤ 8 are considered here, regardless of the injury severity. When information on intubation is missing it is considered as „no intubation", while an alternative airway is counted here as „intubation".

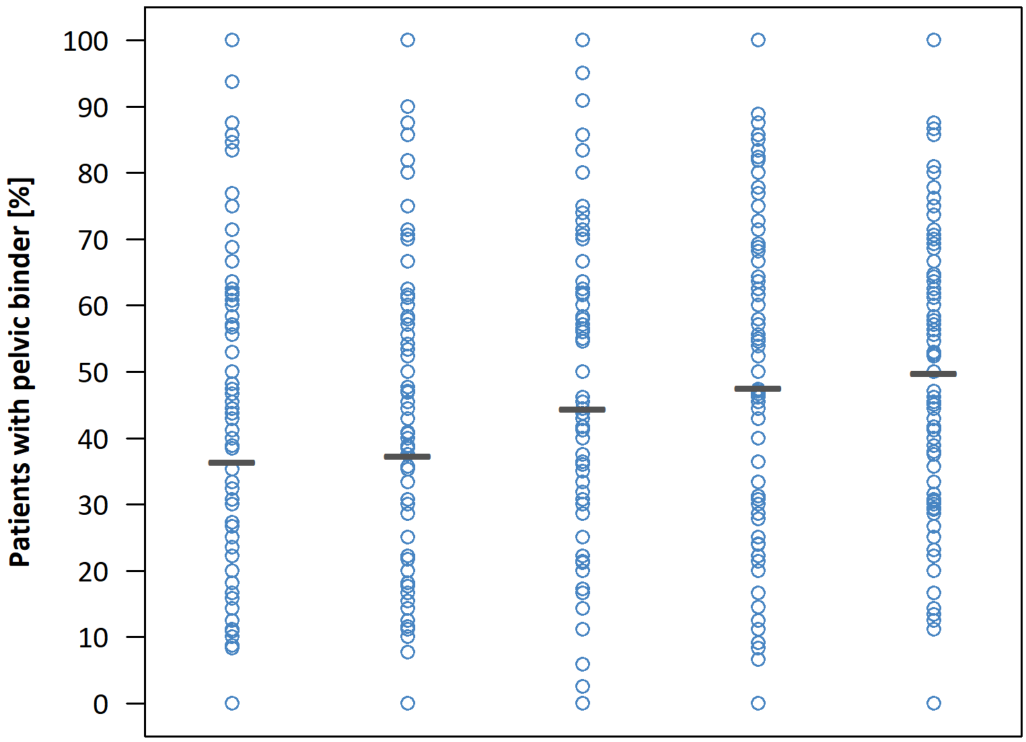


Year:	2018	2019	2020	2021	2022
TR-DGU:	83 %	80 %	83 %	84 %	83 %
Intubated (n):	3,732	3,315	3,234	2,966	3,247
Unconscious (N):	4,489	4,168	3,874	3,536	3,922

Figure 6: Distribution of the intubation rate in unconscious patients over all hospitals, 2018-2022, — TR-DGU, o single hospital value

4.1.4 Pelvic binder in pelvic fracture

The stabilisation of an instable pelvic fracture can help to improve the hemodynamic status of the patient. Only cases with a pelvic fracture (AIS severity 3 to 5) are considered here. The pelvic binder is documented in the standard dataset only.



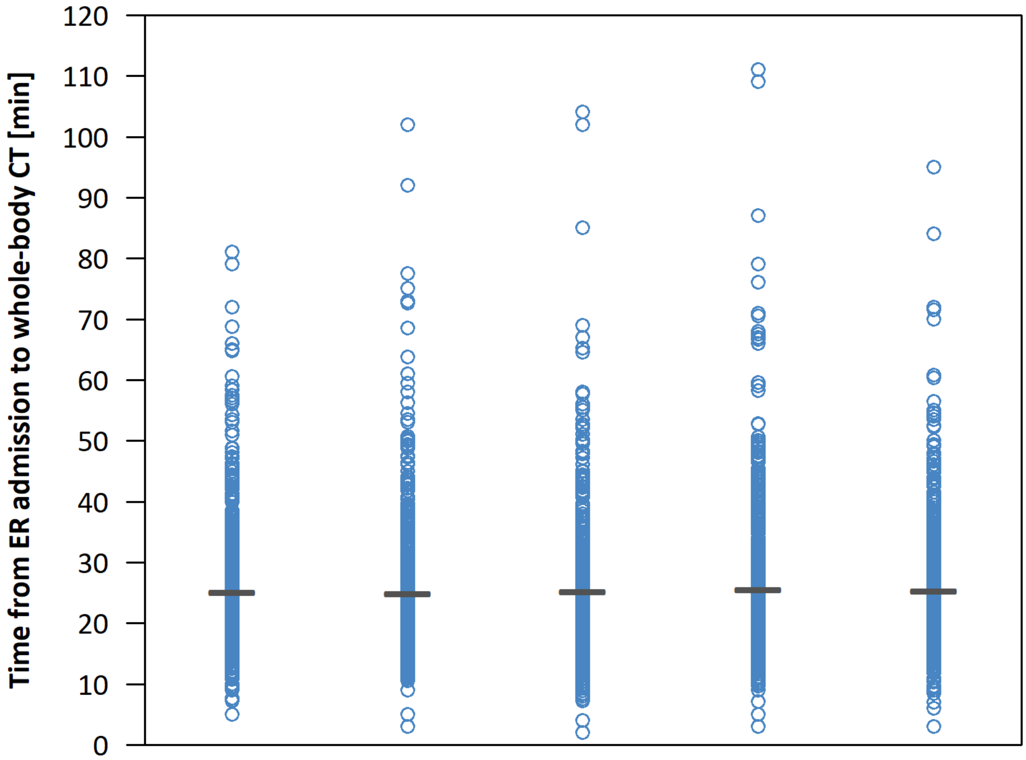
Year:	**2018**	**2019**	**2020**	**2021**	**2022**
TR-DGU:	36 %	37 %	44 %	48 %	50 %
Pelvic binder (n):	513	504	623	795	863
Pelvic fracture (N):	1,409	1,352	1,402	1,673	1,734

Figure 7: Distribution of the pelvic binder rate in patients with an instable pelvic fracture over all hospitals, 2018-2022, — TR-DGU, o single hospital value

4.2 Process times in the emergency room

4.2.1 Time until whole-body CT

If a whole-body CT is indicated, it should be performed immediately after admission to the ER in order to initiate subsequent interventions in a timely manner. Time periods > 120 minutes are excluded from the following analysis. All patients who received a whole-body CT are considered here.

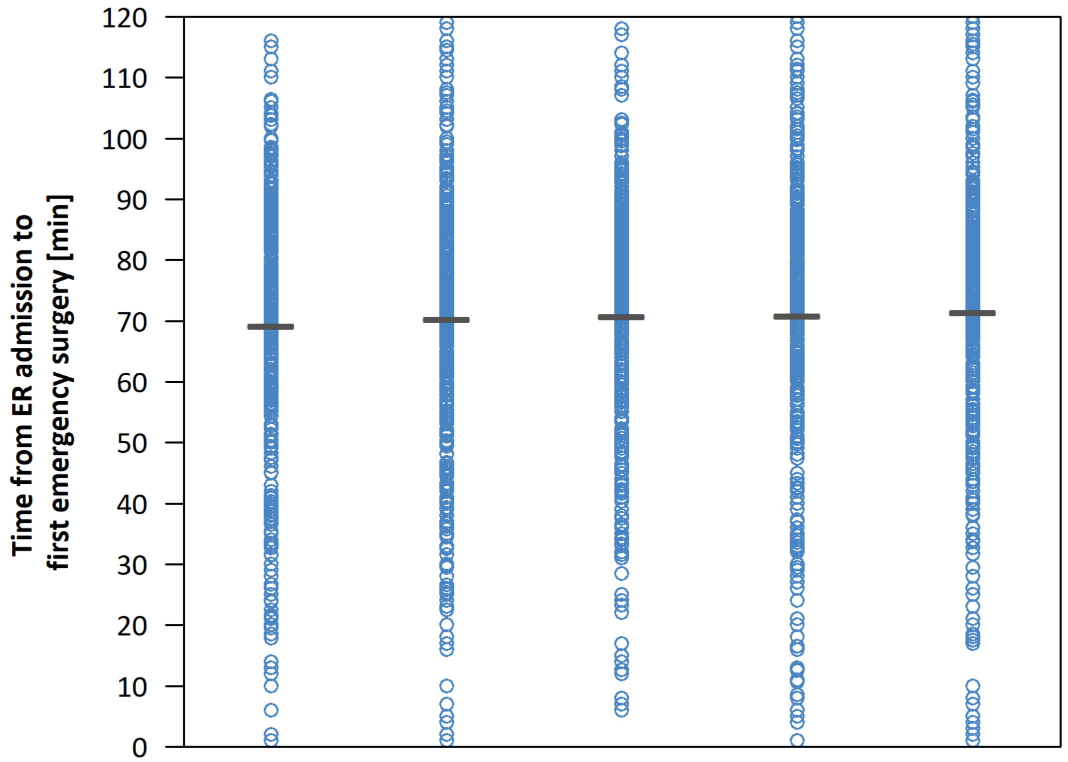


Year:	2018	2019	2020	2021	2022
TR-DGU:	25 [min]	25 [min]	25 [min]	26 [min]	25 [min]
n:	23,638	20,962	20,214	19,399	21,010
Min-Max:	1-120 [min]	1-120 [min]	1-120 [min]	1-120 [min]	1-120 [min]

Figure 8: Distribution of the mean duration from admission to the ER until whole-body CT over all hospitals, 2018-2022, — TR-DGU, o single hospital value

4.2.2 Time until first emergency surgery

Eight different emergency interventions are documented in TR-DGU (surgical liquid drain or brain decompression, laminectomy, thoracotomy, laparotomy, revascularisation, embolisation, and stabilisation of pelvis or extremities). All patients with at least one of these interventions are considered here. Time periods between admission to the ER and emergency surgery > 120 minutes are excluded.

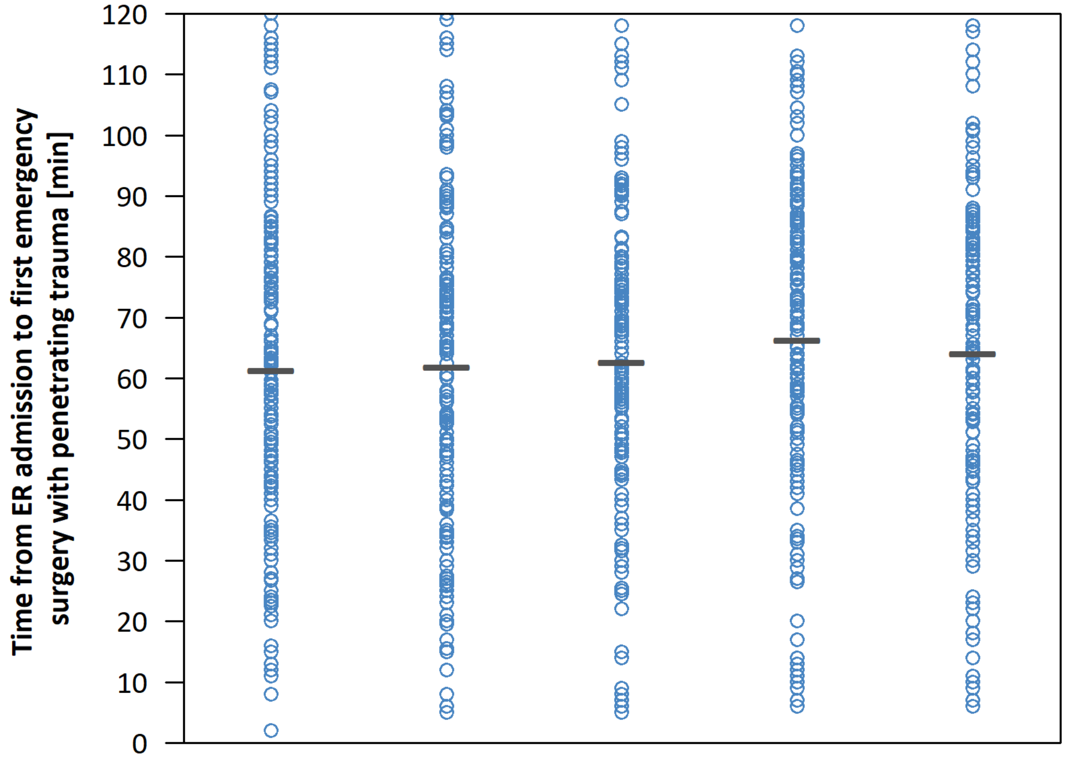


Year:	2018	2019	2020	2021	2022
TR-DGU:	69 [min]	70 [min]	71 [min]	71 [min]	71 [min]
n:	4,550	4,042	3,912	3,665	3,754
Min-Max:	1-120 [min]	1-120 [min]	1-120 [min]	1-120 [min]	1-120 [min]

Figure 9: Distribution of the mean duration from admission to the ER until the first emergency surgery over all hospitals, 2018-2022, — TR-DGU, o single hospital value

4.2.3 Time from admission to the ER until surgery in penetrating trauma

Time period between admission to the ER and the first surgical intervention (list of procedures see 4.2.2) in patients with penetrating injuries (stabbing, gunshot, etc.). Time periods longer than 120 minutes are excluded from this analysis.

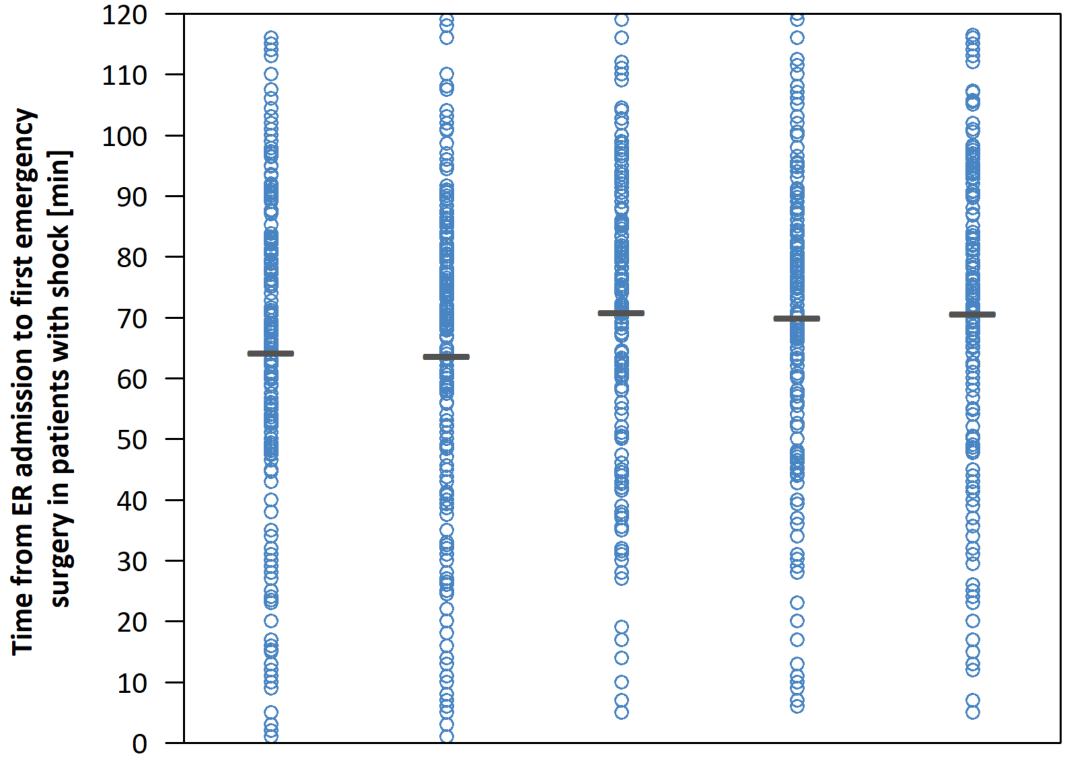


Year:	2018	2019	2020	2021	2022
TR-DGU:	61 [min]	62 [min]	63 [min]	66 [min]	64 [min]
n:	418	401	333	374	352
Min-Max:	1-120 [min]	1-120 [min]	1-120 [min]	6-120 [min]	5-120 [min]

Figure 10: Distribution of the mean duration from admission to the ER until surgery in patients with penetrating trauma over all hospitals, 2018-2022, — TR-DGU, o single hospital value

4.2.4 Time until surgery in patients in shock

Time period from admission to the ER until the first surgical intervention (list of procedures see 4.2.2) in patients in shock (systolic blood pressure ≤ 90 mmHg). Time periods longer than 120 minutes are excluded from this analysis.

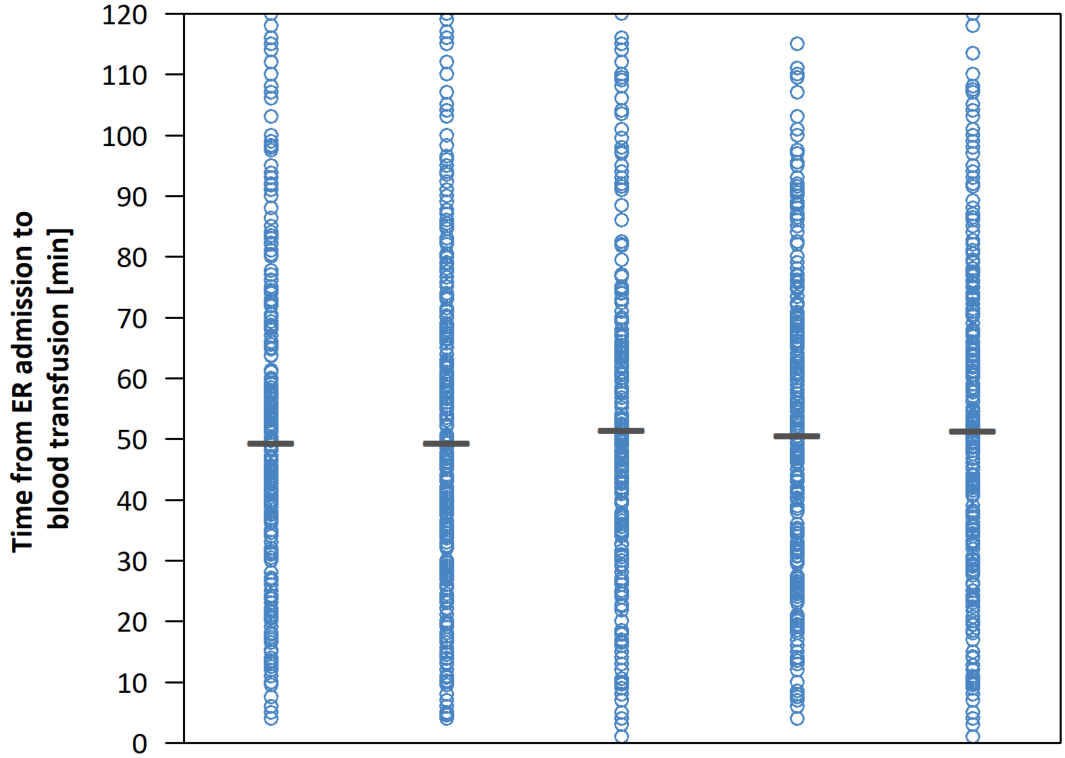


Year:	2018	2019	2020	2021	2022
TR-DGU:	64 [min]	64 [min]	71 [min]	70 [min]	71 [min]
n:	696	596	543	517	536
Min-Max:	1-120 [min]	1-120 [min]	1-120 [min]	2-120 [min]	5-120 [min]

Figure 11: Distribution of the mean duration from admission to the ER until surgery in patients with shock over all hospitals, 2018-2022, — TR-DGU, o single hospital value

4.2.5 Time until start of blood transfusion

If blood substitution is required, this should be done as quickly as possible. All patients with a valid time to blood transfusion (pRBC) are considered here. Time periods between admission to the ER and time of blood transfusion over 120 minutes are excluded from this analysis.

