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Diagnostic groups of risk in trauma patients as independent groups of patients. Proposition for National Health Foundation. Clinical estimation costs of treatment. III. Diagnostic groups of risk

Diagnostyczne grupy ryzyka (DGR) w obrażeniach ciała, jako osobne jednorodne grupy pacjentów (jgp). Propozycja do katalogu NFZ. Ocena kliniczna kosztów leczenia.

III. Diagnostyczne grupy ryzyka (DGR)

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With the use of all the data and numerous statistical tests, conclusions presented in previous publications in this series were obtained, allowing the distribution of injured patients into different risk groups. If factors like severity, extent and localization of the injuries and also age and gender of patients have deciding influence on the medical and economical effects of injuries (what was shown in previous reports), those parameters themselves may form grounds for creating classification of the patients dividing them into diagnostic groups of risk (DGR), similar to diagnosis related groups (DRG), but concerning injuries. The aim of study was to develop classification of patients after injuries into groups basing on the severity of the injuries (according to QIS and the location of injuries), age and gender of patients and assessment of usability of created DGR classification for performed examinations and attempt of efficiency assessment of this classification for potential performance of prospective studies. Statistical analysis of data concerning 3614 patients with injuries was performed (3435 patients hospitalized in the urgent way during the emergency service and 179 patients deceased in the preoperative period. In the statistical analysis there were sums, averages, percentage values, standard deviations calculated and a number of statistical test were used: t-Student test, Pearson chi-squared test. All of the patients were divided into groups according to the area of the body which was injured, the severity of the injury described with the use of QIS, age and gender, where the criterion of classification was the retirement age limit in Poland. It was 65th year of age for men and 60th year of age for women. There were 7 body areas distinguished (head, thorax, abdomen, pelvis, spine, upper extremities and lower extremities) with the group of multiply trauma as the 8th area. Within the 7 main groups there were 4 sub-groups created - light and medium injuries (QIS<4) and heavy injuries (QIS≥4) in two different age groups. Similar classification was used for multiple trauma (MT), but as light and medium injuries were injuries characterized by QIS<9 and the heavy ones

Wykorzystując wszystkie informacje oraz przeprowadzając liczne testy statystyczne uzyskano zaprezentowane w poprzednich pracach z tego cyklu wnioski, uprawniające podział uszkodzonych na grupy o różnym ryzyku. Jeśli więc, jak wynika z poprzednich doniesień, decydujący wpływ na medyczne i ekonomiczne skutki urazów odgrywają czynniki takie, jak: ciężkość, rozległość i lokalizacja obrażeń oraz wiek i płeć poszkodowanych, to te właśnie parametry mogą dawać podstawę do stworzenia podziału wszystkich chorych na diagnostyczne grupy ryzyka (DGR), na kształt jednorodnych grup pacjentów (JGP), tyle, że po urazach. Celem pracy był podział chorych po urazach na grupy na podstawie ciężkości obrażeń (wg LSO i umiejscowienia uszkodzeń ciała) oraz wieku i płci leczonych oraz ocena przydatności stworzonego podziału DGR dla przeprowadzonych badań, a także próba oceny skuteczności tegoż podziału dla ewentualnego prowadzenia badań prospektywnych. Dokonano analizy statystycznej danych o 3614 chorych z obrażeniami ciała (3435 hospitalizowanych w trybie nagłym i 179 zmarłych w okresie przedszpitalnym. W analizie statystycznej obliczono sumy, różnice, średnie, wartości procentowe, odchylenia standardowe, a także szereg testów statystycznych - T-Studenta, chi2. Wszystkich chorych podzielono na grupy w zależności od okolicy ciała, która uległa obrażeniu, ciężkości urazu wyrażonego za pomocą LSO i wieku oraz płci chorego, gdzie kryterium podziału stanowiła granica wieku emerytalnego w Polsce. Dla mężczyzn był to 65 a dla kobiet 60 rok życia. Wyróżniono 7 regionów ciała (głowa, klatka piersiowa, brzuch, miednica, kręgosłup, kończyny górne i kończyny dolne), a jako ósmy dodano grupę mnogich obrażeń ciała (MOC). W 7 podstawowych grupach wyróżniono 4 podgrupy - urazów lekkich i średnich (LSO<4), oraz ciężkich (LSO≥4) w dwóch różnych grupach wiekowych. Dla MOC przyjęto podobny podział, z jedną tylko różnicą, że lekkie i średnie urazy to obrażenia z LSO<9, a ciężkie z LSO≥9. W sumie utworzono 32 grupy, które nazwano diagnostycznymi grupami ryzyka (DGR). Najbardziej istotnymi różni-

were characterized by QIS19. In all there were 32 groups described as the diagnostic groups of risk (DGR). The differences, which proved to be the most essential in individual DGR are: period of hospitalization depending on the age, direct costs and losses, including the economical losses, related to the sick absence in particular age groups and the severity of the injuries in individual groups. The above considerations show that creating of Diagnostic Groups of Risk Classification was fully justified. The ability of multidirectional application of DGR both in retrospective studies and also to classifying the injuries and prognostication its economic results, system's simplicity and clarity, after taking many additional factors influencing the efficacy of the treatment into account and also the forecast of the patient's future state - it all makes the system an accessible and friendly tool for people wanting to deal with a problem of economical results of the injuries. It also forms grounds for modifying the system of the clearance of medical procedures and can facilitate the decision making for emergency services about transporting the patient to appropriate center. DGR efficiently performed all the functions and tasks, which were assumed during its creation. Nevertheless the similarities to the American equivalents, it seems that their existing mistakes were avoided, it was successfully adapted to the realities of the Polish health service and also its structure was significantly simplified. With the use of DGR it was possible to extrapolate the results and compare them with other authors' work results, concerning the problem of incidence of traumas, the mechanism of the injury, the influence of additional factors, the costs of the injuries or the economical results of the injuries, including post-traumatic disability.

Introduction

With the use of all the data and numerous statistic tests, conclusions presented in previous publications in this series were obtained, allowing the distribution of injured patients into different risk groups. It not only allows to assess the economical results of injuries in retrospective studies, but in the future also to initially estimate the needs of every patient - required way of dressing, need of treatment in the reference or specialized centers, estimated time of hospitalisation, direct cost of treatment, forecast of the future state. Real assessment of economical loss connected with indirect costs would be possible at the very beginning, just after the injury and thereby it would be possible to plan a treatment in the way that cuts down the unnecessary costs. Parameters describing the patients were selected in the way allowing very precise comparisons between individual diagnostic groups of risk.

