

Treatment of Diabetic Ketoacidosis by Internists and Family Physicians: A Comparative Study

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This study contrasts the treatment of diabetic ketoacidosis in a teaching hospital by internists and family physicians. Parameters studied included laboratory use and length of stay. The period of hospitalization was longer in the internal medicine program compared with the family practice group, 5.09 days and 4.60 days, respectively, a 10.65 percent increase. In addition, the total number of laboratory tests and x-ray procedures per patient and per hospital day were notably increased in the internal medicine group compared with the family practice group; 49.20 and 29.68, and 9.67 and 6.45, respectively, the former being a 65.77 percent increase and the latter being 49.92 percent higher. There were no deaths in either group. Serum glucose and urine spillage were comparable in both groups upon discharge.

The cost of health care in the United States is rapidly increasing. In the decade 1966-1976, annual expenditures for health care grew at a yearly rate of 11 percent.¹ For 1980 the total cost for health care is estimated at \$247 billion. If this rate is not altered, the cost will exceed \$1 trillion by 1990.² The largest proportion of the health care bill is hospital costs. Most Americans blame physicians for rising medical costs, which may be appropriate because an estimated 70 percent of annual costs are determined by physician behavior.³ Expanded use of diagnostic tests and longer hospitalizations have contributed particularly to the increase in hospital costs. In the past ten years there has been rapid increase in family practice pro-

grams. There are more than 380 family practice residency programs training approximately 7,000 residents each year.⁴ Several studies have suggested that family physicians use laboratory procedures less frequently in ambulatory practice.^{5,6} Reported here is a retrospective study contrasting the treatment of diabetic ketoacidosis by internists and family physicians in a teaching hospital environment.

Methods

In this study the internists admitted their patients to the university hospital, the primary teaching hospital of the University of Missouri-Kansas City School of Medicine, whereas the family physicians, who admitted their patients to a different

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hospital, were based at a free-standing accredited family practice residency program affiliated with the medical school. In this study, 12 patients admitted in 1980 were included from the internal medicine program, and 16 patients admitted in 1980 were included from the family practice residency. Patients who met the criteria for inclusion were selected in sequence. All cases fulfilled the following criteria for diabetic ketoacidosis: arterial pH of 7.30 or less or a venous pH of 7.25 or less, serum glucose of 300 mg/100 mL or more, serum bicarbonate concentration of 15 mEq/L, or less, glycosuria, and a positive nitroprusside (Acetest) reaction. Intercurrent illnesses were similar in the two groups. Noncompliance or infections were listed as a contributing secondary diagnosis in all patients in both groups.*

Patient days in the intensive care unit were comparable in both settings. Patients in the internal medicine group were admitted to a general internal medicine service, which included a full-time attending faculty member, a second or third year resident in internal medicine, two first year internal medicine residents, several medical students, and a clinical pharmacist. Several patients were under the supervision of full-time attending faculty members who were board certified or had advanced training in endocrinology. Patient care in the family practice program was delivered by a team including a full-time attending faculty member, a second or third year resident in family practice, a first year resident in family practice, and a medical student. Age, sex, and length of hospitalization were analyzed, and the following determinations were taken: arterial blood gas; venous blood gas; serum glucose; SMA-6 (sodium, potassium, chloride, bicarbonate, glucose, blood urea nitrogen); SMA-12 (calcium, phosphate, total protein, albumin, cholesterol, bilirubin, lactic dehydrogenase, SGOT, blood urea nitrogen, uric acid, alkaline phosphatase, glucose); serum potassium; serum electrolytes (sodium, potassium, chloride, bicarbonate); nitroprusside (Acetest) reactions; and miscellaneous tests. Total tests and number of tests per patient per hospital day were determined. All patients received an inpatient diabetes educa-

tion teaching program. The difference in means were analyzed for significance by *t* test.

Results

The results are shown in Table 1. The period of hospitalization was longer in the internal medicine group (5.09 days) compared with the family practice group; (4.60 days), a 10.65 percent difference. In addition, the total number of laboratory tests and x-ray procedures and average number of each per patient per hospital day were notably increased in the internal medicine group (49.20, average 9.67) as compared with the family practice group (29.68, 6.45). The total is a 65.77 percent increase, and the average is a 49.92 percent increase over the family practice group. There were no deaths in either group. Serum glucose and urine glucose spillage were comparable in both groups upon discharge.

Discussion

Health care costs are generally thought to be higher in teaching hospitals than in their nonteaching counterparts.⁷ Suggested reasons for this discrepancy include period of hospitalization and usage of ancillary services. In separate studies Busby and associates, and McCorkle found the duration of stay to be greater in a university setting than in a community hospital.^{8,9} In addition, Schroeder and O'Leary found an increased use of diagnostic tests and procedures in a teaching hospital.⁷ Data by Griner and Liptzin suggest that internal medicine house staff ask for laboratory studies excessively and often with questionable relationship to patient care.¹⁰ Dixon and Laszlo found that only 5 percent of chemistry determinations ordered by medical house staff actually altered patient care.¹¹

Family practice residency programs may not be optimally cost effective. Pawlson and Watkins found that the average cost per outpatient visit

*In both groups pyelonephritis, viral syndrome, or gastritis was the secondary diagnosis under infection.

