Transition of Care: Evaluating the Harborview Medical Center Diabetes Recent Discharge Clinic

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CHAPTER 1

BACKGROUND AND SIGNIFICANCE

Prevalence and Cost of Diabetes

At least 25.8 million people, or 8.3% of the United States population, are estimated to be living with diabetes. [1] About 18.8 million of these people are diagnosed, 1.9 million newly diagnosed, and 7 million undiagnosed. Among those aged 65 years and older, 26.9% had diabetes in 2010 and 50% had prediabetes. Overall, an estimated 79 million American adults aged 20 years or older have prediabetes. In adults, Type 2 diabetes accounts for up to 95% of all diagnosed cases.[2]

Diabetes is both pervasive and expensive, accounting for over $174 billion annually in medical and health care services in the US, with about $116 billion attributable to direct medical costs and $58 billion to the disability, work loss and premature death caused by this disease.[1] In 2010, medical expenses for people with diabetes were more than two times higher than for people without diabetes. It is the leading cause of kidney failure, new cases of adult blindness and nontraumatic lower limb amputations, and a major cause of heart disease and stroke.[1] Chronic complications of diabetes account for over $25 billion of total annual costs.[3]

Inpatient Care

The largest component of general medical expenditures comes from hospital inpatient care, which accounts for over 33% of total health care costs.[4] For diabetes patients, this percentage rises to nearly 50%.[1,5] Studies have shown that individuals with diabetes are admitted to hospitals more frequently and they experience longer inpatient stays compared to individuals without diabetes, incurring two-fold higher inpatient costs per capita than people without diabetes.[6,7,8] Improving the glycemic control of diabetic patients is associated with significant cost savings since poor glycemic control greatly contributes to the morbidity of these patients.[9, 10] It has been shown that co-morbidities such as cardiovascular disease contribute to prolonged hospital stays for diabetic patients, which subsequently increase costs.[11]

Among hospitalized patients with diabetes, 30% have been found to have multiple inpatient stays.[7] Repeat hospitalizations that occur within the first 30 days after discharge are generally attributed to inadequate inpatient care, [12] which improved inpatient glycemic control and comprehensive pre-discharge planning can alleviate. [9,13] Readmissions that occur within a longer period of time, such as 180 days

or 6 months, may be more indicative of inadequate outpatient care,[12] and these can potentially be remedied by ensuring continuity of diabetes care post discharge.[14] Findings in the literature suggest that monitoring long-term readmission rates is particularly relevant for chronic diseases like diabetes.[12]

Several studies have examined risk factors that contribute to readmissions. The majority has focused on clinical parameters and includes three main categories: 1) healthcare system-related issues; 2) clinician-related issues; or 3) patient-related issues.[15] The first category includes delayed or inaccurate communication between hospital-based and primary care physicians, [16] failure to record a diabetes diagnoses for subsequent hospitalizations after the initial diabetes-related inpatient stay, [17] and inadequate inpatient diabetes education.[18, 19] The second category refers to medication and lab or "work-up" errors [20] and inappropriate discharges by clinicians. [13] Patient-related issues include poor glycemic control, [9, 21] low income and race/ethnicity, [22, 23, 14] polypharmacy in older adults or use of high-risk medications, [24, 25] low literacy [26] and comorbidity.[27]

Outpatient Care

Despite the large economic burden attributable to hospital admissions, outpatient settings are the most common sites of diabetes care, accounting for the majority of physician contacts. [28] The quality of care provided to diabetes patients in these settings can therefore have a great impact on long-term diabetes management, and poor quality of care may contribute to uncontrolled diabetes and increased complications and costs. This is particularly important within public hospital systems such as Harborview Medical Center which serve large numbers of low-income, racially and ethnically diverse populations that according to Chew, "often have a complex set of medical, psychological, and social problems that make their care difficult to manage." [29]

Diabetes is known as an Ambulatory Care-Sensitive Condition (ACSC) and has been cited as one of the diagnoses for which readmissions are likely to be a valid measure of quality of care. [21,30,31] Ambulatory Care-Sensitive Conditions are those considered by the Agency for Healthcare Research and Quality (AHRQ) to be "prevention quality indicators," which when treated with timely and appropriate outpatient care can potentially reduce avoidable hospitalizations. [31] In essence, regular and integrated outpatient diabetes care may promote good glycemic control and decreased health services utilization. [10, 21]

Transition of diabetes care from inpatient to outpatient settings

Studies indicate that recently discharged diabetes patients often continue to have uncontrolled diabetes or unresolved complications which put them at risk for readmission. [21, 32] The fact that patients with diabetes continue to have high readmission rates suggests there is a need to better understand the recently discharged diabetic population. Of particular concern is evidence that shows disparities in hospitalization rates among Blacks and Hispanics and those living in low-income areas.[33, 7] Racial and ethnic disparities were more evident in 180-day readmission rates than in 30-day rates, especially among Medicare populations.[14] In these studies, Hispanics had the highest rates of readmissions overall, while Blacks and Hispanics had a higher risk for complications that were more likely to be preventable with effective post discharge care. Interestingly, Whites were found to have higher percentages of readmission for macro vascular conditions.

These statistics indicate the need to ensure that recently discharged diabetic patients receive ongoing, long-term diabetes care by establishing contact with an outpatient team soon after hospital discharge. Wheeler addressed this issue by examining the patterns of post discharge follow-up and patient characteristics associated with outpatient follow-up among a cohort of hospitalized patients with diabetes from an urban, public safety-net health care system.[34] Results from her study revealed the following: (1) 43% of recently discharged diabetes patients had their first post discharge visit at an outpatient diabetes clinic, 26% at a primary care clinic, and 15% in the emergency department (ED) or urgent care with 1% as inpatient readmissions; (2) the average time between discharge and an outpatient visit was 6 weeks, but 12 weeks for an ED or urgent care visit; and (3) 16% of patients who had to pay for any portion of their medical costs were less likely to have any follow-up visit, except to ED or urgent care.

Wheeler's study points to certain factors that may lessen the likelihood of diabetic patients having an ED or urgent care visit or readmission after being discharged from the hospital. These factors include being older, being discharged with insulin, being uninsured, having a new diagnosis of diabetes, and receiving a referral from inpatient diabetes educators to follow-up at an outpatient clinic. The investigators postulate that older patients may be more concerned about their health and therefore seek medical care before complications arise, that patients using insulin may perceive their illness to be worse and therefore want to participate in an educational program with the goal of eventually discontinuing insulin therapy, that

patients without insurance are served by the safety-net system and therefore continue to receive care, and that patients newly diagnosed are likely to be more motivated to learn about their disease and therefore seek care.

In the Wheeler study, delayed post-discharge visits to urgent care or ED appear to be more influenced by the need to pay for medical charges than by acute diabetes-related complications. In contrast, the most common reasons for initial or repeat hospitalizations among adult diabetic patients have been found to be diseases of the circulatory system – specifically congestive heart failure, coronary heart disease and heart attack – and various infections.[35] Generally, studies have shown that adults with diabetes have 2 to 4 times higher rates or risk for heart disease and stroke than adults without diabetes.[1]

Ensuring a smoother transition of diabetes care from inpatient to outpatient settings for recently discharged patients may be facilitated by the coordination of care that outpatient diabetes clinics provide. It has been shown that patients who attend structured diabetes clinics with ongoing specialist support, education and communication have substantially improved outcomes, [36, 37] indicating the important role of these clinics in assuring continuity of care and improving patient health status. One model described by Wagner [37] utilizes "chronic care clinics" within a primary care setting which consists of one-half day groups for about eight patients, during which standardized assessments, visits with the primary care physician, nurse, and clinical pharmacist, and group education/peer support meetings are provided. This model resulted in improved patient satisfaction and glycemic control.

A different model in the UK uses an "intermediate diabetes care" clinic which facilitates primary care management of diabetes that can offer a range of diabetes services. This approach helps patients and families bridge the transition out of the hospital during the period before seeing an ambulatory primary care provider. [38, 39] One study published this year followed patients discharged from an intermediate diabetes care clinic to primary care services and found that glycemic control remained stable for up to twelve months post discharge, but that eighteen months later had slowly begun to rise. [39] The author suggests that patients should continue to receive intermediate diabetes care until glycemic targets have been reached. The Diabetes Recent Discharge Clinic (DRDC) of Harborview Medical Center (HMC) is similar to the intermediate diabetes care model used in the UK.

The DRDC Model

DRDC is a specialized outpatient diabetes clinic at HMC that was started at the end of June 2008 by a group of health care providers comprised of a diabetes educator, nurse practitioner and an endocrinology physician. The goals of the program are to:

- Improve the transition of diabetes care from inpatient to outpatient settings
- Reduce emergency department (ED) use post hospital discharge
- Reduce readmissions post hospital discharge
- Improve probability of outpatient follow-up with a primary care provider (PCP) post DRDC discharge

Patients meeting criteria for DRDC during their inpatient stay may be referred to the clinic. Although the main criteria to be eligible for DRDC services is to have diabetes and be recently discharged from the hospital, the inpatient glycemic team focuses on referring patients who have had a change in their diabetes treatment, are newly diagnosed, or do not have a primary care physician.

After discharge, patients who are referred and make a DRDC visit are offered services that include medication reviews and adjustments, physical assessment and medical history by a nurse practitioner; diabetes self-management review and education by a certified diabetes educator; nutritional assessment and education by a dietician; and referral to HMC primary care providers and ophthalmology services. No physician visits are offered at this clinic. Patients are discharged from DRDC when they have stable glycemic control, have completed a visit with a primary care provider (PCP), or have an appointment to see a PCP in the near future. In a typical month during the study period, approximately 8-12 new diabetic patients were seen by DRDC.

