



# Improving Access to an Outpatient Endocrinology Clinic

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# Background

- 14.5% of US adults moderately or severely obese (NHANES 2011 – 2012)
- High risk of chronic diseases
  - Diabetes, hypertension, coronary artery disease
- High cost
  - \$245 billion for diagnosed diabetes (ADA 2012)
  - 1 of 5 health care dollars attributed to diabetes

# Weight Management Program (WMP)

- 2-year program designed by Amy Rothberg, MD
- Partnership with Blue Care Network
- Eligibility
  - BMI  $\geq 32$  kg/m<sup>2</sup> with  
1 or more comorbidities
  - BMI  $\geq 35$  kg/m<sup>2</sup>





# Program Protocol

- Regimented recurrent MD and Registered Dietitian (RD) visits
  - Phase 1: Intensive caloric restriction
  - Phase 2: Weight maintenance
- Strict visit schedule for effectiveness

Before Program	Week of Program (100 Weeks Total)								
	1	2	3	4	5	6	7	8	...
New Patient (MD)	RD	RD	RD	RD				RD	
			MD					MD	

# Challenges of Scheduling

- MDs booked weeks out
- Patients not seen according to protocol



Retrieved from <http://classroomtogo.blogspot.com/2012/07/prefixes-over.html>



Goal

Ensure timely access

**AND**

Provide adequate capacity for patients  
to adhere to the program

# New Opportunity

- Program implementation in primary care clinics
- No current patients
- Designated time blocks







# Solution Approach

- **Patient Template**
  - Set up appointments for entire schedule
  - Remind upcoming appointments at each visit



# Model Assumptions

- New patient appointment is part of template
- MD visit right after RD visit
- Consistent appointment start time



# Schema of Scheduling Problem

Week	1	2	3	4	5	6	7	8	9	10	11	12
8:00 AM		RD	RD	RD	RD				RD			
8:15 AM	NP											
8:30 AM	(MD)		RD	MD RD	RD	RD			MD	RD		
8:45 AM		NP										
9:00 AM		(MD)		RD	MD RD	RD	RD			MD	RD	
9:15 AM			NP									
9:30 AM		RD	(MD) RD	RD	RD	MD			RD		MD	
9:45 AM	NP											
10:00 AM	(MD)		RD	MD RD	RD	RD			MD	RD		
10:15 AM		NP										
10:30 AM		(MD)		RD	MD RD	RD	RD			MD	RD	
10:45 AM			NP									
11:00 AM			(MD)			MD					MD	
11:15 AM												



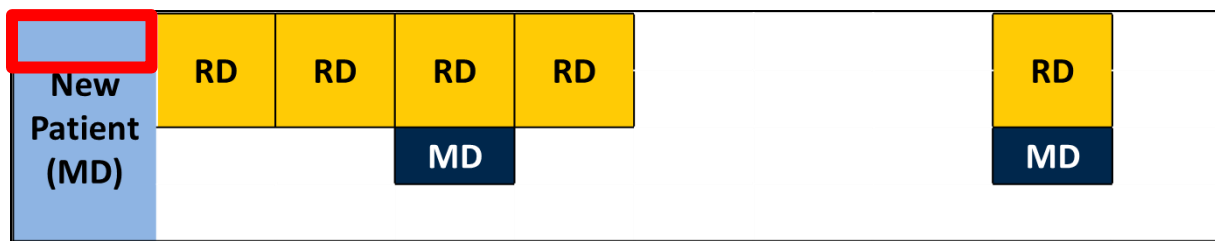
# Model Parameters

$W$	number of weeks in horizon
$D$	number of days in a week
$S$	number of slots in a day
$L$	length of program, in weeks
$P$	number of patients to be scheduled

# Model Parameters

$$\delta_{w_s d_s s_s w_c d_c s_c}^M, \delta_{w_s d_s s_s w_c d_c s_c}^R$$

1 if a patient starts on week  $w_s$ , day  $d_s$ , and slot  $s_s$   
occupies an MD, RD slot on week  $w_c$ , day  $d_c$ , and slot  $s_c$ ,  
0 otherwise



$$c_{w_c d_c s_c}^M, c_{w_c d_c s_c}^R$$

capacity of MD, RD on week  $w_c$ , day  $d_c$ , slot  $s_c$



# Model Variable

$x_{wds}$

1 if there is a patient starting program on week  $w$ , day  $d$ , and slot  $s$ , 0 otherwise

# Model Constraints

A patient has to start program once and only once

$$\sum_{w=1}^W \sum_{d=1}^D \sum_{s=1}^S x_{wds} = P$$

(1)

# Model Constraints (cont'd)

MD and RD capacity

$$\sum_{w_s=1}^{w_c} \sum_{d_s=1}^{d_c} \sum_{s_s=1}^{s_c} \delta_{w_s d_s s_s}^{M/R} x_{w_s d_s s_s} \leq C_{w_c d_c s_c}^{M/R}$$

$$w_c \in \{1..W\}$$

$$d_c \in \{1..D\}$$

$$s_c \in \{1..S\}$$

(2)



# Model Objective Function

Start all patients as soon as possible

$$\mathbf{min} \quad z$$

Maximum starting week

$$wx_{wds} \leq z$$

$$w \in \{1..W\}$$

$$d \in \{1..D\}$$

$$s \in \{1..S\}$$

(3)



# Relaxation of Assumptions

- Separate new patient appointment and patient template
- Separate MD and RD appointments
- Allow deviation in appointment time



# Next Steps

- Develop scheduling guideline
  - Cover withdrawal, cancellation, and no-show
- Develop training materials
- Provide training to schedulers



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# THANK YOU!

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