

## COMPREHENSIVE DIABETES MANAGEMENT PROGRAM (CDMP)

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### ABSTRACT

The Comprehensive Diabetes Management Program (CDMP) is a web-based diabetes medical informatics tool developed by a consortium of researchers, physicians, and educators specializing in diabetes and its management. The overall goal behind the development of the CDMP is to provide an interactive, web-based clinical tool for care managers to efficiently manage and coordinate appropriate care for diabetic patients and to encourage patient behavior changes. The CDMP focuses on patient behavior change as the catalyst for improved outcomes. To achieve this goal, CDMP has two very distinct user interfaces: the first for providers and care managers (referred to as CDMP) and the second for direct patient access which incorporates the CDMP patient access portal (referred to as DMEverywhere). The CDMP is being used in 12 organizations and data are currently being collected for studies of clinical efficacy and cost efficiency.

### KEY WORDS

Diabetes, chronic disease management, web-based clinical tool, care coordination, decision support, and medical data aggregation

### 1. Introduction

The CDMP is a web-based diabetes case management tool developed by a consortium of researchers, physicians, and educators specializing in diabetes and its management. The consortium is drawn from the Telehealth Research Institute (University of Hawaii School of Medicine), the Department of Defense Walter Reed Army Medical Center, Veterans Health Affairs (Boston Veterans Hospital), the Indian Health Service (IHS), and the Joslin Diabetes Center. The overall goal behind the development of the CDMP is to provide an interactive, web-based clinical tool for care managers to efficiently manage and coordinate appropriate clinical care for their diabetes patients, to address patient barriers to self-care, and to involve patients in their care and self-management. Unlike many other diabetes health

information technology (HIT) solutions, CDMP focuses on patient engagement as the catalyst for improved outcomes.

The CDMP has two user interfaces: the first for providers and care managers (referred to as CDMP); and the second for direct patient access (referred to as DMEverywhere). The CDMP is intended to: provide an automatic system to foster continuous care and HIPAA compliant secure communication among patients and providers; insure that the latest clinical guidelines (as identified by the American Diabetes Association) are used in the care; and focus on clinical outcomes, education, and patients' barriers and successes in their self-care, rather than just clinical outcomes, as is usually the case in diabetes care. In the CDMP case management model, the care manager is the key coordinator between patients and the health care team that includes MDs, NPs, educators, subspecialists, nutritionists, and behavioral clinicians.

The standard clinical care for a patient with diabetes typically follows a pattern similar to that outlined below:

- 1) Patient assessment by review of medical records, lab reports;
- 2) Referral of patient needing immediate medical care for non-diabetic problems to his/her primary care provider (PCP) or identification of a PCP for any patient who does not have one;
- 3) Assessment of the physical, psychological, and learning status of the patient (via formal or informal interviewing techniques and/or exams);
- 4) Preparation and maintenance of a treatment plan for the patient, with an emphasis on patient self-management;
- 5) Referral of the patient to consultants (e.g. ophthalmology, nephrology) as needed;
- 6) Referral of the patient to diabetes education services, including classes, booklets, and other media;
- 7) Ongoing follow-up and feedback to the patient and treatment providers.

By contrast, the CDMP was designed to contribute to the standard clinical process by:

- 1) Generating red, yellow, and green alerts for the care manager or provider, all of which are based on a risk assessment algorithm and ADA diabetes management guidelines;
- 2) Providing clinical assessment, notification, and communication tools;
- 3) Providing a clinical risk assessment based on subspecialty diagnoses such as heart disease or eye complications;
- 4) Providing an assessment of patient barriers to self-care (including social support, finances, mood, etc.)
- 5) Tracking availability and patient use of educational resources that are site and user specific;
- 6) Summarizing patient knowledge and the impact of educational interventions;
- 7) Providing dynamic care planning which is done with the patient and targets physical wellness, lifestyle self-management, and psychosocial health (incorporating information from the clinical and self-care assessments);
- 8) Connecting with the health organization's health information system or available electronic data (with provisions for client and medical records privacy).

The application has undergone human factors and usability analyses, the results of which have been incorporated into the application.

## **2. Provider Care Manager Interface (CDMP)**

CDMP is designed for implementation in a wide range of clinical settings, including those with and without Electronic Medical Record (EMR) systems.

CDMP is designed to be superimposed functionally and integrated into a health care institution's unique Electronic Medical Records (EMR) system. CDMP automatically downloads patient data from the institution's EMR into a dedicated CDMP analysis server. Downloaded data can include patients' vital signs, procedures, laboratory reports, medications, procedures, diagnoses, and admissions, among other things. The CDMP inserts the newly downloaded data into the appropriate patient medical records, automatically updating the care provider's information.