If factors like severity, expanse and localization of the injuries and also age and gender of patients have deciding influence on the medical and economical effects of injuries (what was shown in previous reports), those parameters themselves may form grounds for creating classification of the patients dividing them into diagnostic groups of risk (DGR), similar to diagnosis related groups (DRG), but concerning injuries [1]. Creation of the classification was based on experien-

camy w poszczególnych DGR okazały się następujące parametry: długość hospitalizacji w zależności od wieku, koszty bezpośrednie, oraz straty, w tym również ekonomiczne, związane z absencją chorobową w poszczególnych grupach wiekowych oraz w poszczególnych grupach ciężkości obrażeń. Powyższe rozważania wykazują, że stworzenie podziału na Diagnostyczne Grupy Ryzyka jest w pełni uzasadnione. Możliwość wielokierunkowego wykorzystania DGR zarówno w celach prowadzenia badań retrospektywnych, jak i użycia tego systemu do klasyfikacji obrażeń i prognozowania ich ekonomicznych następstw, jego prostota i przejrzystość, przy uwzględnieniu wielu czynników dodatkowych wpływających na skuteczność leczenia, oraz dalsze losy chorego czyni go przystępnym i przyjaznym narzędziem dla osób pragnących zająć się problemami ekonomicznymi następstw urazów. Daje ono również podstawy do zmodyfikowania systemu rozliczania procedur medycznych, jak też może ułatwić podjęcie służbom ratunkowym prawidłowych decyzji, co do przewozu pacjenta po urazie do odpowiedniego ośrodka. DGR spełniają więc wszystkie zadania i funkcje, które założono, przy ich tworzeniu. Pomimo podobieństw do jego amerykańskich odpowiedników, wydaje się, że udało się uniknąć błędów, które popelniono przy tworzeniu tamtych klasyfikacji, dostosowano go na potrzeby funkcjonowania w realiach polskiej służby zdrowia, a także znacznie uproszczono ich strukturę. Z pomocą DGR udało się ekstrapolować wyniki i porównać je z wynikami prac innych autorów, zajmujących się problemami urazowości, mechanizmami urazów, wpływem dodatkowych czynników na uraz, kosztów urazów czy wreszcie ekonomicznych następstw urazów, w tym również inwalidztwa pourazowego.

ce of American authors (E. McKenzie and co-authors), who in the eighties became the pioneers in the field of costs of injuries and proposed a model of groups based on the injury severity score (in this case: ISS), age and gender. This is how DRG were created (Diagnosis Related Groups). It was mainly used for the purposes of forecasting of the costs of injuries and it was a kind of "triage" for the patients after the injuries. It was modified throughout the years - the number of groups grew from 40 primary groups up to 172 final groups after introducing a very precise system of diagnosis [2,3]. In a way it was a result of the fact that AIS scale was integrated with the ICD-10 classification [4]. Similarly, there were subgroups created within existing DRG groups and more precise diagnosis were performed, which led to more accurate forecasting of the costs. The system was created basing on a huge material (over 20 thousand patients - studies were performed in all the injury centers in Maryland) and it became widely used in many injury centers, not only in the United States.

The system was used for the prognostic estimation of the costs and also for the selection of the patients - due to classification of the patients into sub-groups it was possible to determine if treatment in specialized centers of I or II degree of reference is needed or if the patient may be treated in a lower reference centers. Such action was performed in order to decrease the costs of treatment by redu-

cing the unnecessary expenses. In spite of very precise classification of the patients with single injuries, the system lacked the ability for detailed classification of the patients with multiple trauma, which was a kind of difficulty, especially due to the growing number of injuries of this type worldwide [5-8]. Nowadays DRG are used not only to estimate the costs of injuries, but also in all branches of medicine. It was possible due to the fusion with ICD-9. In effect, every disease has currently its place in DRG classification. There were tries of creating other classifications based on similar parameters, but although they weren't as complicated, they didn't come into wide use (TRG - Trauma Resource Groups and PMC - Patient Management Categories) [9,10].

Unlike American authors, who mostly highlighted the precise description of the location of the injury and its severity in few age brackets (resulting in plurality of the groups), our DGR (Diagnostic Groups of Risk) system is based on QIS (Quantitative Injury Scale). It allowed to decrease number of groups and separate multiply trauma patients. Only two age groups for women were created: under 60 years of age and older and also two age groups for men: under and over 65 years of age. Age in this case determines the occupational activity: patients in working and post-working age. This is a simple way to define if patient generates indirect costs related to the loss of Gross

Table I
General characteristics of Diagnostic Groups of Risk (DGR).

DGR	N	Men	Women	Age	Alcoh	LSO	Lenght of stay	Days in ICU	N patients in ICU	Operative treatment	Conservat. treatment	Prehosp.
A	2069	1485	584	36.41 ± 13.78	356	2.26 ± 1.00	4.86 ± 5.34	72	14	1170	896	3
1	788	551	237	34.04 ± 13.30	194	1.82 ± 0.56	3.14 ± 2.02	2	2	275	513	0
3	93	80	13	42.54 ± 14.48	16	2.35 ± 0.67	5.72 ± 4.57	23	6	37	56	0
5	32	24	8	27.87 ± 13.01	2	1.62 ± 0.75	3.06 ± 1.29	0	0	9	23	0
7	38	23	15	36.82 ± 14.76	2	2.13 ± 0.81	4.97 ± 4.94	5	1	9	29	0
9	360	275	85	37.04 ± 14.01	67	2.28 ± 0.61	4.37 ± 4.02	2	1	293	65	2
11	606	426	180	38.45 ± 13.20	53	2.30 ± 0.55	6.58 ± 6.11	4	1	490	115	1
13	59	38	21	40.03 ± 14.65	5	2.59 ± 0.59	4.41 ± 2.87	0	0	1	58	0
29	93	68	25	35.05 ± 14.28	17	5.70 ± 1.18	10.24 ± 13.58	36	3	56	37	0
B	439	358	81	39.85 ± 14.39	131	9.29 ± 6.10	12.97 ± 13.36	755	66	208	85	146
2	100	90	10	38.96 ± 14.30	38	6.19 ± 2.32	7.24 ± 7.82	139	22	21	49	30
4	25	18	7	39.88 ± 13.51	7	5.80 ± 1.80	11.56 ± 9.37	27	2	10	6	9
6	20	20	0	32.70 ± 15.70	2	4.65 ± 0.75	8.20 ± 2.84	4	1	18	2	0
8	5	4	1	32.80 ± 10.01	2	4.20 ± 0.45	16.00 ± 18.75	0	0	0	5	0
10	8	8	0	29.37 ± 10.41	2	4.00 ± 0.00	8.12 ± 4.42	0	0	7	1	0
12	110	77	33	45.82 ± 13.61	16	4.27 ± 0.47	14.61 ± 7.65	31	2	102	8	0
14	13	13	0	39.31 ± 14.85	3	6.23 ± 1.74	5.22 ± 5.17	26	3	1	8	4
30	158	128	30	37.96 ± 13.98	61	16.58 ± 3.83	20.80 ± 23.98	528	36	49	6	103
C	606	181	425	74.21 ± 8.00	21	2.57 ± 1.23	6.77 ± 7.62	106	8	315	291	0
15	178	61	117	74.89 ± 8.45	17	1.84 ± 0.65	4.70 ± 3.52	35	4	78	100	0
17	39	18	21	76.95 ± 8.24	0	2.46 ± 0.72	6.77 ± 4.02	2	1	3	36	0
19	3	1	2	72.33 ± 9.45	0	2.00 ± 1.00	4.00 ± 1.00	0	0	0	3	0
21	28	7	21	80.36 ± 8.35	0	2.57 ± 0.69	7.79 ± 9.30	2	1	1	27	0
23	151	34	117	73.63 ± 7.30	1	2.59 ± 0.52	5.96 ± 6.82	0	0	127	24	0
25	117	30	87	71.76 ± 7.43	2	2.32 ± 0.66	8.97 ± 10.80	0	0	76	41	0
27	40	18	22	73.97 ± 6.80	0	2.65 ± 0.77	5.90 ± 6.16	0	0	0	40	0
31	50	12	38	73.98 ± 7.83	1	5.72 ± 1.33	11.74 ± 10.32	67	2	30	20	0
D	500	126	374	79.20 ± 8.04	22	5.44 ± 3.55	14.91 ± 8.46	336	41	404	66	30
16	29	16	13	76.03 ± 6.34	12	5.72 ± 2.05	9.29 ± 10.09	71	9	6	18	5
18	6	4	2	74.50 ± 5.01	1	4.50 ± 0.84	21.50 ± 11.54	58	2	5	1	0
20	3	2	1	75.00 ± 9.17	0	5.67 ± 1.15	12.50 ± 2.12	1	1	2	0	1
22	2	1	1	70.00 ± 5.6	0	4.50 ± 0.71	21.50 ± 9.19	0	0	1	1	0
24	4	2	2	78.50 ± 11.12	0	4.25 ± 0.50	17.25 ± 5.97	0	0	4	0	0
26	408	74	334	80.18 ± 7.94	3	4.40 ± 0.49	15.30 ± 7.16	37	14	374	34	0
28	9	6	3	75.11 ± 6.47	0	4.44 ± 1.01	12.78 ± 23.33	75	2	1	8	0
32	39	21	18	73.79 ± 7.40	6	16.64 ± 4.25	10.60 ± 16.20	94	13	11	4	24