CHAPTER 2

STUDY PURPOSE AND SETTING

The main purpose of this study was to examine the transfer of care from inpatient to outpatient settings for diabetic patients recently discharged from Harborview Medical Center, in order to better understand what patient characteristics may influence post discharge outpatient follow-up, readmission rates and glycemic control. HMC is an urban, public safety-net health care system in King County, Washington

The study focused on patients who were eligible for and seen by the Diabetes Recent Discharge Clinic and patients who were eligible for but not seen by DRDC. The following research questions were addressed:

1. What are the demographic characteristics of DRDC and non-DRDC patients and how do they differ?
2. What are the similarities and differences in clinical characteristics, glycemic control, and health service utilization between DRDC and non-DRDC patients during the 8 month period before and after index inpatient admission? (Glycemic control was defined as the last measured HbA1c level during the 8 month period prior to and including index inpatient discharge, and the 8 month period after index inpatient discharge. Health service utilization included the number of ED visits, inpatient readmissions, and PCP visits during the 8 month period after index inpatient discharge. Index inpatient admission was defined as the original or first inpatient admission patients experienced during the study period).
3. What demographic or clinical characteristics are associated with glycemic control or health service utilization during the 8 month period after index inpatient discharge? (Index inpatient discharge was defined as the first discharge that occurred after index inpatient admission).
4. What are the patterns of DRDC Activity? (This includes the number of DRDC appointments scheduled, completed, canceled or were no-shows; whether or not patients completed their first scheduled appointment; the average number of days from the original discharge date to the first DRDC appointment; and the breakdown of visits to each DRDC provider).

CHAPTER 3

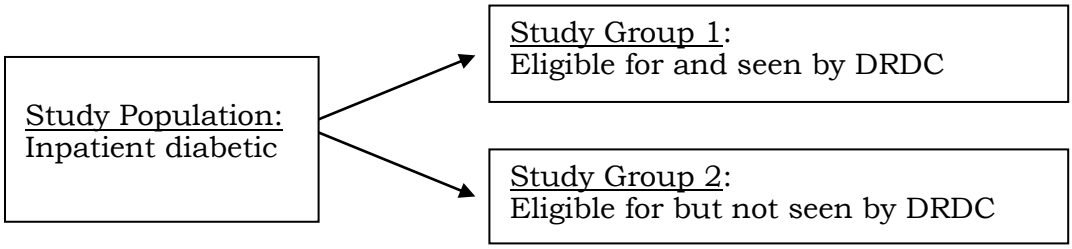
METHODOLOGY

Study Design

This was a descriptive retrospective study of transitional care among two groups of diabetic patients recently discharged from inpatient care at Harborview Medical Center: those eligible for and seen by DRDC and those eligible for but not seen by DRDC. In addition, a pre-post study design was used to compare glycemic control among patients before and after they were seen by DRDC.

Study Population and Selection of Study Subjects

The target population for this study was adult diabetic patients with a primary or secondary diagnosis of diabetes upon discharge from Harborview Medical Center hospital between July 1, 2008 and April 30, 2010. This population was divided into two main groups: DRDC and non-DRDC. The latter group included patients who were never referred to DRDC and those who were referred but failed to make a visit to DRDC.



Inclusion Criteria

Met criteria for DRDC eligibility:

- Male or female at least 18 years of age at date of discharge
- Have confirmed diagnosis of either type 1 or type 2 diabetes or is newly diagnosed
- Had a primary or secondary diagnosis of diabetes upon discharge from HMC hospital or ED between July 1, 2008 and April 30, 2010. *[ICD 9 codes: 250.xx]*

- Met criteria for poor glycemic control while inpatient: two measures of blood glucose levels > 180 mg/dl *(A1c ≥ 8%)* ** or one measure < 70 mg/dl

  *** Based on ADA recommended conversion of A1c values to "estimated average glucose" or eAG: 28.7 x A1c – 46.7 = eAG. An A1c of 8% = eAG of 183 mg/dl. http://professional.diabetes.org/GlucoseCalculator.aspx.*

- All races and ethnicities
- All languages
- All income levels
- All insurance types

Additional criteria for DRDC study group:

- Had at least 1 clinic visit with a Diabetes Recent Discharge Clinic nurse practitioner (ARNP) or certified diabetes educator (CDE) between July 1, 2008 and August 31, 2010. (Time frame allows for four months of lag time between index discharge date and first completed appointment with DRDC).

Additional criteria for non-DRDC study group:

- Had no recorded visits with either a DRDC nurse practitioner or certified diabetes educator between July 1, 2008 and August 31, 2010.

Exclusion Criteria

Among the subjects from both study groups who meet the Inclusion Criteria, those meeting the following exclusion criteria were not eligible to enroll:

- Patients with a diagnosis of gestational diabetes *[ICD-9 code: 648.0x – 648.04]*
- Patients with abnormal glucose tolerance *[ICD-9 code: 648.8]*
- Patients with visits to DRDC that occurred after August 31, 2010
- Patients discharged to another facility (skilled nursing facility, another hospital, nursing home)
- Patients from out of state
- Patients whose primary residence is outside of King, Pierce, or Snohomish counties
- Patients who are recorded as having died during their 8 month post-discharge period

Sample Size and Power

A sample size of at least 161 subjects was estimated to detect a mean difference of -0.50 percent in HbA1c levels between pre and post DRDC exposure. For a mean difference of -0.75 percent, at least 73 subjects were required. Power calculations were made prior to data extraction and were based on 80% power, a two-tailed alpha of 0.05, and a standard deviation of 2.25.

Representativeness of Study Sample

The DRDC group was a sample derived from all patients meeting the criteria for poorly controlled diabetes mellitus who were referred to DRDC within the specified time frame. The non-DRDC group was a sample also derived from the same population with the exception of not being referred to DRDC. Both study groups, in general, may be representative of all patients with poorly controlled diabetes mellitus seen in the emergency department or admitted to HMC. However, because patients who were actually selected for referral may have differed in unknowable ways from those who were not referred, generalizations about these two groups may be limited. Harborview is also a "safety-net" health system that serves a large population of disparate or marginalized patients which may also limit generalization of findings to patient populations from similar health settings.

Data Quality

The primary threat to validity for this retrospective study is the potential for existing data to be incomplete, inaccurate, or measured in ways that are not ideal for answering the research questions. To the extent that data errors may occur, they would have occurred randomly across all patients and potentially point toward there being no difference between the study groups (i.e. bias towards the null). There are no data quality assurance protocols available at HMC at this time.

Data Collection and Measures

Procedures and materials were approved by the University of Washington Institutional Review Board prior to commencement of this study. Data extraction was conducted by a decision support analyst from Harborview Medical Center using available electronic patient databases. Data collected included demographics, outpatient clinic utilization (DRDC clinic visits and PCP visits), inpatient and ED utilization, outpatient insulin use, and hemoglobin A1c values. Each subject was assigned a unique study number by the analyst and all personal identifiers were removed before data were transferred to the principal investigator in a password

protected Excel file. Complete data lists with links to personal identifiers were password protected and accessible only to the decision support analyst who was not involved with the data analysis.

Key Measures

Demographic:

- Age at discharge from hospital (in years)
- Gender (male or female)
- Race/Ethnicity (list of most commonly used in HMC records)
- Primary language spoken (English and other specific languages available in the records)
- Insurance status at time of referral to DRDC (Medicaid, Medicare, Self-pay/Charity, Sponsored)
- Distance of primary residence from HMC in miles (0 - 10 miles, 10.1 - 20 miles, 20.1 - 30 miles, greater than 30 miles)
- Is a King County resident (yes, no, or unknown)

Clinical:

- Completion of HbA1c testing during the 8 month period prior to and including day of index discharge for DRDC patients (yes or no). Index discharge refers to the original or first hospital discharge patients experienced during the study period.
- Completion of HbA1c testing during the 8 month period after index discharge from hospital (yes or no)
- Last measured HbA1c level during the 8 month period prior to and including day of index discharge for DRDC patients (%)
- Last measured HbA1c level during the 8 month period after index discharge from hospital (%)
- Outpatient insulin use based on refill data during the 8 month period prior to index admission date and 8 month period post index discharge date, including day of discharge (yes or no). Index admit refers to the original or first inpatient admission patients experienced during the study period.

- Primary care provider or PCP visit within Harborview Medical Center during the 8 month period prior to index admit date and 8 month period post index discharge date (yes or no)

Health Care Utilization for DRDC only:

- Whether a patient had a DRDC appointment between July 1, 2008 and August 31, 2010 but did not complete any visit during this period
- Whether a patient had at least one DRDC visit between July 1, 2008 and August 31, 2010
- Number of days from index discharge date to first DRDC appointment not completed
- Number of days from index discharge date to first completed DRDC appointment
- Total number of DRDC visits completed during the 8 month period after discharge from hospital
- Number of DRDC visits where Certified Diabetes Educator was seen
- Number of DRDC visits where Nurse Practitioner was seen
- Number of DRDC visits where Nutritionist was seen

Health Care Utilization for Both Groups:

- Number of days from date of index discharge to first inpatient readmission, if any
- Number of diabetes-related inpatient readmissions in the first 30 days after index discharge from hospital
- Number of diabetes-related inpatient readmissions in the first 8 months after index discharge from hospital
- Total number of inpatient readmissions for all causes/reasons in the first 8 months after index discharge from hospital
- Number of days from date of index discharge to first ED visit, if any
- Number of diabetes-related ED visits in the first 30 days after index discharge from hospital

- Number of diabetes-related ED visits in the first 8 months after index discharge from hospital
- Total number of ED visits for all causes/reasons in the first 8 months after index discharge from hospital
- Whether a patient had at least one appointment with HMC primary care provider in the 8 months prior to index admit date
- Whether a patient had at least one follow-up appointment with HMC primary care provider in the 8 months after index discharge from hospital

Construction of Variables

Several demographic variables were re-categorized or re-coded into new variables prior to running statistical tests. For race, a sixth category "unknown" was included to capture patients whose records did not indicate their race. Main language was re-categorized into the six most frequently recorded languages and the remaining languages were grouped together and labeled as "other". Another variable, zip code of residence, was recoded to "distance from Harborview Medical Center" and broken down into four categories: 0 to 10 miles, 10.1 to 20 miles, 20.1 to 30 miles, and greater than 30 miles.

After the first run of statistical testing on demographic variables, additional recoding of the variable "main language spoken" was conducted to ensure that no language category contained less than 5 subjects. With consultation from the data analyst, this variable was recoded to include the three most frequently used languages among Harborview patients: English, Spanish and Vietnamese. A fourth category "other" was used to capture the remaining languages and any marked as "unknown. All other binary and categorical variables were recoded into new variables with numerical values (i.e. gender: male=0, female=1).

Two clinical variables were recoded into binary variables: the number of hemoglobin A1c tests completed post discharge was changed to indicate if testing was done or not, and the number of insulin refills recorded post discharge was changed to indicate if insulin was used or not.