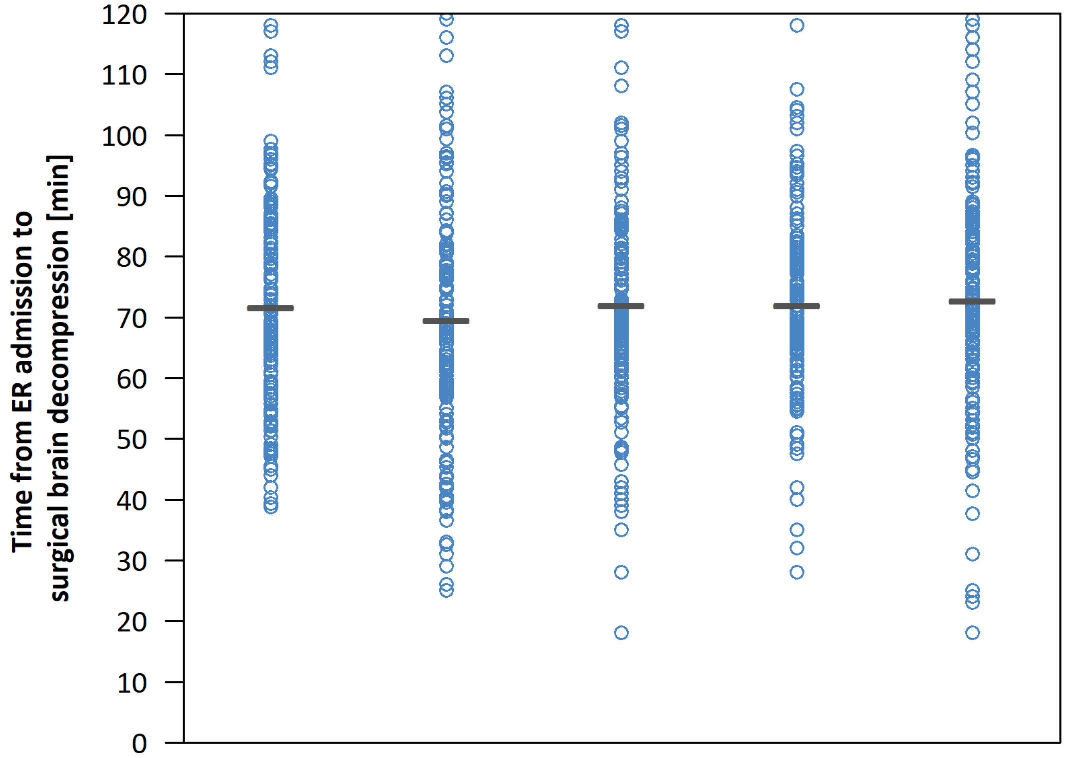


Year:	2018	2019	2020	2021	2022
TR-DGU:	49 [min]	49 [min]	51 [min]	51 [min]	51 [min]
n:	1,366	1,238	1,151	1,195	1,346
Min-Max:	1-120 [min]	1-120 [min]	1-120 [min]	1-120 [min]	1-120 [min]

Figure 12: Distribution of the mean duration from admission to the ER until start of the transfusion over all hospitals, 2018-2022, — TR-DGU, o single hospital value

4.2.6 Surgical brain decompression

In patients with intracranial bleeding after severe traumatic brain injury (TBI, AIS severity = 5) a surgical brain decompression is indicated. Only surgery patients with a valid time to surgery (max. 120 minutes) and AIS severity degree of 5 are considered in this analysis.



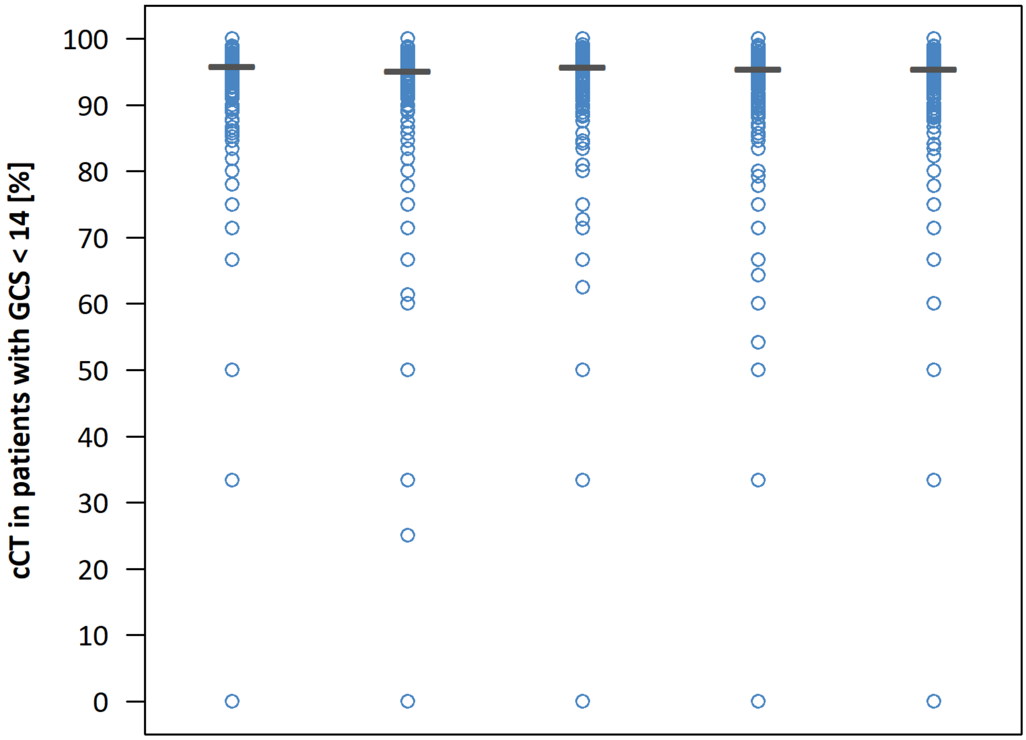
Year:	2018	2019	2020	2021	2022
TR-DGU:	72 [min]	69 [min]	72 [min]	72 [min]	73 [min]
n:	712	628	668	597	685
Min-Max:	1-120 [min]	1-120 [min]	14-120 [min]	16-120 [min]	3-120 [min]

Figure 13: Distribution of the mean duration from admission to the ER until surgical brain decompression over all hospitals, 2018-2022, — TR-DGU, o single hospital value

4.3 Diagnostics and interventions

4.3.1 Cranial CT (cCT) with GCS < 14

A reduced consciousness could be indicative of a TBI and should be investigated with a cranial CT (cCT) or whole-body CT. All patients with a GCS < 14 are included, either prehospital or on admission (if not intubated). Patients who died within the first 30 minutes after admission are excluded, because a cCT / whole-body CT is no longer possible. A missing value regarding cCT / whole-body CT is considered as „not performed".

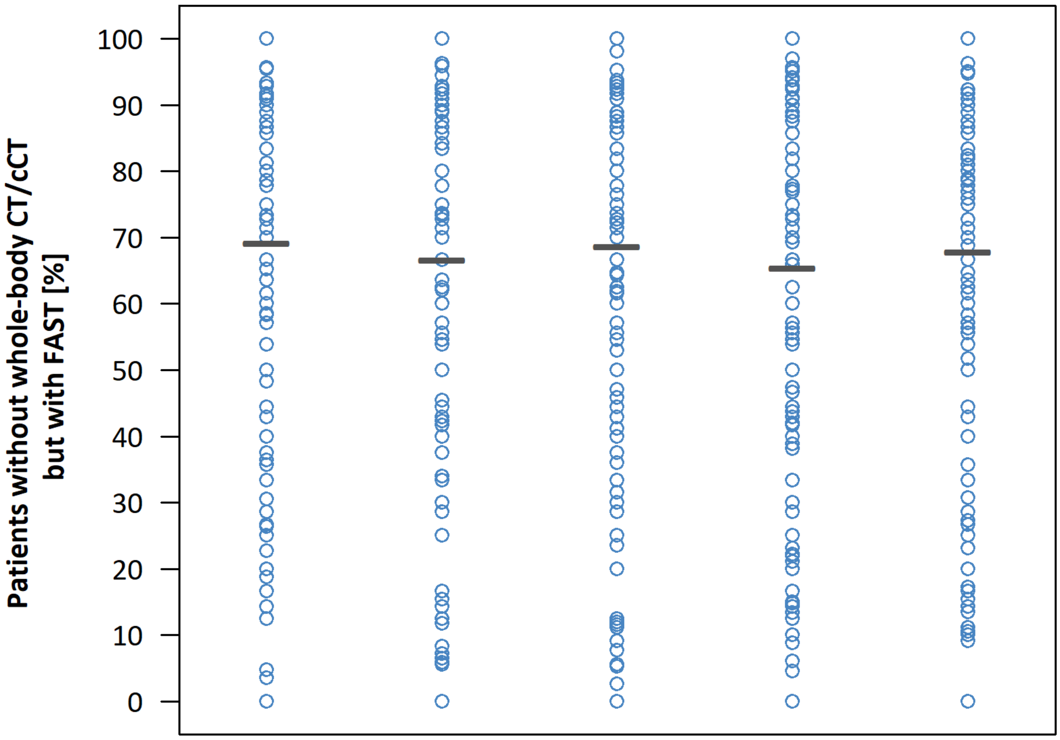


Year:	2018	2019	2020	2021	2022
TR-DGU:	96 %	95 %	96 %	95 %	95 %
cCT (n):	8,755	7,701	7,498	7,234	7,849
GCS < 14 (N):	9,129	8,093	7,834	7,581	8,224

Figure 14: Distribution of the cCT rate in patients with GCS < 14 over all hospitals, 2018-2022, — TR-DGU, o single hospital value

4.3.2 Sonography in patients without CT

If no whole-body CT / cCT has been performed, abdominal sonography (FAST = Focused Assessment with Sonography for Trauma) should be part of the diagnostic work-up. All patients without a documented whole-body CT / cCT are included in this analysis. A missing value regarding the FAST is considered as „not performed".

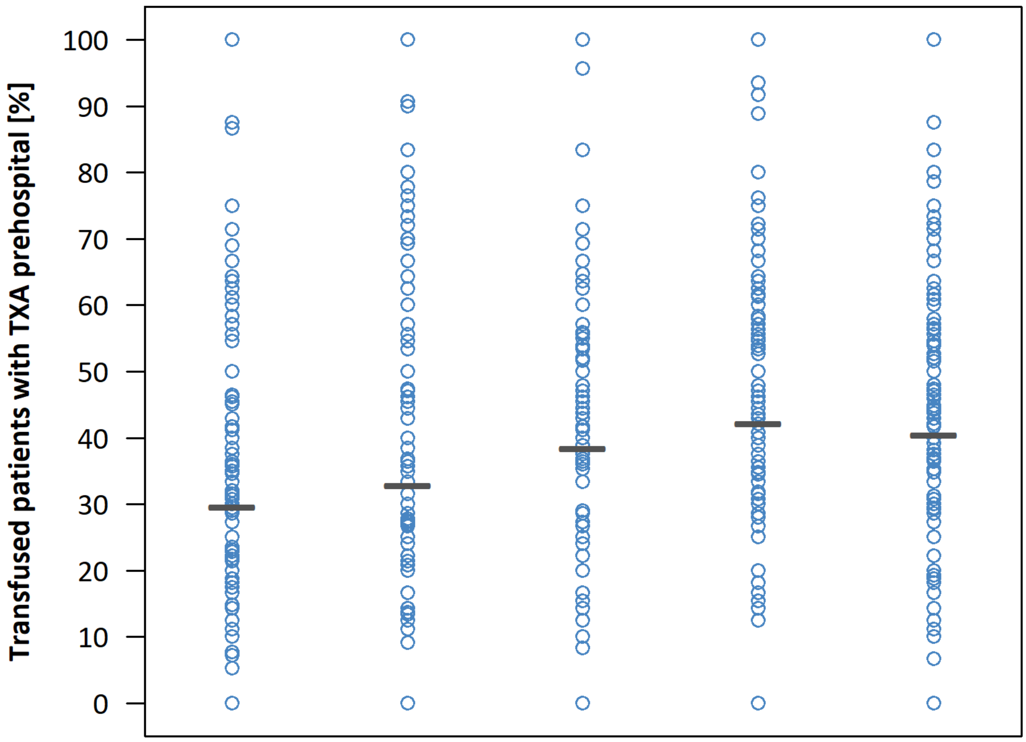


Year:	2018	2019	2020	2021	2022
TR-DGU:	69 %	67 %	69 %	65 %	68 %
FAST (n):	1,968	1,764	2,094	2,079	2,094
No WBCT/cCT (N):	2,845	2,647	3,048	3,176	3,085

Figure 15: Distribution of the sonography rate in patients without whole-body CT / ccT over all hospitals, 2018-2022, — TR-DGU, o single hospital value

4.3.3 Prehospital tranexamic acid in patients with blood transfusion

Based on a randomized trial, patients receiving tranexamic acid (TXA) need a reduced transfusion volume or even no transfusion at all. Therefore, patients who require a blood transfusion should have been previously given TXA. All patients with documented blood transfusion (received pRBCs in the ER up to ICU admission) are included here. A missing value regarding prehospital TXA administration is considered as „no TXA given".

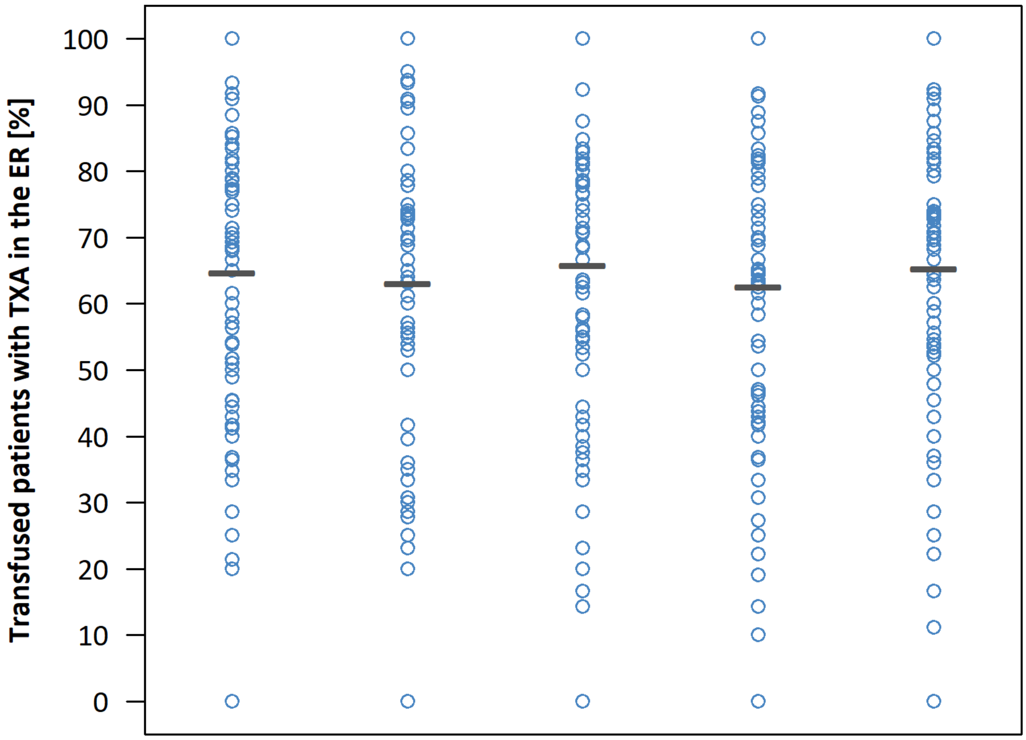


Year:	2018	2019	2020	2021	2022
TR-DGU:	30 %	33 %	38 %	42 %	41 %
TXA prehosp. (n):	618	629	756	873	889
Transfused (N):	2,086	1,912	1,969	2,068	2,195

Figure 16: Distribution of the prehospital tranexamic acid rate in the ER or surgery phase transfused patients over all hospitals, 2018-2022, — TR-DGU, o single hospital value

4.3.4 Tranexamic acid in the ER in patients with blood transfusion

Currently, tranexamic acid given in the ER is only documented in the standard dataset. All patients with documented blood transfusion (received pRBCs in the ER up to ICU admission) are included here. A missing value regarding TXA administration in the ER is considered as „no TXA given".



Year:	2018	2019	2020	2021	2022
TR-DGU:	65 %	63 %	66 %	63 %	65 %
TXA in ER (n):	921	822	868	1,000	1,145
Transfused (N):	1,423	1,303	1,319	1,597	1,754

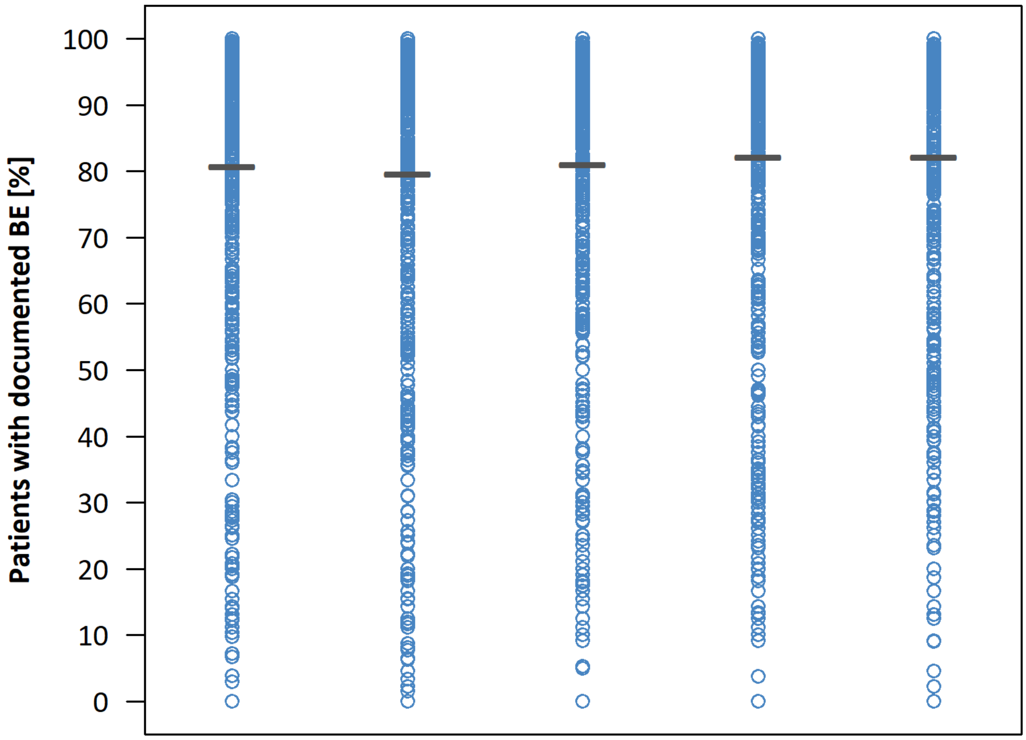
Figure 17: Distribution of the TXA admission rate in the ER in patients transfused between ER and intensive therapy over all hospitals, 2018-2022, — TR-DGU, o single hospital value

4.4 Data quality

4.4.1 Blood gas analysis performed / Base excess documented

A blood gas analysis (BGA) provides important and timely information about the condition of a trauma patient. But often these measurements are not documented in the TR-DGU. Specifically the base excess (BE) is an important outcome predictor that is used in the RISC II prognostic score. Detailed results regarding the completeness of data are presented in chapter 10. As an example, the completeness of BE data is presented here in the same way as the process indicators above.

All primary admitted patients are considered in this analysis and the proportion of patients with valid BE values is calculated. BE values less than -50 mmol/l or greater than 20 mmol/l are excluded.



Year:	2018	2019	2020	2021	2022
TR-DGU:	81 %	80 %	81 %	82 %	82 %
Document. BE (n):	24,729	21,896	22,007	21,958	23,328
Patients (N):	30,639	27,515	27,152	26,719	28,400

Figure 18: Distribution of the patient rate with documented base excess (BE) over all hospitals, 2018-2022, — TR-DGU, o single hospital value

5 Comparisons of the hospitals in the TraumaNetzwerk DGU®

In chapter 5, the hospitals in the TraumaNetzwerk DGU® are displayed corresponding to their trauma level. The classification into local, regional, supra-regional TraumaZentrum DGU® results from the certification requirements of the Whitebook Medical Care of the Severly Injured from the German Trauma Society. Hospitals that are not certified are not considered in the data.

5.1 Documented TraumaNetzwerk DGU® patients in the last 10 years

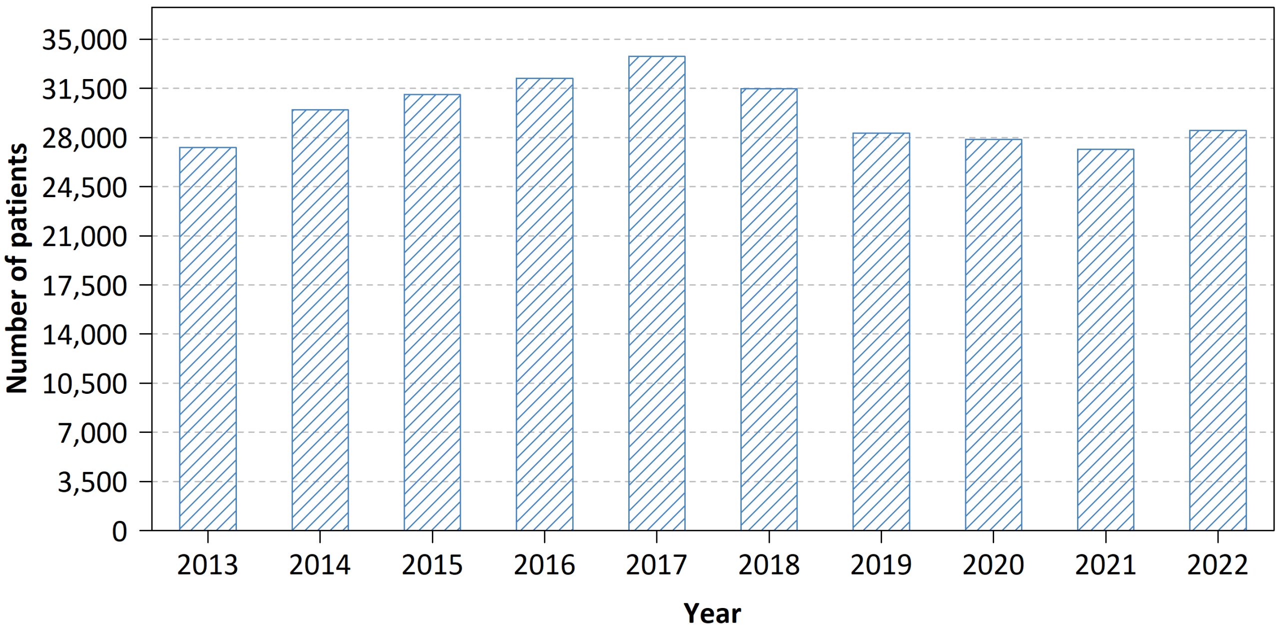


Figure 19: Documented number of patients in the TraumaNetzwerk DGU® basic group from 2012-2022 (bars)

5.2 Number of patients in each trauma level

In the latest year, the TraumaNetzwerk DGU® documented **28506 patients** in the basic group. The values in figure 20 represent the median (vertical line), the interquartile range (grey box) and the minimum/maximum (horizontal line). Hospitals without a TraumaNetzwerk DGU® certification are excluded here.

