

# Short-term Adherence with Discharge Recommendation for Insulin Treatment among Patients with Type 2 Diabetes

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**ABSTRACT:** **Background:** Basal-bolus (BB) insulin treatment is increasingly used in poorly controlled diabetes patients during hospitalization and is commonly recommended at discharge; however, the extent of adherence with this recommendation is unknown. **Objectives:** To determine short-term adherence of type 2 diabetes mellitus (T2DM) patients discharged from internal medicine wards with recommendation for BB insulin treatment. **Methods:** Prescription (primary physician adherence) and purchase (patient adherence) of long-acting and short-acting insulins during the first month following discharge from internal medicine wards was determined in 153 T2DM patients. Adherence was defined as full if prescription/purchase of both basal (long-acting) and bolus (short-acting) insulin was completed, and as partial if only one kind of insulin (basal or bolus) was prescribed/purchased. Association between demographic and clinical parameters and adherence was determined. **Results:** Full adherence to discharge instructions was higher for primary physicians than for patients (79.1% vs. 69.3%, respectively,  $P = 0.0182$ ). Pre-hospitalization hemoglobin A1C was significantly associated with adherence by both patients and primary physicians (full-adherence group  $9.04\% \pm 2.04\%$ ; no-adherence group  $7.51\% \pm 1.35\%$ ,  $P = 0.002$ ). Age was negatively associated with adherence of both primary physicians and patients; however, this association did not reach statistical significance. Patients with certain background diseases such as atrial fibrillation, coronary heart disease, and chronic heart failure had significantly worse adherence ( $P < 0.05$ ). When the sole cause of admission was diabetes, full adherence (100%) of both primary physicians and patients was found. **Conclusions:** Short-term adherence with discharge recommendation for BB insulin treatment is associated with pre-hospitalization patient characteristics.

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**KEY WORDS:** basal-bolus (BB) insulin treatment, diabetes, hospitalization, insulin, internal medicine department

Medication non-adherence may reduce the effectiveness of therapies. Non-adherence to prescription medications is associated with risk of death and hospitalization [1-3]. This concern is particularly important at the time of hospital discharge, which involves a transfer in responsibility from the in-patient provider or hospitalist to the primary care physician [4]. Inadequate hospital–community transition contributes to a high rate of adverse events, the majority of which are drug events [5-7]. Medication reconciliation at hospital admission, transfer, and discharge have been designated as required hospital practices to reduce adverse drug events [8]. At any given moment, approximately 30–40% of patients hospitalized in the general medicine wards have type 2 diabetes mellitus (T2DM) [9]. At admission, many of these patients are treated with basal-bolus (BB) insulin, as recommended by the American Diabetes Association (ADA), due to in-hospital hyperglycemia [10]. At discharge, this treatment regimen remains relevant in a significant portion of these patients and is included in the recommendation discharge letter. A structured discharge treatment plan for every diabetes patient has been recommended recently by the ADA [11]. Non-adherence at the time of hospital discharge has been reported by some studies. Notably, Jackevicius et al. [3] reported increased 1-year mortality for those patients who did not fill all of their discharge medications after hospitalization for acute myocardial infarction, regardless of their pre-hospitalization treatment [12]. There is no published data regarding the implementation and continuity of discharge recommendations for insulin-based discharge recommendations. We therefore sought to determine short-term (1 month) adherence of primary physicians and T2DM patients with discharge recommendation for BB insulin regimen.

## PATIENTS AND METHODS

This research was a retrospective single center study.

## DATA RETRIEVAL

Demographic and clinical data of T2DM patients discharged from the internal medicine wards of Assaf Harofeh Medical Center with recommendation for BB insulin regimen between 1 October 2013 and 31 March 2014 were retrieved from the

\*The first and second authors contributed equally to this study

hospital electronic database. The discharge recommendations were based on the clinical judgment of physicians during hospitalization.

Pre-hospitalization hemoglobin A1C (HbA1c) levels and first month post-discharge data regarding prescription and purchasing of insulin were retrieved from the Israeli national patient database, as this information is not available in the hospital electronic database. The last available HbA1c of each patient before admission was analyzed. The results were from 3–6 months before admission. Our study was approved by the research ethics committee at Assaf Harofeh Medical Center.