*Prehospital deaths supplement the amounts of patients operated and treated conservatively in individual DGR, those deceased patients were also not taken into account while calculating the average hospitalisation period.

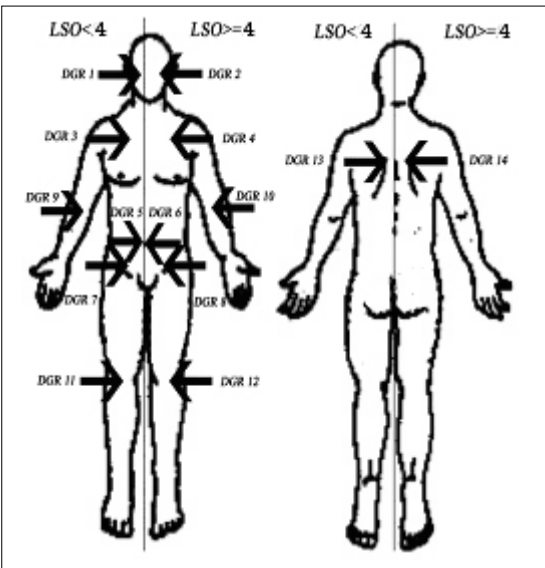
Domestic Product (GDP), sickness benefits and pensions. Majority of the publications concerning injuries of the elderly persons describes them as people from 60 to 65 years old. It formed grounds for conducting of the precise epidemiological examination and more detailed assessment of economical results of injuries.

This case is essential due to the fact that the procedures associated with treat-

ment of effects of injuries - as the National Health Foundation proposed - were spread between individual diagnosis related groups, including diseases of the organs, systems or areas of the body. Only one criteria of classification is in force here: the anatomical or the physiological criteria. Such division would be an alternative for the currently binding catalogues of the National Health Foundation con-

cerning post-traumatic procedures. Classification based on such criteria is reasonable due to the cost analysis: they grow with the severity of the injury - which is obvious - but also with age. It seems that such classification including diagnostic groups of risk, maybe with some modifications applied, may in the future also be used (or at least make easier) as the prognostic cost assessment of results of the

Men up to 65 years old and women up to 60 years old



Men over 65 years old and women over 60 years old

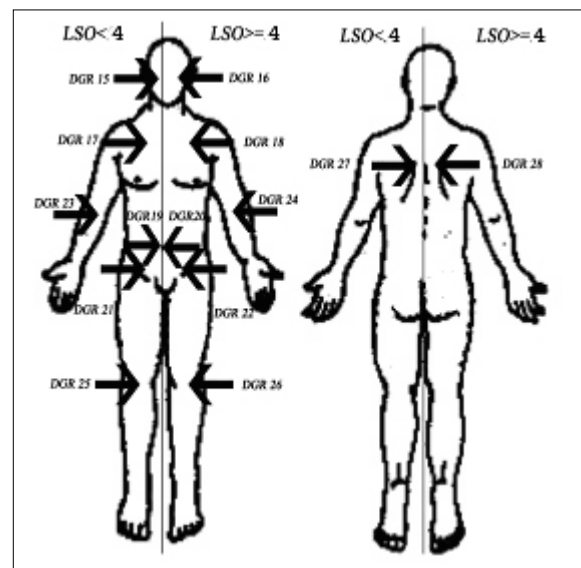


Figure 1

Classification into diagnostic groups of risk (DGR). The 4 last groups consist of the accident victims with multiple trauma (MT): up to 65 years of age: LSO ?8 - DGR 29, LSO ?9 - DGR 30, over 65 years of age: LSO ?8 - DGR 31, LSO ?9 - DGR 32.

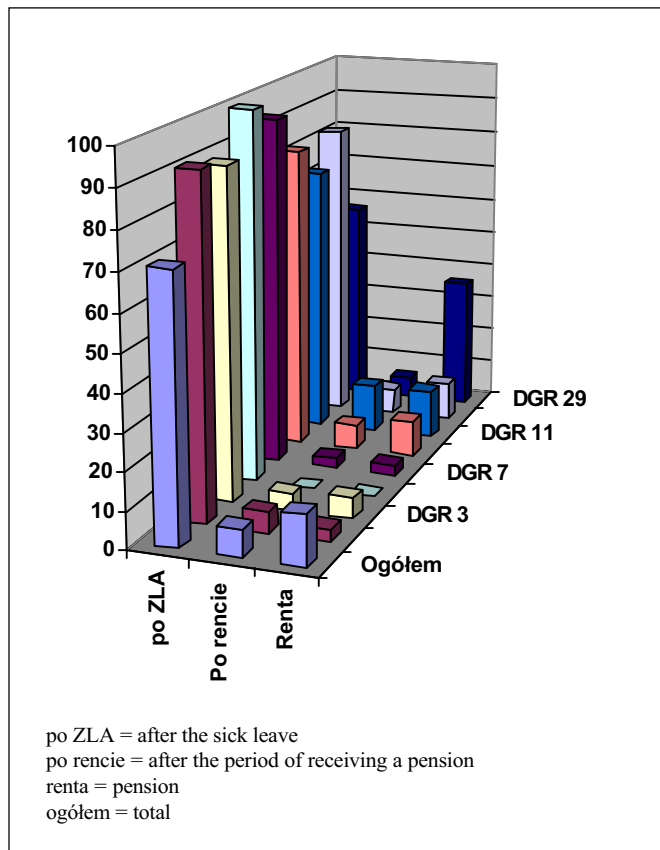


Figure 2

DGR of patients in the working age with light injuries: come back to work (A).

