

A Feasibility Study: Testing Whether a Sleep Application Providing Objective Sleep Data to Physicians Improves Patient-Physician Communication Regarding Sleep Experiences, Habits and Behaviors

Sana Durrani MBBS¹

Sha Cao PhD⁵

Na Bo MS⁵

Jennifer K. Pai, ScD, MHS³

Jarod Baker MS¹

Lori Rawlings BSN, RN, CCRC¹

Zaina P. Qureshi, PhD, MS, MPH⁴

Ninotchka L. Sigua MD²

Shalini Manchanda MD²

Babar Khan MD, MS²

¹Regenstrief Institute, 1101 West 10th street, Indianapolis, IN 46202 USA

²Division of Pulmonary, Critical Care, Sleep and Occupational Medicine, Department of Medicine, Indiana University School of Medicine, 535 Barnhill Drive, Indianapolis, IN 46202, USA

³Merck & Co., Inc. Boston, MA USA

⁴Merck & Co., Inc. Kenilworth, NJ USA

⁵Indiana University, 1050 Wishard Blvd. Indianapolis, IN 46202

Corresponding Author:

Babar Khan, MD, MS

Regenstrief Institute

1101 West 10th Street

Indianapolis, IN 46202

bakhan@iu.edu

APPENDIX A

Table A.1: Study instrument questions mapped to outcome variables

Question	Outcome
Sleep Health questionnaire	
1. In general, how would you rate your sleep quality	Sleep outcome: Sleep quality subindex
2. During the past 7 days, how many days did you wake up feeling well-rested, if any?	Sleep outcome: Sleep quality subindex
3. How many nights did you have trouble <u>falling</u> asleep?	Sleep outcome: Sleep quality subindex
4. How many nights did you have trouble staying asleep?	Sleep outcome: Sleep quality subindex
5. How many days did poor or insufficient sleep significantly impact your daily activities, like your work performance, socializing, exercising, or other typical activities?	Sleep outcome: Sleep quality subindex
6. How many days did you fall asleep without intending to, such as dozing off in front of the TV or in any other situation?	Sleep outcome: Sleep quality subindex
7. How many nights did you take over-the-counter or prescription medication to help you sleep?	Sleep outcome: Disordered sleep subindex
Patient Satisfaction Questionnaire	
1. I am very satisfied with the medical care I receive	General Satisfaction
2. Doctors are good about explaining the reason for medical tests	Communication
3. The medical care I have been receiving is just about perfect	General Satisfaction
4. During my medical visits, I am always allowed to say everything that I think is important	Communication
5. Sometimes doctors use medical terms without explaining what they mean	Communication
6. There are things about the medical system I receive my care from that need to be improved	General Satisfaction
7. There are some things about the medical care I receive that could be better	General Satisfaction
8. Those who provide my medical care sometimes hurry too much when they treat me	General Satisfaction/Time with Doctor – considered G
9. Doctors sometimes ignore what I tell them	Communication
10. All things considered, the medical care I receive is excellent	General Satisfaction
11. Doctors listen carefully to what I have to say	Communication

12. Doctors usually spend plenty of time with me

General
Satisfaction/Time with
Doctor – considered GS

13. I am dissatisfied with some things about the medical care I receive

General Satisfaction

Physician Satisfaction Questionnaire

1. Encouraged the patient to express his or her thoughts concerning his or her health problems

Communication

2. Listened carefully to what the patient had to say

Communication

3. Understood what the patient had to say

Communication

4. If a physical examination was required, explained what was done and why

Communication

5. Discussed treatment options with the patient

Communication

6. Gave the patient as much information as he or she wanted

General Satisfaction

7. Checked with the patient to see if the treatment plan(s) was acceptable

General Satisfaction

8. Explained medications, if any, including possible side-effects

Communication

9. Encouraged the patient to ask questions

Communication

10. Responded to the patient's questions and concerns

General Satisfaction

11. Involved the patient in decisions as much as he or she wanted

General Satisfaction

12. Discussed next steps including any follow-up plans

Communication

13. Checked to be sure the patient understood everything

General Satisfaction

14. Showed care and concern about the patient as a person

General Satisfaction

15. Spent the right amount of time with the patient

General Satisfaction

16. Overall, I was satisfied with my consultation about sleep

General Satisfaction

Table A.2: Study instrument questions with original scoring.