For health service utilization, the number of days from last primary care provider visit to index admit date was recoded as a binary variable indicating if a patient had seen a PCP prior to their original inpatient admission or not. The total number of PCP visits each patient made post index discharge was recoded to a binary

variable to indicate if a patient saw a PCP or not after their first discharge from inpatient stay.

To arrive at a variable indicating whether a patient had a readmission or not, and whether it occurred within the first 30 days post index discharge, the number of days from index discharge to first readmission was first recoded into a categorical variable separating patients who had readmissions within 30 days, greater than 30 days to 8 months, and those without; then this variable was recoded as a binary variable indicating those who had a readmission (regardless of when) and those with no readmissions. The same procedures were done for the variable indicating the number of days from index discharge to first ED visit. Another health service utilization variable served as a marker for those patients whose readmits and ED visits were diabetes-related in order to distinguish them from visits that were due to other causes.

To determine the total number of DRDC appointments scheduled during the study period, including those completed and not completed, multiple appointments made by individual patients post discharge were counted. These appointments were then recoded to a binary variable indicating if patients were scheduled for an appointment or not. Data were filtered by selecting only "primary first" cases to make unique patient counts for those who were scheduled, those who completed their first scheduled appointment, and those who did not complete their first scheduled appointment. For provider visits completed by DRDC patients, the number of visits for two different nutritionists was combined into one category labeled as "nutritionist," resulting in three categories of providers: Advanced Practice Nurse Practitioner, Certified Diabetes Educator, and Nutritionist.

The mean number of days from index discharge to first scheduled DRDC appointment was further delineated to show the average number of days from first scheduled appointment that was completed or not completed. After the first run of statistical testing on the mean number of days from index discharge to first scheduled appointment, the dataset was filtered to remove outliers, which was defined by the DRDC team as values greater than 100 days or less than zero (day of discharge).

To compare those who completed one DRDC appointment with those who completed two or more appointments during the study period, two new binary variables were created according to patients who had only one completed appointment and those with two or more completed appointments.

Data Analysis

SPSS version 16.0 was used to analyze all extracted data. Descriptive statistics were computed for demographic and clinical characteristics, glycemic control, and health service utilization for each research group: DRDC and non-DRDC. To determine whether the demographic characteristics, clinical characteristics, or health service utilization differed significantly between the DRDC and non-DRDC groups, two sample T-tests were used for continuous variables and Chi-square tests were used for binary and categorical variables. A paired T-test was used to determine if average hemoglobin A1c levels significantly differed pre and post DRDC exposure.

To determine the mean number of days from index discharge to the first scheduled appointment for patients with DRDC appointments, the dataset with DRDC activity was first filtered to select only the first scheduled appointment for each unique patient. A two sample t-Test was run on this group by appointment status to distinguish those patients who completed their first scheduled appointment from those who did not. On the one group who completed appointments, descriptive statistics were run to get frequencies and means. On the two groups who did not complete appointments, a two sample t-Test was run to compare means. These two groups were comprised of DRDC patients who did not complete their first scheduled appointment but did complete a future appointment, and non-DRDC patients who did not complete any appointments during the entire study period. An additional two sample t-Test was run on the one group of patients who completed at least one appointment (DRDC) sometime during the study period, based on appointment status to determine the relationship between those who completed their first appointment and those did not. The two sample t-Tests above were repeated for the dataset without outliers to provide a comparison against results derived from the dataset with outliers.

Bivariate associations between patient characteristics and glycemic control (which was defined as the last measured A1c post index discharge) were determined using Pearson's correlation for the continuous variable "age," one-way ANOVA for all categorical variables and post hoc tests for significant differences, and two sample t-test for the binary variable "post discharge insulin use." Bivariate associations between patient characteristics and health service utilization (readmissions, ED visits and PCP visits post index discharge) were determined using two sample t-test for "age" and Chi-square test for all other binary and categorical variables.

To determine if the number of visits completed by DRDC patients was associated with patient characteristics or glycemic control, two sample T-tests were run on numerical variables and Chi-square tests on binary and categorical variables. A paired T-test was also run to evaluate differences in A1c values pre and post DRDC exposure for the two groups of patients: those completing only one DRDC visit and those completing two or more.

A final analysis was done to determine bivariate associations between patient characteristics and completion of A1c testing post index discharge for non-DRDC patients using the two sample T-test for “age” and Chi-square tests for all other binary and categorical variables.

CHAPTER 4

RESULTS

Demographic

A total of 1658 records were extracted from electronic patient databases of which 93 were patients seen by DRDC and 1565 were not. Patients in both groups were predominantly white, middle-aged males who spoke English as their main language, lived in King County, and lived within 10 miles from Harborview Medical Center **(Table 1)**.

The two study groups differed significantly in several patient characteristics. The mean age for DRDC patients was 45, which is 11 years younger on average than non-DRDC patients ($p<.001$). Although both study groups were predominantly male, there was a higher percentage of males in the DRDC group compared to the non-DRDC group ($p<.01$). More DRDC patients spoke English or Spanish compared to non-DRDC patients, but more languages were represented within the non-DRDC group ($p<.001$). Over 50% of DRDC patients relied on self-pay/charity compared to only 15% of non-DRDC patients, while 41% of non-DRDC patients had Medicare and only 17% of DRDC patients did ($p<.001$).

Clinical Characteristics

For both study groups, the percentage of pre-admit insulin use were similar. Insulin use for DRDC patients was 20% and non-DRDC 15. Pre-admit A1c testing was completed by 54% of DRDC patients with a mean A1c of 11.6%. For purposes of this thesis, data on pre-admit A1c testing was not obtained for the non-DRDC group. The mean A1c post index discharge was similar for both groups: 8.7% for DRDC patients and 8.2% for non-DRDC patients **(Table 2)**.

Completion rates for post discharge A1c testing, however, differed significantly between the two study groups ($p<.001$): 77% of DRDC patients returned for testing while only 35% of non-DRDC patients did. A similar pattern was found for post discharge insulin usage ($p<.001$): 87% of DRDC patients used insulin after discharge and only 27% of non-DRDC patients did. For post discharge PCP use, the change was a dramatic 68%. Patients seen by DRDC who completed both pre-admission and post-discharge A1c testing (37 patients) showed significant improvement in their pre-post A1c levels, with a mean difference of -2.5% ($p<.001$). The mean pre-admission A1c for this group was 11.6% and the mean post-discharge A1c was 8.7%.

Further analysis looking at the relationship between patient characteristics and completion of post discharge A1c testing for non-DRDC patients indicate that significant differences in patient characteristics existed between non-DRDC patients who completed the A1c test and those who did not. With the exception of age, gender and main language spoken, the two groups differed significantly for all other patient characteristics: race, insurance type, county of residence, distance of residence from Harborview Medical Center, and post-index discharge insulin use, all p<.001 (Table 3).

DRDC patients who completed one visit versus those who completed two or more were similar in the number of patients who completed A1c testing prior to index admission, but differed significantly in the number who completed testing post index discharge, p<.01 **(Table 4)**. The number of patients with two or more DRDC visits who completed A1c testing was nearly twice the number of patients completing testing among those with only one DRDC visit (47 and 25 patients, respectively). The paired T-test was significant for patients with two or more completed visits (p<.01) and nearly significant for patients with only one completed visit (p=.052). Though not significant, a breakdown of the number of patients with insulin use post index discharge indicates that for both groups, the majority were discharged with insulin (53 out of 93 total patients).

Results of the paired t-test according to the number of DRDC visits completed show that 12 of the patients who made one visit completed both pre and post A1c testing, while 25 patients who made 2 or more visits completed both tests. The mean pre-admit A1c (%) for the one-visit group was 10.68 and the post DRDC A1c 7.94, indicating a mean difference and improvement of -2.74% (p=.052). For patients who completed two or more visits, their mean pre-admit A1c was 11.68 and post DRDC A1c 9.28, with a mean difference and improvement of -2.4% (p<.004).

Table 1: Demographic Characteristics by Research Group

	Total (n=1658)	DRDC (n=93)	Non-DRDC (n=1565)	p-value
Age (years), *mean* (SD)	55 (14)	45 (12)	56 (14)	**<.001**
Gender, *n* (%)				**<.01**
Female	621 (38)	23 (25)	598 (38)	
Male	1037 (63)	70 (75)	967 (61)	
Race, *n* (%)				**0.079**
Am Indian/Alaska Native	41 (3)	0 (0)	41 (3)	
Asian	257 (16)	16 (17)	241 (15)	
Black/African American	419 (25)	28 (30)	391 (25)	
Hispanic	154 (9)	15 (16)	139 (9)	
White	777 (47)	34 (37)	743 (48)	
Unknown	10 (1)	0 (0)	10 (1)	
Top Six Languages, *n* (%)				**<.001**
English	678 (41)	48 (52)	630 (40)	
Spanish	95 (6)	12 (13)	83 (5)	
Vietnamese	58 (4)	0 (0)	58 (4)	
Chinese	17 (1)	1 (1)	16 (1)	
Amharic	16 (1)	3 (3)	13 (1)	
Somali	16 (1)	0 (0)	16 (1)	
Other	778 (47)	29 (31)	749 (48)	
Insurance, *n* (%)				**<.001**
Medicaid	433 (26)	16 (17)	417 (27)	
Medicare	653 (39)	16 (17)	637 (41)	
Self-Pay/Charity	280 (17)	50 (54)	230 (15)	
Sponsored	292 (18)	11 (12)	281 (18)	
County, *n* (%)				**0.538**
King	1409 (85)	81 (87)	1328 (85)	
Pierce	97 (6)	3 (3)	94 (6)	
Snohomish	152 (9)	9 (10)	143 (9)	
Distance from HMC, *n* (%)				
0-10 miles	1058 (64)	63 (68)	995 (64)	**0.482**
10.1 - 20 miles	325 (20)	20 (22)	305 (20)	
20.1 - 30 miles	172 (10)	6 (7)	166 (11)	
> 30 miles	103 (6)	4 (4)	99 (6)	