When no EMR is present, however, the CDMP can still be used. In this scenario, the CDMP patient data is collected manually (i.e., on paper) and the data are entered into the system. Then all of the care management functions are activated as if the CDMP were integrated with an EMR. Additionally, for small clinics, the CDMP serves double duty as a basic patient data repository.

CDMP generates "alerts" when a patient has experienced a specific health event or when the results from a patient's test exceed a pre-determined clinical threshold. Alerts are presented to the care manager/provider on his/her home page when next s/he logs into CDMP. The alerts indicate "high risk" to the patient, "moderate risk", or "low risk" to the patient, based on current ADA clinical guidelines and other guidelines already comprising standard operating procedures (SOPs) for the health care institution. The alerts are red (high risk), yellow (medium risk), and green (low risk) icons. Selecting the alert icon activates search options specific to the patient; e.g., demographic data, medication list, laboratory results, the event or result that generated the alert, available options for the care plan, and follow-up actions. These are displayed with a pull-down menu from which the care manager/provider can select various actions to be taken in response to the alert.

The CDMP also provides an overall clinical risk stratification of each patient. The stratification indicates whether and how the patient is above or below established goals in the areas of glycemic control, nephropathy, peripheral vascular disease, peripheral neuropathy, and retinopathy. Together with the care manager's/provider's knowledge of his/her patient, the risk stratification allows the care manager/provider to devise an individualized care plan that includes recommendations regarding the patient's goals, lifestyle, monitoring needs, and areas requiring further education. The risk stratification indicates whether patients are "high risk", "moderate risk", or "low risk" based on the Joslin Diabetes Center Clinical Guidelines for Adults with Diabetes. See Figure 1.

The clinical data in the CDMP are augmented with data obtained separately from the CDMP Behavioral Assessment Tool (BAT) and two separate Nutrition Assessment Tools (NAT A and B). The BAT is designed to assess patients' psychosocial characteristics that impact diabetes care. To date, the available case management systems have concentrated principally on clinical issues (e.g., laboratory test results) and have not focused on salient behavioral issues. The BAT contains assessment of the following psychosocial areas: diabetes history, nutrition, physical activity, frequency of self-monitoring of blood sugar levels, medication use, mood, alcohol use, tobacco use, self-perceived health, social support, access to the clinic, education, and other health-related problem areas and personal information. These areas encompass behaviors with respect to three major behavioral categories: physical wellness, lifestyle and self-management, and psychosocial. It is used to create profiles of risk or problems in these three categories, which can then be used by the care manager/provider and patient to make determinations about the care plan (also in the CDMP) and follow-up education.

Figure 1. CDMP Risk Stratification Report

Comprehensive Diabetes Management Program

Home | My HM Data | Status Center | Private Msgs | Search | Help  
JVN | Studies | Add Patient | User Pref | Admin | Log Out

Print

**Detailed Risk Stratification Report: George Lewis**

**Report**

Category	Risk Level	Stratification Detail
Cardiovascular	High	<b>Very High:</b> No Risk Factors <b>High:</b> NOT receiving ASA and >40 years old (ASA not contraindicated), Presence of A/C ratio 30-300 mcg 2 X out of the last 3 tests and NOT receiving ASA if >=30 years old (ASA not contraindicated) <b>Moderate:</b> No Risk Factors <b>Low:</b> No Risk Factors
Foot Disease	Moderate	<b>Very High:</b> No Risk Factors <b>High:</b> No Risk Factors <b>Moderate:</b> No foot exam or foot training within last year <b>Low:</b> No Risk Factors
Glycemic Control	Moderate	<b>Very High:</b> No Risk Factors <b>High:</b> No Risk Factors <b>Moderate:</b> A1C checked less than 2 times/year <b>Low:</b> No incidence of diabetic ketoacidosis (DKA) within the last year, No incidence of nonketotic hyperosmolar state within the last year, No incidence of severe hypoglycemia within the last year
Nephropathy	Very High	<b>Very High:</b> Serum Creatinine > 4.0 <b>High:</b> Positive macroalbuminuria as evidenced by A/C ratio >300 mcg/mg and treated with ACE or ARB <b>Moderate:</b> Positive microalbuminuria (A/C ratio 30-300 mcg/mg 2x out of the last 3 tests) and treated with ACE or ARB <b>Low:</b> No Risk Factors
Retinopathy	High	<b>Very High:</b> No Risk Factors <b>High:</b> No annual eye exam <b>Moderate:</b> No Risk Factors <b>Low:</b> No diabetic retinopathy (DR) or other diabetes-related eye disease

