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COSTS OF SURGICAL TRAINING IN GERMANY

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In the context of increasing financial pressures on German hospitals, there is a growing interest in the costs incurred during surgical resident training. As training costs are not directly reflected in the German reimbursement system based on Diagnosis Related Groups, hospitals with many residents in training may suffer a financial disadvantage. An exact analysis of training costs is difficult to achieve, as most of the residents' tasks are inseparable from features of the respective patient's case. Therefore, indirect methods must be applied in order to measure the training costs. The aim of the present study therefore was to present an approximation of the costs incurred during the training of residents in general surgery. 1173 inpatient cases were analysed over a period of more than three years in the department for general, visceral, vascular and pediatric surgery of the University Hospital of Saarland, Germany. Patients were grouped according to whether they were operated on by residents or consultants. Factors relevant to costs (operating time, material use, length of hospital stay) were documented. The operating time of surgical procedures performed by residents was shown to be significantly longer, as compared to procedures performed by consultants. More importantly though, the length of hospital stay was significantly increased in patients operated on by residents. This may lead to additional costs, which may even exceed the DRG based revenue of the respective case. The additional costs per individual resident during specialty training in general surgery amounted to approximately 250,000€. With a view to these results, it seems justified to call for extrabudgetary reimbursement of training hospitals.

Key words: *surgical education, surgical training, costs.*

РАСХОДЫ НА ОБУЧЕНИЕ ХИРУРГОВ В ГЕРМАНИИ

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В связи с ростом потребностей финансирования деятельности немецких больниц растет и интерес к величине расходов на подготовку хирурга по программе резидентуры. Поскольку затраты на обучение напрямую не компенсируются немецкой системой возмещения расходов из расчета затрат на диагностически сходные случаи, больницы с большим числом обучающихся резидентов в штате могут оказаться в условиях дефицита финансирования. Точный анализ затрат на обучение труднодостижим, поскольку большинство задач резидентов определяются особенностями случая конкретного пациента. Поэтому для измерения затрат на обучение должны применяться косвенные методы. Соответственно целью настоящего исследования было определение приблизительной величины расходов, понесенных в процессе подготовки резидентов в области общей хирургии. Был проведен анализ 1173 случаев стационарного лечения пациентов в отделениях общей, абдоминальной, сосудистой и детской хирургии Университетской клиники Земли Саар (Германия) в течение более трех лет. Пациенты были разделены на группы в зависимости от того, были они прооперированы врачами-резидентами или штатными консультантами. Анализу подвергались факторы, определяющие затраты на лечение (продолжительность операции, использованные материальные ресурсы, продолжительность пребывания больного в стационаре). Было показано, что время, затраченное непосредственно на выполнение хирургических процедур резидентами, значительно больше, чем при выполнении их консультантами. Еще важнее оказалось то, что продолжительность пребывания в стационаре пациентов, оперированных резидентами, оказалась значимо больше. Эти обстоятельства могут привести к дополнительным расходам, величина которых может даже превышать суммы, возмещаемые исходя из расчета средних затрат на сходные диагностические случаи. Дополнительные затраты на индивидуальную подготовку резидента по общей хирургии за время обучения составили около 250 000 €. Учитывая полученные результаты, представляется оправданным привлекать внебюджетное финансирование для возмещения затрат клиническим больницам, осуществляющим обучение.

Ключевые слова: *хирургическое образование, обучение хирургов, затраты.*

Introduction

In the training of junior doctors, trainees as well as trainers are confronted with growing challenges, which are partly reflected by increasingly specialised training catalogues. Moreover, it is increasingly difficult to attract committed junior colleagues to a surgical career [1, 2]. At the same time, resident training is an investment into the sustainable development of a hospital. A broad spectrum of learning opportunities will be seen as an advantage, especially when compared to other hospitals with less to offer in terms of training and continuing education [3].

Surgical training has recently been subject to extensive debates, as the shortage of junior doctors has be-

come increasingly relevant [4–6]. Hospitals are required to improve recruitment techniques in order to remain fully functional.

University hospitals and academic training hospitals benefit from the steady influx of last year medical students as far as recruitment of junior doctors is concerned [7].

