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Driving backwards: methodological and clinical insights from a retrospective clinical and claims data analysis

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Abstract

Background: As the use of claim databases has been progressively shifting from administrative needs to inferential purposes, methodological concern has arisen pertaining to the accuracy of findings obtained from administrative databases and its use in retrospective analyses. **Aims and Objectives:** The aim of this study is to show that adopting a looking back approach (retrospective analysis) may introduce bias due to lost information relevant to the clinical process as well as to the financial analysis. **Materials and Methods:** The sample includes 389 patients who underwent a primary elective or urgentcoronary artery bypass graft (CABG) surgery and had relevant cost data – these patients were included in the looking forward analysis. At discharge, of these 389 patients, 369 received a CABG DRG and were included in the looking back analysis (20 patients were discharged as non-CABG DRG and were excluded from the analysis). **Statistics:** Chi-square and t tests were conducted to assess differences between patients discharged as CABG and non-CABG DRGs at both baseline and 6 month follow up. **Results:** Patients discharged with a non- CABG DRGcompared to patients discharged with a CABG DRG, while presenting similar sociodemographic and clinical characteristics at admission, reported worse clinical outcome (greater rates of complications and death) and greater costs and length of stay (LOS) at post intervention and 6 month follow up. **Conclusion:** A looking back approach, excluding specific patients, may neglect information relevant both to the clinical process and to the financial analysis, leading to misleading conclusions.

Keywords: Outcomes assessment, CABG, DRG, Retrospective studies, Health care costs.

INTRODUCTION

Analyses based on Diagnostic Related Groups (DRG) discharge data are often used to guide interventions aimed at improving not only costs and resource utilization but also the medical care received by patients. Physicians rely on such analyses to make assumptions about course and prognosis of illness and hospitals uses them to guide their economic and managerial decisions[1].However, relying on findings obtained by using a retrospective 'looking back' approach may lead to underestimating both patients' risk of developing adverse outcomes and related costs. Indeed, methodological concern has arisen pertaining the accuracy of findings obtained from administrative databases according to what is called 'Looking back' approach[2,3].

Retrospectively examining costs and procedures associated with medical care received by patients during a fixed range of time before a specific event (i.e. death, discharge, treatment, etc.), the Looking back approach implicitly assumes that results based on a sample of individuals who present a certain outcome, are equivalent to those obtained from a sample of patients who may or may not develop that same outcome[2,3]. This assumption has been proven wrong by a few studies showing that results can vary notably when analyzed according to different perspective[2,4,5]. Several incongruities have been shown to emerge when dying patients are considered according to a prospective design instead of looking back at the last year of life of decedents. Such discrepancies emphasize the fact that making predictions based on data obtained after outcome may lead to misleading conclusions. This may also be the case every time conclusions are draw retrospectively from outcomes other than mortality, such as patient's diagnosis at discharge (DRG).

Using a sample of patients who underwent elective primary coronary artery bypass graft (CABG) surgery, the aim of this study is to show that adopting a looking back approach may lead to loss of information relevant to the clinical outcomes as well as to the health care utilization.

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The objective of the analysis is to demonstrate the difference in conclusions reached using a 'looking forward' perspective versus a 'looking back' approach. Our hypothesis is that patients initially admitted for the same procedure and with the same DRG (CABG), when compared according to their DRG at discharged (still CABG DRG vs non-CABG DRG), present similar clinical and functional profiles at baseline (admission), but not at 6 month follow up. Identifying patients most likely to have adverse outcomes, higher costs and longer length of stay over geometric mean targets, we will provide evidence for a new approach to improving outcomes and reducing costs.

MATERIALS AND METHODS

Sample

The sample includes 412 patients who underwent a primary elective or urgent CABG surgery without concomitant valve surgery at the Weill Cornell campus of New York Presbyterian Hospital between June 1996 and January 2000[6]. At that time, patients who were enrolled in other clinical trials, who could not perform the neuropsychological testing or were not fluent in English were excluded. Exclusion criteria also included medically unstable patients, defined as those who required vasopressors, balloon pump, more than 100 μg/min of IV nitroglycerin or underwent CABG immediately after catheterization[6]. Of the 412 patients, 23 had missing costs and were excluded from the analyses. No significant differences emerged at baseline between individuals with missing costs and the 389 patients included in the analyses in sociodemographic and clinical variables.