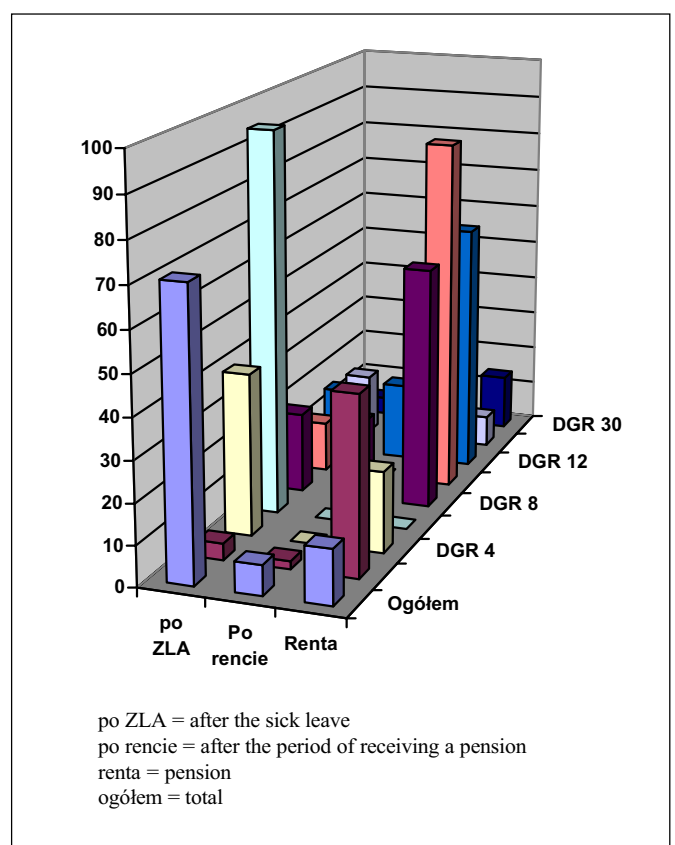


Figure 3

DGR of patients in the working age with heavy injuries: come back to work (B).

injuries, not only in retrospective studies.

Due to specificity of the organism's reaction to injury, the more severe the injury is, the more damage it does to all the functions of the organism, regardless of the injury's location. It is also known for a long time that besides the injury's location, other factors are decisive in matter

of the course of treatment, therapeutic requirements, frequency of complications, mortality and disability. These factors decide about direct treatment costs financed by the National Health Foundation, but also - or rather most of all - they decide about indirect costs, which are ten times higher and debit the state, its tre-

asury, taxpayers and in this way they essentially influence the condition of citizen's and government's finances.

Aim of the study

1. Classification of patients after injuries into groups basing on the severity

Table II
Post-traumatic inability to work and mortality among patients in the working age.

DGR	L. ch.	Niepracujący żyjący	Pracujący żyjący	Powrót do pracy po ZLA	Powrót do pracy po rencie	Renta nadal	Zgony ul/szp uprawn	Renty po urazach po alkoholu	Liczba utraconych lat pracy	Liczba utraconych lat pracy w grupie osób zmarłych do roku 2007
	2508	129	2173	1677	176	320	149/57	127	4664	1478
1	788	43	745	678	42	25	0/0	16	323,39	0
2	100	2	49	4	2	43	30/19	14	323,87	351
3	93	2	90	81	4	5	0/1	1	54,22	6
4	25	0	15	10	0	5	9/1	3	42,72	70
5	32	2	30	30	0	0	0/0	0	1,42	0
6	20	0	19	19	0	0	0/1	0	3,58	8
7	38	1	37	35	1	1	0/0	0	21,75	0
8	5	0	5	1	1	3	0/0	2	22,44	0
9	360	32	326	272	22	32	2/0	13	376,96	13
10	8	0	8	1	0	7	0/0	2	51,22	0
11	606	31	574	423	75	76	1/0	53	939,44	7
12	110	12	96	16	19	61	0/2	14	497,72	14
13	59	2	57	47	4	6	0/0	1	63,53	0
14	13	0	4	2	1	1	4/5	1	10,7	68
29	93	2	89	51	5	33	0/2	3	269,48	9
30	158	0	29	7	0	22	103/26	5	174,67	932
A	2069	115	1948	1617	153	178	3/3	86	3537,08	35
B	439	14	225	60	23	142	146/54	41	1126,92	1443

of the injuries (according to QIS and the location of injuries), age and gender of patients.

2. Assessment of usability of created DGR classification for performed examinations and attempt of efficiency assessment of this classification for potential performance of prospective studies.

Materials and methods

Statistical analysis of data concerning 3614 patients with injuries was performed (3435 patients hospitalized in the urgent way during the emergency service in 2nd Department of Surgery of Collegium Medicum at Jagiellonian University in Krakow and 179 patients deceased in the preoperative period in the same days (6 days in 4 years), in the area covered by the emergency service, inhabited by 800 thousand people above 14 years of age, between 1999-2002). During calculation of the direct treatment costs, which so far included only costs of the medicines, medical materials and so called bed/days costs, the accident victims who died in the preoperative period were not taken into account. So far, the costs of work of the medical personnel and paramedic personnel were also not included. In this part of the study there was an attempt taken to update the costs and include the ones that

were not taken into consideration so far. For the medicines and medical materials the an inflation rate of 1.7 was assumed. It was also assumed that the labour costs in medicine are the half of all the costs. The costs calculated in such way are finally enlarged by adding the amounts resulting from treatment in intensive-care unit with the use of TISS system (Therapeutic Intervention Scoring System). Information about the patients was collected with the use of data base named PATIENTS, created for the Department's needs.

Based on the questionnaire prepared specially for this purpose there was a follow-up carried out, performed within 2-8 years after the accident. That is how the time of complete treatment of the patients was estimated (periods of sick leave, periods of receiving the rehabilitation benefit, pensions), the number of people who to retired on a pension. This data was obtained directly from the medical documentation and partly from the interviews taken from the patients themselves. It was possible to examine the data of 94.63% of all of the patients treated in that time. The remaining 5.37% was excluded due to the incomplete data in case records, the impossibility to examine the patients again or finally, the lack of answer from the patients, which made finishing the qu-

estionnaire impossible.

In the statistical analysis there were sums, averages, percentage values, standard deviations calculated and a number of statistic test were used: t-Student test, Pearson chi-squared test.