Table 2: Clinical Characteristics by Research Group and Completed Visits

	Total (1658)	DRDC (93)	Non-DRDC (1565)	p-value
# Patients who completed Hgb A1c test, *n* (%)∞				
Pre-Index Admit *^	n/a	50 (54)	n/a	**n/a**
Post-Index Discharge**	620 (37)	72 (77)	548 (35)	**<.001**
Both Pre-Index Admit & Post-Index Discharge †^	n/a	37 (40)	n/a	**<.01**
Hgb A1c values (%), *mean* (SD)				
Pre-Index Admit *^	n/a	11.6 (3)	n/a	**n/a**
Post-Index Discharge **	8.2 (2)	8.7 (3)	8.2 (2)	**0.066**
Pre-Post Difference	n/a	2.5 (4)	n/a	**<.001**
Pre Admit ^	n/a	11.4 (3)	n/a	**n/a**
Post Discharge	n/a	8.9 (3)	n/a	**n/a**
# Patients with Insulin Usage, *n* (%) ∞				
Pre-Index Admit *	257 (16)	19 (20)	238 (15)	**0.176**
Post-Index Discharge **	507 (31)	81 (87)	426 (27)	**<.001**

	Sample Size	One^^ visit	Two or more^^ visits
# Patients who completed Hgb A1c test, *n* (%)∞			
Both Pre-Index Admit & Post-Index Discharge †^	37	12	25
Hgb A1c values (%), *mean* (SD)			
Pre-Post Difference	n/a	2.7 (4)	2.4 (4)
Pre Admit	n/a	10.7 (4)	11.7 (3)
Post Discharge	n/a	7.9 (2)	9.3 (3)

∞ = Based on unique patient counts

n/a = Not applicable

* = 8 month period before and including index admit date

** = 8 month period after and including index discharge date

^ = Pre-admit Hgb A1c data only obtained for DRDC group

^^ = n(%) based on sample size

† = p-value based on McNemar's Test for n=37 subjects

Table 3: Completion of Post Discharge A1c Test by Non-DRDC Patients

Patient & Clinical Characteristics	Sample Size	Did Not ^ Complete A1c Test	Completed ^ A1c Test	p-value
Age (yrs), *mean* (SD)	1565	56 (13.8)	56 (12.8)	**0.685**
Gender, n (%)				**0.176**
Female	598	401 (67.1)	197 (32.9)	
Male	967	616 (63.7)	351 (36.3)	
Race, n (%)				**<.001**
Am Indian/Alaska Native	41	29 (70.7)	12 (29.3)	
Asian	241	142 (58.9)	99 (41.1)	
Black/African American	391	217 (55.5)	174 (44.5)	
Hispanic	139	79 (56.8)	60 (43.2)	
White	743	542 (72.9)	201 (27.1)	
Unknown	9	8 (88.9)	1 (11.1)	
Main Language Spoken, n (%)				**0.649**
English	630	346 (54.9)	284 (45.1)	
Spanish	83	50 (60.2)	33 (39.8)	
Vietnamese	58	32 (55.2)	26 (44.8)	
Other	794	1 (100.0)	0	
Insurance, n (%)				**<.001**
Medicaid	417	250 (60.0)	167 (40.0)	
Medicare	637	409 (64.2)	228 (35.8)	
Self-Pay/Charity	230	122 (53.0)	108 (47.0)	
Sponsored	281	236 (84.0)	45 (16.0)	
County, n (%)				**<.001**
King	1328	828 (62.3)	500 (37.7)	
Pierce	94	77 (81.9)	17 (18.1)	
Snohomish	143	112 (78.3)	31 (21.7)	
Distance from HMC, n (%) ^				**<.001**
0-10 miles	995	578 (58.1)	417 (41.9)	
10.1 - 20 miles	305	223 (73.1)	82 (26.9)	
20.1 - 30 miles	166	136 (81.9)	30 (18.1)	
> 30 miles	99	80 (80.8)	19 (19.2)	
Post Index D/C Insulin Usage, n (%)				**<.001**
Yes	426	172 (40.4)	254 (59.6)	
No	1139	845 (74.2)	294 (25.8)	

^ = n (%) based on sample size
* = p<.05
** = p<.01
*** = p<.001

Table 4: Demographics by Number of Completed DRDC Visits

	Sample Size	One Visit^	Two or more Visits^	p-value
Age (years), *mean* (SD)	93	47 (11)	44 (12)	**.301**
Gender, *n* (%)				**.863**
Female	23	10 (43)	13 (57)	
Male	70	29 (41)	41 (59)	
Race, *n* (%)				**.449**
Am Indian/Alaska Native	0	0	0	
Asian	16	7 (44)	9 (56)	
Black/African American	28	15 (54)	13 (46)	
Hispanic	15	5 (33)	10 (67)	
White	34	12 (35)	22 (65)	
Unknown	0	0	0	
Main Language Spoken, *n* (%)				**<.01**
English	48	13 (27)	35 (73)	
Spanish	33	21 (64)	12 (36)	
Vietnamese	12	5 (42)	7 (58)	
Other	0	0	0	
Insurance, *n* (%)				**.088**
Medicaid	16	4 (25)	12 (75)	
Medicare	16	9 (56)	7 (44)	
Self-Pay/Charity	50	24 (48)	26 (52)	
Sponsored	11	2 (18)	9 (82)	
County, *n* (%)				**.441**
King	81	32 (40)	49 (60)	
Pierce	3	2 (67)	1 (33)	
Snohomish	9	5 (56)	4 (44)	
Distance from HMC, *n* (%)				**.620**
0-10 miles	63	25 (40)	38 (60)	
10.1 - 20 miles	20	8 (40)	12 (60)	
20.1 - 30 miles	6	4 (67)	2 (33)	
> 30 miles	4	2 (50)	2 (50)	

^ = n(%) based on sample size

Patient Characteristics and Glycemic Control

No personal or clinical characteristics were associated with glycemic control during the 8 month period after index discharge for DRDC patients **(Table 5)**. For non-DRDC patients, several characteristics were associated with glycemic control **(Table 6**). There was a significant, yet weak association with age (Pearson's correlation: -.201, $p<.001$) suggesting that as age increased, there was a tendency for A1c to decrease. Also, patients who used insulin post index discharge had a higher mean A1c (8.9%) than those who did not use insulin (7.5%), $p<.001$.

Other significant differences existed between the group means for race ($p<.01$), main language spoken ($p<.05$), and insurance type ($p<.01$). Post Hoc LSD tests show that (1) Asians had lower A1c levels than Black/African Americans and Hispanics, Hispanics had higher A1c levels than Whites, and A1c levels were not meaningfully different between other races; (2) English-speaking patients had higher A1c levels than Vietnamese-speaking patients, and A1c levels did not significantly differ between patients who spoke other languages; and (3) Medicaid patients had higher A1c levels than Medicare patients, Medicare patients had lower A1c levels than self-pay/charity patients, and A1c levels were not meaningfully different between other insurance types.

Table 5: Associations with Post Discharge A1c for DRDC Patients

Patient & Clinical Characteristics	Sample ^ Size	A1c (%) *mean(SD)*	Pearson's correlation	p-value
Age in years	93	8.7 *(2.7)*	-.214	.071
Gender				
Female	18	9.1 *(2.5)*		
Male	54	8.5 *(2.7)*		
Race				
Am Indian/Alaska Native	0	n/a		
Asian	12	8.8 *(3.1)*		
Black/African American	20	8.9 *(3.3)*		
Hispanic	14	8.3 *(1.8)*		
White	26	8.6 *(2.4)*		
Main Language Spoken				
English	41	8.8 *(2.6)*		
Spanish	11	8.4 *(1.9)*		
Vietnamese	0	n/a		
Other	20	8.7 *(3.1)*		
Insurance				
Medicaid	14	8.7 *(2.2)*		
Medicare	14	9.3 *(2.8)*		
Self-Pay /Charity	36	8.2 *(2.5)*		
Sponsored	8	9.7 *(3.9)*		
County				
King	61	8.8 *(2.8)*		
Pierce	3	7.0 *(0.8)*		
Snohomish	8	8.7 *(2.1)*		
Distance from HMC ^				
0-10 miles	49	8.6 *(2.6)*		
10.1 - 20 miles	16	9.0 *(3.1)*		
20.1 - 30 miles	3	8.5 *(2.8)*		
> 30 miles	4	8.2 *(2.4)*		
Post Index D/C Insulin Usage				
Yes	9	8.6 *(2.7)*		
No	63	9.1 *(2.5)*		

A1c (%) = Glycosylated hemoglobin test that measures the average level of blood sugar over the past 2-3 months. Measured as a percentage of the hemoglobin that is glycated, or has glucose bound to it.
^ = 21 patients with no A1c values were excluded from the table.
n/a = Not applicable
* = p<.05
** = p<.01
*** = p<.001

Table 6: Associations with Post Discharge A1c for Non-DRDC Patients

Patient & Clinical Characteristics	Sample ^ Size	A1c (%) *mean (SD)*	Pearson's correlation	p-value
Age in years	1565	8.2 *(2.2)*	-.201	<.001
Gender				
Female	197	7.9 *(2.1)*		
Male	351	8.3 *(2.2)*		
Race				
Am Indian/Alaska Native	12	8.7 *(3.3)***		
Asian	99	7.5 *(1.4)*		
Black/African American	174	8.4 *(2.3)*		
Hispanic	60	8.7 *(2.4)*		
White	201	8.0 *(2.2)*		
Multiracial	1	10.9 *(n/a)*		
Unknown	1	9.5 *(n/a)*		
Main Language Spoken				
English	284	8.4 *(2.3)* *		
Spanish	33	7.9 *(1.5)*		
Vietnamese	26	7.3 *(1.3)*		
Other or Unknown	205	8.0 *(2.2)*		
Insurance				
Medicaid	167	8.4 *(2.3)***		
Medicare	228	7.8 *(2.0)*		
Self-Pay/Charity	108	8.5 *(2.4)*		
Sponsored	45	7.9 *(2.2)*		
County				
King	500	8.2 *(2.3)*		
Pierce	17	7.7 *(1.7)*		
Snohomish	31	8.3 *(1.8)*		
Distance from HMC				
0-10 miles	417	8.2 *(2.3)*		
10.1 - 20 miles	82	7.9 *(2.0)*		
20.1 - 30 miles	30	8.2 *(1.8)*		
> 30 miles	19	8.1 *(1.7)*		
Post Index D/C Insulin Usage				
Yes	254	8.9 *(2.2)****		
No	294	7.5 *(1.9)*		

A1c (%) = Glycosylated hemoglobin test that measures the average level of blood sugar over the past 2-3 months. Measured as a percentage of the hemoglobin that is glycated, or has glucose bound to it.
^ = 1017 patients with no post A1c values were excluded from the table.
n/a = Not applicable
* = p<.05
** = p<.01
*** = p<.001

Health Service Utilization

The percentage of DRDC and non-DRDC patients who saw a primary care provider within Harborview Medical Center during the 8 months prior to their index inpatient admission did not differ significantly: 32% of DRDC patients had PCP visits while 37% of non-DRDC patients did **(Table 7)**. The overall percentages of readmits and ED visits post index discharge also were similar: 37% of DRDC patients were readmitted and 30% had ED visits, while 30% of non-DRDC patients were readmitted and 32% had ED visits.

