The Effect of Predicted Hemoglobin Trajectories on Dialysis Patients

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- Introduction and Background
- Data
- Client's Questions
- How to summarize ESA Dose
- Concerns
- Group Discussion
- Our suggested approach

Introduction & Background:

Background:

- Patients with end stage renal disease induced anemia
- Medicare pays flat rate per dialysis patient
- Hemoglobin fluxuates

Research:

- Track EPO dosing of patients
- Track hemoglobin concentration
- Track proteins related to anemia

The Data:

- 24 patients out of the 930 in UVA dialysis system
- From one of the eleven UVA clinics across Virginia
- Data collected over 20 months (10 pre-recommendations, 10 post)

Variables:

- Patient ID
- Month, Year, Week
- Gender, Race, Age
- Diabetic Status

- Dialysis Vintage
- IRON
- PSAT
- Ferritin

- Hemoglobin
- EPO_Dose
- Post Intervention

New Variables:

- **Iron**: blood iron level
- **PSAT**: percent saturation of transferrin
- **FERITIN**: amount in blood(many missing values)

- **Diabetic**: 0 - no, 1 - yes
- **Gender**: Male or Female
- **Race**: White or Black
- **Age**: in years at start of intervention
- **Dialysis_Vintage**: how long the person has been on dialysis (in units of quarters - 1 month is 3 quarters)

Correlated?
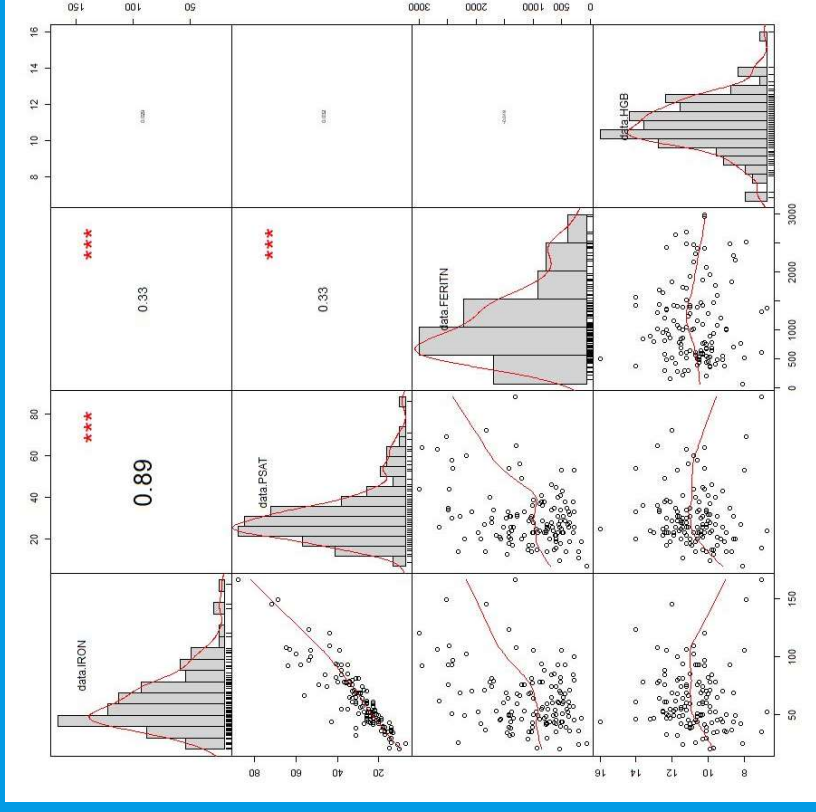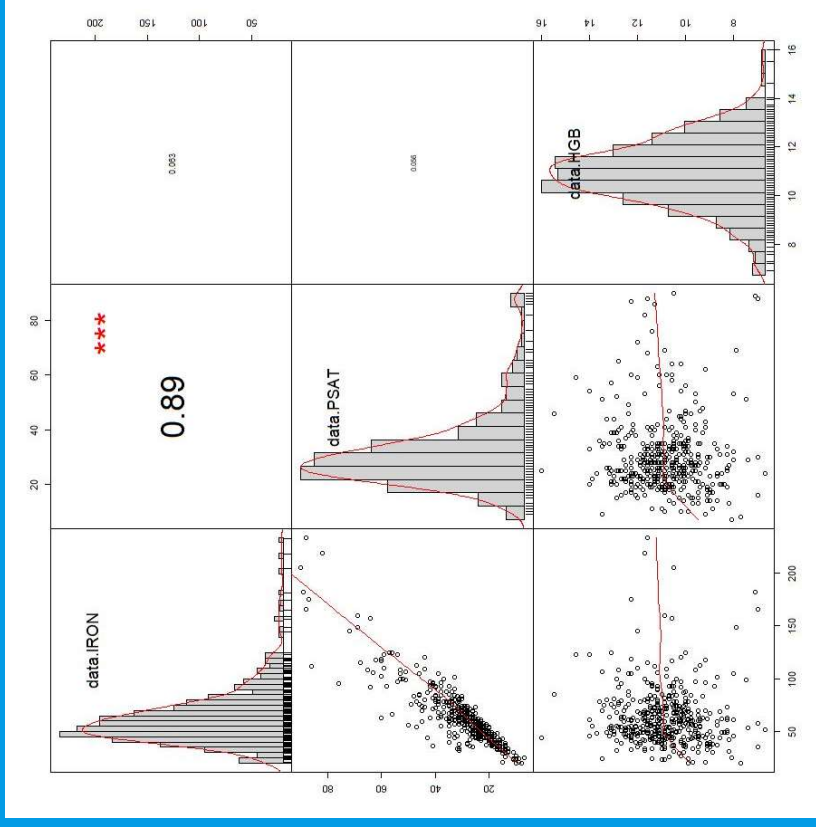
Focus on HGB -- Summary Statistics