However, in the context of increasing economic pressure on German hospitals it is unlikely that surgical training will remain cost neutral in the future. It is generally acknowledged that specialty training is time-consuming and requires good availability of personal resources, particularly when manual skills are involved [8], because training and supervision of residents have to be implemented without compromising patients' safety. Surgical training causes costs [3, 9] which are not covered by the current German DRG reimbursement system [10, 11]. The funding agencies' position that training costs are covered by regular hospital reimbursements is more than questionable. While it is true that the residents' posts as such are covered by the hospital revenues in general, the case-based reimbursement does not reflect whether procedures are performed by residents or by consultants [10].

Thus, an efficiently managed consultant hospital would profit from the German DRG reimbursement system, whereas training hospitals would not receive a refund of the additional costs incurred in the context of training.

Although this issue has become a focus of attention [3, 9–11], it is still difficult to analyse the costs of training, because much of the residents' daily workload is integrated into patient care, and content specifically associated with training is difficult to isolate. Therefore, only an indirect analysis of the costs is possible, e. g. by assessing the need to provide additional ressources for surgical procedures performed by residents in terms of staff or material. In the present study, the approximate costs of resident training at a maximum care centre will be analysed.

Methods

Data analysis was performed with data deposited in the hospital information system (SAP/i.s.h.med, St. Leon-Rot, Germany). The chosen surgical procedures were some with relatively low complexity (cholecystectomy, inguinal herniotomy, femoral thrombendarterectomy, thyroidectomy) and some with middle complexity (right hemicolectomy, rectal resection). High complexity procedures (e. g. liver or pancreas surgery) were not taken into account. All of the above procedures performed over a period of three years in the department for general, visceral, vascular, and pediatric surgery at the University Hospital of Saarland were analysed on the basis of the data documented in the hospital information system.

Cost-relevant variables were operating time and the use of surgical material including non-reusable instruments and implants. Use of material in anesthesia and sterilisable material was not taken into account.

Human ressources costs were deduced from staffing and the respective colleagues' salaries. These were calculated on the basis of the standard wages during the survey period (2007–2010). Staff from all departments (anesthesiology, surgery) and all occupational groups (doctors, nurses) working in the operating room were taken into account. Standard wages for OR nurses were calculated according to German BAT ("Bundesangestelltentarifvertrag", i.e. collective agreement for employees) pay group E8, resulting in a 0.26€ wage per minute per person. The wage per minute per person for doctors was calculated according to the TVÄ ("Tarifvertrag für Ärzte", i.e. collective agreement for employee doctors). Thus, for the head of department, the wage per minute was calcuated at 1.14€, for a senior consultant 0.79€, for a consultant 0.58€ and for residents 0.46€. Note that these calculations were based on the median of five salary levels of the relevant pay group (Ä1).

Final year medical students assisting in surgical procedures were not taken into account as this group received no payment during the survey period.

Material use for each surgical procedure was calculated on the basis of gross prices for the respective items as documented in the hospital's purchasing division.

Another parameter relevant to cost calculation was the length of stay of each patient in the surgical department, compared to the revenue according to the DRG reimbursement system.

As a starting point, the mean DRG-based revenue of surgical procedures performed by residents was calculated. Average costs for material and salaries (average costs of surgery) were subtracted, as these costs were not relevant to the length of stay. The difference was divided through the mean length of stay to calculate an approximation of the daily costs of a case, which the hospital incurred apart from costs generated in the operating room. Finally, the length of stay of patients operated on by residents was correlated to these numbers.

Primary data collection was conducted with SAP/i.s.h.med and Excel (Microsoft, Unterschleißheim, Germany). Statistical analysis was performed in SPSS (Version 15.0.1, SPSS Inc. Chicago, USA). As none of the parameters displayed normal distribution in any of the numeric variables tested, Mann-Whitney U tests were used to analyse the group differences. Relations between categorial variables were analysed with chi-square tests (Pearson) or Fisher's exact tests (mean value ± SEM, $p < 0.05$).

Results

Distribution of surgical procedures, age of patients, ASA scores

During the survey period with 1173 cases, 237 (20.2%) surgical procedures were performed by residents, 936 (79.8%) were performed by consultants. 741 (63.2%) procedures were classified as low complexity, including 376 laparoscopic cholecystectomies. 432 (36.8%) procedures were classified as middle complexity, including 286 rectal resections and 146 right hemicolectomies. Table 1 gives an overview of the procedu-

Table 1

Distribution of procedures (numbers and percentage) within the group of residents (A) and consultants (B)

