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

Isaac D. Gerg
The Pennsylvania State Univeristy
Applied Research Laboratory
State College, PA 16804–0030
Email: idg101@arl.psu.edu

Sameer Dhalla, MD
The Johns Hopkins University School of Medicine
Division of Gastroenterology and Hepatology
Baltimore, MD

***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 first 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. Believed to be $>$15% of the general population diagnosed with IBS [3], treating it difficult. Doctors and have many approaches to treatment which include antispasmodics, cognitive behaviour therapy (CBT), altered diet [4], 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 [5].

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 first 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 [6] may be large and the side effect profile of many IBS treatments may add to IBS symptoms themselves [7].

II. Tracking Methodology

The patient uses a simple android application and Google spreadsheet for daily tracking. The android application used is Bowel Move [8] 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 Scale [9] are recorded. Google spreadsheets are available on most internet connected platforms and smart phones making it easy to find a suitable computer to enter in daily data.

TABLE I
Definition of Health Quality Index

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 not present.

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

- 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 level shown in I.

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 Collection

The data is collected from January 1, 2017 through April 9, 2017. A total of ninety-nine days of daily records were recorded which resulted in TODO movements recorded. Record keeping compliance exceeds 99%. On January 28, 2017, the following laboratory tests were conducted and no anomalies reported.

- CBC/Diff

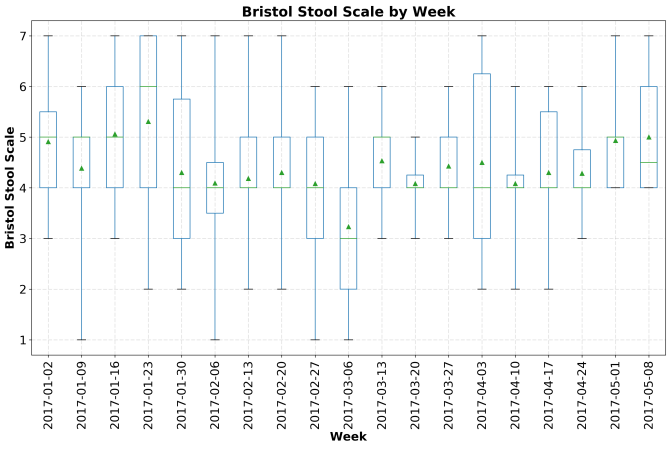

Fig. 1. Bristol Stool Score by week. A score of 3-5 is desirable.

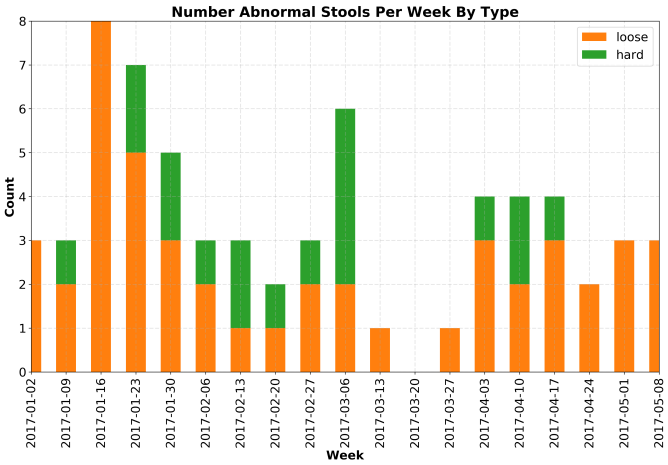

Fig. 2. Abnormal Bowel Movements by week and type.

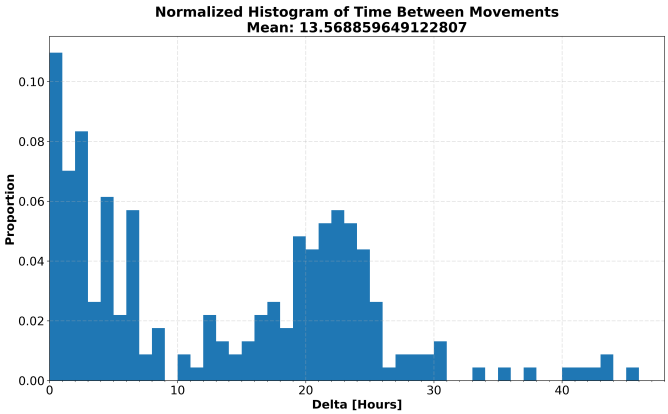

Fig. 3. Distribution of time between bowel movements.

- 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. Four pounds of weight were lost during the study period attributed to diet and regular exercise.

Several medications and an exercise regiment were employed to mitigate the IBS symptoms, mostly abdominal pain and diarrhea. Nexium was prescribed January 28, 2017 20mg bid. Librax was prescribed prior to the study to be taken prn and over the study period was taken on average twice a day, usually first thing in the morning. Vitamin D was self prescribed at a dosage of 5000 IU daily and taken roughly forty percent of the time. Finally, cardiovascular exercise, usually in the form of mountain biking), was performed several times a week and averaged average thirty minutes per day.