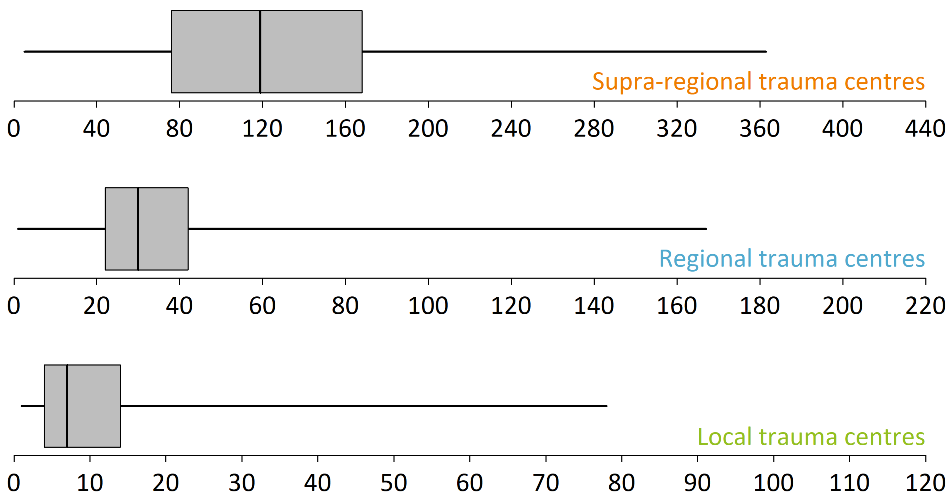


Figure 20: Median number of cases of the in the TraumaNetzwerk DGU® participating trauma centres separated by the trauma level in 2022

5.3 Comparisons between the trauma levels

Table 4 allows a comparison of the hospitals in the TraumaNetzwerk DGU® with the same trauma level. The total values of all certified trauma centres from the TR-DGU are presented as well.

Again, only cases from the **basic group** are considered here. In order to reduce the statistical uncertainty, all patients from the **last three years** are pooled and analysed together.

Table 4: Basic data from the total data from the TR-DGU trauma centres over the past three years

		Trauma centre DGU			
Characteristics		**local**	**regional**	**supra-regional**	**TR-DGU**
Number of hospitals		290	225	133	648
Portion of patients in the TR-DGU		11 %	29 %	60 %	100 %
Patients per year and hospital (mean)	n	**10** / year	**36** / year	**124** / year	**42** / year
Patients (3 years, cumulated)	n	8,926	24,053	49,599	82,578
Primary admitted and treated	n (%)	7,220 (81 %)	20,697 (86 %)	43,191 (87 %)	71,108 (86 %)
Primary admitted and transferred out early (< 48 h)	n (%)	1,578 (18 %)	2,702 (11 %)	776 (2 %)	5,056 (6 %)
Transferred in from another hospital	n (%)	128 (1 %)	654 (3 %)	5,632 (11 %)	6,414 (8 %)

Table 4 continuation:

		Trauma centre			
Characteristics		**local**	**regional**	**supra-regional**	**TR-DGU**
Patients					
Average age [years]	M	56.5	56.6	53.2	54.6
Patients aged 70 years and older	%	32 %	33 %	28 %	30 %
Males	%	68 %	68 %	70 %	69 %
ASA 3-4	%	21 %	25 %	22 %	23 %
Injuries					
Injury Severity Score (ISS) [points]	M	13.5	16.0	20.0	18.1
Proportion with ISS ≥ 16	%	34 %	46 %	61 %	54 %
Proportion polytrauma *	%	7 %	10 %	18 %	14 %
Proportion with life-threatening severe injury **	%	17 %	26 %	36 %	31 %
Patients with TBI, AIS ≥ 3	%	19 %	28 %	43 %	36 %
Patients with thoracic injury, AIS ≥ 3	%	36 %	38 %	39 %	38 %
Patients with abdominal injury, AIS ≥ 3	%	7 %	9 %	10 %	9 %
Prehospital care (primary admissions only)					
Rescue time (accident to hospital) [min]	M	60.8	63.7	71.6	67.6
Prehospital volume administration [ml]	M	447	509	676	594
Prehospital intubation	%	3 %	8 %	27 %	19 %
Proportion unconscious (GCS ≤ 8)	%	4 %	7 %	19 %	13 %
Emergency room (primary admissions only)					
Blood transfusion	%	3 %	4 %	10 %	7 %
Whole-body CT	%	66 %	70 %	80 %	75 %
Cardio-pulmonary resuscitation	%	1 %	2 %	4 %	3 %
Shock / hypotension	%	4 %	4 %	9 %	7 %
Coagulopathy	%	8 %	9 %	12 %	10 %
Length of stay (without early transfers out)					
Length of intubation on the intensiv care unit [days]	M	4.3	5.1	6.7	6.4
Length of stay on the intensiv care unit [days]	M	2.4	3.7	6.3	5.2
Length of stay in the hospital [days]	M	9.7	11.9	16.0	14.3
Outcome and prognosis (without transfers in and early transfers out and patients deceased within the first week with a patient's volition)					
Patients	n	7,220	20,697	43,191	71,108
Non-survivors	n	279	1,184	3,589	5,052
Hospital mortality	%	4.0 %	6.0 %	8.9 %	7.5 %
RISC II prognosis	%	4.3 %	6.3 %	9.5 %	8.0 %

GCS = Glasgow Coma Scale; AIS = Abbreviated Injury Scale; M = Mean

* Polytrauma: see „Berlin-Definition" (Pape et al. 2014)

** Life-threatening severe injury: ISS ≥ 16 in conjunction with phys. effects (Paffrath et al. 2014)

5.4 State of transfer within the trauma levels

The transfer status of all patients in the TraumaNetzwerk DGU® is displayed in the following figure, classified according to the trauma level for the year 2022. As expected, the proportion of patients that are transferred out of a local trauma centre as well as the proportion of patients that are transferred into a supra-regional trauma centre are the highest.

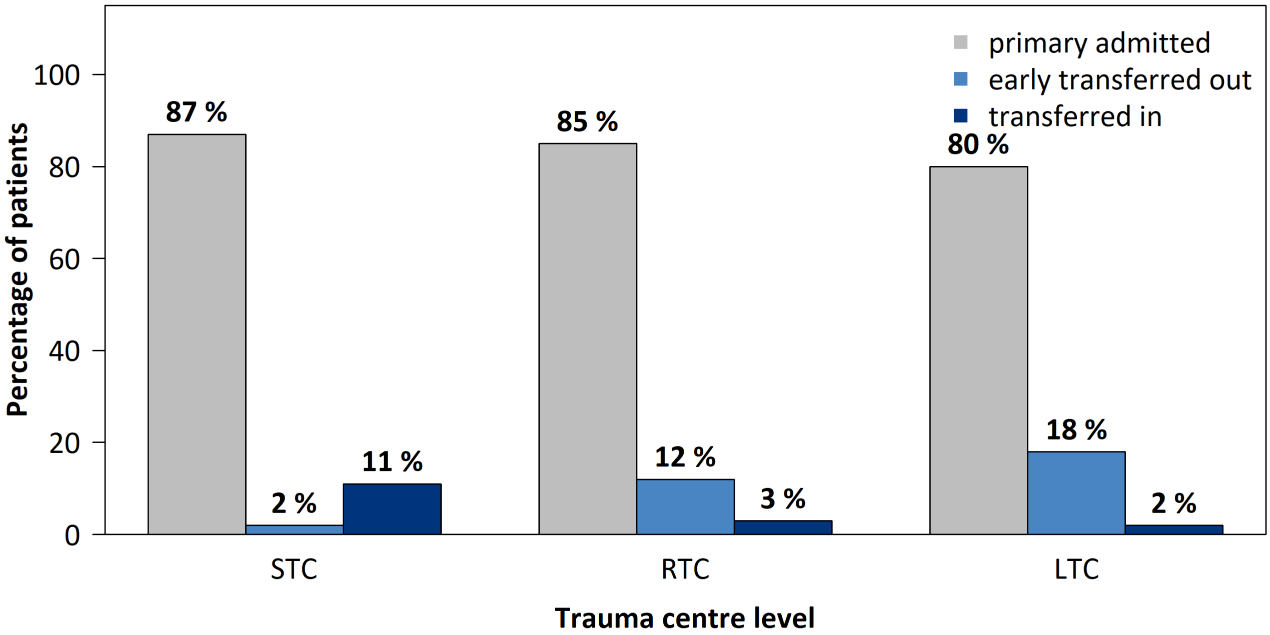


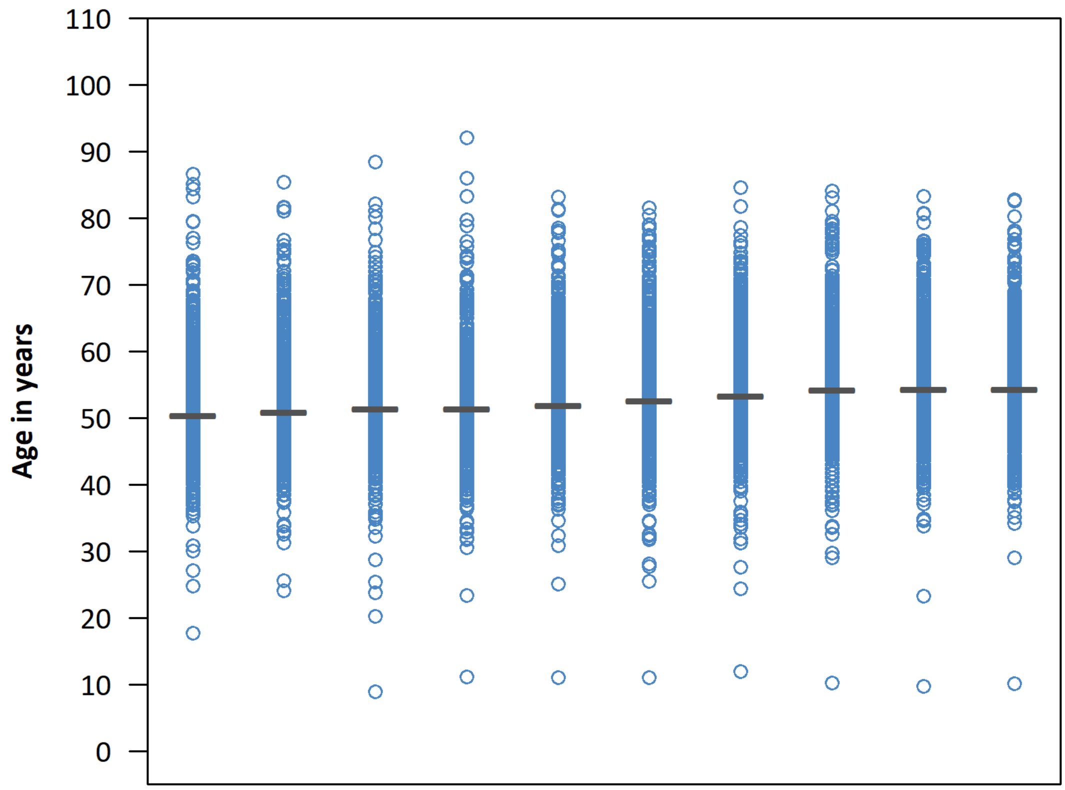
Figure 21: Transfer status classified according to the trauma level in 2022

6 Graphical comparisons with other hospitals

Below, selected information about the patients from the years **2013-2022** from the hospitals in the TraumaRegister DGU® are displayed. Only cases from the **basic group** are considered (see page 5). Different from the values in chapter 3, only hospitals are analysed, where **at least 3 patients** were available. The hospitals from the TR-DGU are indicated as light blue circles. The horizontal grey line is the mean value over all hospitals per year.

6.1 Distribution of age in the past 10 years

The figure below shows the distribution of mean age of the patients from the TR-DGU **with at least 3 patients** over the past ten years.

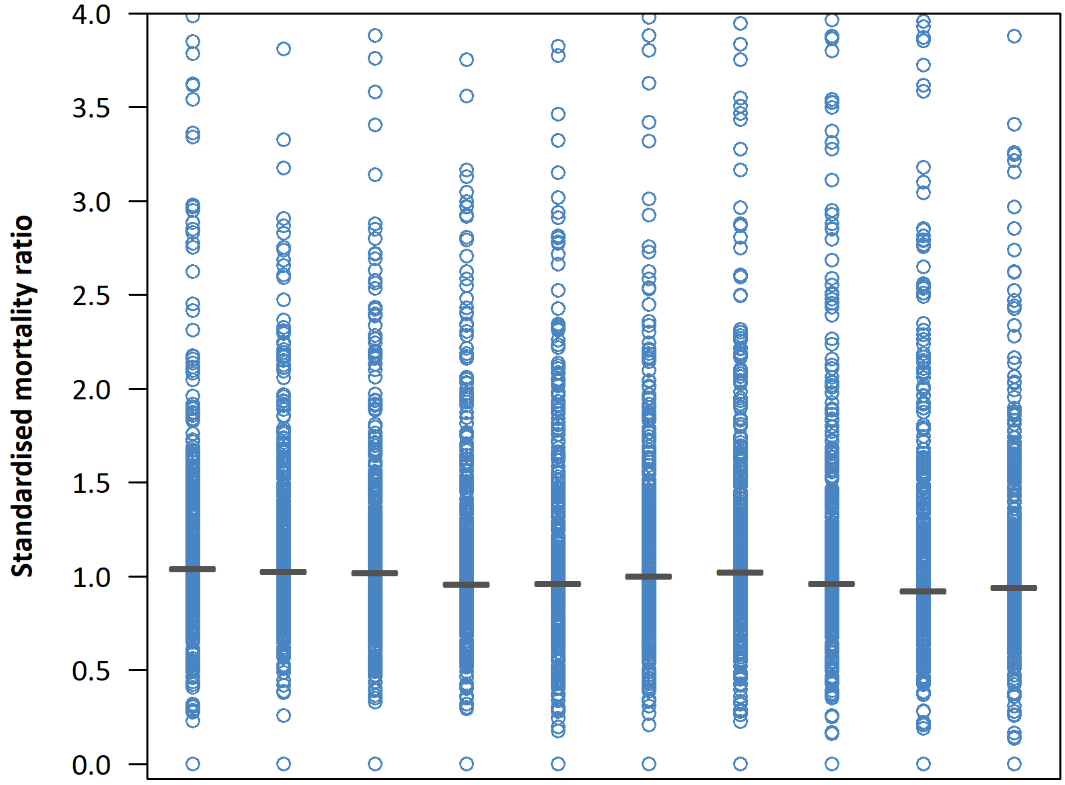


Year:	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
TR-DGU:	50.4	50.9	51.4	51.4	51.9	52.6	53.4	54.2	54.3	54.3

Figure 22: Mean patient's age in the — TR-DGU compared to the o single hospital values in the TR-DGU for the years 2013-2022

6.2 Distribution of the standardised mortality ratio (SMR) over the past ten years

Only primary admitted patients are displayed here (from hospitals with at least 3 cases). Early transfers out (< 48 h) are excluded. Patients deceased within one week after admission **with a patient's volition** are excluded from this analysis to ensure a correct presentation of the quality of treatment in a hospital, as in chapter 2. The standardised mortality ratio is shown for each hospital as well as for the TR-DGU over the past ten years. The standardised mortality ratio is defined as the quotient of the observed mortality and the risk of death prognosis (RISC II) for each hospital. A SMR value > 1 means, that the observed mortality is higher than expected. A SMR value < 1 indicates that the observed mortality is lower than expected. Figure 23 shows an SMR slightly under 1 for 2021.



Year:	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
TR-DGU:	1.04	1.03	1.02	0.96	0.96	1.00	1.02	0.96	0.93	0.94

Figure 23: Standardised mortality ratio of the — TR-DGU compared to the o single hospital values in the TR-DGU for the years 2013-2022

6.3 Length of stay and injury severity

The length of stay of patients is highly variable and depends on diverse factors. Figure 24 describes the relationship between the average length of stay (LOS) in hospital and injury severity (ISS). The mean value is calculated for survivors from the basic group. Patients transferred to another hospital (n= 4,482) are excluded here. Hospitals with **fewer than 3 patients** are **not** displayed in the figure due to their statistical uncertainty.

TR-DGU 2022:

The value is based on:
22,551 patients

Mean length of stay:
15.5 days

Mean ISS:
16.3 points

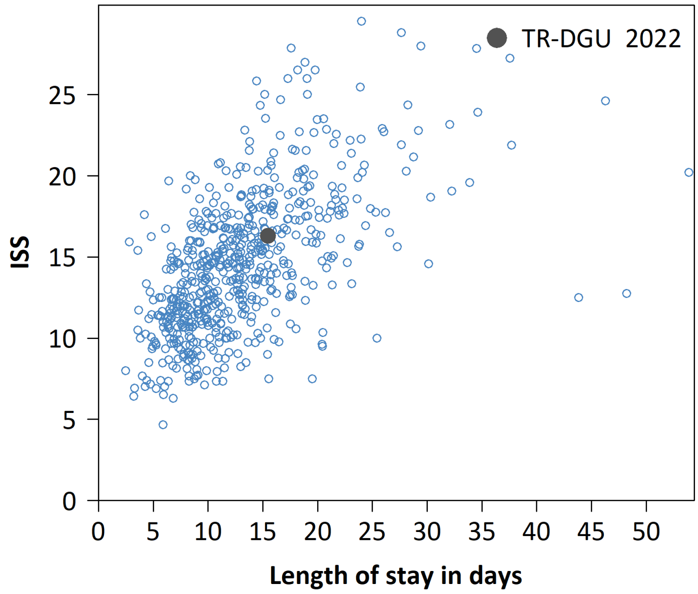


Figure 24: Relationship between length of stay and injury severity over all hospitals in 2022

6.4 Length of stay of the deceased patients

The following figure shows the distribution of length of stay of the deceased patients (N = 3,771) within the first 30 days (n = 3,624) in the TR-DGU in the last year.

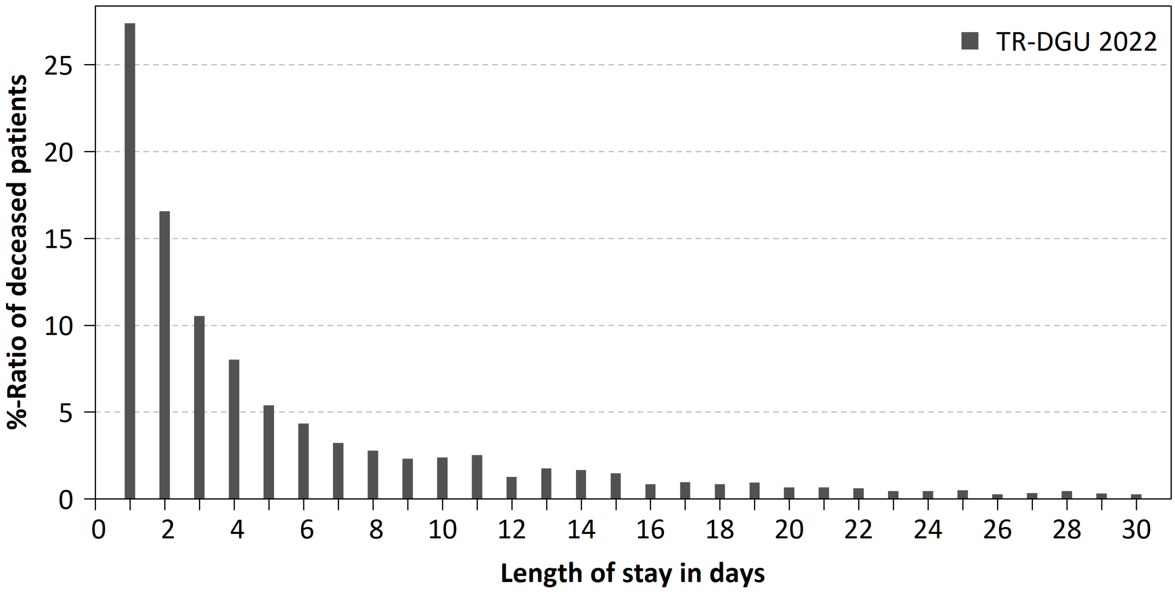


Figure 25: Time point of death of the patients from the TR-DGU [length of stay in days] in 2022

7 Basic data of trauma care

The following pages present basic data from the trauma care of the actual year 2022. The data refer to patients from the **basic group** (see page 5). Shown is data from the TraumaRegister DGU® basic group in the current year, (**TR-DGU 2022**), and the registry data sumarized from the last 10 years, 2013-2022 (**TR-DGU 10 years**).