#### PATIENT ADHERENCE

Adherence by patients was defined as “full adherence” if the patient had purchased basal (long-acting) as well as bolus (short-acting) insulin, “partial adherence” if the patient had purchased only one kind of insulin (basal or bolus), and “no adherence” if the patient did not purchase any insulin.

#### PHYSICIAN ADHERENCE

Adherence by physicians was defined as “full adherence” if the primary physician had prescribed basal and bolus insulin, “partial adherence” if only one kind of insulin had been prescribed, and “no adherence” if no insulin had been prescribed.

#### STATISTICAL ANALYSIS

Statistical analyses were performed using IBM Statistical Package for the Social Sciences statistics software, version 19 (SPSS, IBM Corp, Armonk, NY, USA). Categorical variables are reported as frequency and percentages, and continuous variables are reported as mean  $\pm$  standard deviation. Categorical variables were compared using chi-square test or Fisher's exact test and continuous variables by independent samples *t*-test or analysis of variance (ANOVA) test. A two-tailed  $P < 0.05$  was considered statistically significant. A logistic regression was done to calculate adjusted odds ratio of variables.

## RESULTS

#### PATIENT ADHERENCE WITH DISCHARGE RECOMMENDATION

The study comprised 153 patients. Of these, 81 (53.6%) were male. The average age was  $67.5 \pm 13.1$  years. Table 1 describes patient adherence by demographic characteristics and clinical parameters. The majority of patients, 106 (69.3%), showed full adherence to discharge instructions. Twenty-five patients (16.3%) showed no adherence and 22 (14.4%) showed partial adherence. A significant positive association was found between pre-hospitalization HbA1c and patient adherence. The average pre-hospitalization HbA1c was  $9.04\% \pm 2.04$  in the full-adherence group,  $8.67\% \pm 1.70$  in the partial-adherence group, and  $7.51\% \pm 1.35$  in the no-adherence group ( $P = 0.002$ ). In addition, there was a trend toward better adherence with younger age that did not reach statistical significance. No association was found between any other clinical and demographic parameters and patient adherence.

Overall, these data demonstrate that patients with higher pre-hospitalization HbA1c were significantly more compliant with discharge instructions for continuous BB insulin treatment.

#### PHYSICIAN ADHERENCE WITH DISCHARGE RECOMMENDATIONS

Table 2 describes physician adherence by demographic characteristics and clinical parameters of discharged patients. Physician full adherence with discharge instructions was significantly higher than patient full adherence, 121 (79.1%) vs. 106 (69.3%), respectively ( $P = 0.0182$ ), suggesting that 20% of physicians do not prescribe insulin according to discharge recommendations and an additional subset of patients do not adhere to their physician's prescription. A significant association was found between pre-hospitalization HbA1c and physician adherence as well as a trend toward better adherence with younger age, which did not reach statistical significance. No association was found between any other clinical and demographic parameters and physician adherence.

These data demonstrate that similarly to patient adherence, pre-hospitalization HbA1c and age affect primary physician

**Table 1.** Patient adherence by demographic characteristics and clinical parameters

	Total	No adherence	Partial adherence	Full adherence	P value
	n=153	n=25 (16.3%)	n=22 (14.4%)	n=106 (69.3%)	
Age, years, mean $\pm$ SD	67.5 $\pm$ 13.06	71.04 $\pm$ 12.48	70.27 $\pm$ 12.13	66.15 $\pm$ 13.24	0.14
<b>Gender</b>					
Male	81 (53%)	13 (16%)	8 (9.8%)	60 (74%)	0.22
Female	72 (47%)	12 (16.6%)	14 (19.4%)	46 (63.8%)	
HbA1c, %	8.74 $\pm$ 1.97	7.51 $\pm$ 1.35	8.67 $\pm$ 1.70	9.04 $\pm$ 2.04	0.002
BMI, kg/m <sup>2</sup>	30.3 $\pm$ 6.0	30.6 $\pm$ 5.5	30.4 $\pm$ 6.9	30.2 $\pm$ 6.0	0.96
Creatinine, mg/dl	1.56 $\pm$ 1.14	1.68 $\pm$ 1.64	1.88 $\pm$ 1.09	1.46 $\pm$ 1.0	0.236