Assessment

Prior to surgery and 6 months after the procedure, patients' demographic (age, sex, race and marital status), clinical, psychosocial and functional status were documented.

Clinical characteristics

Clinical characteristics of the sample at baseline and 6 month follow up included presence of angina, occurrence of myocardial infarction (MI), heart failure (CHF), and stroke. Burden of comorbid diseasesas measured by the Charlson Comorbidity Index (CCI)[7], were also reported at baseline. Hospitalization after the procedure and death were also included as clinical endpoints at 6 month follow up.

Psychosocial variables

Occurrence of life events, depressive symptoms as measured by the Center for Epidemiologic Studies Depression Scale (CESD)[8], and patient's functional status assessed by the SF-36 Health Survey[9] were reported at both baseline and 6 months follow up.

Financial analysis

The New York Hospital cost accounting system (Transition System Inc, Boston Massachusetts) tracked inpatients costs including ancillary tests. Most of costs were captured by the system as actual costs, while a small minority were costs converted from charges by specific cost to charge ratios(accordingly, utilization included: total costs of the hospitalization, length of stay in days and in excess of geometric mean target for both groups).

Statistical analysis

Chi-square and t tests were conducted to assess differences between patients discharged as CABG and non-CABG DRGs at both baseline and 6 month follow up. All analyses were perform using the Statistical Package for Social Science (SPSS) 22.0 for windows. Significance level was set at α=0.05.

RESULTS

Overall, 389 patients were admitted with a CABG DRG and had cost data. Of the 389 patients, 20 patients were discharged withnon-CABG DRG. The remaining 369 who were discharged with a CABG-DRG.

Clinical and functional status at entry

Table 1 illustrates the baseline characteristics of the patients at admission and at discharge. At admission CABG patientspresented similar clinical and psychosocial profilesin both DRG groups. Significant differences emerged between patients discharged with a CABG DRG vs non-CABG DRG, only in marital status and burden of comorbidity. Non-CABG DRG patients were more likely to be unmarried (40% vs 64%; p=0.05) and to report a comorbidity score greater than 4 (35% vs 16%; p=0.034). With regard to functional status, only social function significantly differed between the two groups. Specifically, patients discharged as non-CABG reported lower social interactions than those discharged as CABG patients (49 vs 63; p=0.01).

Post-operative outcomes and 6 month follow up

Post-operative outcomes showed that overall, patients discharged with a non-CABG DRG reported more complications than patients discharged as a CABG DRG (40% vs 10%, p=0.001). They also incurred in more cardiac complications than patients discharged with a CABG DRG (25% vs 8%, p=0.001) (Table 2). Furthermore, patients discharged as non-CABG DRG have more post-operative episodes of pulmonary edema than CABG DRG patients (10% vs 1%; p=0.033).

At 6-month follow-up, patients with a non-CABG DRG showed worse clinical and functional status that those who received a CABG DRG. Overall, they presented more cardiac complications than patients discharged with a CABG DRG (25% vs 7%, p=0.049) (Table 3). Non-CABG patients were more likely to report pain (31% vs 9%; p=0.03) and heart failure (21% vs 3%; p=0.01) (Table 2). They were also 2 fold more likely to be readmitted (64% vs 31%; p=0.02) and about 9 fold more likely to die (13% vs 1%; p=0.04) (Table 3).

Comparable results emerged for the patient's functional status. Indeed, non-CABG DRG patients rated their health as worse (2.6 vs 3.2; p=0.04), and reported less physical functioning (42% vs 69%; p<0.001) and energy (42% vs 60%; p=0.01) than patients discharged with a CABG DRG (Table 3).

Financial analysis

Financial analysis showed different results in the two groups. Specifically, costs (fixed, variable and total) and LOS were all significantly greater for patients discharged as a non-CABG DRG than in those discharged with a CABG DRG (all p≤0.003) (Table 4).

DISCUSSION

The aim of this investigation was to show that analyzing data from the framework of endpoints may lead to a distorted view and losing information relevant to the diagnostic process and financial analysis. According to a *looking back* approach, the same focus of the analysis should include only patients discharged with a CABG DRG. However, in this case, it would mean excluding those 21 patients who entered the hospital with the same diagnosis but were discharged as non-CABG DRG and had significantly worse outcomes over 6 months. Our results show that, at admission, clinical and functional status of patients discharged with a CABG DRG, were rather similar to those who were subsequently discharged with a non-CABG DRG. On the contrary, clinical and functional endpoints post intervention and 6 month follow up were quite different between the two groups, with patients discharged as non-CABG DRG reporting worse clinical outcomes (longer

LOS, greater rates of cardiac events and death) than those who had a CABG DRG.