Table 5: Data from the TR-DGU regarding the patients and accident type

(S) Patient and accident	TR-DGU 2022		TR-DGU 10 years	
Patients in the **basic group** (n)	30,806		317,846	
Primary admissions / transfers	%	n	%	n
Primary admitted	**92.2 %**	28,400	**91.2 %**	289,828
... and transferred out within 48 h	**6.3 %**	1,927	**6.5 %**	20,543
Transferred in within 24 h after accident	**7.1 %**	2,179	**7.9 %**	25,253
Transferred in after 24 h	**0.7 %**	227	**0.9 %**	2,765
Patient characteristics	**M** ± SD*/%	n	**M** ± SD*/%	n
Age [years]	**54.3** ± 22.7	30,806	**52.4** ± 22.7	317,846
Children under 16 years	**3.7 %**	1,140	**3.9 %**	12,521
Elderly over 70 years	**29.2 %**	8,987	**27.2 %**	86,530
Males	**69.6 %**	21,445	**69.7 %**	221,421
ASA 3-4 prior to trauma (since 2009)	**22.6 %**	6,572	**18.9 %**	54,410
Mechanism of injury	%	n	%	n
Blunt	**95.9 %**	27,750	**96.0 %**	289,546
Penetrating	**4.1 %**	1,193	**4.0 %**	12,003
Type and cause of accident	%	n	%	n
Traffic: Car	**16.4 %**	4,973	**19.2 %**	59,968
... thereof as car passenger (since 2020)	**15.7 %**	4,741	**4.1 %**	12,755
... thereof as lorry passenger (since 2020)	**0.6 %**	189	**0.2 %**	532
... thereof as bus passenger (since 2020)	**0.1 %**	42	**0.0 %**	108
Traffic: Motor bike	**10.9 %**	3,292	**11.9 %**	37,345
Traffic: Bicycle	**12.3 %**	3,710	**10.3 %**	32,204
... thereof as supported bike (since 2020)	**1.7 %**	500	**.4 %**	1,195
Traffic: Pedestrian	**4.3 %**	1,306	**5.5 %**	17,146
Traffic: E-scooter (since 2020)	**0.8 %**	252	**0.2 %**	470
High fall (> 3m)	**15.5 %**	4,691	**15.3 %**	47,769
Low fall (≤ 3m)	**27.7 %**	8,389	**26.4 %**	82,572
... thereof as ground level fall (since 2020)	**9.5 %**	2,886	**2.4 %**	7,466
Suicide (suspected)	**4.5 %**	1,353	**4.4 %**	13,703
Assault (suspected)	**2.8 %**	829	**2.5 %**	7,813

* M = Mean; SD = Standard deviation

Table 6: Data from the TR-DGU regarding findings at the accident scene. Information for primary admitted patients

Time point A: Findings at the accident scene	TR-DGU 2022		TR-DGU 10 years	
Primary admitted patients (n) (%-ratio of the basic group)	28,400 (92 %)		289,828 (91 %)	
Vital signs	**M** ± SD*	n	**M** ± SD*	n
Systolic blood pressure [mmHg]	**134.4** ± 32.5	23,547	**133.6** ± 33.0	249,066
Respiratory rate [1/min]	**16.0** ± 5.6	19,342	**15.8** ± 5.8	185,169
Glasgow Coma Scale (GCS) [points]	**12.8** ± 3.8	25,426	**12.6** ± 3.9	266,121
Findings	%	n	%	n
Shock (systolic blood pressure ≤ 90 mmHg)	**8.1 %**	1,900	**8.5 %**	21,206
Unconsciousness (GCS ≤ 8)	**15.4 %**	3,922	**16.3 %**	43,407
Therapy	%	n	%	n
Cardio-pulmonary resuscitation	**3.0 %**	849	**2.9 %**	8,308
Pre-hospital thoracotomy (since 2020)	**0.2 %**	49	**0.0 %**	117
Endotracheal intubation	**18.8 %**	5,336	**20.1 %**	58,357
Alternative airway	**1.1 %**	324	**1.0 %**	2,886
Surgical airway (since 2020)	**0.1 %**	15	**0.0 %**	44
Cervical spine immobilization (since 2020)	**63.4 %**	15,684	**63.1 %**	41,937
Analgo-sedation **	**49.0 %**	13,911	**33.9 %**	98,116
Chest drain (with and without needle decompression) **	**2.7 %**	774	**1.8 %**	5,144
... thereof only with needle decompression (since 2020)	**0.5 %**	153	**0.1 %**	422
Catecholamines **	**7.9 %**	2,247	**4.9 %**	14,097
Pelvic binder **	**15.9 %**	4,522	**6.4 %**	18,666
Tourniquet (since 2020)	**1.4 %**	393	**0.3 %**	1,004
Intraosseous access (since 2020)	**1.5 %**	420	**0.4 %**	1,165
Tranexamic acid	**15.2 %**	4,308	**7.3 %**	21,104
Volume administration	**M** ± SD*/%	n	**M** ± SD*/%	n
Patients without volume administration	**21.3 %**	5,492	**19.2 %**	51,946
with volume administration	**78.7 %**	20,285	**80.8 %**	218,989
with colloids	**1.6 %**	402	**3.6 %**	9,274
Average amount in patients with volume administration [ml]	**583** ± 511	25,777	**624** ± 537	270,935
Average amount in patients with and without volume administration [ml]	Median **500**		Median **500**	

* M = Mean; SD = Standard deviation

** Not available in the reduced QM dataset

Table 7: Data from the TR-DGU on emergency room and surgery. Information for primary admitted patients

Time point B: Emergency room / surgery	TR-DGU 2022		TR-DGU 10 years	
Primary admitted patients (n) (%-ratio of the basic group)	28,400 (92 %)		289,828 (91 %)	
Transportation to the hospital	%	n	%	n
With helicopter	**18.8 %**	5,335	**18.8 %**	54,352
Glasgow Coma Scale (GCS)	**M** ± SD*	n	**M** ± SD*	n
Prehospital intubated patients	**3.4** ± 1.8	3,320	**3.3** ± 1.5	34,557
Patients not prehospital intubated	**13.9** ± 2.3	13,909	**13.9** ± 2.4	109,702
Initial diagnostics	%	n	%	n
Sonography of the abdomen	**79.7 %**	22,643	**80.6 %**	233,728
X-ray of the thorax	**16.8 %**	4,771	**28.7 %**	83,194
cCT (isolated or whole-body)	**89.1 %**	25,315	**89.4 %**	259,029
Whole-body CT	**74.9 %**	21,277	**76.2 %**	220,813
Selective CT: Cervical spine (since 2020)	**10.2 %**	2,892	**9.2 %**	7,561
Selective CT: Chest/thoraric spine (since 2020)	**5.2 %**	1,466	**4.6 %**	3,746
Selective CT: Abdomen/lumbar spine/pelvis (since 2020)	**74.0 %**	21,006	**68.2 %**	56,107
Time period in the emergency room	**M** ± SD*/%	n	**M** ± SD*/%	n
Transfer to the operating theatre	**22.3 %**	6,032	**23.7 %**	47,849
If so: Duration from admission to the ER* until surgery [min]	**84.6** ± 67.1	5,518	**78.6** ± 62.6	43,158
Transfer to intensive care unit	**62.1 %**	16,801	**63.3 %**	127,758
If so: Duration from admission to the ER* until ICU* [min]	**108.7** ± 89.3	14,834	**92.0** ± 78.8	110,929
Bleeding and transfusion	**M** ± SD*/%	n	**M** ± SD*/%	n
Pre-existing coagulopathy	**22.0 %**	5,392	**20.4 %**	35,492
Systolic blood pressure ≤ 90 mmHg	**6.8 %**	1,810	**7.4 %**	20,080
Hemostasis therapy**	**22.7 %**	3,866	**19.8 %**	26,674
Administration of tranexamic acid**	**15.2 %**	3,658	**15.1 %**	19,061
ROTEM / thrombelastography**	**10.2 %**	1,594	**10.5 %**	12,268
Patients with blood transfusion	**7.7 %**	2,195	**7.4 %**	21,562
Number of pRBC, if transfused	**4.7** ± 5.4	2,195	**5.0** ± 6.1	21,562
Number of FFP, if transfused	**2.9** ± 4.8	2,195	**3.1** ± 5.5	21,562
Treatment in the ER*	%	n	%	n
Cardio-pulmonary resuscitation **	**2.1 %**	549	**1.9 %**	4,027
Chest drain**	**9.2 %**	2,368	**7.8 %**	16,747
Endotracheal intubation**	**8.4 %**	2,107	**12.3 %**	20,754
Initial laboratory values	**M** * ± SD	n	**M** * ± SD	n
Base excess [mmol/l]	**-1.6** ± 4.8	23,345	**-1.7** ± 4.7	225,928
Haemoglobin [g/dl]	**13.1** ± 2.2	27,556	**13.2** ± 2.2	278,461
INR	**1.1** ± 0.4	26,510	**1.2** ± 0.5	268,309
Quick's value [%]	**88.5** ± 20.3	25,874	**88.0** ± 21.4	261,560
Temperature [C°]**	**36.3** ± 1.0	18,094	**36.2** ± 1.1	105,993

* ICU = Intensiv care unit; ER = Emergency room; M = Mean; SD = Standard deviation
** Not available in the reduced QM dataset

Table 8: Data from the TR-DGU on intensive care unit

Time point C: Intensive care unit	TR-DGU 2022		TR-DGU 10 years	
Patients with **intensive care therapy** (n) (%-ratio of the basic group)	25,894 (84 %)		273,868 (86 %)	
Treatment	%	n	%	n
Hemostasis therapy **	**12.2 %**	2,030	**14.2 %**	20,233
Dialysis / hemofiltration **	**2.1 %**	353	**2.1 %**	3,077
Blood transfusion ** (within the first 48 h after admission to ICU)	**24.0 %**	3,201	**25.0 %**	29,049
Mechanical ventilation / intubated	**34.0 %**	8,803	**36.9 %**	101,012
Complications on ICU	%	n	%	n
Organ failure **	**29.4 %**	5,020	**32.2 %**	46,548
Multiple organ failure (MOF) **	**15.6 %**	2,660	**18.5 %**	26,484
Sepsis **	**4.9 %**	829	**5.4 %**	7,681
Length of stay and ventilation	**M** ± SD*	n	**M** ± SD*	n
Length of intubation [days]	**6.9** ± 9.5	8,677	**7.3** ± 10.2	99,881
	Median **3**		Median **3**	
Length of stay on ICU* [days]	**6.0** ± 9.4	25,894	**6.3** ± 9.9	273,868
	Median **2**		Median **2**	

* ICU = Intensiv care unit; ER = Emergency room; M = Mean; SD = Standard deviation
** Not available in the reduced QM dataset

Table 9: Data from the TR-DGU on discharge and outcome

Time point D: Discharge / outcome	TR-DGU 2022		TR-DGU 10 years	
Patients from the basic group	30,806		317,846	
Diagnoses	**M** ± SD*/%	n	**M** ± SD*/%	n
Number of injuries / diagnoses per patient	**4.6** ± 3.0		**4.5** ± 2.9	
Patients with only **one** injury	**9.7 %**	2,990	**10.3 %**	32,811
Surgeries	**M** ± SD*/ %	n	**M** ± SD*/ %	n
Patients requiring surgery	**65.4 %**	14,172	**66.4 %**	115,389
Number of surgeries per patient, if undergone surgery**	**2.9** ± 3.3		**3.4** ± 7.1	
Thrombo-embolic events (MI; pulmonary embolism; DVT; stroke; etc.)	%	n	%	n
Patients with at least one event **	**2.7 %**	504	**2.8 %**	4,352
Outcome (without early transfers out)	%	n	%	n
Survivors	**86.9 %**	25,108	**88.3 %**	262,566
Hospital mortality	**13.1 %**	3,771	**11.7 %**	34,737
Died within 30 days	**12.5 %**	3,624	**11.2 %**	33,312
Died within 24 hours	**4.6 %**	1,341	**4.4 %**	13,060
Died in the ER (without ICU)	**1.6 %**	464	**1.5 %**	4,508
Died with end-of-life-decision (since 2015)	**70.4 %**	2,510	**55.0 %**	11,868
... palliative reason (since 2020)	**50.1 %**	1,264	**47.1 %**	3,067
... presumed will of the patient (since 2020)	**33.8 %**	853	**35.8 %**	2,332
... written willingness of the patient (since 2020)	**16.1 %**	406	**17.1 %**	1,116

* M = Mean; SD = Standard deviation
** Not available in the reduced QM dataset

Table 9 continuation:

Time point D: Discharge / outcome	**TR-DGU 2022**		**TR-DGU 10 years**	
Patients from the basic group	30,806		317,846	
Transfer / discharge (all survivors)	%	n	%	n
Survivors who were discharged and …	**100.0 %**	27,035	**100.0 %**	283,109
transferred into another hospital	**16.6 %**	4,482	**17.3 %**	48,885
... among them early discharges (< 48 h)	**7.1 %**	1,927	**7.3 %**	20,543
transferred into a rehabilitation center	**13.9 %**	3,758	**16.3 %**	46,160
other destination	**3.6 %**	967	**3.7 %**	10,354
sent home	**65.9 %**	17,828	**62.8 %**	177,710
Condition at the time of discharge (according to the parameter „outcome“; without early transfers out)	%	n	%	n
Patients with a valid value		28,662		290,011
of these surviving patients		24,891		255,274
- good recovery	**58.9 %**	14,663	**64.1 %**	163,633
- moderate disability	**30.1 %**	7,481	**25.7 %**	65,733
- severe disability	**9.8 %**	2,444	**8.8 %**	22,491
- persistant vegetative state	**1.2 %**	303	**1.3 %**	3,417
Length of stay in hospital [days] (all patients from the basic group)	**M** ± SD*	n	**M** ± SD*	n
All patients	**13.7** ± 16.8	30,804	**14.6** ± 17.0	317,807
Median	**9**		10	
Only survivors	**14.6** ± 17.1	27,033	**15.5** ± 17.2	283,076
Median survivors	10		**11**	
Only non-survivors	**7.4** ± 11.9	3,771	**7.5** ± 12.8	34,731
Median non-survivors	3		3	
LOS when transferred to a rehabilitation centre	**28.1** ± 23.0	3,757	**28.3** ± 22.0	46,155
when transferred to another hospital	**10.1** ± 14.6	4,482	**10.2** ± 14.6	48,884
when sent home	**12.4** ± 13.9	17,827	**13.3** ± 14.1	177,686
Costs of treatment *** (without early transfers out)	**€**	n	**€**	n
Average costs in € per patient				
... all patients	**23,032**	9,025	**22,322**	113,731
... only non-survivors	**12,973**	2,497	**12,745**	25,474
... only survivors	**26,879**	6,528	**25,086**	88,257
... only patients with ISS ≥ 16	**24,796**	7,225	**25,047**	85,347
Sum of all costs	207,860,177 €		2,538,674,424 €	
Sum of all days in hospital	189,916 days		2,359,135 days	
Average costs per day per patient	1094.5 €		1076.1 €	

* M = Mean; SD = Standard deviation; LOS = Length of stay
** Not available in the reduced QM dataset
***** Treatment costs:** The estimated treatment costs are based on data from 1,002 German TR-DGU patients treated in 2007/08. For these patients a detailed cost analysis is available (Lefering et al., Unfallchirurg, 2019). Assuming a cost increase of 2 % per year the costs today would be 29 % higher.

8 Subgroup analyses

Specific subgroups are presented on these pages. Besides descriptive data on the patients and the process of care, also the outcome (hospital mortality) and prognosis are presented here for each subgroup. In order to reduce the statistical uncertainty occurring in subgroup analyses, patients from the last three years (2020-2022) are pooled together. Again, only patients from the **basic group** are considered here.

8.1 Subgroups within the TR-DGU

All results in table 10 refer to **primary admitted cases** from the basic group. Patients transferred in as well as those transferred out early (within 48 h) are not considered here. There are a total of **76,838 patients** from the TR-DGU in the last three years.

Table 10: Basic data from the TR-DGU on selected subgroups. The percentage frequency refers to the number of patients from the respective subgroup in the basic group

		Primary patients 2020-2022	Subgroups					
			No TBI	**Combined trauma**	**Isolated TBI**	**Shock**	**Severe injuries**	**Elderly**
Definition of the subgroups		All	AIS head ≤ 1	AIS head and body each ≥ 2	AIS head ≥ 3 and AIS elsewhere ≤ 1	sBP ≤ 90 mmHg on admission	ISS ≥ 16 and at least 1 phys. problem*	Age 70 years or more
Number of basic group patients	n	76,838	38,862	27,942	10,034	4,928	23,761	22,419
	%	100 %	50.6 %	36.4 %	13.1 %	6.4 %	30.9 %	29.2 %
Patients								
Age [years]	M	54.3	51.2	55.7	62.6	53.7	63.2	80.7
Males	%	69.3 %	70.8 %	69.1 %	64.3 %	70.2 %	66.7 %	56.2 %
ASA 3-4	%	21.9 %	17.0 %	23.6 %	36.5 %	26.5 %	36.0 %	51.8 %
Injuries								
ISS [points]	M	18.0	14.5	23.0	18.0	29.5	28.0	18.6
Head injury (AIS ≥ 3)	%	34.7 %		59.5 %	100.0 %	47.1 %	64.7 %	46.3 %
Thoracic injury (AIS ≥ 3)	%	39.3 %	46.3 %	43.5 %		56.1 %	51.0 %	36.0 %
Abdominal injury (AIS ≥ 3)	%	9.3 %	13.2 %	7.2 %		22.4 %	13.0 %	4.6 %
Prehospital care								
Duration from accident to hospital [min]	M	68	67	69	71	74	73	70
Intubation	%	19.2 %	9.3 %	29.3 %	29.8 %	57.5 %	44.0 %	18.1 %
Volume [ml]	M	594.9	593.1	638.7	478.0	928.9	724.9	505.4
Emergency room								
Blood transfusion	%	7.8 %	7.6 %	9.7 %	3.3 %	38.3 %	18.2 %	6.6 %
Whole-body CT	%	75.1 %	75.9 %	81.4 %	54.7 %	77.7 %	77.3 %	67.3 %
Cardio-pulmonary resuscitation	%	2.3 %	1.9 %	2.9 %	1.9 %	14.6 %	6.3 %	2.3 %
Physiological problems *								
Age ≥ 70 years	%	29.2 %	22.2 %	32.0 %	48.1 %	30.2 %	54.0 %	100.0 %
Shock (sBP ≤ 90 mmHg)	%	11.2 %	9.8 %	13.8 %	8.7 %	100.0 %	28.1 %	11.0 %
Acidosis (BE < -6)	%	12.1 %	9.9 %	15.3 %	11.6 %	44.8 %	28.9 %	12.1 %
Coagulopathy	%	11.3 %	8.7 %	13.9 %	14.2 %	35.3 %	26.4 %	19.3 %
Unconsciousness (GCS ≤ 8)	%	15.6 %	4.0 %	25.0 %	33.9 %	44.0 %	42.3 %	17.9 %

* According to the definition of patients with severe life-threatening injuries from Paffrath et al. (2014); physiological problems are defined according to Pape et al. (2014).

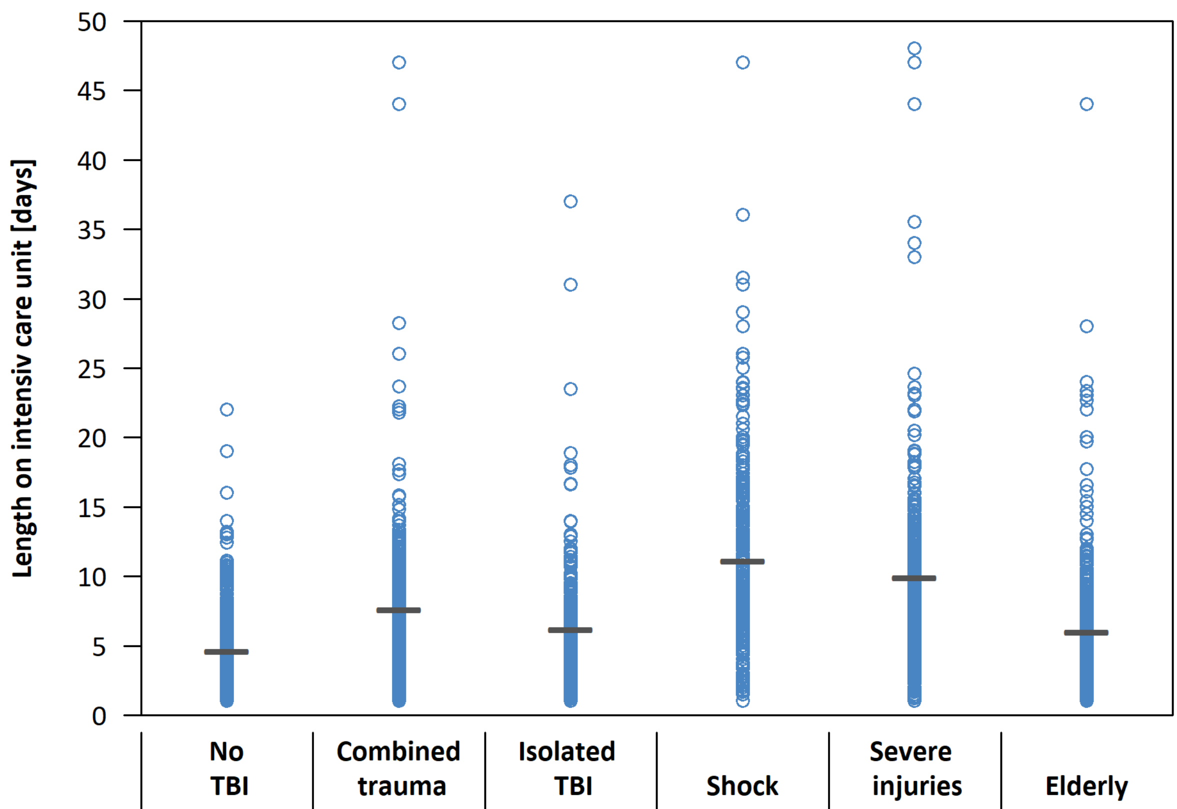
Table 10 continuation:

		Primary patients 2020-2022	Subgroups					
			No TBI	Combined trauma	Isolated TBI	Shock	Severe injuries	Elderly
Length of stay								
Patients with intensive care therapy	n	66,742	32,102	25,715	8,925	4,186	21,161	19,096
- Intubation on intensive care unit [days]	M	6.9	5.6	8.1	6.2	7.8	7.9	6.4
- Intensive care unit [days]	M	5.9	4.6	7.6	6.2	11.1	9.9	6.0
Days in hospital, all patients	M	14.3	14.1	15.4	11.7	18.7	17.8	13.8
Mortality and prognosis (without patients deceased within the first week with a patient's volition)								
Non-survivors	n	5,601	1,463	2,730	1,408	1,213	4,535	2,920
Mortality	%	7.7 %	3.8 %	10.5 %	16.9 %	28.9 %	22.6 %	15.1 %
Risk of death prognosis (RISC II)	%	8.2 %	4.0 %	11.6 %	16.7 %	32.7 %	23.9 %	15.8 %

8.2 Graphical comparison of the length of stay between subgroups

To graphically illustrate the deviations between the different subgroups regarding their length of stay, the following figures are given. As in chapter 6, the hospitals from the TR-DGU are indicated as light blue circles. The horizontal grey line is the mean value over all hospitals per group.