In contrast, more DRDC patients saw their PCP during the 8 month period after index discharge (68%) than non-DRDC patients (35%), $p<.001$. Non-DRDC patients had fewer diabetes-related return visits to the emergency department during the first 30 days after index discharge (49%) than DRDC patients (80%), $p<.05$. The percentage of DRDC patients with diabetes-related ED visits during the first 8 months after index discharge was also higher at 75% compared to the percentage for non-DRDC patients DRDC patients at 50% ($p<.001$).

Patient Characteristics and Health Service Utilization

For DRDC patients, only one clinical characteristic was associated with health service utilization post index discharge **(Table 8)**. Patients who used insulin after index discharge had higher PCP use compared to patients who did not use insulin after index discharge ($p=.038$). For non-DRDC patients, several characteristics were associated with health service utilization **(Table 9)**. Patients who had diabetes-related ED visits post index discharge significantly differed from those who did not with respect to age. Those with ED visits were on average 3 years younger than those with no ED visits ($p<.001$). Males had significantly more ED visits than females ($p<.05$). A larger percentage of American Indian/Alaska Native and Black/African American patients were re-admitted compared to other races ($p<.05$). Black/African Americans experienced the most number of ED visits post index discharge compared to other races ($p<.001$) and also visited their PCP after discharge more often than the other races ($p<.001$).

In addition, insurance type was significantly associated with all health service utilization. Medicaid recipients represented the largest percentage ($p<.001$) of those with inpatient readmissions, ED visits and PCP use post index discharge, followed by Medicare recipients, self-pay/charity recipients, then sponsored recipients. Patients with the largest percentage of inpatient readmissions, ED visits, and PCP use lived in

King County (p<.001) and lived within 10 miles of Harborview Medical Center. Readmissions, ED visits, and PCP use were significantly more common among patients who used insulin after index discharge (p<.001).

Table 7: Health Services Utilization by Research Group

	Total (1658)	DRDC (93)	Non-DRDC (1565)	p-value
# Patients with Primary Care Activity, *n* (%)				
Pre-Index Admit Visits *^	607 (37)	30 (32)	577 (37)	**0.370**
Post-Index Discharge Visits **^	605 (37)	63 (68)	542 (35)	**<.001**
# Patients with Post D/C Activity, *n* (%)				
Inpatient Readmits ^	510 (31)	34 (37)	476 (30)	**0.212**
Emergency Department (ED) Visits ^	524 (32)	28 (30)	496 (32)	**0.749**
# Days from Index Discharge, *mean* (SD)				
To First Inpatient Re-admission ^	70.1 (67)	72.9 (69)	69.9 (67)	**0.800**
To First ED Re-admission ^	73.5 (70)	70.6 (69)	73.7 (70)	**0.818**
# Readmits post Index Discharge, *n* (%) †				
Diabetes-related in First 30 days	207 (13)	14 (15)	193 (12)	**0.489**
Diabetes-related in First 8 months	836 (87)	63 (68)	773 (49)	**0.065**
Total All Cause in First 30 days	239 (14)	14 (15)	225 (14)	**0.447**
Total All Cause in First 8 months	965 (58)	67 (72)	898 (57)	**0.220**
# ED Visits post Index Discharge, *n* (%) †				
Diabetes-related in First 30 days	148 (9)	12 (13)	136 (9)	**<.05**
Diabetes-related in First 8 months	603 (36)	48 (52)	555 (36)	**<.001**
Total All Cause in First 30 days	292 (18)	15 (16)	277 (18)	**0.797**
Total All Cause in First 8 months	1178 (71)	64 (69)	1114 (71)	**0.429**

* = 8 month period before and including index admit date

** = 8 month period after and including index discharge date

† = Based on actual visits, not patient counts

^ = Based on unique patient counts with post d/c visits

Table 8: Associations with Health Services Utilization for DRDC Patients

Patient & Clinical Characteristics	Sample Size	Re-Admitted ^ *n (%)*	ED Visits ^ *n (%)*	PCP Use ^ *n (%)*
Age in years	93	46 (12)	45 (14)	46 (13)
Gender				
Female	23	9 (39)	6 (26)	17 (74)
Male	70	25 (36)	22 (31)	46 (66)
Race				
Am Indian/Alaska Native	0	n/a	n/a	n/a
Asian	16	9 (56)	3 (19)	8 (50)
Black/African American	28	9 (32)	8 (29)	21 (75)
Hispanic	15	5 (33)	4 (27)	12 (80)
White	34	110 (32)	13 (38)	22 (65)
Unknown	0	n/a	n/a	n/a
Main Language Spoken				
English	48	21 (44)	18 (38)	34 (71)
Spanish	12	21 (33)	3 (25)	9 (75)
Vietnamese	0	n/a	n/a	n/a
Other	33	9 (27)	7 (21)	20 (61)
Insurance				
Medicaid	16	8 (50)	5 (31)	13 (81)
Medicare	16	7 (44)	7 (44)	14 (88)
Self-Pay /Charity	50	15 (30)	14 (28)	31 (62)
Sponsored	11	4 (36)	2 (18)	5 (46)
County				
King	81	30 (37)	24 (30)	54 (67)
Pierce	3	1 (33)	1 (33)	2 (67)
Snohomish	9	3 (33)	3 (33)	7 (78)
Distance from HMC ^				
0-10 miles	63	23 (37)	22 (35)	43 (68)
10.1 - 20 miles	20	6 (30)	3 (15)	15 (75)
20.1 - 30 miles	6	3 (50)	2 (33)	3 (50)
> 30 miles	4	2 (50)	1 (25)	2 (50)
Post Index D/C Insulin Usage				
Yes	81	30 (37)	27 (33)	58 (72)*
No	12	4 (33)	1 (8)	5 (42)

^ = n (%) Based on sample size and patients who had HS utilization
n/a = Not applicable
* = p<.05
** = p<.01
*** = p<.001

Table 9: Associations with Health Services Utilization for Non-DRDC Patients

Patient & Clinical Characteristics	Sample Size	Re-Admits ^ *n (%)*	ED Visits ^ *n (%)*	PCP Usage ^ *n (%)*
Age in years (SD)	1565	56 (14)	54 (13)***	57 (13)
Gender				
Female	598	167 (28)	168 (28)*	200 (33)
Male	967	309 (32)	328 (34)	342 (35)
Race				
Am Indian/Alaska Native	41	15 (37)*	16 (39)***	9 (22)***
Asian	241	77 (32)	58 (24)	99 (41)
Black/African American	391	143 (37)	177 (45)	191 (49)
Hispanic	139	40 (29)	53 (38)	55 (40)
White	743	199 (27)	191 (26)	187 (25)
Unknown	9	1 (11)	0	0
Main Language Spoken				
English	630	235 (37)	261 (41)	300 (48)
Spanish	83	22 (27)	29 (35)	33 (40)
Vietnamese	58	24 (41)	15 (26)	29 (50)
Other	794	1 (100)	0	1 (100)
Insurance				
Medicaid	417	152 (37)***	181 (43)***	181 (43)***
Medicare	637	217 (34)	197 (31)	234 (37)
Self-Pay/Charity	230	66 (29)	74 (32)	96 (42)
Sponsored	281	41 (15)	44 (16)	31 (11)
County				
King	1328	430 (32)***	470 (35)***	511 (39)***
Pierce	94	19 (20)	10 (11)	9 (10)
Snohomish	143	27 (19)	16 (11)	22 (15)
Distance from HMC				
0-10 miles	995	342 (34)***	390 (39)***	426 (43)***
10.1 - 20 miles	305	76 (25)	73 (24)	84 (28)
20.1 - 30 miles	166	42 (25)	24 (15)	21 (13)
> 30 miles	99	16 (16)	9 (9)	11 (11)
Post Index D/C Insulin Usage				
Yes	426	173 (41)***	192 (45.1)***	243 (57)***
No	1139	303 (27)	304 (26.7)	299 (26)

^ = n (%) Based on sample size and patients who had HS utilization
* = p<.05
** = p<.01
*** = p<.001

DRDC Activity

A total of 451 DRDC appointments were scheduled during the study period. Of these, 374 appointments were scheduled to 93 unique patients who completed at least one of these appointments **(Table 10)**. These patients represented the DRDC study group. The remaining 77 appointments were scheduled to 48 patients who were eligible for and referred to DRDC but who never completed their appointments. These patients were included in the non-DRDC study group. Of the 374 appointments scheduled to patients who completed at least one visit, 225 appointments were completed and 149 were not. Appointments not completed consisted of 69 cancellations and 80 no shows. Twenty-two of the 93 unique patients did not complete their first scheduled appointment, but did complete a later re-scheduled appointment. Completed visits were comprised of 142 visits with the DRDC nurse practitioner ARNP), 42 visits with the certified diabetes educator (CDE) and 41 with the clinical nutritionist.

For the 93 patients who completed at least one appointment during the 8 month period after discharge and was labeled the DRDC group, 71 experienced an average wait time of 63 days from index discharge date to the first scheduled and completed DRDC appointment. In contrast, for the remaining 22 patients who completed at least one visit but not their first, the average wait time was 20 days. Descriptive statistics indicate that this data did not have a normal distribution with kurtosis >7 (Levene's Test =.018, so equal variances were not assumed, and significance was $p<.05$).

Results from the analyses with outliers removed indicate the data had a normal distribution and 104 patients had their first scheduled appointment at least one day but less than 100 days from day of index discharge. The breakdown for this group was 56 patients (DRDC) who completed at least one visit and 48 patients (non-DRDC) who did not complete any visit during the 8 month period post discharge. With all outliers removed, DRDC patients had a mean number of days from day of discharge to the first scheduled and completed appointment of 29 days and to the first missed appointment, 25 days.

For patients who never completed any appointment, an average of 30 days past between day of index discharge to their first scheduled but missed appointment. Based on results of the breakdown showing the number of patients in each increment of 30 days from discharge who had their first appointment scheduled, the majority of

patients had visits scheduled within the first 100 days from date of index discharge **(Figure 1)**.

