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Costs of Measuring Outcomes of Acute Hospital Care in a Longitudinal Outcomes Measurement System

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It is widely acknowledged that the measurement of outcomes of care and the comparison of outcomes over time within health care providers and risk-adjusted comparisons among providers are important parts of improving quality and cost-effectiveness of care. However, few studies have assessed the costs of measuring outcomes of care. We sought to evaluate the personnel and financial resources spent for a prospective assessment of outcomes of acute hospital care by health professionals in internal medicine. The study included 15 primary care hospitals participating in a longitudinal outcomes measurement program and 2005 patients over an assessment period with an average duration of 6 months. Each hospital project manager participated in a previously-tested structured 30-minute telephone interview. Outcome measures include time spent by the individual job titles in implementing and running the outcomes measurement program. Job-title–specific times were used to calculate costs from the hospitals' perspective. One-time costs (€2132 ± 1352) and administrative costs (€95 ± 97 per week) varied substantially. Costs per patient were fairly stable at around €20. We estimated that the total cost for each hospital to assess outcomes of care for accreditation (10 tracer diagnoses over 6 months) would be €9700 and that continuous monitoring of outcomes (5 tracer diagnoses) would cost €12,400 per year. This study suggests that outcomes of acute hospital care can be assessed with limited resources and that standardized training programs would reduce variability in overall costs. This study should help hospital decision makers to estimate the necessary funding for outcomes measurement initiatives.

Key words: Costs, measurement, outcomes research, quality of care.

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It is widely acknowledged that the measurement of outcomes of care and the comparison of outcomes over time within health care providers and risk-adjusted comparisons among providers are important parts of improving quality and cost-effectiveness of care (1). Studies have shown that providing health care providers with data on standardized comparisons on the processes and outcomes of care can lead to improvements in care (2) and may result in savings (3). The effectiveness of public disclosure of risk-adjusted outcomes data is still debated (4, 5). However, critics may claim that the costs of measuring and comparing risk-adjusted outcomes of care may outweigh the benefits.

Although the evidence of an improvement in quality of care based on outcomes measurement is limited, there are even fewer studies on the costs of assessing the outcomes of care (6). Costs vary depending on the measurement design. Generally, it is assumed that costs increase with the involvement of more qualified

Table 1

Mean One-Time Costs (€) Associated With the Implementation of QMK (±Standard Deviation [SD]). The Implementation Is Divided Into 3 Components: General Introduction, Specific Introduction, and Tutorial (1 € = 1.956 DM)

		General Introduction						Specific Introduction[a]	
		Time[b]		Volume		Cost		Time	
	Cost Factor	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Project manager	0.675–1.33[c]	188.08	177.97	0.85	0.38	105.92	104.26	461.64	349.35
Second project manager	0.675–1.33[c]	27.69	71.90	0.15	0.38	14.14	36.45	88.57	185.62
Physician-in-chief	2.33	42.69	61.19	0.46	0.66	59.11	84.88	30.45	47.80
Attending physician	1.33	80.77	134.38	0.46	0.52	54.92	91.38	39.67	67.26
House officer	0.983	105.00	173.21	1.23	2.59	81.77	122.80	44.75	65.62
Resident	0.35	—	—	—	—	—	—		
Nurse-in-chief	1.12	65.77	132.41	0.38	0.51	37.66	75.82	49.50	59.02
Head nurse	0.833	140.77	201.76	0.62	0.87	65.85	86.95	70.94	88.48
Nurse	0.675–0.7[c]	45.00	63.64	3.23	6.51	99.95	184.26	54.86	48.62
Administration	0.633–1.75[c]	41.54	101.39	0.31	0.63	23.93	68.96	218.99	462.84
Total average component cost						479.69 ± 392.31			

[a] Including the development of a specific implementation plan.
[b] Time in minutes.
[c] These jobs are filled by professionals with slightly different backgrounds.

professionals. Relatively inexpensive systems are based on retrospective claims data, which frequently are criticized for their limited ability to achieve a satisfactory level of risk adjustment. More refined and costly methods include retrospective medical records abstraction, and more thorough approaches include patient interviews or prospective outcomes assessment by health professionals. Although each of these approaches has its limitations for achieving valid estimates of outcomes of care, it seems intuitive that the prospective assessment by health professionals is one of the most expensive methods. Yet this approach is currently tested (7) or implemented (8) in several European countries.

