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Is discharge policy a balanced decision between clinical considerations and hospital ownership policy? The CABG example

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Objectives: To explore to what extent patient discharge from the hospital is a balanced decision between clinical considerations and management policy; specifically: (1) to assess the role of patient risk as a determinant of discharge in comparison with administrative factors such as hospital ownership; (2) to evaluate whether variations in discharge policy were translated into differences in clinical outcomes.

Methods: A national study of coronary artery bypass surgery was used as an example. The population included 4778 patients undergoing coronary artery bypass surgery in 14 institutions. The mode of discharge day, rather than the mean, was used as the best indicator of discharge policy. Parametric survival model was used to assess factors associated with the day of discharge.

Results: The mode of discharge day varied widely among institutions. This variation between 4 and 7 days after surgery corresponded to hospital ownership. The mode of discharge day was almost invariant to the patients' risk, but serious postoperative complications resulted in prolonged stay for a minority of the patients. The influence of hospital ownership prevailed over patient insurance carriers. Differences in discharge policies were not associated with increased risk of late mortality or rehospitalization.

Conclusions: Discharge policy beyond the rare occurrence of dramatic patient postoperative complications was mainly dependent on hospital owner's cost-effectiveness considerations. However, despite the weight given to administrative factors in the decision-making process, it did not affect the outcome of care.

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The decision to discharge a patient from the hospital by the physician is a selective process that distinguishes, on a daily basis, between patients who are able to continue the recovery process outside the hospital and those who are not yet ready to leave. This selective process, however, is potentially influenced by a variety of factors, not exclusively clinical considerations. For example, changes in the reimbursement systems for hospitalizations (giving incentives for reducing the length of stay [LOS]) may influence the discharge policy. With cost considerations gaining increasing importance, the weight of administrative factors in the decision-making process grows. We were especially interested in the interface between providers such as hospital clinicians versus administrators.

For the role of discharge in relation to patient outcomes to be fully appreciated, a long-term follow-up, beyond hospital stay, of patients is required. In fact, discharge can be viewed as an informative intermediate event in the long-term process of care and recovery of hospitalized patients. On the one hand, a variety of clinical

TABLE 1. Patient characteristics by hospital ownership

Patient characteristics	Total population (n = 4778)	Government (n = 1865)	HMO-A (n = 1473)	Public (n = 838)	Private (n = 602)
Demographic					
Age (y, mean ± SD)	64.0 ± 9.8	64.7 ± 9.9	64.4 ± 9.1	63.5 ± 10.0	61.8 ± 10.1
Female sex (%)	1008 (21.0%)	22.0	23.7	18.0	16.3
Living alone (%)	742 (15.6%)	16.0	17.9	13.1	12.7
Country of birth: Europe/America (%)	2593 (55.2%)	56.4	55.3	50.7	57.2
Clinical					
Operation					
Emergency (%)	95 (2.0%)	2.1	1.9	2.3	1.5
Urgent (%)	1820 (38.0%)	38.8	43.3	31.0	32.7
Elective (%)	2805 (58.7%)	56.5	54.2	66.5	65.6
Acute myocardial infarction (%)	129 (2.7%)	3.0	2.9	3.1	0.8
Redo CABG (%)	170 (3.6%)	3.6	2.4	5.6	3.3
Chronic renal disease (%)	169 (3.6%)	3.4	3.6	3.7	3.9
Chronic obstructive pulmonary disease (%)	273 (5.7%)	5.3	7.1	5.7	3.8
Extreme body mass index (%)	443 (9.3%)	9.0	11.5	7.9	6.6
Past stroke, (%)	234 (4.9%)	4.8	5.4	5.5	3.0
Past hospitalization >2 (%)	728 (15.2%)	13.4	17.4	20.3	8.6
Canadian class III-IV (%)	2088 (45.1%)	50.3	38.7	53.6	32.4

and institutional factors influence the decision to discharge a particular patient on any given day. On the other hand, discharge implies changing environments reflecting changes in the level of medical supervision and, thus, may modify the risks of adverse outcomes such as mortality, complications, and rehospitalizations.[1]

This article illustrates an approach to characterize and evaluate the variability in discharge policy and its outcomes. Data from a national prospective study on patients undergoing coronary artery bypass grafting (CABG) were used as an example. Several previous studies evaluated the clinical factors, at admission and postoperatively, that affected duration of stay after CABG surgery.[2-5] A few of these studies also found a significant interhospital variability in LOS, above what was explained by patient factors,[4,6] but did not attempt to specify institutional factors that could explain this variation. Further, the studies were limited to the hospitalization period.

