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

AUC - Academy for Trauma Surgery

Annual Report 2019

TraumaRegister DGU®

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Annual Report 2019 - TraumaRegister DGU®

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Content

Preface

Dear participants in TraumaRegister DGU®,

we are pleased to send you the **2019 annual report** of TraumaRegister DGU® for your hospital. This issue includes - as usual - the data analysis for the seriously injured in 2018 (basic group), which you have documented until the end of March 2019. This basic group, in the sense of the TraumaRegister DGU® definition of a seriously injured person, counts 32,580 cases in 2018.

The documentation of a total of 40,882 patients also includes patients with less severe injuries (e.g. concussion). For reasons of better comparability, these are not included in the scientific analysis.

With a total of 660 hospitals participating in TraumaRegister DGU® at the end of 2018. In addition to the 603 hospitals from Germany, there are participating hospitals from eight other countries in the registry. Of these, 23 hospitals come from Austria, 11 from Switzerland and 11 from Belgium.

What is new in the 2019 annual report?

Beside many changes regarding the layout in the annual report, new figures with time components especially for the data presentations in chapter 4 are introduced this year.

Furthermore, not only the list of publications from the TraumaRegister DGU® of the last three years is presented in the report, but also the corresponding abstracts for the year 2019.

We very much hope that the annual report – in terms of healthcare research - will provide you all in your hospitals with findings that can contribute to further improve the treatment of seriously injured patients.

Yours sincerely

Christine Hoefer Stefan Huber-Wagner Rolf Lefering Ruth Volland Christian Waydhas

1 Number of cases

Admission via the emergency room and need for intensive care are the official inclusion criteria for documenting a patient in the TraumaRegister DGU® (TR-DGU). 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 injuries.

However, the number of patients with only minor injuries continuously increased in recent years. On the one hand, this means a higher workload, but more important it diminishes also the comparability of findings, both between hospitals and over time. Therefore, a **basic group** has been defined in 2015 and nearly all analyses presented in this report refer to this patient group only (and not to all documented patients).

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

All patients with MAIS ≥ 3 are included as well as MAIS 2 patients who have died or were treated on the intensive care unit.

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

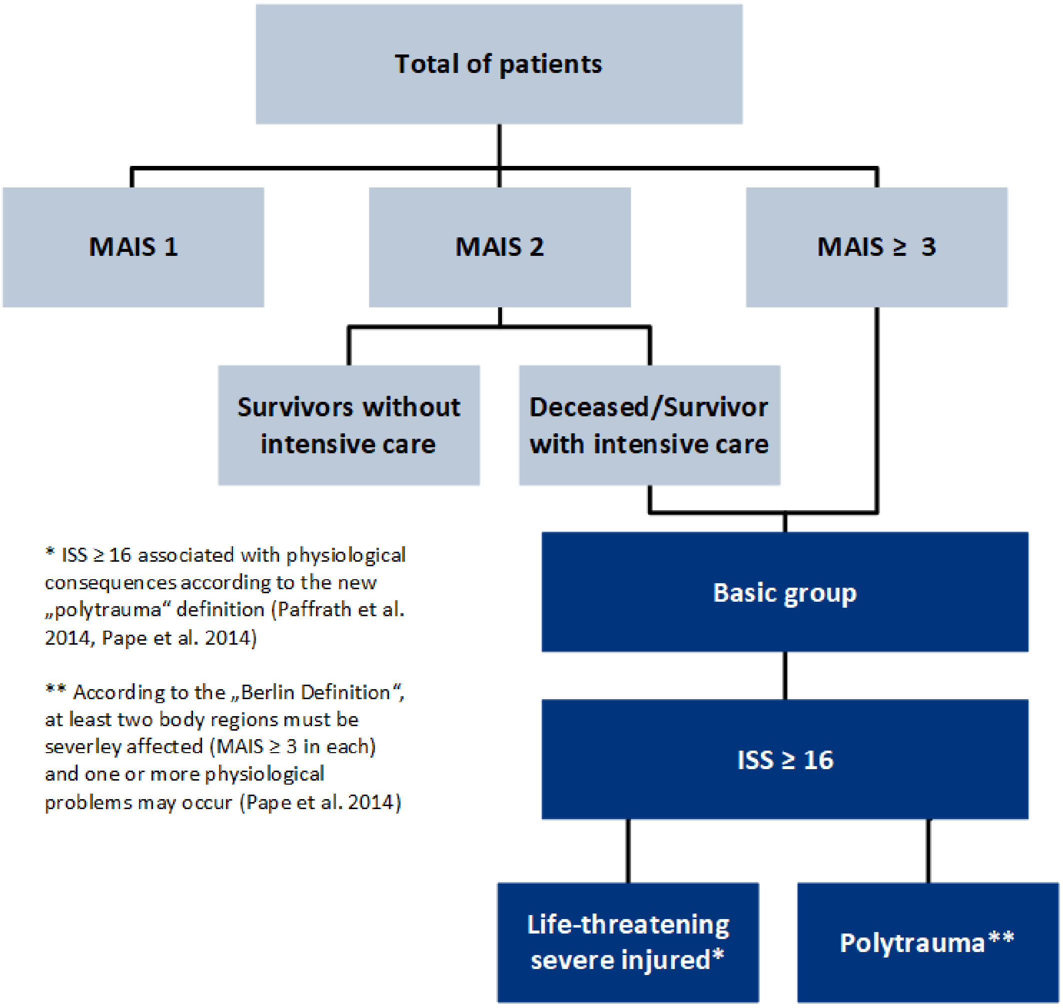


Figure 1: Flowchart to the composition of the basic group

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. The number of cases of your hospital and the total registry for the last year is presented.

Table 1: Number of cases in 2017 your hospital *vs.* TR-DGU

	Your hospital 2018	Primary admitted	Transfer in	Early transfer out	**TR-DGU 2018**
Total number Of documented patients.	**40,882**	35,357	2,777	2,748	40,882
MAIS 1 The most severe injury of these patients was of 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 further analysis (except chapter 5.3).	**5,305** (13%)	5,140	54	111	5,305 (13%)
MAIS 2 survivors without intensive care The worst injury was of AIS grade 2. All patients survived and did not receive any intensive care.	**2,997** (7%)	5,684	227	223	2,997 (7%)
MAIS 2 deceased or survivors with intensive care The worst injury was of AIS grade 2. The patients are dead or survived with intensive care.	**6,256** (15%)	27,239	2,524	1,039	6,256 (15%)
MAIS ≥ 3 The worst injury was of AIS grade 3 or more (MAIS 3+) which recently was defined as a „*serious injury*" by the EU when looking for an internationally agreed definition for road traffic research.	**26,324** (64%)	21,832	2,450	2,042	26,324 (64%)
Non-basic group Patients with MAIS 1 as well as patients with MAIS 2 that survived without intensive care.	**8,302** (20%)	7,728	91	483	8,302 (20%)
Up to here all absolute numbers and percentages refer 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 with valid age data.	**32,580**	**27,629**	**2,686**	**2,265**	**32,580**
Intensive care Patients who required intensive care due to their injuries (admission to ICU).	**28,267** (87%)	24,801	2,477	989	28,267 (87%)
Deceased Patients who died in the acute care hospital.	**3,481** (11%)	3,123	358	0	3,481 (11%)
ISS 16+ The definition ISS ≥ 16 (or > 15) is used in many scientific papers to define a serious injury.	**17,664** (54%)	14,320	1,898	1,446	17,664 (54%)
Life-threatening severe injury Injury severity of ISS ≥ 16 in conjunction with phys. effects according to the new „polytrauma" definition (Paffrath et al. 2014, Pape et al. 2014).	**10,047** (31%)	8,375	934	738	10,047 (31%)
Polytrauma According to the „Berlin Definition", two body regions need to be severly affected and one or more phys. problems are present (Pape et al. 2014).	**4,735** (15%)	4,116	327	292	4,735 (15%)

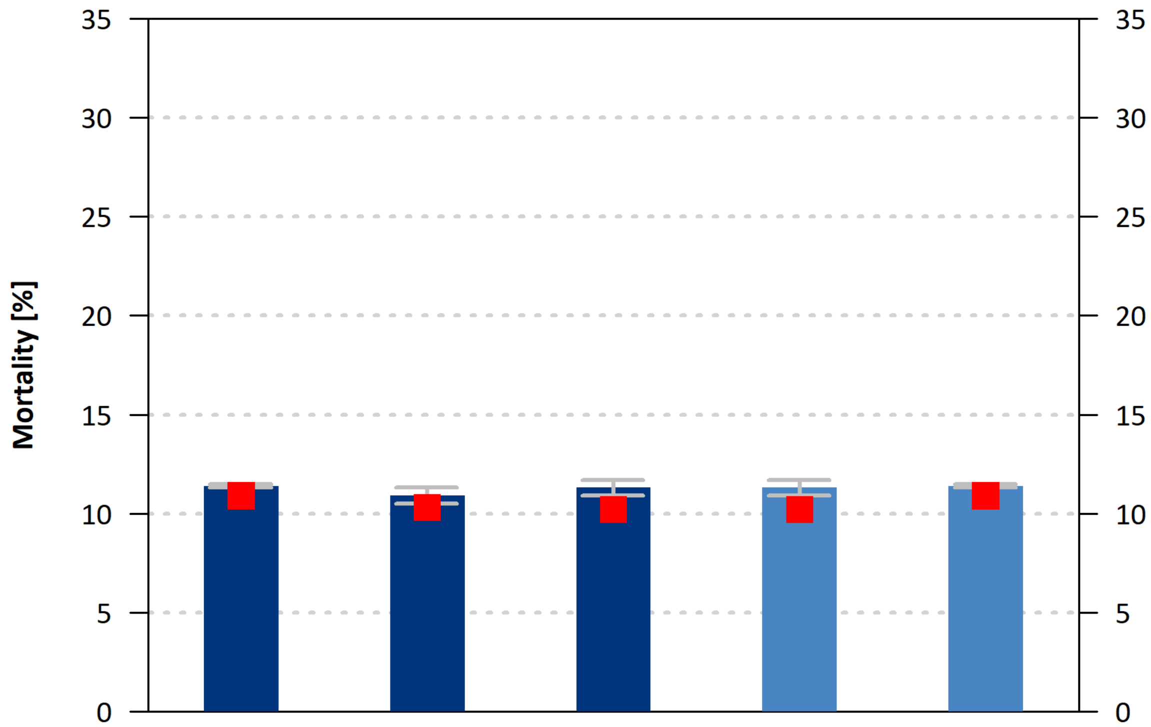
2 Observed mortality and prognosis

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 from the **RISC II** prognostic score (Revised Injury Severity Classification; Lefering et al. 2014). This score can be calculated for all primary admitted patients. The analysis in chapter 2 is limited to the **basic group** as defined on page 5.

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 = 2,686 in 2018), the initial status from primary admission is missing; for patients **transferred out early** (within 48 hours after admission; n = 2,265 in 2018), no final outcome is documented.

No. of patients of your hospital (basic group) documented in the last 10 years (2009-2018)	n = **268,105**
- among them, documented last year (2018)	n = **32,580**
- among them, primary admitted cases (no transfer in; no early transfer out)	n = **27,629**

The mean age of the 27,629 patients is 52.3 years and 70% are males. The mean ISS was 18 points. Of these patients 3,123 died in hospital, which is **11.3%** (95% confidence interval: 10.9 - 11.7). The risk of death prognosis based on RISC II is **10.2%**. You find these values in figure 2, where your hospital results from previous years are also presented together with the overall result in the registry.



	Your hospital 10 years	Your hospital 2017	Your hospital 2018	TR-DGU 2018	TR-DGU 10 years
No. of pat. (n):	225,382	30,202	27,629	27,629	225,382
Mortality [%]:	11.4	10.9	11.3	11.3	11.4
RISC II [%]:	10.9	10.3	10.2	10.2	10.9

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

Legend to the figure:

The bars represent the observed mortality rate; percentages are given at the bottom of each bar. The predicted mortality rate based on RISC II is given as a yellow vertical **bar**. This bar 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 should be considered that these findings depend on statistical uncertainty. Therefore, the 95% confidence interval (CI) for the observed mortality rate is given as well (vertical line). The 95%-CI describes a range of values which cover the „true" value with a high probability (95%). The more patients a value is based on, the narrower the CI. If the observed mortality rate is based on less than 5 cases, the large CI will not be presented.

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 forms 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 required 13 informations are recorded by both datasets. The only mandatory components are age and injury severity. However, every additional information about the patient increases the accuracy of the outcome prediction.

Therefore, supplementary information about 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) means: **more than 95%** of cases were well documented,
- (yellow) means: **80 - 94%** of cases were well documented,
- (red) means: **less than 80%** of cases were well documented.

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

	Your hospital 10 years	Your hospital 2017	Your hospital 2018	TR-DGU 2018	TR-DGU 10 years
Total no. of cases (n)	225,382	30,202	27,629	27,629	225,382
„Well documented" (n)	175,315	24,111	22,769	22,769	175,315
„Well documented" (%)	78	80	82	82	78
Data quality colour code	(red)	(yellow)	(yellow)	(yellow)	(red)
Average no. of missing values per patient for the calculation of the RISC II	0.9	0.9	0.7	0.7	0.9

Mortality *vs.* risk of death prognosis

Your hospital 2018:	Patients in the basic group:	**27,629**	primary admitted cases
	Deviation between mortality and prognosis:	**+1.1%**	(TR-DGU: 1.1%)

Figure 3 compares each hospital's **observed mortality** with the respective **RISC II of all the TR-DGU participating hospitals prognosis in 2018**. 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 **less than 5 patients** are not included due to the large statistical uncertainty.

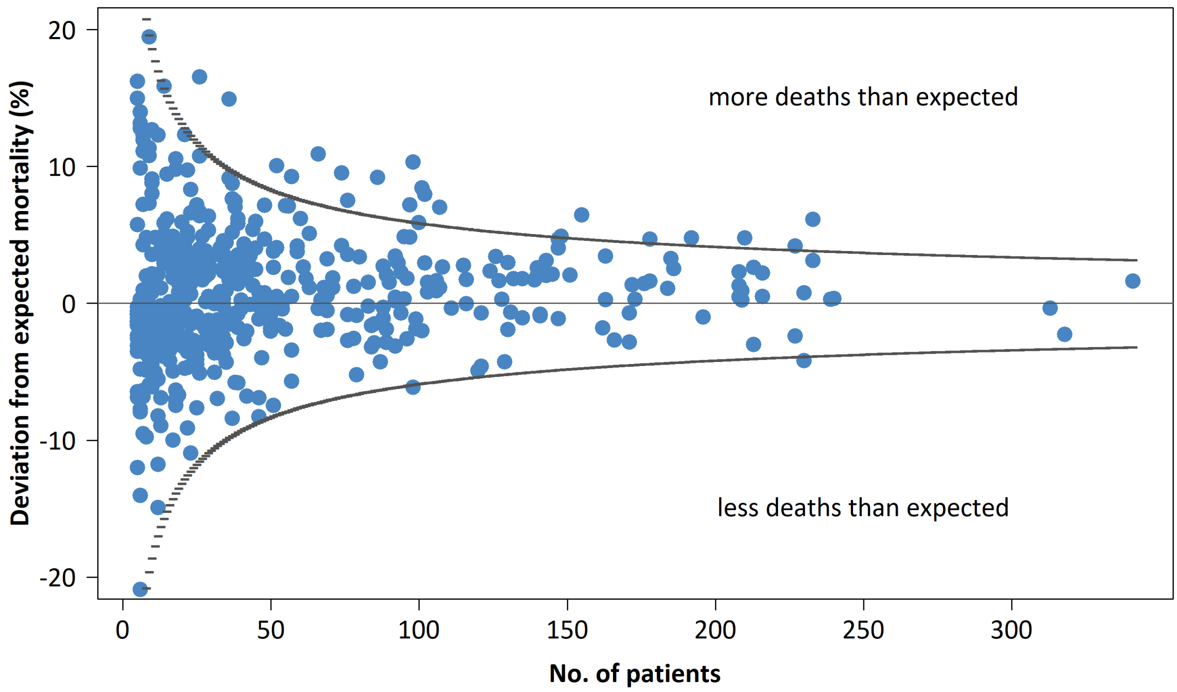


Figure 3: Deviation between the observed mortality and the risk of death prognosis (RISC II) of every in the TR-DGU participating hospital with more than 5 cases in the year 2018, ♦: Your hospital

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 have to be interpreted with caution when the number of patients is < 5!

Table 3: Overview of the data from your hospital in the basic group from the last 3 years

		Your hospital				TraumaRegister DGU®	
		10 years	2016	2017	**2018**	2018	10 years
Total number of patients	(n)	268,105	34,453	35,854	**32,580**	32,580	268,105
Primary admitted and treated patients	(n)	225,382	29,088	30,202	**27,629**	27,629	225,382
Patients early transferred out	(n)	17,411	2,277	2,344	**2,265**	2,265	17,411
All primary admissions	(n)	242,793	31,365	32,546	**29,894**	29,894	242,793
Patients transferred in	(n)	25,312	3,088	3,308	**2,686**	2,686	25,312

Table 3 continuation:

		Your hospital				TraumaRegister DGU®	
		10 years	2016	2017	**2018**	2018	10 years
Demography (patients from the basic group)							
Mean age	[years]	50.5	51.4	51.8	**52.5**	52.5	50.5
70 years or older	[%]	24.8	26.1	26.3	**27.1**	27.1	24.8
Amount of men	[%]	70.2	70.3	69.8	**70.2**	70.2	70.2
Trauma (patients from the basic group)							
Blunt trauma	[%]	95.9	96.1	95.9	**96.2**	96.2	95.9
Mean ISS	[points]	18.9	18.6	18.2	**18.3**	18.3	18.9
ISS ≥ 16	[%]	56	55.2	53.9	**54.2**	54.2	56
TBI (AIS head ≥ 3)	[%]	37.7	37.9	36.4	**35.9**	35.9	37.7
Prehospital care (only primary admissions)							
Intubation by emergency physician	[%]	24.3	21.8	20.7	**20.2**	20.2	24.3
Unconscious (GCS ≤ 8)	[%]	17.9	17.3	16.1	**15.8**	15.8	17.9
Shock (RR ≤ 90 mmHg)	[%]	9.9	8.5	8.1	**8.3**	8.3	9.9
Average amount of volume	[ml]	700	651	635	**633**	633	700
Emergency room care (only primary admissions)							
Whole-body CT	[%]	76.7	78.4	79	**79.5**	79.5	76.7
X-ray of thorax	[%]	37	33.8	30.5	**26.6**	26.6	37
Patients with blood transfusion	[%]	8.5	7.3	7.1	**6.9**	6.9	8.5
Treatment in hospital (patients from the basic group)							
Patients with surgery [1)]	[%]	67.4	66.5	66.3	**65.4**	65.4	67.4
if yes, no. of pat. with surgery [2)]	(n)	3.5	3.3	3.3	**3.4**	3.4	3.5
Patients treated on ICU	[%]	87.2	87.6	87.6	**86.8**	86.8	87.2
Length of stay on ICU [3)]	[days]	6.8	6.5	6.2	**6.2**	6.2	6.8
Intubated/ventilated patients on ICU [3)]	[%]	41.6	38.3	35.8	**35.7**	35.7	41.6
Length of intubation [3)]	[days]	3.1	2.9	2.6	**2.6**	2.6	3.1
Outcome (patients from the basic group)							
Length of stay in hospital [4)]	[days]	16.8	16.1	15.5	**15.3**	15.3	16.8
Hospital mortality [4)]	[n]	28,714	3,609	3,704	**3,481**	3,481	28,714
	[%]	11.5	11.2	11.1	**11.5**	11.5	11.5
Multiple organ failure [2) 4)]	[%]	21	20.4	19	**19**	19	21
Discharge to other hospital	[%]	17.4	17.8	17.7	**18**	18	17.4

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

[2)] not available in the reduced QM dataset

[3)] only ICU patients

[4)] without patients transferred out early

4 Indicators of process quality

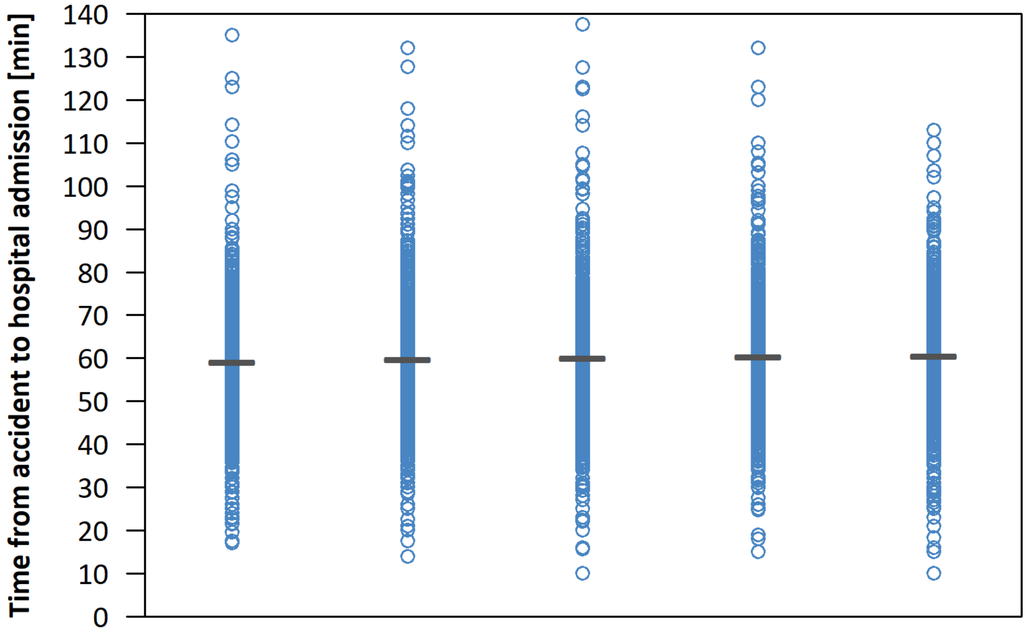
Quality indicators are measurements which are presumed to be associated with the quality of care and outcome. All results presented here are based on **primary admitted cases only from the basic group in 2018** (your hospital = 27,629) with valid data or respective subgroups thereof. This includes early 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 single hospital value. The value of your hospital is displayed by a dark blue diamond, respectively. The grey horizontal line presents the mean value over all hospitals and over time.

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 were excluded.