We sought to evaluate the personnel and financial resources spent for a prospective assessment of outcome of acute hospital care by health professionals of internal medicine. We used detailed telephone interviews of project managers from 15 hospitals participating in the evaluation of a comprehensive outcomes measurement system. Our study took into consideration the hospitals' perspective.

METHODS

Setting of the Outcomes Measurement System

QMK is a longitudinal outcomes measurement system that assesses several dimensions of outcomes of acute hospital care with standardized tools. Risk-adjusted outcomes of acute hospital care were compared with hierarchical regression models (9) among 23 participating hospitals between July 2000 and May 2001. The program was initiated by the largest German health fund (AOK) and 2 private hospital chains (ASKLEPIOS GmbH and HELIOS GmbH).

Carefully selected and evaluated outcome indicators for selected medical tracer diagnoses (7) were prospectively measured at the time of admission and discharge. The risk-adjusted difference between discharge value and admission value of these indicators (=delta value) represents the outcome indicator value. The mean length of stay for medical diagnoses in the participating hospitals was 10 days in 2000.

The structure of QMK is described elsewhere in detail (7, 10, 11). Several dimensions of health were assessed at the time of admission

- A generic questionnaire on demographics, living situation, social functioning, and physical functioning (base module). The main purpose of the base module is risk adjustment based on patient characteristics at the time of hospital admission.
- A patient questionnaire on self-reported health status using the physical and mental component scales of the 12-Item Short-Form Health Survey (12) (patient-centered module).
- Five organ-specific questionnaires measuring outcome indicators and comorbidities (organ-specific module). Physical functioning and comorbidities were combined into the Index of Coexisting Diseases (13, 14).

Table 1

Extended

Specific Introduction[a]				Tutorial on Each Ward					
Volume		Cost		Time		Volume		Cost	
Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
1.00	0.00	235.93	186.50	81.79	59.86	0.86	0.36	75.29	65.99
0.40	0.47	35.18	65.80	12.86	28.13	0.21	0.43	13.17	34.81
0.30	0.61	26.89	42.29	23.21	31.48	0.43	0.51	27.66	37.50
1.20	2.00	50.32	85.42	24.29	32.51	1.14	1.70	38.37	54.83
1.79	2.39	64.66	107.81	38.57	37.75	3.50	4.18	92.98	129.11
				2.14	8.02	0.29	1.07	1.53	5.74
0.44	0.50	22.60	28.76	3.57	13.36	0.07	0.27	2.05	7.65
2.07	1.94	76.05	92.12	23.43	20.57	2.57	2.28	41.68	39.60
7.64	13.93	161.47	287.91	35.50	32.83	22.29	18.80	333.21	306.35
0.35	0.71	53.11	142.28	6.43	16.34	3.50	12.81	3.12	8.43
		733.98 ± 556.30						597.10 ± 404.47	

Only 1 organ-specific module will be selected for the primary diagnosis of each eligible patient. At the time of discharge, a second patient-centered module and an organ-specific module were administered. Nurse practitioners collected informed consent from patients, administered the base module, and instructed patients in the patient-centered module. Physicians administered the use of organ-specific modules.

Costs for implementing and conducting QMK can be divided into 3 blocks, each consisting of several components.

The first block consists of all one-time costs and includes 3 components:

I.1. A general introduction to QMK for all hospitals. Usually, each hospital project manager, the physician-in-chief, and selected staff attended a regional meeting that included several hospital teams.

I.2. A specific introduction within each hospital, outlining and discussing what QMK means to a specific hospital and how it will be implemented.

I.3. A tutorial on each ward offered by each hospital project manager to train all nurses, physicians, and administrative staff in the hospital-specific implementation of QMK. Implementations were allowed to vary among hospitals to a limited extent.

I.4. A one-time hospital questionnaire on structural resources of each hospital and its region.

I.5. A one-time survey was sent to all referring physicians to assess their opinions on the quality of hospital care provided to their patients.

