

Mortality in surgical units and postoperative care

Research Article

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Abstract: In the year 2005, 10 public health care institutions in Lodz contained general surgery units. The lowest mortality rate, 0,35%, was recorded in the surgical unit of University Teaching Hospital No. 5 (UH No. 5). We performed a retrospective comparative analysis of mortality in this hospital and in the two remaining university teaching hospitals, University Teaching Hospital No. 1 (UH No. 1) and University Teaching Hospital No. 2 (UH No. 2). The study was comprised of data from 18911 patients treated in these units from 01.01.2003 to 31.12.2005. The statistical data were collected by the Provincial Centre of Public Health in Lodz. The structure of the analysed units and the structure of the selected groups of diagnoses were compared. A relative structure similarity index was used to compare the structure of hospitalised patients in the analysed units, in an attempt to discover the reasons for significantly lower mortality among patients hospitalised in surgical unit of UH No. 5. A detailed analysis of the selected diagnoses and of mortality indicated that early postoperative intensive care in severely ill patients and immediate admission to the ICU, when indicated, significantly decrease mortality.

Keywords: Surgery • Mortality • Postoperative intensive care • ICD-10

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1. Introduction

In the year 2005, 10 public health care institutions in the area of Lodz contained general surgery units: three university teaching hospitals, three provincial hospitals, three county hospitals and one departmental hospital. The lowest mortality rate, 0,35%, was noted in the surgical unit of University Teaching Hospital No. 5 in Lodz (UH No. 5). We analyzed the causes of death in this hospital and in the two remaining university teaching hospitals: University Teaching Hospital No. 1 in Lodz (UH No. 1) and University Teaching Hospital No. 2 in Lodz (UH No. 2).

Postoperative care at the University Teaching Hospital No 5 is performed by the staff of the Department of Anaesthesiology and Intensive Care Unit [1-3]. The surgeons are consultants. Such a configuration

is extremely rare not only in Poland but also in other countries [3]. In the two remaining university hospitals postoperative care is conducted in a traditional way, in recovery rooms with surgeons in charge. The authors decided to analyse the factors affecting mortality in selected general surgery units with particular consideration of the functioning model of postoperative care.

2. Material and Methods

The study was a retrospective analysis of mortality in general surgery units located at three university hospitals in Lodz: N. Barlicki University Hospital No. 1, WAM University Hospital No. 2 and B. Szarecki University Hospital No. 5. The selection of the hospitals was influenced by the following factors: The Medical

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University of Lodz is the founding body of all the hospitals subjected to analysis; these hospitals are only few kilometres away from each other; the units have similar number of beds; and all units have well-educated medical and nursing staff. Heads of the hospital departments have all been awarded professorships. Health benefits are provided on the basis of the same list of benefits as part of contracts with the same payer – Lodz Provincial Branch of National Health Fund (LPB NHF).

The study included data from 18911 patients treated in these units from 01.01.2003 to 31.12.2005. The available statistical material was collected by the Provincial Centre of Public Health in Lodz (PCPH) (data from centralized public health). The obtained information included the number of treated patients, the number of patients transferred, discharged or dead, the number of days of treatment per patient, mean bed use, mean hospitalisation time, mean number of patients per bed and mortality.

Authors also used additional data included in questionnaires received from the heads of surgical departments in Lodz province, including general information about the department, about the number and qualifications of the medical staff and data about the performed surgeries.

In the second stage of the analysis the structure of the analysed units and the structure of the selected groups of diagnoses were compared. A relative structure similarity index (Pw) was used to compare the structure of hospitalised patients in the analysed units:

$$P_w = \frac{\sum_{k=1}^m \min(u_{k1}, u_{k2})}{\sum_{k=1}^m \max(u_{k1}, u_{k2})}$$

The statistical analysis was performed with Microsoft Excel. The tests for two means for independent samples (HO: $\mu_1 = \mu_2$; H1: $\mu_1 \neq \mu_2$) were used for the statistical analysis.

The goal of the study was to explain the reasons for significantly lower mortality among patients hospitalised in the surgical unit of UH No. 5.

The treatment of postoperative patients in recovery rooms in conditions similar or identical to those in the intensive therapy unit is extremely rare. The general surgery unit of B. Szarecki University Teaching Hospital in Lodz provides such conditions. An anaesthesiologist and 2 anaesthesiological nurses provide medical care (4-bedded rooms). When needed, a surgeon is asked for consultation. All the postoperative patients are moved to recovery rooms where their vital functions are monitored. Most frequently the patients stay there for 24 hours

after the surgical procedure. The scope of monitoring depends on the type and extent of surgery. Standard monitoring includes ECG, arterial blood pressure by indirect method, plethysmography, respiratory rate, body temperature, fluid supply, and diuresis. In the case of major surgery, monitoring is significantly broadened and includes central venous pressure in patients with central venous access, arterial blood pressure by direct method and capnography in ventilated patients. All these allow early detection and treatment of any occurring complications. The application of high quality analgesic treatment with the use of phentanyl infusion in combination with nonsteroidal anti-inflammatory drugs is of importance. Effective analgesia not only improves the patient's comfort but prevents the occurrence of numerous complications as well. Ready availability of infusion pumps allows for application of drug infusion (e.g. catecholamines, nitroglycerin, beta-blockers, hypotensive drugs, etc.) and fluids.

Perioperative procedures applied in B. Szarecki University Hospital No. 5 make it easier to transfer the patients immediately after major surgery into the Intensive Care Unit, which in our opinion is prophylactic against the development of serious, life-threatening complications. The patients who were transferred to the ICU also meet the requirements given by LPB NHF, that is, obtaining the adequate number of points on the TISS 28 scale (25 points).