We explored the determinants and implications of discharge timing, using a surgical procedure, which was paid by differential tariffs. The objectives of the study were as follows: (1) to assess the role of patient risk as a determinant of discharge in comparison with administrative factors such as hospital ownership and (2) to evaluate whether variation in discharge policy was manifested in clinical outcomes.

Methods

Population and Data

The study was based on the Israeli CABG study, carried out in 1994 in all 14 Israeli hospitals that performed this surgery.[7-9] The subjects were the 4778 patients who survived the operation (were alive beyond the first 3 days) and for whom complete data were available. Rehospitalizations within 100 days of the operation and mortality data up to 6 months after the operation were independently ascertained.

Study Definitions

Hospital ownership. The analysis was focused on groups of hospitals rather than individual institutions. The groups were formed on the basis of hospital ownership, which is the dominant characteristic in the administrative hierarchy. We classified hospital ownership into 4 groups: owned directly by the government (Ministry of Health), owned by the main health insurance company (HMO-A), owned privately, and owned by various public nonprofit organizations. HMO-A has a dual function in that it both insures patients' health care and owns a significant number of acute care hospitals. The effect of HMO-A on the day of discharge, therefore, could be examined once as the patient's insurance carrier in any of the hospitals and once as the actual owner of the hospital where the patient had the operation.

Health insurance. There are 4 health insurance companies in Israel, of which HMO-A is the oldest and the largest. At the time of the study, HMO-A insured 65.5% of population; HMO-B, HMO-C, and HMO-D covered 17.6, 8.7, and 8.2% of the population, respectively. The government, at the time of the study, paid for patients below the poverty line.

Distribution of discharge days. To describe the distribution of discharge days, the modal day of discharge, rather than the mean or median of the distribution, was chosen. By definition, the mode is the day with the highest frequency of discharges. Thus, the mode captures the most common patterns of discharge and hence is likely to reflect more strongly a hospital policy, while the mean is strongly influenced by extreme values relevant to few patients with long duration of stay.