\*A risk level could not be determined from the data provided

Generated Using The Following Data From: 03/28/2007

**A1C**

**Recent Readings:**

1. A1C (Most Recent)	Date: 02/19/2005	Result: 7.3
2. A1C	Date: 11/14/2004	Result: 7.5

**Interventions**

Medication Adjustment       Meal Plan Adjustment       Education Session

The CDMP contains other features intended to assist the care manager/provider in the organization of his/her caseload. For example, the CDMP home page shows the care manager's/provider's daily reminders. The reminders show the patient's name, the type of reminder needed (e.g., clinical assessment, modification of the care plan, etc.), and pertinent details regarding the reminder such as type of action needed. The CDMP home page also shows each day's upcoming appointments. Further, there is an online scheduler within the CDMP that helps care managers to schedule routine appointments. Finally, the CDMP provides the care manager/provider easy access to complete, and/or up-to-date paperless records of each patient in his/her caseload. For each patient, these records include a history of his/her behavioral assessment, a photograph, demographics, and vital signs, medication usage, record of laboratory results, procedures the patient has had, diagnoses, patient admission history, education history, and the results, if performed, of the non-dilated retinal examination using the Joslin Vision Network digital, stereo non-mydratric cameras. See Figure 2.

### 3. Patient Direct Access Interface (DMEeverywhere)

DMEeverywhere is a secure internet portal intended to provide patients with direct access to their personal health information, learning materials offered by their health care institution (with tools to track patient compliance and evaluation of the impact of the educational intervention on patient behavior) and care team communications. Key components of DME include:

1. Biometric data upload with automated, graphical analysis and feedback..
2. Personal Care Plans created in concert with the patients Care Manager.
3. A personalized learning plan, utilizing pre-approved online training materials.
4. Access to data including lab results, medications, procedures and diagnosis.
5. Secure, HIPPA compliant patient/provider electronic private messaging/communications.
6. Automated patient notification, when new data and/or analyses are available.
7. Access to public diabetes discussion and support forums.

Figure 2. CDMP Snapshot

Home | Status Center | Private Msgs | Search | Help
JVW | Studies | Add Patient | User Pref | Admin | Log Out

**Comprehensive Diabetes Management Program**

open all | close all

**Patient Snapshot: Robert Salvo**

**Gender:** MALE      **Diabetes Type:** 1      **Ethnicity:**

**Age:** 59      **Diabetes Onset:** 01/01/1972      **Taking Aspirin:** Yes

**Patient Status Data**

Red Alerts: 2 Open, 2 in last 90 days

Yellow Alerts: 0 Open, 0 in last 90 days

Care Plan: Open Care Plan - Planned End Date: 12/15/2006  
Last Updated: 08/15/2006

Foot Exam: Self-reported as of 02/09/2006

Eye Exam: Self-reported as of 02/09/2006

JVW: 02/07/2006

BAT: 02/09/2006

NAT: 08/15/2006

Procedures: 0 in last 365 days

Admissions: 0 in last 365 days

**Risk Profile (View)**

Blood Sugar  High

Heart Disease  High

Nerve Damage  Medium

Vision Impairment  High

Kidney Disease  High

**BAT Scores (02/09/2006)**

( Summary | Detail )

Smoking 1 (1 - 3)  Low

Psycho-Social 7 (1 - 21)  Low

Physical Wellness 17 (1 - 30)  Medium

Self-Management / Lifestyle 32 (1 - 45)  High

**Educ. Assessment (08/15/2006)**

PsychoSocial Proficient

Pregnancy No Education

Physical Inadequate

Medications Adequate

Monitoring Adequate

Nutrition Inadequate

Goal Setting Inadequate

Acute Complications Proficient

PsychoSocial Inadequate

Pregnancy Inadequate

Chronic Complications Inadequate

Disease Process Inadequate

**Labs and Vital Signs**

Lab	Date	Value/Trend
A1c	07/06/2006	6.2% -
Triglycerides	02/21/2005	163mg/dL
LDL	02/21/2005	127mg/dL
Serum Creatinine	02/22/2005	57mg/dL +
Fasting Glucose	09/13/2004	221mg/dL
Random Glucose	No Results Found	
A/C ratio	02/21/2005	87.9mcg/mg +
Protein on dipstick	01/17/2005	6.6g/dL
Protein in urine	01/17/2005	NEGATIVEN/A
<b>Vital</b>		
Systolic Pressure	07/17/2006	110 -
Diastolic Pressure	07/17/2006	77 -
Height	07/17/2006	65 =
Weight	07/17/2006	178.0 -
BMI	07/17/2006	29.62 -

**Medications last 365 days**

Medication Name	Last Fill Date	Refills Left
METFORMIN HCL	06/01/2006 (prescribed)	5
ACTOS	05/13/2006 (prescribed)	5
GLIPIZIDE	04/07/2006 (prescribed)	5
A.S.A.	03/09/2006 (prescribed)	3

**Diagnosis Listing**

DM w/eye mnfst, type 1

DM w/neuro mnfst, type 1

DM w/renal mnfst, type 1, uncntrl

Hypertension, essential NOS

Hypertension, secondary, benign

Impotence, organic origin

Unknown Diagnosis

**Graph**

**A1c**

Graph only displays data from last 24 months.