In the general surgery units of N. Barlicki University Hospital No. 1 in Lodz and WAM University Hospital No. 2 in Lodz, postoperative care is provided by surgeons and surgical nurses. In the conditions of surgical units, there is not always a possibility of application of adequate monitoring and rapid reaction to life-threatening conditions. Very often, analgesic therapy is limited to application of nonsteroidal anti-inflammatory drugs on the patient's demand.

A relatively insignificant percentage of postoperative patients, due to organizational, medical or other problems, land in the Intensive Care Units at N. Barlicki University Teaching Hospital No. 1 in Lodz and WAM University Hospital No. 2 in Lodz. These are most frequently patients in very severe condition. It seems that earlier transfer of patients with high postoperative risk could prevent such deterioration in some cases.

3. Results

The structure of hospitalisation in general surgery units in selected hospitals according to basic disease (A00-A99; ...; Z00-Z99) in the years 2003 to 2005 is presented in Table 1. The relative structure similarity indices of

Table 1. Structure of hospitalisation in general surgery units (code: 4500) in selected hospitals according to basic disease (A00-A99; ...; Z00-Z99) in the years 2003 to 2005.

Basic disease acc. ICD 10	Total (Hospital No. 1; Hospital No. 2; Hospital No. 5)		Hospital No. 1		Hospital No. 2		Hospital No. 5		Hospital No. 2	
	Number of patients	Coefficients of structure (%)	Number of patients	Coefficients of structure (%)	Number of patients	Coefficients of structure (%)	Number of patients	Coefficients of structure (%)	Number of patients	Coefficients of structure (%)
Total:	18911	100%	5018	100%	9699	100%	4194	100%	4194	100%
A00 - A99	31	0,16%	4	0,08%	25	0,26%	2	0,05%	2	0,05%
B00 - B99	6	0,03%	0	0,00%	6	0,06%	0	0,00%	0	0,00%
C00 - C97	2681	14,18%	287	5,72%	1811	18,67%	583	13,90%	583	13,90%
D00 - D89	1897	10,03%	193	3,85%	1084	11,18%	620	14,78%	620	14,78%
E00 - E90	1270	6,72%	370	7,37%	704	7,26%	196	4,67%	196	4,67%
F00 - F99	3	0,02%	0	0,00%	0	0,00%	3	0,07%	3	0,07%
G00 - G99	10	0,05%	4	0,08%	2	0,02%	4	0,10%	4	0,10%
H00 - H95	1	0,01%	0	0,00%	1	0,01%	0	0,00%	0	0,00%
I00 - I99	1690	8,94%	487	9,71%	484	4,99%	719	17,14%	719	17,14%
J00 - J99	200	1,06%	7	0,14%	6	0,06%	187	4,46%	187	4,46%
K00 - K93	8459	44,73%	2297	45,78%	4602	47,45%	1560	37,20%	1560	37,20%
L00 - L99	437	2,31%	194	3,87%	116	1,20%	127	3,03%	127	3,03%
M00 - M99	38	0,20%	16	0,32%	9	0,09%	13	0,31%	13	0,31%
N00 - N99	354	1,87%	66	1,32%	270	2,78%	18	0,43%	18	0,43%
O00 - O99	3	0,02%	1	0,02%	1	0,01%	1	0,02%	1	0,02%
Q00 - Q99	16	0,08%	2	0,04%	6	0,06%	8	0,19%	8	0,19%
R00 - R99	566	2,99%	33	0,66%	479	4,94%	54	1,29%	54	1,29%
S00 - S99	1094	5,78%	995	19,83%	36	0,37%	63	1,50%	63	1,50%
T00 - T98	127	0,67%	58	1,16%	37	0,38%	32	0,76%	32	0,76%
Z00 - Z99	28	0,15%	4	0,08%	20	0,21%	4	0,10%	4	0,10%

(A00-B99) Infections or parasitic diseases; (C00-D48) Neoplasms; (D50-D98) Diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism; (F00-F99) Mental and behavioural disorders; (G00-G99) Disease of the nervous system; (I00-199) Diseases of the circulatory system; J00-J99 diseases of the respiratory system; (K00-K93) Diseases of the digestive system; (L00-L99) Diseases of the skin and subcutaneous tissue; (M00-M99) Diseases of the musculoskeletal system and connective tissue; (N00-N99) Diseases of the genitourinary system; (O00-O99) Pregnancy, childbirth and puerperium; (P00-P96) Certain conditions originating in the perinatal period; (Q00-Q99) Congenital malformations, deformations and chromosomal abnormalities; (R00-R99) Symptoms, signs and abnormal clinical and laboratory findings not elsewhere classified; (S00-T98) Injury, poisoning and certain other consequences of external causes; (Z00-Z99) Factors influencing health status and contact with health services.

the hospitalised patients in general surgery units in the selected hospitals acc. to the basic disease (A00-A99; ...; Z00-Z99) in the years 2003-2005 were respectively: UH No. 1/UH No. 2 - 0,518; UH No. 1/UH No. 5 - 0,561; UH No. 2/UH No. 5 - 0,613 and 0,416 together for UH No. 1/ UH No. 2/ UH No. 5.

To compare mortality rates, the diagnostic groups including the largest number of patients (C00-C97; D00-D89 and K00-K93) were selected for further analysis.

The mortality in group of patients with diagnosed C00-C97 was in UH No. 1 15,68%, in UH No. 2 9,61% and in UH No. 5 1,55% (UH No. 1/ UH No. 5 $p < 0.001$ and UH No. 2/ UH No. 5 $p < 0.001$). Relative structure similarity indices were in the range of C00 - C97 diagnoses respectively: UH No. 1/UH No. 2 - 0,338; UH No. 1/UH No. 5 - 0,354; UH No. 2/UH No. 5 - 0,272 and 0,207 together for UH No. 1/ UH No. 2/ UH No. 5. After taking into account these indices (appropriate modification of the structure and number of deaths) the mortality was respectively: in UH No. 1 14,33%, in UH No. 2 7,29% and in UH No. 5 2,49% (UH No. 1/ UH No. 5 $p < 0.001$ and UH No. 2/ UH No. 5 $p < 0.01$).

