[DRAFT IN PROGRESS] Managing Irritable Bowel Syndrome Through Lightweight, Daily Tracking

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***Abstract*—Irritable bowel syndrome (IBS) is a multifaceted syndrome with generally unknown etiology with few exceptions. It primarily manifests itself through one or more symptoms of chronic diarrhea, constipation, and abdominal pain. Generally, it is a diagnosis of exclusion after the patient has had a comprehensive workup. In this paper, we show how the author, the patient, who is a 34 year old male diagnosed with irritable bowel syndrome manifesting through symptoms of abdominal pain and diarrhea, utilizes a smartphone application and spreadsheet to track bowel movements, medication, exercise, and overall functionality to assess treatment efficacy.**

I. Introduction

IBS is a multifaceted syndrome with generally unknown etiology with the exception of the recent work done by Rao [1] and Pimentel [2]. Generally, patients go through a battery of tests and eventually IBS is diagnosed as moreso an exclusion of other, more life threatening conditions such as Crohn's disease or ulcerative colitis. Depits TODO of US population diagnosed with IBS, treating it difficult. Doctors and have many approaches to treatment which include antispasmodics, cognitive behaviour therapy (CBT), altered diet [3], selective serotonin reuptake inhibitors (SSRIs), and tricyclic antidepressants (TCAs). Anecdotal, doctors and patients generally use a try-and-see approach for symptom management akin to contemporary SSRI management [4].

In this study, we seek to quantify symptom severity, bowel habits, and medications in a lightweight manner making daily compliance of record keeping easy and regress on the data to determine what treatments are effective for an N=1 study, i.e. the author. There has been much overlap between etiologies of anxiety and depression with IBS so there is a strong need to have objective evidence to support a particular treatment especially because the placebo effect [5] may be large and the side effect profile of many IBS treatments may add to IBS symptoms themselves [6].

II. Tracking Methodology

The patient uses a simple android application and Google spreadsheet for daily tracking. The android application used is Bowel Move [7] and requires a handful of taps to enter a bowel movement (BM), hereinafter we refer to as simply a movement. Movements time and Bristol Stool Scae [8] are recorded.

The patient keeps log of the following items through a Google spreadsheet:

noitemsep

- AM/PM Health Quality Index (HQI)
- Medication intake as dosage
- Time spent performing cardiovascular exercise
- Body weight

HQI is defined on a 1-4 scale describing how the symptoms manifest themselves as a function of the patients ability to complete his daily wishes and plans (e.g. work, exercise, time with family, etc). HQI has defined levels which are:

Health Quality Index (HQI)	
1	Symptom severity requires medical urgent medical attention (e.g. ED visit)
2	Symptom severity prevents patient from complectly daily wishes (e.g. missed a day of work due to persistent abdominal pain)
3	Symptoms notable but patient is able to cope with symptoms to complete daily wishes (e.g. a stomach ache while at a baseball game which is tolerable and resolves with time)
4	Symptoms are not present.

Medications are recorded as total daily dose. For example, a daily dose of 20mg Nexium bid is entered as 40mg. Time spent performing cardio recorded as total daily time in minutes. For example, a two-hour mountain bike ride is records as 120 minutes. Daily weight is recorded first thing in the morning and entered in pounds.

III. Data Visualization

Bristol Stool Scores (BSS) over the sampling period are shown below.

We are interested in the number of bowel movements outside the 3-5 BSS. We defines these as abnormal movements and wish to minimize their presence. We show their