Classification into diagnostic groups of risk was made according to the injured areas of the body and withing that, two age groups and another two severity groups were created (Fig. 1).

Results

2508 patients (69.39%) were in the working age and 1106 (30.61 %) were in the post-working age. Information about the number of patients in each DGR group, their gender and age, hospitalisation, treatment results etc. is presented in the Table 1. In part A (similarly to other tables) the younger patients suffering from light injuries were presented, in part B - younger patients with heavy injuries, in part C - older patients with light injuries and in the part D - older patients with heavy injuries. These parts are obviously differ from each other in age, severity of injuries and gender (in the group of post-working age patients women dominate). But the differences are seen also between individual DGR groups, similar to each other due to these parameters.

Table III
Mortality in individual DGR.

A	DGR 1	DGR 3	DGR 5	DGR 7	DGR 9	DGR 11	DGR 13	DGR 29
Liczba chorych (N = 3614)	788 21,80%	93 2,57%	32 0,89%	38 1,05%	360 9,96%	606 16,77%	59 1,63%	93 2,57%
Zgony	0	1 1,08%	1 3,12%	0	2 0,56%	1 0,17%	0	2 2,15%
zgony przedszpitalne	0	0	0	0	2	1	0	0
zgony szpitalne	0	1	1	0	0	0	0	2
Śmiertelność na 100 tys./rok	0	0,02	0,16	0	0,31	0,16	0	0,31
Utracone lata życia na zgon na 100 tys/rok	0	17,38 17,38 2,72	40,43 40,43 6,32	0	78,43 39,21 12,25	23,91 23,91 3,74	0	42,62 21,31 6,66
B	DGR 2	DGR 4	DGR 6	DGR 8	DGR 10	DGR 12	DGR 14	DGR 30
Liczba chorych (N = 3614)	100 2,76%	32 0	20 0,55%	5 0,14%	8 0,22%	110 3,04%	13 0,36%	158 4,37%
Zgony	49 49%	0	1	0	0	2 1,82%	9 69,23%	129 81,65%
zgony przedszpitalne	30 30%	0	0	0	0	0	4 30,76%	103 65,19%
zgony szpitalne	19 19%	0	1	0	0	2 1,82%	5 38,46%	26 16,46%
Śmiertelność na 100 tys./rok	7,66	0	0,16	0	0	0,31	1,41	20,16
Utracone lata życia na zgon na 100 tys/rok	1661,44 33,91 259,60	0	40,43 40,43 6,32	0	0	63,4 31,7 9,91	350,35 38,93 54,74	5469,3 42,40 854,58
C	DGR 15	DGR 17	DGR 19	DGR 21	DGR 23	DGR 25	DGR 27	DGR 31
Liczba chorych (N = 3614)	178 4,94%	39 1,08%	3 0,08%	28 0,77%	151 4,18%	117 3,24%	40 1,11%	50 1,38%
Zgony	3 1,69%	2 5,12%	0	2 7,14%	0	0	0	0
zgony przedszpitalne	0	0	0	0	0	0	0	0
zgony szpitalne	3	2	0	2	0	0	0	0
Śmiertelność na 100 tys./rok	0,47	0,32	0	0,31	0	0	0	0
Utracone lata życia	18,52 6,17/zg	6,98	0	19,27 9,64/zg	0	0	0	0
Współcz. utraconych lat życia na 100 tys.	2,89	1,09	0	3,01	0	0	0	0
D	DGR 16	DGR 18	DGR 20	DGR 22	DGR 24	DGR 26	DGR 28	DGR 32
Liczba chorych (N = 3614)	29 0,81%	6 0,17%	3 0,08%	2 0,06%	4 0,11%	408 11,29%	9 0,25%	39 1,08%
Zgony	13 44,83%	0	1 33,33%	0	0	33 8,09%	1	35 89,74%
zgony przedszpitalne	5 17,24%	0	1	0	0	0	0	24 61,54%
zgony szpitalne	8 27,59%	0	0	0	0	33	1 11,1%	11 28,21%
Śmiertelność na 100 tys./rok	2,03	0	0,16	0	0	5,16	0,16	5,47
Utracone lata życia	124,69 9,59/zg	0	5,02 5,02/zg	0	0	222,71 6,75/zg	13,06 13,06/zg	376,68 10,76/zg
Współcz. utraconych lat życia na 100 tys.	19,48	0	0,78	0	0	34,80	2,04	58,86

Among the younger patients with light injuries (A) the highest share of accident victims under the influence of alcohol was noted in DGR 1 - up to 24.62% and the lowest share was noted in DGR 7, where there were only 2 such patients (5.26%). Average time of hospitalisation (for 2066 patients) was 4.86±5.34 days;

it oscillated from 3.06±1.29 days in DGR 5 to 6.58±6.11 in DGR 11 and in DGR 29 was on average 10.24±13.58 days. 0.68% of the patients were treated in the intensive-care unit; they were mostly patients from DGR 3 and 29. 56.63% of the hospitalized patients were operated (3 died in the preoperative period) and the

surgical treatment definitely dominated in DGR 9, 11 and 29, while the conservative treatment - in DGR 3, 5, 7 and 13.

Among the younger patients with heavy injuries (B) the highest share of accident victims under the influence of alcohol was noted in DGR 8 - up to 40% (but there were only 5 patients in this group)

Table IV
Direct and indirect costs of injuries in the individual DGR.