BMI = body mass index, HbA1c = hemoglobin A1C, SD = standard deviation

**Table 2.** Physician adherence by demographic characteristics and clinical parameters of patients

	Total	No adherence	Partial adherence	Full adherence	P value
	n=153	n=20 (13.1%)	n=12 (7.8%)	n=121 (79.1%)	
Age, years, mean $\pm$ SD	67.5 $\pm$ 13.06	72.65 $\pm$ 11.07	70.25 $\pm$ 13.7	66.43 $\pm$ 13.16	0.108
<b>Gender</b>					
Male	81 (52.9%)	10 (12.3%)	6 (7.4%)	65 (80.2%)	0.932
Female	72 (47.1%)	10 (13.8%)	6 (8.3%)	56 (77.7%)	
HbA1c, %	8.74 $\pm$ 1.97	7.38 $\pm$ 1.0	9.18 $\pm$ 1.6	8.93 $\pm$ 2.04	0.003
BMI, kg/m <sup>2</sup>	30.3 $\pm$ 6.0	29.96 $\pm$ 3.86	28.88 $\pm$ 4.71	30.5 $\pm$ 6.41	0.657
Creatinine, mg/dl	1.56 $\pm$ 1.14	1.86 $\pm$ 1.8	1.57 $\pm$ 1.08	1.51 $\pm$ 1.01	0.437

BMI = body mass index, HbA1c = hemoglobin A1C, SD = standard deviation

adherence to discharge recommendations for continuous BB insulin treatment.

**PATIENT ADHERENCE BY HOSPITALIZATION PARAMETERS**

Table 3 describes the association between patient adherence and hospitalization parameters. No association was found between the length of hospitalization and/or the number of co-morbidities and patient adherence. However, a strong inverse association was found between specific background diseases and patients adherence. Patients with background coronary heart disease (CHD), congestive heart failure (CHF), and atrial fibrillation (AF) had significantly lower adherence. Physician adherence was not associated with these background diseases (data not shown). It is of interest that patient and physician adherence in eight patients (5.2%) whose cause of hospitalization was uncontrolled symptomatic diabetes (hyperglycemia or hypoglycemia) was 100%. No other association was found between cause of hospitalization and adherence [Figure 1].

Taken together, these data demonstrate that T2DM patient and physician adherence with discharge recommendations for BB insulin treatments are differently affected by background diseases.

**DISCUSSION**

In this study we examined the short-term adherence with recommendations for continuous BB insulin treatment after discharge from a general internal medicine service. The majority of patients (69.3%) and primary physicians (79.1%) were fully adherent with these discharge recommendations. Two parameters were associated with higher adherence of both patients and physicians: higher pre-admission glycated hemoglobin and younger age. In addition, sub-analysis demonstrated that cardiac patients with background CHD, CHF, and/or AF had significantly lower adherence while patients whose main cause for admission was uncontrolled diabetes displayed complete adherence. Overall, these data suggest that a younger, uncontrolled T2DM patient admitted to an internal medicine ward for a non-cardiac problem is most likely to continue BB treatment during the first month after discharge.

This clinical profiling is important as the transition of care from the inpatient to the outpatient setting is a vulnerable time. Adverse events during this transition occur frequently and are associated with a higher risk of death and more frequent readmissions [1,3]. Non-adherence to discharge recommendations is the most frequent adverse drug event [7,13].

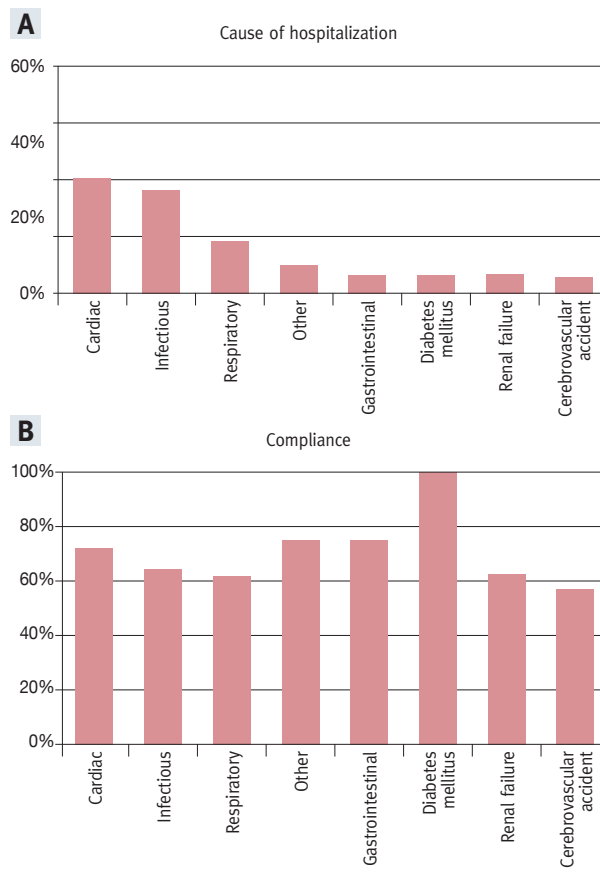
The continuity of patient care post-hospital discharge is a national priority and many authorities emphasize the need for safe transition of patients from hospital to the outpatient setting [8,10,11,14,15]. We emphasize that the patients in the