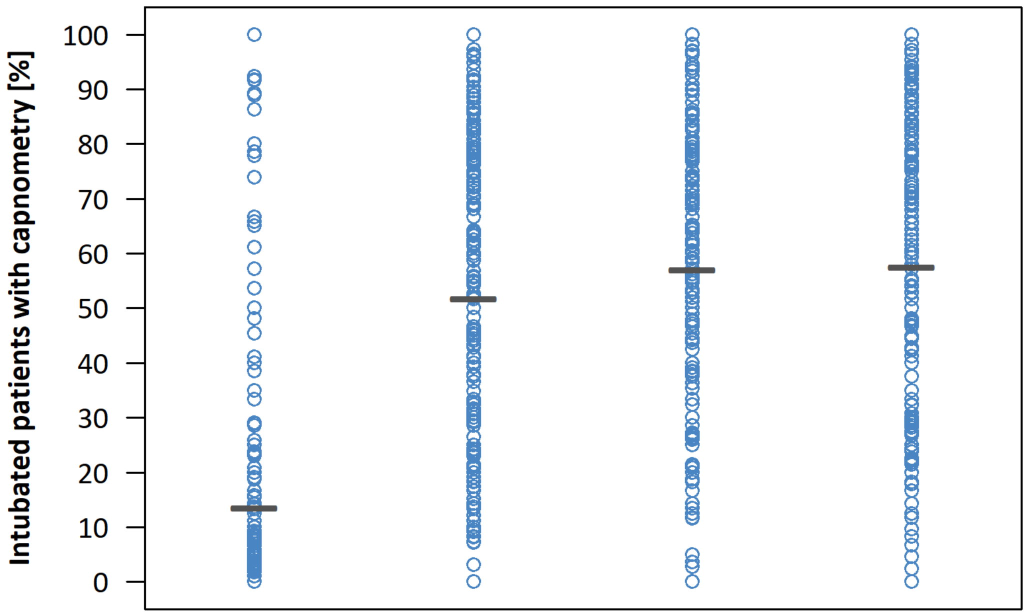


Year:	2014	2015	2016	2017	2018
Your hospital:	59 [min]	60 [min]	60 [min]	60 [min]	60 [min]
n:	11,877	12,339	12,585	12,907	12,043
Min-Max:	5-240 [min]	5-240 [min]	5-240 [min]	5-240 [min]	5-240 [min]
TR-DGU:	59 [min]	60 [min]	60 [min]	60 [min]	60 [min]
n:	11,877	12,339	12,585	12,907	12,043
Min-Max:	5-240 [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, 2014-2018, ♦ Your hospital, — TR-DGU, o single hospital value

4.1.2 Capnometry in intubated patients

A capnometry in intubated patients allows to detect a malpositioning of the tubus. Only patients with a prehospital endotracheal intubation with valid data for capnometry are considered here (since dataset revision 2015). Intubated patients without data to the capnometry cannot be analysed (n = 1,803).

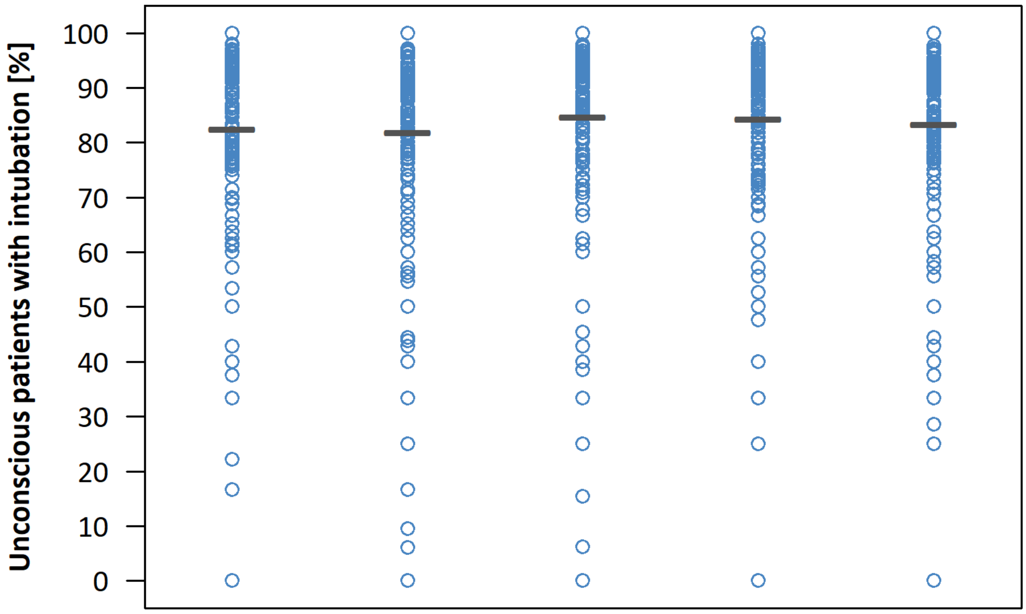


Year:	2015	2016	2017	2018
Your hospital:	14 %	52 %	57 %	57 %
Capnometry (n):	876	3,390	3,666	3,355
Intubated (N):	6,478	6,545	6,429	5,835
TR-DGU:	14 %	52 %	57 %	57 %
Capnometry (n):	876	3,390	3,666	3,355
Intubated (N):	6,478	6,545	6,429	5,835

Figure 5: Distribution of the capnometry rate in prehospital intubated patients over all hospitals, 2015-2018, ♦ Your hospital, — TR-DGU, o single hospital value

4.1.3 Intubation of unconscious patients

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

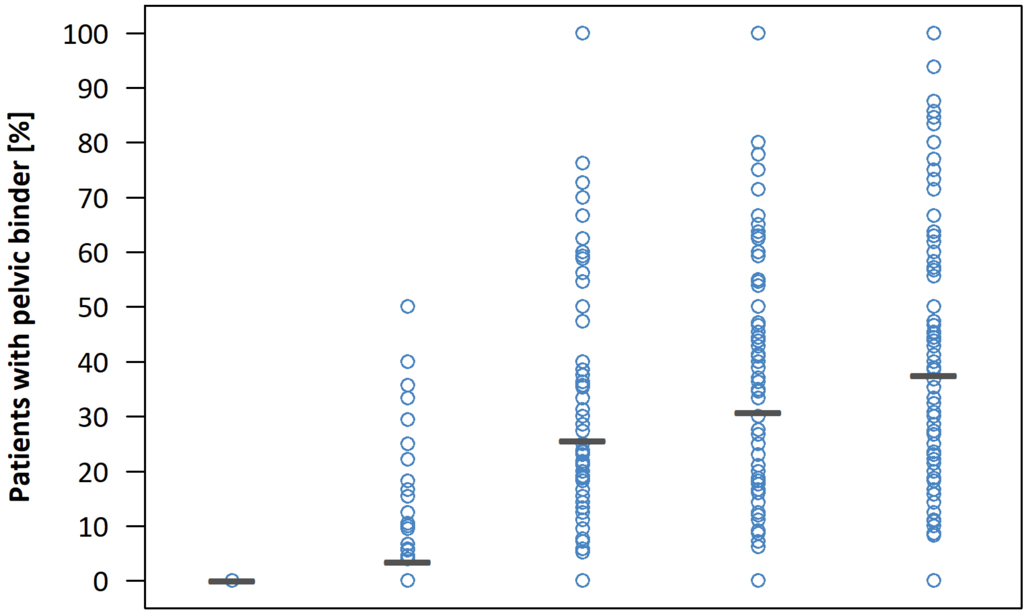


Year:	2014	2015	2016	2017	2018
Your hospital:	82 %	82 %	85 %	84 %	83 %
Intubated (n):	3,638	3,939	4,227	4,064	3,672
Unconscious (N):	4,411	4,812	4,990	4,817	4,407
TR-DGU:	82 %	82 %	85 %	84 %	83 %
Intubated (n):	3,638	3,939	4,227	4,064	3,672
Unconscious (N):	4,411	4,812	4,990	4,817	4,407

Figure 6: Distribution of the intubation rate in unconscious patients over all hospitals, 2014-2018, ♦ Your hospital, — 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 (since the dataset revision 2020).



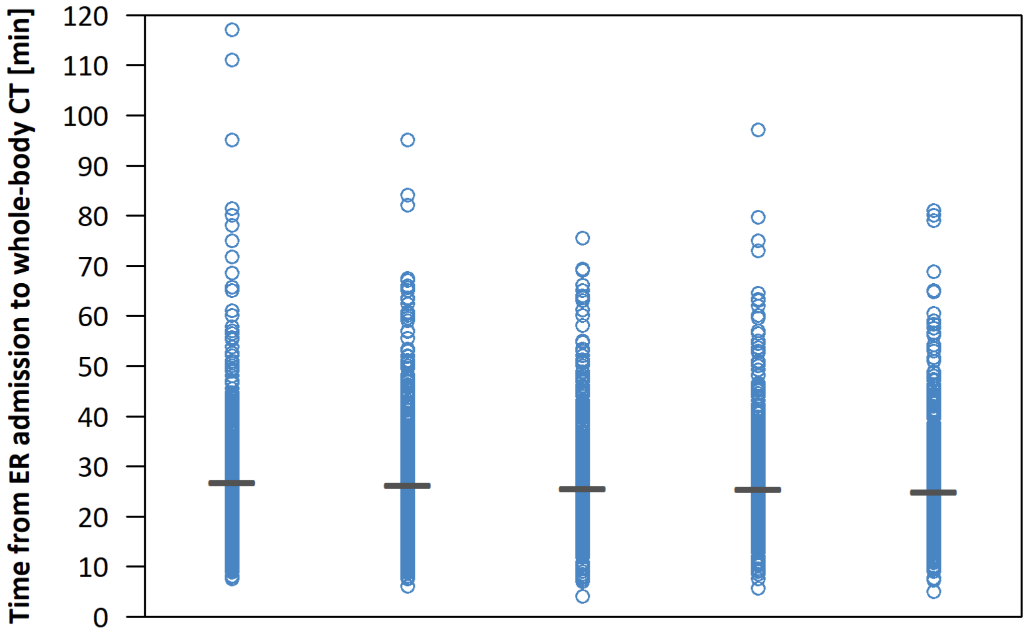
Year:	2014	2015	2016	2017	2018
Your hospital:	0 %	3 %	26 %	31 %	37 %
Pelvic binder (n):	0	46	364	465	512
Pelvic fracture (N):	1,275	1,329	1,422	1,512	1,366
TR-DGU:	0 %	3 %	26 %	31 %	37 %
Pelvic binder (n):	0	46	364	465	512
Pelvic fracture (N):	1,275	1,329	1,422	1,512	1,366

Figure 7: Distribution of the pelvic binder rate in patients with an instable pelvic fracture over all hospitals, 2014-2018, ♦ Your hospital, — TR-DGU, o single hospital value

4.2 Process times in the emergency room

4.2.1 Duration 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 without loss of time. Time periods > 120 minutes are excluded from the following analysis. All patientes who received a whole-body CT are considered here.

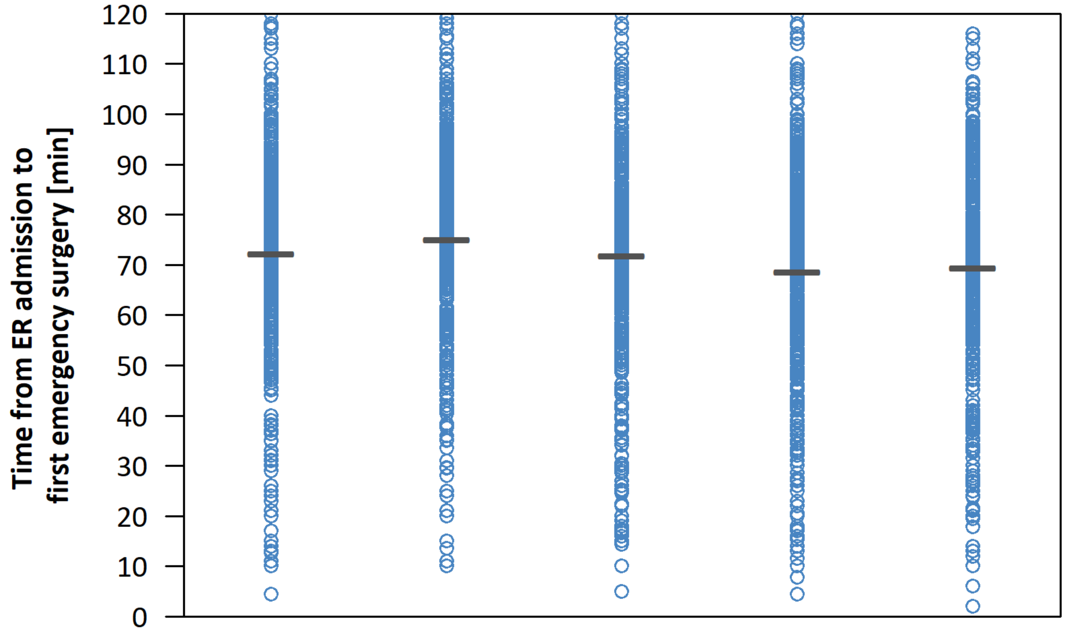


Year:	2014	2015	2016	2017	2018
Your hospital:	27 [min]	26 [min]	26 [min]	25 [min]	25 [min]
n:	20,315	22,415	23,826	24,996	23,118
Min-Max:	1-120 [min]	1-120 [min]	1-120 [min]	1-120 [min]	1-120 [min]
TR-DGU:	27 [min]	26 [min]	26 [min]	25 [min]	25 [min]
n:	20,315	22,415	23,826	24,996	23,118
Min-Max:	1-120 [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, 2014-2018, ♦ Your hospital, — TR-DGU, o single hospital value

4.2.2 Duration until first emergency surgery

Eight different emergency interventions are documented in TR-DGU (surgical liquor 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.

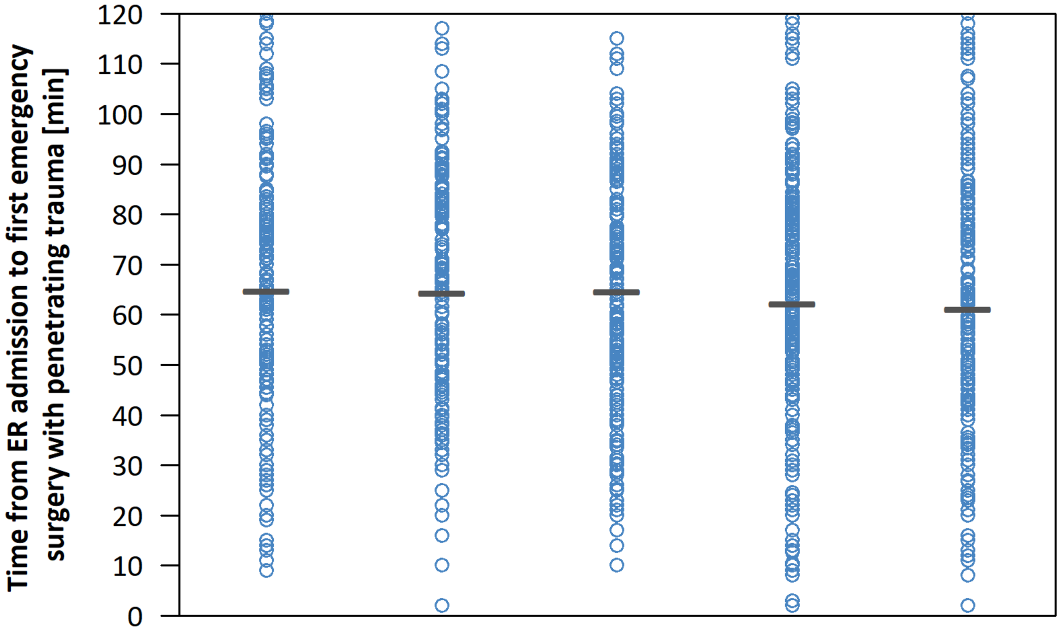


Year:	2014	2015	2016	2017	2018
Your hospital:	72 [min]	75 [min]	72 [min]	69 [min]	69 [min]
n:	3,571	3,833	4,977	5,178	4,493
Min-Max:	1-120 [min]	1-120 [min]	1-120 [min]	1-120 [min]	1-120 [min]
TR-DGU:	72 [min]	75 [min]	72 [min]	69 [min]	69 [min]
n:	3,571	3,833	4,977	5,178	4,493
Min-Max:	1-120 [min]	1-120 [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, 2014-2018, ♦ Your hospital, — TR-DGU, o single hospital value

4.2.3 Duration 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 over 120 hours are excluded from this analysis.

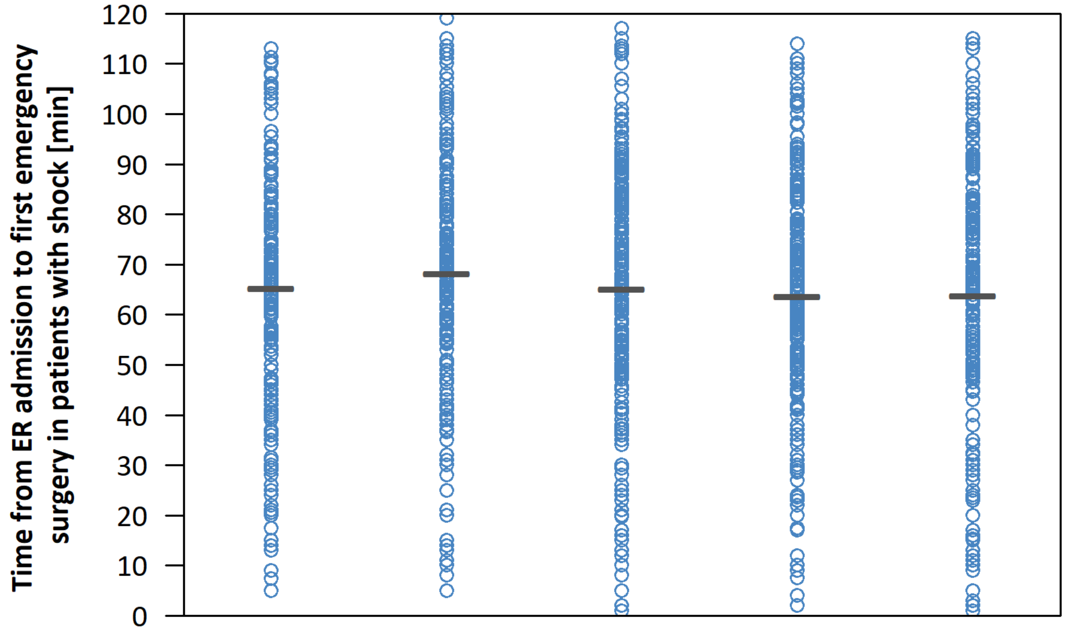


Year:	2014	2015	2016	2017	2018
Your hospital:	65 [min]	64 [min]	65 [min]	62 [min]	61 [min]
n:	389	396	464	513	406
Min-Max:	2-120 [min]	1-120 [min]	1-120 [min]	1-120 [min]	1-120 [min]
TR-DGU:	65 [min]	64 [min]	65 [min]	62 [min]	61 [min]
n:	389	396	464	513	406
Min-Max:	2-120 [min]	1-120 [min]	1-120 [min]	1-120 [min]	1-120 [min]

Figure 10: Distribution of the mean duration from admission to the ER until surgery in patients with penetrating trauma over all hospitals, 2014-2018, ♦ Your hospital, — TR-DGU, o single hospital value

4.2.4 Duration until surgery in patients with shock

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

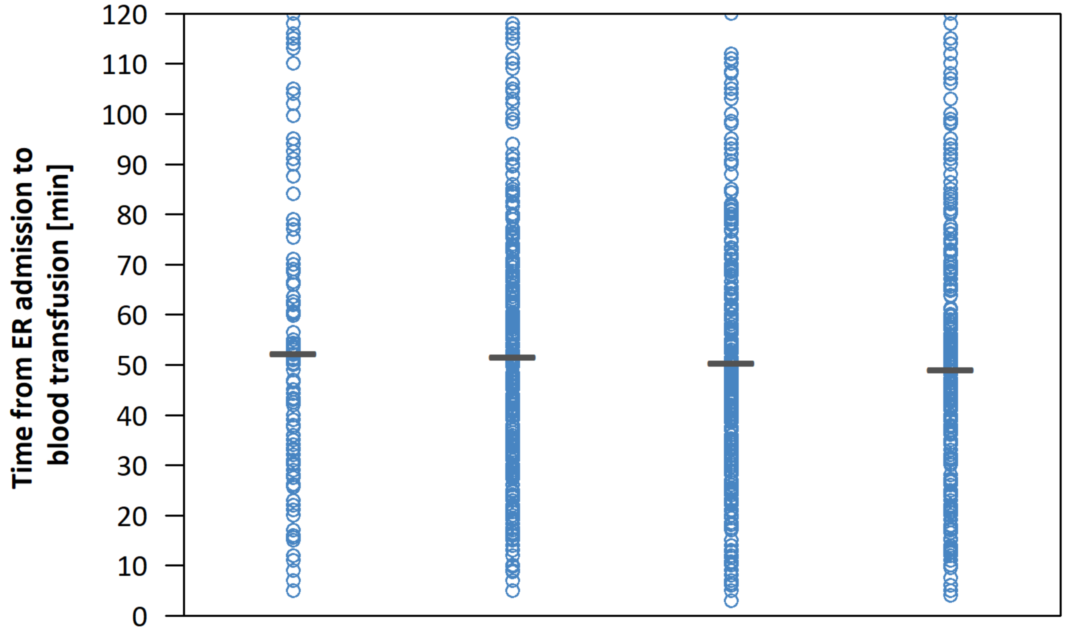


Year:	2014	2015	2016	2017	2018
Your hospital:	65 [min]	68 [min]	65 [min]	64 [min]	64 [min]
n:	586	602	724	751	686
Min-Max:	2-120 [min]	1-120 [min]	1-120 [min]	1-120 [min]	1-120 [min]
TR-DGU:	65 [min]	68 [min]	65 [min]	64 [min]	64 [min]
n:	586	602	724	751	686
Min-Max:	2-120 [min]	1-120 [min]	1-120 [min]	1-120 [min]	1-120 [min]

Figure 11: Distribution of the mean duration from admission to the ER until surgery in patients with shock over all hospitals, 2014-2018, ♦ Your hospital, — TR-DGU, o single hospital value

4.2.5 Duration until start of blood transfusion

If blood substitution is required, this should be done as early 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 hours are excluded from this analysis.