The mortality in group of patients with diagnosed D00-D89 was in UH No. 1 5,70%, in UH No. 2 0,32% and in UH No. 5 0,09% (UH No. 1/ UH No. 5 $p < 0.01$ and UH No. 2/ UH No. 5 $p > 0.05$). Relative structure similarity indices were in the range of D00 - D89 diagnoses respectively: UH No. 1/UH No. 2 - 0,239; UH No. 1/ UH No. 5 - 0,545; UH No. 2/UH No. 5 - 0,195 and 0,156 together for UH No. 1/ UH No. 2/ UH No. 5. After taking into account these indices (appropriate modification of the structure and number of deaths) the mortality was respectively: in UH No. 1 5,90 %, in UH No. 2 0,00 % and in UH No. 5 0,06 % (UH No. 1/ UH No. 5 $p > 0.05$ and UH No. 2/ UH No. 5 $p > 0.05$).

In the most numerous group (K00-K93) the mortality was in UH No. 1 2,31%, in UH No. 2 0,96% and in UH No. 5 0,11% (UH No. 1/ UH No. 5 $p < 0.001$ and UH No. 2/ UH No. 5 $p < 0.001$). Relative structure similarity indices were in the range of K00 - K93 diagnoses respectively: UH No. 1/UH No. 2 - 0,669; UH No. 1/UH No. 5 - 0,495; UH No. 2/UH No. 5 - 0,555 and 0,434 together for UH No. 1/ UH No. 2/ UH No. 5. After taking into account these indices (appropriate modification of the structure and number of deaths) the mortality was respectively: in UH No. 1 1,62% , in UH No. 2 0,92% and in UH No. 5 0,13% (UH No. 1/ UH No. 5 $p < 0.001$ and UH No. 2/ UH No. 5 $p < 0.02$).

Number of hospitalisations, number of deaths and mortality in the group of hospitalised patients with the diagnosis C00; ...; C97; D00; ... ;D89 and K00; ...; K93 acc. to the basic disease in general surgery units in selected hospitals in the years 2003-2005 after

modification of the structure and number of deaths are presented in Table 2, 3 and 4.

To assess the effect of the quality of postoperative care and the current model of postoperative care on mortality, the mortality of patients with the same diagnoses was subjected to analysis according to the basic disease in the groups C00; ...;C97; D00;...; D89 and K00;...; K93 (after modification of the structure and the number of deaths). The results are demonstrated in Table 5.

The selected data of provincial surgical consultants on the basis of questionnaires for the year 2005 are presented in Table 6.

4. Discussion

Literature reports comparing mortality in surgical units generally concern the mortality of patients subjected to a specific surgical procedure. The comparison of mortality in surgical units, comprising both the patients operated on and those treated conservatively, is very rare due to methodological difficulties faced by researchers as well as numerous complicating factors hard that affect mortality in the analysed units. The structure of the admitted patients, their clinical condition, kind of procedures performed, skills and experience of the operating surgeons, type of postoperative care, and cooperation with other units including intensive care unit are the most essential factors affecting mortality in surgical units [1-3].

Postoperative care performed by surgeons in a recovery room or intensive (surgical) care room is a widespread model of care in Poland and also in other countries. Sometimes an anaesthesiologist is included on the surgical team; however his or her task is first of all anaesthetization of patients admitted to this unit, and less frequently postoperative treatment.

In general, in Poland anaesthesiologists have greater experience in the management of patients with respiratory, circulatory or urinary dysfunction than do surgeons, as a result of the educational model and the organization of national health care system. This situation is similar to that found in a many countries. Since this is the case, the lower mortality in a surgical unit where postoperative care is conducted by anaesthesiologists should not be a surprise. In the opinion of the authors of this study, the greater the number of patients operated on in severe condition or with a significant illness burden, the more noticeable should be the difference in mortality between anaesthesiologist-provided and standard postoperative care.

Table 2. Number of hospitalizations, number of deaths and mortality in the group of hospitalised patients with the diagnosis C00; ...; C97 acc. to the basic disease in general surgery units (code: 4500) in selected hospitals in the years 2003-2005 after modification of the structure and number of deaths.