Time (months ago)	A1c Value
24	7.8
18	8.1
12	7.2
6	7.4
0 (Present)	6.2


Figure 3. DMEverywhere

DM Everywhere - MyCare Tools - Health Profile - Microsoft Internet Explorer

Address: http://localhost:8080/dme/secure/healthProfile.do?task=get

Google Search Web PageRank 1402 blocked Options

**GLYCEMIC CONTROL RISK**




Your risk for developing complications related to Glycemic Control is HIGH.

This health profile is based on the following factor(s):

- A1c checked < 2 times in 1 year

[What's This Mean?](#) | [View Glycemic Control Health Profile Guidelines](#)

**RETINOPATHY RISK**




Your risk for developing complications related to Retinopathy is HIGH.

This health profile is based on the following factor(s):

- No annual eye exam in past year

[What's This Mean?](#) | [View Retinopathy Health Profile Guidelines](#)

**CARDIAC RISK**



Your risk for developing complications related to Cardiac is HIGH.

This health profile is based on the following factor(s):

Done Local intranet

Comprehensive Diabetes Management Program

Home | My HM Data | Status Center | Private Msgs | Search | Help

JWN | Studies | Add Patient | User Pref | Admin | Log Out

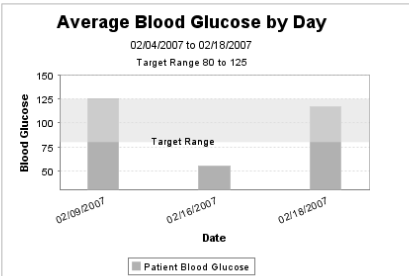
Home Monitoring: George Lewis

Retrieve Data

**Blood Glucose**

Date	Total Daily Readings	Daily Average
02/18/2007	1	117
02/16/2007	1	55
02/09/2007	1	125

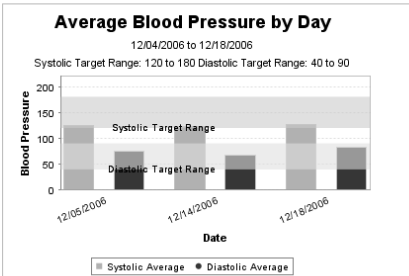
**Average Blood Glucose by Day**  
02/04/2007 to 02/18/2007  
Target Range 80 to 125



**Blood Pressure**

Date	Total Daily Readings	Daily Average
12/18/2006	1	126/82
12/14/2006	1	122/68
12/05/2006	1	124/76

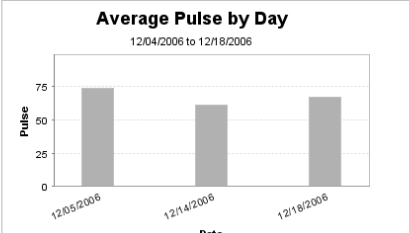
**Average Blood Pressure by Day**  
12/04/2006 to 12/18/2006  
Systolic Target Range: 120 to 180 Diastolic Target Range: 40 to 90



**Pulse**

Date	Total Daily Readings	Daily Average (bpm)
12/18/2006	1	67
12/14/2006	1	61
12/05/2006	1	74

**Average Pulse by Day**  
12/04/2006 to 12/18/2006



**Weight**

There is no weight data to display

open all | close all

When used in combination, these resources allow patients to better understand their condition and modify their behavior accordingly.

#### 4. Reporting

The centralized CDMP database was designed to provide a rich reporting environment for both its end users and diabetes researchers. Users can report on almost any diabetes related performance metric at the provider, group, or implementation level. When used under an approved research protocol, CDMP data from multiple installations is de-identified and sent to a central research data store.

#### 5. Conclusion

The CDMP is being used at the Diabetes Institute at the Walter Reed Army Medical Center (Washington, DC), the VA ViSN-1 (Boston, MA), the Phoenix Indian Medical Center (Phoenix, AZ), Lackland Air Force Base (San Antonio, TX), the Joslin Diabetes Center (Boston, MA), and eight community health centers (MA, SC and HI). It has been subjected to expert review and usability tests. Data is currently being collected for studies of clinical efficacy and cost efficiency.

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