Liczba chorych (N = 3614)	788 21,80%	93 2,57%	32 0,89%	38 1,05%	360 9,96%	606 16,77%	59 1,63%	93 2,57%
Utracone lata pracy (zgon+ZLA+renta)	324	60,27	11,30	22,45	391,29	947,25	63,6	278,62
Współcz. utraconych lat pracy na 100 tys.	50,62	9,42	1,77	3,51	61,14	148,01	9,94	43,53
Koszty bezpośrednie ogółem	529 934	111 112	24 613	56 691	484 356	1 165 607	66 577	208 022
Koszty bezpośrednie średnio*	673 ± 422	1195 ± 783	769 ± 321	1492 ± 1340	1345 ± 945	1927 ± 1160	1128 ± 798	2237 ± 1962
Koszty pośrednie (ZLA+renta)	3 588 120	686 580	31 320	319 320	4 570 560	11 385 300	804 900	2 721 120
Koszty pośrednie (utracony PKB)	14 646 632	2 727 752	64 728	985 924	17 709 928	42 872 752	2 878 536	12 610 180
Koszty pośrednie ogółem	18 234 752	3 414 332	96 048	1 305 244	22 280 488	54 258 052	3 683 436	15 331 300
Koszty ogółem	18 764 686	3 525 444	120 661	1 361 935	22 764 844	55 423 659	3 750 013	15 539 322
Koszty bezpośr/pośr	2,82%	3,06%	20,40%	4,16%	2,13%	2,10%	1,78%	1,34%
B	DGR 2	DGR 4**	DGR 6	DGR 8	DGR 10	DGR 12	DGR 14	DGR 30
Liczba chorych (N = 3614)	100 2,76%	25 0,69%	20 0,55%	5 0,14%	8 0,22%	110 3,04%	13 0,36%	158 4,37%
Utracone lata pracy (zgon+ZLA+renta)	674	121,11	11,30	22,45	51,24	511,91	78,71	1105
Współcz. utraconych lat pracy na 100 tys.	105,31	18,92	1,77	3,51	8,01	79,99	12,30	172,66
Koszty bezpośrednie ogółem	206 375	47 129	63 212 zł	12 076	21 990	427 002	10 745	404 042
Koszty bezpośrednie średnio*	2948 ± 3229	2946 ± 3309	3161 ± 1954	2415 ± 953	2749 ± 1817	3882 ± 1597	1194 ± 1465	7346 ± 6775
Koszty pośrednie (ZLA+renta)	2 893 920	420 240	72 180 zł	219 240	462 480	4 752 300	119 880	1 566 000
Koszty pośrednie (utracony PKB)	30 520 000	5 073 956	511 252 zł	1 016 180	2 319 048	23 168 904	3 562 520	50 012 300
Koszty pośrednie ogółem	33 414 660	5 494 196	583 432	1 235 420	2 781 528	27 921 204	3 682 400	51 578 300
Koszty ogółem	33 621 035	5 541 325	646 644	1 247 496	2 803 518	28 348 206	3 693 145	51 982 342
Koszty bezpośr/pośr	0,61%	0,86%	9,78%	0,97%	0,78%	1,51%	0,29%	0,78%
C	DGR 15	DGR 17	DGR 19	DGR 21	DGR 23	DGR 25	DGR 27	DGR 31
Liczba chorych (N = 3614)	178 4,94%	39 1,08%	3 0,08%	28 0,77%	151 4,18%	117 3,24%	40 1,11%	50 1,38%
Koszty bezpośrednie	199 152	56 912	3 140 zł	47 456	272 399	270 239	42 016	143 176
Średni koszt na jednego pacjenta*	1119 ± 786	1459 ± 934	1045 ± 393	1695 ± 1417	1804 ± 1083	2310 ± 1864	1050 ± 956	2864 ± 2806
D	DGR 16	DGR 18	DGR 20	DGR 22	DGR 24	DGR 26	DGR 28	DGR 32
Liczba chorych (N = 3614)	29 0,81%	6 0,17%	3 0,08%	2 0,06%	4 0,11%	408 11,29%	9 0,25%	39 1,11%
Koszty bezpośr. ogółem	58 809	46 276	5437	7734	14 014	1 554 959	27 252	55 475
Koszty bezpośr. średnio	2450 ± 2158	7713 ± 7990	2718 ± 653	3867 ± 2109	3503 ± 661	3811 ± 1208	3028 ± 6641	3698 ± 3856

* death+sick leave+pension; ** excluding street deaths

*** two underage patients received perpetual pensions without receiving any sick leave earlier

and in DGR 30 - 38.61% and the lowest share was noted in DGR 6 - 10%. Average time of hospitalisation of 293 patients was 12.97 ± 13.36 days; it oscillated from 5 in DGR 14 to 16 in DGR 8 and in DGR 30 was on average almost 21 days. 66 patients (15.03%) were treated in the intensive-care unit (but 22.53% were hospitalized); they were mostly patients from DGR 2 and 30. In total, time of the treatment in the intensive-care unit was 755 days, that is on average 2 days on the whole and 11.44 for every patient treated there. 208 patients were operated (70.99% of the hospitalized patients).

Conservative treatment dominated only in DGR 2, 8 and 14 and in the rest of the cases was incidental.

Among the older patients with light injuries (C) the highest share of accident victims under the influence of alcohol was noted in DGR 15 (9.55%), but in four DGR (17, 19, 21 and 27) such cases were not observed. Average time of hospitalisation was 6.77 ± 7.62 days; it oscillated from 4 in DGR 19 to 9 in DGR 25 and in DGR 31 was on average almost 12 days. Only 8 patients (1.32%) were treated in the intensive-care unit and they were mostly patients from DGR 15. 315 pa-

tients (51.98%) were operated.

Among the older patients with heavy injuries (D) the highest share of accident victims under the influence of alcohol was noted in DGR 16 - up to 41.38%, but similarly to the previous case, in four DGR (20, 22, 24, 28) such cases were not observed. Average time of hospitalisation for 470 patients was 14.91 ± 8.46 days; it oscillated from 9 days in DGR 16 to 21 days in DGR 18 and 22, however in DGR 32 it was only 10.60 ± 16.20 days on average, because most of those patients died soon after admission. 8.72% of the hospitalized patients were treated in the in-

Table V
Listing of adjusted direct costs for the individual DGR for the purposes of calculating the National Health Foundation point values.

Koszty bezpośrednie skorygowane*							
DGR	opis	Ogółem				Średnio na chorego*	Koszty bezpoś./ koszty ogółem
		l.ch.	x wskaźnik 1,7	+ TISS (l. dni IT x 27 pkt x 51 zł)	+ koszty osobowe (x2)		
1	lek. obr. głowy - młod.	788	900 888	2754	1 807 284	2294	9,02%
15	lek. obr. głowy - star.	178	338 558	48 195	773 506	4346	
2	cięż. obr. głowy - młod.	100	350 837	191 403	1 084 480	15 493	3,14%
16	cięż. obr. głowy - star.	29	99 975	97 767	395 484	16 478	
3	lek. obr. kl.p. - młod.	93	188 890	31 671	441 122	4743	11,44%
17	lek. obr. kl.p. - star.	39	96 750	2754	199 008	5103	
4	cięż. obr. kl.p. - młod.	25	80 119	37 179	234 596	14 662	4,10%
18	cięż. obr. kl.p. - star.	6	78 669	79 866	317 070	52 845	
5	lek. obr. brzucha-młod.	32	41 842	0	83 684	2615	46,56%
19	lek. obr. brzucha-star.	3	5338	0	10 676	3559	
6	cięż. obr. brzucha-młod	20	5338	0	10 676	3559	19,18%
20	cięż. obr. brzucha-star.	3	9243	1377	21 240	10620	
7	lek. obr. miedn-młod.	38	96 375	34 425	261 600	6884	16,70%
21	lek. obr. miedn-star.	28	80 675	2754	83 429	2980	
8	cięż. obr. miedn-młod	5	20 529	0	41 058	8212	3,22%
22	cięż. obr. miedn-star.	2	13 148	0	26 296	13 148	
9	lek. obr. k.grm.-młod.	360	823 405	2754	1 652 318	4615	6,90%
23	lek. obr. k.grm.-star.	151	463 078	0	926 156	6133	
10	cięż. obr. k.grm.-młod	8	37 383	0	74 766	9346	2,62%
24	cięż. obr. k.grm.-star.	4	14 014	0	28 028	7007	
11	lek. obr. k.dln.-młod.	606	1 981 532	5508	3 974 080	6558	6,82%
25	lek. obr. k.dln.-star.	117	459 406	0	918 812	7853	
12	cięż. obr. k.dln.-młod	110	725 903	42 287	1 537 180	13 974	5,22%
26	cięż. obr. k.dln.-star.	408	2 643 430	50 949	2 694 379	6603	
13	lek. obr. kręg.-młod.	59	113181	0	226362	3837	2,98%
27	lek. obr. kręg.-star.	40	71 427	0	142 854	3571	
14	cięż. obr. kręg.-młod	13	18 266	35 802	108136	12 015	2,85%
28	cięż. obr. kręg.-star.	9	46 328	103 275	299 206	33 245	
29	lek. MOC - młod.	93	353 637	49 572	806 418	8671	5,0%
30	cięż. MOC - młod.	158	686 871	727 056	2 827 854	51 415	5,20%
31	lek. MOC - star.	50	243 399	92 259	671 316	13 426	
32	cięż. MOC - star.	39	94 307	129 438	447 490	29 833	