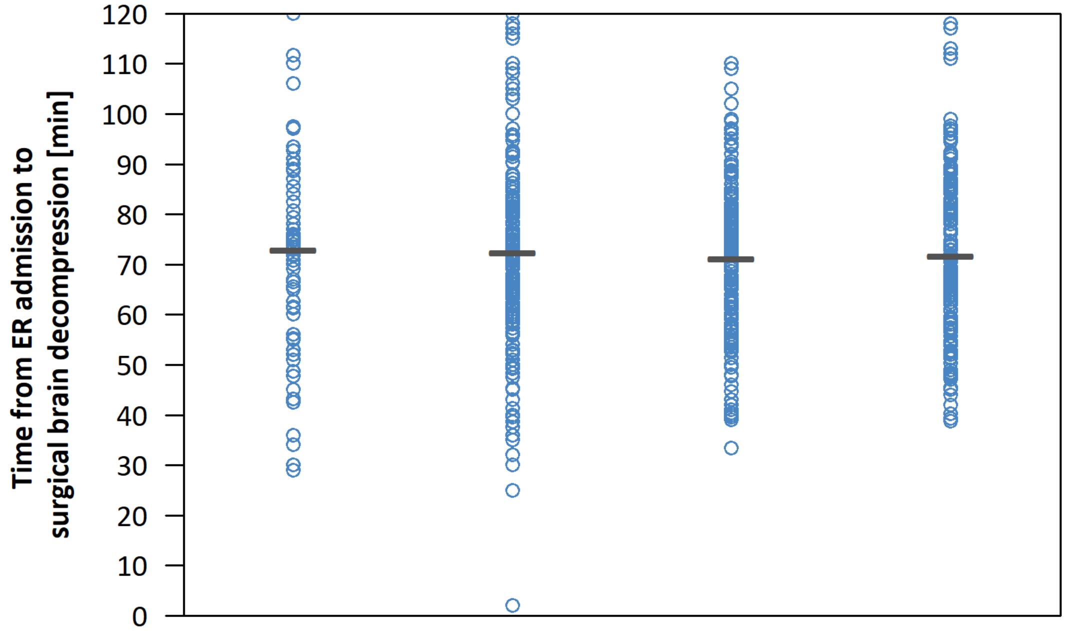


Year:	2015	2016	2017	2018
Your hospital:	52 [min]	52 [min]	50 [min]	49 [min]
n:	352	1,499	1,479	1,356
Min-Max:	3-120 [min]	1-120 [min]	1-120 [min]	1-120 [min]
TR-DGU:	52 [min]	52 [min]	50 [min]	49 [min]
n:	352	1,499	1,479	1,356
Min-Max:	3-120 [min]	1-120 [min]	1-120 [min]	1-120 [min]

Figure 12: Distribution of the mean duration from admission to the ER until start of the transfusion over all hospitals, 2015-2018, ♦ Your hospital, — 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.



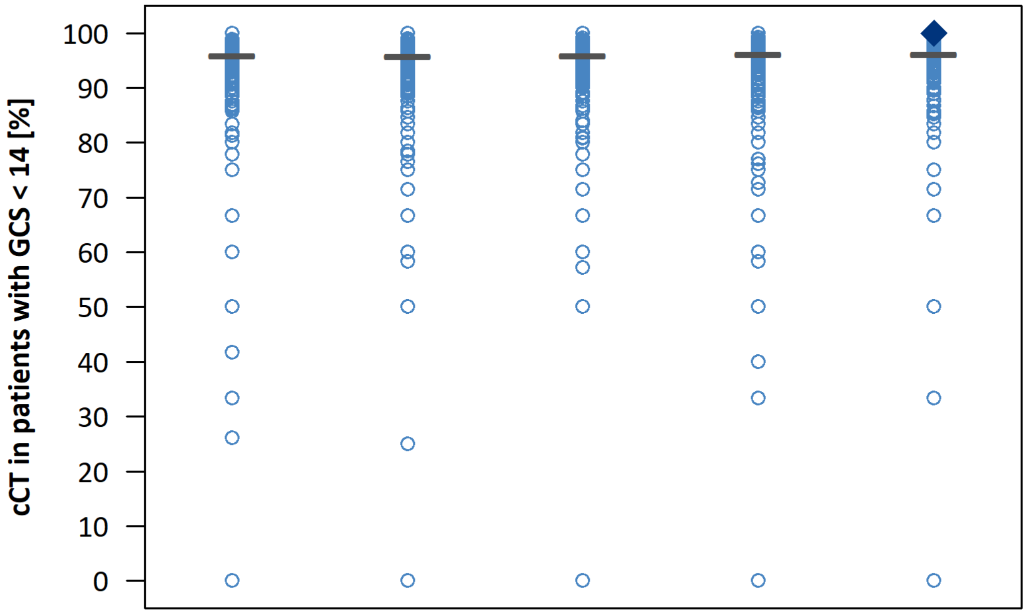
Year:	2015	2016	2017	2018
Your hospital:	73 [min]	72 [min]	71 [min]	72 [min]
n:	192	796	789	702
Min-Max:	20-120 [min]	2-120 [min]	1-120 [min]	15-120 [min]
TR-DGU:	73 [min]	72 [min]	71 [min]	72 [min]
n:	192	796	789	702
Min-Max:	20-120 [min]	2-120 [min]	1-120 [min]	15-120 [min]

Figure 13: Distribution of the mean duration from admission to the ER until surgical brain decompression over all hospitals, 2015-2018, ♦ Your hospital, — 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 for 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 between admission to the ER and cCT / whole-body CT are excluded. A missing value regarding cCT / whole-body CT is considered as „not performed".

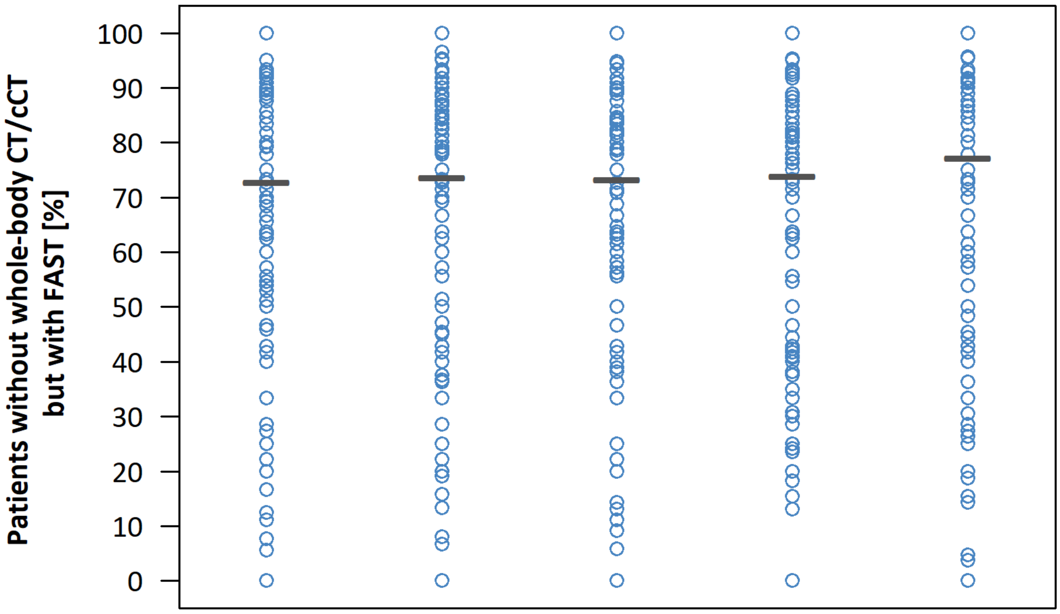


Year:	2014	2015	2016	2017	2018
Your hospital:	96 %	96 %	96 %	96 %	96 %
cCT (n):	8,780	9,338	9,646	9,638	8,574
GCS < 14 (N):	9,159	9,753	10,063	10,020	8,921
TR-DGU:	96 %	96 %	96 %	96 %	96 %
cCT (n):	8,780	9,338	9,646	9,638	8,574
GCS < 14 (N):	9,159	9,753	10,063	10,020	8,921

Figure 14: Distribution of the cCT rate in patients with GCS < 14 over all hospitals, 2014-2018, ♦ Your hospital, — 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 with no documented whole-body CT / cCT are included in this analysis. A missing value regarding the FAST is considered as „not performed".

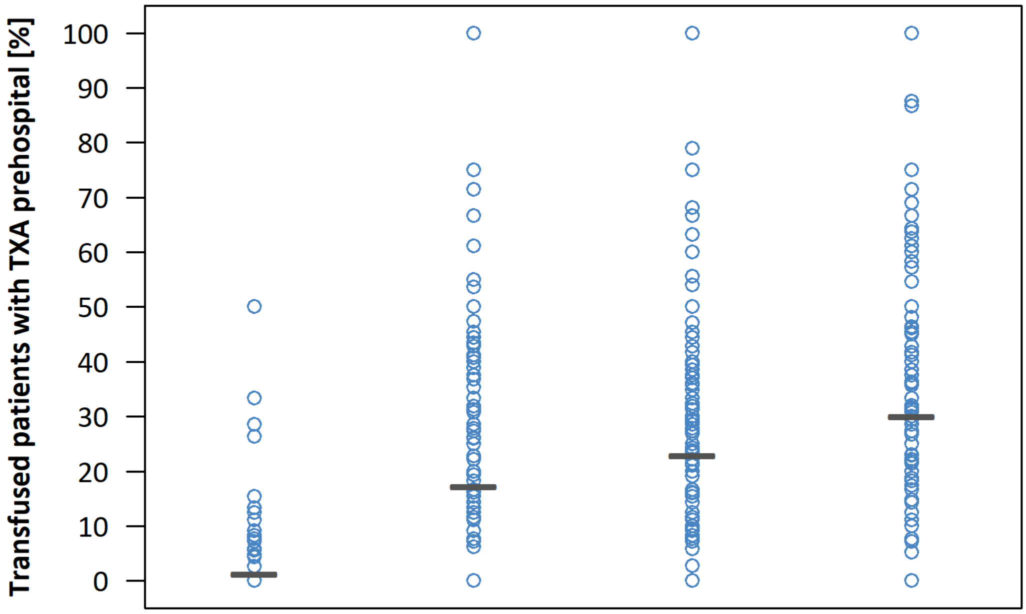


Year:	2014	2015	2016	2017	2018
Your hospital:	73 %	74 %	73 %	74 %	77 %
FAST (n):	2,038	2,119	2,045	2,080	1,947
No WBCT/cCT (N):	2,800	2,875	2,791	2,814	2,522
TR-DGU:	73 %	74 %	73 %	74 %	77 %
FAST (n):	2,038	2,119	2,045	2,080	1,947
No WBCT/cCT (N):	2,800	2,875	2,791	2,814	2,522

Figure 15: Distribution of the sonography rate in patients without whole-body CT / ccT over all hospitals, 2014-2018, ♦ Your hospital, — TR-DGU, o single hospital value

4.3.3 Prehospital tranexamic acid in patients with blood transfusion

Based on a randomized trial, tranexamic acid (TXA) is assumed to reduce the amount or even avoid the blood transfusion or the transfused volume. Therefore, patients who require a blood transfusion should have been given TXA perviously. 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".

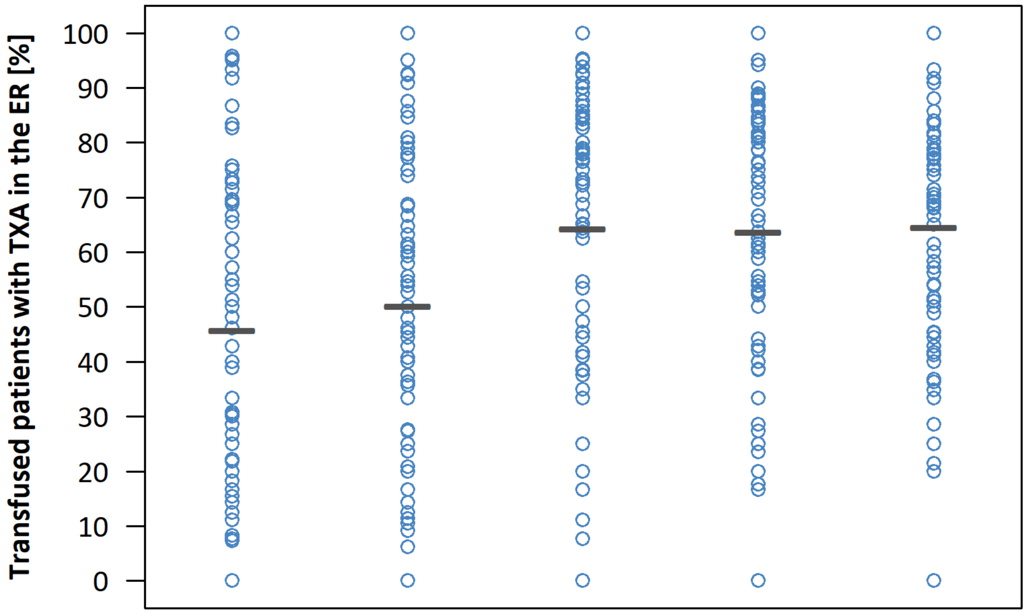


Year:	2015	2016	2017	2018
Your hospital:	1 %	17 %	23 %	30 %
TXA prehosp. (n):	29	381	506	612
Transfused (N):	2,218	2,202	2,214	2,037
TR-DGU:	1 %	17 %	23 %	30 %
TXA prehosp. (n):	29	381	506	612
Transfused (N):	2,218	2,202	2,214	2,037

Figure 16: Distribution of the prehospital tranexamic acid rate in the ER or surgery phase transfused patients over all hospitals, 2015-2018, ♦ Your hospital, — TR-DGU, o single hospital value

4.3.4 Tranexamic acid in the ER in patients with blood transfusion

Actually, tranexamic acid in the ER is recorded only 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:	2014	2015	2016	2017	2018
Your hospital:	46 %	50 %	64 %	64 %	65 %
TXA in ER (n):	552	635	952	994	917
Transfused (N):	1,205	1,266	1,481	1,562	1,420
TR-DGU:	46 %	50 %	64 %	64 %	65 %
TXA in SR (n):	552	635	952	994	917
Transfused (N):	1,205	1,266	1,481	1,562	1,420

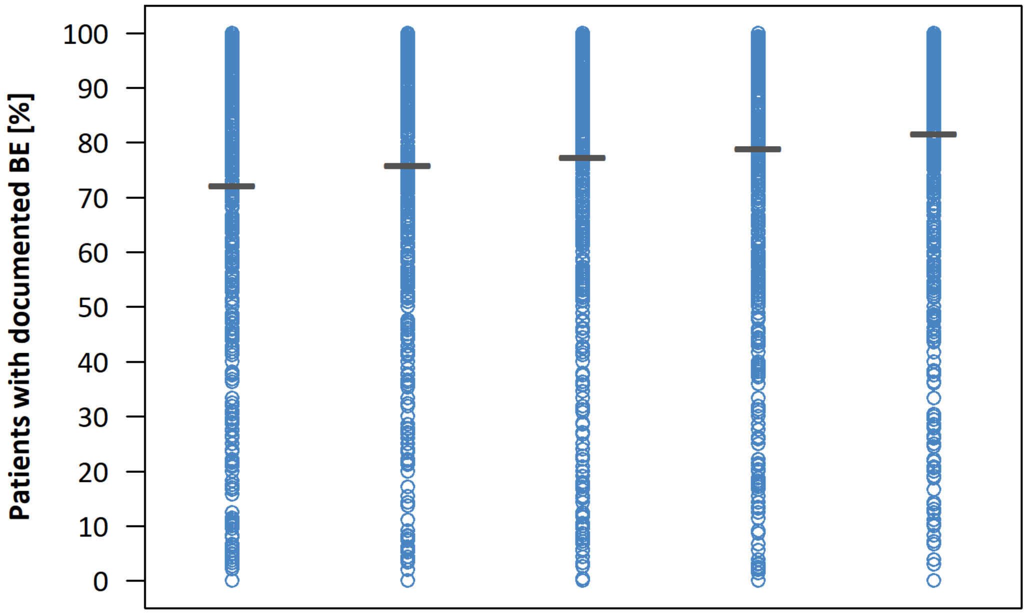
Figure 17: Distribution of the TXA admission rate in the ER in patients transfused between ER and intensive therapy over all hospitals, 2014-2018, ♦ Your hospital, — TR-DGU, o single hospital value

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 amount of valid BE values is calculated. BE values less than -50 mmol/l or greater than 20 mmol/l are excluded.



Year:	2014	2015	2016	2017	2018
Your hospital:	72 %	76 %	77 %	79 %	82 %
Document. BE (n):	20,824	22,859	24,254	25,684	24,406
Patients (N):	28,851	30,152	31,365	32,546	29,894
TR-DGU:	72 %	76 %	77 %	79 %	82 %
Document. BE (n):	20,824	22,859	24,254	25,684	24,406
Patients (N):	28,851	30,152	31,365	32,546	29,894

Figure 18: Distribution of the patient rate with documented base excess (BE) over all hospitals, 2014-2018, ♦ Your hospital, — TR-DGU, o single hospital value

5 Individual cases

5.1 Non-survivors with a low risk of death (< 15% according to RISC II)

Patients from the **basic group** who **died** in hospital although their initial **risk of death prognosis** (based on the RISC II score) seemed to be rather low are listed here. In total, 641 of such cases were observed in the whole registry in 2018. A low risk of death does not mean that none of these patients would die. In fact, it doesn't occur very often. So, a detailed analysis of such cases may lead to relevant quality problems during the acute care of these patients. But this can only be assessed by a more detailed internal hospital individual analysis of these cases.

Your hospital: Among the 35,357 primary admitted cases, **23,254 patients had a risk of death prognosis < 15%. From these cases** 641 patients died. They are listed in the following table.

Table 4: Non-survivors with a low risk of death prognosis (RISC II < 15%)

Patient ID*	RISC II [%]	ISS	Age [years]	Sex	Date of admission	LOS** in the hospital [days]	Patient's volition

5.2 Survivors with a high risk of death (> 70% according to RISC II)

Patients who **survived** although their risk to die was rather high (> 70%) could be indicative for a **very well functioning interdisciplinary approach in acute care**. Overall, 179 such cases were observed in the total registry in 2018. Again, details can only be assessed after individual analysis of each case. Because of the RISC II prognosis, only primary admitted patients are considered here. That means, patients transferred into another hospital within the first two days are disregarded.

Your hospital: Among the 35,357 primary admitted cases, **1,469 patients** had a risk of death prognosis according to RISC II > 70%. The **survivors** among these patients (**n = 179**) are listed below.

Table 5: Survivors with a high risk of death prognosis (RISC II > 70%)

Patient ID*	RISC II [%]	ISS	Age [years]	Sex	Date of admission	LOS** in the hospital [days]

* The ID corresponds to your individual patient code as recorded in the data base
** LOS = length of stay

5.3 Non-survivors with minor injuries (MAIS 1)

In 2018 there were 5,305 patients with the most severe injury of AIS severity grade = 1 (MAIS 1). These patients are **excluded** from the **basic group**. Although such patients usually survive, we observed 33 deaths in this subgroup (0.6%). These cases should be subject of a detailed internal revision, including the correctness and completeness of injury coding.

Your hospital: **5,305 patients** had a max. AIS = 1; **33 of them died**.

Table 6: Non-survivors with minor injuries

Patient ID*	ISS	Age [years]	Sex	Date of admission	LOS in the hospital [days]	Patient's volition

* The ID corresponds to your individual patient code as recorded in the data base
** LOS = length of stay

6 Comparisons of the hospitals in the TraumaNetzwerk DGU®

In chapter 6, your hospital is compared graphically and tabularly to the other hospitals in the TraumaNetzwerk DGU® that are corresponding to your trauma level. There are **three trauma levels** (local, regional, supra-regional) for which a hospital can be certified as a trauma centre according to the requirements of the Whitebook Medical Care of the Severly Injured. Hospitals that are not certified are not considered in the data.

6.1 Documented patients of your hospital in the last 10 years

Figure 19 presents the number of documented trauma patients in the last ten years. Only cases from the **basic group** are considered here (see page 5 for definition). From your hospital **268,105 patients** were documented in the last 10 years, among them **32,580 patients from 2018**.

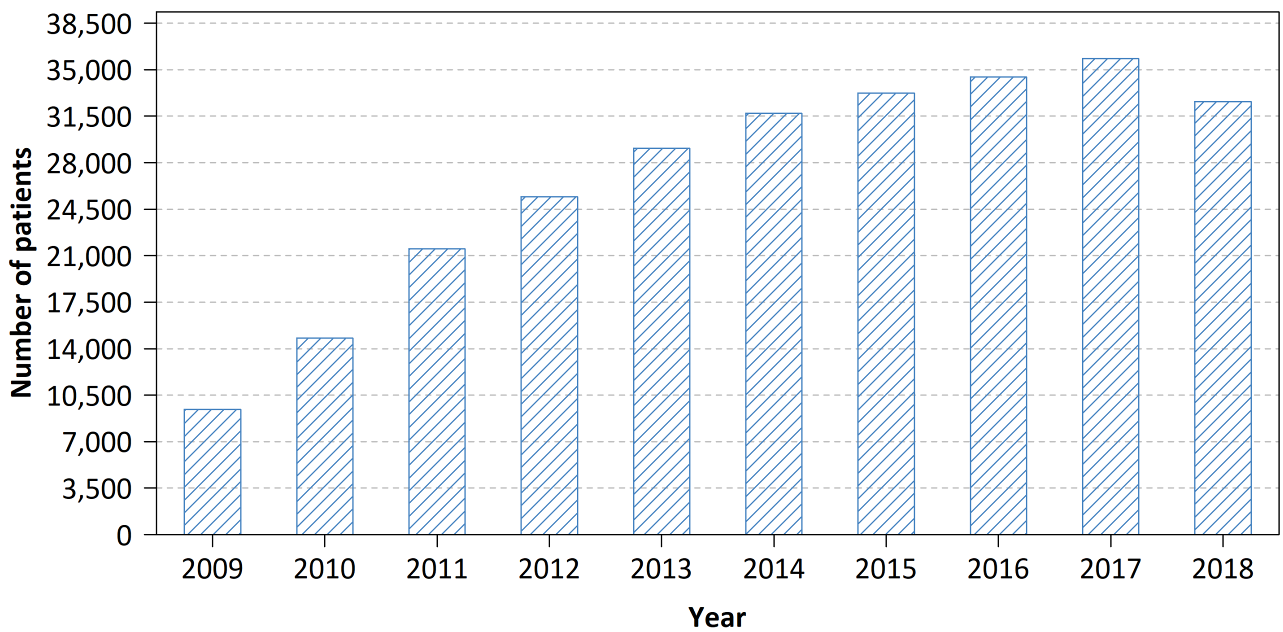


Figure 19: Documented number of patients of your hospital in the TR-DGU basic group from 2009-2018 (bars) compared to the median annual number of cases per trauma level (curves). Colour of the bars = acutal trauma level of your hospital (no trauma centre)

6.2 Number of patients within the trauma level

In 2018, your hospital documented **32,580 patients** in the basic group. The value of your hospital within your trauma level is marked with a **blue diamond and line**. The values in figure 21 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.