Basic disease	Treated patients					Dead					Mortality (%)				
	Total	Hospital No. 1	Hospital No. 5	Hospital No. 2	Basic disease	Total	Hospital No. 1	Hospital No. 5	Hospital No. 2	Basic disease	Total	Hospital No. 1	Hospital No. 5	Hospital No. 2	
C15	1,48	0,16	1,00	0,32	C15	0,06	0,05	0,00	0,02	C15	4,20%	28,57%	0,00%	5,26%	
C16	220,73	23,63	149,10	48,00	C16	14,00	5,19	4,81	4,00	C16	6,34%	21,95%	3,23%	8,33%	
C18	321,90	34,46	217,44	70,00	C18	11,54	6,63	3,92	1,00	C18	3,59%	19,23%	1,80%	1,43%	
C19	82,78	8,86	55,91	18,00	C19	2,56	0,00	0,56	2,00	C19	3,10%	0,00%	1,01%	11,11%	
C20	234,53	25,11	158,42	51,00	C20	3,12	1,67	0,45	1,00	C20	1,33%	6,67%	0,28%	1,96%	
C21	22,99	2,46	15,53	5,00	C21	1,00	0,00	0,00	1,00	C21	4,35%	0,00%	0,00%	20,00%	
C22	14,80	1,58	10,00	3,22	C22	0,34	0,14	0,00	0,19	C22	2,28%	9,09%	0,00%	6,00%	
C23	8,88	0,95	6,00	1,93	C23	0,74	0,25	0,00	0,48	C23	8,29%	26,67%	0,00%	25,00%	
C24	8,88	0,95	6,00	1,93	C24	0,35	0,00	0,00	0,35	C24	3,95%	0,00%	0,00%	18,18%	
C25	93,27	9,98	63,00	20,28	C25	11,92	1,86	6,00	4,06	C25	12,78%	18,64%	9,52%	20,00%	
C26	4,60	0,49	3,11	1,00	C26	0,39	0,00	0,39	0,00	C26	8,44%	0,00%	12,50%	0,00%	
C34	1,48	0,16	1,00	0,32	C34	0,19	0,16	0,00	0,03	C34	13,06%	100,00%	0,00%	10,84%	
C44	1,48	0,16	1,00	0,32	C44	1,00	0,00	1,00	0,00	C44	67,55%	0,00%	100,00%	0,00%	
C50	2,96	0,32	2,00	0,64	C50	0,00	0,00	0,00	0,00	C50	0,00%	0,00%	0,00%	0,00%	
C53	4,60	0,49	3,11	1,00	C53	1,25	0,25	0,00	1,00	C53	5,35%	50,00%	0,00%	0,00%	
C54	4,60	0,49	3,11	1,00	C54	1,00	0,00	0,00	1,00	C54	21,75%	0,00%	0,00%	100,00%	
C73	22,99	2,46	15,53	5,00	C73	5,00	0,00	0,00	5,00	C73	0,00%	0,00%	0,00%	0,00%	
C76	11,84	1,27	8,00	2,58	C76	2,76	0,21	1,00	1,55	C76	23,28%	16,67%	12,50%	60,00%	
C78	9,20	0,98	6,21	2,00	C78	0,16	0,16	0,00	0,00	C78	1,78%	16,67%	0,00%	0,00%	
C79	5,92	0,63	4,00	1,29	C79	0,43	0,00	0,00	0,43	C79	7,25%	0,00%	0,00%	33,33%	
Total:	1079,92	115,61	729,48	234,84	Total:	57,81	16,57	18,13	17,11	Total:	4,80%	14,33%	2,49%	7,29%	

* - C16 (stomach cancer), C18 (colon cancer), C20 (malignant neoplasm of the rectum)

Table 3. Number of hospitalizations, number of deaths and mortality in the group of hospitalised patients with the diagnosis D00; ...; D89 acc. to the basic disease in general surgery units (code: 4500) in selected hospitals in the years 2003-2005 after modification of the structure and number of deaths.

Basic disease	Treated patients					Dead					Mortality (%)				
	Total	Hospital No. 1	Hospital No. 5	Hospital No. 2	Hospital No. 1	Total	Basic disease	Hospital No. 1	Hospital No. 5	Hospital No. 2	Total	Basic disease	Hospital No. 1	Hospital No. 5	Hospital No. 2
D12	88,46	9,00	50,55	28,91	0,00	0,00	D12	0,00	0,00	0,00	0,00%	D12	0,00%	0,00%	0,00%
D13	40,25	4,10	23,00	13,15	0,00	0,00	D13	0,00	0,00	0,00	0,00%	D13	0,00%	0,00%	0,00%
D17	43,75	4,45	25,00	14,30	0,00	0,00	D17	0,00	0,00	0,00	0,00%	D17	0,00%	0,00%	0,00%
D18	1,75	0,18	1,00	0,57	0,00	0,00	D18	0,00	0,00	0,00	0,00%	D18	0,00%	0,00%	0,00%
D21	7,00	0,71	4,00	2,29	0,00	0,00	D21	0,00	0,00	0,00	0,00%	D21	0,00%	0,00%	0,00%
D23	9,83	1,00	5,62	3,21	0,00	0,00	D23	0,00	0,00	0,00	0,00%	D23	0,00%	0,00%	0,00%
D24	7,00	0,71	4,00	2,29	0,00	0,00	D24	0,00	0,00	0,00	0,00%	D24	0,00%	0,00%	0,00%
D29	1,75	0,18	1,00	0,57	0,00	0,00	D29	0,00	0,00	0,00	0,00%	D29	0,00%	0,00%	0,00%
D35	8,75	0,89	5,00	2,86	0,00	0,00	D35	0,00	0,00	0,00	0,00%	D35	0,00%	0,00%	0,00%
D37	244,77	24,90	139,87	80,00	2,65	2,47	D37	2,65	2,47	0,19	1,08%	D37	9,90%	0,14%	0,00%
D39	9,18	0,93	5,25	3,00	0,00	0,00	D39	0,00	0,00	0,00	0,00%	D39	0,00%	0,00%	0,00%
D41	9,18	0,93	5,25	3,00	0,00	0,00	D41	0,00	0,00	0,00	0,00%	D41	0,00%	0,00%	0,00%
D44	24,50	2,49	14,00	8,01	0,00	0,00	D44	0,00	0,00	0,00	0,00%	D44	0,00%	0,00%	0,00%
D48	78,75	8,01	45,00	25,74	1,00	1,00	D48	1,00	1,00	0,00	1,27%	D48	12,50%	0,00%	0,00%
D73	3,06	0,31	1,75	1,00	0,00	0,00	D73	0,00	0,00	0,00	0,00%	D73	0,00%	0,00%	0,00%
Total	577,98	58,80	330,28	188,90	3,66	3,47	Total	3,66	3,47	0,19	0,63%	Total	5,90%	0,06%	0,00%

* - D37 (oral cavity and digestive system neoplasms of uncertain behavior and/or unspecified nature)

Table 4. Number of hospitalizations, number of deaths and mortality in the group of hospitalised patients with the diagnosis K00; ...; K93 acc. to the basic disease in general surgery units (code: 4500) in selected hospitals in the years 2003-2005 after modification of the structure and number of deaths.