Table 1: Baseline demographic, clinical and psychosocial differences between CABG patients discharged in CABG and non-CABG DRG.

	Patients admitted with a CABG DRG (N=389)			
	Discharged in CABG DRG (n=368)	**Discharged in non-CABG DRG** (n=21)	**t/χ^2**	**p**
Sociodemographic				
Age	65.2(±10.0)	65.4(±12.6)	0.08	0.937
Sex (female)	36%	45%	0.74	0.474
Married	64%	40%	4.66	0.055
Race			1.33	0.875
Caucasian	70%	70%		
African American	13%	20%		
Latino	13%	10%		
Others	4%	-		
Clinical				
Class 3-4 Angina	39%	26%	1.19	0.338
Previous myocardial infarction	36%	33%	0.07	0.821
Previous CABG	18%	14%	0.19	>0.999
Congestive Heart failure	10%	14%	0.51	0.446
Stroke	6%	5%	0.03	>0.999
Comorbidity			**7.65**	**0.021**
0-1	51%	35%		
2-3	31%	48%		
>4	18%	17%		
Psychosocial				
Depression (Cesd)	13(±11)	13(±8)	0.15	0.885
SF-36 Self rated health status	3(±1)	3(±1)	0.72	0.473
SF-36 Physical Functioning	61(±29)	57(±27)	0.735	0.463
SF-36 Social Functioning	**64(±25)**	**49(±27)**	**2.46**	**0.014**
SF-36 Emotional Functioning	68(±23)	65(±19)	0.57	0.572
SF-36 Energy	50(±27)	45(±24)	0.72	0.474
SF-36 Pain	78(±29)	73(±29)	0.65	0.518
Social support	43(±7)	42(±5)	0.70	0.482
Social isolation	33%	25%	0.49	0.625

Table 2: Post-operative outcomes of CABG patients according to DRG at discharge.

	Patients admitted with a CABG DRG (N=389)			
	Discharged in CABG DRG (n=368)	**Discharged in non-CABG DRG** (n=21)	**χ^2**	**P**
Total complications	**10%**	**40%**	**16.05**	**0.001**
Total cardiac complications	**6%**	**25%**	**11.34**	**0.001**
Complications:				
Myocardial infarction	2%	10%	5.51	0.073
Myocardial ischemia	1%	5%	3.27	0.191
Congestive Heart failure	3%	10%	3.37	0.122
Cardiogenic shock	0.3%	5%	8.30	0.100
Cardiac arrest	0.5%	5%	4.93	0.147
Renal dysfunction	4%	5%	0.04	0.578
Pulmonary edema	**1%**	**10%**	**9.93**	**0.033**
Death	0.3%	5%	8.30	0.100

Table 3: Clinical and psychosocial differences between CABG patients discharged in CABG and non-CABG DRG at 6 month follow up

	Patients admitted with a CABG DRG (N=389)			
	Discharged in CABG DRG (n=368)	**Discharged in non-CABG DRG** (n=21)	χ^2	**P**
Clinical variables				
Total complications	15%	33%	1.49	0.235
Total cardiac complications	**7%**	**25%**	**5.74**	**0.049**
Class 3-4 Angina	15%	36%	4.06	0.059
Hospitalization	**31%**	**64%**	**6.88**	**0.016**
Heart attack	1%	8%	3.67	0.178
Myocardial Ischemia	2%	8%	1.66	0.273
Congestive Heart failure	**3%**	**21%**	**11.73**	**0.014**
Death	**1%**	**13%**	**9.23**	**0.037**
Psychosocial				
Depression (Cesd)	20.2(±9.5)	25.5(±0.7)	0.54	0.587
SF-36 Self rated health status	**3.2(±1.1)**	**2.6(±0.8)**	**2.09**	**0.038**
SF-36 Physical Functioning	**69(±28)**	**41(±24)**	**3.57**	**<0.001**
SF-36 Social Functioning	72(±23)	57(±30)	2.35	0.082
SF-36 Emotional Functioning	72(±22)	76(±12)	0.58	0.565
SF-36 Energy	**60(±24)**	**42(±20)**	**2.63**	**0.009**
SF-36 Pain	87(±25)	75(±24)	1.73	0.085
Social support	43(±8)	43(±4)	0.70	0.482
Social isolation	35%	36%	0.001	>0.999