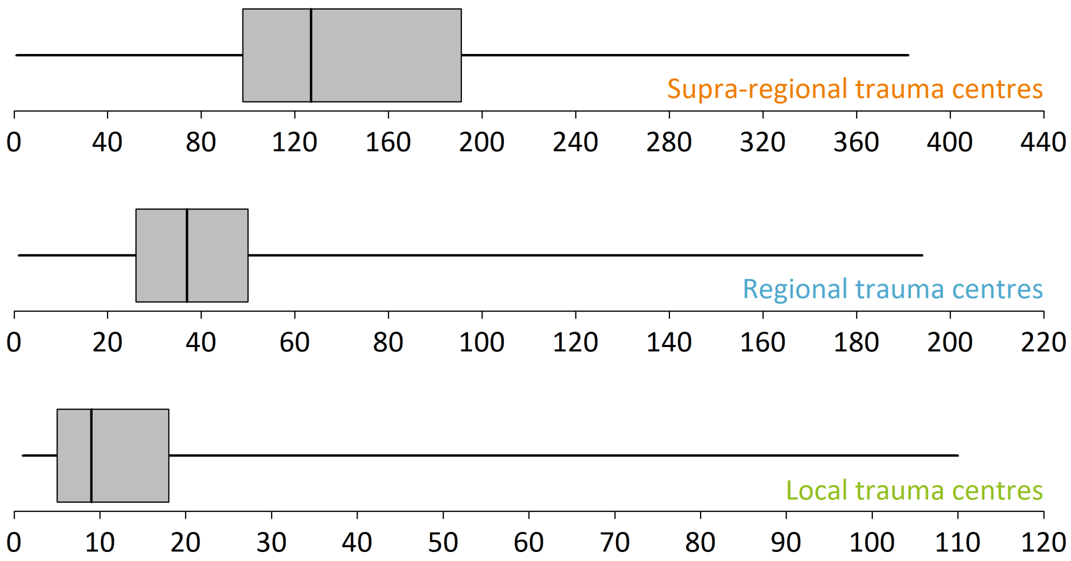


Figure 20: Median number of cases of the in the TR-DGU participating trauma centres separated by the trauma level in 2018. Your hospital is no certified trauma centre und here not shown

6.3 Comparison of the basic data between the trauma level

Table 7 allows a comparison of your hospital with hospitals of the same trauma level in the TraumaNetzwerk DGU®. The column with comparative data for your hospital **(TR-DGU)** is marked with a blue cross. 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 7: Basic data from your hospital in comparison to the total data from the TR-DGU trauma level over the past three years

		Your hospital	**Trauma centre DGU**			
Characteristics			**local**	**regional**	**supra-regional**	**TR-DGU**
Trauma level						†
Number of hospitals			285	217	120	622
Amount of patients in the TR-DGU			11%	30%	59%	100%
Patients per year (mean)	n	**50** / year	**12** / year	**44** / year	**152** / year	**50** / year
Patients (3 years, cumulated)	n	93,354	10,188	28,405	54,761	93,354
Primary admitted and treated	n (%)	79,181 (85%)	7,827 (77%)	23,984 (84%)	47,370 (86%)	79,181 (85%)
Primary admitted and early (< 48 h) transferred out	n (%)	6,501 (7%)	2,202 (22%)	3,525 (12%)	774 (1%)	6,501 (7%)
Transferred in from another hospital	n (%)	7,672 (8%)	159 (2%)	896 (3%)	6,617 (12%)	7,672 (8%)

Table 7 continuation:

Characteristics		Your hospital	Trauma centre local	Trauma centre regional	Trauma centre supra-regional	TR-DGU
Level of trauma care						†
Patients						
Average age [years]	M	52.2	54.9	53.6	50.9	52.2
Patients aged 70 years and older	%	27%	31%	29%	25%	27%
Males	%	70%	68%	68%	71%	70%
ASA 3-4	%	18%	19%	21%	17%	18%
Injuries						
Injury Severity Score (ISS) [points]	M	18.1	13.9	16.5	19.8	18.1
Ratio with ISS ≥ 16	%	53%	36%	48%	59%	53%
Ratio of polytrauma *	%	14%	7%	11%	18%	14%
Patients with TBI, AIS ≥ 3	%	36%	20%	29%	42%	36%
Patients with thoracic injury, AIS ≥ 3	%	37%	34%	36%	38%	37%
Patients with abdominal injury, AIS ≥ 3	%	10%	8%	9%	10%	10%
Prehospital care (primary admissions only)						
Rescue time (accident to hospital) [min]	M	63.1	55.7	59.2	67.3	63.1
Prehospital volume administration [ml]	M	646	493	589	712	646
Prehospital intubation	%	21%	4%	11%	29%	21%
Unconsciousness (GCS ≤ 8)	%	15%	5%	9%	20%	15%
Emergency room (primary admissions only)						
Blood transfusion	%	7%	3%	4%	9%	7%
Whole-body CT	%	79%	66%	75%	84%	79%
Cardio-pulmonary resuscitation	%	3%	2%	2%	3%	3%
Shock / hypotension	%	7%	4%	5%	9%	7%
Coagulopathy	%	10%	8%	9%	12%	10%
Length of stay (without early transfers out)						
Length of intubation on the intensiv care unit [days]	M	2.5	0.4	1.4	3.3	2.5
Length of stay on the intensiv care unit [days]	M	5.7	2.7	4.3	6.8	5.7
Length of stay in the hospital [days]	M	15.3	10.8	13.3	16.9	15.3
Outcome and prognosis (without transfers in and early transfers out)						
Patients	n	79,181	7,827	23,984	47,370	79,181
Non-survivors	n	8,616	417	2,099	6,100	8,616
Hospital mortality	%	10.9%	5.3%	8.8%	12.9%	10.9%
RISC II prognosis	%	10.1%	5.2%	7.9%	12%	10.1%

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

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

6.4 State of transfer within the trauma levels

The percentage distribution of 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 2018. As expected, the rate of patients that are transferred out from a local trauma centre as well as the rate of patients that are transferred in a supra-regional trauma centre is the highest.

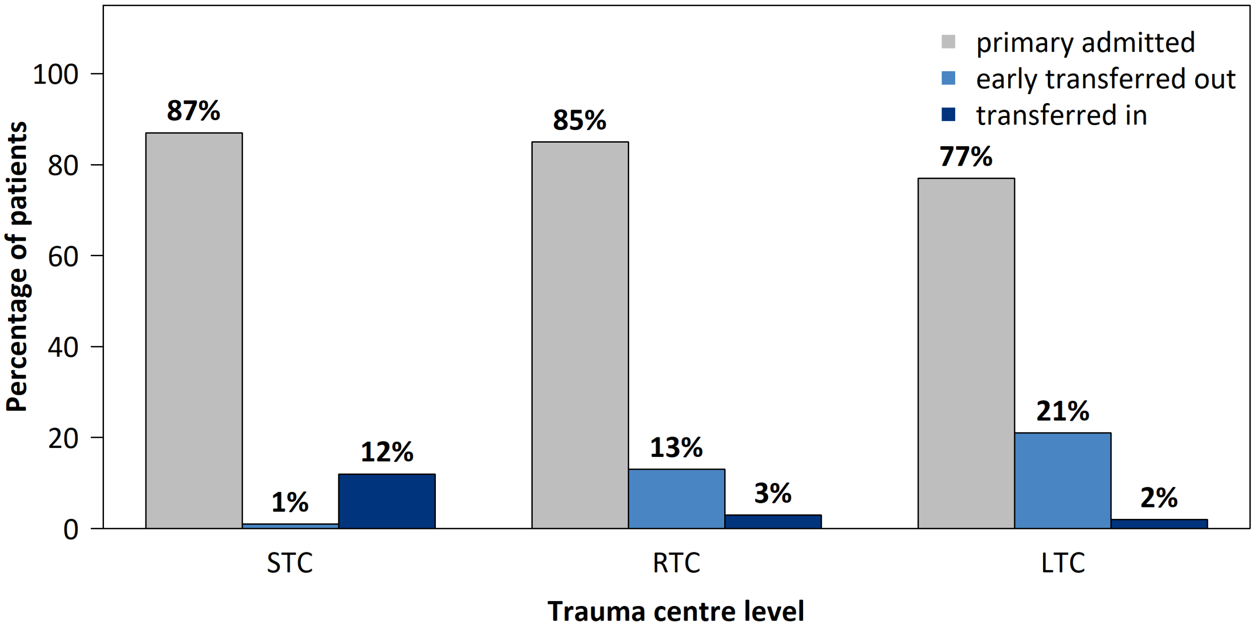


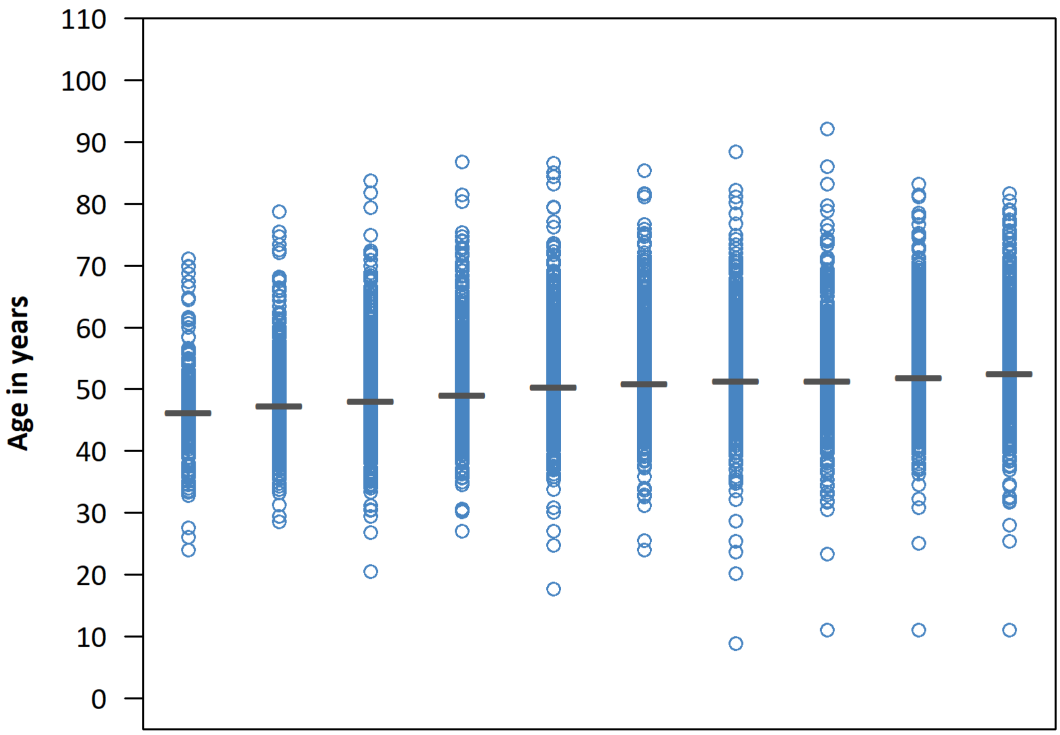
Figure 21: Transfer status classified according to the trauma level in 2018

7 Graphical comparisons with other hospitals

Below, selected information about your patients from the years **2009-2018** is compared with the respective data from all other hospitals in the TraumaRegister DGU®. 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. Your hospital's value is indicated as a **dark blue diamond**, whereas the other hospitals from the TR-DGU are indicated as light blue circles. The horizontal grey line is the mean value over all hospitals per year.

7.1 Distribution of age in the past 10 years

The lower figure shows the distribution of mean age of the patients from your hospital and other hospitals in the TR-DGU over the past ten years **with at least 3 patients**).

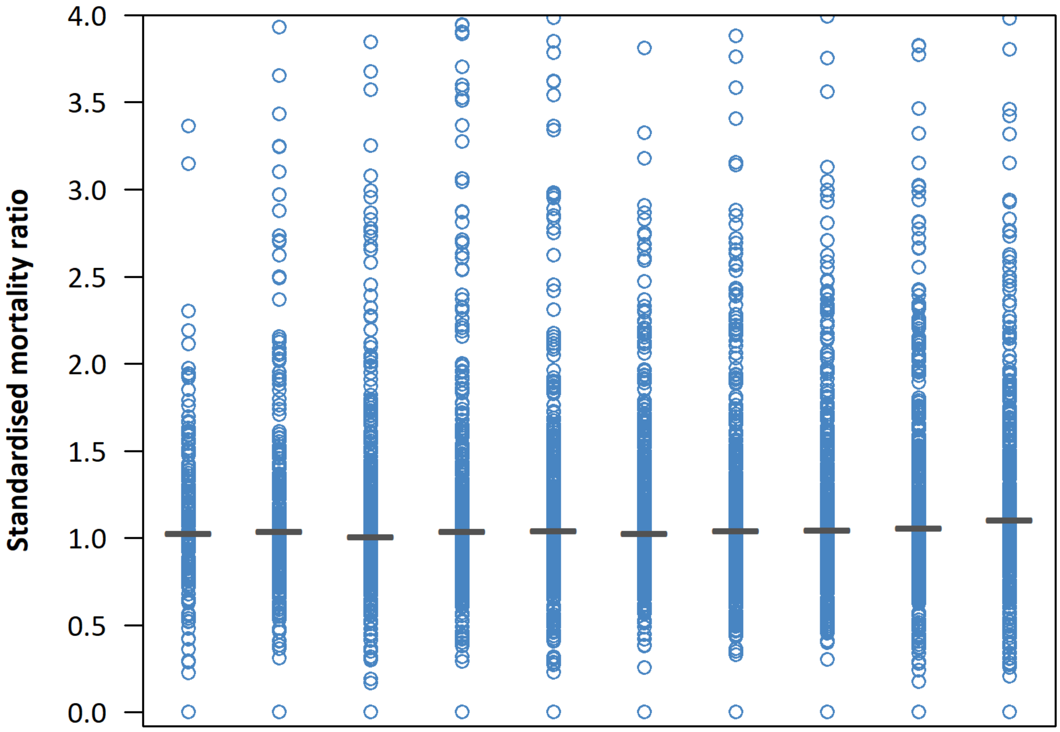


Year:	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Your hospital:	46.2	47.4	48.1	49.1	50.4	50.9	51.4	51.4	51.8	52.5
TR-DGU:	46.2	47.4	48.1	49.1	50.4	50.9	51.4	51.4	51.8	52.5

Figure 22: Mean patient's age in ♦ your hospital and in the — TR-DGU compared to the o single hospital values in the TR-DGU for the years 2009-2018

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

Only primary admitted patients are displayed here per year (with at least 3 cases). Early transfers out (< 48 h) are excluded. The standardised mortality ratio is shown for each hospital 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 as expected. A SMR value < 1 indicates that the observed mortality is lower as expected.



Year:	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Your hospital:	1.03	1.04	1.01	1.04	1.04	1.03	1.04	1.05	1.06	1.11
TR-DGU:	1.03	1.04	1.01	1.04	1.04	1.03	1.04	1.05	1.06	1.11

Figure 23: Standardised mortality ratio of ♦ your hospital and of the — TR-DGU compared to the o single hospital values in the TR-DGU for the years 2009-2018

Figure 23 shows a slight increase in SMR compared to previous years. Regarding Figure 3 (page 9), the number of hospitals exceeding the 95% confidence interval has not increased to such an extent that one can assume an overall poorer quality of results. Overall, the increase is small but needs further analysis considering the large total number of cases. One possible explanation for the increase is that the average age of patients has continued to rise in the recent years. Also, the proportion of deceased patients with a patient's volition has increased slightly over the years (see table 8). A first analysis of this trend shows that the SMR for the whole registry would be below 1.00 if one excluded deaths in which a patient's volition was documented. However, hospitals above the 95% confidence interval should critically review their single case analyses (Chapter 5) and procedures.

Table 8: Number of hospitals that have according to figure 3 more deaths than expected and the number of patients with a documented patient's volition and proportion within the deceased for the years 2015-2018

Year	2015	2016	2017	2018
Number of hospitals above the 95% confidence curve in fig. 3 (more deaths than expected)	8	14	15	23
Number of patients with a *patient's volition*	287	1,182	1,327	1,378
Percentage of deceased with a *patient's volition*	38%	39%	40%	43%

7.3 Length of stay and injury severity

The length of stay of the patients is very 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= 5,225) are excluded here. Hospitals with **less than 3 patients** are **not** displayed in the figure due to their statistical uncertainty.

Your hospital 2018:

Your value is based on:
23,871 patients

Mean length of stay:
16.3 days

Mean ISS: **16.1 points**

TR-DGU 2018:

Patients: 23,871

Mean length of stay:
16.3 days

Mean ISS: 16.1 points

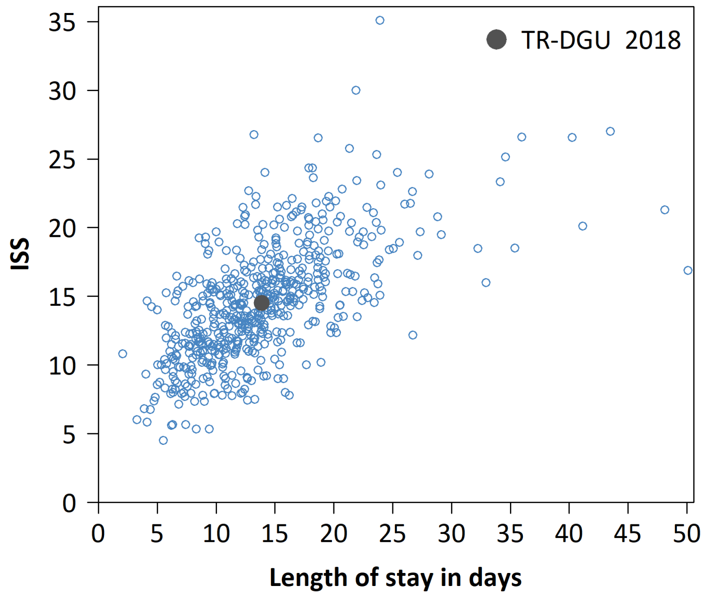


Figure 24: Relationship between length of stay and injury severity over all hospitals in 2018

7.4 Length of stay of the deceased patients

The following figure shows the distribution of length of stay of your deceased patients (N = 3,481) within the first 30 days (n = 3,333) in comparison to the TR-DGU in 2018.

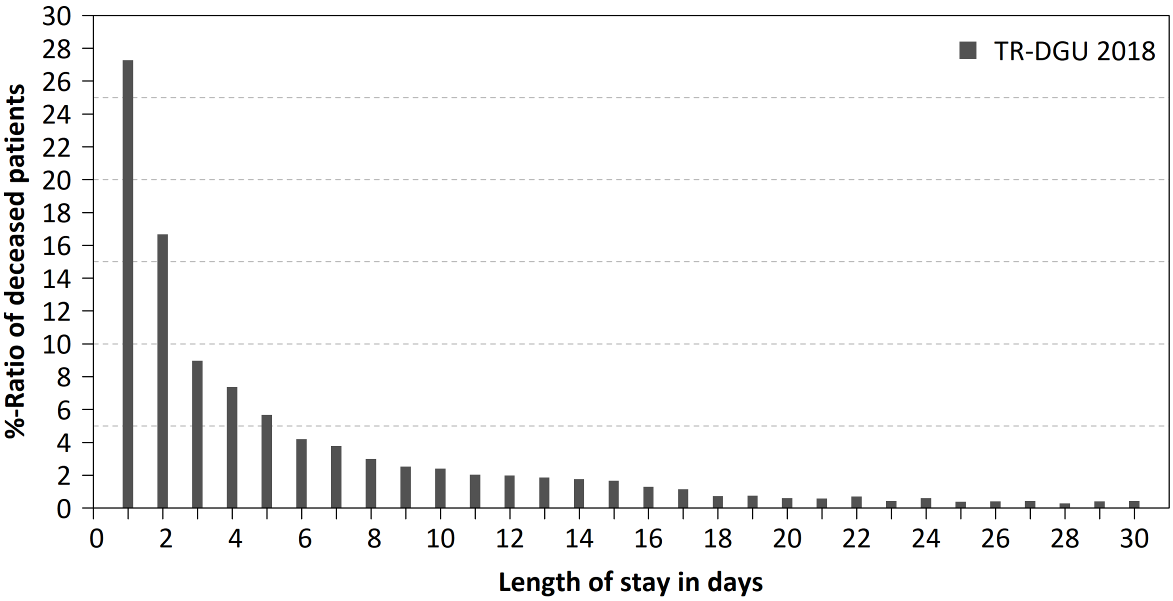


Figure 25: Time point of death of the patients from your hospital [length of stay in days] compared to the TR-DGU in 2018

8 Basic data of trauma care

The following pages present basic data from the trauma care of the actual year 2018. Your hospital data refer to patients from the **basic group** (see page 5). Comparison groups are respectively data from the TraumaRegister DGU® basic group of the same year (**TR-DGU 2018**) and of the last 10 years 2009-2018 (**TR-DGU 10 years**).