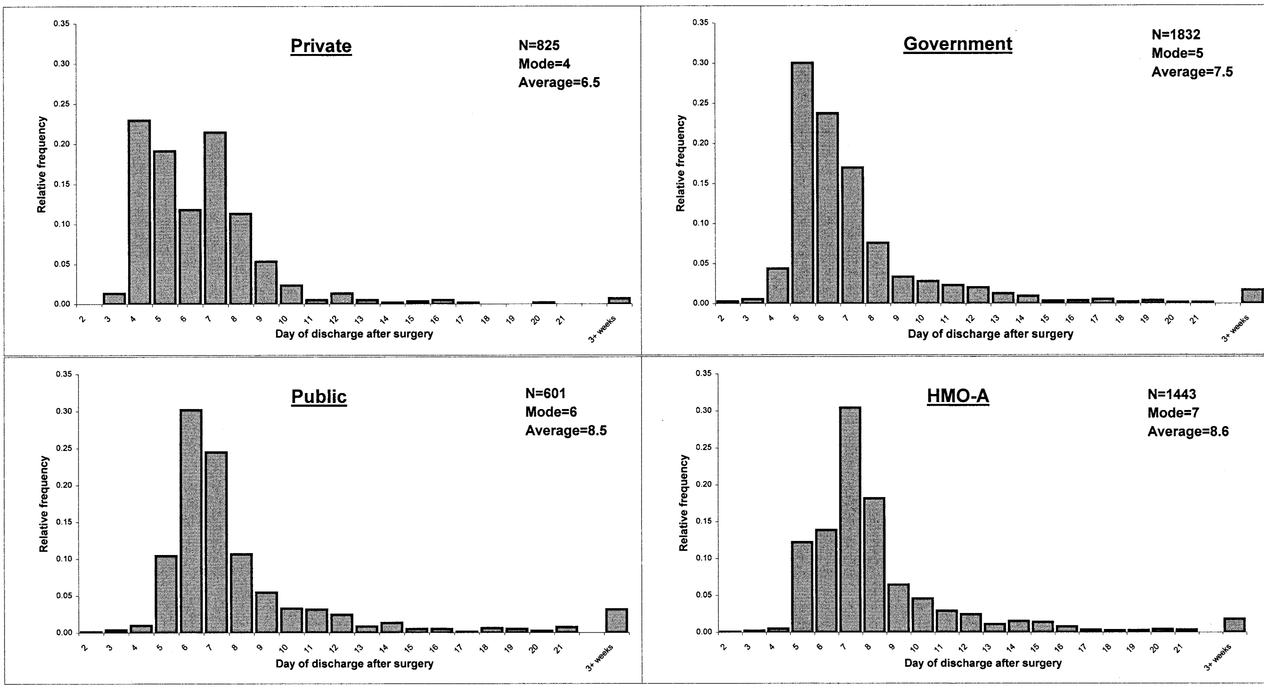

Figure 1. Distribution of day of discharge in groups of hospitals by ownership. Distribution of day of discharge in groups of hospitals by ownership.

Short hospitalization. We decided to avoid defining "short hospitalization" as a fixed number of days, since there is no commonly accepted threshold. Rather, "short hospitalization" was defined as an LOS shorter than the mode for each of the hospital-ownership groups.

Determinants of length of stay. All variables that had a potential for affecting the time of discharge were grouped into hospital ownership, patient sociodemographic background, preadmission diagnoses, and perioperative clinical risk factors such as surgical and immediate postoperative complications. Only complications occurring within the first 72 hours postoperatively were included as possible determinants of LOS, because later complications could in turn be affected by long duration rather than cause it.

Statistical Analysis

The descriptive comparison of discharge policies was made within strata of patients' severity of illness. These strata were formed previously by us[8] and were created by the use of an independent multivariate logistic model for 30-day mortality (including case-mix and intraoperative complications). The risk for each patient was defined as the sum of the coefficients from the model multiplied by the respective values of the covariates for that patient. Quartiles of the score distribution formed the risk strata. The score is given by the following formula:

$$\begin{aligned}\text{Risk score} = {} & -5.75 + 0.39\ (\text{age: 70-75}) + 0.60\ (\text{age: } {>}75) + 0.38\ (\text{female sex}) + 0.58\ (\text{diabetes}) \\ & + 0.69\ (\text{LVD: moderate}) + 0.85\ (\text{LVD: severe}) + 0.71\ (\text{renal dysfunction}) + 0.62\ (\text{urgent operation}) \\ & + 1.96\ (\text{emergency operation}) + 0.71\ (\geq 3 \text{ bypasses} + \text{LMD}) + 0.5\ (\geq 3 \text{ bypasses without LMD}) \\ & + 0.19\ (\text{LMD alone}) + 1.41\ (\text{intraoperative complications: severe}) \\ & + 0.40\ (\text{intraoperative complications: moderate}) + 0.52\ (\text{HLM withdrawal: 1 attempt and inotropes}) \\ & + 0.80\ (\text{HLM withdrawal: } \geq 2 \text{ attempts}) + 1.50\ (\text{intraoperative IABP}) + 1.00\ (\text{no HLM}) \\ & + 0.46\ (\text{crossclamp time} > 25 \text{ minutes per bypass})\end{aligned}$$

where LVD is left ventricular dysfunction; LMD is left main disease; HLM is heart-lung machine; and IABP is intra-aortic balloon pump.