Basic disease	Treated patients				Dead				Mortality (%)					
	Total	Hospital No. 1	Hospital No. 5	Hospital No. 2	Basic disease	Total	Hospital No. 1	Hospital No. 5	Hospital No. 2	Basic disease	Total	Hospital No. 1	Hospital No. 5	Hospital No. 2
K22	7,35	2,00	4,00	1,36	K22	0,00	0,00	0,00	0,00	K22	0,00%	0,00%	0,00%	0,00%
K25	47,79	12,98	26,00	8,81	K25	1,98	1,10	0,00	0,88	K25	4,14%	8,45%	0,00%	10,00%
K26	45,95	12,48	25,00	8,47	K26	1,55	0,42	0,00	1,13	K26	3,36%	3,33%	0,00%	13,33%
K28	5,42	1,47	2,95	1,00	K28	0,74	0,74	0,00	0,00	K28	13,58%	50,00%	0,00%	0,00%
K29	92,07	25,00	50,09	16,98	K29	0,00	0,00	0,00	0,00	K29	0,00%	0,00%	0,00%	0,00%
K31	44,19	12,00	24,04	8,15	K31	1,00	1,00	0,00	0,00	K31	2,26%	8,33%	0,00%	0,00%
K35	156,24	42,43	85,00	28,81	K35	0,25	0,25	0,00	0,00	K35	0,16%	0,58%	0,00%	0,00%
K36	3,68	1,00	2,00	0,68	K36	0,00	0,00	0,00	0,00	K36	0,00%	0,00%	0,00%	0,00%
K38	5,42	1,47	2,95	1,00	K38	0,00	0,00	0,00	0,00	K38	0,00%	0,00%	0,00%	0,00%
K40	863,91	234,59	470,00	159,32	K40	0,46	0,00	0,00	0,46	K40	0,05%	0,00%	0,00%	0,29%
K41	16,27	4,42	8,85	3,00	K41	0,00	0,00	0,00	0,00	K41	0,00%	0,00%	0,00%	0,00%
K42	115,80	31,45	63,00	21,36	K42	1,61	1,61	0,00	0,00	K42	1,39%	5,13%	0,00%	0,00%
K43	265,70	72,15	144,55	49,00	K43	0,64	0,64	0,00	0,00	K43	0,24%	0,89%	0,00%	0,00%
K44	32,53	8,83	17,70	6,00	K44	0,00	0,00	0,00	0,00	K44	0,00%	0,00%	0,00%	0,00%
K45	12,87	3,49	7,00	2,37	K45	0,15	0,00	0,00	0,15	K45	1,15%	0,00%	0,00%	6,25%
K50	14,73	4,00	8,01	2,72	K50	0,00	0,00	0,00	0,00	K50	0,00%	0,00%	0,00%	0,00%
K51	7,37	2,00	4,01	1,36	K51	0,00	0,00	0,00	0,00	K51	0,00%	0,00%	0,00%	0,00%
K52	25,78	7,00	14,02	4,75	K52	0,00	0,00	0,00	0,00	K52	0,00%	0,00%	0,00%	0,00%
K55	12,87	3,49	7,00	2,37	K55	2,97	2,18	0,00	0,79	K55	23,12%	62,50%	0,00%	33,33%
K56	86,76	23,56	47,20	16,00	K56	5,30	3,86	0,44	1,00	K56	6,10%	16,36%	0,93%	6,25%
K57	51,56	14,00	28,05	9,51	K57	4,00	4,00	0,00	0,00	K57	7,76%	28,57%	0,00%	0,00%
K58	3,68	1,00	2,00	0,68	K58	0,00	0,00	0,00	0,00	K58	0,00%	0,00%	0,00%	0,00%
K59	21,69	5,89	11,80	4,00	K59	0,00	0,00	0,00	0,00	K59	0,00%	0,00%	0,00%	0,00%
K60	77,34	21,00	42,07	14,26	K60	0,00	0,00	0,00	0,00	K60	0,00%	0,00%	0,00%	0,00%
K61	25,78	7,00	14,02	4,75	K61	0,00	0,00	0,00	0,00	K61	0,00%	0,00%	0,00%	0,00%
K62	69,97	19,00	38,07	12,90	K62	0,00	0,00	0,00	0,00	K62	0,00%	0,00%	0,00%	0,00%
K63	150,99	41,00	82,14	27,85	K63	1,87	1,00	0,00	0,87	K63	1,24%	2,44%	0,00%	3,13%
K65	27,11	7,36	14,75	5,00	K65	1,67	0,67	0,00	1,00	K65	6,16%	9,09%	0,00%	20,00%
K66	34,92	9,48	19,00	6,44	K66	0,68	0,68	0,00	0,00	K66	1,94%	7,14%	0,00%	0,00%
K72	3,68	1,00	2,00	0,68	K72	0,67	0,00	0,67	0,00	K72	18,13%	0,00%	33,33%	0,00%

continued Table 4. Number of hospitalizations, number of deaths and mortality in the group of hospitalised patients with the diagnosis K00, ..., K93 acc. to the basic disease in general surgery units (code: 4500) in selected hospitals in the years 2003-2005 after modification of the structure and number of deaths.