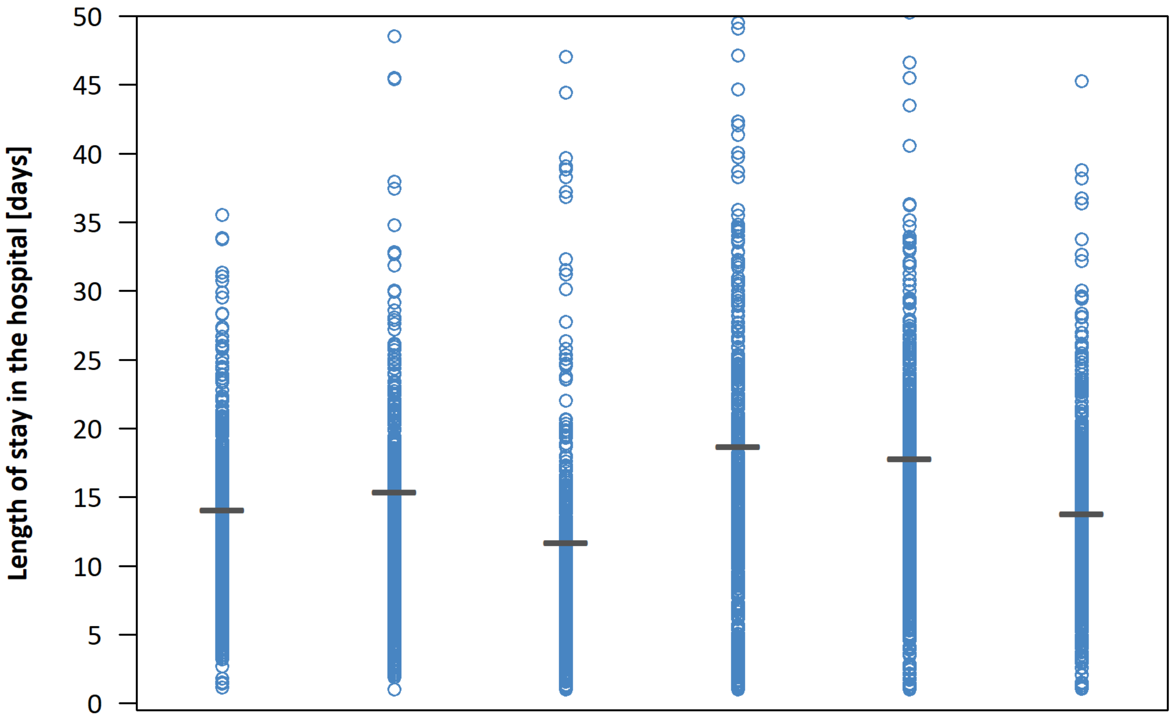
Figure 26 shows the **length of stay in the intensive care unit** in days for 2020-2022 between the subgroups defined in table 10 for all primary admitted and treated patients of the TR-DGU in the basic group.



	No TBI	Combined trauma	Isolated TBI	Shock	Severe injuries	Elderly
TR-DGU:	4.6	7.6	6.2	11.1	9.9	6.0
n:	32,102	25,715	8,925	4,186	21,161	19,096

Figure 26: Length of stay in the intensive care unit [days] and number of patients divided into subgroups, for definition see tab. 10, patients 2020-2022, — TR-DGU, o single hospital value

Figure 27 compares the **length of stay in hospital** in days for 2020-2022 between the subgroups defined in table 10 for all primary admitted and treated patients of the TR-DGU in the basic group.



	No TBI	Combined trauma	Isolated TBI	Shock	Severe injuries	Elderly
TR-DGU:	14.1	15.4	11.7	18.7	17.8	13.8
n:	38,862	27,942	10,034	4,928	23,761	22,419

Figure 27: Length of stay in hospital [days] and number of patients divided into subgroups, for definition see tab. 10, patients 2020-2022, — TR-DGU, o single hospital value

9 Data quality and completeness

9.1 Completeness of selected variables

Registries and audit reports can only be as good as the data they are based on. If a lot of patients have missing data in important variables, then the results might be biased or even wrong. Table 12 describes the **completeness rates („ % ")** of several important variables, together with **the number of patients with missing data („ {} ")**. The list of variables only contains the prognostic variables needed for the RISC II.

As on the previous pages, only cases from the **basic group** are considered here. The completeness rates of the **TR-DGU in 2022** are compared with the data from the previous years (**since 2013**). Cases with implausible data are classified as missing.

Table 11: Evaluation criteria for data quality in the TR-DGU

Coding	Evaluation	Data completeness in general	Data completeness based on the surgery rate
(green)	Good	> 95 %	≥ 70 %
(yellow)	Moderate	90 %-95 %	50 %-69 %
(red)	Insufficient	< 90 %	< 50 %

Table 12: Completeness rates [%], number of missing values {} for selected parameters as well as time to case documentation in the TR-DGU [months]

Variable	Explanation	TR-DGU 2022		TR-DGU 2013-2021	
Pre-hospital data (A)		%	{}	%	{}
Only primary admitted patients, who have not admitted themselves / were not admitted privately		n = 27,757		n = 256,097	
GCS	RISC II requires the motor component; quality indicators use the GCS for the definition of cases	**91 %**	2,466	**93 %**	17,286
Blood pressure	Initial blood pressure is important for validating the volume therapy and for the definition of shock	**85 %**	4,267	**88 %**	31,355
Pupils *	Pupil size and reactivity are relevant for prognosis (RISC II)	**93 %**	1,908	**76 %**	61,627
CPR	Cardio-pulmonary resuscitation is seldom but highly predictive for outcome; required for RISC II	**85 %**	4,203	**91 %**	24,179
Emergency room (B)					
Only primary admitted patients		n = 28,400		n = 261,428	
Time of admission	Required to calculate the diagnostic time periods (quality indicators)	**%**		**99 %**	1,817
Blood pressure	Blood pressure on admission is used by RISC II as a prognostic variable and to define shock	**93 %**	1,940	**93 %**	17,884
Base excess	The initial base excess is part of the RISC II and an important prognostic factor	**82 %**	5,072	**77 %**	59,027
Coagulation	The INR (or Quick's value) is needed for the RISC II as coagulation marker	**93 %**	1,890	**92 %**	19,629
Haemoglobin	Prognostic factor; is part of the RISC II prognosis	**97 %**	844	**96 %**	10,523
Patients and outcome					
All patients from the basic group		n = 30,806		n = 287,040	
ASA	Prior diseases are relevant for outcome prediction (RISC II)	**94 %**	1,775	**90 %**	28,257
Surgical treatment *	A low rate of surgical patients could be based on incomplete documentation	**60 %**	12,277	**51 %**	139,674
Outcome	The levels according to the parameter „outcome" describe the patient's condition at discharge or transfer	**99 %**	402	**96 %**	10,957
Process data - Period of time until documentation					
All patients from the basic group		n = 30,806		n = 287,040	
Time from accident to case creation in the TR-DGU**	A **prompt documentation** of patients increases the data quality of a case in the TR-DGU. Therefore, the time period from accident to the start of documentation is given here	**4.0 months**		**4.2 months**	
Time from discharge to case completion in the TR-DGU**	Time from discharge of a patient to **completion** of documentation in the registry	**5.0 months**		**5.4 months**	

* Since the dataset revision in 2015 the parameter is also part of the QM dataset

** Not to be interpreted for imported data, because only the import date is recorded and not the date of creation and completion of the case documentation

9.2 Comparison of data quality among hospitals

Detailed completeness rates for different variables are presented in chapter 9.1. In order to compare data quality among hospitals, a combined **quality score** is generated here.

The calculation of this quality score is based on the following ten variables:
Prehospital phase: GCS, blood pressure, cardio-pulmonary resuscitation
Emergency room phase: Time of admission, blood pressure, base excess, coagulation (Quick's value or INR), haemoglobin
Patient information: Previous health status (pre-injury ASA), outcome (according to the parameter „outcome").
All these variables are part of both the standard and the reduced QM dataset.

The number of missing data from all **primary admitted patients in the basic group** is summarised. This leads to the calculation of an average completeness rate.

Table 13: Data completeness for the TR-DGU in 2022 and comparison over the time

Data quality: Completeness	TR-DGU 2022	TR-DGU 2013-2021
Primary admitted patients from the basic group	n = 28,400	n = 261,428
Expected number of documented values	n = 284,000	n = 2,614,280
Number of missing values	{} 24,176	{} 228,273
Average completeness rate (%) based on the 10 specified parameters	**91.5 %**	**91.3 %**

9.2.1 Graphical comparison with other hospitals

Figure 28 summarises the average completeness value from all 687 hospitals with documented basic group cases **in the last year**. It follows the idea of a box plot in which the light blue box ranging from 86.9 % to 96.3 % covers half of all hospital values. The black vertical line within the box is the median average completeness value 92.5 %.

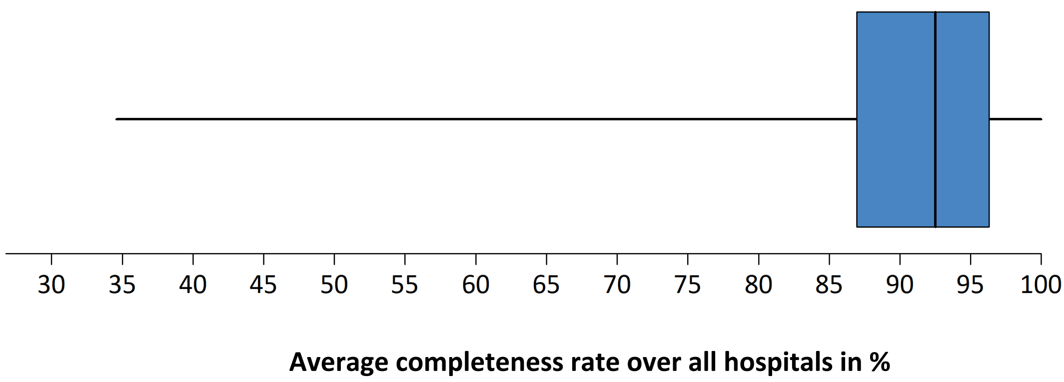


Figure 28: Distribution of the data completeness rate in 2022 over all hospitals

9.2.2 Development over time

Figure 29 shows the development of data completeness over the last ten years since 2013. For each documentation form (standard/QM dataset) a separate line is given. It can be seen that the data completeness rate of the QM dataset is slightly increased since 2013. The data completeness of the standard dataset has been approaching that of the QM dataset for years. In 2022 the completeness of both datasets are over 90 %.

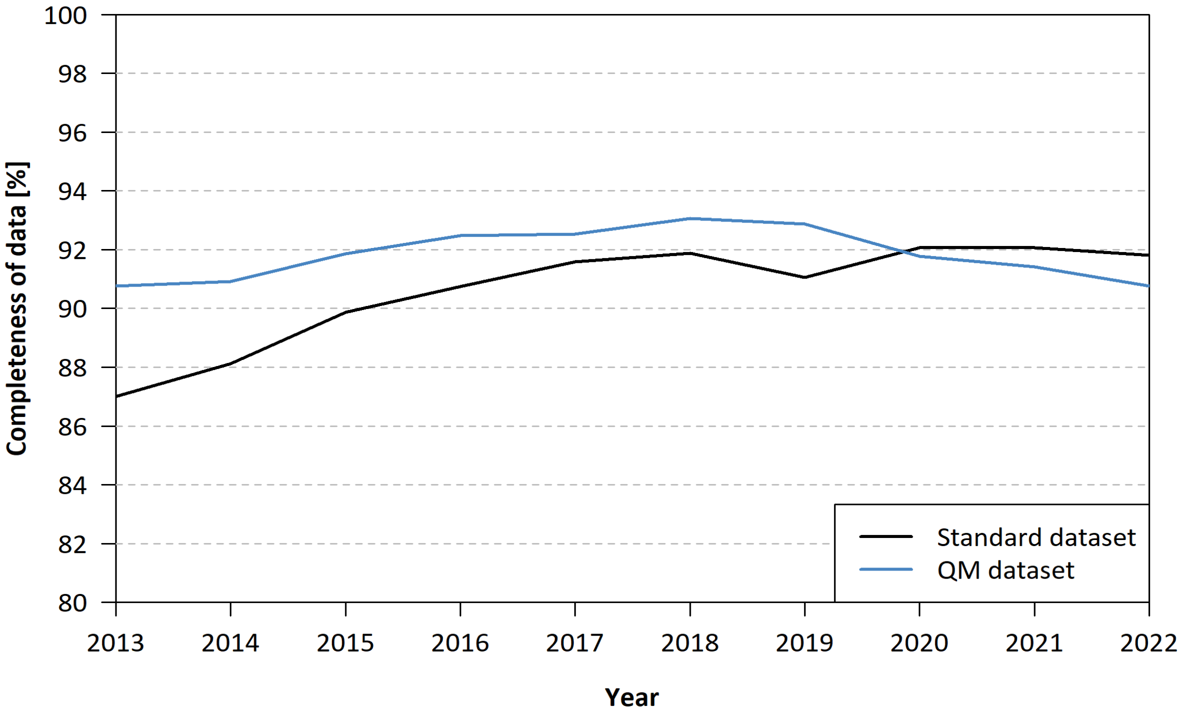


Figure 29: Development over time of the documentation quality: completeness rate in the TR-DGU 2013-2022

10 Injury pattern

In table 14, the average injury pattern of the TraumaRegister DGU® patients is presented. Only cases from the **basic group** are considered. In order to increase precision, all patients from the **last three years (2020-2022)** are pooled. Data are presented for each of the nine body regions according to the **Abbreviated Injury Scale (AIS)**. The percents refer to injuries with an injury **severity of at least two points** (including radius fractures, spine fractures, lung contusions, etc.).

Figure 30 shows in colour the injury pattern over the the body regions that were documented in the TR-DGU in 2020-2022.

Table 14: Distribution of the injuries from all recorded patients (basic group) for the years 2020-2022

	TR-DGU 2020-2022
Patients in the basic group	**100 %** (N = 89,496)
Head	**45.6 %** (n = 40,828)
Face	**10.8 %** (n = 9,656)
Neck	**1.8 %** (n = 1,565)
Thorax	**45.6 %** (n = 40,830)
Abdomen	**14.0 %** (n = 12,573)
Spine	**29.8 %** (n = 26,669)
Arms	**29.2 %** (n = 26,099)
Pelvis	**15.5 %** (n = 13,851)
Legs	**22.6 %** (n = 20,186)

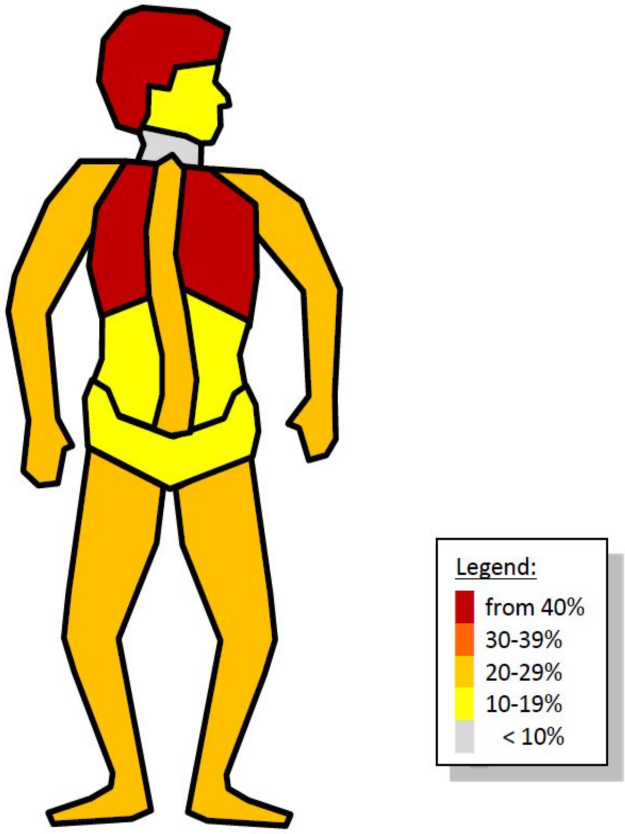


Figure 30: Injury pattern in the TR-DGU for the basic group from 2020-2022

Serious injuries (AIS 3+)

Injuries with a severity of 3 points or more (AIS) are considered „serious". The prevalence of serious injuries in the four most important body regions (head, thorax, abdomen, extremities) is given in table 15. The body regions considered here refer to the respective regions of the **Injury Severity Score** (ISS). Spinal injuries are assigned to the respective regions head, thorax or abdomen.

Different from table 14 only patients with at least one relevant serious injury (MAIS 3+, see chapter 1) are considered here.

Table 15: Ratio of serious injured patients (AIS ≥ 3) per body region for the years 2020-2022 (basic group)

	TR-DGU 2020-2022
Serious injury (AIS ≥ 3)	**83.0 %** (N = 74,237)
... of the **head**	**44.0 %** (n = 32,698)
... of the **thorax**	**46.3 %** (n = 34,382)
... of the **abdomen**	**11.6 %** (n = 8,640)
... of the **extremities**	**27.8 %** (n = 20,649)
Patients with **more than one** seriously injured body region	**28.9 %** (n = 21,470)

11 General results

Some results of the actual data analysis from the TraumaRegister DGU® are of general interest. They are presented here without reference to individual hospitals' results.

Hospitals

In the latest year, 38,545 patients were registered from 694 hospitals that documented cases in the TraumaRegister DGU®. The **basic group** that this report is based on comprises **30,806 patients** from 687 hospitals (details on the definition see chapter 1).

There were 16,866 patients with ISS ≥ 16 from 643 hospitals in the basic group. The distribution of the number of ISS ≥ 16 patients per hospital is shown in figure 31.

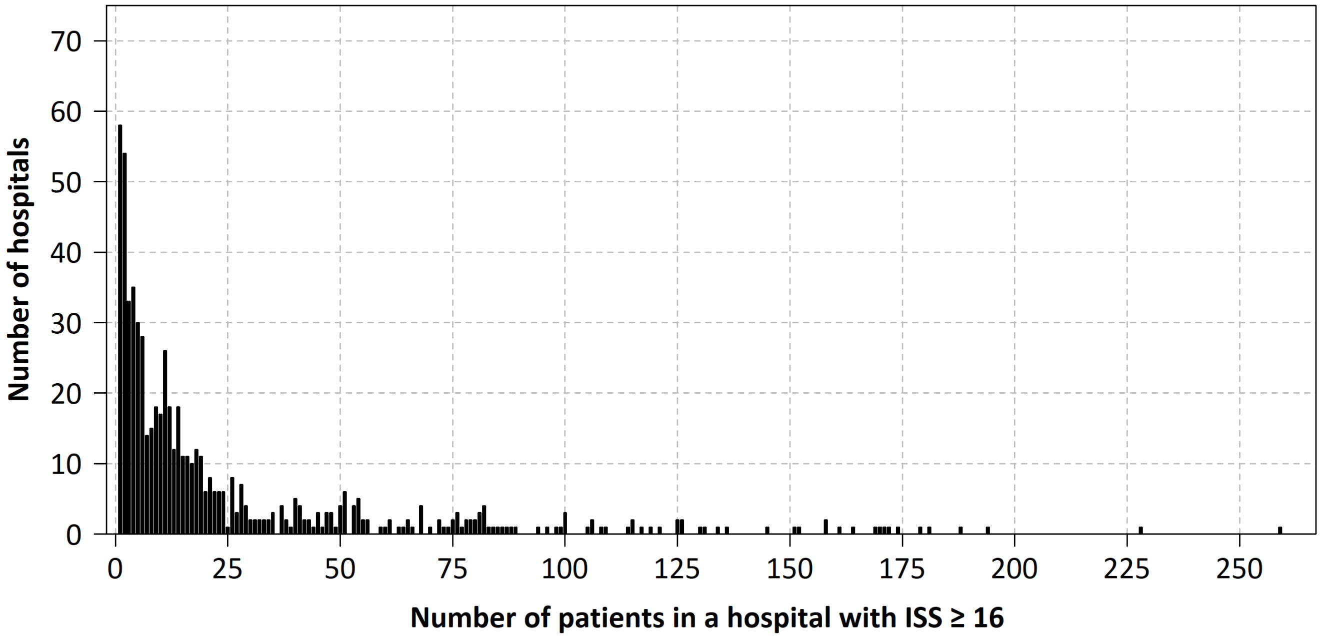


Figure 31: Frequency distribution of ISS ≥ 16 patients numbers per hospital in the TR-DGU 2022

Patients

Figure 32 demonstrates the continuous increase of registered patients over time since 2002. In the latest year, 7,739 documented patients did not fulfill the criteria to be included in the basic group and were not seriously injured per TR-DGU definition. There were 63.4 % German patients in the basic group that were documented by the standard dataset (S) in 2021.