As the trial progressed, Claritin-D was added to mitigate seasonal allergies. Claritin-D was self-prescribed and seasonal allergies validated through previous skin-prick tests administered by an Allergist. Claritin-D was taken prn (no more than once a day) before bedtime from January 24, 2017 to March 10, 2017. Metamucil was taken prn from February 12, 2017 to March 16, 2017 to mitigate hard stools which the results of this study are believed to be caused by the Claritin-D.

Bristol Stool Scores (BSS) over the sampling period are shown in Figure 1. We are interested in the number of bowel movements outside the 3-5 BSS. We define these as abnormal movements and wish to minimize their presence. We show their contributions in Figure 2.The time between movements we list for completeness in Figure 3. The figure shows bimodal distribution; the left-most peak is characteristic of the IBS-D subtype. HQI over the sampling period is shown in Figure 4.

IV. Analysis

Ordinary least squares regression using the data above to assess how medications and cardio affect HQI and BSS means on two different future time-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 our dependent variables at a level of $p < 0.05$.

TODO Verify and notate that all regression had significant p-value of f stat.

We regress on the HQI mean three and seven days in the future shown in Tables **??** and **??** respectively. We regress on the number of abnormal movements occurring three and seven days in the future shown in Tables **??** and **??** respectively.

Tables **??** and **??** show statistically positive significance for Nexium and Librax intake. This is expected for IBS. However, Claritin-D has a significant effect in Table **??** and **??** with a positive coefficient meaning and increasing Claritin-D intake results in increased number of abnormal movements – this is not desirable. Claritin-D is not significant in Tables **??** and

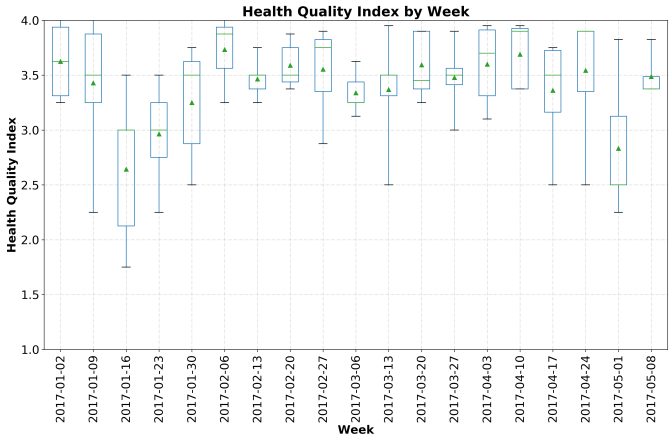

Fig. 4. Health Quality Index by Week.

TABLE II
REGRESSOR: HQI 3-DAY MEAN

Regressor: HQI 3-Day Mean				
	coef	std err	t	p-value
Intercept	3.176	0.080	39.518	0.000
cardio	-0.069	0.045	-1.538	0.128
nexium	0.160	0.052	3.081	0.003
librax	0.060	0.033	1.835	0.070
clrtn	-0.086	0.082	-1.052	0.296
vitd	-0.014	0.015	-0.965	0.337
mtmcl	-0.036	0.083	-0.437	0.663
Regressor: HQI 7-Day Mean				
	coef	std err	t	p-value
Intercept	3.190	0.070	45.439	0.000
cardio	-0.046	0.039	-1.169	0.246
nexium	0.129	0.045	2.837	0.006
librax	0.066	0.029	2.244	0.028
clrtn	-0.051	0.071	-0.713	0.478
vitd	-0.011	0.013	-0.901	0.370
mtmcl	-0.065	0.072	-0.896	0.373

??; therefore, we conclude it does not positively contribute to overall wellbeing. We note Nexium's coefficient shows decrease in abnormal events – the desired outcome during initial prescription to the patient. This effect is most easily seen in Figure 2 as the number of loose movements decreases from the start of January 23, 2017.

The administration of Claritin-D was administrated prn during the period Nexium and Librax were administered (which are regularly dosed). The abnormal stool 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 – advice inconsistent with the regression models. The author reduced the Librax as instructed resulting in a slight increase in symptoms; this was predicted by the model. The author then discontinued taking Claritin-d and the symptoms resolved as predicted by the regression model. This effect is seen in Figures 1 and 2 with the decrease of hard stool beginning the week of March 13, 2017.

TABLE III
REGRESSOR: ABNORMAL EVENTS

Abnormal Events 3-Day Mean				
	coef	std err	t	p-value
Intercept	2.346	0.342	6.864	0.000
cardio	-0.081	0.192	-0.422	0.674
nexium	-0.702	0.221	-3.180	0.002
librax	-0.142	0.139	-1.018	0.312
clrtn	1.237	0.349	3.547	0.001
vitd	0.020	0.062	0.328	0.744
mtmcl	-0.043	0.354	-0.122	0.903
Abnormal Events 7-Day Mean				
Intercept	4.799	0.585	8.208	0.000
cardio	-0.025	0.328	-0.076	0.939
nexium	-1.132	0.378	-2.995	0.004
librax	-0.259	0.245	-1.061	0.292
clrtn	1.309	0.591	2.216	0.030
vitd	0.144	0.106	1.360	0.178
mtmcl	-0.026	0.601	-0.044	0.965

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. We identify in this study a commonly self-prescribed medicine, Claritin-D, and demonstrate it adverse effects on an IBS patient.

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