Results comparing the 93 patients who either completed one appointment versus two or more indicate that only one characteristic differed significantly – main language spoken, p<.01 **(Table 11)**. Of the 39 patients who completed just one visit to DRDC, the largest number was Spanish-speaking (21 patients). In contrast, 35 of the 54 patients who completed two or more visits was English-speaking, p<.01.

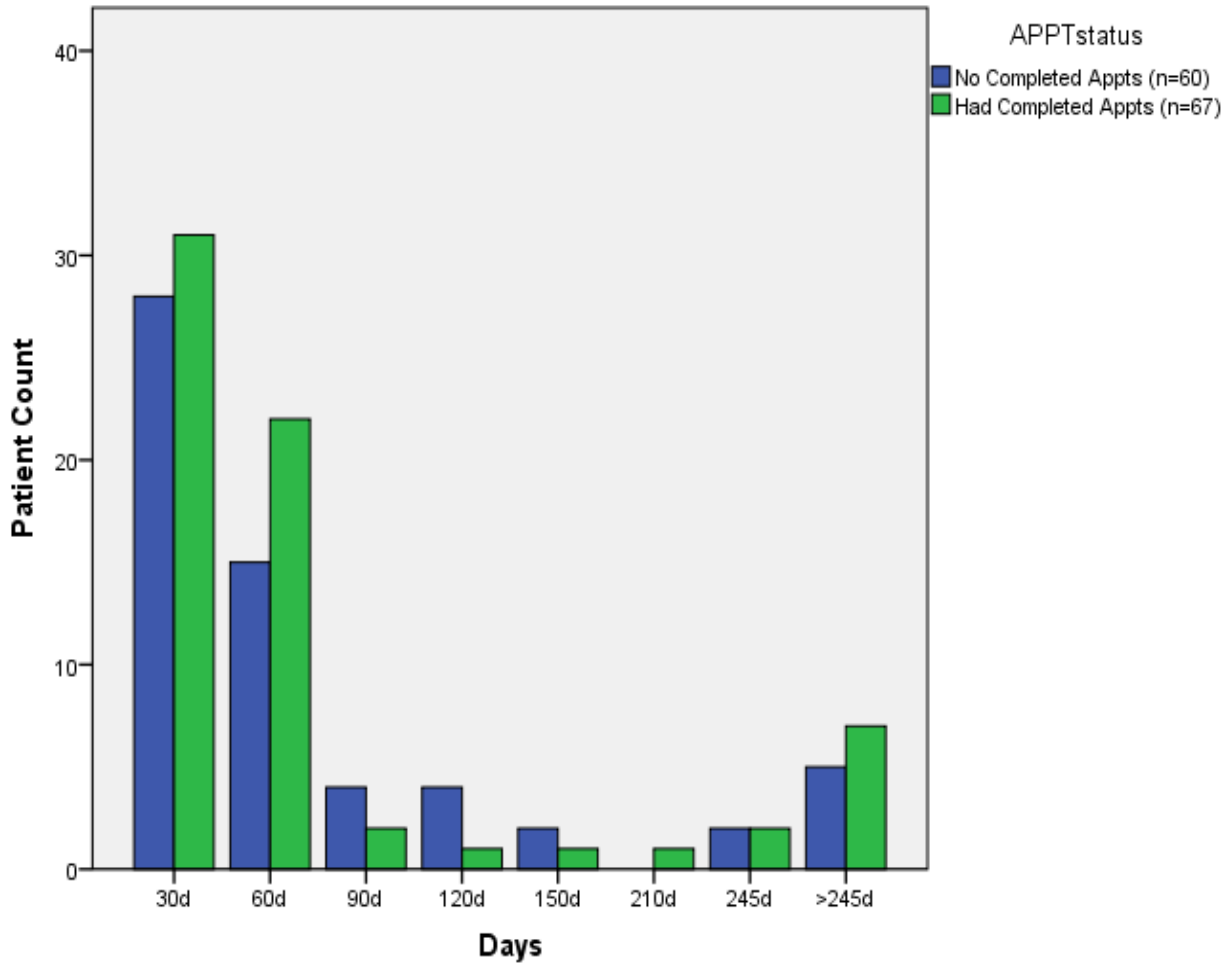


Figure 1: Mean Number of Days from Index Discharge to First Scheduled Appointments

Table 10: Activity Patterns of Patients Referred to DRDC

	Sample Size	Completed Appt. ^	No Completed Appt. † ^
# DRDC Appointments Post Index D/C, *n* (%)			
Total Appointments Scheduled *	451	374 (83)	77 (17)
Total Completed *	225	225 (100)	n/a
Total Not Completed *	226	149 (66)	77 (34)
Canceled	97	69 (71)	28 (29)
No Show	129	80 (62)	49 (38)
# Patients w/DRDC Appointments Post Index D/C, *n* (%) ∞			
Total Patients Scheduled for Initial Appointments	141	93 (66)	48 (34)
First Scheduled and Completed	71	71 (100)	n/a
First Scheduled and Not Completed	70	22 (31)	48 (69)
# Days from Index D/C to First DRDC Appointment, *mean* (SD) ∞			
To First Scheduled and Completed	71	63 (127)	n/a
To First Scheduled and Not Completed	70	20 (44)	56 (175)
# Days from Index D/C to First DRDC Appointment, *mean* (SD) £			
To First Scheduled and Completed	56	29 (19)	n/a
To First Scheduled and Not Completed	48	25 (16)	30 (24)
# Patients for each 30 days Post Index D/C to First Scheduled Appointment, *n* (%) €			
0 – 30 days	59	31 (53)	28 (47)
30 – 60 days	37	22 (60)	15 (40)
60 – 90 days	6	2 (33)	4 (67)
90 – 120 days	5	1 (20)	4 (80)
120 – 150 days	3	1 (33)	2 (67)
150 – 180 days	0	0	0
180 – 210 days	1	1 (100)	0
210 – 245 days	4	2 (50)	2 (50)
> 245 days	12	7 (58)	5 (42)

† = Patients eligible for and referred to DRDC but never completed a DRDC appointment. Included in non-DRDC study group.

^ = Percentages are based on sample size

Index D/C = Refers to the original (first) discharge from hospital.

* = Includes multiple appointments by unique patients during 8 month period post index D/C between 7/1/08 to 12/31/10.

n/a = Not applicable

∞ = Based on unique patients counts with all outliers included

£ = Based on 104 scheduled patients minus those with outliers (<0 or >100 days post D/C to first scheduled appointment).

€ = Based on all 141 scheduled patients minus those with negative outliers (<0 days post D/C to first scheduled appointment).

Table 11: Clinical Characteristics by Number of Completed DRDC Visits

	Sample Size	One visit^	Two or more visits^	p-value
# Patients who completed Hgb A1c test, *n* (%) ∞				
Pre-Index Admit *^	50	22 (44)	28 (56)	**.664**
Post-Index Discharge**	72	25 (35)	47 (65)	**<.01**
Hgb A1c values (%), mean (SD)				
Pre-Index Admit *	50	11.3 (3.7)	11.8 (2.5)	**.549**
Post-Index Discharge **	72	8.5 (2.6)	8.8 (2.7)	**.638**
Pre-Post Difference	12	2.7 (4.4)	---	**.052**
Pre Admit	---	10.7 (3.7)	---	**n/a**
Post Discharge	---	7.9 (1.7)	---	**n/a**
Pre-Post Difference	25	---	2.4 (3.8)	**<.01**
Pre Admit	---	n/a	11.7 (2.5)	**n/a**
Post Discharge	---	n/a	9.3 (3.0)	**n/a**
# Patients with Insulin Use, n (%) ∞				
Pre-Index Admit *	19	11 (58)	8 (42)	**.114**
Post-Index Discharge **	---	---	---	**.999**
At day of discharge	53	22 (42)	31 (58)	**n/a**
1-30 days post discharge	19	8 (42)	11 (58)	**n/a**
> 30 days post discharge	9	4 (44)	5 (56)	**n/a**
Unknown or missing value	12	5 (42)	7 (58)	**n/a**

^ = n(%) based on sample size

∞ = Based on unique patient counts

* = 8 month period before and including index admit date

** = 8 month period after and including index discharge date

n/a = Not applicable

CHAPTER 5

DISCUSSION

The main purpose of this study was to examine the transfer of care from inpatient to outpatient settings of diabetic adults recently discharge from Harborview Medical Center (HMC). Specifically, this study compared the patient characteristics of a group of diabetic adults who received post-discharge services through the Diabetes Recent Discharge Clinic at HMC with those who did not, to see what characteristics may be associated with post discharge outpatient follow-up, readmission rates, and glycemic control.

Demographic Characteristics

Findings from this study revealed certain characteristics that were expected to be common in both groups, primarily county of residence and distance of residence from Harborview. It follows that the majority of patients in the study group lived in the county in which Harborview is located and within 10 miles of the medical center because traveling long distances is barrier for return appointments.

Findings not necessarily expected but common to both groups were observed for age, gender and ethnicity. Both groups of patients were predominantly middle-aged, White males. Given that on average, patients hospitalized with diabetes are older and that at Harborview, about half of the patient population are persons of color, this was somewhat a surprise. There is however, research indicating that the mean age of patients hospitalized with a principal diagnosis of diabetes can be over ten years younger than the average patient hospitalized for any diabetes-related conditions, and that the percentage of males who are hospitalized with a principal diagnosis of diabetes can be up to 50% of all hospitalized diabetics. [41] This seems to be the case for both study groups, but even more so for DRDC patients who were on average, 11 years younger than non-DRDC patients.

Furthermore, these results are very similar to the general characteristics of patients in the Wheeler study[34] which looked at patterns and determinants of immediate post discharge follow-up among a cohort of urban, hospitalized patients with diabetes. In that study the mean age at time of admission was 49 years and 52% of the patients were male. Additionally, research literature suggest that males in general may be less inclined to seek preventive health care that could potentially prevent hospitalizations.[42, 43] With a condition like diabetes that requires a significant

amount of self-care, it is feasible that a lack of diabetes self-care among males in the study contributed to their being hospitalized more often than females.