Table 1. Treatment of Diabetic Ketoacidosis in a Family Practice and Internal Medicine Residency

	Family Practice Program	Internal Medicine Program
Number of patients	16	12
Sex	8 male, 8 female	9 male, 3 female
Age, years (range)*	37 (11-66)	38 (17-54)
Duration of stay (days)	4.60	5.09 ($t = 0.5$)**
Arterial blood gases (mean, 7.22 upon admission)	0.60	3.08 ($t = 3.48$; $P < .01$)
Venous blood gases (mean, 7.19 upon admission)	2.75	—
Serum glucose (range)†	9.25(2-21)	18.59(7-36) ($t = 3.20$; $P < .01$)
Serum electrolytes	5.68	3.88 ($t = 1.28$)
SMA-12	1.19	0.58 ($t = 1.60$)
SMA-6	—	1.75
Serum potassium	0.12	3.75 ($t = 5.15$; $P < .01$)
Nitroprusside reactions (range)	1.19(0-2)	5.25(1-17) ($t = 3.03$; $P < .01$)
Miscellaneous tests (x-ray, CBC, serum Ca and creatinine, urinalysis, urine culture, ECG, PT, PTT)	8.90	12.32 ($t = 2.00$)
Tests per patient	29.68	49.20 ($t = 3.96$; $P < .01$)
Tests per patient per day	6.45	9.67 ($t = 2.58$; $P < .05$)

*This and all following are averaged unless otherwise indicated
** t test for independent samples (26 *df*)
†Mean admitting serum glucose: 406 mg/100 mL in family practice group; 436 mg/160 mL in internal medicine group

involving a family practice resident was approximately 11 percent higher than for a visit when a resident was not delivering the care.¹² Interestingly, Garg and associates estimated that 11 percent of tests ordered in a teaching hospital were for educational purposes only.¹³ Several studies have suggested that family physicians may make use of laboratory testing and diagnostic procedures less frequently than do their internal medicine counterparts in ambulatory practice. Noren and associates in the National Ambulatory Medical Care Survey found that family physicians and general practitioners ordered fewer laboratory and x-ray studies as compared with internists.⁶ In addition, Scherger and colleagues, using five simulated patients with common ambulatory patient problems, found that third year residents in internal medicine

generally incurred greater laboratory charges than third year family practice residents, particularly in regard to chemistry testing and chest x-ray examinations.⁵ The present study supports the concept that internal medicine residents use laboratory tests and diagnostic procedures more than do family practice residents, and they may also hospitalize their patients for longer periods of time.

The implications of this study are severalfold. First, internists and residents in internal medicine probably order laboratory tests and diagnostic procedures more frequently than do their family practice counterparts, and second, hospitalization for patients with diabetic ketoacidosis may be shortened. Reduction in laboratory use is proper only if patient care is not compromised. A question still to be answered concerns the degree

to which laboratory use may be reduced without jeopardizing the quality of care. In addition, if laboratory testing may be reduced without affecting the quality of care, how can physician behavior be modified to accomplish this task? Griner et al and Eisenberg in separate studies have demonstrated that physician education may reduce laboratory usage. Griner showed that programs of house staff education stabilized or decreased the use of laboratory tests and radiological procedures over a seven-year period in a university hospital, and Eisenberg found that intensive educational intervention decreased use of the prothrombin test by 36 percent.^{14,15} In both studies, the theory that behavior is most easily changed if the stimulus is continually reinforced is demonstrated. Thus, education in cost-effective health care delivery logically should begin during the undergraduate training period. In this regard it is disconcerting that a 1978 survey by the Association of the American Medical Colleges showed only 34 percent of medical schools had an ongoing or planned program in cost containment.¹⁶

The question whether outpatient treatment of certain illnesses may be successfully accomplished and the duration of hospitalization shortened is one that needs careful assessment. The studies that have analyzed this question are conflicting. In a study of early discharge for inguinal hernia and varicose veins, Adler et al found no significant difference in the occurrence of major postoperative complications between those patients discharged after two days and those patients hospitalized for six or seven days, nor was the recurrence rate of the two groups different.¹⁷ Similar results have been found in a more recent study.¹⁸ In contrast, Chant and colleagues, in comparing inpatient surgical treatment of varicose veins with outpatient sclerotherapy, found the latter to be associated with an increased rate of occurrence.¹⁹ In addition, patients undergoing day care surgery for hemorrhoids were more likely to experience postoperative complications than was a similar group who were inpatients.²⁰ Thus the clinical outcome and cost effectiveness of substituting ambulatory care for inpatient care is still largely unknown, and the results of future studies are awaited concerning this important subject.

In summary, in the treatment of diabetic ketoacidosis in training programs in internal medicine and family practice, the former use laboratory test-

ing and diagnostic procedures more than do their counterparts in family practice. Second, the length of hospitalization for the internal medicine program was notably longer. Studies are needed to assess the cost effectiveness of health care delivery by internists and family physicians.

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