Next, to examine the effect of ownership on discharge policy adjusting for several factors simultaneously, we developed a multivariate survival regression model assuming a log-logistic distribution for the hazard. In this model, time to discharge was the dependent variable, and deaths were treated as censored observations contributing information until time of death. One advantage of the parametric model over a Cox regression model is that the effect of covariates can be expressed on the time scale rather then as a relative risk measure. Formally, the association between binary risk factors and discharge time was expressed as the ratio of the expected time-to-discharge in the risk category compared with the reference group. A time ratio (TR) value > 1 reflected a later discharge relative to the reference group, whereas a TR value < 1 reflected an earlier discharge and hence a shorter stay. The log-logistic survival model assumes that the hazard is initially 0, increases in the early period to a peak, and then declines gradually toward 0. This form of the hazard gave a good fit to the pattern of discharges over time. This is the only part of the analysis in which the mean LOS was the outcome, and thus the model is driven by a minority of patients with extremely long duration of stay. This is in contrast to the descriptive previous analysis based on the mode of discharge that captures the most common patterns.

The last part of the analysis examined the clinical implications of "short hospitalization" as defined above. Only patients discharged alive from hospital were included. Six-month mortality and hospital readmissions were considered as the clinical outcomes of interest.

Results

Of the CABG population, government hospitals accounted for 39.0% of the patients (4 hospitals), HMO-A for 30.8% (4 hospitals), public for 17.6% (2 hospitals), and private for 12.6% (4 hospitals). Comparative characteristics of patients by hospital ownership are presented in Table 1. For the majority of case-mix factors, there were no substantial differences in the proportion of patients at risk between those operated on in government- and HMO-A-owned hospitals. Private hospitals had fewer patients at high risk.

The majority of patients (90%) were discharged home, 7% were discharged to a recovery facility (all those patients were operated in the private hospitals), and 3% were transferred to other hospitals or rehabilitation institutions.

The distribution of the day of discharge by hospital ownership is shown in Figure 1. The modal day varied and was 4 days for private, 5 days for government, 6 for public, and 7 for HMO-A (the respective mean durations of stay by ownership were 6.5, 7.5, 8.6, and 8.6 days). The two major ownership groups (government and HMO-A) had a 2-day difference in their mode of discharge. The mode of discharge remained constant after stratification by patient risk score (Figure 2). For example, in the HMO-A-owned hospitals, there was evidence of an increase in the LOS for some patients with increased risk, while the mode remained 7 days. In the private hospitals, a bimodal distribution across the risk strata was found, with very early discharges (mode = 4 days) observed in 1 of the private hospitals and a later discharge (mode = 7 days) observed in the other 3 smaller private hospitals.

Table 2 represents the effect of the patient's health insurance carrier on the LOS. In government- and in HMO-A-owned hospitals, the modal days for hospital discharge were the usual 5 and 7 days, respectively, irrespective of insurer, and between 6 and 7 days in public-owned hospitals. Consequently, patients who were insured by HMO-A but were operated on in government hospitals had a shorter stay than those operated on in HMO-A's own hospitals.

Factors found in the multivariate model to affect time-to-discharge after CABG are presented in Figure 3 (and Appendix 1). In the graph, the adjusted effects are expressed as a percent increase in hospital days (for time ratios and confidence intervals, see Appendix 1). Perioperative complications had a major effect on time-to-discharge. Postoperative stroke increased time-to-discharge by 60.8%, congestive heart failure by 36.5%, need for IABP during the operation by 30.4%, and wound infection occurring immediately after the operation by 27.2%. Similarly, prolonged mechanical ventilation (>24 hours), additional operations during the same hospitalization, intraoperative complication, difficulties in withdrawal from HLM, and multiple blood transfusions all tended to keep patients in the hospital longer, with an increase in the LOS of 6% to 14%. Among case-mix clinical factors, only emergency operation had strong effect on time-to-discharge (19.5% increase). Other factors such as renal insufficiency, redo CABG, acute myocardial infarction, history of chronic obstructive pulmonary disease, extreme body mass index, past stroke, and multiple prior hospitalizations had moderate increase in LOS of 4.8% to 10.1%. Of the sociodemographic characteristics, age (4% increase per 10 years of age), living alone (3.4%), and Asia or Africa as the country of birth were all associated with a longer hospital stay. Hospitals owned by either HMO-A or the public were associated with an increase in LOS by 14% to 15% relative to either government or private ownership, adjusting for all the factors that entered the regression equation. The late outcome implications of early discharge are examined in Table 3. "Short" hospitalization was defined in relative terms, as discharge on a day earlier than the mode observed for that ownership group. Hence the same day of discharge, say day 5, could be considered "early" discharge for the hospital group with a mode of discharge at days 6 or 7 but not for others with shorter mode of stay. Mortality rates up to 6 months after surgery and 3-month readmissions to hospital (Table 3) were compared for patients discharged alive from the hospital, either "early" or not. For both outcomes, "early" discharge was associated with neither an increased risk for mortality nor readmissions.