Results on other demographic characteristics suggest that the two study groups were different from each other. Although most patients were White, a breakdown of ethnic groups revealed that the percentage of Black/African American patients in the DRDC group was just 6% less than Whites, compared to 23% less for non-DRDC patients. The higher percentage of Black/African American patients in the DRDC group is more reflective of research from the Centers for Disease Control and Prevention that has found Black/African Americans to have the highest rates of hospitalization for diabetes.[1] Combined with the results that DRDC patients were predominantly uninsured and dependent on charity/self-pay while the majority of non-DRDC patients had Medicare, it would appear that DRDC patients were overall a younger group who did not yet qualify for Medicare and that the majority lived in poverty.

Findings also suggest that non-DRDC patients may have had fewer access barriers to health services than the predominantly uninsured DRDC patients because having non-Medicaid insurance increased access to care from other public and private health care organizations outside of Harborview. As described further below, this may have impacted post discharge health service utilization by this group.

Clinical Characteristics

In addition to looking at the demographic make-up of DRDC and non-DRDC patients, this study examined clinical characteristics and glycemic control before and after inpatient admission. A comparison between the two groups show that percentages of pre-admission A1c testing, A1c values and insulin use among DRDC patients were higher overall than that for non-DRDC patients. This may be an indication that DRDC patients in general had worse glycemic control. However, the reader should note a few limitations regarding pre-admission A1c levels. First, percentages for A1c testing do not reflect any testing that may have been done outside of the HMC system. Second, a distinction was not made between A1c's that were truly "pre-admit"(those taken before the actual day of admission) and A1c's that were done during inpatient stay up to day of discharge. A1c's taken during inpatient stay would potentially have been affected by treatment received in the hospital. For more accuracy, the terminology "pre-discharge" would have been preferred to "pre-admission" with regards to A1c testing and values. Third, the comparison was limited by a lack of pre-admission A1c data for the non-DRDC group so no associations

between the two groups could be tested. However, because the DRDC team was able to access this data independent of this study, the results of their analysis of this data was provided for purposes of discussion.

Specifically, the DRDC team analysis found that pre-admission A1c testing at Harborview for non-DRDC patients was 41% with a mean A1c of 8.3%. The mean difference for pre-post A1c was 0.08% (p=.785), with only 7% of non-DRDC patients completing both pre and post A1c testing. In comparison, study analysis found that 54% of DRDC patients completed A1c testing prior to being admitted with a mean A1c of 11.6% and the mean pre-post A1c was 2.5% (p<.001), with 40% of these patients completing both pre and post A1c testing. One could suggest that pre-admission A1c testing may have been more frequent among DRDC patients because they had less stable glycemic control to begin with, as evidenced by a mean pre-admission A1c of 11.6% (estimated average glucose or eAG = 286 mg/dl, normal range <120 mg/dl),[44] and these patients were encouraged to have testing done regularly. Another possibility may have to do with non-DRDC patients having their testing done outside of HMC, as will be described in more detail in a later section.

The large difference in the mean pre-post A1c between the two groups may in part be a reflection of the small percentage of non-DRDC patients completing post discharge A1c testing at Harborview, but more likely an indication that exposure to the DRDC program contributed to lower A1c readings for patients who participated in the program. Further analysis comparing DRDC patients who completed one visit with those who completed two or more indicate that the significance level of pre-post differences in mean A1c was higher for patients who completed additional visits. This finding, however, does not support the possibility of a "dose response" in response to DRDC exposure, considering the mean difference in pre-post A1c for patients who completed two or more visits was actually .4% less than that of patients with only one completed visit.

The rather small percentage of non-DRDC patients who completed both pre and post A1c testing (7%) led to further analysis of this study group's demographics based on those who completed post-discharge A1c testing and those who did not. Results indicate that demographically, these two groups of non-DRDC patients differed significantly on several characteristics: race, insurance type, county of residence, distance of residence from Harborview, and post index discharge insulin use. Of particular interest were the results showing that patients who did not complete A1c testing made up 65% of all non-DRDC patients and of these, 83% did not use insulin post index discharge, 43% lived greater than 10 miles from Harborview, and 40% were

on Medicare. These findings suggest that this group of patients had more stable glycemic control and thereby less need for insulin, that these patients may have chosen not to return to Harborview for their A1c testing because distance was a barrier, and that these patients were able to seek health services elsewhere as a result of having Medicare insurance.

Significant differences in post index discharge A1c testing and insulin use for DRDC and non-DRDC patients may have additional explanations. First, as mentioned earlier, DRDC patients may have had worse glycemic control that increased the need for more frequent A1c tests and insulin treatment. Second, it is possible that patients who were seen by DRDC were generally a more adherent group than those not seen, which made it more likely that they would have followed through to obtain A1c testing and fill their insulin prescriptions after inpatient discharge.

Another explanation may be that post discharge A1c testing and insulin use were influenced by the frequency of primary care physician (PCP) visits patients made. More frequent PCP visits could have meant patients were more closely followed or monitored so that A1c testing and insulin use were reinforced. It is also plausible that PCP's were oriented towards dispensing insulin as a main form of diabetes treatment and patients who saw them regularly were more likely to have been prescribed insulin, such as DRDC patients. Finally, with DRDC patients experiencing a greater level of poverty in general when compared to non-DRDC patients, it was very likely that these patients depended more on Harborview for free or low-cost care, leading to more visits at Harborview where A1c testing can be done and insulin refills can be obtained.

Associations with Glycemic Control

No personal or clinical characteristics were associated with glycemic control during the 8 month period after index discharge for DRDC patients. The most probable explanation is the small total sample size of this study group, especially when considering that glycemic control was associated with several patient characteristics for the non-DRDC group which was 18 times larger in size (1658 subjects versus 93).

For non-DRDC patients, there was a significant yet weak negative association with age suggesting that as age increased, there was a tendency for A1c to decrease. Although there is no definitive research that indicates a positive association between age and A1c among diabetics, there are studies that have found this association among non-diabetics, [46] making this result somewhat unexpected. It is not clear why this association existed for this group. Other significant differences existed between the group means for race, main language spoken, and insurance type. Among all the

racial groups, Asians had the lowest A1c levels. Lack of available research on comparisons of A1c levels between ethnic groups that include Asians make it difficult to provide possible explanations for this result. Among insurance types, patients on Medicare had the lowest A1c levels, which may be due partly to these patients having more access to health services than those with Medicaid or who are dependent on charity care.

Health Service Utilization

Results show that DRDC and non-DRDC patients were similar in their pre-admission utilization of primary care providers but differed significantly in their utilization of PCPs post index discharge, with DRDC patients having more PCP visits. One possible explanation for this finding is that the DRDC program was succeeding in its goal to connect hospitalized diabetics patients with Harborview primary care physicians, particularly those previously without one.

Another explanation is related to post discharge insulin use. At Harborview and perhaps other medical facilities, refilling an insulin prescription requires that patients be seen by a physician or nurse practitioner. Patients followed by DRDC were also able to fill their insulin through the clinic. According to DRDC practitioners, a new prescription for insulin is typically good for one month and patients new to insulin are generally scheduled to see a PCP for follow up at least once a month, with a visit to nutrition or pharmacy providers in between, especially if glycemic control remains unstable. Knowing that DRDC patients had higher usage of insulin post discharge, it is plausible to conclude that these patients required additional visits to their PCP in order to monitor insulin use and to receive additional refills. They also may have been encouraged by DRDC providers to see their PCP for regular monitoring. It follows that non-DRDC patients who had significantly less insulin use would have also had fewer PCP visits.

A third possibility is that non-DRDC patients chose to go elsewhere for their follow-up care, considering the majority of these patients had Medicare or other health insurance, as was described earlier. This finding has implications for outpatient care at Harborview, particularly around the image that patients may have about primary care. According to their patient statistics, Harborview provides the largest portion of charity care in Washington State and gives priority to serving a very diverse population that includes incarcerated persons in King County jail, mentally ill patients requiring involuntary treatment, substance abusers and indigents without third-party coverage. For some, there may be a tendency to view the clientele Harborview most frequently

serves in a negative way, thus discouraging these patients from seeking outpatient services at the medical center.

Finally, a fourth possible explanation as to why DRDC patients had more PCP visits than non-DRDC patients post index discharge is that non-DRDC patients may have already had a PCP at another clinic to whom they were returning to for their care. Considering that the percentage of non-DRDC patients who saw HMC primary care providers before being admitted (37%) remained virtually unchanged after discharge (35%), it is plausible to suggest that the remaining non-DRDC patients already had access to a PCP outside of the Harborview system before and after their inpatient stay.

Of particular interest is the finding that the number of diabetes-related ED visits was higher for DRDC patients, both in the first 30 days post index discharge and during the 8 month period after discharge. This was not the case for ED visits due to all other causes. A variety of possible explanations exist for this observed finding. The first is the possible adverse effects associated with insulin use. As mentioned above, DRDC patients had significantly higher utilization of insulin post discharge (87%) compared to non-DRDC patients (27%). There is research to suggest that use of anti-diabetic medications like insulin, as well as use of anti-thrombotic medications, increases the risk for ED visits among older adults and that improved management of these medications could prevent ED visits for adverse events.[43] Considering that a larger percentage of DRDC patients were discharged on insulin or initiated insulin therapy within 30 days of index discharge, it is reasonable to suggest that adverse effects stemming from insulin use by this group may have contributed to increased ED visits.

This may have been especially true if DRDC patients held the perception of being more ill than they may have been. It is possible that the use of insulin, a referral to the DRDC program, and the need for additional PCP visits may have fostered a perception of being more “sick” among these patients, reinforcing their desire to seek ED services when health issues developed post discharge, especially those related to adverse events from insulin use.

Related to perceptions of health status, it is possible that ED visits may have occurred after discharge but before a DRDC or PCP visit when patients were in between care providers, and those patients who believed they were “sick” but did not know how to quickly access health services opted to be seen through the ED. Addressing this critical “in between” time period has some implications on general patient education given to patients being discharged from the hospital, which ideally

should cover information on how and where to obtain health services other than the emergency department during this "in between" period, and on non-ED health services that can be provided during this transition time. For example, it may be useful to provide some form of phone-based care management for patients immediately discharged from HMC until the point they have made contact with either DRDC or a PCP. Access to phone assistance for at least 3 months (the time period in which most patients were seen in ED post index discharge in this study) could provide the additional support that recently discharged diabetic patients need to avoid unnecessary ED visits.