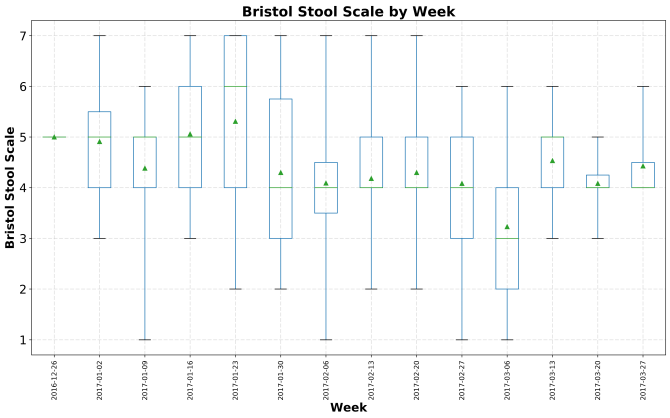

Fig. 1. Bristol Stool Score by Week

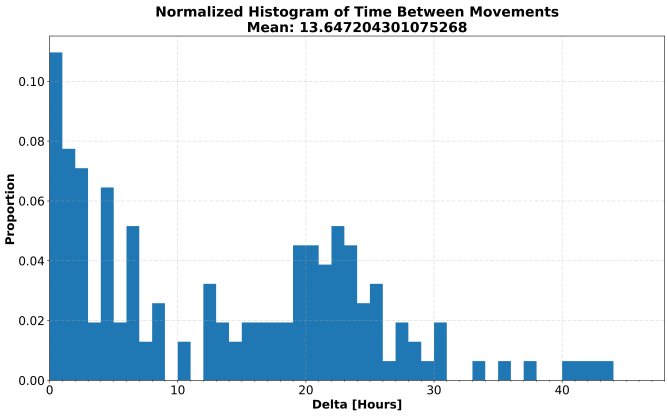

Fig. 3. Distribution of Time Between Bowel Movements

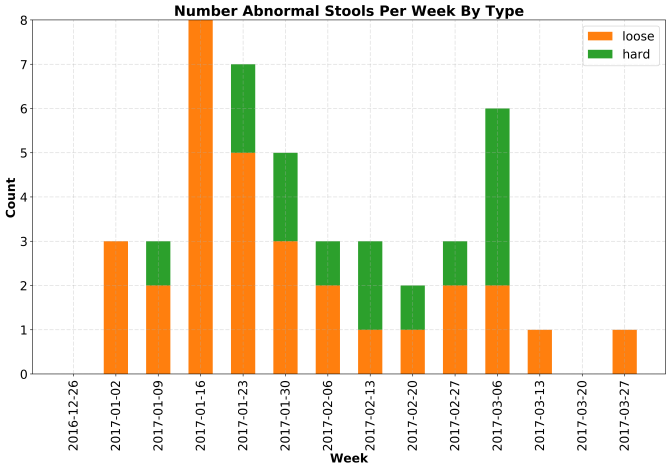

Fig. 2. Abnormal Bowel Movements by Week and Type

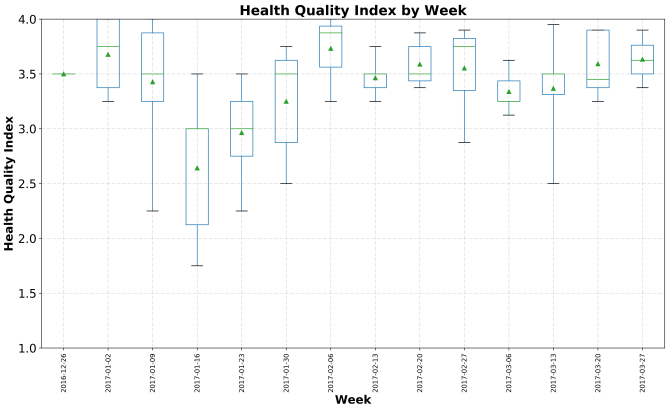

Fig. 4. Health Quality Index by Week

The time between movements we list for completeness below. The plot shows a bimodal distribution and the author believes the left-most peak is characteristic of IBS-D.

Bristol Stool Score (BSS) [TODO cite] of movement.

Health Quality Index plots by week are presented below.

Mean minutes of cardio per week

Mean dosage of medicines per week

Mean daily weight per week

On January 28, 2017, the following laboratory tests were conducted and no anomalies reported. noitemsep

- CBC/Diff
- Renal Function Panel
- H Pylori Antigetn Stool
- C Difficile/EPI, PCR
- Hep Function Panel

On December 13, 2016, Vitamin B12 level was checked and reported normal.