In the latest year, there were **687 hospitals** that documented patients in the basic group, 73 hospitals were from foreign countries (10.6 %), namely Belgium, Finland, Luxembourg, The Netherlands, Austria, Switzerland, Slovenia and the United Arab Emirates and 614 hospitals from Germany.

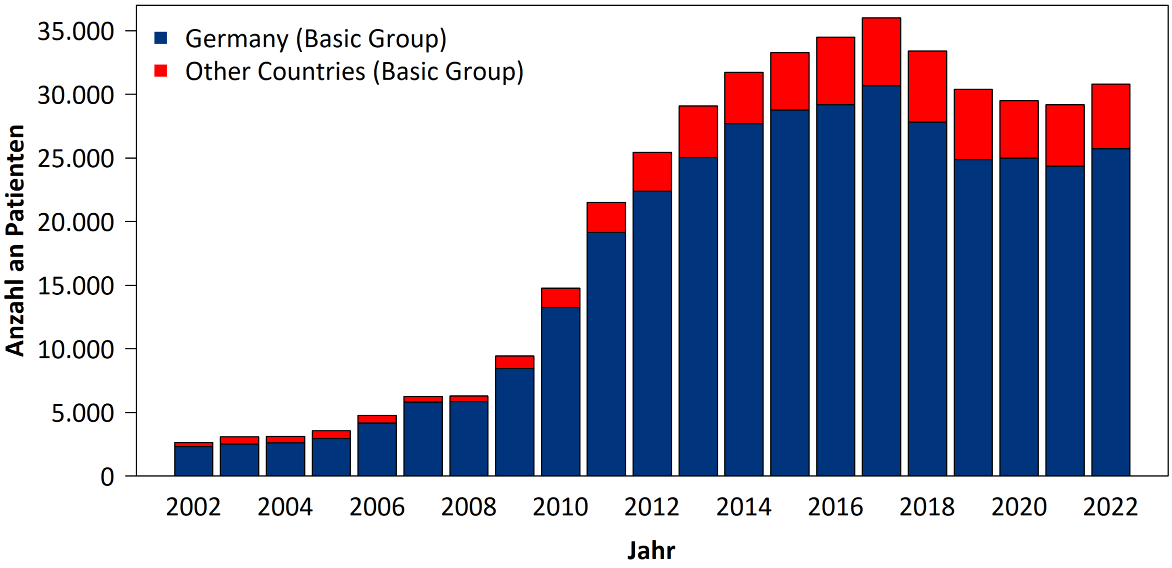


Figure 32: Number of cases in the TR-DGU 2002-2022

11.2 COVID-19

In July 2021, in parallel to the introduction of the new data set version (V2020), questions pertaining to COVID-19 were added to the emergency room questionairre.
Here we present the number of COVID-19 tests conducted, the distribution of test results and mortality rates of tested patients in .

Tabelle 16: Number of Patients tested for COVID-19, their test results and the distrubtion of deaths

Number of patients from the basic group tested for COVID-19	**26,953 / 30,806 (87 %)**
COVID +	**1,213 (4.5 %)**
.... of these, number of deaths	217 (17.9 %)
COVID -	**25,646 (95.2 %)**
.... of these, number of deaths	2,826 (11.0 %)
COVID test result unknown	**51 (0.2 %)**
.... of these, number of deaths	10 (19.6 %)

11.3 Patients with a documented patient's volition

With the revision of the data set in 2015, the new parameter "Patient's volition" was added in order to more accurately assess treatment quality. This parameter allows for the identification of patients who were against life-sustaining treatments. In this report all analyses comparing the actual mortality rates with the risk of death prognoses, excluded patients who denied care of their own volition and subsequently died within the first week of treatment. This was done in order to better assess the quality of treatment in each hospital.

The following analysis will provide a deeper insight into this special cohort. Table 17 shows the deceased of the basic group, separated according to patient's volition available or not available.

Table 17: Number of deceased patients with a documented patient's volition for the years 2018-2022

Year	2018	2019	2020	2021	2022
Number of deceased	3,629	3,386	3,501	3,414	3,771
Number of deceased **without** a patient's volition	1,675	1,048	1,056	941	1,054
Number of deceased **with** a patient's volition	1,322	1,144	1,989	2,247	2,510
...among them deceased within the first 7 days	812	734	1,318	1,485	1,721
Proportion of deceased **with a patient's volition**	44 %	52 %	65 %	70 %	70 %

The analysis of the age of the deceased shows (Table 18) that their mean age in the past 5 years was over 68.3. Furthermore, that deceased patients with a patient's volition were on average approximately 15.40.0 years older compared to the deceased without a patient's volition.

Table 18: Mean age of the deceased separated by availability of a patient's volition in the years 2018-2022

Year	2018	2019	2020	2021	2022
Mean age of the deceased [years]	67.7	67.2	68.1	69.5	68.9
Mean age of the deceased **with** a patient's volition [years]	76.9	76.5	74.2	74	74.2
Mean age of the deceased **without** a patient's volition [years]	61.2	59.7	58.1	59.7	57.3

12 Publications from the TraumaRegister DGU®

An extended list of publications from the TraumaRegister DGU® since 1997 is available on **www.traumaregister-dgu.de**.

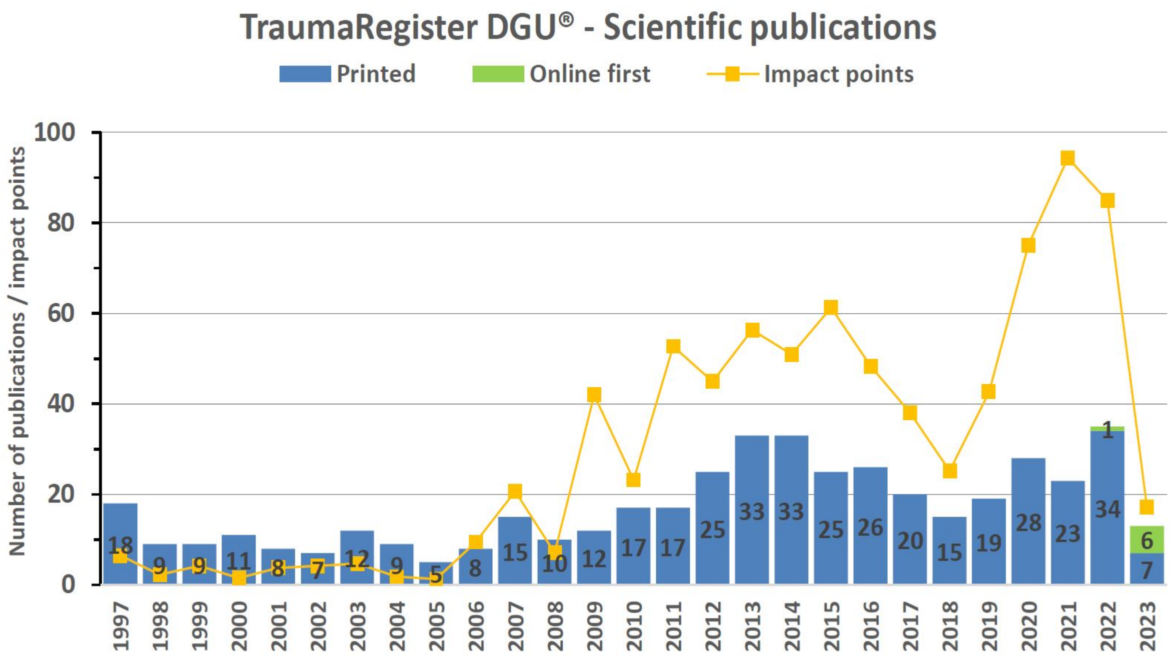


Figure 33: Number of publications from the TraumaRegister DGU® and their impact points since 1997

12.1 Facts from the Reviewboard in

The Reviewboard meets every 4-6 weeks to discuss incoming applications and manuscripts from the TraumaRegister DGU® and to initiate the review process. The Reviewboard consists of four members of the NIS, that meet in a quarterly rotation system with Prof. Lefering, Dr. Höfer Mr. Huber and Ms. Barth. The administrative management is performed by Ms. Isserstedt. Table 19 gives an overview over the work of the TraumaRegister DGU® Reviewboard in the year 2022.

Table 19: Facts from the Reviewboard 2022

	2022
Number of new research proposals	29
Number of research proposals discussed in the Reviewboard (incl. Revisions)	52
Number of research proposals reviewed (incl. resubmissions)	20
Number of manuscripts reviewed	19
Number of manuscripts approved for publication	10
Number of participating reviewers	56

12.2 Publications from the TR-DGU 2022 - 06/2023

2023

Bakir S, Lefering R, Auerbach L, Ekkernkamp A and the TraumaRegister DGU. The quality of care of persons with severe trauma in Germany during the COVID-19 pandemic as assessed with data from the 2020 DGU Trauma Registry. [Versorgungsqualität Schwerverletzter in Deutschland während der COVID-19-Pandemie anhand von Daten aus dem TraumaRegister DGU 2020]. Dtsch Arztebl Int 2023; 120: 400-401.

Berger M, Lefering R, Bauer M, Hofmann GO, Reske S, Hilbert-Carius P; DGU Trauma Registry. Mortality With and Without Whole-Body CT in Severely Injured Children. Dtsch Arztebl Int. 2023; 120(11):180-185.

Deluca A, Deininger C, Wichlas F, Traweger A, Lefering R, Mueller EJ. Präklinisches Management bei Traumapatienten und die zunehmende Zahl von Helikopter-Rettungstransporten: Eine epidemiologische Studie des TraumaRegister DGU® [Prehospital management in trauma patients and the increasing number of helicopter EMS transportations: An epidemiological study of the TraumaRegister DGU®]. Unfallchirurgie (Heidelb). 2023. [Epub ahead of print].

Fuchs K, Backhaus R, Jordan MC, Lefering R, Meffert RH, Gilbert F; das TraumaRegister DGU. Der schwer verletzte ältere Fahrradfahrer – Auswertung des TraumaRegister DGU® : Retrospektive, multizentrische Querschnittstudie anhand des TraumaRegister DGU® [The severely injured older cyclist-Evaluation of the TraumaRegister DGU® : Retrospective, multicenter cross-sectional study based on the TraumaRegister DGU®]. Unfallchirurgie 2023 [Epub ahead of print].*

Helsloot D, Fitzgerald MC, Lefering R, Verelst S, Missant C; and the TraumaRegister DGU®. The first hour of trauma reception is critical for patients with major thoracic trauma: A retrospective analysis from the TraumaRegister DGU. Eur J Anaesthesiol. 2023 [Epub ahead of print].

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von Lübken F, Prause S, Lang P, Friemert BD, Lefering R, Achatz G. Early total care or damage control orthopaedics for major fractures ? Results of propensity score matching for early definitive versus early temporary fixation based on data from the trauma registry of the German Trauma Society (TraumaRegister DGU®). Eur J Trauma Emerg Surg. 2023. [Epub ahead of print].

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2022

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Willms A, Güsgen C, Schwab R, Lefering R, Schaaf S, Lock J, Kollig E, Jänig C, Bieler D; Committee on Emergency Medicine, Intensive Care, Trauma Management (Sektion N. I. S.) of the German Trauma Society (DGU). Status quo of the use of DCS concepts and outcome with focus on blunt abdominal trauma : A registry-based analysis from the TraumaRegister DGU®. Langenbecks Arch Surg. 2022; 407: 805-817.*

13.3 Abstracts 06/2022 - 06/2023

Dtsch Arztebl Int 2023; 120: 400-1; DOI: 10.3238/arztebl.m2023.0013

Versorgungsqualität Schwerverletzter in Deutschland während der COVID-19-Pandemie anhand von Daten aus dem TraumaRegister DGU 2020

Bakir S, Lefering R, Auerbach L, Ekkernkamp A; TraumaRegister DGU.

Die COVID-19-Pandemie hat die medizinische Versorgung in Deutschland in den letzten Jahren stark beeinflusst. Neben den durch die Therapie der symptomatischen COVID-Patientinnen und -Patienten direkt betroffenen Intensivstationen hatte die Pandemie auch Einfluss auf chirurgische Fachdisziplinen, beispielsweise durch Reduktion der Operationsmöglichkeiten. Inwieweit sich die traumatologische Versorgung von Schwerverletzten durch die COVID-19-Pandemie verändert hat, war Ziel dieser Datenanalyse aus dem TraumaRegister DGU (TR-DGU) der Deutschen Gesellschaft für Unfallchirurgie. Hierbei sollte analysiert werden, inwieweit sich durch gesteigerte Hygienemaßnahmen bei unklarem COVID-Infektionsstatus die absolute Behandlungszeit verändert hat, zum Beispiel präklinisch oder vom Schockraumbeginn bis zur Durchführung einer Computertomografie (CT) oder des Beginns einer Operation.

Front Surg. 2022 May 11;9:852097. doi: 10.3389/fsurg.2022.852097.

Impact of Time of Surgery on the Outcome after Surgical Stabilization of Rib Fractures in Severely Injured Patients with Severe Chest Trauma-A Matched-Pairs Analysis of the German Trauma Registry.

Becker L, Schulz-Drost S, Spering C, Franke A, Dudda M, Kamp O, Lefering R, Matthes G, Bieler D; Committee on Emergency Medicine, Intensive Care and Trauma Management (Sektion NIS) of the German Trauma Society (DGU).

PURPOSE : In severely injured patients with multiple rib fractures, the beneficial effect of surgical stabilization is still unknown. The existing literature shows divergent results, and the indication and especially the right timing of an operation are the subject of a broad discussion. The aim of this study was to determine the influence of the time point of surgical stabilization of rib fractures (SSRF) on the outcome in a multicenter database with special regard to the duration of ventilation, intensive care, and overall hospital stay.

METHODS: Data from the TraumaRegister DGU collected between 2010 and 2019 were used to evaluate patients above 16 years of age with severe rib fractures [Abbreviated Injury Score (AIS) ≥ 3] who received an SSRF in a matched-pairs analysis. In this matched-pairs analysis, we compared the effects of an early SSRF within 48 h after initial trauma vs. late SSRF 3-10 days after trauma.

RESULTS: After the selection process, we were able to find 142 matched pairs for further evaluation. Early SSRF was associated with a significantly shorter length of stay in the intensive care unit (16.2 days vs. 12.7 days, $p = 0.020$), and the overall hospital stay (28.5 days vs. 23.4 days, $p = 0.005$) was significantly longer in the group with late SSRF. Concerning the days on mechanical ventilation, we were able to demonstrate a trend for an approximately 1.5 day shorter ventilation time for patients after early SSRF, although this difference was not statistically significant ($p = 0.226$).

CONCLUSIONS: We were able to determine the significant beneficial effects of early SSRF resulting in a shorter intensive care unit stay and a shorter length of stay in hospital and additionally a trend to a shorter time on mechanical ventilation.

Dtsch Arztebl Int. 2023 Mar 17;120(11):180-185. doi: 10.3238/arztebl.m2022.0414.

Mortality With and Without Whole-Body CT in Severely Injured Children.

Berger M, Lefering R, Bauer M, Hofmann GO, Reske S, Hilbert-Carius P; TraumaRegister DGU.

BACKGROUND: The choice of imaging modality-the use of whole-body computed tomography (WB-CT) versus a step-wise diagnostic procedure-in injured children is controversial. In this study we availed ourselves of data from the TR-DGU, the trauma registry of the German Society for Trauma Surgery (Deutsche Gesellschaft für Unfallchirurgie), to investigate whether the use of WB-CT improves the outcome.

METHODS: The TR-DGU data from the period 2012-2021 were evaluated. A three-stage analysis began with comparison of children with adults aged ≤ 50 years. As a second step, the observed and expected mortality in children with WB-CT was compared with the mortality in children without WB-CT. Finally, predictors of the use of WB-CT were identified so that a propensity score analysis of matched pairs could be performed.

RESULTS: A total of 65 092 patients were included, 4573 children (7%) and 60 519 adults (93%), with differences in accident type and injury pattern. Comparison of the ratio of observed to expected mortality revealed no difference between the two groups of children (standardized mortality ratio 0.97 with WB-CT, 0.95 without WB-CT). In adults, however, there was an advantage for the WB-CT group. The propensity score analysis of 1101 matched pairs showed identical mortality in the two groups (3.9% with WB-CT, 4.0% without WB-CT).

CONCLUSION: The TR-DGU data show no benefit of WB-CT compared with step-wise diagnosis in the care of severely injured children. In view of the radiation exposure involved, with the danger of inducing malignancy, the benefits and risks of the use of WB-CT in children should be weighed up carefully in team discussions.

Eur J Trauma Emerg Surg. 2022 Oct 28. doi: 10.1007/s00068-022-02140-5. Online ahead of print.

CT scan and conventional x-ray in multiple injured patient care: diagnostic strategies and outcomes analysed from the TraumaRegister DGU®.

Biber R, Kopschina C, Willauschus M, Bail HJ, Lefering R; TraumaRegister DGU.

PURPOSE: To evaluate the current practice regarding the prevalence and sequence of x-ray and CT scan in diagnostic algorithms for multiple injured patients.

METHODS: All primarily treated patients with ISS ≥ 9 were selected from the TraumaRegister DGU® (years 2008-2015; n = 109,257). Four subgroups of diagnostic algorithm were defined: CT only (group C; n = 63,763), CT before x-ray (group CX; n = 3711), x-ray followed by CT (group XC; n = 33,590), and x-ray only (group X, n = 8193). We analysed the type and sequence of diagnostic procedures and their association with hospital mortality and length-of-stay in the emergency room (ER-LOS).

RESULTS: Predominant strategies were CT only (58.4%) and x-ray followed by CT (30.7%). Overall mortality was between 10 and 12% in all subgroups involving CT, and 6.6% in the x-ray only group. Expected mortality was within the 95% confidence of observed mortality except for the CX group (observed 10.0%; CI95 8.9-11.0; expected 11.1%). Mean / median length of stay in the emergency room was shortest in the CT only subgroup: (60 / 50 min). Prior x-ray diagnostic resulted in additional 3 min (group XC). The use of additional x-ray diagnostic decreased from 51.6% (in 2008) to 35.4% (in 2015).

CONCLUSIONS: ER-LOS is significantly affected by diagnostic pathway. CT scan alone accelerates ER-LOS, which however was not associated with lower mortality rates. Performing completive x-ray examinations after an initial CT scan seems not to deteriorate mortality rates.

J Clin Med. 2022 Nov 28;11(23):7036. doi: 10.3390/jcm11237036.

Impact of the First and Second Wave of the SARS-CoV-2 Pandemic on Severe Trauma and the Care Structures in the German TraumaNetzwerk DGU®.

Colcuc C, Fischer S, Leimkühler P, Miersbach M, Lefering R, TraumaRegister DGU, Wähnert D, Vordemvenne T, Grüneweller N.

BACKGROUND: The aim of this study was to investigate the effects of the pandemic on transfer rates of severely injured patients within the German TraumaNetzwerk of the DGU. Furthermore, cause of accident, rescue times, and trauma cases are compared to pre-pandemic times.

METHODS: For this investigation patients documented in the TraumaRegister DGU® from 2018 to 2020 were analyzed. The years 2018 and 2019 served as a comparison to 2020, the first COVID-19 pandemic year. All primary admissions and transfers were included if treated on an intensive care unit.

RESULTS: Demographics (age, sex) and injury severity in 2020 were comparable with 2018/2019. In 2020, a significant decrease (3.7%) in car accidents was found. In contrast, a significant increase (3.2%) in bicycle accidents was seen. During the second wave, there was a significant burden of COVID-19 patients on hospitals. In this time, we found a significant increase in early transfers of trauma patients primarily from small level 3 to large level 1 centers. There was also a small but significant increase in rescue time, especially during the 2nd wave.

CONCLUSION: Our data confirm the importance of the network structures established in the TraumaNetzwerk DGU®, especially during the pandemic. The established structures allow smaller hospitals to spread their resources and prevent internal collapse. Therefore, the structures of the TraumaNetzwerk DGU® play a prominent role in stabilizing the healthcare system by helping to maintain both surgical and critical care capacity and providing adequate emergency care.

Unfallchirurgie (Heidelb). 2023 Jul 3. doi: 10.1007/s00113-023-01337-6. Online ahead of print.

Prehospital management in trauma patients and the increasing number of helicopter EMS transportations : An epidemiological study of the TraumaRegister DGU®.

Deluca A, Deininger C, Wichlas F, Traweger A, Lefering R, Mueller EJ.

BACKGROUND/OBJECTIVE: To compare the prehospital treatment modalities and intervention regimens for major trauma patients with comparable injury patterns between Austria and Germany.

PATIENTS AND METHODS: This analysis is based on data retrieved from the TraumaRegister DGU®. Data included severely injured trauma patients with an injury severity score (ISS) ≥ 16, an age ≥ 16 years, and who were primarily admitted to an Austrian (n = 4186) or German (n = 41,484) level I trauma center (TC) from 2008 to 2017. Investigated endpoints included prehospital times and interventions performed until final hospital admission.

RESULTS: The cumulative time for transportation from the site of the accident to the hospital did not significantly differ between the countries (62 min in Austria, 65 min in Germany). Overall, 53% of all trauma patients in Austria were transported to the hospital with a helicopter compared to 37% in Germany ($p < 0.001$). The rate of intubation was 48% in both countries, the number of chest tubes placed (5.7% Germany, 4.9% Austria), and the frequency of administered catecholamines (13.4% Germany, 12.3% Austria) were comparable ($\Phi = 0.00$). Hemodynamic instability (systolic blood pressure, BP ≤ 90 mmHg) upon arrival in the TC was higher in Austria (20.6% vs. 14.7% in Germany; $p < 0.001$). A median of 500 mL of fluid was administered in Austria, whereas in Germany 1000 mL was infused ($p < 0.001$). Patient demographics did not reveal a relationship ($\Phi = 0.00$) between both countries, and the majority of patients sustained a blunt trauma (96%). The observed ASA score of 3-4 was 16.8% in Germany versus 11.9% in Austria.