Another potential explanation may be related to the negative image described above in that non-DRDC patients may have chosen to seek ED services outside of Harborview, after having experienced the system during their index inpatient admission. Since HMC is located in an area where several other major hospitals exist, it is feasible that patients with health insurance may have chosen to go to a nearby ED, especially if they were referred out by HMC staff due to full capacity. With HMC being the only Level I adult and pediatric trauma center for Washington State, as well as the regional referral center for the Northwestern States, there is a greater chance that its ED capacity is reached more quickly and patients with health insurance are referred elsewhere.

A fifth explanation is that some patients seen at DRDC and other outpatient clinics at HMC are referred directly to ED when patients are too unstable to be treated in the clinic or require more interventions than are available in the clinic. Knowing that DRDC patients overall had more unstable glycemic control than non-DRDC patients, and that they had higher utilization of insulin, they were probably more likely to experience these in-house referrals. Since the study did not distinguish between ED visits initiated by patients and ED visits resulting from referrals by clinic staff, it is not possible to determine how frequent an occurrence this really was.

Finally, in response to the possibility of increased PCP utilization leading to more in-house referrals to ED, which one might consider as the result of a domino effect occurring from DRDC patients having worse glycemic control leading to more insulin use and further leading to more use of PCP services, it is important to note that ED visits post discharge between DRDC and non-DRDC patients differed only with respect to ED visits for diabetes, and not for other reasons. If access to primary care and increased PCP visits were driving ED visits, one would expect an overall increase in ED visits, not just ED visits related to diabetes.

Associations with Health Service Utilization

For DRDC patients, only one clinical characteristic was associated with health service utilization post index discharge. Patients who used insulin after index discharge had higher PCP use compared to patients who did not use insulin after index discharge. As described earlier, this relationship may be largely due to a protocol used at Harborview that requires patients to see their PCP for insulin refills and encourages patients new to insulin to have monthly follow-up visits with their PCP. The fact that almost three-fourths of the DRDC patients who had PCP visits had post discharge insulin use and that over half of these were newly prescribed provides lend support for this association. The smaller sample size likely also contributed to the lack of significant associations between patient characteristics and health service utilization in the DRDC group.

In contrast, several patient characteristics were associated with health service utilization for non-DRDC patients. Again, this may largely be the result of sample size, which for this group was much larger than the DRDC group. The finding that patients who had more ED visits were younger, male, and of Black/African American decent support research mentioned earlier that the largest percentage of patients hospitalized with a principal diagnosis of diabetes tend to be younger males of this ethnic group. It also comes as no surprise that Medicaid recipients represented the largest percentage of those with inpatient readmissions, ED visits and PCP use post index discharge. It confirms known patterns that poverty is related to worse health.

DRDC Activity

Based on results, a total of 141 unique patients were referred to and scheduled for DRDC appointments, with 93 completing at least one and 48 not completing any. These 48 patients were unique in that they were referred and scheduled for DRDC appointments but completed no visits, so technically, the non-DRDC group was comprised of two sets of patients who may have been quite different from each other as well as from the DRDC group. It is likely that two sets of comparisons – one between the 93 DRDC patients and the 48 non-DRDC patients, and one between the 48 non-DRDC patients and the remaining non-DRDC patients who were never referred to the program and therefore never scheduled – would yield valuable information about the characteristics of patients who do not follow through on scheduled visits, similar to the findings of a comparison between non-DRDC patients who did or did not complete A1c testing. Since the focus of this study was on patients eligible for DRDC and were either seen or not, rather than patients referred to DRDC or not, it is

recommended that further analysis looking at the additional comparisons be undertaken in the future.

The high level of significance resulting from the comparison between the number of DRDC appointments by patients who were referred and completed appointments with those who were referred but did not complete any appointments is most likely due to the huge discrepancy in sample sizes. There were only 93 DRDC subjects compared to 1565 non-DRDC subjects. Additional findings show that the 93 DRDC patients had an average of 2.5 visits with DRDC during the 8 month post index discharge period (225 completed appointments divided by 93 patients), indicating that in less than 3 visits with DRDC practitioners, it was possible for patients to significantly improve their A1c levels, as was described earlier. This suggests that even brief intervention with an intermediate diabetes care clinic like DRDC can make a large impact on glycemic control for less controlled diabetic patients. With regards to the breakdown of DRDC provider us, it is evident that visits with the advanced registered nurse practitioner (ARNP) was crucial to the program considering 63% of all visits during the study period were with this provider.

An intriguing finding related to DRDC activity was the length of time from the date of discharge to the first scheduled appointment in comparison to the length of time to the first scheduled and missed appointment. The results indicate that for patients who completed at least one visit, appointments were being scheduled as early as 20 days from date of discharge (and being missed), but it was taking an average of 63 days for patients to actually be seen in the clinic. Consultation with the DRDC team revealed that during the study period, the procedures used in scheduling patients was flawed. Patients were required to make an appointment that included a visit with all three of the practitioners on the same day. Because ARNP visits were most often sought, the lack of availability of these appointments made it difficult to schedule DRDC patients soon after their inpatient discharge. According to the team, it was not unusual for patients to wait over 3 weeks before securing an appointment. If patients missed their first scheduled appointment, the wait time for another open appointment was even longer.

It is also possible that some patients who were not referred to DRDC during their index admission, had a second hospitalization during the study period (that would have been captured as a readmission) and were referred at that time. Data extracted did not include information on delayed referrals, so it is not possible to know if this situation occurred frequently enough to affect the lag time between index discharge to a completed DRDC appointment.

An important to note to make is that the significance level obtained with the results for the mean number of days from post index discharge to first scheduled appointment was not based on an assumption of equal variances, as explained in the Results section, so caution should be exercised when interpreting these results. When outliers were not included in the analysis, the adjusted results indicate that the majority of patients were actually scheduled within 100 days from date of index discharge. For patients who completed at least one visit (the DRDC group), the average number of days from discharge to the first scheduled and completed visit was only 29 days, as opposed to the 63 days reflected by data with outliers included. These results suggest that both the referral and scheduling process for DRDC appointments may still benefit from an adjustment in order to avoid missed patient referrals and reduce wait times for initial visits.

CHAPTER 6

SUMMARY

This process evaluation has provided useful information about the role that DRDC plays in the transition of diabetes care for adults recently discharged from inpatient stay at Harborview Medical Center, and the characteristics of patients who were referred to the program and seen. The DRDC program is representative of the "intermediate diabetes care" model found in other settings which aim to ease the transition of patients out of the hospital during the period before seeing an outpatient primary care provider, through the provision of care coordination and a range of diabetes services. [38, 39]

Findings from this study indicate that DRDC providers were successful in identifying and targeting those who clinically were most in need – patients with worse or less stable glycemic control (average A1c of 11.6%), and those initiated on insulin therapy during inpatient stay or at discharge who would benefit from close follow-up after discharge. They also succeeded in meeting the program goal of improving outpatient follow-up with a primary care provider post DRDC discharge for their patients. Compared to pre-admission frequencies, contact with primary care providers post discharge for DRDC patients increased from 32 to 68 percent.

From a public health point of view, the DRDC program addresses the issue of health disparities by providing "equitable" access to care by successfully serving a "high need" subgroup of patients with access barriers. General results from this study indicate that although DRDC and non-DRDC patients shared a similar make-up and were predominantly middle-aged, white males living within 10 miles of the medical center, they differed greatly in that the majority of DRDC patients depended on charity to pay for medical costs, had worse glycemic control prior to being admitted (average A1c of 11.6%), and had higher utilization of health services post index discharge. Overall, DRDC patients had a higher prevalence of poverty and lack of insurance, which is correlated with worse health in the literature.

In general, the DRDC model of brief intervention at a critical moment post discharge of a major illness is one effective way to improve glycemic control and ensure primary care services to a vulnerable group. With as little as 3 visits in an 8 month period, A1c levels of DRDC participants dropped an average of 2.5%.

In addition to revealing the performance of the DRDC program, this evaluation also found areas for improvement. First, the results showing that both study groups were comprised of predominantly middle-aged males suggest the need for more

effective targeting of this population and the development of measures to improve diabetes self-care management and adherence to recommended interventions for this group. Second, with only 40% of DRDC patients and 7% of non-DRDC patients completing both pre-admit and post discharge A1c testing at Harborview, it would seem useful to devise a more consistent way to track or record A1c testing, preferably including those completed outside of the HMC system. One possibility is the use of "cards" similar to those used for recording blood pressures which patients can carry with them at all times. Having a record of A1c testing and results could improve the ability of providers to evaluate the effectiveness of their interventions especially when comparing pre-post DRDC values.

A third recommendation is to suggest that HMC put in place a process that more pro-actively targets those patients referred to DRDC who miss their appointments (like the 48 patients in the study who were scheduled but did not complete any visits). This may include better tracking measures post discharge for patients identified as DRDC candidates, increased efforts to educate potential DRDC patients before discharge on the value of the program, and reaching out to these patients by phone or email during the time between discharge and their first appointment with DRDC.

This latter measure can also serve the purpose of providing additional support that recently discharged diabetic patients may need to avoid unnecessary ED visits during the critical "in between" time after discharge and before contact with either DRDC or a PCP. Access to phone or email assistance for at least 3 months after discharge may be the most crucial as this is the time period in which most patients were seen in ED post index discharge in this study. Considering free cell phones are now available for those with low-income or on state assistance, this measure may be more feasible than before. It may also be useful to ensure that patient education during this time addresses common concerns that may occur immediately after discharge and provides patients with information on how and where to obtain non-ED services during this "in between time." One final and related measure would be to reduce the lag time between discharge and the initial contact with DRDC providers by improving scheduling procedures so appointments are available sooner.

Results of this study point to the need for additional research on the transition of diabetes care at HMC. Particularly useful would be a chart review of patients seen in ED to better understand the nature of diabetes-related issues that lead to seeking ED care. This may shed light on the unexpected finding that DRDC patients experienced more diabetes-related ED visits than non-DRDC patients post discharge.

Also, it is likely that two sets of comparisons would yield valuable information about the characteristics of patients who do not follow through on scheduled visits, and ways to better monitor or reach this group – one between the 93 DRDC patients and the 48 non-DRDC patients with no completed visits, and one between the 48 non-DRDC patients and the remaining non-DRDC patients who were never referred to the program and therefore never scheduled.

Finally, as this study was only a process evaluation, future studies looking at actual impacts of the DRDC program would be beneficial.

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