* excluding street deaths

tensive-care unit and they were mostly patients from DGR 26 and 32. In total, time of the treatment in the intensive-care unit was 336 days, that is on average nearly 1 day and 8.20 for every patient treated there. 404 patients (up to 51.98% of the hospitalized) were operated.

DGR of patients in the working age are presented in the Table 2. Several parameters were analysed: the moment of coming back to work after the accident (after receiving the sickness benefit or temporary annuity), percentage of people

still remaining on a disability pension and mortality. This data was assumedly supposed to describe the results of treatment of total of 2508 patients in these groups; 129 survival patients (5.60%) didn't receive the social security contributions (lack of ability, too young age, etc.). 206 patients (8.21%) died. As a result, 1478 years of work was lost (counted till the year 2008, mainly consisted of DGR 32 and DGR 2 - 351 years). In case of the deceased victims with multiply trauma (DGR 32) on average 6 years of work was

lost and in case of victims with severe injuries of the spine (DGR 14) - on average over 5 years of work.

It was possible to conduct the expected comparison of time of inability to work just for 2173 patients (94.40%) entitled to receiving the disability pension. Loss of further 4664 years of work was related to short-time (sickness benefit) or long-time (pension) inability to work. Injuries of lower limbs were the most serious in this respect: DGR 11 - over 939 and DGR 12 - almost 498 years. Of cour-

se those values were to a great degree dependent on the quantity of patients in individual DGR. It was on average 6 years in DGR 10, almost 5 years in DGR 12, over 4 years in DGR 8 and over 3 years in DGR 2. It's worth to draw attention to 127 patients who went on a pension due to the accident under the influence of alcohol. It was specifically seen in DGR 2 - 14% of such patients and DGR 12 - 12.72%.

As for the mortality, the most fatal results were achieved in DGR 30 and DGR 2, in which 129 (81.65%) and 49 (49%) of the eventually deceased patients were observed correspondingly, whereof 133 persons died in the preoperative period. In percentage terms DGR 14 and DGR 4 turned out to be equally threatened. In other DGR, in which younger patients (in working age) were included, the deaths were incidental. Permanent disability (patients still remaining on a pension due to the inability to work, up to 8 years) was found to be the most often in DGR 11 and 12. High rate of post-traumatic permanent disability was also noted in DGR 10 - 87.5% and DGR 8 - 60%, but in these cases it is not that problematic because of significantly smaller groups. The best and the fastest complete recovery (understood as coming back to work directly after the period of receiving long-time or short-time sickness benefit) was observed in DGR 5 and 6 - 93.75% and 95% of the patients correspondingly and in DGR 7 - 92.11%.

Patients with light injuries (A) and heavy injuries (B) are also presented in the table. Among the patients with light injuries the mortality was incidental (0.31%), but the labour time lost due to the inability to work after the accident reached up to 3.5 thousand years, which is almost 2 years per every hospitalized case, regardless of the fact that the patients who came back to work after the period of receiving the sickness benefit were up to 83.01%. Among the patients with heavy injuries the overall mortality was 45.56% and the labour time lost due to the injury reached 1443 years - Figure 2 and 3. Those who survived, successively lost over 1125 years, which sums up to over 5.5 year per every patient. Among the less injured victims, the patients coming back to work after the period of receiving the sickness benefit are dominant, except for DGR 29 and among heavy injured victims in general only the patients from DGR 4 and 6 are coming back to work after the sickness benefit. Most of

the other patients are still on a pension.

The deaths within individual DGR are presented in Table 3. Mortality was higher in DGR of patients with heavy injuries and elders. In DGR 32 it had the highest values (almost 90%). High death rate was also observed in DGR 16 (nearly 45%) and in DGR 20 (one-third of the patients died). For the purpose of comparison it is worth noticing that in the group of younger patients in DGR 30 mortality reached a bit above 80% and in DGR 2 almost 50%. What decided about the failure of treatment was more the severity of the injuries than age. In DGR including patients with light injuries half of the deaths occurred to younger patients in the preoperative period and in the group of older patients the deaths occurred in the hospital.

DGR were finally compared in terms of treatment costs. The biggest direct costs among the young patients with light injuries were a result of the treatment in DGR 11 - over one million zlotys (PLN) and also in DGR 1 and DGR 9. Such big amounts of costs were mostly caused by great number of patients in specified DGR. After comparing the average treatment costs in individual DGR it turns out that multiply trauma patients (DGR 29 - 2237±1962 zlotys) and injuries of the lower limbs (DGR 11 - 1927±1160 zlotys) are the most costly and the injuries of the head (DGR 1) characterized by the amount of 673±422 zlotys are the least expensive.

DGR 11 leads the field when it comes to the number of lost working years - over 947 years. In the group of light injuries among young patients the inability to work and its duration is composed mostly of injuries of the motor system, yet less numerous than injuries of the head. It is reflected in the indirect costs, which in DGR 11 reached over 54 million, in DGR 9 over 22 million and at the same time in DGR 1 they reached only over 18 million and in DGR 29 only over 15 million zlotys. The number of lost labour years (the loss of GDP) influences the proportion between the direct and indirect costs. The share of direct costs in DGR 5 is over 20% and in other groups it oscillates from 1.34% (DGR 29) to 4.16% (DGR 7).

The highest direct costs among young patients with heavy injuries were a result of the treatment in DGR 12 - 427 002 zlotys and DGR 30. DGR 2 was left far behind with the costs of 206 375 zlotys and other DGR showed values from 10 745

(DGR 14) to 63 212 zlotys (DGR 6). Most of these values was related not only to the quantity of patients in individual DGR, but also to the percentage of fatal accidents, especially the street deaths. When the average costs of these DGR are compared, multiple trauma turns out to be the most expensive to treat (DGR 30 - 7346±6775 zlotys) and in the successive DGR the values oscillate from 1194 ±1465 (DGR 14) to 3882±1597 zlotys (DGR 12).