Table 2

Mean Costs per Enrolled Patient (€) Associated With QMK (±Standard Deviation [SD]). Patient-Specific Questionnaires Are Divided Into 3 Components: Base Module, Organ-Specific Modules, and a Patient-Centered Module, Including Informed Consent

		Base Module				Organ-Specific Module				Patient-Centered Module Including Consent			
	Cost Factor	Time		Cost		Time		Cost		Time		Cost	
		Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Project manager	0.675–1.3									17.50	3.54	9.32	1.03
Attending physician	1.33									10.00	0	6.80	0
House officer	0.983					18.47	5.33	9.28	2.68	20.50	6.36	10.30	3.20
Nurse	0.675	8.20	2.11	2.83	0.73					14.54	8.86	5.02	3.06
Administration	0.633									10.00	0	6.33	0
Total average component cost				2.83 ± 0.73				9.28 ± 2.68				7.53 ± 3.29	

The second block consists of all costs per enrolled patient, including

II.1. the base module,
II.2. a organ-specific module,
II.3. the patient-centered module including informed consent.

The third block summarizes all administrative costs on a weekly basis (III).

Study Design

This study is based on a random sample of 15 hospitals (60%) participating in the QMK program. Typically, these primary care hospitals had 1 or 2 medical wards with an average of 90 beds. Together, the sampled hospitals included 2005 patients over an assessment period of an average of 6 months. One of the authors (Ms Manstetten) conducted a previously-tested structured 30-minute telephone interview with each hospital project manager. Each participating hospital received written information on this study before the interview. The interview focused on assessing the time each job title contributed to the successful implementation of QMK.

Costs of Measuring Health Outcomes

As a first step, we measured the time spent by professionals with specific job titles in implementing and running the QMK longitudinal outcomes measurement system. This approach was described by Suver et al. (15) Only activities directly related to QMK were included. For each activity, the job title(s) of the person(s) performing that activity was recorded. Within each job title, the number of people involved was multiplied by the time spent for each activity. This job time was further multiplied by the hourly costs for that job title. Means and standard deviations of these component-cost estimates were reported for 15 participating hospitals and aggregated on several levels. Costs for the design of QMK, data entry, analysis, and production of hospital-specific reports were not considered.

Statistical Analysis

Within each activity category, the time commitment of each job title was added for each hospital and multiplied by a job-title–specific cost factor expressed in Euros per minute. We calculated means and standard deviations for these actions and personnel-specific Euro values. Within each activity category, the sum of the averages and the corresponding standard deviation were computed to reflect the average cost for a component. Variability in costs for specific activities/components was reported as the coefficient of variation that adjusts the standard deviation for the sample mean (16). Because component costs have different denominators (constant, patients, or weeks), they cannot be simply added to a total. Therefore, we constructed 3 scenarios of how the outcomes measurement system may be used depending on the duration and comprehensiveness of the outcome assessment. For these scenarios, total average costs and standard deviations were computed by adding the appropriate multiples of component costs.

RESULTS

The average 1-time costs for the general introduction session, hospital-specific introduction, and tutorials on each ward were €480, €734, and €597, respectively. We observed large variations among hospitals in the time each job title contributed to these components (Table 1). The coefficients of variation (CV) were consistent with large variation: 0.82, 0.76, 0.68. There was less variation in the administration of the base module (CV = 0.26), organ-specific modules (CV = 0.29), and patient-centered module (CV = 0.44) (Table 2). Administrative costs were also quite variable (CV = 1.02) (Table 3).

These cost components added up to 1-time costs of €2132, average costs of €20 per patient, and administrative costs of €95 per week (Table 4). On the basis of these component costs, we calculated several scenarios of how the QMK could be administered. Scenario A is the full accreditation scenario, which was actually performed during our study. The full accreditation scenario takes 6 months and involves all components described above. It costs each hospital on average €9733 (Table 5). This scenario can be reduced to core measures (B) of 3 instead of 10 tracer diagnoses. Costs can be further reduced to €5912 per accreditation if the hospital survey and survey of referring physicians are dropped (Table 5). A continuous year-round outcome-monitoring scenario (C), restricted to 5 instead of 10 diagnoses, would cost €12,393 per year (Table 5).