Procedures	Group A	Group B
Femoral TEA	16 (12.5%)	112 (87.5%)
Cholecystectomy	99 (26.33%)	277 (73.67%)
Inguinal herniotomy	58 (34.94%)	108 (65.06%)
Thyroidectomy	8 (11.27%)	63 (88.73%)
Right hemicolectomy	29 (19.86%)	117 (80.14%)
Rectal resection	27 (9.44%)	259 (90.56%)
Total [Σ]	237 (20.2%)	936 (79.8%)

Table 2

Patients′ age at procedure (years) within the group of residents (A) and consultants (B)

Procedures	Patients' age (total)	Patients' age group A	Patients' age group B	p-value
Femoral TEA	68.6 ± 0.8	66.0 ± 1.8	69.0 ± 0.9	0.13
Cholecystectomy	51.5 ± 0.9	51.8 ± 1.7	51.4 ± 1.0	0.92
Inguinal herniotomy	62.4 ± 1.2	65.7 ± 1.8	60.6 ± 1.6	0.047
Thyroidectomy	50.8 ± 1.8	42.6 ± 5.1	51.8 ± 1.9	0.11
Right hemicolectomy	65.6 ± 1.2	68.2 ± 2.5	65.0 ± 1.3	0.17
Rectal resection	65.0 ± 0.7	63.2 ±2.5	65.2 ± 0.8	0.34
Total [Σ]	59.9 ± 0.5	59.1 ± 1.1	60.1 ± 0.5	0.53

Table 3

ASA-Score of patients within the group of residents (A) and consultants (B)

Procedures	ASA (total)	ASA group A	ASA group B	p-value
Femoral TEA	2.91 ± 0.04	2.81 ± 0.10	2.93 ± 0.04	0.35
Cholecystectomy	1.99 ± 0.03	2.00 ± 0.06	1.99 ± 0.04	0.83
Inguinal herniotomy	2.27 ± 0.05	2.28 ± 0.08	2.27 ± 0.06	0.92
Thyroidectomy	2.07 ± 0.07	1.88 ± 0.23	2.10 ± 0.07	0.31
Right hemicolectomy	2.51 ± 0.06	2.55 ± 0.09	2.50 ± 0.07	0.68
Rectal resection	2.44 ± 0.04	2.48 ± 0.12	2.43 ± 0.04	0.66
Total [Σ]	2.31 ± 0.02	2.24 ± 0.04	2.33 ± 0.02	0.09

res grouped as resident (A) or consultant (B) procedures. The average age of the patients was comparable in both groups, apart from patients with inguinal herniotomy. In this group, patients operated on by residents were 5 years older on average with a significance of $p = 0.047$ (table 2). There was no difference of ASA scores between group A and group B (table 3).

Duration of surgery, material costs, costs of surgery

A significant difference was seen in the operating time for cholecystectomies, herniotomies and hemicolectomies, which were performed significantly faster by consultants than by residents ($p < 0.001$, $p = 0.04$ und $p = 0.005$). On average, consultants' operating times were 10 minutes shorter for all procedures examined. This difference, however, was not significant (table 4). There was no significant difference between both groups in material use and related costs for any of the procedures examined. For nearly all procedures (excluding right hemicolectomy), higher material costs were incurred when consultants performed the surgeries, leading to significantly higher average material costs for all procedures ($p < 0,001$; table 5).

Table 4

Operating time (OT, minutes) within the group of residents (A) and consultants (B)

Procedures	OT (total)	OT group A	OT group B	p-value
Femoral TEA	107.35 ± 3.33	96.44 ± 5.02	109.31 ± 3.26	0.26
Cholecystectomy	74.20 ± 1.45	84.33 ± 2.44	70.58 ± 2.12	<0.001
Inguinal herniotomy	76.54 ± 2.18	81.24 ± 3.02	74.22 ± 3.32	0.04
Thyroidectomy	91.32 ± 4.03	92.03 ± 11.05	91.23 ± 4.28	0.92
Right hemicolectomy	130.51 ± 3.37	149.48 ± 8.29	126.21 ± 4.01	0.005
Rectal resection	177.26 ± 3.53	176.00 ± 9.35	177.39 ± 4.18	0.83
Total [Σ]	111.30 ± 2.09	103.36 ± 3.32	113.41 ± 2.38	0.11

Table 5

Costs for surgical material (material, €) within the group of residents (A) and consultants (B)