DGR 30 also leads the field when it comes to the number of lost working years - over 1000 years, and the following DGR are left far behind: DGR 2 - 674 years and DGR 12 - almost 512 years. Therefore in the group of heavy injuries among young patients the sum of different the injuries in the Multiple Organs Injury (MOC) group are decisive in case of inability to work.

It is reflected in the indirect costs, which in DGR 30 reached over 51 million and in other DGR they were half as big or several times lower. The number of lost labour years (the loss of GDP) influences the proportion between the direct and indirect costs. The direct costs significantly matter in general costs only in DGR 5 and 6, amounting to 20.4% and 9.78% correspondingly.

Similarly to the previous case, among the older patients with light injuries, the biggest costs are created during treatment of injuries of limbs - 272 399 i 270 239 zlotys correspondingly. Although DGR 15 was larger, it was characterized by lower costs and the lowest treatment costs were observed in DGR 19 - 3 140 zlotys, but there was only three of them as well. In respect of average direct costs in individual DGR the most costly were obviously the patients in DGR 31 - 2864±2806, treatment is also expensive in DGR 25 - 2310±1864; treatment was the least expensive in DGR 19 and 27.

Direct costs among older patients with heavy injuries were the highest in the most numerous group here, DGR 26 - which is understandable due to the fact that this group includes patients suffering from the fracture of the femoral head. They amount to over 1.5 million zlotys. Costs of treatment were on the similar level of 40-50 thousand zlotys in DGR 16, 32 and 18 and the costs of other injuries were lower by 20-30 thousand zlotys. In respect of average direct costs, the highest were generated in DGR 18 - 7713±7990 zlotys, which was for sure influenced by the costs of staying in the intensive-care unit.

The costs of treatment of the pelvis and lower limbs injuries were also high (DGR 22 and 26 correspondingly) and behind them the costs of treatment of multiply trauma were placed (DGR 32) - 3698 ± 3856 zlotys, which as it seems was influenced by high and early mortality of these patients.

After comparing the data described above it is clear that direct costs in all of the DGR pairs were higher in groups involving patients with heavy injuries; the biggest difference was observed in DGR 17 and DGR 18, where it was over five times bigger and the smallest one was observed in DGR 31 and 32, where the proportion was 1.3.

Overall costs were presented in table V, once more precisely defining the individual diagnostic groups of risk.

Discussion

All of the patients were divided into groups according to the area of the body which was injured, the severity of the injury described with the use of QIS, age and gender, where the criterion of classification was the retirement age limit in Poland. It was 65th year of age for men and 60th year of age for women. There were 7 body areas distinguished with the group of multiply trauma as the 8th area. Within the 7 main groups there were 4 sub-groups created - light and medium injuries (QIS<4) and heavy injuries (QIS4) in two different age groups. Similar classification was used for MOV, but as light and medium injuries were injuries characterized by QIS<9 and the heavy ones were characterized by QIS≥9. In all there were 32 groups described as the diagnostic groups of risk (DGR).

Unfortunately, there are no publications about comparing the economical results of injuries of specific body areas, except for the superficial information on this topic presented in E. MacKenzie's works during the effectiveness assessment of created by her team Diagnosis Related Groups [11].

As already mentioned, the suggested classification was created on the basis of American authors who in the eighties introduced the DGR classification (diagnosis related group) [2,3,5,10,12-15].

Application of the QIS scale for assessing the severity of the injury allowed to avoid many mistakes related to using the AIS or ISS. The fusion of AIS scale with the international classification of diseases ICD-10 and ICD-9CM enabled

very precise classifying of individual injury, but on the other hand it caused significant difficulties. Those changes also resulted in changes in DGR and the system increased to up to 172 groups. QIS not only takes into account all kinds of injuries (including multiply trauma), but also remains a clear and easy applicable tool [16].

System of the clearance of medical procedures currently used in Poland proposed by the National Health Foundation (Diagnosis Related Group - DRG) is more like PMC classification (Patient Management Categories) although considerably less advanced and not taking all of the factors influencing the direct treatment costs into account. The main criteria of patients classification still remain the type of injury and the type of procedure performed, described by the international classification of diseases and medical procedures ICD-10 and ICD-9, hospitalisation period and the way of admission: planned or urgent. The system lacks the description of the severity of the injury or patient's age, which significantly influence the costs of treatment. It is also worth noticing that the application of ICD-10 classification limits the ability to classify the multiply trauma and there is also shortage of updating the ICD-9 classification by adding the new, widely used procedures. All of this is leading to the underestimation of the costs of individual procedures and at times simply to the inability of putting a patient to any of the DGR. Application of the DGR classification or at least its modification and taking the early mentioned factors into account would let to significantly more precise estimation of the real costs of treatment.

The differences, which proved to be the most essential in individual DGR are: period of hospitalization depending on the age, direct costs and losses, including the economical losses, related to the sick absence in particular age groups and the severity of the injuries in individual groups.

It turned out that there are essential differences during the hospitalization of the patients with similar injuries, but in different age groups. Patients in post-working age were staying in the hospital longer (almost 15 days on average, while the young patients were staying for almost 13 days). The differences between the length of hospitalization in individual age groups are on the one hand a result of additional strain with chronic illnesses like ischemic heart disease, diabetes, ar-

terial hypertension, sclerosis - which occurrence grows with age, and on the other hand a result of the compensatory ability of the organism, which decreases with age. The same rules apply to staying in the intensive-care unit, but the severity of injuries plays a greater role there. These problems were also stressed by many authors in their works [17-20].

The above considerations show that creating of Diagnostic Groups of Risk Classification was fully justified. The ability of multidirectional application of DGR both in retrospective studies and also to classifying the injuries and prognostication its economic results, system's simplicity and clarity, after taking many additional factors influencing the efficacy of the treatment into account and also the forecast of the patient's future state - it all makes the system an accessible and friendly tool for people wanting to deal with a problem of economical results of the injuries. It also forms grounds for modifying the system of the clearance of medical procedures and can facilitate the decision making for emergency services about transporting the patient to appropriate center.

DGR efficiently performed all the functions and tasks, which were assumed during its creation. Nevertheless the similarities to the American equivalents, it seems that their existing mistakes were avoided, it was successfully adapted to the realities of the Polish health service and also its structure was significantly simplified.

With the use of DGR it was possible to extrapolate the results and compare them with other authors' work results, concerning the problem of incidence of traumas, the mechanism of the injury, the influence of additional factors, the costs of the injuries or the economical results of the injuries, including post-traumatic disability.

Conclusions

1. Despite the high direct costs of the treatment of the injuries it is clear that they account for only small percent of the overall costs. Arguably for the relatively small price it is possible to get better treatment results, which means significantly bigger values in economizing the indirect costs.

2. The created classification of patients into DGR (diagnostic groups of risk) allows to assess the economical results of injuries both in the aspect of di-

rect costs and also indirect costs.

3. The presented DGR classification, verified here in the retrospective study, may in the future be used in forecasting of costs and in prospective studies.

4. In Polish realities DGR is a considerably simpler and easier system for patient classification than its American equivalents (DRG, TGR, PMC).

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