K74	11,03	2,99	6,00	2,03	K74	0,94	0,60	0,00	0,34	K74	8,50%	20,00%	0,00%	16,67%
K75	11,05	3,00	6,01	2,04	K75	0,00	0,00	0,00	0,00	K75	0,00%	0,00%	0,00%	0,00%
K76	22,06	5,99	12,00	4,07	K76	0,00	0,00	0,00	0,00	K76	0,00%	0,00%	0,00%	0,00%
K80	2080,69	565,00	1131,97	383,72	K80	2,44	0,00	1,67	0,77	K80	0,12%	0,00%	0,15%	0,20%
K81	262,85	71,38	143,00	48,47	K81	1,68	0,84	0,00	0,84	K81	0,64%	1,18%	0,00%	1,72%
K82	44,11	11,98	24,00	8,14	K82	1,43	0,89	0,00	0,54	K82	3,24%	7,41%	0,00%	6,67%
K83	82,72	22,46	45,00	15,25	K83	0,50	0,23	0,00	0,27	K83	0,60%	1,02%	0,00%	1,75%
K85	238,95	64,89	130,00	44,07	K85	3,43	2,43	1,00	0,00	K85	1,44%	3,75%	0,77%	0,00%
K86	169,11	45,92	92,00	31,19	K86	0,00	0,00	0,00	0,00	K86	0,00%	0,00%	0,00%	0,00%
K91	16,27	4,42	8,85	3,00	K91	0,00	0,00	0,00	0,00	K91	0,00%	0,00%	0,00%	0,00%
K92	70,49	19,14	38,35	13,00	K92	0,38	0,38	0,00	0,00	K92	0,53%	1,96%	0,00%	0,00%
Total:	5338,74	1449,71	2904,46	984,56	Total:	36,32	23,50	3,77	9,04	Total:	0,68%	1,62%	0,13%	0,92%

* - K29 (gastritis and duodenitis), K35 (acute appendicitis), K40 (inguinal hernia), K42 (umbilical hernia), K56 (paralytic ileus), K63 (other intestinal diseases i.e. abscess, perforation, fistula), K80 (cholelithiasis), K81 (cholecystitis), K83 (other disorders of biliary tract), K85 (acute pancreatitis) and K86 (other diseases of pancreas).

Table 5. Number of hospitalizations, mortality and statistical significance in general surgery units (code: 4500) in selected hospitals in the groups of hospitalised patients with the diagnosis C00, ..., C97, D00; ...; D89, K00, ..., K93 according to basic disease in the years 2003 to 2005 after modification of the structure and number of deaths.

Treated patients Basic disease*	Mortality (%)										Statistical significance		
	Total	Hospital No. 1	Hospital No. 2	Hospital No. 5	Hospital No. 1	Hospital No. 2	Hospital No. 5	Hospital No. 1/ Hospital No. 5	Hospital No. 2	Hospital No. 5	Hospital No. 1/ Hospital No. 5	Hospital No. 2	Hospital No. 5
C15	1,48	0,16	0,32	0,32	C15	4,20%	28,57%	0,00%	0,00%	5,26%	NS	NS	NS
C16	220,73	23,63	48	48	C16	6,34%	21,95%	3,23%	3,23%	8,33%	p<0.04	NS	NS
C18	321,9	34,46	70	70	C18	3,59%	19,23%	1,80%	1,80%	1,43%	p<0.02	NS	NS
C19	82,78	8,86	18	18	C19	3,10%	0,00%	1,01%	1,01%	11,11%	NS	NS	NS
C20	234,53	25,11	51	51	C20	1,33%	6,67%	0,28%	0,28%	1,96%	NS	NS	NS
C21	22,99	2,46	5	5	C21	4,35%	0,00%	0,00%	0,00%	20,00%	NS	NS	NS
C22	14,8	1,58	10	3,22	C22	2,28%	9,09%	0,00%	0,00%	6,00%	NS	NS	NS
C23	8,88	0,95	6	1,93	C23	8,29%	26,67%	0,00%	0,00%	25,00%	NS	NS	NS
C24	8,88	0,95	6	1,93	C24	3,95%	0,00%	0,00%	0,00%	18,18%	NS	NS	NS
C25	93,27	9,98	63	20,28	C25	12,78%	18,64%	9,52%	9,52%	20,00%	NS	NS	NS
C26	4,6	0,49	1	1	C26	8,44%	0,00%	12,50%	12,50%	0,00%	NS	NS	NS
C34	1,48	0,16	0,32	0,32	C34	13,06%	100,00%	0,00%	0,00%	10,84%	NS	NS	NS
C44	1,48	0,16	0,32	0,32	C44	67,55%	0,00%	100,00%	0,00%	0,00%	NS	NS	NS
C50	2,96	0,32	0,64	0,64	C50	0,00%	0,00%	0,00%	0,00%	0,00%	NS	NS	NS

continued Table 5. Number of hospitalizations, mortality and statistical significance in general surgery units (code: 4500) in selected hospitals in the groups of hospitalised patients with the diagnosis C00; ...; C97, D00; ...; D89, K00; ...; K93 according to basic disease in the years 2003 to 2005 after modification of the structure and number of deaths.