1. In general, how would you rate your sleep quality? (SL-SQ)

- Excellent
- Very good
- Good
- Only fair
- Poor

Scoring: Each response option is essentially converted to a 0-100 scale score. As such, excellent = 100, Very Good = 75, Good = 50, Only Fair = 25, and Poor = 0

2. During the past 7 days, how many days did you wake up feeling well-rested, if any? (SL-SQ)

- 7 Days
- 6 Days
- 5 Days
- 4 Days
- 3 Days
- 2 Days
- 1 Day
- 0 Days

Scoring: Each response option is essentially converted to a 0-100 scale score - 7d = 100, 6d = 86, 5d = 71, 4d = 57, 3d = 43, 2d = 29, 1d = 14, 0d = 0

3. How many nights did you have trouble falling asleep? (SL-SQ)

0 Days

- 1 Day
- 2 Days
- 3 Days
- 4 Days
- 5 Days
- 6 Days
- 7 Days

Scoring: Each response option is essentially converted to a 0-100 scale score - 0d = 100, 1d = 86, 2d = 71, 3d = 57, 4d = 43, 5d = 29, 6d = 14, 7d = 0

4. And how many nights did you have trouble staying asleep? (SL-SQ)

- 0 Days
- 1 Day
- 2 Days
- 3 Days
- 4 Days
- 5 Days
- 6 Days
- 7 days

Scoring: Each response option is essentially converted to a 0-100 scale score - 0d = 100, 1d = 86, 2d = 71, 3d = 57, 4d = 43, 5d = 29, 6d = 14, 7d = 0

5. Still thinking about the past 7 days, how many days did poor or insufficient sleep significantly impact your daily activities, like your work performance, socializing, exercising, or other typical activities? (SL-SQ)

- 0 Days
- 1 Day
- 2 Days
- 3 Days
- 4 Days
- 5 Days
- 6 Days
- 7 days

Scoring: Each response option is essentially converted to a 0-100 scale score - 0d = 100, 1d = 86, 2d = 71, 3d = 57, 4d = 43, 5d = 29, 6d = 14, 7d = 0

6. How many days did you fall asleep without intending to, such as dozing off in front of the TV or in any other situation? (SL-SQ)

- 0 Days
- 1 Day
- 2 Days
- 3 Days
- 4 Days
- 5 Days
- 6 Days
- 7 days

Scoring: Each response option is essentially converted to a 0-100 scale score - 0d = 100, 1d = 86, 2d = 71, 3d = 57, 4d = 43, 5d = 29, 6d = 14, 7d = 0

Score of SQ subscale: Average the 6 items.

7. How many nights did you take over-the-counter or prescription medication to help you sleep? (SL-DS)

- 0 Days
- 1 Day
- 2 Days
- 3 Days
- 4 Days
- 5 Days
- 6 Days
- 7 days

Scoring: Each response option is essentially converted to a 0-100 scale score - 0d = 100, 1d = 86, 2d = 71, 3d = 57, 4d = 43, 5d = 29, 6d = 14, 7d = 0

***The DS subscale is usually scored with 2 other items (if respondent has a sleep disorder and if the respondent has discussed sleep problems with their doctor). The answers to both of these remaining questions for the purposes of this study are likely, yes (=0). We may not want to produce the overall DS score, however, and just be able to report out in general the direct response to the question (#7), which is of interest by itself.*

Patient Satisfaction:

Thinking about your sleep care specifically:

- I am very satisfied with the medical care I receive (PSQ3, GS):

Strongly agree	Agree	Uncertain	Disagree	Strongly Disagree
1	2	3	4	5
- Doctors are good about explaining the reason for medical tests (PSQ6, C):

Strongly agree	Agree	Uncertain	Disagree	Strongly Disagree
1	2	3	4	5
- The medical care I have been receiving is just about perfect (PSQ11, GS):

Strongly agree	Agree	Uncertain	Disagree	Strongly Disagree
1	2	3	4	5
- During my medical visits, I am always allowed to say everything that I think is important (PSQ13, C):

Strongly agree	Agree	Uncertain	Disagree	Strongly Disagree
1	2	3	4	5
- Sometimes doctors use medical terms without explaining what they mean (PSQ18, C):

Strongly agree	Agree	Uncertain	Disagree	Strongly Disagree
1	2	3	4	5
- There are things about the medical system I receive my care from that need to be improved (PSQ21, GS):