Procedures	Material (total)	Material group A	Material group B	p-value
Femoral TEA	161.78 ± 10.45	144.63 ± 8.67	164.23 ± 11.87	0.55
Cholecystectomy	72.06 ± 2.95	64.88 ± 4.13	74.63 ± 3.71	0.72
Inguinal herniotomy	101.36 ± 4.37	97.70 ± 3.42	103.33 ± 6.47	0.77
Thyroidectomy	10.33 ± 2.06	6.84 ± 0.92	10.78 ± 2.31	0.99
Right hemicolectomy	348.95 ± 15.85	358.84 ± 57.73	346.50 ± 13.87	0.93
Rectal resection	788.69 ± 17.72	752.71 ± 64.39	792.44 ± 18.41	0.56
Total [Σ]	291.45 ± 10.01	190.66 ± 17.72	316.98 ± 11.56	< 0.001

Table 6

Entire costs generated in the operating room (OR costs, €) within the group of residents (A) and consultants (B)

Procedures	OR costs (total)	OR costs group A	OR costs group B	p-value
Femoral TEA	480.09 ± 17.74	407.34 ± 20.59	490.48 ± 19.89	0.21
Cholecystectomy	277.55 ± 4.72	287.78 ± 8.07	273.89 ± 5.71	0.07
Inguinal herniotomy	314.26 ± 8.76	310.52 ± 8.90	316.27 ± 12.62	0.49
Thyroidectomy	281.62 ± 11.69	258.05 ± 31.96	284.61 ± 12.56	0.50
Right hemicolectomy	741.38 ± 22.85	771.03 ± 79.02	734.03 ± 20.95	0.74
Rectal resection	1,327.03 ± 24.25	1,243.05 ± 79.82	1,335.79 ± 25.44	0.24
Total [Σ]	618.71 ± 14.41	468.37 ± 24.85	656.77 ± 16.70	< 0.001

Likewise, analysis of surgery costs yielded no significant differences between both groups. However, the mean costs for all procedures were significantly higher for consultants as compared to residents ($p < 0.001$; table 6).

Hospital stay, DRG reimbursement

The length of hospital stay after cholecystectomy, herniotomy and hemicolectomy performed by consultants was significantly shorter than after the same surgical procedures performed by residents ($p = 0.03$; $p = 0.02$ und $p = 0.008$). The average length of hospital stay for all procedures analysed was also significantly shorter for procedures performed by consultants ($p = 0.001$; table 7). While the DRG reimbursement was not significantly different when the single procedures were compared between both groups, the average across all procedures yielded a significantly higher revenue for procedures performed by consultants ($p < 0.001$; 6,289.70 ± 141.36€ vs. 4,671.39 ± 242.86€; table 8).

Table 7

Hospital stay (HS, days) within the group of residents (A) and consultants (B)

Procedures	HS (total)	HS group A	HS group B	p-value
Femoral TEA	12.88 ± 0.68	11.94 ± 2.04	13.01 ± 0.72	0.79
Cholecystectomy	4.09 ± 0.11	4.42 ± 0.25	3.97 ± 0.13	0.03
Inguinal herniotomy	3.79 ± 0.18	4.33 ± 0.35	3.50 ± 0.20	0.02
Thyroidectomy	3.69 ± 0.17	3.25 ± 0.59	3.75 ± 0.18	0.33
Right hemicolectomy	14.99 ± 0.67	17.48 ± 1.62	14.38 ± 0.73	0.008
Rectal resection	15.68 ± 0.42	15.81 ± 1.70	15.66 ± 0.43	0.7
Total [Σ]	9.16 ± 0.23	7.76 ± 0.48	9.52 ± 0.25	0.001

Table 8

DRG-reimbursement (DRG, €) within the group of residents (A) and consultants (B)

Procedures	DRG (total)	DRG group A	DRG group B	p-value
Femoral TEA	6,345.11 ± 219.78	6,288.83 ± 482.97	6,353.15 ± 242.18	0.76
Cholecystectomy	2,902.65 ± 41.85	2,849.00 ± 71.59	2,921.83 ± 50.74	0.77
Inguinal herniotomy	2,187.63 ± 37.17	2,252.65 ± 68.10	2,152.71 ± 43.77	0.44
Thyroidectomy	3,188.95 ± 84.03	3,208.44 ± 337.43	3,186.47 ± 85.74	0.75
Right hemicolectomy	8,929.53 ± 208.85	8,699.05 ± 366.50	8,986.66 ± 244.66	0.48
Rectal resection	11,179.83 ± 213.99	11,698.30 ± 870.21	11,125.78 ± 218.60	0.76
Total [Σ]	5,962.72 ± 124.42	4,671.39 ± 242.86	6,289.70 ± 141.36	< 0.001

Discussion

In the context of growing pressure on economic and human resources, training of junior surgeons appears to be a major challenge in the future of the medical profession [3, 9]. Surveys have shown a steady decrease of interest in surgical training in the last few years [4–6, 11]. Residents report that the prevalence of administrative tasks and other duties not concerned with surgery as such [12–14] and the lack of family-friendly workplaces [15] have led to decreasing numbers of applications for surgical residencies.