C53	4,6	0,49	3,11	1	C53	5,35%	50,00%	0,00%	0,00%	NS
C54	4,6	0,49	3,11	1	C54	21,75%	0,00%	0,00%	100,00%	
C73	22,99	2,46	15,53	5	C73	0,00%	0,00%	0,00%	0,00%	
C76	11,84	1,27	8	2,58	C76	23,28%	16,67%	12,50%	60,00%	NS
C78	9,2	0,98	6,21	2	C78	1,78%	16,67%	0,00%	0,00%	NS
C79	5,92	0,63	4	1,29	C79	7,25%	0,00%	0,00%	33,33%	NS
D12	88,46	9	50,55	28,91	D12	0,00%	0,00%	0,00%	0,00%	
D13	40,25	4,1	23	13,15	D13	0,00%	0,00%	0,00%	0,00%	
D17	43,75	4,45	25	14,3	D17	0,00%	0,00%	0,00%	0,00%	
D18	1,75	0,18	1	0,57	D18	0,00%	0,00%	0,00%	0,00%	
D21	7	0,71	4	2,29	D21	0,00%	0,00%	0,00%	0,00%	
D23	9,83	1	5,62	3,21	D23	0,00%	0,00%	0,00%	0,00%	
D24	7	0,71	4	2,29	D24	0,00%	0,00%	0,00%	0,00%	
D29	1,75	0,18	1	0,57	D29	0,00%	0,00%	0,00%	0,00%	
D35	8,75	0,89	5	2,86	D35	0,00%	0,00%	0,00%	0,00%	
D37	244,77	24,9	139,87	80	D37	1,08%	9,90%	0,14%	0,00%	NS
D39	9,18	0,93	5,25	3	D39	0,00%	0,00%	0,00%	0,00%	
D41	9,18	0,93	5,25	3	D41	0,00%	0,00%	0,00%	0,00%	
D44	24,5	2,49	14	8,01	D44	0,00%	0,00%	0,00%	0,00%	
D48	78,75	8,01	45	25,74	D48	1,27%	12,50%	0,00%	0,00%	NS
D73	3,06	0,31	1,75	1	D73	0,00%	0,00%	0,00%	0,00%	
K22	7,35	2	4	1,36	K22	0,00%	0,00%	0,00%	0,00%	
K25	47,79	12,98	26	8,81	K25	4,14%	8,45%	0,00%	10,00%	NS
K26	45,95	12,48	25	8,47	K26	3,36%	3,33%	0,00%	13,33%	NS
K28	5,42	1,47	2,95	1	K28	13,58%	50,00%	0,00%	0,00%	NS
K29	92,07	25	50,09	16,98	K29	0,00%	0,00%	0,00%	0,00%	
K31	44,19	12	24,04	8,15	K31	2,26%	8,33%	0,00%	0,00%	NS
K35	156,24	42,43	85	28,81	K35	0,16%	0,58%	0,00%	0,00%	NS
K36	3,68	1	2	0,68	K36	0,00%	0,00%	0,00%	0,00%	
K38	5,42	1,47	2,95	1	K38	0,00%	0,00%	0,00%	0,00%	
K40	863,91	234,59	470	159,32	K40	0,05%	0,00%	0,00%	0,29%	NS
K41	16,27	4,42	8,85	3	K41	0,00%	0,00%	0,00%	0,00%	

continued Table 5. Number of hospitalizations, mortality and statistical significance in general surgery units (code: 4500) in selected hospitals in the groups of hospitalised patients with the diagnosis C00; ...; C97, D00; ...; D89, K00; ...; K93 according to basic disease in the years 2003 to 2005 after modification of the structure and number of deaths.

K42	115,8	31,45	63	21,36	K42	1,39%	5,13%	0,00%	0,00%	NS
K43	265,7	72,15	144,55	49	K43	0,24%	0,89%	0,00%	0,00%	NS
K44	32,53	8,83	17,7	6	K44	0,00%	0,00%	0,00%	0,00%	
K45	12,87	3,49	7	2,37	K45	1,15%	0,00%	0,00%	6,25%	NS
K50	14,73	4	8,01	2,72	K50	0,00%	0,00%	0,00%	0,00%	
K51	7,37	2	4,01	1,36	K51	0,00%	0,00%	0,00%	0,00%	
K52	25,78	7	14,02	4,75	K52	0,00%	0,00%	0,00%	0,00%	
K55	12,87	3,49	7	2,37	K55	23,12%	62,50%	0,00%	33,33%	p<0.05
K56	86,76	23,56	47,2	16	K56	6,10%	16,36%	0,93%	6,25%	NS
K57	51,56	14	28,05	9,51	K57	7,76%	28,57%	0,00%	0,00%	p<0.03
K58	3,68	1	2	0,68	K58	0,00%	0,00%	0,00%	0,00%	
K59	21,69	5,89	11,8	4	K59	0,00%	0,00%	0,00%	0,00%	
K60	77,34	21	42,07	14,26	K60	0,00%	0,00%	0,00%	0,00%	
K61	25,78	7	14,02	4,75	K61	0,00%	0,00%	0,00%	0,00%	
K62	69,97	19	38,07	12,9	K62	0,00%	0,00%	0,00%	0,00%	
K63	150,99	41	82,14	27,85	K63	1,24%	2,44%	0,00%	3,13%	NS
K65	27,11	7,36	14,75	5	K65	6,16%	9,09%	0,00%	20,00%	NS
K66	34,92	9,48	19	6,44	K66	1,94%	7,14%	0,00%	0,00%	NS
K72	3,68	1	2	0,68	K72	18,13%	0,00%	33,33%	0,00%	NS
K74	11,03	2,99	6	2,03	K74	8,50%	20,00%	0,00%	16,67%	NS
K75	11,05	3	6,01	2,04	K75	0,00%	0,00%	0,00%	0,00%	NS
K76	22,06	5,99	12	4,07	K76	0,00%	0,00%	0,00%	0,00%	
K80	2080,69	565	1131,97	383,72	K80	0,12%	0,00%	0,15%	0,20%	NS
K81	262,85	71,38	143	48,47	K81	0,64%	1,18%	0,00%	1,72%	NS
K82	44,11	11,98	24	8,14	K82	3,24%	7,41%	0,00%	6,67%	NS
K83	82,72	22,46	45	15,25	K83	0,60%	1,02%	0,00%	1,75%	NS
K85	238,95	64,89	130	44,07	K85	1,44%	3,75%	0,77%	0,00%	NS
K86	169,11	45,92	92	31,19	K86	0,00%	0,00%	0,00%	0,00%	
K91	16,27	4,42	8,85	3	K91	0,00%	0,00%	0,00%	0,00%	
K92	70,49	19,14	38,35	13	K92	0,53%	1,96%	0,00%	0,00%	NS

* - C16 (stomach cancer), C18 (colon cancer), C20 (malignant neoplasm of the rectum), D37 (oral cavity and digestive system neoplasms of uncertain behaviour and/or unspecified nature), K29 (gastritis and duodenitis), K35 (acute appendicitis), K40 (inguinal hernia), K42 (umbilical hernia), K56 (paralytic ileus), K63 (other intestinal diseases i.e. abscess, perforation, fistula), K80 (cholelithiasis), K81 (cholecystitis), K83 (other disorders of biliary tract), K85 (acute pancreatitis) and K66 (other diseases of pancreas)

Table 6. Selected data from the 2005 questionnaire answered by provincial surgical consultants.