Strongly agree	Agree	Uncertain	Disagree	Strongly Disagree
1	2	3	4	5
- There are some things about the medical care I receive that could be better (PSQ33, GS):

Strongly agree	Agree	Uncertain	Disagree	Strongly Disagree
1	2	3	4	5

8. Those who provide my medical care sometimes hurry too much when they treat me (PSQ35, **TD/GS**):

Strongly agree	Agree	Uncertain	Disagree	Strongly Disagree
1	2	3	4	5

9. Doctors sometimes ignore what I tell them (PSQ38, **C**):

Strongly agree	Agree	Uncertain	Disagree	Strongly Disagree
1	2	3	4	5

10. All things considered, the medical care I receive is excellent (PSQ42, **GS**):

Strongly agree	Agree	Uncertain	Disagree	Strongly Disagree
1	2	3	4	5

11. Doctors listen carefully to what I have to say (PSQ43, **C**):

Strongly agree	Agree	Uncertain	Disagree	Strongly Disagree
1	2	3	4	5

12. Doctors usually spend plenty of time with me (PSQ46, **TD/GS**):

Strongly agree	Agree	Uncertain	Disagree	Strongly Disagree
1	2	3	4	5

13. I am dissatisfied with some things about the medical care I receive (PSQ49, **GS**):

Strongly agree	Agree	Uncertain	Disagree	Strongly Disagree
1	2	3	4	5

Scoring: All questions highlighted, need to be reverse coded at the time of scoring – so, a response of 1 will be recoded to 5, 2 recoded to 4, 3 remains 3, 4 recoded to 2, and 5 recoded to 1. Each scale score is summed (e.g., Sum all of the 6 GS questions, range: 6-30). Scale scores can then be transformed linearly to a 0-100 possible range (e.g., $6=0$, $30 = 100$, unit increase = 4.167).

Focus on agreement (Strongly agree, agree, Indifferent, Disagree, strongly D) or frequency (Always Often Sometimes rarely never)

App Satisfaction:

1. I am satisfied with the way the app works.
2. I feel that the sleep app provides helpful or useful information.
3. I pay more attention to my sleep since using the app.
4. I feel more connected to my physician by using the app.
5. The app is easy to use.

Physician Satisfaction/Communication

1. Encouraged the patient to express his or her thoughts concerning his or her

health problems (C)						
Strongly agree	Agree	Uncertain	Disagree	Strongly Disagree		
1	2	3	4		5	
2. Listened carefully to what the patient had to say (C)						
Strongly agree	Agree	Uncertain	Disagree	Strongly Disagree		
1	2	3	4		5	
3. Understood what the patient had to say (C):						
Strongly agree	Agree	Uncertain	Disagree	Strongly Disagree		
1	2	3	4		5	
4. If a physical examination was required, explained what was done and why (C):						
Strongly agree	Agree	Uncertain	Disagree	Strongly Disagree		
1	2	3	4		5	
5. Discussed treatment options with the patient (C):						
Strongly agree	Agree	Uncertain	Disagree	Strongly Disagree		
1	2	3	4		5	
6. Gave the patient as much information as he or she wanted (GS):						
Strongly agree	Agree	Uncertain	Disagree	Strongly Disagree		
1	2	3	4		5	
7. Checked with the patient to see if the treatment plan(s) was acceptable (GS):						
Strongly agree	Agree	Uncertain	Disagree	Strongly Disagree		
1	2	3	4		5	
8. Explained medications, if any, including possible side-effects (C):						
Strongly agree	Agree	Uncertain	Disagree	Strongly Disagree		
1	2	3	4		5	
9. Encouraged the patient to ask questions (C):						
Strongly agree	Agree	Uncertain	Disagree	Strongly Disagree		
1	2	3	4		5	
10. Responded to the patient's questions and concerns (GS):						
Strongly agree	Agree	Uncertain	Disagree	Strongly Disagree		
1	2	3	4		5	
11. Involved the patient in decisions as much as he or she wanted (GS):						
Strongly agree	Agree	Uncertain	Disagree	Strongly Disagree		
1	2	3	4		5	
12. Discussed next steps including any follow-up plans (C):						
Strongly agree	Agree	Uncertain	Disagree	Strongly Disagree		
1	2	3	4		5	
13. Checked to be sure the patient understood everything (GS)						
Strongly agree	Agree	Uncertain	Disagree	Strongly Disagree		
1	2	3	4		5	
14. Showed care and concern about the patient as a person (GS):						
Strongly agree	Agree	Uncertain	Disagree	Strongly Disagree		
1	2	3	4		5	