Discussion

We found a substantial variability in the policy of discharge between various hospital owners, as represented by the mode of the discharge distribution (Figure 1).

Discharge policy patterns (as represented by the mode of discharge) persisted even after stratification by patients' severity of illness, although there was a modest tendency for longer duration among patients in the highest risk stratum. Ownership prevailing over risk was strongly demonstrated by the long duration of stay for low-risk patients in hospitals with a prolonged LOS policy. Thus, for example, in HMO-

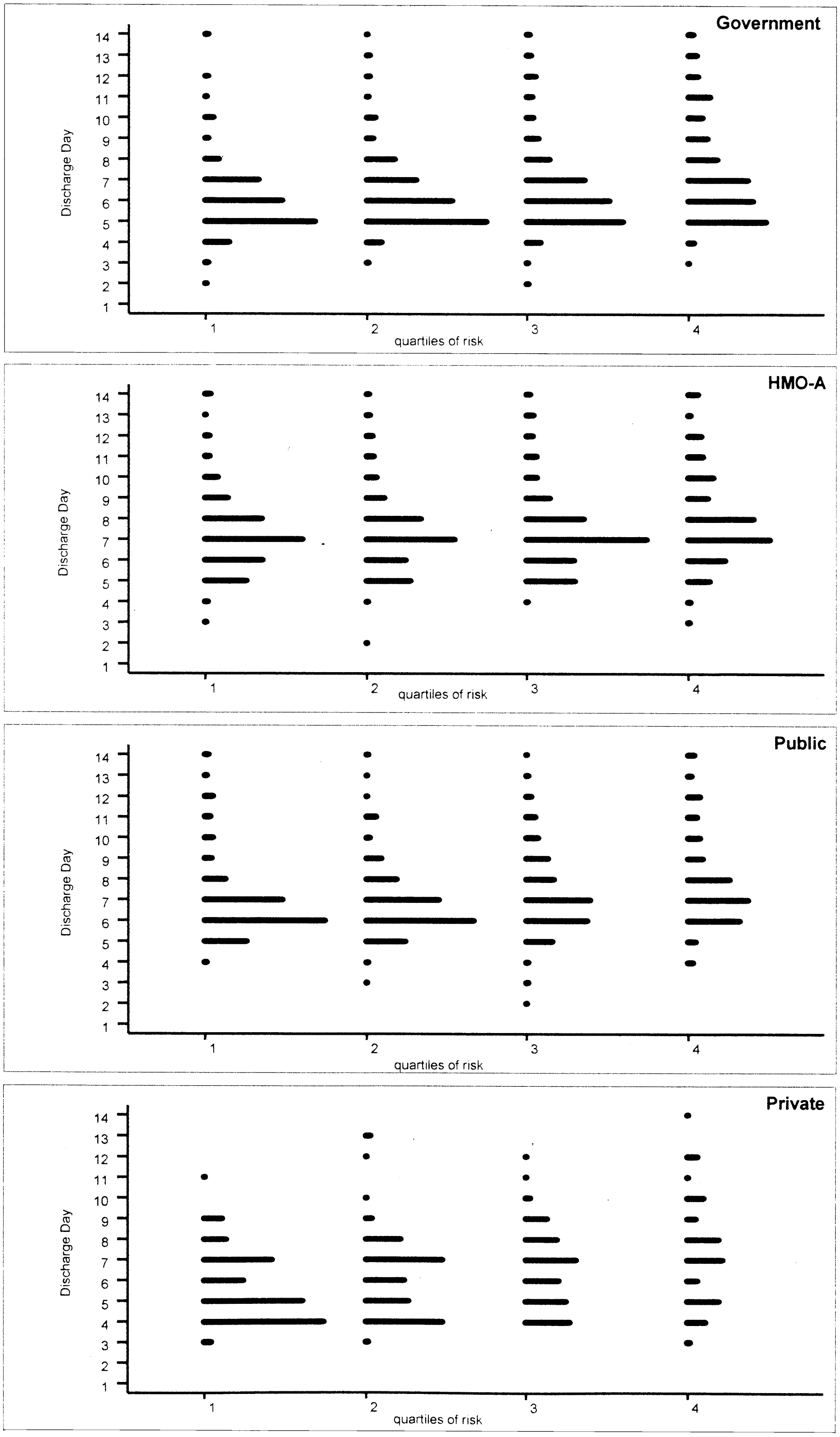

Figure 2. Discharge day by ownership, stratified by patients' risk quartiles (see text). Discharge day by ownership, stratified by patients' risk quartiles (see text).

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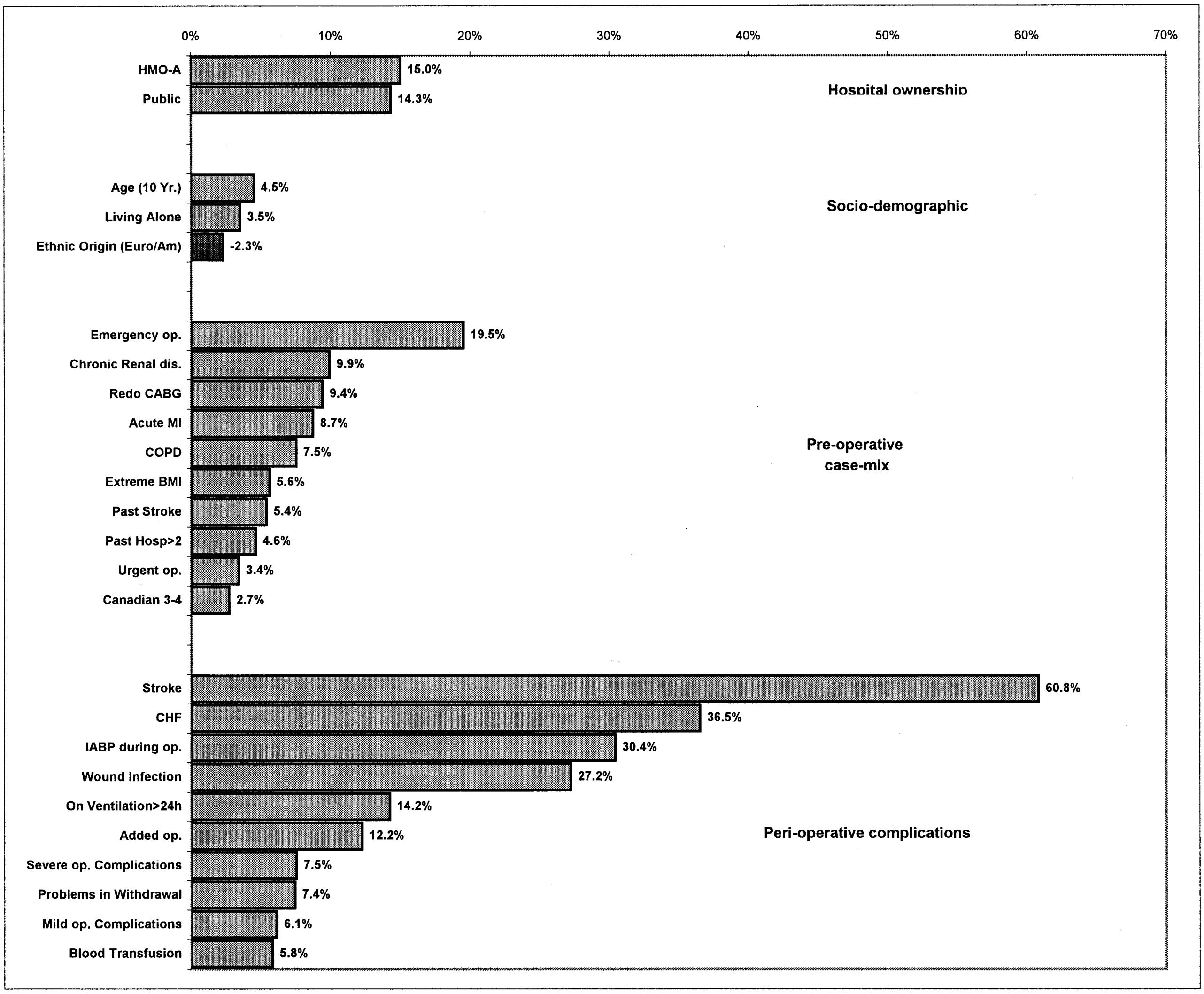