Parameter	UH No. 1	UH No. 5	UH No. 2
Patients subjected to surgery (%)	77,49%	68,28%	91,62%
Urgent mode of surgery (%)	13,58%	4,45%	3,76%
Planned mode of the surgery (%)	86,42%	95,55%	96,24%
Patients with malignant neoplasm subjected to surgery (%)	81,39%	83,46%	84,70%

The authors analysed in detail the patients with the diagnoses C00;...;C97; D00; ...;D89 and K00; ...; K93 from the years 2003-2005. The patients with these diagnoses, the number of whom was at least 15 in each hospital (after modification of the structure) were qualified for further analysis. These diagnoses had the following statistical numbers: C16 (stomach cancer), C18 (colon cancer), C20 (malignant neoplasm of the rectum), D37 (oral cavity and digestive system neoplasms of uncertain behaviour and/or unspecified nature), K29 (gastritis and duodenitis), K35 (acute appendicitis), K40 (inguinal hernia), K42 (umbilical hernia), K56 (paralytic ileus), K63 (other intestinal diseases i.e. abscess, perforation, fistula), K80 (cholelithiasis), K81 (cholecystitis), K83 (other disorders of biliary tract), K85 (acute pancreatitis) and K86 (other diseases of pancreas). Among these diagnoses: K35 (acute appendicitis), K40 (inguinal hernia), K42 (umbilical hernia), K43 (abdominal hernia) and K80 (cholelithiasis) are the ones in which mortality should be low and it should not differ statistically. If such statistically significant differences occurred, they would manifest inadequate qualifications of the operating surgeons and/or improper sanitary rigour. The diagnoses: C16 (malignant neoplasm of the rectum), K56 (paralytic ileus), K63 (other intestinal diseases, i.e. abscess, perforation, fistula), K85 (acute pancreatitis) are the ones with the increased risk of complications and death, in which proper postoperative care or timely treatment in intensive care unit may be of importance to decrease mortality. A significant difference in mortality in these groups of patients between any of the analysed hospitals would indicate a difference in effectiveness of postoperative care.

The statistical analysis demonstrated very low mortality in the groups of patients with the diagnoses of K35, K40, K42, K43 and K80. The mortality in these groups of patients did not differ statistically among the analysed hospitals. This result shows that the skills of the operating teams were similar in all the analysed hospitals and that typical complications for these diagnoses (e.g. infections), were not a distinct problem from the point of view of mortality in these groups of patients. It also points indirectly to sufficient sanitary rigour.

Among the diagnoses with increased risk of complications and death, statistical significance was

found in the group of patients with diagnosed C16 ($p<0,04$)(UH No 1/UH No 5), C18 ($p<0,02$) (UH No 1/ UH No 5) (the number after structure modification). When the number was taken into account in the groups of patients with single diagnoses before structure modification (more patients, unchanged mortality), statistical significance was observed in the group of patients with the diagnoses of C16 ($p<0,02$) (UH No 1/ UH No 5), C18 ($p<0,01$) (UH No 1/UH No 5), and K56 ($p<0,01$) (UH No 1/UH No 5). This result demonstrates the advantage of postoperative care system in UH No 1 in relation to UH No 5.

It is also worth paying attention to the fact that mortality in the group of patients with diagnosed C00-C97 was 14,33% in UH No 1, 27,29% in UH No 2, and 52,49% in UH No 5 (UH No 1/UH No 5 $p<0,001$ and UH No 2/UH No 5 $p<0,01$) and in the group of patients with diagnosed K00-K93 the mortality was 1,62% in UH No 1, 0,92% in UH No 2, and 0,13% in UH No 5 (UH No 1/ UH No 5 $p<0,001$ and UH No 2/UH No 5 $p<0,02$)(after appropriate modification of the structure and number of deaths). The results demonstrate that the mortality in the analysed groups of patients is significantly lower in UH No1 than in the other hospitals, showing that in high-risk patients postoperative care may be of importance to decrease mortality.

Analysing the questionnaires answered by the heads of the surgical units and the provincial consultant in surgery, the authors did not find any other probable differences in care to explain the differences in mortality between patients in the analysed surgical units of the selected hospitals.

High-intensity ICUs have been associated with improved outcomes. Angus et al. defined an ICU as "high intensity" if $\geq 80\%$ of patients were cared for by a critical care physician (intensivist) and defined an ICU as compliant with Leapfrog if it was both high-intensity and providing some form of in-house physician coverage during all hours [1]. In case of UH No. 5 all patients subjected to surgery are in intensive care for for at least 1 day after surgery, whereas in the University Hospitals No. 1 and 2 the intensive care ceases as soon as the patient comes out from under the anesthetic. High-intensity vs low-intensity ICU physician staffing is associated with reduced

hospital and ICU mortality and hospital and ICU [4,5].

A detailed analysis of the diagnoses and of mortality leads to the conclusion that early postoperative intensive care in severely ill patients and in cases of need immediate admission to ICU significantly decrease mortality. The latter is of great importance to explain the difference in mortality between surgical units of UH No. 1 and UH No. 2. The Intensive Care Unit at UH No. 2 can admit more patients from other hospital units due to underestimation of the value of contract with National Health Fund and thus fewer patients than in ICU at UH No. 1.

The authors are aware of the fact that with the continuous shortage of beds in intensive care units due

to the treatment of trauma cases and patients with acute cardio-pulmonological states, rapid change of the system of treatment of postoperative patients is impossible. Nevertheless, the significance of the numbers quoted in this study seems to justify the usefulness of considering such activities.

Changing the system of postoperative care would consist of anesthesiologists and anaesthesiological nurses taking over postoperative care, intensive monitoring of postoperative patients, and immediate transfer of patients with at risk to the Intensive Care Unit. Such steps could be expected to significantly decrease mortality in a surgical unit.

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