Table 9: Data from your hospital and the TR-DGU on the patients and accident type

(S) Patient and accident	Your hospital 2018		TR-DGU 2018		TR-DGU 10 years	
Patients of the **basic group** (n)	32,580		32,580		268,105	
Primary admissions / transfers	%	n	%	n	%	n
Primary admitted	**91.8%**	29,894	**91.8%**	29,894	**90.6%**	242,793
Among these transferred out within 48 h	**7%**	2,265	**7%**	2,265	**6.5%**	17,411
Transferred in within 24 h after accident	**7.5%**	2,439	**7.5%**	2,439	**8.5%**	22,706
Transferred in after 24 h	**0.8%**	247	**0.8%**	247	**1%**	2,606
Patient characteristics	**M** ± SD*/%	n	**M** ± SD*/%	n	**M** ± SD*/%	n
Age [years]	**52.5** ± 22.7	32,580	**52.5** ± 22.7	32,580	**50.5** ± 22.6	268,105
Children under 16 years	**4%**	1,313	**4%**	1,313	**4.3%**	11,401
Elderly over 70 years	**27.1%**	8,832	**27.1%**	8,832	**24.8%**	66,541
Males	**70.2%**	22,875	**70.2%**	22,875	**70.2%**	187,833
ASA 3-4 prior to trauma (since 2009)	**18.2%**	5,490	**18.2%**	5,490	**16.5%**	38,609
Mechanism of injury	%	n	%	n	%	n
Blunt	**96.2%**	29,939	**96.2%**	29,939	**95.9%**	243,962
Penetrating	**3.8%**	1,197	**3.8%**	1,197	**4.1%**	10,551
Type and cause of accident	%	n	%	n	%	n
Traffic: Car	**19.6%**	6,340	**19.6%**	6,340	**21.1%**	55,318
Traffic: Motor bike	**12.4%**	3,995	**12.4%**	3,995	**12.4%**	32,573
Traffic: Bicycle	**10.1%**	3,262	**10.1%**	3,262	**9.1%**	23,814
Traffic: Pedestrian	**5.3%**	1,721	**5.3%**	1,721	**6.3%**	16,630
High fall (> 3m)	**15.2%**	4,898	**15.2%**	4,898	**15.7%**	41,074
Low fall (≤ 3m)	**26.3%**	8,488	**26.3%**	8,488	**24%**	62,855
Suicide (suspected)	**4.3%**	1,373	**4.3%**	1,373	**4.5%**	11,657
Assault (suspected)	**2.5%**	813	**2.5%**	813	**2.5%**	6,509

* M = Mean; SD = Standard deviation

Table 10: Data from your hospital and the TR-DGU on findings at the accident scene. Information for primary admitted patients

Time point A: Findings at the accident scene	Your hospital 2018		TR-DGU 2018		TR-DGU 10 years	
Primary admitted patients (n) (%-ratio of the basic group)	29,894 (92%)		29,894 (92%)		242,793 (91%)	
Vital signs	**M** ± SD*	n	**M** ± SD*	n	**M** ± SD*	n
Systolic blood pressure [mmHg]	**134.1** ± 32.7	26,102	**134.1** ± 32.7	26,102	**131.2** ± 33.4	211,361
Respiratory rate [1/min]	**15.9** ± 5.5	19,446	**15.9** ± 5.5	19,446	**15.7** ± 5.9	149,300
Glasgow Coma Scale (GCS) [points]	**12.7** ± 3.9	27,876	**12.7** ± 3.9	27,876	**12.4** ± 4	225,080
Findings	%	n	%	n	%	n
Shock (systolic blood pressure ≤ 90 mmHg)	**8.3%**	2,171	**8.3%**	2,171	**9.9%**	21,023
Unconsciousness (GCS ≤ 8)	**15.8%**	4,407	**15.8%**	4,407	**17.9%**	40,230
Therapy	%	n	%	n	%	n
Cardio-pulmonary resuscitation	**2.9%**	829	**2.9%**	829	**3%**	6,964
Endotracheal intubation	**20.2%**	5,835	**20.2%**	5,835	**24.3%**	57,078
Alternative airway	**1.2%**	349	**1.2%**	349	**0.7%**	1,598
Analgo-sedation **	**61.5%**	8,769	**61.5%**	8,769	**62.1%**	73,802
Chest drain **	**3.2%**	453	**3.2%**	453	**3.1%**	3,682
Catecholamines **	**8.8%**	1,257	**8.8%**	1,257	**8.1%**	9,585
Pelvic binder **	**12.5%**	1,787	**12.5%**	1,787	**3.8%**	4,520
Tranexamic acid	**9.3%**	2,694	**9.3%**	2,694	**2.7%**	6,405
Volume administration	**M** ± SD*/%	n	**M** ± SD*/%	n	**M** ± SD*/%	n
Patients without volume administration	**17.3%**	4,858	**17.3%**	4,858	**16.2%**	36,708
with volume administration	**82.7%**	23,209	**82.7%**	23,209	**83.8%**	189,953
with colloids	**3%**	807	**3%**	807	**9.6%**	20,901
Average amount in patients with volume administration [ml]	**633** ± 533	28,067	**633** ± 533	28,067	**700** ± 593	226,661
Average amount in patients with and without volume administration [ml]	Median **500**		Median **500**		Median **500**	

* M = Mean; SD = Standard deviation

** Not available in the reduced QM dataset

Table 11: Data from your hospital and the TR-DGU on emergency room and surgery. Information for primary admitted patients

Time point B: Emergency room / surgery	Your hospital 2018		TR-DGU 2018		TR-DGU 10 years	
Primary admitted patients (n) (%-ratio of the basic group)	29,894 (92%)		29,894 (92%)		242,793 (91%)	
Transportation to the hospital	%	n	%	n	%	n
With helicopter	**18.6%**	5,556	**18.6%**	5,556	**19.8%**	48,005
Glasgow Coma Scale (GCS)	**MW** ± SA*	n	**MW** ± SA*	n	**MW** ± SA*	n
Prehospital intubated patients	**3.3** ± 1.6	3,510	**3.3** ± 1.6	3,510	**3.2** ± 1.3	32,865
Patients not prehospital intubated	**13.9** ± 2.4	10,071	**13.9** ± 2.4	10,071	**13.8** ± 2.5	78,459
Initial diagnostics	%	n	%	n	%	n
Sonography of the abdomen	**83.5%**	24,815	**83.5%**	24,815	**81.5%**	195,539
X-ray of the thorax	**26.7%**	7,939	**26.7%**	7,939	**37.4%**	89,792
cCT (isolated or whole-body)	**90.9%**	27,186	**90.9%**	27,186	**89.1%**	216,384
Whole-body CT	**79.5%**	23,615	**79.5%**	23,615	**76.7%**	183,843
Time period in the emergency room	**M** ± SD*/%	n	**M** ± SD*/%	n	**M** ± SD*/%	n
Transfer to the operating theatre	**23.5%**	6,733	**23.5%**	6,733	**24%**	23,097
If so: Duration from admission to the ER* until surgery [min]	**76.9** ± 62.1	6,210	**76.9** ± 62.1	6,210	**75.7** ± 61.1	20,530
Transfer to intensive care unit	**64.2%**	18,362	**64.2%**	18,362	**64.1%**	61,748
If so: Duration from admission to the ER* until ICU* [min]	**85.1** ± 73.5	16,362	**85.1** ± 73.5	16,362	**84.7** ± 73.8	52,404
Bleeding and transfusion	**M** ± SD*/%	n	**M** ± SD*/%	n	**M** ± SD*/%	n
Pre-existing coagulopathy	**20.1%**	4,835	**20.1%**	4,835	**19.3%**	15,206
Systolic blood pressure ≤ 90 mmHg	**7.2%**	2,054	**7.2%**	2,054	**8.4%**	18,737
Hemostasis therapy**	**20.4%**	2,739	**20.4%**	2,739	**15.9%**	17,023
Administration of tranexamic acid**	**16.5%**	2,221	**16.5%**	2,221	**15.5%**	7,139
ROTEM / thrombelastography**	**9.8%**	1,176	**9.8%**	1,176	**10.3%**	8,687
Patients with blood transfusion	**6.9%**	2,068	**6.9%**	2,068	**8.5%**	20,711
Number of pRBC, if transfused	**4.9** ± 5.6	2,068	**4.9** ± 5.6	2,068	**5.6** ± 6.8	20,711
Number of FFP, if transfused	**3.1** ± 6.1	2,068	**3.1** ± 6.1	2,068	**3.5** ± 6.1	20,711
Treatment in the ER	%	n	%	n	%	n
Cardio-pulmonary resuscitation **	**2.5%**	357	**2.5%**	357	**2.7%**	3,194
Chest drain**	**10.4%**	1,476	**10.4%**	1,476	**11.3%**	13,235
Endotracheal intubation**	**13.6%**	1,912	**13.6%**	1,912	**16.7%**	19,254
Initial laboratory values	**M** * ± SD	n	**M** * ± SD	n	**M** * ± SD	n
Base excess [mmol/l]	**-1.5** ± 4.6	24,425	**-1.5** ± 4.6	24,425	**-1.8** ± 4.7	174,143
Hemoglobine [g/dl]	**13.2** ± 2.2	29,267	**13.2** ± 2.2	29,267	**13.1** ± 2.3	230,544
INR	**1.2** ± 0.5	28,270	**1.2** ± 0.5	28,270	**1.2** ± 0.6	221,043
Quick's value [%]	**88.5** ± 21.3	27,303	**88.5** ± 21.3	27,303	**86.6** ± 21.6	216,046
Temperature [C°]**	**36.3** ± 1.1	8,637	**36.3** ± 1.1	8,637	**36.2** ± 1.2	62,967

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

Table 12: Data from your hospital and the TR-DGU on intensive care unit

Time point C: Intensive care unit	Your hospital 2018		TR-DGU 2018		TR-DGU 10 years	
Patients with **intensive care therapy** (n) (%-ratio of the basic group)	28,267 (87%)		28,267 (87%)		233,655 (87%)	
Treatment	%	n	%	n	%	n
Hemostasis therapy **	**13.9%**	1,951	**13.9%**	1,951	**15.3%**	17,610
Dialysis / hemofiltration **	**2.1%**	291	**2.1%**	291	**2.4%**	2,719
Blood transfusion ** (within the first 48 h after admission to ICU)	**23.7%**	2,710	**23.7%**	2,710	**28.4%**	27,611
Mechanical ventilation / intubated	**35.7%**	10,085	**35.7%**	10,085	**41.6%**	97,305
Complications on ICU	%	n	%	n	%	n
Organ failure **	**32.9%**	4,615	**32.9%**	4,615	**35.4%**	41,744
Multiple organ failure (MOF) **	**19%**	2,642	**19%**	2,642	**21%**	24,656
Sepsis **	**6%**	13,901	**6%**	13,901	**6%**	115,270
Length of stay and ventilation	M ± SD*	n	M ± SD*	n	M ± SD*	n
Length of intubation [days]	**2.6** ± 7.1	28,181	**2.6** ± 7.1	28,181	**3.1** ± 7.8	232,523
	Median **0**		Median **0**		Median **0**	
Length of stay on ICU* [days]	**6.2** ± 10.1	28,267	**6.2** ± 10.1	28,267	**6.8** ± 10.5	233,654
	Median **2**		Median **2**		Median **3**	

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

Table 13: Data from your hospital and the TR-DGU on discharge and outcome

Time point D: Discharge / outcome	Your hospital 2018		TR-DGU 2018		TR-DGU 10 years	
Patients from the basic group	32,580		32,580		268,105	
Diagnoses	M ± SD*/%	n	M ± SD*/%	n	M ± SD*/%	n
Number of injuries / diagnoses per patient	**4.5** ± 3		**4.5** ± 3		**4.5** ± 2.9	
Patients with only **one** injury	**10%**	3,258	**10%**	3,258	**9.8%**	26,322
Surgeries	M ± SD*/ %	n	M ± SD*/ %	n	M ± SD*/ %	n
Patients with surgery	**65.4%**	10,993	**65.4%**	10,993	**67.4%**	91,330
Number of surgeries per patient, if undergone surgery**	**3.4** ± 4		**3.4** ± 4		**3.5** ± 4.1	
Thrombo-embolic events (MI; pulmonary embolism; DVT; stroke; etc.)	%	n	%	n	%	n
Patients with at least one event **	**2.7%**	410	**2.7%**	410	**2.8%**	3,502

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

Table 13 continuation:

Time point D: Discharge / outcome	**Your hospital 2018**		**TR-DGU 2018**		**TR-DGU 10 years**	
Patients from the basic group	32,580		32,580		268,105	
Outcome (without early transfers out)	%	n	%	n	%	n
Survivors	**88.5%**	26,834	**88.5%**	26,834	**88.5%**	221,980
Hospital mortality	**11.5%**	3,481	**11.5%**	3,481	**11.5%**	28,714
Died within 30 days	**11%**	3,333	**11%**	3,333	**11%**	27,518
Died within 24 hours	**4.1%**	1,241	**4.1%**	1,241	**4.6%**	11,596
Died in the ER (without ICU)	**1.4%**	433	**1.4%**	433	**1.6%**	4,102
Transfer / discharge (all survivors)	%	n	%	n	%	n
Survivors who were discharged and ...	**100%**	29,099	**100%**	29,099	**100%**	239,388
transferred into another hospital	**18%**	5,225	**18%**	5,225	**17.4%**	41,669
... among them early discharges (< 48 h)	**7.8%**	2,265	**7.8%**	2,265	**7.3%**	17,411
transferred into a rehabilitation center	**15.1%**	4,387	**15.1%**	4,387	**19.4%**	46,385
other destination	**3.6%**	1,055	**3.6%**	1,055	**3.6%**	8,512
sent home	**63.3%**	18,432	**63.3%**	18,432	**59.7%**	142,822
Condition at the time of discharge (according to the parameter „outcome"; without early transfers out)	%	n	%	n	%	n
Patients with a valid value		30,104		30,104		242,441
of these surviving patients	**100%**	26,623	**100%**	26,623	**100%**	213,727
- good recovery	**65.2%**	17,366	**65.2%**	17,366	**65.6%**	140,108
- moderate disability	**24.8%**	6,591	**24.8%**	6,591	**24.4%**	52,158
- severe disability	**8.8%**	2,334	**8.8%**	2,334	**8.6%**	18,286
- persistant vegetative state	**1.2%**	332	**1.2%**	332	**1.5%**	3,175
Length of stay in hospital [days] (all patients from the basic group)	M ± SD*	n	M ± SD*	n	M ± SD*	n
All patients	**14.3** ± 16.2	32,576	**14.3** ± 16.2	32,576	**15.8** ± 17.9	268,058
Median	Median **10**		Median **10**		Median 11	
Only survivors	**15.1** ± 16.3	29,095	**15.1** ± 16.3	29,095	**16.8** ± 18.2	239,348
Median survivors	**11**		11		**12**	
Only non-survivors	**7.8** ± 13.2	3,481	**7.8** ± 13.2	3,481	**7.3** ± 12.3	28,710
Median non-survivors	3		3		3	
LOS when transferred to a rehabilitation centre	**28.1** ± 21.2	4,387	**28.1** ± 21.2	4,387	**29.5** ± 22.2	46,379
when transferred to another hospital	**9.9** ± 14.4	5,224	**9.9** ± 14.4	5,224	**10.4** ± 14.9	41,664
when sent home	**13.2** ± 13.3	18,429	**13.2** ± 13.3	18,429	**14.3** ± 15.1	142,793
Costs of treatment *** (without early transfers out)	**€**	n	**€**	n	**€**	n
Average costs in € per patient						
... all patients	**13,822**	30,232	**13,822**	30,232	**15,329**	249,637
... only non-survivors	**11,198**	3,462	**11,198**	3,462	**11,110**	28,530
... only survivors	**14,161**	26,770	**14,161**	26,770	**15,874**	221,107
... only patients with ISS ≥ 16	**18,333**	16,153	**18,333**	16,153	**20,052**	138,088
Sum of all costs	417,859,956 €		417,859,956 €		3,826,797,293 €	
Sum of all days in hospital	463,169 days		463,169 days		4,189,172 days	
Average costs per day per patient	902.2 €		902.2 €		913.5 €	

* 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, 2017). Assuming a cost increase of 2% per year the costs today would be 23% higher.

9 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 (2016-2018) are pooled together. Again, only patients from the **basic group** are considered here.

9.1 Subgroups within your hospital

All results in table 14 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 is a total of **86,919 patients** from your hospital in the last three years.

Table 14: Basic data from your hospital on selected subgroups. The percentage frequency refers to the number of patients from the respective subgroup in the basic group

		Primary patients 2016-2018	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	79,181	43,659	32,362	10,898	6,227	26,332	22,442
	%	100%	50.2%	37.2%	12.5%	7.2%	30.3%	25.8%
Patients								
Age [years]	M	51.7	48.7	52.6	60.5	51.6	60.6	80.1
Males	%	70.1%	71.8%	69.3%	65.2%	68.9%	66.1%	55.8%
ASA 3-4	%	17.2%	13.3%	18%	31.1%	21%	28.8%	46.4%
Injuries								
ISS [points]	M	18	14.4	22.8	18.2	30.1	28.6	18.9
Head injury (AIS ≥ 3)	%	33.7%		56.8%	100%	46%	64.3%	46.5%
Thoracic injury (AIS ≥ 3)	%	38.2%	44.5%	42.6%		56.4%	51.3%	35.4%
Abdominal injury (AIS ≥ 3)	%	9.6%	13.5%	7.6%		23.7%	14.2%	5%
Prehospital care								
Duration from accident to hospital [min]	M	64	62	65	66	70	69	66
Intubation	%	21.5%	11%	31.7%	33.3%	61.7%	47.9%	20.8%
Volume [ml]	M	646.1	650.3	685.1	509.5	994.2	774.6	544.8
Emergency room								
Blood transfusion	%	7.3%	7%	9.1%	2.7%	35.4%	17.7%	6.1%
Whole-body CT	%	79.7%	81.5%	84.2%	59%	80.2%	81.2%	72.1%
Cardio-pulmonary resuscitation	%	2.5%	2.1%	3.1%	1.9%	13.8%	6.4%	2.7%
Physiological problems *								
Age ≥ 70 years	%	25.8%	19.3%	28.1%	45%	27.2%	49.3%	100%
Shock (sBP ≤ 90 mmHg)	%	11.9%	10.6%	14.4%	9.3%	100%	30.1%	11.7%
Acidosis (BE < -6)	%	11.6%	9.2%	14.8%	11.6%	42.3%	28.6%	11.7%
Coagulopathy	%	11.5%	8.7%	14%	15.6%	34.4%	27.2%	21.5%
Unconsciousness (GCS ≤ 8)	%	16.6%	4.4%	26.4%	36%	46.7%	44.8%	19%

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

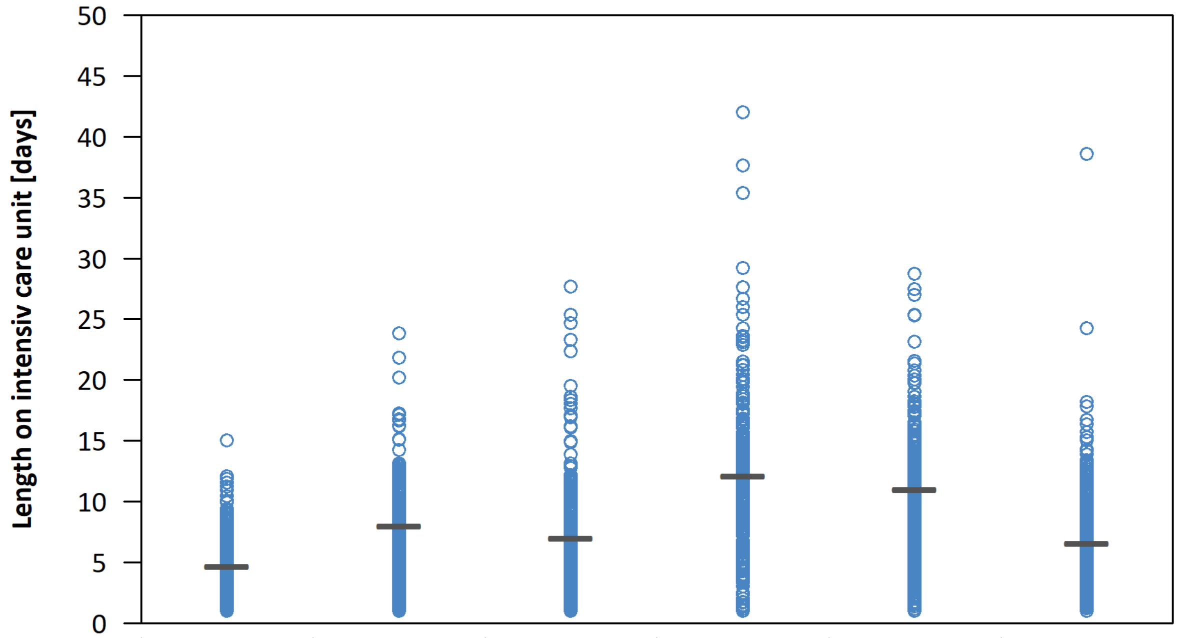
Table 14 continuation:

		Primary patients 2016-2018	Subgroups					
			No TBI	Combined trauma	Isolated TBI	Shock	Severe injuries	Elderly
Length of stay								
Patients with intensiv care therapy	n	78,405	38,296	30,172	9,937	5,310	23,930	19,987
- Intubation on intensiv care unit [days]	M	2.6	1.3	4	3.6	6.9	6.1	2.8
- Intensiv care unit [days]	M	6.3	4.7	8	7	12.1	11	6.6
Days in hospital, all patients	M	15.4	15.4	16.2	13.1	20.1	19.5	15
Mortality and prognosis								
Non-survivors	n	9,655	1,987	4,737	2,931	2,304	8,145	5,519
Mortality	%	11.1%	4.6%	14.6%	26.9%	37%	30.9%	24.6%
Risk of death prognosis (RISC II)	%	10.4%	4.1%	14.4%	23.8%	38.4%	29.4%	21.8%

9.2 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 7, your hospital's value is indicated as a **dark blue diamond** and the other hospitals from the TR-DGU as light blue circles. The horizontal grey line is the mean value over all hospitals per group.

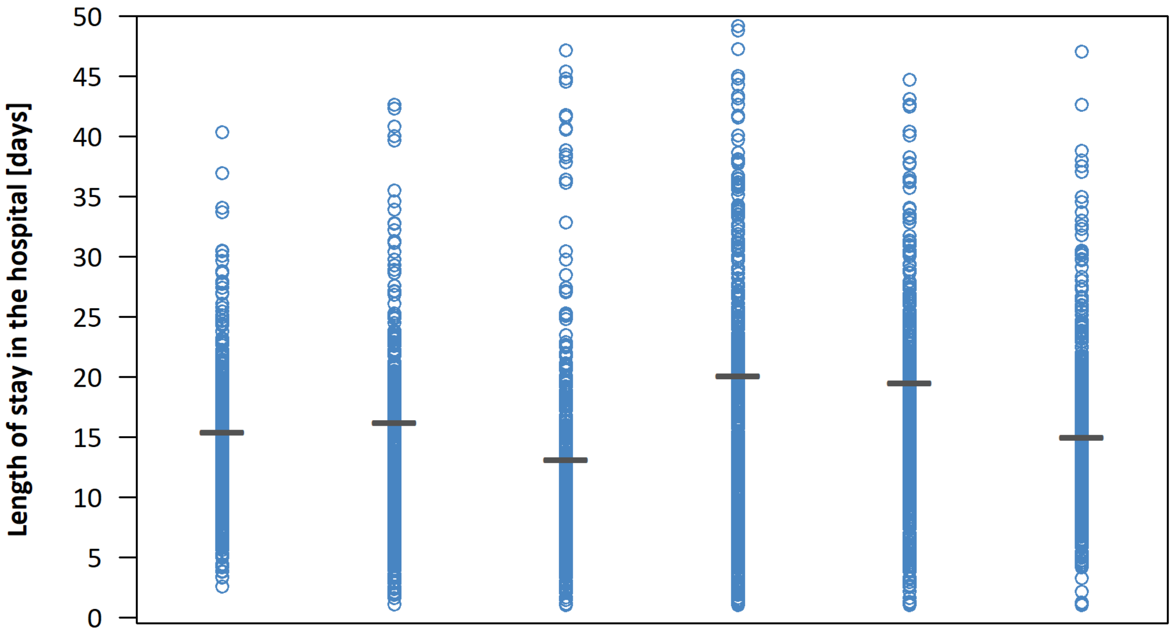
Figure 26 shows the **length of stay on intensive care unit** in days for 2016-2018 between the subgroups defined in table 14 for all primary admitted and treated patients of your hospital in the basic group (patients ≥ 3).