CONCLUSION: Significantly more helicopter EMS transportations (HEMS) were carried out in Austria. The authors suggest implementing international guidelines to explicitly use the HEMS system for trauma patients only a) for the rescue/care of people who have had an accident or are in life-threatening situations, b) for the transport of emergency patients with ISS > 16, c) for transportation of rescue or recovery personnel to hard to reach regions or, d) for the transport of medicinal products, especially blood products, organ transplants or medical devices.

Emerg Med J. 2022 Dec;39(12):912-917. doi: 10.1136/emermed-2020-211091.

Keeping it simple: the value of mortality prediction after trauma with basic indices like the Reverse Shock Index multiplied by Glasgow Coma Scale.

Frieler S, Lefering R, Gerstmeyer J, Drotleff N, Schildhauer TA, Waydhas C, Hamsen U; TraumaRegister DGU.

BACKGROUND: Identification of trauma patients at significant risk of death in the prehospital setting is challenging. The prediction probability of basic indices like vital signs, Shock Index (SI), SI multiplied by age (SIA) or the GCS is limited and more complex scores are not feasible on-scene. The Reverse SI multiplied by GCS score (rSIG) has been proposed as a triage tool to identify trauma patients with an increased risk of dying at EDs. Age adjustment (rSIG/A) displayed no advantage.We aim to (1) validate the accuracy of the rSIG in predicting death or early transfusion in a large trauma registry population, and (2) determine if the rSIG is valid for evaluation of trauma patients in the prehospital setting.
METHODS: 70 829 trauma patients were retrieved from the TraumaRegister DGU database (time period between 2008 and 2017). The area under the receiver operating characteristic curve (AUROC) was calculated to measure the ability of SI, SIA, rSIG and rSIG divided by age (rSIG/A) to predict in-hospital mortality from data at the time of hospital arrival and solely from prehospital data.
RESULTS: The rSIG at time of hospital admission was not sufficiently predictive for clinical decision-making. However, rSIG calculated solely from prehospital data accurately predicted risk of death. Using prehospital data, the AUROC for mortality of rSIG/A was the highest (0.85; CI: 0.85 to 0.86), followed by rSIG (0.76; CI: 0.75 to 0.77), SIA (0.71; CI: 0.70 to 0.71) and SI (0.48; CI: 0.47 to 0.49).
CONCLUSION: The prehospital rSIG/A can be a useful adjunct for the prehospital evaluation of trauma patients and their allocation to trauma centres or trauma team activation. However, we could not confirm that the rSIG at hospital admission is a reliable tool for risk stratification.

Unfallchirurgie (Heidelb). 2023 Mar 29. doi: 10.1007/s00113-022-01286-6. Online ahead of print.

The severely injured older cyclist-Evaluation of the TraumaRegister DGU®: Retrospective, multicenter cross-sectional study based on the TraumaRegister DGU®.

Fuchs K, Backhaus R, Jordan MC, Lefering R, Meffert RH, Gilbert F; das TraumaRegister DGU.

BACKGROUND: Contrary to the trend of decreasing traffic fatalities, the number of cyclists killed in Germany has been steadily increasing in recent years. With the increasing popularity of cycling in all age groups, the number of accidents with sometimes serious injuries is rising. In the course of this, the question arises what influence age has on the type and severity of injuries, the probability of survival and the length of hospital stay in seriously injured cyclists.
METHODS: A retrospective analysis of data from the TraumaRegister DGU® (TR-DGU) from 2010 to 2019 was performed. All severely injured cyclists with a maximum abbreviated injury scale (MAIS) of 3+ (n = 14,651) in the TR-DGU were included in this study and the available parameters were evaluated. A subdivision into three age groups (60-69, 70-79, and ≥ 80 years) and a control group (20-59 years) was carried out.
RESULTS: Injuries to the head were by far the most common, accounting for 64.2%. There was a marked increase in severe head injuries in the 60-plus years age group. Furthermore, with increasing age, the probability of prehospital intubation, catecholamine requirement, intensive care and hospital length of stay, and mortality increased.
CONCLUSION: Head injuries represent the most common serious injury, especially among older cyclists. As helmet wearing was not recorded in the TraumaRegister DGU® during the evaluation period, no conclusion can be drawn about its effect. Furthermore, a higher age correlates with a longer hospital stay and a higher mortality, but does not represent an independent risk factor for death in severely injured patients.

Eur J Trauma Emerg Surg. 2022 Jun;48(3):1975-1983. doi: 10.1007/s00068-020-01515-w.

Epidemiology and predictors of traumatic spine injury in severely injured patients: implications for emergency procedures.

Häske D, Lefering R, Stock JP, Kreinest M; TraumaRegister DGU.

PURPOSE: This study aimed to identify the prevalence and predictors of spinal injuries that are suitable for immobilization.
METHODS: Retrospective cohort study drawing from the multi-center database of the TraumaRegister DGU®, spinal injury patients ≥ 16 years of age who scored ≥ 3 on the Abbreviated Injury Scale (AIS) between 2009 and 2016 were enrolled.
RESULTS: The mean age of the 145,833 patients enrolled was 52.7 ± 21.1 years. The hospital mortality rate was 13.9%, and the mean injury severity score (ISS) was 21.8 ± 11.8. Seventy percent of patients had no spine injury, 25.9% scored 2-3 on the AIS, and 4.1% scored 4-6 on the AIS. Among patients with isolated traumatic brain injury (TBI), 26.8% had spinal injuries with an AIS score of 4-6. Among patients with multi-system trauma and TBI, 44.7% had spinal injuries that scored 4-6 on the AIS. Regression analysis predicted a serious spine injury (SI; AIS 3-6) with a prevalence of 10.6% and cervical spine injury (CSI; AIS 3-6) with a prevalence of 5.1%. Blunt trauma was a predictor for SI and CSI (OR 4.066 and OR 3.640, respectively; both p < 0.001) and fall > 3 m for SI (OR 2.243; p < 0.001) but not CSI (OR 0.636; p < 0.001). Pre-hospital shock was predictive for SI and CSI (OR 1.87 and OR 2.342, respectively; both p < 0.001), and diminished or absent motor response was also predictive for SI (OR 3.171) and CSI (OR 7.462; both p < 0.001). Patients over 65 years of age were more frequently affected by CSI.
CONCLUSIONS: In addition to the clinical symptoms of pain, we identify '4S' [spill (fall) > 3 m, seniority (age > 65 years), seriously injured, skull/traumatic brain injury] as an indication for increased attention for CSIs or indication for spinal motion restriction.

Eur J Anaesthesiol. 2023 May 3. doi: 10.1097/EJA.0000000000001834. Online ahead of print.

The first hour of trauma reception is critical for patients with major thoracic trauma: A retrospective analysis from the TraumaRegister DGU.

Helsloot D, Fitzgerald MC, Lefering R, Verelst S, Missant C; and the TraumaRegister DGU®.

BACKGROUND: Up to 25% of trauma deaths are related to thoracic injuries. OBJECTIVE: The primary goal was to analyse the incidence and time distribution of death in adult patients with major thoracic injuries. The secondary goal was to determine if potentially preventable deaths occurred within this time distribution and, if so, identify an associated therapeutic window. DESIGN: Retrospective observational analysis.
SETTING: TraumaRegister DGU.
PATIENTS: Major thoracic injury was defined as an Abbreviated Injury Scale (AIS) 3 or greater. Patients with severe head injury (AIS ≥ 4) or injuries to other body regions with AIS being greater than the thoracic injury (AIS other >AIS thorax) were excluded to ensure that the most severe injury described was primarily thoracic related. MAIN OUTCOME MEASURES: Incidence and time distribution of mortality were considered the primary outcome measures. Patient and clinical characteristics and resuscitative interventions were analysed in relation to the time distribution of death. RESULTS: Among adult major trauma cases with direct admission from the accident scene, 45% had thoracic injuries and overall mortality was 9.3%. In those with major thoracic trauma (n = 24 332) mortality was 5.9% (n = 1437). About 25% of these deaths occurred within the first hour after admission and 48% within the first day. No peak in late mortality was seen. The highest incidences of hypoxia and shock were seen in non-survivors with immediate death within 1 h and early death (1 to 6 h). These groups received the largest number of resuscitative interventions. Haemorrhage was the leading cause of death in these groups, whereas organ failure was the leading cause of death amongst those who survived the first 6 h after admission.
CONCLUSION: About half of adult major trauma cases had thoracic injuries. In non-survivors with primarily major thoracic trauma, most deaths occurred immediately (<1h) or within the first 6 h after injury. Further research should analyse if improvements in trauma resuscitation performed within this time frame will reduce preventable deaths. TRIAL REGISTRATION: The present study is reported within the publication guidelines of the TraumaRegister DGU® and registered as TR-DGU project ID 2020-022.

Crit Care. 2023 Jul 6;27(1):267. doi: 10.1186/s13054-023-04541-3.

Trauma-induced disturbances in ionized calcium levels correlate parabolically with coagulopathy, transfusion, and mortality: a multicentre cohort analysis from the TraumaRegister DGU®.

Helsloot D, Fitzgerald M, Lefering R, Verelst S, Missant C; TraumaRegister DGU.

BACKGROUND: To which extent trauma- induced disturbances in ionized calcium (iCa2+) levels have a linear relationship with adverse outcomes remains controversial. The goal of this study was to determine the association between the distribution and accompanying characteristics of transfusion-independent iCa2+ levels versus outcome in a large cohort of major trauma patients upon arrival at the emergency department.

METHODS: A retrospective observational analysis of the TraumaRegister DGU® (2015-2019) was performed. Adult major trauma patients with direct admission to a European trauma centre were selected as the study cohort. Mortality at 6 h and 24 h, in-hospital mortality, coagulopathy, and need for transfusion were considered as relevant outcome parameters. The distribution of iCa2+ levels upon arrival at the emergency department was calculated in relation to these outcome parameters. Multivariable logistic regression analysis was performed to determine independent associations.

RESULTS: In the TraumaRegister DGU® 30 183 adult major trauma patients were found eligible for inclusion. iCa2+ disturbances affected 16.4% of patients, with hypocalcemia (< 1.10 mmol/l) being more frequent (13.2%) compared to hypercalcemia (≥ 1.30 mmol/l, 3.2%). Patients with hypo- and hypercalcemia were both more likely (P < .001) to have severe injury, shock, acidosis, coagulopathy, transfusion requirement, and haemorrhage as cause of death. Moreover, both groups had significant lower survival rates. All these findings were most distinct in hypercalcemic patients. When adjusting for potential confounders, mortality at 6 h was independently associated with iCa2+ < 0.90 mmol/L (OR 2.69, 95% CI 1.67-4.34; P < .001), iCa2+ 1.30-1.39 mmol/L (OR 1.56, 95% CI 1.04-2.32, P = 0.030), and iCa2+ ≥ 1.40 mmol/L (OR 2.87, 95% CI 1.57-5.26; P < .001). Moreover, an independent relationship was determined for iCa2+ 1.00-1.09 mmol/L with mortality at 24 h (OR 1.25, 95% CI 1.05-1.48; P = .0011), and with in-hospital mortality (OR 1.29, 95% CI 1.13-1.47; P < .001). Both hypocalcemia < 1.10 mmol/L and hypercalcemia ≥ 1.30 mmol/L had an independent association with coagulopathy and transfusion.

CONCLUSIONS: Transfusion-independent iCa2+ levels in major trauma patients upon arrival at the emergency department have a parabolic relationship with coagulopathy, need for transfusion, and mortality. Further research is needed to confirm whether iCa2+ levels change dynamically and are more a reflection of severity of injury and accompanying physiological derangements, rather than an individual parameter that needs to be corrected as such.

Front Public Health. 2023 May 2;11:1136159. doi: 10.3389/fpubh.2023.1136159.

Severe trauma in Germany and Israel: are we speaking the same language? A trauma registry comparison.

Kaim A, Bodas M, Bieler D, Radomislensky I, Matthes G, Givon A, Trentzsch H; Israel Trauma Group; Waydhas C, Lefering R.

BACKGROUND: Trauma registries are a crucial component of trauma systems, as they could be utilized to perform a benchmarking of quality of care and enable research in a critical but important area of health care. The aim of this study is to compare the performance of two national trauma systems: Germany (TraumaRegister DGU®, TR-DGU) and Israel (Israeli National Trauma Registry, INTR).

METHODS: The present study was a retrospective analysis of data from the described above trauma registries in Israel and Germany. Adult patients from both registries treated during 2015-2019 with an Injury Severity Score (ISS) ≥ 16 points were included. Patient demographics, type, distribution, mechanism, and severity of injury, treatment delivered and length of stay (LOS) in the ICU and in the hospital were included in the analysis.

RESULTS: Data were available from 12,585 Israeli patients and 55,660 German patients. Age and sex distribution were comparable, and road traffic collisions were the most prevalent cause of injuries. The ISS of German patients was higher (ISS 24 vs. 20), more patients were treated on an intensive care unit (92 vs. 32%), and mortality was higher (19.4 vs. 9.5%) as well.

CONCLUSION: Despite similar inclusion criteria (ISS ≥ 16), remarkable differences between the two national datasets were observed. Most probably, this was caused by different recruitment strategies of both registries, like trauma team activation and need for intensive care in TR-DGU. More detailed analyses are needed to uncover similarities and differences of both trauma systems.

Eur J Trauma Emerg Surg. 2023 Mar 8:1-9. doi: 10.1007/s00068-023-02257-1. Online ahead of print.

Changes in injury patterns, injury severity and hospital mortality in motorized vehicle accidents: a retrospective, cross-sectional, multicenter study with 19,225 cases derived from the TraumaRegister DGU®.

Koch DA, Hagebusch P, Lefering R, Faul P, Hoffmann R, Schweigkofler U; TraumaRegister DGU.

PURPOSE: In the last 20 years, the number of fatalities due to road traffic accidents (RTA) in Germany has steadily decreased from 7503 to 2724 per year. Due to legal regulations, educational measures and the continuous development of safety technology the number of severe traumatic injuries and injury patterns are most likely to change. The aim of the study was to analyse severely injured motorcyclists (MC) and car occupants (CO) that were involved in RTAs in the last 15 years and investigate the development and changes of injury patterns, injury severity and hospital mortality.

METHODS: We retrospectively evaluated data from the TraumaRegister DGU® (TR-DGU) considering all RTA-related injured MCs and COs (n = 19,225) that were registered in the TR-DGU from 2006 to 2020 with a primary admission to a trauma center with continuous participation (14 of 15 years) in the TR-DGU, an Injury Severity Score (ISS) ≥ 16 and aged between 16 and 79 years. The observation period was divided into three 5-year interval subgroups for further analysis.

RESULTS: The mean age increased by 6.9 years and the ratio of severely injured MCs to COs changed from 1:1.92 to 1:1.45. COs were in 65.8% male and more often severely injured in the age groups under 30, while the majority of severely injured MCs were in the age group around 50 years and in 90.1% male. The ISS (- 3.1 points) as well as the mortality of both groups (CO: 14.4% vs. 11.8%; MC: 13.2% vs. 10.2%) steadily decreased over time. Nevertheless, the standardized mortality ratio (SMR) hardly changed and stayed < 1. Regarding the injury patterns, the greatest decline of injuries with AIS 3 + were to the head (CO: - 11.3%; MC: - 7.1%), in addition, a decrease of injuries to extremities (CO: - 1.5%; MC: - 3.3%), to the abdomen (CO: - 2.6%; MC: - 3.6%), to the pelvis in COs (- 4.7%) and to the spine (CO: + 0.1%; MC: - 2.4%) were observed. Thoracic injuries increased in both groups (CO: + 1.6%; MC: + 3.2%) and, furthermore, pelvic injuries in MCs (+ 1.7%). Another finding was the increase of the utilization of whole body CTs from 76.6 to 95.15%.

CONCLUSION: The severity of injuries and their incidence, especially head injuries, have decreased over the years and seem to contribute to a decreasing hospital mortality of polytraumatized MCs and COs injured in traffic accidents. Young drivers and an increasing number of seniors are the age groups at risk and require special attention and treatment.

Eur J Trauma Emerg Surg. 2022 Dec;48(6):4615-4622. doi: 10.1007/s00068-022-01987-y.

Process times of severely injured patients in the emergency room are associated with patient volume: a registry-based analysis

Lefering R, Waydhas C; TraumaRegister DGU.

PURPOSE: Hospitals involved in the care of severely injured patients treat a varying number of such cases per year. Large hospitals were expected to show a better performance regarding process times in the emergency room. The present investigation analyzed whether this assumption was true, based on a large national trauma registry.

METHODS: A total of 129,193 severely injured patients admitted primarily to one of 675 German hospitals and documented in the TraumaRegister DGU® were considered for this analysis. The analysis covered a 5 years time period (2013-2017). Hospitals were grouped by their average number of annually treated severe trauma patients into five categories ranging from 'less than 10 patients' to '100 or more'. The following process times were compared: pre-hospital time; time from admission to diagnostic procedures (sonography, X-ray, computed tomography), time from admission to selected emergency interventions and time in the emergency room.

RESULTS: Seventy-eight high volume hospitals treated 45% of all patients, while 30% of hospitals treated less than ten cases per year. Injury severity and mortality increased with volume per year. Whole-body computed tomography (WB-CT) was used less frequently in small hospitals (53%) as compared to the large ones (83%). The average time to WB-CT fell from 28 min. in small hospitals to 19 min. in high volume hospitals. There was a linear trend to shorter performance times for all diagnostic procedures (sonography, X-ray, WB-CT) when the annual volume increased. A similar trend was observed for time to blood transfusion (58 min versus 44 min). The median time in the emergency room fell from 74 min to 53 min, but there was no clear trend for the time to the first emergency surgery. Due to longer travel times, prehospital time was about 10 min higher in patients admitted to high volume hospitals compared to patients admitted to smaller local hospitals.

CONCLUSION: Process times in the emergency room decreased consistently with an increase of patient volume per year. This decrease, however, was associated with a longer prehospital time.

Injury. 2023 May;54(5):1271-1277. doi: 10.1016/j.injury.2023.01.002.

Extracorporeal membrane oxygenation in traumatic brain injury - A retrospective, multicenter cohort study.

Mader MM, Lefering R, Westphal M, Maegele M, Czorlich P.

INTRODUCTION: Patients with traumatic brain injury (TBI) regularly require intensive care with prolonged invasive ventilation. Consequently, these patients are at increased risk of pulmonary failure, potentially requiring extracorporeal membrane oxygenation (ECMO). The aim of this work was to provide an overview of ECMO treatment in TBI patients based upon data captured into the TraumaRegister DGU® (TR-DGU).

METHODS: A retrospective multi-center cohort analysis of patients registered in the TR-DGU was conducted. Adult patients with relevant TBI (AISHead ≥3) who had been treated in German, Austrian, or Swiss level I or II trauma centers using ECMO therapy between 2015 and 2019 were included. A multivariable logistic regression analysis was used to identify risk factors for the need for ECMO treatment.

RESULTS: 12,247 patients fulfilled the inclusion criteria. The overall rate of ECMO treatment was 1.1% (134 patients). Patients on ECMO had an overall hospital mortality rate of 38% (51/134 patients) while 13% (1523/12,113 patients) of TBI patients without ECMO therapy died. Male gender ($p = 0.014$), AISChest 3+ ($p<0.001$), higher Injury Severity Score ($p<0.001$) and packed red blood cell (pRBC) transfusion ($p<0.001$) were associated with ECMO treatment.

CONCLUSION: ECMO therapy is a potentially lifesaving modality for the treatment of moderate-to-severe TBI when combined with severe chest trauma and pulmonary failure. The in-hospital mortality is increased in this high-risk population, but the majority of patients is surviving.

Eur J Trauma Emerg Surg. 2022 Dec;48(6):4451-4459. doi: 10.1007/s00068-020-01544-5.

Traumatic brain injury with concomitant injury to the spleen: characteristics and mortality of a high-risk trauma cohort from the TraumaRegister DGU®.

Mader MM, Lefering R, Westphal M, Maegele M, Czorlich P.

PURPOSE: Based on the hypothesis that systemic inflammation contributes to secondary injury after initial traumatic brain injury (TBI), this study aims to describe the effect of splenectomy on mortality in trauma patients with TBI and splenic injury.

METHODS: A retrospective cohort analysis of patients prospectively registered into the TraumaRegister DGU® (TR-DGU) with TBI (AISHead ≥ 3) combined with injury to the spleen (AISSpleen ≥ 1) was conducted. Multivariable logistic regression modeling was performed to adjust for confounding factors and to assess the independent effect of splenectomy on in-hospital mortality.

RESULTS: The cohort consisted of 1114 patients out of which 328 (29.4%) had undergone early splenectomy. Patients with splenectomy demonstrated a higher Injury Severity Score (median: 34 vs. 44, p < 0.001) and lower Glasgow Coma Scale (median: 9 vs. 7, p = 0.014) upon admission. Splenectomized patients were more frequently hypotensive upon admission (19.8% vs. 38.0%, p < 0.001) and in need for blood transfusion (30.3% vs. 61.0%, p < 0.001). The mortality was 20.7% in the splenectomy group and 10.3% in the remaining cohort. After adjustment for confounding factors, early splenectomy was not found to exert a significant effect on in-hospital mortality (OR 1.29 (0.67-2.50), p = 0.45).

CONCLUSION: Trauma patients with TBI and spleen injury undergoing splenectomy demonstrate a more severe injury pattern, more compromised hemodynamic status and higher in-hospital mortality than patients without splenectomy. Adjustment for confounding factors reveals that the splenectomy procedure itself is not independently associated with survival.