Table 4: Financial analysis of CABG patients according to DRG at discharge

	Patients admitted with a CABG DRG (N=389)			
	CABG DRG (n=369)	**Non-CABG DRG** (n=21)	**t**	**p**
Total cost	$23,585(±11507)	$98,133(±84722)	14.65	0.001
Costs expressed in geometrical mean	10(±2)	24(±16)	13.44	0.001
Length of stay in days	10(±5)	30(±27)	11.16	0.003

These findings are consistent with previous studies showing that the two approaches do not yield matching results[2,5]. Bach and colleagues[2] examined in two cohorts of cancer patients the differences emerging when adopting one approach over the other. According to a *looking back* approach, studying a sample of decedents should be equivalent to studying a sample of dying patients such as patients with a stage IV diagnosis (*looking forward*). However, as pointed out by the Authors[2], several dissimilarities emerged not only in subjects included in the two cohorts but also in the observed time periods. For example, to retrospectively analyze cancer patients who died 1 year after receiving the diagnosis (*looking back* cohort), means also including patients in the early stages of disease (stages I, II, and III), and not only those presenting with the greatest risk (stage IV; *looking forward* cohort). In addition, results could be biased because early stages may be overrepresented in the mortality rate since patients receiving such diagnoses are greater in number than those who receive a stage IV diagnosis[2]. Therefore, mortality predictors in patients with earlier stages of disease may not exactly overlap those of patients with a IV stage diagnosis. Likewise, since results of both approaches are assumed the same, time period of observations should be similar in the two cohorts. However, this may not be the case. Indeed, following up cancer patients who are dying means observing those months occurring between the formulation of the diagnosis and their actual death. This time period may vary markedly since not all patients who are expected to die within a year, actually do[2].

Besides from the differences occurring when applying the two methods, the looking back approach may suffer from other methodological bias. First, as noted by Ong et al.[5], all patients present the same outcome (i.e. death, DRG, etc.), when at the beginning (study entry, admission, etc.) it is not clear who is going to develop the outcome. In their analysis on variation in hospital resource use for elderly patients with heart failure, they suggested that forcing the outcome to be identical in all patients (100% mortality), the looking back method ignores that resources may have been directed to actually improve survival[5]. Thus, when cost analysis follows a *looking back* approach, it minimizes the likelihood that costs can be allocated to patients who developed worse outcomes but survived. Accordingly, higher costs may be associated with specific DRGs which, however, were not the same at admission. In our case, using a retrospective analysis would lead to the conclusion that resources used for CABG patients are only those identified in patients who have a CABG DRG at discharged. However, our financial analysis clearly showed that some of the patients initially admitted as CABG developed adverse clinical

outcomes, which, in turn, lead to greater cost. These patients however are not likely to be capture by a *looking back* analysis because worse outcome also means a non-CABG DRG at discharge. Hence a *looking back* approach would mistakenly imply that the cost of a specific condition or procedure (i.e. CABG at discharge) is lower than what is estimated for other conditions (i.e. non-CABG diagnosis at discharge) even though patients were initially admitted with the same diagnosis.

Similarly, the risk of using DRGs at discharge to track back what may have influenced costs or LOS, is to underestimate the relevance of variables such as comorbidity, since patients with greater comorbidity may be excluded from the analysis due to a different DRG. With regard to our results, according to a looking back approach, one could think that patients who are admitted for a CABG surgery may have a better prognosis (low rates of death, readmission and cardiac complications) than it would have been by including also patients who were initially admitted as CABG but discharged with a different DRG. Some investigations[10,11], showed that a discrepancy between admission and discharge diagnoses is associated with longer LOS and greater costs, suggesting that patients' DRGs at entry may be a source of important information. Yet, what authors missed is that such discrepancy may be important not per se, but because it may reflect the methodological bias inherent in the *looking back* method. In their investigations, from 68%[11] to 75.6%[10] of patients presented a discrepancy between their admitting and discharge diagnosis. Hence, looking just at discharge data to draw conclusions about specific diagnosis/diseases may be misleading because only 30% of patients actually had a 'linear' clinical course and were discharged with the same diagnosis they presented at admission. As stated by Ong *et al.*[5], looking forward instead of backward may be a preferable tool to ensure that information relevant to the outcome are not missed.