	No TBI	Combined trauma	Isolated TBI	Shock	Severe injuries	Elderly
Your hospital:	4.7	8.0	7.0	12.1	11.0	6.6
n:	39	50	25	18	68	27
TR-DGU:	4.7	8.0	7.0	12.1	11.0	6.6
n:	38,222	30,033	9,745	5,091	23,777	19,858

Figure 26: Length of stay on intensive care unit [days] and number of patients divided into subgroups, for definition see tab. 14, patients 2016-2018, ♦ your hospital, — TR-DGU, o single hospital value

Figure 26 compares the **length of stay in hospital** in days for 2016-2018 between the subgroups defined in table 14 for all primary admitted and treated patients of your hospital in the basic group.



	No TBI	Combined trauma	Isolated TBI	Shock	Severe injuries	Elderly
Your hospital: **n:**	15.4 350	16.2 230	13.1 49	20.1 50	19.5 187	15.0 2
TR-DGU: **n:**	15.4 43,659	16.2 32,362	13.1 10,898	20.1 6,227	19.5 26,332	15.0 22,442

Figure 27: Length of stay in hospital [days] and number of patients divided into subgroups, for definition see tab. 14, patients 2016-2018, ♦ your hospital, — TR-DGU, o single hospital value

10 Data quality and completeness

10.1 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 15 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 your hospital **in 2018** are compared with your hospital's data from the previous years (**since 2009**) and with actual overall data from the **whole TR-DGU 2018**. Cases with implausible data are classified as missing.

Table 15: 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 16: Completeness rates [%], number of missing values {} for selected parameters as well as time to case documentation in the TR-DGU [months]

Variable	Explanation	Your hospital 2018		Your hospital 2009-2017		TR-DGU 2018	
Prehospital data (A)		%	{}	%	{}	%	{}
Only primary admitted patients, who have not admitted themselves / were not admitted privately		n = 29,327		n = 208,929		n = 29,327	
GCS	RISC II requires the motor component; quality indicators use the GCS for the definition of cases	**94%**	1,644	**94%**	13,460	**94%**	1,644
Blood pressure	Initial blood pressure is important for validating the volume therapy and for the definition of shock	**89%**	3,300	**88%**	24,434	**89%**	3,300
Pupils *	Pupil size and reactivity are relevant for prognosis (RISC II)	**91%**	91	**60%**	82,742	**91%**	2,667
CPR	Cardio-pulmonary resuscitation is seldom but highly predictive for outcome; required for RISC II	**92%**	2,240	**93%**	15,534	**92%**	2,240
Emergency room (B)							
Only primary admitted patients		n = 29,894		n = 212,899		n = 29,894	
Time of admission	Required to calculate the diagnostic time periods (quality indicators)	**99%**	236	**99%**	2,483	**99%**	236
Blood pressure	Blood pressure on admission is used by RISC II as a prognostic variable and to define shock	**95%**	1,542	**92%**	17,265	**95%**	1,542
Base excess	The initial base excess is part of the RISC II and an important prognostic factor	**82%**	5,488	**70%**	63,318	**82%**	5,488
Coagulation	The INR (or Quick's value) is needed for the RISC II as coagulation marker	**95%**	1,624	**90%**	20,126	**95%**	1,624
Hemoglobine	Prognostic factor; is part of the RISC II prognosis	**98%**	627	**94%**	11,622	**98%**	627
Patients and outcome							
All patients from the basic group		n = 32,580		n = 235,525		n = 32,580	
ASA	Prior diseases are relevant for outcome prediction (RISC II)	**93%**	2,410	**86%**	32,362	**93%**	2,410
Surgical treatment *	A low rate of surgical patients could be based on incomplete documentation	**40%**		**58%**		**40%**	
Outcome	The levels according to the parameter „outcome" describe the patient's condition at discharge or transfer	**98%**	522	**95%**	12,226	**98%**	522
Process data - Period of time until documentation							
All patients from the basic group		n = 32,580		n = 235,525		n = 32,580	
Period of time 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 months**		**4.7 months**		**4 months**	
Period of time discharge to case completion in the TR-DGU**	Time from discharge of a patient to **completion** of documentation in the registry	**5 months**		**5.7 months**		**5 months**	

* Up from the dataset revision 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 a case

10.2 Comparison of data quality among hospitals

Detailed completeness rates for different variables are presented in chapter 10.1. 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), hemoglobine
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 17: Data completeness of your hospital in 2018 - comparison over the time and with the TR-DGU 2018

Data quality: Completeness	Your hospital 2018	Your hospital 2009-2017	TR-DGU 2018
Primary admitted patients from the basic group	n = 29,894	n = 212,899	n = 29,894
Sum over all recorded values	n = 298,940	n = 2,128,990	n = 298,940
Sum of the missing values	{} 20,550	{} 215,641	{} 20,550
Average completeness rate (%) based on the 10 specified parameters	**93.1%**	**89.9%**	**93.1%**

10.2.1 Graphical comparison with other hospitals

Figure 28 summarises the average completeness value from all 660 hospitals that entered cases **in 2018**. It follows the idea of a box plot in which the light blue box ranging from 89.2% to 97.2% covers half of all hospital values. The black vertical line within the box is the median average completeness value 93.6%.

The **mean completeness** of your hospital is 93% and presented as a blue diamond with a line.

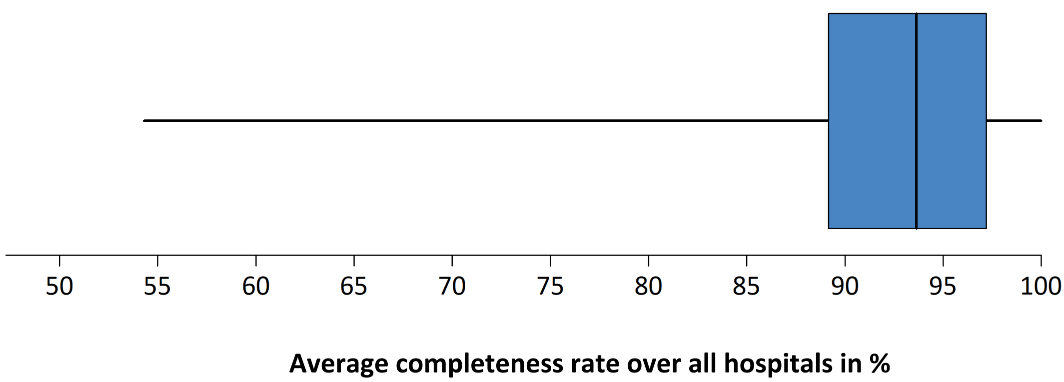


Figure 28: Distribution of the data completeness rate in 2018 over all hospitals and ♦ your hospital

10.2.2 Development over time

Figure 29 shows the development of data completeness over the last ten years since 2009. 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 2012. The data completeness of the standard dataset has approached to the line of the QM dataset since 2013, so that the data completeness in 2018 is similar between the two datasets with a notable value over 90%.

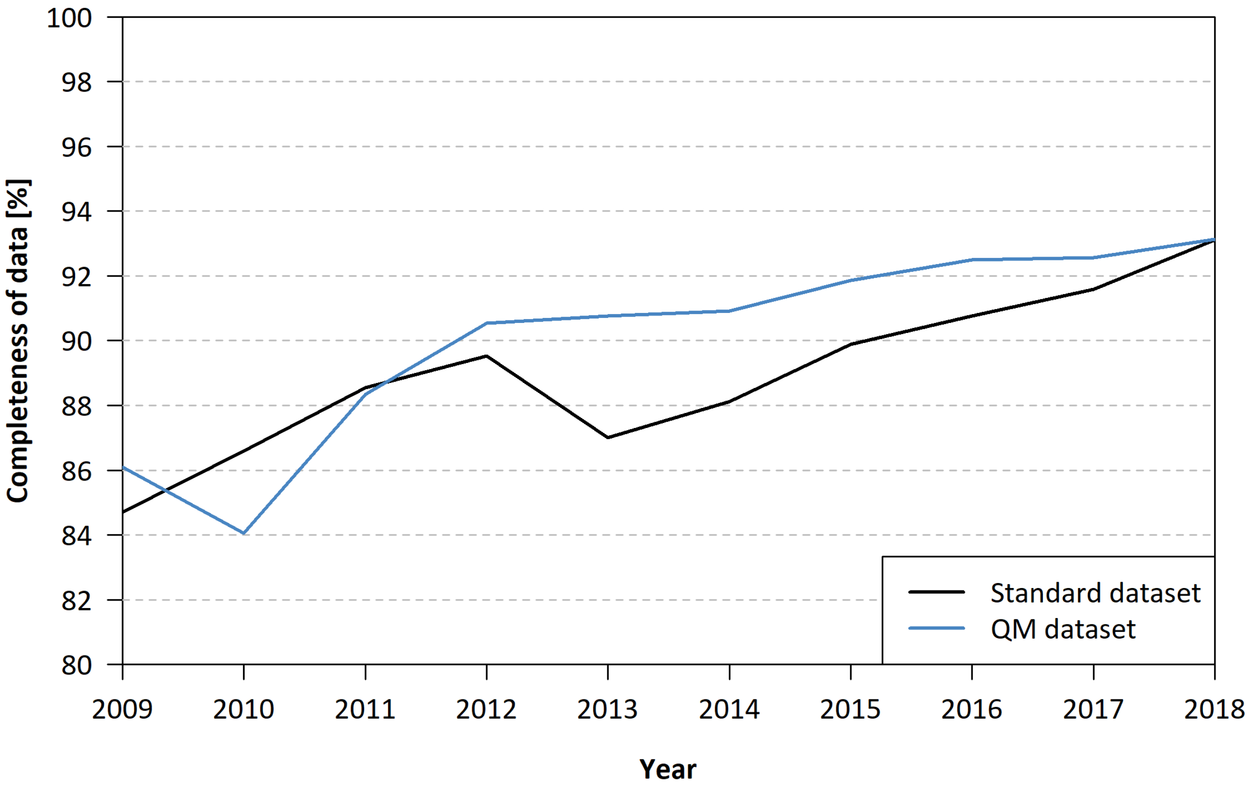


Figure 29: Development over time of the documentation quality: completeness rate in the TR-DGU 2009-2018

11 Injury pattern

In table 18, the average injury pattern of your hospitals patients is presented compared with the TraumaRegister DGU®. Only cases from the **basic group** are considered. In order to reduce the statistical uncertainty, all patients from the **last three years (2016-2018)** are pooled. Data are presented for each of the nine body regions according to the **Abbreviated Injury Scale (AIS)**. The rates 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 2018.

Table 18: Distribution of the injuries from all recorded patients (basic group) for the years 2016-2018

	Your hospital 2016-2018	TR-DGU 2016-2018
Patients in the basic group	**100%** (N = 102,887)	100% (N = 102,887)
Head	**47.1%** (n = 48,436)	47.1% (n = 48,436)
Face	**11.1%** (n = 11,451)	11.1% (n = 11,451)
Neck	**1.5%** (n = 1,588)	1.5% (n = 1,588)
Thorax	**45.2%** (n = 46,523)	45.2% (n = 46,523)
Abdomen	**14.5%** (n = 14,941)	14.5% (n = 14,941)
Spine	**29.7%** (n = 30,518)	29.7% (n = 30,518)
Arms	**28.7%** (n = 29,526)	28.7% (n = 29,526)
Pelvis	**15.1%** (n = 15,533)	15.1% (n = 15,533)
Legs	**23.5%** (n = 24,153)	23.5% (n = 24,153)

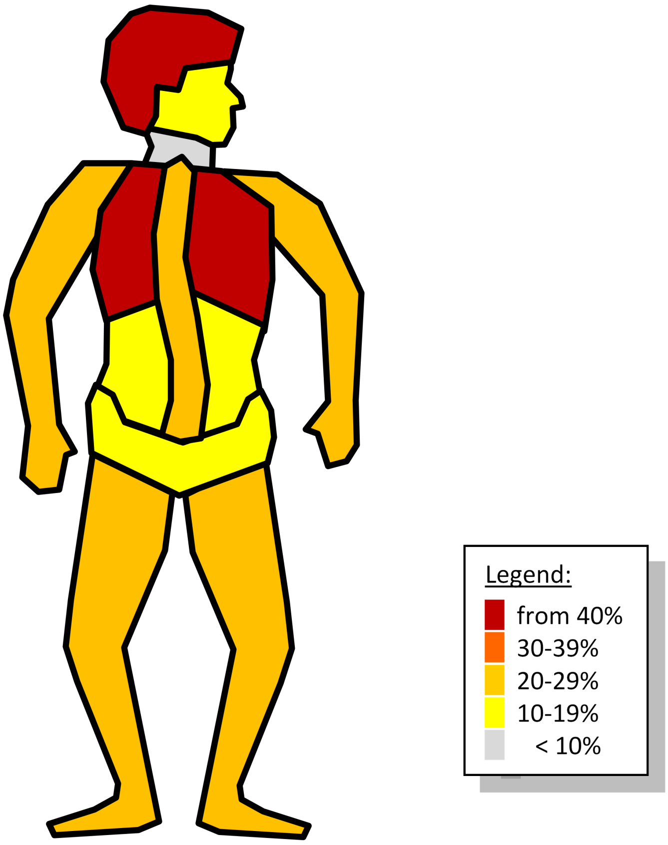


Figure 30: Injury pattern in the TR-DGU for the basic group from 2018

Serious injuries (AIS 3+)

Injuries with a severity of 3 points or more (AIS) are considered as „serious". The prevalence of serious injuries in the four most important body regions (head, thorax, abdomen, extremities) is given in table 18. The body regions considered here refer to the respective regions of the **Injury Severity Score** (ISS). So spine injuries are assigned to the respective regions head, thorax or abdomen.

Different from table 18 only patients with at least one relevant injury (MAIS 3+, see chapter 1) are considered here.

Table 19: Ratio of serious injured patients (AIS ≥ 3) per body region for the years 2016-2018 (basic group)

	Your hospital 2016-2018	TR-DGU 2016-2018
Serious injury (AIS ≥ 3)	**81%** (N = 83,313)	**81%** (N = 83,313)
... of the **head**	**45.4%** (n = 37,786)	**45.4%** (n = 37,786)
... of the **thorax**	**45.8%** (n = 38,196)	**45.8%** (n = 38,196)
... of the **abdomen**	**12.1%** (n = 10,045)	**12.1%** (n = 10,045)
... of the **extremities**	**28.1%** (n = 23,415)	**28.1%** (n = 23,415)
Patients with **more than one** seriously injured body region	**30%** (n = 24,958)	**30%** (n = 24,958)

12 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 2018, 40,882 patients were registered from 660 hospitals that documented cases in the TraumaRegister DGU®. The **basic group** that this report is based on comprises **32,580 patients** from 654 hospitals (details on the definition see chapter 1). There are already **137,905 patients** that have been documented with the in 2015 updated dataset.

There were 17,664 patients with ISS ≥ 16 from 620 hospitals in the basic group. The distribution of the number of ISS ≥ 16 patients per hospital is shown in figure 31.

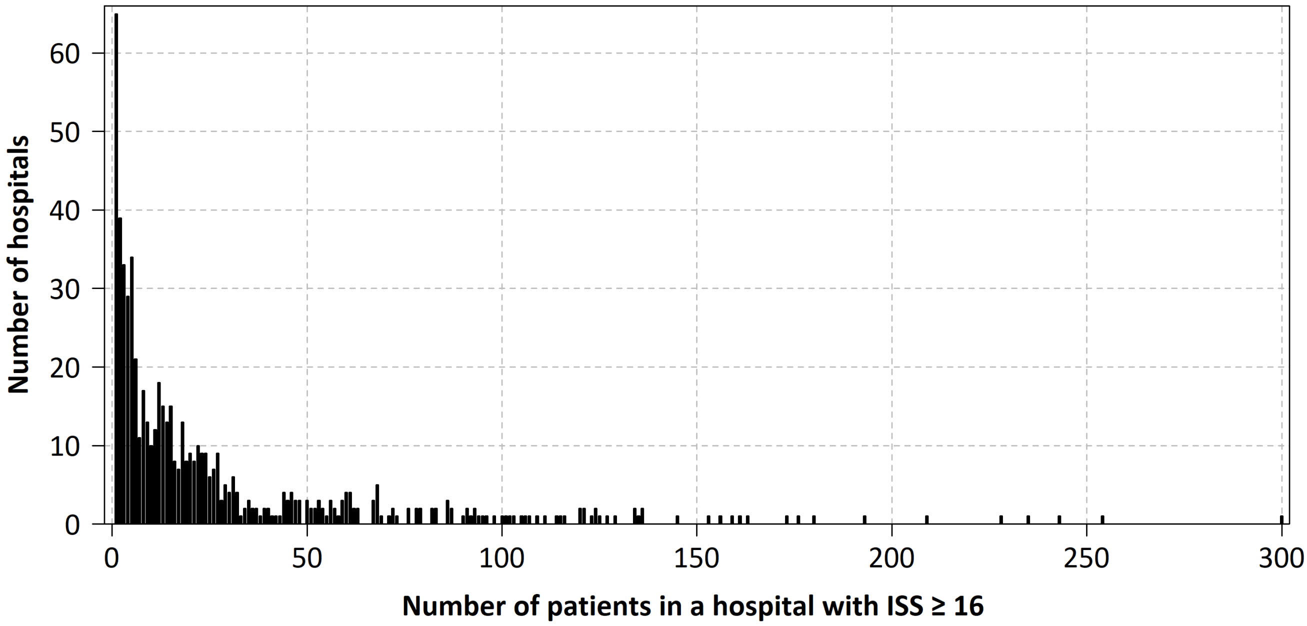


Figure 31: Frequency distribution of ISS ≥ 16 patients numbers per hospital in the TR-DGU 2018

Patients

Figure 32 demonstrates the continuous increase of registered patients over time since 2002. In 2018, 8,302 recorded patients did not fulfil the criteria of the basic group and were not seriously injured per TR-DGU definition. There were 46.9% German patients in the basic group that were documented by the standard dataset (S) in 2018.

In 2018, there were **654 hospitals** that documented patients in the basic group, 57 hospitals were from foreign countries (8.7%), namely Belgium, Finland, Luxembourg, The Netherlands, Austria, Switzerland, Slovenia and the United Arab Emirates and 597 hospitals from Germany.

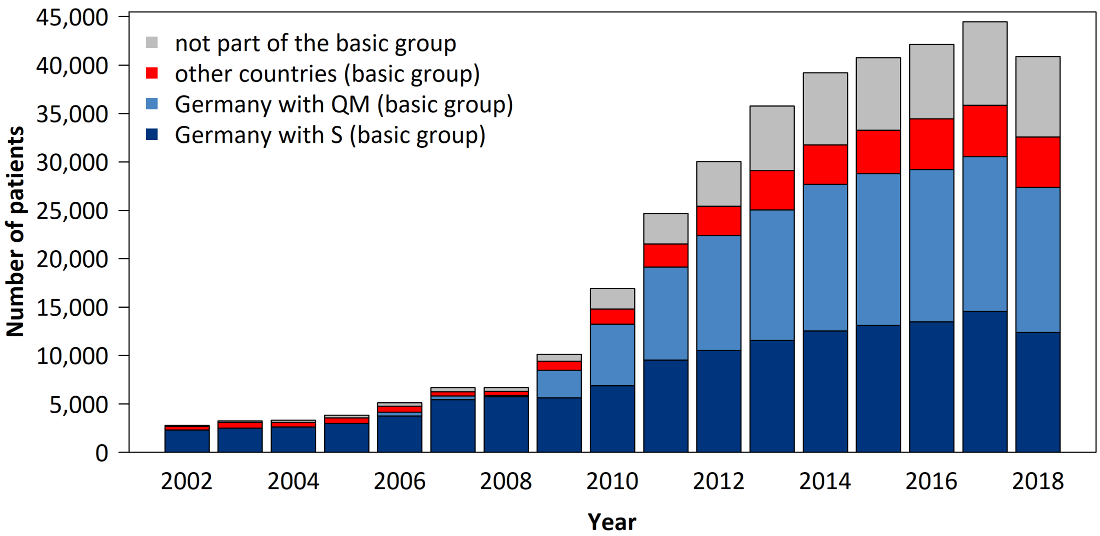


Figure 32: Number of cases in the TR-DGU 2002-2018, S: standard dataset, QM: QM dataset

Revision of the dataset 2020

The TR-DGU dataset has been adapted to the actual requirements in the past and will continue to be revised at regular intervalls in the future by the AK TraumaRegister of the Sektion NIS of the DGU and the AUC. In such a revision, each variable is checked for its completeness and use for scientific analyses and the documentation effort is weighed against the benefit. It is also evaluated whether the actual dataset can answer questions in controversial discussions. In this context it might also become necessary to extend the existing variables. For example, the actual dataset does not show, whether a patient is an employer's liability insurance association case or not or whether the patient had an accident on bike or on e-bike. Furthermore, some information are missing in the reduced QM dataset despite its particularly high scientific relevance. Nevertheless, the overall workload should not be extended.

The revision presented here was intensively discussed, evaluated and finally adopted. Table 20 gives an overview of the parameters that will be newly implemented in the register with the dataset revision 2020.