Figure 3. Factors affecting time to hospital discharge after CABG. Log-logistic multivariate model; adjusted effects expressed as percent increase in hospital stay.

TABLE 2. Distribution of modal day by hospital ownership and insurer

Personal medical insurance	Mode of day of discharge by hospital ownership (No. of patients)			
	Governmental	HMO-A	Public	Private
HMO-A	5 (1327)	7 (1357)	6 (662)	7 (136)
HMO-B	6 (162)	7 (21)	7 (22)	4 (313)
HMO-C	5 (203)	7 (31)	6,7 (38)	7 (36)
HMO-D	5 (60)	7 (24)	6 (46)	7 (60)

A-owned hospitals the discharge mode was day 7 across all risk strata.

The time-to-discharge multivariate model presented the independent effect of ownership on LOS, controlling for clinical factors. Not surprisingly, patients with postoperative complications had prolonged time-to-discharge. Major complications such as stroke, heart failure, and wound infection caused these patients to increase LOS by up to 63%. However, these events were rather uncommon and their impact on the LOS policy in the entire study population was minimal.

Sociodemographic factors associated with delayed discharge in our study were living alone and country of birth.

TABLE 3. The effect of the early* discharge on 180-day mortality and percent rehospitalizations within 100 days after surgery

Day of discharge after surgery	Discharged earlier than owner-specific modal day			Discharged on modal day or later		
	n	% dead	% readmitted	n	% dead	% readmitted
4th postoperative day	111	0.9	18.0	122	0.0	22.9
5th postoperative day	312	1.3	19.2	617	1.1	21.6
6th postoperative day	314	0.6	23.2	641	1.6	22.8
7th postoperative day	—	—	—	1081	1.5	24.6
≥8th postoperative day	—	—	—	1478	5.3	23.0

*Early discharge was defined as duration of stay less than the mode by hospital ownership group.

These factors are probably related to the perception of the attending team of the degree of support available to the patient outside the hospital and point out the importance of community-based infrastructure to support and follow up patients having major surgery.

The most significant finding in this study was the fact that hospital ownership had such a strong effect on LOS, competing seriously with most of the case-mix and demographic risk factors of the patients. Thus, it is suggested that the decision to discharge a patient after a CABG operation was determined, to a large extent, by owner-specific policy, given that the patient did not experience major postoperative complications.