DISCUSSION

This detailed cost analysis of measuring outcomes of hospital care involving patients, nursing staff, and

Table 3

Mean Costs per Week (€) Associated With QMK (±Standard Deviation)

		Administration					
		Time		Volume		Cost	
	Cost Factor	Mean	SD	Mean	SD	Mean	SD
Project manager	0.6775–1.33	178.93	207.95	1.00	0	88.33	100.36
Second project manager	0.6775–1.33	1.57	5.88	0.27	0.27	0.79	2.96
Administration	0.66–1.12	17.86	31.67	0.46	0.52	6.03	10.69
Total average component cost						95.14 ± 96.62	

physicians showed that rigorous comparisons of risk-adjusted outcomes are possible with limited resource use. It was not surprising that the 1-time cost and administrative costs were highly variable among the 15 hospitals. Because the QMK longitudinal outcomes measurement system did not strictly specify the staffing and intensity of training, the variability was a reflection of how seriously individual hospitals approached the outcomes measurement. The variability in administering and/or filling in the questionnaires was much smaller per patient. The fairly constant resources needed per patient, independent of the resources used for training and administration, make it easier to plan the overall financial investment if comprehensive outcome measurement will be used in larger hospitals or for longer time periods because the cost will be increasingly determined by the number of patients.

We presented cost estimates for 3 scenarios. The "accreditation scenario" comprised many diagnoses and indicators that will be measured for a limited time (6 months). This scenario will provide a fairly good assessment of a hospital's performance but should be repeated regularly to measure improvements in the quality of care. The "core-measure scenario" is limited to 3 diagnoses. The assessment will obviously be narrower, but the selection of quality indicators only for the 3 most prevalent diseases in a particular hospital will be used to custom-tailor the assessment to the specific needs of a hospital and at the same time reduce the financial investment of measuring quality by about one third.

The "continuous outcome-monitoring scenario" is the most useful approach for total quality management because it provides constant feedback for a set of 5 diagnoses that will be exchanged over time. Studies have shown that providing health care providers with data on standardized comparisons on the processes and outcomes of care can lead to improvements in care (2) and may result in net cost savings (3, 17). One year of this model will increase the costs of the accreditation scenario by one third.

Our study did not consider costs for data entry analysis and production of the hospital-specific reports. It is obvious that data analysis and production of reports can be automated to a large extent. During the study period all instruments were administered as paper and pencil questionnaires. However, because over 90% of relevant measurements are recorded during routine clinical practice, these mea-

Table 4

Average Component Costs (€) and Standard Deviations

Total Costs	Component Costs	
One-time costs	General introduction	€480 ± 392
€2132 ± 1352	Specific introduction	€734 ± 556
	Tutorial	€597 ± 404
	Hospital questionnaire	€159[a]
	Referring physician survey	€162[a]
Cost per enrolled patient	Base module	€2.8 ± 0.7
€20 ± 6.7	Organ-specific modules	€9.3 ± 2.7
	Patient-centered module including informed consent	€7.5 ± 3.3
Costs per week	Administrative work	€95 ± 97
€96 ± 97		

[a] This is an approximation. Therefore, no empirical standard deviation can be attached.

Table 5

Three Scenarios of Longitudinal Outcomes Measurement and Their Costs for Participating Hospitals (€)

A) Accreditation scenario		
1. One-time costs		€2132
2. 25 patients per tracer diagnosis, 10 tracer diagnoses	(25 × 10 × €20)	€5000
3. 6 mo (24 wk)	(24 × €95)	€2280
4. Hospital structure		€159
5. Referring physicians survey		€162
		Total = €9733/accreditation
B) Core measures scenario		
1. One-time costs		€2132
2. 25 patients per tracer diagnosis, 3 tracer diagnoses	(25 × 3 × €20)	€1500
3. 6 mo (24 wk)	(24 × €95)	€2280
		Total = €5912/accreditation
C) Continuous outcomes monitoring scenario		
1. One-time costs		€2132
2. 25 patients per tracer diagnosis, 5 tracer diagnoses at a time (change of tracer diagnoses every 6 mo)	(25 × 5 × 2 × €20)	€5000
3. 12 mo (52 wk)	(52 × €95)	€4940
4. Hospital structure		€159
5. Referring physicians		€162
		Total = €12,393/y

surements could be derived from an electronic medical records system. This would reduce time and costs of a longitudinal outcomes measurement system but could mean a substantial up-front investment in linking the electronic records database with a database used for the analysis of risk-adjusted outcome comparisons.

The study suggests that outcomes of acute hospital care can be assessed with limited resources and that standardized training programs would reduce variability in overall costs. The study should help hospital decision-makers estimate the necessary funding for outcomes measurement initiatives.

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