Table 20: Parameter that are newly implemented into the TR-DGU with the dataset revision 2020

Form	Topic	Parameter	Remark
S	Case	Employer's liability insurance association case	The aim is an epidemiological assessment of occupational and commuting accidents (only in Germany and Austria).
A	Emergency physician	EMS physician at the accident scene	Considering the introduction of emergency paramedics and the lack of emergency physicians in many places, the collection of this variable can help to assess the pre-clinical care situation.
A	Transport	Additional helicopter claimed, mass casualty incident (MCI)	Considering the introduction of emergency paramedics and the lack of emergency physicians in many places, the collection of this variable can help to assess the pre-clinical care situation. In this case, the variable MCI might help to determine possible changes in the pre-clinical therapy.
A	Therapy	Surgical airway, cervical spine immobilisation, needle decompression, tourniquet, intraosseous access, prehospital thoracotomy	Important and relevant pre-clinical therapeutic measures that have not yet been collected are now presented for analysis.
B	Diagnostic	Selective CT (yes/no, time): cervical spine, chest/thoracic spine, abdomen/lumbar spine/ pelvis, extremities	These variables should adequately represent the implementation of differentiated diagnostics in reality.
B	Volume administration	Divided according to ER- and OP phase	Herewith, a better insight into the increasingly differentiated volume administration should be given herewith.
B	Therapy in ER	Surgical airway, pericardiocentesis	Important therapies for the initial phase in the ER are now recorded and can be analysed.
B	Emergency surgeries prior to ICU admission	REBOA, escharotomy, dermatofasciotomy	These parameters should record the first important surgical initial therapy realistically and in an analysable way.
B	Hemostasis treatment	Divided according to ER- and OP phase	Herewith, a better insight into the increasingly differentiated coagulation monitoring should be given.
B	Medical coagulation treatment	Fibrinogen: time of start, DOAK-Antidot	Herewith, a better insight into the increasingly differentiated coagulation monitoring should be give.
C	Hemostasis Treatment	Platelet concentrate	Herewith, a better insight into the increasingly differentiated coagulation monitoring should be given.
D	Completion	Therapy limitation, end-of-life-decision	These parameters should give a general idea of the circumstances of death, especially in elderly trauma patients. This is a meaningful approach in describing the mortality, as this parameter should be assessed differently for patients who rejected therapy and those who received a maximum therapy.

13 Publications from the TraumaRegister DGU®

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

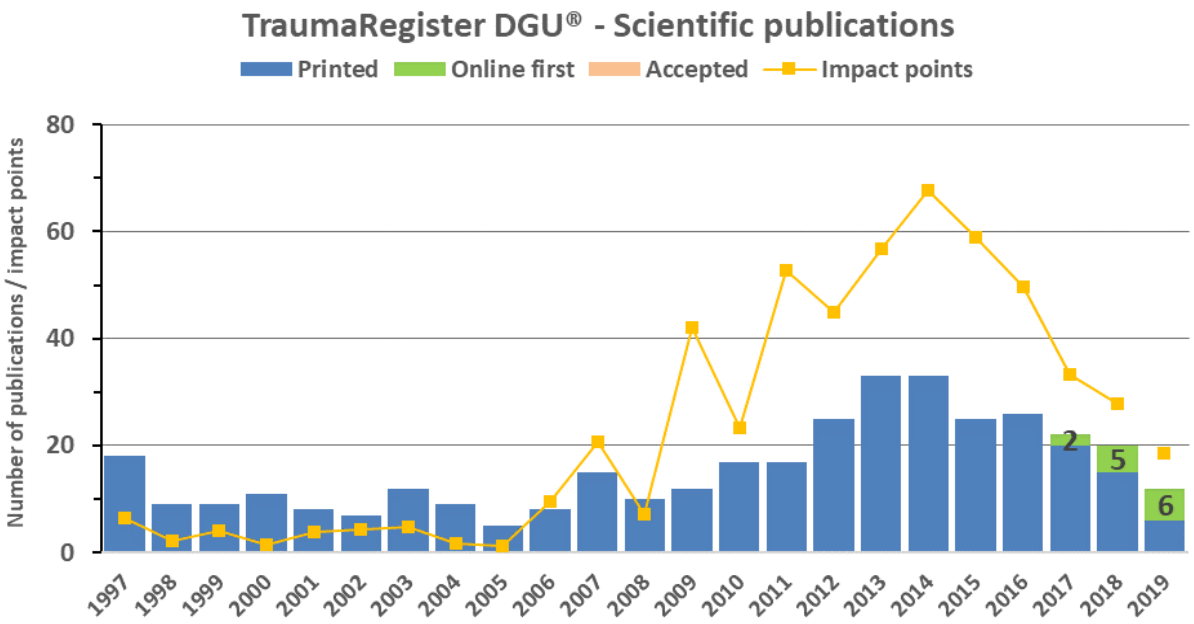


Figure 33: Number of publications from the TraumaRegister DGU® and their impact points since 1997

13.1 Publications from the TR-DGU 2017-07/2019

2019

Bieler D, Hörster A, Lefering R, Franke A, Waydhas C, Huber-Wagner S, Baacke M, Paffrath T, Wnent J, Volland R, Jakisch B, Walcher F, Kulla M. Correction to: Evaluation of new quality indicators for the TraumaRegister DGU® using the systematic QUALIFY methodology. Eur J Trauma Emerg Surg. 2019 [Epub ahead of print].

Debus F, Lefering R, Lechler P, Ruchholtz S, Frink M; TraumaRegister DGU®. Early clinical care strategy for severely injured patients with abdominal trauma. Chirurg. 2019 [Epub ahead of print].

Defosse J, Grensemann J, Gerbershagen MU, Paffrath T, Böhmer A, Joppich R, Lefering R, Wappler F, Schieren M; TraumaRegister DGU. Continuous lateral rotational bed therapy in patients with traumatic lung injury: an analysis from the TraumaRegister DGU®. Med Klin Intensivmed Notfmed. 2019 [Epub ahead of print].

Emami P, Czorlich P, Fritzsche FS, Westphal M, Rueger JM, Lefering R, Hoffmann M; TraumaRegister DGU® of the German Trauma Society (Deutsche Gesellschaft für Unfallchirurgie; DGU) Observed versus expected mortality in pediatric patients intubated in the field with Glasgow Coma Scale scores < 9. Eur J Trauma Emerg Surg. 2019 [Epub ahead of print].

Fitschen-Oestern S, Lippross S, Lefering R, Besch L, Klüter T, Schenzer-Hoffmann E, Seekamp A; TraumaRegister DGU® Missed foot fractures in multiple trauma patients. BMC Musculoskelet Disord 2019; 20(1): 121.

Gäßler M, Ruppert M, Lefering R, Bouillon B, Wafaisade A; TraumaRegister DGU® Pre-hospital emergent intubation in trauma patients: the influence of etomidate on mortality, morbidity and healthcare resource utilization. Scand J Trauma Resusc Emerg Med. 2019; 27(1):61.

Horst K, Andruszkow H, Weber CD, Pishnamaz M, Knobe M, Bläsius FM, Lichte P, Lefering R, Hildebrand F. Surgical treatment strategies in pediatric trauma patients: ETC vs. DCO-an analysis of 316 pediatric trauma patients from the TraumaRegister DGU®. Eur J Trauma Emerg Surg. 2019 [Epub ahead of print].

Hussmann B, Schoeneberg C, Jungbluth P, Heuer M, Lefering R, Maek T, Hildebrand F, Lendemans S, Pape HC. Enhanced prehospital volume therapy does not lead to improved outcomes in severely injured patients with severe traumatic brain injury. BMC Emerg Med. 2019; 9(1): 13.

Klein K, Lefering R, Jungbluth P, Lendemans S, Hussmann B. Is Prehospital Time Important for the Treat-ment of Severely Injured Patients? A Matched-Triplet Analysis of 13,851 Patients from the TraumaRegister DGU®. BioMed Research International. 2019; Article ID 5936345, 10 pages.

Rauf R, von Matthey F, Croenlein M, Zyskowski M, van Griensven M, Biberthaler P, Lefering R, Huber-Wagner S; Section NIS of DGU Changes in the temporal distribution of in-hospital mortality in severely injured patients - An analysis of the TraumaRegister DGU. PLoS One. 2019; 14: e0212095.

Schieren M, Böhmer AB, Lefering R, Paffrath T, Wappler F, Defosse J; TraumaRegister DGU. Impact of body mass index on outcomes after thoracic trauma-A matched-triplet analysis of the TraumaRegister DGU®. Injury. 2019; 50: 96-100.

Weber CD, Lefering R, Weber MS, Bier G, Knobe M, Pishnamaz M, Kobbe P, Hildebrand F; TraumaRe-gister DGU. Predictors for Pediatric Blunt Cerebrovascular Injury (BCVI): An International Multi-center Analysis. World J Surg. 2019 [Epub ahead of print].

2018

Bieler D, Hörster A, Lefering R, Franke A, Waydhas C Huber-Wagner S, Baacke M, Paffrath T, Wnent J, Volland R, Jakisch B, Walcher F, Kulla M. Evaluation of new quality indicators for the TraumaRegister DGU® using the systematic QUALIFY methodology. Eur J Trauma Emerg Surg. 2018 [Epub ahead of print].

Flohé S, Matthes G, Maegele M, Huber-Wagner S, Nienaber U, Lefering R, Paffrath T. Future perspective of the TraumaRegister DGU®: Further development, additional modules and potential limits. Unfallchirurg. 2018; 121: 774-780.

Heinänen M, Brinck T, Lefering R, Handolin L, Söderlund T. Resource use and clinical outcomes in blunt thoracic injury: a 10-year trauma registry comparison between southern Finland and Germany. Eur J Trauma Emerg Surg. 2018 [Epub ahead of print].

Hilbert-Carius P, Schwarzkopf D, Reinhart K, Hartog CS, Lefering R, Bernhard M, Struck MF. Synthetic colloid resuscitation in severely injured patients: analysis of a nationwide trauma registry (TraumaRegister DGU). Sci Rep. 2018; 8: 11567.

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Huckhagel T, Nüchtern J, Regelsberger J, Gelderblom M, Lefering R; TraumaRegister DGU®. Nerve trauma of the lower extremity: evaluation of 60,422 leg injured patients from the TraumaRe-gister DGU® between 2002 and 2015. Scand J Trauma Resusc Emerg Med. 2018; 26: 40.

Kamp O, Jansen O, Lefering R, Meindl R, Waydhas C, Schildhauer TA, Hamsen U; TraumaRegister DGU. Cervical Spinal Cord Injury Shows Markedly Lower than Predicted Mortality (>72 Hours After Multiple Trauma) From Sepsis and Multiple Organ Failure. J Intensive Care Med. 2018 [Epub ahead of print]

Kulla M, Engelhardt M, Holsträter T, Bieler D, Lefering R, Elias K und das TraumaRegister DGU. Do we need REBOA as an adjunct to ER thoracotomy in German trauma centres? A secondary data analysis from the TraumaRegister DGU®. Anästh Intensivmed. 2018; 59: 562-573.

Lefering R, Czorlich P. In Reply to the Letter to the Editor "Body Mass Index >35 as Independent Predictor of Mortality in Severe Traumatic Brain Injury: Statistical and Methodologic Issues". World Neurosurg. 2018; 109: 509.

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Strohm PC, Zwingmann J, Bayer J, Neumann MV, Lefering R, Schmal H, Reising K. Unterschiede im Outcome schwerverletzter Kinder in Abhängigkeit von der Versorgungsstufe. Unfallchirurg. 2018; 121: 306-312.

Timm A, Maegele M, Wendt K, Lefering R, Wyen H, TraumaRegister DGU. Pre-hospital rescue times and interventions in severe trauma in Germany and the Netherlands: a matched-pairs analysis. Eur J Trauma Emerg Surg. 2018 [Epub ahead of print].

Trentzsch H, Maegele M, Nienaber U, Paffrath T, Lefering R. The TraumaRegister DGU® dataset, its development over 25 years and advances in the care of severely injured patients. Unfallchirurg. 2018; 121: 794-801.

Waydhas C, Baake M, Becker L, Buck B, Düsing H, Heindl B, Jensen KO, Lefering R, Mand C, Paffrath T, Schweigkofler U, Sprengel K, Trentzsch H, Wohlrath B, Bieler D. A Consensus-Based Criterion Standard for the Requirement of a Trauma Team. World J Surg. 2018; 42: 2800-2809.

Waydhas C, Lefering R, Hoefer C. Wissenschaftlicher Impact des TraumaRegister DGU®. Unfallchirurg. 2018; 121: 781-787.

Weber CD, Hildebrand F, Kobbe P, Lefering R, Sellei RM, Pape HC; TraumaRegister DGU. Epidemiology of open tibia fractures in a population-based database: update on current risk factors and clinical implications. Eur J Trauma Emerg Surg. 2018 [Epub ahead of print].

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2017

Ali Ali B, Lefering R, Fortun Moral M, Belzunegui Otano T. Epidemiological comparison between the Navarra Major Trauma Registry and the German Trauma Registry (TR-DGU®). Scand J Trauma Resusc Emerg Med. 2017; 25: 107.

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Czorlich P, Dreimann M, Emami P, Westphal M, Lefering R, Hoffmann M. Body-Mass-Index > 35 as an Independent Predictor of Mortality in Severe Traumatic Brain Injury. World Neurosurg. 2017; 107: 515-521.

Emami P, Czorlich P, Fritzsche FS, Westphal M, Rueger JM, Lefering R, Hoffmann M. Impact of Glasgow Coma Scale score and pupil parameters on mortality rate and outcome in pediatric and adult severe traumatic brain injury: a retrospective, multicenter cohort study. J Neurosurg 2017; 126: 760-767.

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13.2 Abstracts 07/2019 - 08/2018

Chirurg. 2019 Apr 8. doi: 10.1007/s00104-019-0817-4. [Epub ahead of print]

Early clinical care strategy for severely injured patients with abdominal trauma

Debus F, Lefering R, Lechler P, Ruchholtz S, Frink M; TraumaRegister DGU.

BACKGROUND: The presence of abdominal injuries has a major impact on the mortality of severely injured patients. For injuries that require surgery, laparotomy is still the gold standard for early surgical care; however, there is increasing evidence that laparoscopy may be an alternative in the early clinical care of polytrauma patients.

OBJECTIVE: The present registry-based study analyzed the utilization and the outcome of laparoscopy in severely injured patients with abdominal trauma in Germany.

MATERIAL AND METHODS: A retrospective analysis of 12,447 patients retrieved from the TraumaRegister DGU® (TR-DGU) was performed. The primary inclusion criteria were an injury severity score (ISS) ≥ 9 and an abbreviated injury scale (AIS) [abdomen] ≥ 1. The included patients were grouped according to early treatment management: (1) laparoscopy, (2) laparotomy and (3) non-operative management (NOM). Finally, group-specific patient characteristics and outcome were analyzed.

RESULTS: The majority of patients were treated by NOM (52.4%, n = 6069), followed by laparotomy (50,6%, n = 6295) and laparoscopy (0.7%, n = 83). The majority of laparoscopies were performed in patients with an AIS [abdomen] ≤ 3 (86.7%). The ISS of the laparoscopy group was significantly lower compared to that of the laparotomy and NOM groups (ISS 23.4 vs. 34.5 vs. 28.2, respectively, p ≤ 0.001). The standardized mortality rate (SMR), defined as the ratio between observed and expected mortality, was lowest in the patients receiving laparoscopy followed by laparotomy and NOM (SMR 0.688 vs. 0.931 vs. 0.932, respectively, p-value = 0.2128) without achieving statistical significance.

CONCLUSION: Despite being rarely employed the data indicate the effectiveness of laparoscopy for the early treatment of severely injured, hemodynamically stable patients with an AIS [abdomen] ≤ 3.

Med Klin Intensivmed Notfmed. 2019 Mar 28. doi: 10.1007/s00063-019-0565-8. [Epub ahead of print]

Continuous lateral rotational bed therapy in patients with traumatic lung injury: an analysis from the TraumaRegister DGU®

Defosse J, Grensemann J, Gerbershagen MU, Paffrath T, Böhmer A, Joppich R, Lefering R, Wappler F, Schieren M; TraumaRegister DGU®.

BACKGROUND: Patients with severe thoracic trauma often receive continuous lateral rotational bed therapy (CLRT) for the treatment of lung contusions. In this study, the effects of CLRT on mortality, morbidity and length of stay (LOS) in the intensive care unit (ICU) and in the hospital were evaluated.

METHODS: Retrospective data from the TraumaRegister DGU® were analysed, focusing on patients with severe thoracic trauma. Patients treated with CLRT were compared to a control group with comparable trauma severity who had received conventional therapy.

RESULTS: A total of 1476 patients (239 with CLRT, 1237 without CLRT) were included in this study. Both groups were similar for demographic characteristics. The median CLRT duration was 6 (4-10) days. Patients receiving CLRT were ventilated for 17 (10-26) days compared to 14 (8-22) days (p = 0.001) in the control group. The ICU length of stay differed significantly (CLRT: 23 [14-32] days; control: 19 [13-28] days; p = 0.002). Also, organ failure occurred more frequently in patients treated with CLRT (CLRT: 76.6%, control: 67.6%; p = 0.006). No differences could be detected regarding mortality rates, multiple organ failure and hospital LOS.

CONCLUSION: The results of this retrospective analysis fail to detect a benefit for CLRT therapy in trauma patients. Considering inherent limitations of retrospective studies, caution should be exerted when interpreting these results. Further research is warranted to confirm these findings in a prospective trial.

Eur J Trauma Emerg Surg. 2019 Jan 10. doi: 10.1007/s00068-018-01065-2. [Epub ahead of print]

Observed versus expected mortality in pediatric patients intubated in the field with Glasgow Coma Scale scores < 9.

Emami P, Czorlich P, Fritzsche FS, Westphal M, Rueger JM, Lefering R, Hoffmann M; TraumaRegister DGU® of the German Trauma Society (Deutsche Gesellschaft für Unfallchirurgie; DGU).

PURPOSE: A Glasgow Coma Scale (GCS) score of 8 or less in patients suffering from severe traumatic brain injury (TBI) represents a decision-making marker in terms of intubation. This study evaluated the impact of prehospital intubation on the mortality of these TBI cases among different age groups.

METHODS: This study included the data from patients predominantly suffering from severe TBI [Abbreviated Injury Scale (AIS) of the head ≥ 3, GCS score < 9, Injury Severity Score (ISS) > 9] who were registered in TraumaRegister DGU® from 2002 to 2013. An age-related analysis of five subgroups was performed (1-6, 7-15, 16-55, 56-79, and ≥ 80 years old). The observed and expected mortality were matched according to the Revised Injury Severity Classification, version II.

RESULTS: A total of 21,242 patients were included. More often, the intubated patients were severely injured when compared to the non-intubated patients (median ISS 29, IQR 22-41 vs. 24, IQR 16-29, respectively), with an associated higher mortality (42.2% vs. 30.0%, respectively). When compared to the calculated expected mortality, the observed mortality was significantly higher among the intubated patients within the youngest subgroup (42.2% vs. 33.4%, respectively; $p = 0.03$).

CONCLUSION: The observed mortality in the intubated children 1-6 years old suffering from severe TBI seemed to be higher than expected. Whether or not a GCS score of 8 or less is the only reliable criterion for intubation in this age group should be investigated in further trials.

BMC Musculoskelet Disord. 2019 Mar 25;20(1):121. doi: 10.1186/s12891-019-2501-8.

Missed foot fractures in multiple trauma patients.

Fitschen-Oestern S, Lippross S, Lefering R, Besch L, Klüter T, Schenzer-Hoffmann E, Seekamp A, TraumaRegister Dgu.

BACKGROUND: Missed or underestimated injuries are one of the central problems in trauma care. Foot injuries can easily be missed because they lay beyond the regularly screened field of a trauma computer tomography scan (CT scan). During primary and secondary survey a careful examination of the extremities often becomes of secondary interest in the severely injured patient.

METHODS: Thirty-four thousand ninety-one multiple trauma patients of the TraumaRegister DGU® were evaluated from 2002 to 2014. We differentiated between patients with foot injuries, patients with missed foot injuries and patients without foot injuries. Included were ankle fractures, calcaneus fractures, talus fractures, metatarsal fractures, toe fractures, amputation, soft tissue injuries and/or ligamentous injuries.

RESULTS: Summarized evaluation of 34,091 trauma patients showed a share of 2532 patients with foot injuries. Time of diagnosis was documented in 2199 cases. 2055 patients had early diagnosed foot injuries and 144 patients had initially missed foot injuries. Missed foot injuries were especially found in patients with car accidents or fall from ≥3 m. Patients with higher Abbreviated Injury Scale (AIS) or lower Glasgow Coma Scale (GCS) were not significantly more affected by missed foot injuries. Missing foot injuries was also not caused by injury severity or higher age.

CONCLUSION: Our data highlights the need of careful evaluation of the feet during primary and secondary survey particularly when a tibia or femur fracture is diagnosed. Special attention should be turned to patients after car accidents or fall from great height. Suicide victims also need major attention. Patients with early operations also need careful examination and tertiary survey is highly recommended.

Scand J Trauma Resusc Emerg Med. 2019 Jun 7;27(1):61. doi: 10.1186/s13049-019-0637-z.

Pre-hospital emergent intubation in trauma patients: the influence of etomidate on mortality, morbidity and healthcare resource utilization.

Gäßler M, Ruppert M, Lefering R, Bouillon B, Wafaisade A; TraumaRegister DGU.

BACKGROUND: Due to its favorable hemodynamic characteristics and by providing good intubation conditions etomidate is often used for induction of general anesthesia in trauma patients. It has been linked to temporary adrenal cortical dysfunction. The clinical relevance of this finding after a single-dose is still lacking appropriate evidence.
METHODS: This retrospective multi-centre study is based on merged data from a German Helicopter Emergency Medical Service (HEMS) database and a large trauma patient registry. All trauma patients who were intubated prior to hospital admission with a documented Injury Severity Score ≥ 9 between 2008 and 2012 were eligible for analysis. The primary endpoint was hospital mortality. Other outcome measures were organ failures, sepsis, length of ventilation, as well as length of stay in hospital and ICU.
RESULTS: One thousand six hundred ninety seven patients were enrolled into the study. Seven hundred sixty two patients received etomidate and 935 patients received other induction agents. The in-hospital mortality was similar in both groups (18.9% versus 18.2%; p = 0.71). Incidences of organ failures and sepsis were not increased in the etomidate group. However, health care resource utilization parameters were prolonged (after adjusting: + 1.3 days for ICU length of stay, p = 0.062; + 0.8 days for length of ventilation, p = 0.15; + 2,7 days for hospital length of stay, p = 0.034). A multivariable logistic regression analysis did not identify etomidate as an independent predictor of hospital mortality (OR: 1.10, 95% CI: 0.77-1.57; p = 0.60).
CONCLUSION: This is the largest trial investigating outcome data for trauma patients who had received a single-dose of etomidate for induction of anesthesia. The use of etomidate did not affect mortality. The influence on morbidity and health care resource utilization remains unclear.