15. Spent the right amount of time with the patient (GS):

Strongly agree	Agree	Uncertain	Disagree	Strongly Disagree	
1	2	3	4	5	

16. Overall, I was satisfied with this consultation today (GS):

Strongly agree	Agree	Uncertain	Disagree	Strongly Disagree	
1	2	3	4	5	

Key:

GS: General Satisfaction

C: Communication

SL: Sleep Outcomes

SQ = Sleep Quality Subindex

DS = Disordered Sleep Subindex

TD: Time with doctor

APPENDIX B

Note that for a patient the measurement may not be on a daily basis, meaning not all of the dates were consecutive.

For each person, NAs were assigned for the non-consecutive dates for all variables. Taking 7 days as a week, each daily measurement was assigned week numbers starting from 1, from earliest date to the last date. The total number of weeks for each patient varied, depending on how many days his or her measurements were recorded by the Fitbit device.

For each variable, for each patient, the means of each measured variable were calculated for each week, if that week had at least one record; otherwise, NA was assigned. This calculation was done for week 1 through week 32, for each patient and each variable. There are 7 plots altogether displayed as Figures B.1-B.7 below. Each plot is for each of the 7 variables of interest. The mean (height of the bar) and the standard deviation (the error bar) for the control (orange) and intervention (blue) groups are shown. The mean of patients' weekly means is shown, except for those weeks with less than 3 patients.