Our investigation has some limitations that need to be addressed. First, these findings were obtained from a specific sample and cannot be generalized to other medical populations. Second, the small sample size of the non-CABG DRG group did not allow us to perform a direct comparison of the two approaches. Third, the *look forward* method may suffer from some limitations itself. As pointed out by Huesch[12], a retrospective analysis is conditioned by an endogenous outcome of the sample (ie. death), while a prospective analysis may be conditioned by an endogenous event (decision to admit). However, this may be more relevant when the focus is on health care expenditure rather than on clinical predictors of illness.

CONCLUSION

Findings based on a *looking forward* approach may be more reliable, and help identify, early in the diagnostic process, which clinical and psychosocial characteristics have the greatest prognostic values, since, at admission, physicians may not be able to predict which patient will develop the worst clinical outcomes. This is particularly relevant when conducting a cost analysis, because patients with unexpected outcomes are those who more frequently incur the greatest cost. More important, patient's care may notably improve since clinicians may rely on such information to tailor the intervention according to the patient's needs. Indeed, interventions targeted on findings obtained retrospectively from DRG will not reduce complications or costs in CABG patients, because they seem to have none. Since to reduce costs and complications programs have to target high risk patients, we need to focus on all patients admitted as CABG, not only those discharged as such; otherwise, the risk will be to miss the opportunity to intervene effectively.

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Conflict of Interest

Authors report no conflicts of interest.

Authors contributions

Study design: Charlson, Offidani; *Acquisition of data:* Charlson, Peterson; *Data analysis:* Offidani, Peterson; *Interpretation of data:* Offidani, Charlson, Peterson; *Writing:* Offidani, Peterson; *Revision:* Charlson. All authors had read and approved the final version of the manuscript.

REFERENCES

1. Dartmouth Atlas of Health Care: The care of patients with severe chronic illnesses. Hanover, NH, 2006.
2. Bach PB, Schrag D, Begg CB: Resurrecting treatment histories of dead patients: a study design that should be laid to rest. JAMA 2004;292:2765–70.
3. Bach PB: A map to bad policy--hospital efficiency measures in the Dartmouth Atlas. N Engl J Med 2010;362:569–73; discussion p 574.
4. Howard DH, Culler SD, Druss BG, Thorpe KE: The relationship between ex ante mortality risk and end-of-life medical costs. Appl Health Econ Health Policy 2006 [cited 2016 Aug 5];5:37–44.
5. Ong MK, Mangione CM, Romano PS, Zhou Q, Auerbach AD, Chun A, et al.: Looking forward, looking back: assessing variations in hospital resource use and outcomes for elderly patients with heart failure. Circ Cardiovasc Qual Outcomes 2009;2:548–57.
6. Charlson ME, Peterson JC, Krieger KH, Hartman GS, Hollenberg JP, Briggs WM, et al.: Improvement of outcomes after coronary artery bypass II: a randomized trial comparing intraoperative high versus customized mean arterial pressure. J Card Surg22:465–72.
7. Charlson ME, Pompei P, Ales KL, MacKenzie CR: A new method of classifying prognostic comorbidity in longitudinal studies: development and validation. J Chronic Dis 1987;40:373–383.
8. Radloff LS: The CES-D Scale: A Self-Report Depression Scale for Research in the General Population. Appl Psychol Meas 1977;1:385–401.
9. Ware JE, Sherbourne CD: The MOS 36-item short-form health survey (SF-36). I. Conceptual framework and item selection. Med Care 1992 [cited 2016 Aug 5];30:473–83.
10. Johnson T, McNutt R, Odwazny R, Patel D, Baker S: Discrepancy between admission and discharge diagnoses as a predictor of hospital length of stay. J Hosp Med 2009;4:234–9.
11. McNutt R, Johnson T, Kane J, Ackerman M, Odwazny R, Bardhan J: Cost and quality implications of discrepancies between admitting and discharge diagnoses. Qual Manag Health Care21:220–7.
12. Huesch MD, Buttery C: Spending and Outcomes Payment Policy Based on Measurement of Health Care Email Alerts Payment Policy Based on Measurement of Health Care Spending and Outcomes. JAMA 2010;303817:2405–2406.
13. Detsky AS, Stricker SC, Mulley AG, Thibault GE: Prognosis, survival, and the expenditure of hospital resources for patients in an intensive-care unit. N Engl J Med 1981;305:667–72.