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Surgical treatment strategies in pediatric trauma patients: ETC vs. DCO-an analysis of 316 pediatric trauma patients from the TraumaRegister DGU®.

Horst K, Andruszkow H, Weber CD, Pishnamaz M, Knobe M, Bläsius FM, Lichte P, Lefering R, Hildebrand F.

PURPOSE: External fixation within the damage control concept in unstable multiple trauma patients is widely accepted. Literature about its usage in the pediatric trauma population, however, is rare. The aim of the present study was to elucidate the factors associated with the application of external fixation in the severely injured child.
METHODS: Patients with severe trauma aged 0-54 years documented in the TraumaRegister DGU® were included in this study. Demographic data, pattern of injury, injury severity, use of the damage control orthopedics (DCO) or early total care (ETC) concept, duration of mechanical ventilation, intensive care stay, and total hospital stay as well as the occurrence of complications and mortality were evaluated. Statistical evaluation was performed using SPSS (Version 21.0.0) using Chi square tests and linear regression models.
RESULTS: While injury severity was comparable between children and adults, type of accident and injury patterns showed significant differences, Overall, the majority of surgical fracture stabilization in AISExtremity ≥ 3 injuries followed the DCO concept in adults (60.3%) and the ETC protocol in children (49.4%). Conservative treatment was chosen for only 11.6% of all children and 9.6% of all adults. An increasing injury severity, AISExtremity ≥ 3 and AISExtremity ≥ 3 in ≥ 2 body regions, and a more advanced age were found to be independent factors in the use of the DCO concept in children.
CONCLUSION: Use of external fixation increases with age and plays a minor role in the very young trauma population. However, this does not produce a difference in outcome between children and adults.

BMC Emerg Med. 2019 Jan 23;19(1):13. doi: 10.1186/s12873-019-0221-x.

Enhanced prehospital volume therapy does not lead to improved outcomes in severely injured patients with severe traumatic brain injury.

Hussmann B, Schoeneberg C, Jungbluth P, Heuer M, Lefering R, Maek T, Hildebrand F, Lendemans S, Pape HC.

BACKGROUND: Whether enhanced prehospital volume therapy leads to outcome improvements in severely injured patients with severe traumatic brain injury (TBI) remains controversial. The aim of this study was to investigate the influence of prehospital volume therapy on the clinical course of severely injured patients with severe TBI.

METHODS: Data for 122,672 patients from TraumaRegister DGU® (TR-DGU) was analyzed. Inclusion criteria were defined as follows: Injury Severety Score (ISS) ≥ 16, primary admission, age ≥ 16 years, Abbreviated Injury Scale (AIS) head ≥3, administration of at least one unit of packed red blood cells (pRBCs), and available volume and blood pressure data. Stratification based on the following matched-pair criteria was performed: group 1: prehospital volumes of 0-1000 ml; group 2: prehospital volumes of ≥1501 ml; AIS head (3, 4, 5 + 6 and higher than for other body regions); age (16-54, 55-69, ≥ 70 years); gender; prehospital intubation (yes/no); emergency treatment time +/- 30 min.; rescue resources (rescue helicopter, emergency ambulance); blood pressure (20-60, 61-90, ≥ 91 mmHg); year of accident (2002-2005, 2006-2009, 2010-2012); AIS thorax, abdomen, and extremities plus pelvis.

RESULTS: A total of 169 patients per group fulfilled the inclusion criteria. Increasing volume administration was associated with reduced coagulation capability and reduced hemoglobin (Hb) levels (prothrombin ratio: group 1: 68%, group 2: 63.7%; p ≤ 0.04; Hb: group 1: 11.2 mg/dl, group 2: 10.2 mg/dl; p ≤ 0.001). It was not possible to show a significant reduction in the mortality rate with increasing volumes (group 1: 45.6, group 2: 45.6; p = 1).

CONCLUSION: The data presented in this study demonstrates that prehospital volume administration of more than 1500 ml does not improve severely injured patients with severe traumatic brain injury (TBI).

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Is Prehospital Time Important for the Treatment of Severely Injured Patients? A Matched-Triplet Analysis of 13,851 Patients from the TraumaRegister DGU®.

Klein K, Lefering R, Jungbluth P, Lendemans S, Hussmann B.

BACKGROUND: The impact of time (the golden period of trauma) on the outcome of severely injured patients has been well known for a long time. While the duration of the prehospital phase has changed only slightly (average time: ~66 min) since the TraumaRegister DGU® (TR-DGU®) was implemented, mortality rates have decreased within the last 20 years. This study analyzed the influence of prehospital time on the outcome of trauma patients in a matched-triplet analysis.

MATERIAL AND METHODS: A total of 93,024 patients from the TraumaRegister DGU® were selected based on the following inclusion criteria: ISS ≥ 16, primary admission, age ≥ 16 years, and data were available for the following variables: prehospital intubation, blood pressure, mode of transportation, and age. The patients were assigned to one of three groups: group 1: 10-50 min (short emergency treatment time); group 2: 51-75 min (intermediate emergency treatment time); group 3: >75 min (long emergency treatment time). A matched-triplet analysis was conducted; matching was based on the following criteria: intubation at the accident site, rescue resources, Abbreviated Injury Scale (AIS) of the body regions, systolic blood pressure, year of the accident, and age.

RESULTS: A total of 4,617 patients per group could be matched. The number of patients with a GCS score ≤8 was significantly higher in the first group (group 1: 36.6%, group 2: 33.5%, group 3: 30.3%; $p < 0.001$). Moreover, the number of patients who had to be resuscitated during the prehospital phase and/or upon arrival at the hospital was higher in group 1 ($p = 0.010$); these patients also had a significantly higher mortality (group 1: 20.4%, group 2: 18.1%, group 3: 15.9%; $p \leq 0.001$). The number of measures performed during the prehospital phase (e.g., chest tube insertion) increased with treatment time.

CONCLUSION: The results suggest that survival after severe trauma is not only a matter of short rescue time but more a matter of well-used rescue time including performance of vital measures already in the prehospital setting. This also includes that rescue teams identify the severity of injuries more rapidly in the most-severely injured patients in critical condition than in less-severely injured patients and plan their interventions accordingly.

PLoS One. 2019 Feb 22;14(2):e0212095. doi: 10.1371/journal.pone.0212095. eCollection 2019.

Changes in the temporal distribution of in-hospital mortality in severely injured patients-An analysis of the TraumaRegister DGU.

Rauf R, von Matthey F, Croenlein M, Zyskowski M, van Griensven M, Biberthaler P, Lefering R, Huber-Wagner S; Section NIS of DGU.

BACKGROUND: The temporal distribution of trauma mortality has been classically described as a trimodal pattern with an immediate, early and late peak. In modern health care systems this time distribution has changed.

METHODS: Data from the TraumaRegister DGU was analysed retrospectively. Between 2002 and 2015, all registered in-hospital deaths with an Injury Severity Score (ISS) ≥ 16 were evaluated considering time of death, trauma mechanism, injured body area, age distribution, rates of sepsis and multiple organ failure. Pre-hospital and post-discharge trauma deaths were not considered.

RESULTS: 78 310 severely injured patients were registered, non-survivors constituted 14 816, representing an in-hospital mortality rate of 18.9%. Mean ISS of non-survivors was 36.0±16.0, 66.7% were male, mean age was 59.5±23.5. Within the first hour after admission to hospital, 10.8% of deaths occurred, after 6 hours the percentage increased to 25.5%, after 12 hours 40.0%, after 24 hours 53.2% and within the first 48 hours 61.9%. Mortality showed a constant temporal decrease. Severe head injury (defined by Abbreviated Injury Scale, AIS-Head≥3) was found in 76.4% of non-survivors. Patients with an isolated head injury showed a more distinct decrease in survival rate, which was accentuated in the first days after admission. The correlation of age and time of death showed a proportional increase with age (55-74a). The rate of sepsis and multiple organ failure among non-survivors was 11.5% and 70.1%, respectively.

CONCLUSION: In a modern trauma care system, the mortality distribution of severely injured patients has changed its pattern, where especially the third peak is no longer detectable.

Injury. 2019 Jan;50(1):96-100. doi: 10.1016/j.injury.2018.09.051. Epub 2018 Sep 28.

Impact of body mass index on outcomes after thoracic trauma-A matched-triplet analysis of the TraumaRegister DGU®.

Schieren M, Böhmer AB, Lefering R, Paffrath T, Wappler F, Defosse J; TraumaRegister DGU.

INTRODUCTION: Chest trauma and obesity are both associated with increased risks for respiratory complications (e.g. hypoxia, hypercarbia, pneumonia), which are frequent causes of posttraumatic morbidity and mortality. However, as there is only limited and inconsistent evidence, the aim of our study was to analyse the effect of body mass index (BMI) on patient outcomes after thoracic trauma.

PATIENTS AND METHODS: We screened 50.519 patients entered in TraumaRegister DGU®, between 2004-2009, when the BMI was part of the standardized dataset. After matching for injury patterns and severity of trauma we performed a matched tripled analysis with regard to the BMI (group 1: <25.0 kg/m2; group 2: 25.0-29.9 kg/m2; group 3: >30.0 kg/m2). Data are shown as percentages and mean values with standard deviation.

RESULTS: The matching process yielded a cohort of 828 patients with serious blunt thoracic trauma, evenly distributed over the 3 BMI groups (276 triplets). BMI did not have an impact on the need for prehospital or emergency department interventions. There was a trend towards more liberal use of whole-body-CT scanning with increasing BMI (group 1: 68.8%; group 2: 73.2%; group 3: 75.0%). Additional abdominal injuries were more common in normal weight patients (Group 1: 28.3%; Group 2: 14.9%; Group 3: 17.8%). Obesity (BMI > 30.0 kg/m2) had a significant impact on the duration of mechanical ventilation (in days; group 1: 6.5 (9.4); group 2: 6.4 (8.9); group 3: 9.1 (14.4); p = 0.002), ICU days (in days; group 1: 11.5 (11.5); group 2: 10.9 (9.6); group 3: 14.1 (16.7); p = 0.005) and hospital length of stay (in days; group 1: 27.8 (19.3); group 2: 27.4 (19.2); group 3: 32.2 (25.9); p = 0.009). There were no significant differences regarding overall mortality (group 1: 3.6%; group 2: 1.8%; group 3: 4.0%; p = 0.26).

CONCLUSION: Obesity has a negative impact on outcomes after blunt chest trauma, as it is associated with prolonged duration of mechanical ventilation, ICU and hospital length of stay. Mortality did not seem to be affected, yet, further research is required to confirm these results in a larger cohort.

World J Surg. 2019 Jun 3. doi: 10.1007/s00268-019-05041-8. [Epub ahead of print]

Predictors for Pediatric Blunt Cerebrovascular Injury (BCVI): An International Multicenter Analysis.

Weber CD, Lefering R, Weber MS, Bier G, Knobe M, Pishnamaz M, Kobbe P, Hildebrand F; TraumaRegister DGU.

INTRODUCTION: Practice guidelines for adult BCVI patients have been implemented recently, but data for this devastating injury pattern in children are still limited. An international multicenter analysis was performed to characterize BCVI in the pediatric population.

METHODS: The TraumaRegister DGU®, a prospectively maintained database, was analyzed (01/2002-12/2015). Pediatric patients (0-17 years) with major injuries [Injury Severity Score (ISS) ≥ 9 points] were included. BCVI was divided into carotid artery injury and vertebral artery injury (VAI). Data of demographics, injury, imaging, therapy, and outcome characteristics were analyzed with SPSS (Version 25, IBM Inc., Armonk, NY).

RESULTS: The study cohort included 8128 pediatric trauma patients. We identified 48 BCVIs in 42 children, resulting in an overall prevalence of 0.5%. Carotid injuries were diagnosed more frequently (n = 30; 0.4%) when compared to VAIs (n = 12; 0.1%). The coincidence of head (p = 0.028), facial (p ≤ 0.001), chest (p ≤ 0.001), and spinal injuries (p ≤ 0.001) was higher in BCVI patients. The risk for thromboembolic complications (8.3% vs. 1%, p = 0.026) and in-hospital mortality (38.1% vs. 7.7%, p ≤ 0.001) was excessive in children with BCVI. We identified various predictors for pediatric BCVI and quantified the cumulative impact of these risk factors.

CONCLUSION: BCVI is more uncommon in pediatric than in adult trauma patients. Due to the considerable relevance of this injury for both children and adults, special attention should be paid to this entity and associated complications in the early treatment phase after severe pediatric trauma, especially in high-risk children.

Eur J Trauma Emerg Surg. 2018 Dec 14. doi: 10.1007/s00068-018-1055-z. [Epub ahead of print]

Evaluation of new quality indicators for the TraumaRegister DGU® using the systematic QUALIFY methodology.

Bieler D, Hörster A, Lefering R, Franke A, Waydhas C, Huber-Wagner S, Baacke M, Paffrath T, Wnent J, Volland R, Jakisch B, Walcher F, Kulla M.

BACKGROUND: The TraumaRegister DGU® (TR-DGU) of the German Trauma Society (Deutsche Gesellschaft für Unfallchirurgie, DGU) enables the participating hospitals to perform quality management. For that purpose, nine so-called audit filters have existed, since its foundation, which, inter alia, is listed in the Annual Report. The objective of this study effort is a revision of these quality indicators with the aim of developing pertinent new and reliable quality indicators for the management of severely injured patients.

MATERIALS AND METHODS: Apart from indicators already used at national and international levels, a systematic review of the literature revealed further potential key figures for quality of the management of severely injured patients. The latter were evaluated by an interdisciplinary and interprofessional group of experts using a standardized QUALIFY process to assess their suitability as a quality indicator.

RESULTS: By means of the review of the literature, 39 potential indicators could be identified. 9 and 14 indicators, respectively, were identified in existing trauma registries (TR-DGU and TARN), 17 in the ATLS® training concept, and 57 in the S3 guideline on the treatment of polytrauma/severe injuries. The exclusion of duplicates and the limitation to indicators that can be collected using the TR-DGU Version 2015 data set resulted in a total of 43 indicators to be reviewed. For each of the 43 indicators, 13 quality criteria were assessed. A consensus was achieved in 305 out of 559 individual assessments. With 13 quality criteria assessed and 43 indicators correspond this to a relative consensus value of 54.6%. None of the indicators achieved a consensus in all 13 quality criteria assessed. The following 13 indicators achieved a consensus in at least 9 quality criteria: time between hospital admission and WBCT, mortality, administration of tranexamic acid to bleeding patients, use of CCT with GCS > 14, time until first emergency surgical intervention (7-item list in the TR-DGU), time until surgical intervention for penetrating trauma, application of pelvic sling belt (prehospital), capnometry (etCO2) in intubated patients, time until CCT with GCS < 15, time until surgery for hemorrhagic shock, time until craniotomy for severe TBI, prehospital airway management in unconscious patients (GCS < 9), and complete basic diagnostics available. Two indicators achieved a consensus in 11 criteria and thus represent the maximum consensus achieved within the group of experts. Four indicators only achieved a consensus in three quality criteria. 17 indicators had a mean value for the 3 relevance criteria of ≥ 3.5 and were, therefore, assessed by the group of experts as being highly relevant.

CONCLUSION: Not all the key figures published for the management of severely injured patients are suitable for use as quality indicators. It remains to be seen whether the quality indicators identified by experts using the QUALIFY process will meet the requirements in practice. Prior to the implementation of the assessed quality indicators in standardized quality assurance programs, a scientific evaluation based on national data will be required.

Unfallchirurg. 2018 Oct;121(10):774-780. doi: 10.1007/s00113-018-0558-8.

Future perspective of the TraumaRegister DGU® : Further development, additional modules and potential limits.

Flohé S, Matthes G, Maegele M, Huber-Wagner S, Nienaber U, Lefering R, Paffrath T.

Since its founding in 1993 the TraumaRegister DGU® has become one of the largest registries especially in terms of data diversity. Since the introduction of the TraumaNetzwerk DGU®, the TraumaRegister DGU® has enabled a quasi-nationwide picture of the quality of care of severely injured patients in Germany. The register is subject to constant development, under the guidance of the working groups of the German Society for Trauma Surgery (DGU). The first modular expansion of special injury entities (craniocerebral trauma and complex hand injuries) is currently taking place. The future developments will involve the extension of the register to certain injury patterns. The existing registry will also be supplemented with other recorded qualities (from the supplementary serum database up to the quality of life). This makes the TraumaRegister DGU® a tool for quality assurance and science which is well prepared for the future.

Eur J Trauma Emerg Surg. 2018 Sep 17. doi: 10.1007/s00068-018-1004-x. [Epub ahead of print]

Resource use and clinical outcomes in blunt thoracic injury: a 10-year trauma registry comparison between southern Finland and Germany.

Heinänen M, Brinck T, Lefering R, Handolin L, Söderlund T.

PURPOSE: Serious thoracic injuries are associated with high mortality, morbidity, and costs. We compared patient populations, treatment, and survival of serious thoracic injuries in southern Finland and Germany.
METHODS: Mortality, patient characteristics and treatment modalities were compared over time (2006-2015) in all patients with Abbreviated Injury Scale (AIS) thorax ≥ 3, Injury Severity Score (ISS) > 15, age > 15 years, blunt trauma mechanism, and treatment in Intensive Care Unit (ICU) in Level 1 hospitals included in the Helsinki Trauma Registry (HTR) and the TraumaRegister DGU® (TR-DGU).
RESULTS: We included 934 patients from HTR and 25 448 patients from TR-DGU. Pre-hospital differences were seen between HTR and TR-DGU; transportation in the presence of a physician in 61% vs. 97%, helicopter use in 2% vs. 42%, intubation in 31% vs. 55%, and thoracostomy in 6% vs. 10% of cases, respectively. The mean hospital length of stay (LOS) and ICU LOS was shorter in HTR vs. TR-DGU (13 vs. 25 days and 9 vs. 12 days, respectively). Our main outcome measure, standardised mortality ratio, was not statistically significantly different [1.01, 95% confidence interval (CI) 0.84-1.18; HTR and 0.97, 95% CI 0.94-1.00; TR-DGU].
CONCLUSION: Major differences were seen in pre-hospital resources and use of pre-hospital intubation and thoracostomy. In Germany, pre-hospital intubation, tube thoracostomy, and on-scene physicians were more prevalent, while patients stayed longer in ICU and in hospital compared to Finland. Despite these differences in resources and treatment modalities, the standardised mortality of these patients was not statistically different.

Sci Rep. 2018 Aug 1;8(1):11567. doi: 10.1038/s41598-018-30053-0.

Synthetic colloid resuscitation in severely injured patients: analysis of a nationwide trauma registry (TraumaRegister DGU).

Hilbert-Carius P, Schwarzkopf D, Reinhart K, Hartog CS, Lefering R, Bernhard M, Struck MF.

The purpose of this study was to investigate the efficacy and safety of synthetic colloid resuscitation among severely injured patients. Fluid resuscitation of trauma patients of a nationwide trauma registry was analysed between 2002 and 2015. Effects of synthetic colloid resuscitation in the pre-hospital setting and emergency department on renal failure, renal replacement therapy and multiple organ failure were analysed among patients with ≥2 days intensive care unit stay, and in-hospital mortality was analysed among all patients. 48,484 patients with mean age of 49 years and mean injury severity score of 23 points were included; 72.3% were male and 95.5% had blunt trauma. Risk-adjusted analyses revealed that patients receiving >1,000 ml synthetic colloids experienced an increase of renal failure and renal replacement therapy rates (OR 1.42 and 1.32, respectively, both $p \leq 0.006$). Any synthetic colloid use was associated with an increased risk of multiple organ failure ($p < 0.001$), but there was no effect on hospital mortality ($p = 0.594$). Between 2002 and 2015 usage of synthetic colloids dropped, likewise did total fluid intake and usage of blood products. The data from this analysis suggests that synthetic colloid resuscitation provides no beneficial effects and might be harmful in patients with severe trauma.

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Nerve injury in severe trauma with upper extremity involvement: evaluation of 49,382 patients from the TraumaRegister DGU® between 2002 and 2015.

Huckhagel T, Nüchtern J, Regelsberger J, Lefering R; TraumaRegister DGU.

BACKGROUND: Peripheral nerve injury (PNI) as an adjunct lesion in patients with upper extremity trauma has not been investigated in a Central European setting so far, despite of its devastating long-term consequences. This study evaluates a large multinational trauma registry for prevalence, mechanisms, injury severity and outcome characteristics of upper limb nerve lesions.

METHODS: After formal approval the TraumaRegister DGU® (TR-DGU) was searched for severely injured cases with upper extremity involvement between 2002 and 2015. Patients were separated into two cohorts with regard to presence of an accompanying nerve injury. For all cases demographic data, trauma mechanism, concomitant lesions, severity of injury and outcome characteristics were obtained and group comparisons performed.

RESULTS: About 3,3% of all trauma patients with upper limb affection (n = 49,382) revealed additional nerve injuries. PNI cases were more likely of male gender (78,6% vs.73,2%) and tended to be significantly younger than their counterparts without nerve lesions (mean age 40,6 y vs. 47,2 y). Motorcycle accidents were the most frequently encountered single cause of injury in PNI patients (32,5%), whereas control cases primarily sustained their trauma from high or low falls (32,2%). Typical lesions recognized in PNI patients were fractures of the humerus (37,2%) or ulna (20,3%), vascular lacerations (arterial 10,9%; venous 2,4%) and extensive soft tissue damage (21,3%). Despite of similar average trauma severity in both groups patients with nerve affection had a longer primary hospital stay (30,6 d vs. 24,2 d) and required more subsequent inpatient rehabilitation (36,0% vs. 29,2%).

CONCLUSION: PNI complicating upper extremity trauma might be more commonly encountered in Central Europe than suggested by previous foreign studies. PNI typically affect males of young age who show significantly increased length of hospitalization and subsequent need for inpatient rehabilitation. Hence these lesions induce extraordinary high financial expenses besides their impact on health related quality of life for the individual patient. Further research is necessary to develop specific prevention strategies for this kind of trauma.

14 Literature used in the annual report

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17 List of abbreviations

AIS	Abbreviated Injury Scale
ASA	American Society of Anaesthesiologists (classification)
AUC	AUC – Academy of 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

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