IV. Analysis

A total of TODO days of daily records were recorded which resulted in TODO BMs recorded. The recorded time period is January 1, 2017 to TODO. We perform ordinary least squares regression using the data above to assess how medications and cardio affect HQI and BSS means on two different scales, three days and seven days. Two different time scales are assessed allowing a degree of freedom for the treatments to reach therapeutic level when initiated and washout when discontinued. We define significance for the independent variables as $p <= 0.05$ and denote the significance with an asterisk (*) in the tables following.

With width specified:

TODO Verify and notate that all regression had significant

TABLE I
Regressor: HQI 3-Day Mean

	coef	std err	t	$P > \|t\|$
Intercept	3.177	0.082	38.540	0.000
cardio	-0.074	0.046	-1.606	0.112
nexium	0.169	0.053	3.179	*0.002
librax	0.065	0.034	1.895	0.062
clrtn	-0.097	0.083	-1.163	0.249
vitd	-0.016	0.015	-1.065	0.290
mtmcl	-0.052	0.085	-0.610	0.544

TABLE II
REGRESSOR: HQI 7-DAY MEAN

	coef	std err	t	$P > \|t\|$
Intercept	3.191	0.073	43.786	0.000
cardio	-0.050	0.041	-1.210	0.230
nexium	0.125	0.048	2.580	*0.012
librax	0.070	0.032	2.189	*0.032
clrtn	-0.049	0.073	-0.670	0.505
vitd	-0.011	0.013	-0.858	0.394
mtmcl	-0.066	0.074	-0.885	0.379

TABLE III
REGRESSOR: ABNORMAL EVENTS 3-DAY MEAN

	coef	std err	t	$P > \|t\|$
Intercept	2.385	0.354	6.735	0.000
cardio	-0.087	0.199	-0.437	0.663
nexium	-0.673	0.229	-2.940	*0.004
librax	-0.151	0.148	-1.019	0.311
clrtn	1.212	0.358	3.387	*0.001
vitd	0.011	0.064	0.171	0.865
mtmcl	-0.073	0.364	-0.200	0.842

p-value of f stat.

We regress on the number of abnormal movements occurring three and seven days in the future.

Tables I and I show statistically positive significance for Nexium and Librax intake. This is expected for IBS. However, Clariten-D has a postively significant effect in tables III and **??**. The coefficient is positive meaning and increasein Clariten-D intake results in an increase of abnormal movements – this is not desirable. Simultaneously, Nexium shows a significant decrease in abnormal events. Clariten-D is not significant in tables I and I; therefore, we conclude it does not positively contribute to overall wellbeing.

The administration of Clariten-D was administrated prn during the period Nexium and Librax were administered (which are regularly dosed). The adverse events during this period prompted the author to contact several doctors and described the problem requesting a recourse. All doctors suggested the librax was the main contributor and advised to reduce intake – advise inconsistent with the regression models. The author reduced the Librax as instructed resulting in a slight increase in symptoms. The author then discontinued taking Clariten-d and the symptoms resolved as predicted by the regression model.

TABLE IV
REGRESSOR: ABNORMAL EVENTS 7-DAY MEAN

	coef	std err	t	$P > \|t\|$
Intercept	4.942	0.598	8.259	0.000
cardio	-0.028	0.340	-0.083	0.934
nexium	-1.139	0.397	-2.872	*0.005
librax	-0.224	0.263	-0.850	0.398
clrtn	1.229	0.601	2.044	*0.044
vitd	0.120	0.109	1.104	0.273
mtmcl	-0.123	0.611	-0.202	0.841

CONCLUSION

We demonstrate simple, lightweight daily tracking of medications, exercise, Bristol Stool Scores, and a Health Quality Index can be utilized to manage and reduce symptoms in an N=1 setting. We demonstrate how simple statistical analysis can be used to tailor medical treatment for an individual allowing for the identification and resolution of bowel issues for an IBS patient.

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