**Table 3.** Patient adherence by hospitalization parameters

	Total	No adherence	Partial adherence	Full adherence	P value
	n=153	n=25 (16.3%)	n=22 (14.4%)	n=106 (69.3%)	
Length of hospitalization	7.94 ± 6.38	8.36 ± 5.4	9.82 ± 8.45	7.45 ± 6.07	0.27
Number of background diseases	3.88 ± 1.73	3.88 ± 1.53	4.68 ± 1.81	3.72 ± 1.73	0.061
Background CHD	Yes (n=76)	13 (17.1%)	16 (21.0%)	47 (61.8%)	0.05
Background CHF	Yes (n=43)	7 (16.2%)	11 (25.5%)	25 (58.1%)	0.043
Background AF	Yes (n=34)	4 (11.7%)	11(32.3%)	19 (55.8%)	0.003

AF = atrial fibrillation, CHD = coronary heart disease, CHF = congestive heart failure

**Figure 1.** [A] Main cause of hospitalization (%), [B] Full adherence (compliance) by cause of hospitalization (%)



current study had hyperglycemia during hospitalization, and therefore were discharged with instructions to continue BB insulin that was initiated during their hospital stay. Better understandings of the key factors that determine the adherence of these patients with discharge recommendations is crucial for a smooth transition to the community, to ensure better glycemic control, and to prevent adverse outcome.

Adherence to insulin treatment post-hospitalization is not known. However, some studies examined adherence with other prescribed medications post-hospital discharge. In agreement with the findings in the current study, Fallis and colleagues [12] found 72% adherence with prescribed medications 30 days after discharge from a general internal medicine service and Jackevicius et al. [3] found 73% adherence to prescribed medication in the first week post-discharge for acute myocardial infarction in an Ontario, Canada, registry. Thus, the adherence for BB insulin after discharge falls in the same range as described for other drugs.

Our study emphasizes two gaps in the continuity of care. The first gap is between hospital and community as indicated by the incomplete adherence of the primary physicians with the discharge recommendations for continuous insulin treatment. This incomplete adherence, in many ways, disrupts the continuity of care and underscore the need for smooth transition and direct communication between hospital and community physicians [6,16]. Physicians often do not blindly follow guidelines, but rather evaluate their adequacy for a particular patient and adjust the treatment according to their assessment [17]. The second gap is between the primary physician and the patient, as indicated by the significantly higher adherence of the primary physician with discharge recommendations for BB insulin treatments than patients (79% vs. 69.3%, respectively). This finding underscores the need for patient education before hospital discharge, especially in cases of injectable medication regimen and specifically, insulin. A reasoned and clear discharge report for the primary physician is also needed.

Our study has several limitations. We did not have information regarding diabetes treatment pre-hospitalization; therefore, some patients might have used insulin before admission. Nevertheless, the decision to start BB insulin was based on hyperglycemia during admission, according to structured inpatient hyperglycemia protocols. Also, we did not continue the follow-up to determine the long-term adherence with insulin treatment.

## CONCLUSIONS

This study demonstrates that patient and physician short-term adherence to discharge recommendation for BB insulin treatment is partial and associated with the patient profile, including pre-admission poor diabetes control, younger age, and cardiac background diseases.

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**“We have forty million reasons for failure, but not a single excuse”**

Rudyard Kipling, (1865–1936), English author

**“I am always doing that which I cannot do, in order that I may learn how to do it”**

Pablo Picasso, (1881–1973), Spanish artist