CABG operations in 1994 in Israel are an example of how the reimbursement system could influence LOS patterns. Although all hospitals were to be paid for these operations by differential tariffs (ie, get the same fee regardless of the LOS), it was actually true only for the government- and public-owned hospitals. HMO-A hospitals were at the time reimbursed by a global budget, giving no economic incentive to cut LOS in their hospitals. Furthermore, patients operated on in private hospitals had to pay per day of hospitalization in addition to the surgeon's fee. This could explain the second modal pattern (7 days) for this ownership, while the first modal pattern of 4 days was associated with 1 of the private hospitals discharging patients to continuing care facilities. Therefore, it seems that the discharge policy, beyond the rare occurrence of dramatic patient postoperative complication, was mainly dependent on hospital owner's cost-effectiveness considerations.

A number of recent studies indicated that short LOS after surgery does not compromise patient outcome.[10-14] Our study showed that early discharge after CABG does not have adverse effects on patient 6-month mortality or 3-month rehospitalization rate, providing these patients did not have major clinical complications (about half of the patients). A study of elderly Medicare patients in the United States, where hospitalization at 5 days or less was considered early discharge, demonstrated no association with higher rates of death or rehospitalization.[12] Loubani and colleagues[13] found that in a population undergoing elective CABG, early discharge 4 days after the operation did not compromise patient outcome and was safe. A similar conclusion was drawn by Angevine and coworkers[14] after carotid endarterectomy, comparing outcomes before and after a planned discharge policy change. In our study 60% of patients who stayed in the hospital for 8 days and more were in the two highest risk quartiles, with two thirds of the dead among them, whereas for 40% the reasons for the prolonged LOS were not clear. None of these patients had higher rates of rehospitalization.

Our analysis, using the discharge mode as the indicator of policy, clearly demonstrated the dominance of hospital ownership in the decision process regarding discharge. A policy of encouraging early discharge after a major operation such as CABG has an obvious appeal for the goal of increasing efficiency of the health delivery system. This study indicates that such policy changes could be attained without having adverse effect on patients' clinical outcome.

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APPENDIX 1. Factors associated significantly with time-to-discharge after CABG operations: multivariate log-logistic survival model

Factors: high risk vs low/no risk*	Time ratio†	95% CI	Factors: high risk vs low/no risk*	Time ratio†	95% CI
Institutional			Chronic obstructive pulmonary disease	1.075	1.030, 1.122
Hospital owner			Extreme body mass index	1.056	1.023, 1.090
HMO-A	1.150	1.050, 1.260	Past stroke	1.054	1.001, 1.110
Public	1.143	1.066, 1.225	Past hospitalization > 2	1.046	1.023, 1.070
Government/private	1.000		Canadian class III-IV	1.027	1.006, 1.049
Demographic			Perioperative complications		
Age (per 10 y)	1.045	1.031, 1.057	Operative complications[3]‡		
Living situation			Severe	1.075	1.034, 1.117
Alone	1.035	1.012, 1.058	Mild	1.061	1.000, 1.127
Not alone	1.000		None	1.000	
Country of birth			HLM‡ withdrawal		
Europe/America	0.977	0.956, 0.998	Problems	1.074	1.044, 1.106
Other	1.000		Missing values	1.076	1.028, 1.126
Clinical			No problems	1.000	
Operation			Stroke	1.608	1.351, 1.914
Emergency	1.195	1.094, 1.305	Congestive heart failure	1.365	1.156, 1.612
Urgent	1.034	1.003, 1.067	IABP§ during operation	1.304	1.116, 1.524
Elective	1.000		Wound infection	1.272	1.134, 1.427
Acute myocardial infarction	1.087	1.037, 1.139	On ventilation >24 h	1.142	1.064, 1.227
Redo CABG	1.094	1.039, 1.153	Added operation	1.122	1.046, 1.202
Chronic renal disease	1.099	1.037, 1.165	Blood transfusions	1.058	1.005, 1.114

*For binary factors the reference group representing no risk (time ratio = 1.000) does not appear in the table.

†Effects expressed as the ratio of expected mean duration of hospital stay in each risk category relative to the reference category.

‡Definition based on specific diagnoses such as: intraoperative massive bleeding, add bypasses, etc.

§*HLM,* Heart-lung machine; *IABP,* intra-aortic balloon pump.