Figure B.1: Plot showing how long the patients slept for, in minutes

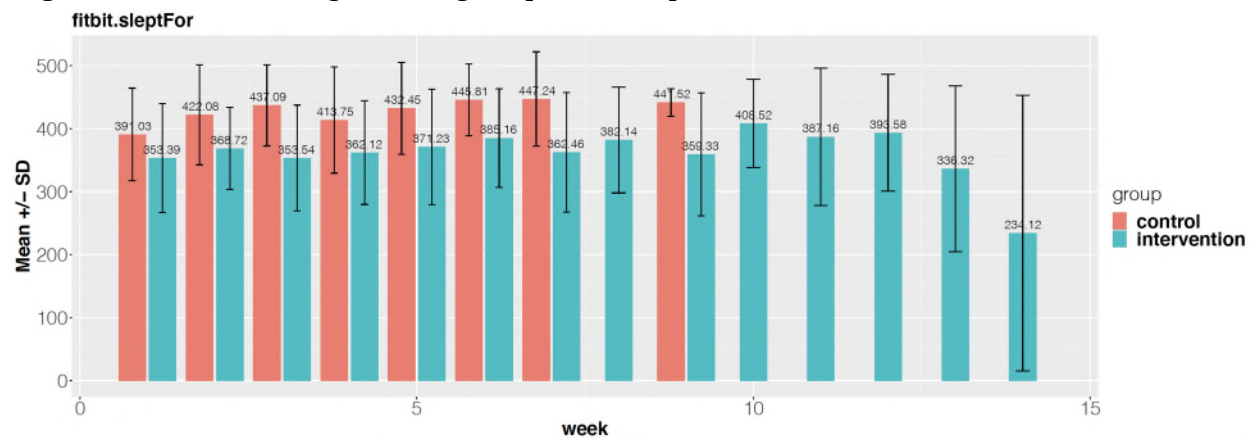


Figure B.2: Plot showing how long the patients spent in bed in total, in minutes

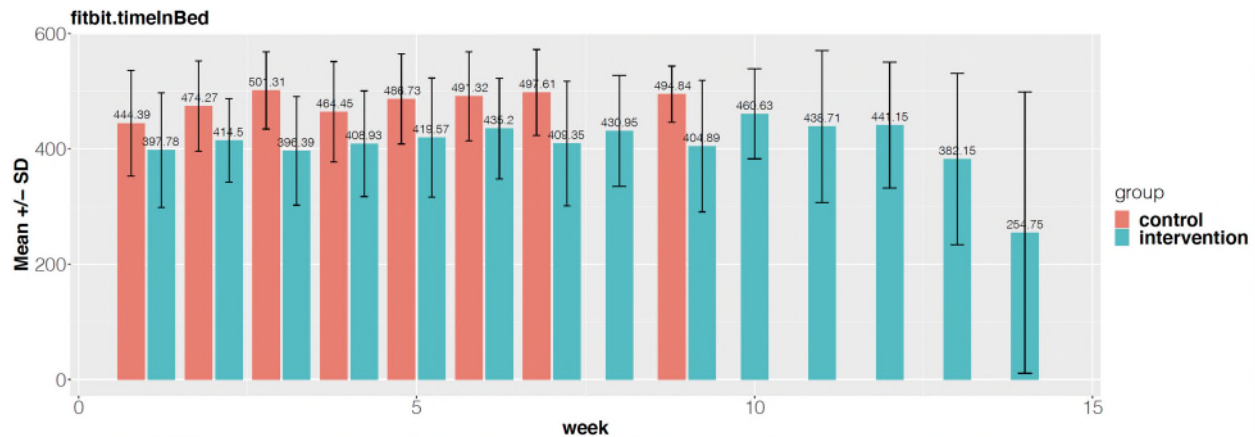


Figure B.3: Plot showing how long the patient spent in bed before falling asleep, in minutes

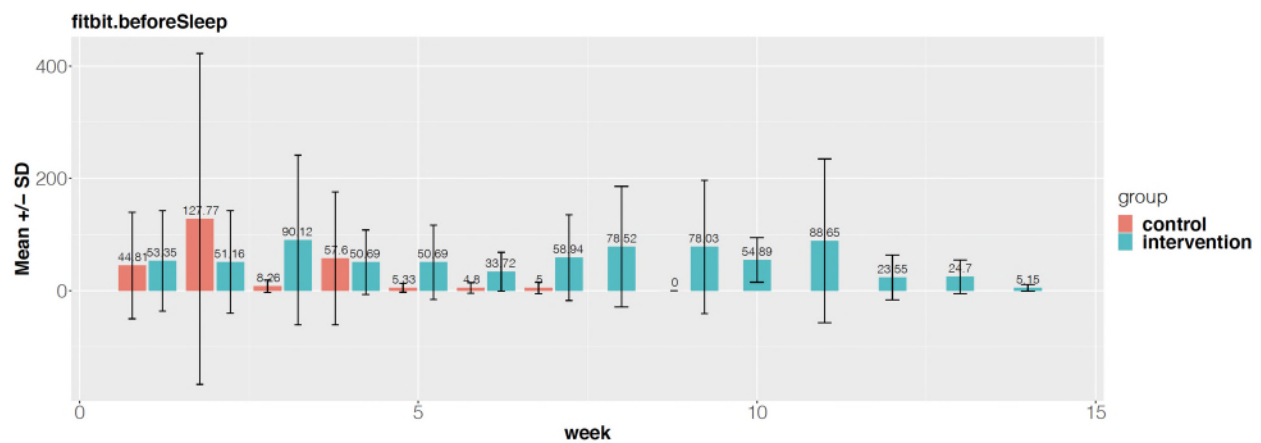


Figure B.4: Plot showing the number of times the patient woke up after falling asleep

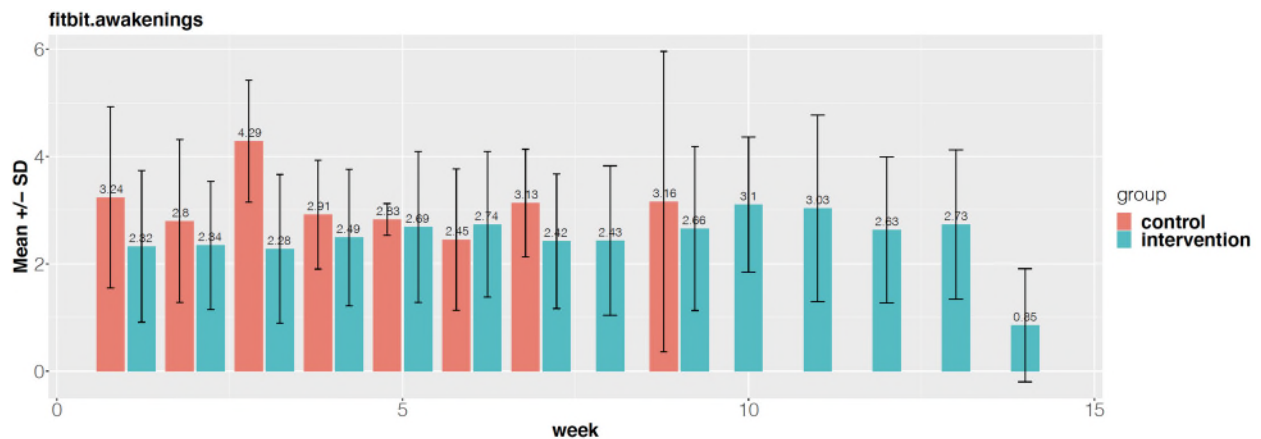


Figure B.5: Plot showing the amount of time the patient spent awake after falling asleep, in minutes