Thus, it seems all the more important not only to improve the framework of surgical training in order to make surgery attractive again, but also to establish a suitable form of reimbursement for costs incurred through training of junior surgeons.

These costs can be calculated only by approximation, as the principle of "learning on the job" makes it almost impossible to separate patient care from training in teaching hospitals.

In the present study, some essential and well-defined factors including operating time, material costs and length of stay are compared to the revenue of the respectives cases. The procedures analysed in this study were chosen partly because they are procedures frequently performed in this department, partly because they are typical training procedures according to current regulations of training in general surgery [16].

In an economic perspective, extended operating times are seen as a measure of low productivity [3]. There is abundant evidence for significantly longer operating times for training procedures. This has been discussed with reference to many different types of surgical procedures [8, 11, 17–19]. In our study, significantly longer operating times were seen in typical training procedures, i. e. cholecystectomy, herniotomy and hemicolectomy, which account for more than 75% of the training procedures.

There are no published data showing significantly increased material costs in training procedures. Rather, any higher costs reported so far were specifically related to operating time [7, 8, 20]. On the contrary, in the present study, material costs were higher in consultant procedures, significantly so in the average of all procedures. An explanation could be that the consultants performed more complex surgical procedures. Shorter operating times did not suffice to balance the higher costs of material and human resources.

We were unable to confirm the assumption proposed by other authors that longer surgery times will automatically be associated with higher costs and thus lead to losses in revenue [3, 8, 17, 21].

However, cholecystectomy, herniotomy and hemicolectomy as training procedures were associated not only with an increased operating time but also with longer length of stay than consultant procedures. Negative correlations between duration of surgery or length of stay and case number or proficiency of the surgeon have been shown in several studies [22–25]. These studies argue that mean treatment costs decrease with higher case numbers [23–25], and that significantly longer lengths of stay are the main cause for higher costs in assisted procedures [12, 26, 27]. This is an especially interesting finding in the setting of the present study, because IT based clinical pathways (including a well-defined length of stay) were at hand for all procedures analysed here at our institution [28, 29]. Therefore, a longer length of stay can only be explained as a conscious decision of the doctors in charge.

As the mean length of stay in the three training procedures mentioned above was below the high trim point, an extended stay with an identical DRG-based revenue would result in revenue loss.

Additional costs can only be approximated due to flat-rate reimbursement according to DRG, and due to the loss of hospital per diem charges. However, it is safe to assume that 50 herniotomies and 25 cholecystectomies (as specified in the current training catalogue [16]) would cause additional costs of 36,913€. When taking into account 25 right hemicolectomies, which are also recommended by the training catalogue, costs would increase by 34,016€ to a total of 70,929€ per surgical resident. This amounts to a mere 25% of the recommended procedures. Thus, the overall costs caused by a surgical resident throughout his or her training may be estimated at approximately 250,000€.

Current studies have shown that procedures performed by residents cause higher costs than those performed by consultants [11, 30, 31], even if complications relevant to the Patient Clinical Complexity Level (PCCL), which may lead to a more profitable DRG-based reimbursement in training procedures, are taken into account [11].

A discussion concerning cost recovery is already under way in other countries [30, 32–36]. It has been suggested that teaching hospitals should receive financial compensation for the costs which they incur, as opposed to hospitals which do not participate in the training of junior doctors [11]. Last but not least, at the 117th general meeting of German doctors (117. Deutscher Ärztetag) the delegates proposed that the legislative should secure the current standard of care for the German population by supporting high-quality training, e. g. by introducing a case-based subsidy for in- and outpatient care [37].

Conclusion

A surgical resident causes costs of approximately 250,000€ during his or her training, which have so far not been taken into account in the DRG-based reimbursement system. On the background of strained financial and human resources, it is an important challenge for politics to secure surgical training by adequate reimbursement.

Conflicts of interest

The authors of this paper certify that they have no affiliations with or involvement in organisations with financial or non-financial interest in the issues discussed in this paper.

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