BMC Emerg Med. 2022 Dec 6;22(1):194. doi: 10.1186/s12873-022-00750-1.

Is prehospital intubation of severely injured children in accordance with guidelines?

Maek T, Fochtmann U, von Loewenich A, Jungbluth P, Zimmermann W, Lefering R, Lendemans S, Hussmann B.

BACKGROUND: The current German S3 guideline for polytrauma lists five criteria for prehospital intubation: apnea, severe traumatic brain injury (GCS ≤8), severe chest trauma with respiratory failure, hypoxia, and persistent hemodynamic instability. These guideline criteria, used in adults in daily practice, have not been previously studied in a collection of severely injured children. The aim of this study was to assess the extent to which the criteria are implemented in clinical practice using a multivariate risk analysis of severely injured children.

METHODS: Data of 289,698 patients from the TraumaRegister DGU® were analyzed. Children meeting the following criteria were included: Maximum Abbreviated Injury Scale 3+, primary admission, German-speaking countries, years 2008-2017, and declaration of intubation. Since children show age-dependent deviating physiology, four age groups were defined (years old: 0-2; 3-6; 7-11; 12-15). An adult collective served as a control group (age: 20-50). After a descriptive analysis in the first step, factors leading to prehospital intubation in severely injured children were analyzed with a multivariate regression analysis.

RESULTS: A total of 4489 children met the inclusion criteria. In this cohort, young children up to 2 years old had the significantly highest injury severity (Injury Severity Score: 21; p ≤ 0.001). Falls from both high (> 3 m) and low heights (< 3 m) were more common in children than in adults. The same finding applied to the occurrence of severe traumatic brain injury. When at least one intubation criterion was formally present, the group up to 6 years old was least likely to actually be intubated (61.4%; p ≤ 0.001). Multivariate regression analysis showed that Glasgow Coma Scale score ≤ 8 in particular had the greatest influence on intubation (odds ratio: 26.9; p ≤ 0.001).

CONCLUSIONS: The data presented here show for the first time that the existing criteria in the guideline for prehospital intubation are applied in clinical practice (approximately 70% of cases), compared to adults, in the vast majority of injured children. Although severely injured children still represent a minority of all injured patients, future guidelines should focus more on them and address them in a specialized manner.

Front Neurosci. 2022 Oct 19;16:974519. doi: 10.3389/fnins.2022.974519.

The outcome of severely injured patients following traumatic brain injury is affected by gender-A retrospective, multicenter, matched-pair analysis utilizing data of the TraumaRegister DGU®.

Mair O, Greve F, Lefering R, Biberthaler P, Hanschen M; TraumaRegister DGU.

INTRODUCTION: Traumatic brain injury (TBI) causes a major health-concern globally. Gender-dependent differences in mortality outcome after TBI have been controversially discussed.

MATERIALS AND METHODS: We conducted a retrospective, multicenter, matched-pair analysis using data collected by the TraumaRegister DGU® of the German Trauma Society between 2009 and 2020. All patients after severe trauma with the leading injury of TBI (AIS ≥ 3), above 18 years of age were included. Thereby, 42,034 cases were identified. We used 12 different matching criteria to ensure highly accurate matching and were able to match 11,738 pairs of one female and one male patient.

RESULTS: Average age at injury was 67.5 ± 19.6 years in women and 66.7 ± 19.1 years in men. Mean Injury Severity Score (ISS) was 21.3 ± 8.1 in women and 21.6 ± 8.2 in men. While women were more likely to die within the first week after trauma, the mortality was significantly higher in men overall (30.8 vs. 29.2%, p < 0.002). Women were less likely to suffer from multi organ failure (MOF) (27.5 vs. 33.0%) or sepsis (4.5 vs. 7.1%). When comparing younger (≤ 45-years) and older (> 45 years) patients, overall mortality was lower in men (13.1% men vs. 13.4% women) in the younger age group, but in the older group mortality was lower in women (33.8% men vs. 31.8% women).

DISCUSSION: Gender-specific differences in the clinical outcome of severely injured patients with leading TBI could be detected. While women are overall characterized by an advantage in survival, this feature is not equally reproducible in premenopausal women. Therefore, the exact pathophysiological reasons for the described survival advantages of women will have to be explored in further prospective clinical studies.

J Clin Med. 2023 May 31;12(11):3802. doi: 10.3390/jcm12113802.

Impact of a Femoral Fracture on Outcome after Traumatic Brain Injury-A Matched-Pair Analysis of the TraumaRegister DGU®.

Paul MM, Mieden HJ, Lefering R, Kupczyk EK, Jordan MC, Gilbert F, Meffert RH, Sirén AL, Hoelscher-Doht S.

Traumatic brain injury (TBI) is the leading cause of death and disability in polytrauma and is often accompanied by concomitant injuries. We conducted a retrospective matched-pair analysis of data from a 10-year period from the multicenter database TraumaRegister DGU® to analyze the impact of a concomitant femoral fracture on the outcome of TBI patients. A total of 4508 patients with moderate to critical TBI were included and matched by severity of TBI, American Society of Anesthesiologists (ASA) risk classification, initial Glasgow Coma Scale (GCS), age, and sex. Patients who suffered combined TBI and femoral fracture showed increased mortality and worse outcome at the time of discharge, a higher chance of multi-organ failure, and a rate of neurosurgical intervention. Especially those with moderate TBI showed enhanced in-hospital mortality when presenting with a concomitant femoral fracture (p = 0.037). The choice of fracture treatment (damage control orthopedics vs. early total care) did not impact mortality. In summary, patients with combined TBI and femoral fracture have higher mortality, more in-hospital complications, an increased need for neurosurgical intervention, and inferior outcome compared to patients with TBI solely. More investigations are needed to decipher the pathophysiological consequences of a long-bone fracture on the outcome after TBI.

Unfallchirurgie (Heidelb). 2023 Jun 21. doi: 10.1007/s00113-023-01325-w. Online ahead of print.

Impact of the COVID-19 pandemic on the care of major trauma patients: analysis from the TraumaRegister DGU®.

Pflüger P, Lefering R, Dommasch M, Biberthaler P, Kanz KG.

BACKGROUND: The treatment of major trauma patients requires intensive care capacity, which is a critical resource particularly during the coronavirus disease 2019 (COVID-19) pandemic. Therefore, the aim of this study was to analyze the impact on major trauma care considering the intensive care treatment of COVID-19 positive patients.

METHODS: Demographic, prehospital, and intensive care treatment data from the TraumaRegister DGU® of the German Trauma Society (DGU) in 2019 and 2020 were analyzed. Only major trauma patients from the state of Bavaria were included. Inpatient treatment data of COVID-19 patients in Bavaria in 2020 were obtained using IVENA eHealth.

RESULTS: In total, 8307 major trauma patients were treated in the state of Bavaria in the time period investigated. The number of patients in 2020 (n = 4032) compared to 2019 (n = 4275) was not significantly decreased (p = 0.4). Regarding COVID-19 case numbers, maximum values were reached in the months of April and December with more than 800 intensive care unit (ICU) patients per day. In the critical period (> 100 patients with COVID-19 on ICU), a prolonged rescue time was evident (64.8 ± 32.5 vs. 67.4 ± 30.6 min; p = 0.003). The length of stay and ICU treatment of major trauma patients were not negatively affected by the COVID-19 pandemic.

CONCLUSION: The intensive medical care of major trauma patients could be ensured during the high-incidence phases of the COVID-19 pandemic. The prolonged prehospital rescue times show possible optimization potential of the horizontal integration of prehospital and hospital.

J Clin Med. 2022 Oct 19;11(20):6150. doi: 10.3390/jcm11206150.

Is ROTEM Diagnostic in Trauma Care Associated with Lower Mortality Rates in Bleeding Patients?-A Retrospective Analysis of 7461 Patients Derived from the TraumaRegister DGU®.

Riehl K, Lefering R, Maegele M, Caspers M, Migliorini F, Schenker H, Hildebrand F, Fröhlich M, Driessen A.

INTRODUCTION: Death from uncontrolled trauma haemorrhage and subsequent trauma-induced coagulopathy (TIC) is potentially preventable. Point-of-care devices such as rotational thromboelastometry (ROTEM®) are advocated to detect haemostatic derangements more rapidly than conventional laboratory diagnostics. Regarding reductions in RBC transfusion, the use of ROTEM has been described as being efficient and associated with positive outcomes in several studies.

OBJECTIVE: The effect of ROTEM use was assessed on three different outcome variables: (i) administration of haemostatics, (ii) rate of RBC transfusions and (iii) mortality in severely injured patients.

METHODS AND MATERIAL: A retrospective analysis of a large data set of severely injured patients collected into the TraumaRegister DGU® between 2009 and 2016 was conducted. The data of 7461 patients corresponded to the inclusion criteria and were subdivided into ROTEM-using and ROTEM-non-using groups. Both groups were analysed regarding (i) administration of haemostatics, (ii) rate of RBC transfusions and (iii) mortality. RESULTS: A lower mortality rate in ROTEM-using groups was observed (p = 0.043). Furthermore, more patients received haemostatic medication when ROTEM was used. In ROTEM-using groups, there was a statistically relevant higher application of massive transfusion.

CONCLUSIONS: In this retrospective study, the use of ROTEM was associated with reduced mortality and an increased application of haemostatics and RBC transfusions. Prospective evidence is needed for further evidence-based recommendations.

BMC Emerg Med. 2022 Sep 10;22(1):158. doi: 10.1186/s12873-022-00714-5.

Survival after traumatic cardiac arrest is possible-a comparison of German patient-registries.

Seewald S, Wnent J, Gräsner JT, Tjelmeland I, Fischer M, Bohn A, Bouillon B, Maurer H, Lefering R.

BACKGROUND: Out-of-hospital cardiac arrest (OHCA) due to trauma is rare, and survival in this group is infrequent. Over the last decades, several new procedures have been implemented to increase survival, and a "Special circumstances chapter" was included in the European Resuscitation Council (ERC) guidelines in 2015. This article analysed outcomes after traumatic cardiac arrest in Germany using data from the German Resuscitation Registry (GRR) and the TraumaRegister DGU® (TR-DGU) of the German Trauma Society.

METHODS: In this study, data from patients with OHCA between 01.01.2014 and 31.12.2019 secondary to major trauma and where cardiopulmonary resuscitation (CPR) was started were eligible for inclusion. Endpoints were return of spontaneous circulation (ROSC), hospital admission with ROSC and survival to hospital discharge.

RESULTS: 1.049 patients were eligible for inclusion. ROSC was achieved in 28.7% of the patients, 240 patients (22.9%) were admitted to hospital with ROSC and 147 (14.0%) with ongoing CPR. 643 (67.8%) patients were declared dead on scene. Of all patients resuscitated after traumatic OHCA, 27.3% (259) died in hospital. The overall mortality was 95.0% and 5.0% survived to hospital discharge (47). In a multivariate logistic regression analysis; age, sex, injury severity score (ISS), head injury, found in cardiac arrest, shock on admission, blood transfusion, CPR in emergency room (ER), emergency surgery and initial electrocardiogram (ECG), were independent predictors of mortality.

CONCLUSION: Traumatic cardiac arrest was an infrequent event with low overall survival. The mortality has remained unchanged over the last decades in Germany. Additional efforts are necessary to identify reversible cardiac arrest causes and provide targeted trauma resuscitation on scene.

Eur J Trauma Emerg Surg. 2022 Dec;48(6):4623-4630. doi: 10.1007/s00068-022-01988-x.

Endotracheal intubation in trauma patients with isolated shock: universally recommended but rarely performed.

Stausberg T, Ahnert T, Thouet B, Lefering R, Böhmer A, Brockamp T, Wafaisade A, Fröhlich M; TraumaRegister DGU.

PURPOSE: The indication for pre-hospital endotracheal intubation (ETI) must be well considered as it is associated with several risks and complications. The current guidelines recommend, among other things, ETI in case of shock (systolic blood pressure < 90 mmHg). This study aims to investigate whether isolated hypotension without loss of consciousness is a useful criterion for ETI.

METHODS: The data of 37,369 patients taken from the TraumaRegister DGU® were evaluated in a retrospective study with regard to pre-hospital ETI and the underlying indications. Inclusion criteria were the presence of any relevant injuries (Abbreviated Injury Scale [AIS] ≥ 3) and complete pre-hospital management information.

RESULTS: In our cohort, 29.6% of the patients were intubated. The rate of pre-hospital ETI increased with the number of indications. If only one criterion according to current guidelines was present, ETI was often omitted. In 582 patients with shock as the only indication for pre-hospital ETI, only 114 patients (19.6%) were intubated. Comparing these subgroups, the intervention was associated with longer time on scene (25.3 min vs. 41.6 min; $p < 0.001$), higher rate of coagulopathy (31.8% vs. 17.2%), an increased mortality (8.2% vs. 11.5%) and higher standard mortality ratio (1.17 vs. 1.35). If another intubation criterion was present in addition to shock, intubation was performed more frequently.

CONCLUSION: Decision making for pre-hospital intubation in trauma patients is challenging in front of a variety of factors. Despite the presence of a guideline recommendation, ETI is not always executed. Patients presenting with shock as remaining indication and subsequent intubation showed a decreased outcome. Thus, isolated shock does not appear to be an appropriate indication for pre-hospital ETI, but clearly remains an important surrogate of trauma severity and the need for trauma team activation.

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Early total care or damage control orthopaedics for major fractures? Results of propensity score matching for early definitive versus early temporary fixation based on data from the trauma registry of the German Trauma Society (TraumaRegister DGU®).

von Lübken F, Prause S, Lang P, Friemert BD, Lefering R, Achatz G.

PURPOSE: Damage control orthopaedics (DCO) und early total care (ETC) are well-established strategies for managing severely injured patients. There is no definitive evidence of the superiority of DCO over ETC in polytrauma patients. We conducted this study to assess the probability of a polytraumatised patient undergoing DCO. In addition, the effect of DCO on complications and mortality was investigated.

METHODS: We analysed data from 12,569 patients with severe trauma (Injury Severity Score ≥ 16) who were enrolled in the trauma registry of the German Trauma Society (TraumaRegister DGU®) from 2009 to 2016 and had undergone surgery for extremity or pelvic fractures. These patients were allocated to a DCO or an ETC group. We used the propensity score to identify factors supporting the use of DCO. For a comparison of mortality rates, the groups were stratified and matched on the propensity score.

RESULTS: We identified relevant differences between DCO and ETC. DCO was considerably more often associated with packed red blood cell (pRBC) transfusions (33.9% vs. 13.4%), catecholamine therapy (14.1% vs. 6.8%), lower extremity injuries (72.4% vs. 53.5%), unstable pelvic fractures (41.0% vs. 25.9%), penetrating injuries (2.8% vs. 1.5%), and shock (20.5% vs. 10.8%) and unconsciousness (23.7% vs. 16.3%) on admission. Based on the propensity score, patients with penetrating trauma, pRBC transfusions, unstable pelvic fractures, and lower extremity injuries were more likely to undergo DCO. A benefit of DCO such as reduced complications or reduced mortality was not detected.

CONCLUSION: We could identify some parameters of polytrauma patients used in the trauma registry (Traumaregister DGU®), which led more likely to a DCO therapy. The propensity score did not demonstrate the superiority of DCO over ETC in terms of outcome or complications. It did not appear to adequately adjust for the variables used here. Definitive evidence for or against the use of DCO remains unavailable.

Langenbecks Arch Surg. 2022 Dec;407(8):3681-3690. doi: 10.1007/s00423-022-02629-y.

Traumatic diaphragmatic rupture: epidemiology, associated injuries, and outcome-an analysis based on the TraumaRegister DGU®.

Weber C, Willms A, Bieler D, Schreyer C, Lefering R, Schaaf S, Schwab R, Kollig E, Güsgen C; and the Committee on Emergency Medicine, Intensive Care and Trauma Management (Sektion NIS) of the German Trauma Society (DGU).

INTRODUCTION: Traumatic diaphragmatic rupture is a rare injury in the severely injured patient and is most commonly caused by blunt mechanisms. However, penetrating mechanisms can also dominate depending on regional and local factors. Traumatic diaphragmatic rupture is difficult to diagnose and can be missed by primary diagnostic procedures in the resuscitation room. Initially not life-threatening, diaphragmatic ruptures can cause severe sequelae in the patient's long-term course if untreated. The objective of this study was to assess the epidemiology, associated injuries, and outcome of traumatic diaphragmatic ruptures based on a multicenter registry-based analysis.

MATERIAL AND METHODS: Data from all patients enrolled in the TraumaRegister DGU® between 2009 and 2018 were retrospectively analyzed. That multicenter database collects data on prehospital, intra-hospital emergency, intensive care therapy, and discharge. Included were all patients with a Maximum Abbreviated Injury Scale (MAIS) score of 3 or above and patients with a MAIS score of 2 who died or were treated in the intensive care unit, for whom standard documentation forms had been completed and who had sustained a diaphragmatic rupture (AIS score of 3 or 4). The data has been analyzed using descriptive statistics and chi-square test or Mann-Whitney U test.

RESULTS: Of the 199,933 patients included in the study population, 687 patients (0.3%) had a diaphragmatic rupture. Of these, 71.9% were male. The mean patient age was 46.1 years. Blunt trauma accounted for 73.5% of the injuries. Primary diagnosis was established in the resuscitation room in 93.1% of the patients. Multislice helical computed tomography (MSCT) was performed in 82.7% of the cases. Rib fractures were detected in 60.7% of the patients with a diaphragmatic injury. Patients with diaphragmatic rupture had a higher mean Injury Severity Score (ISS) than patients without a diaphragmatic injury (32.9 vs. 18.6) and a higher mortality rate (13.2% vs. 9.0%).

CONCLUSIONS: In contrast to the literature, primary diagnostic procedures in the resuscitation room detected relevant diaphragmatic ruptures (AIS ≥ 3) in more than 90% of the patients in our study population. In addition, complex associated serial rib fractures are an important diagnostic indicator.

Z Orthop Unfall. 2023 Jun;161(3):297-303. doi: 10.1055/a-1651-0996.

Causes of Death in the Seriously Injured -Why do Severely Injured Patients Die Today?

Wilharm A, Pflug A, Loos F, Sommerfeld O, Hofmann GO, Sauer S.

BACKGROUND: The leading cause of death among people under 45 years of age is trauma. However, there is little information from the last 10 years on the exact causes of death of seriously injured people after hospital admission in Germany. The aim of the study is to evaluate the data of a level I trauma centre from the last 10 years. The reliability of the data, frequency of the causes of death and correlations with the mechanism of injury as well as the confirmability of the data in the TraumaRegister DGU are to be investigated.

MATERIALS AND METHODS: The University Hospital Jena data were analysed for 203 deceased trauma patients from accidental death between 2007 and 2017.

RESULTS: A clear determination of the cause of death is possible in about 85% of cases on the basis of hospital data. The most frequent cause of death of severely injured patients after admission to the hospital is traumatic brain injury (59.6%), followed by organ failure (17%), haemorrhage (14%) and other causes of death (9.4%). Verification using data from the TraumaRegister DGU is possible. There is a clear correlation between mechanism of injury and cause of death.

CONCLUSIONS: The cause of death is very often a subjective assessment of the recording doctor. In particular, there are difficulties with patients who die in the resuscitation room before further diagnosis. The most frequent cause of death today is traumatic brain injury. For future evaluations, the new information in the TraumaRegister DGU is helpful because the cause of death can only be partially derived from other registry data. The correlation between the type of accident and the cause of death could be used for preventive measures.

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16 List of abbreviations

AIS	Abbreviated Injury Scale
ASA	American Society of Anaesthesiologists (classification)
AUC	AUC – Academy for Trauma Surgery (Akademie der Unfallchirurgie GmbH)
BE	Base excess
BGA	Blood gas analysis
CI	Confidence interval
CT	Computer tomography
cCT	Cranial computer tomography
CPR	Cardio-pulmonary resuscitation
DGU	German Trauma Society (Deutsche Gesellschaft für Unfallchirurgie e.V.)
DVT	Deep vein thrombosis
EMS	Emergency medical services
ER	Emergency room
FAST	Focused assessment with sonography for trauma
FFP	Fresh frozen plasma
GCS	Glasgow coma scale
h	Hours
ICU	Intensiv care unit
IFOM	Institute for Research in Operative Medicine (Institut für Forschung in der Operativen Medizin)
INR	International normalised ratio
ISS	Injury severity score
LOS	Length of stay
LTC	Local trauma centre
M	Mean
m	Metre
MAIS	Maximum AIS severity score
Max	Maximum
MCI	Mass casualty incident
MI	Myocardial infarction
[min]	Minute
Min	Minimum
ml	Millilitre
mmHg	Millimetre of mercury
mmol	Millimol
MOF	Multiple organ failure
NIS	Committee on Emergency Medicine, Intensive Care and Trauma Management of the German Trauma Society DGU (Sektion Notfall-, Intensivmedizin und Schwerverletztenversorgung (Sektion NIS) der DGU)
NISS	New injury severity score
No.	Number

OP	Operation
Pat.	Patients
phys.	physiological
pRBC	packed red blood cells
QM	Quality management
REBOA	Resuscitative endovascular balloon occlusion of the aorta
RTC	Regional trauma centre
RISC	Revised injury severity score (prognostic score)
RR	Systolic blood pressure (according to Riva-Rocci in mmHg)
S	Standard dataset
sBP	Systolic blood pressure
SD	Standard deviation
SMR	Standardised mortality ratio
STC	Supra-regional trauma centre
tab.	table
TBI	Traumatic brain injury
TR-DGU	TraumaRegister DGU®
TXA	Tranexamic acid
vs.	versus
WBCT	Whole-body computer tomography