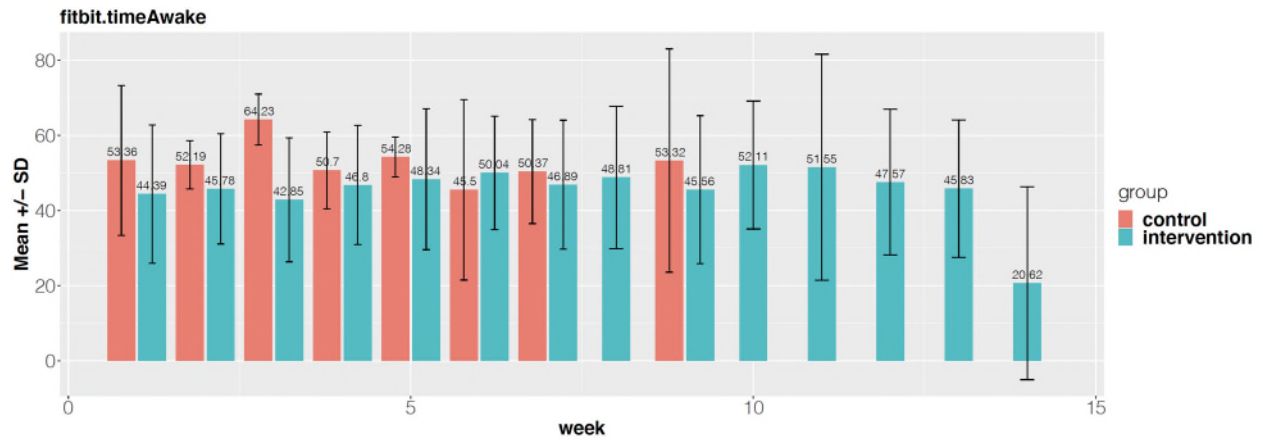


Figure B.6: Plot showing the efficiency of patients sleep

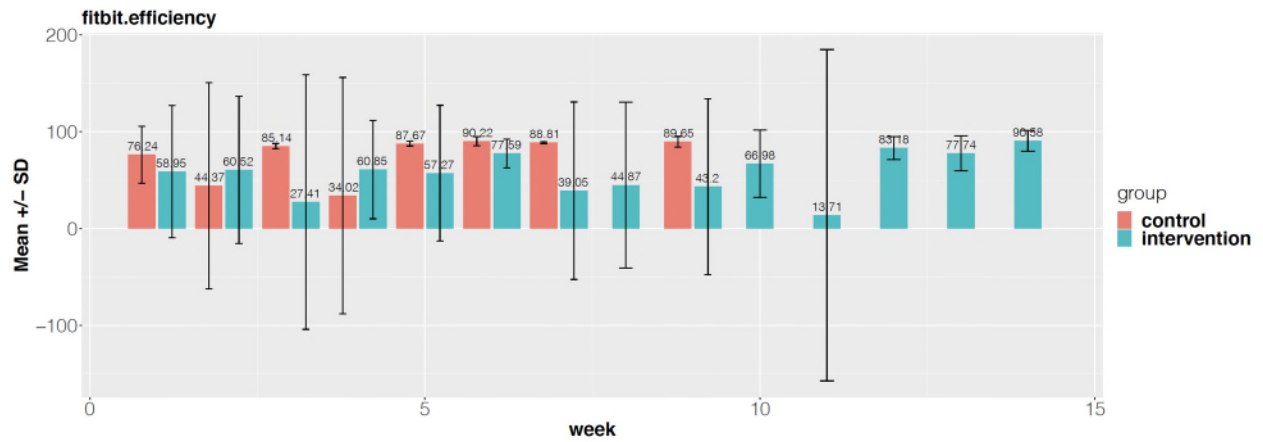


Figure B.7: Plot showing what percentage of time the patient spent awake in bed (time awake/time in bed * 100)