	stat.desc.prior.HGB.
nbr.val	232.00000000
nbr.null	0.00000000
nbr.na	0.00000000
min	6.70000000
max	16.00000000
range	9.30000000
sum	2517.00000000
median	10.90000000
mean	10.84913793
SE.mean	0.09654618
CI.mean.0.95	0.19022364
var	2.16251008
std.dev	1.47054754
coef.var	0.13554511

	stat.desc.post.HGB.
nbr.val	214.00000000
nbr.null	0.00000000
nbr.na	0.00000000
min	7.00000000
max	14.00000000
range	7.00000000
sum	2332.80000000
median	10.90000000
mean	10.90093458
SE.mean	0.09156422
CI.mean.0.95	0.18048809
var	1.79417753
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coef.var	0.12287654

Different Factors? - Percent of Time in Range
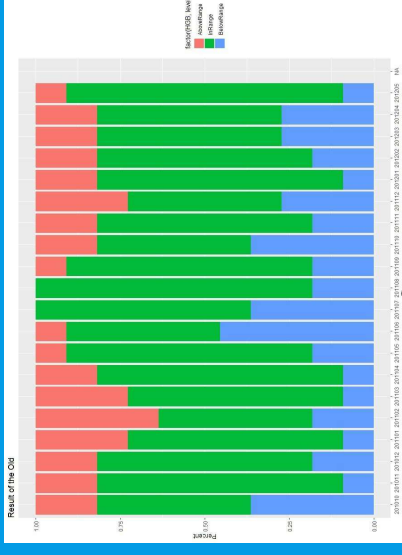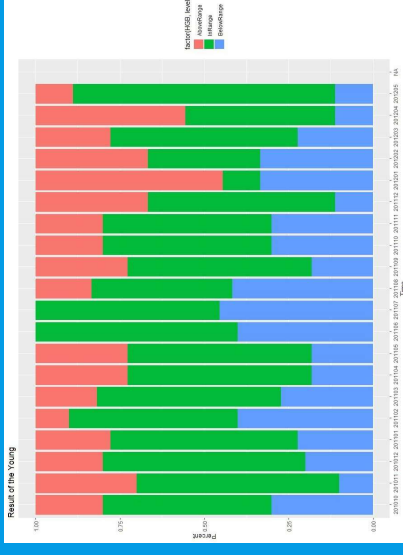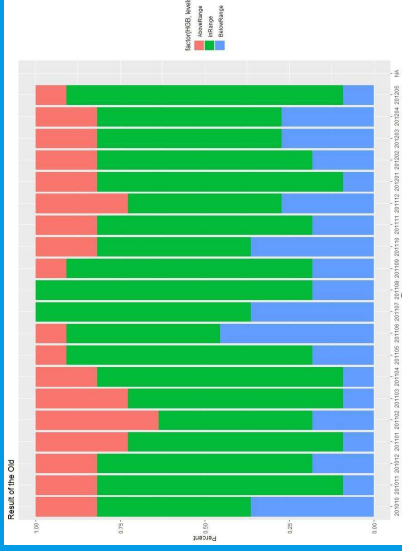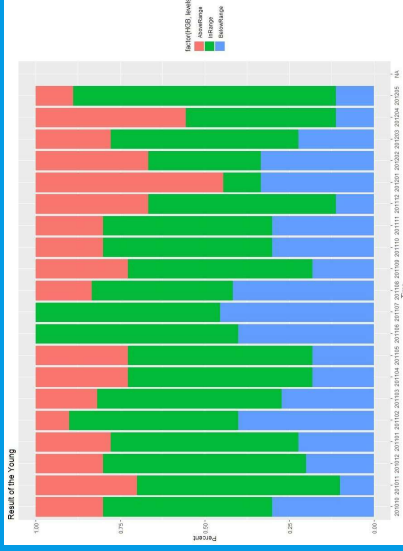
Black (13) v.s. White (10)
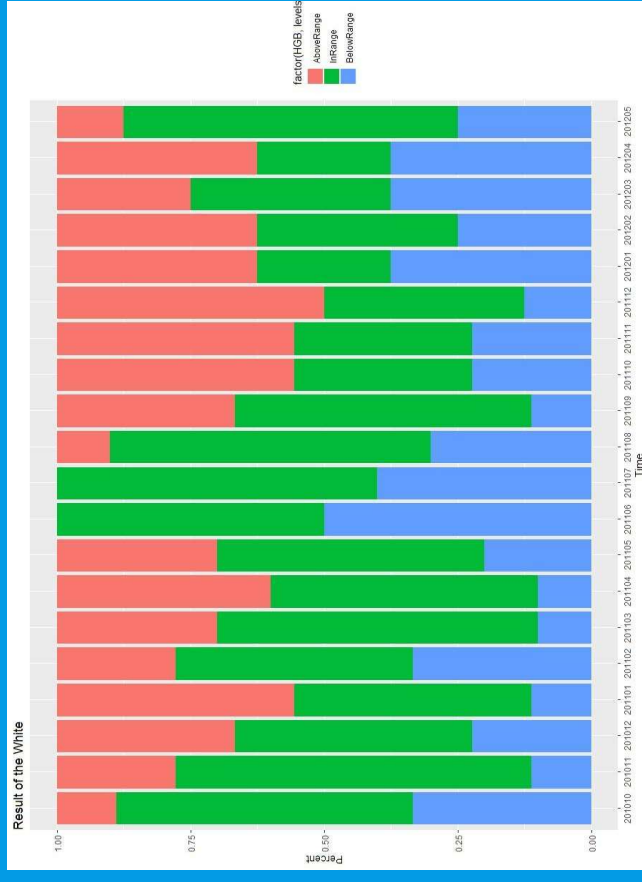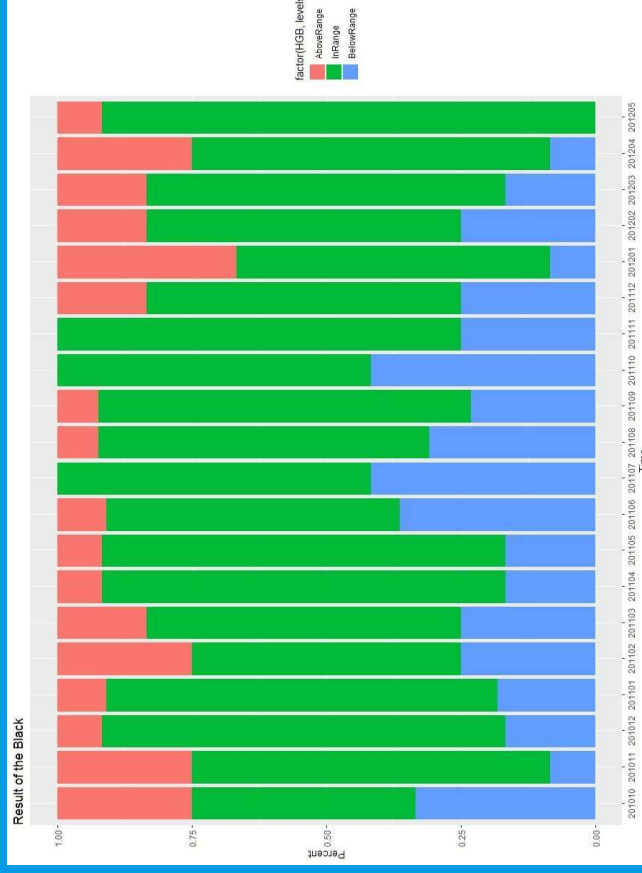
Different Factors? - Percent of Time in Range
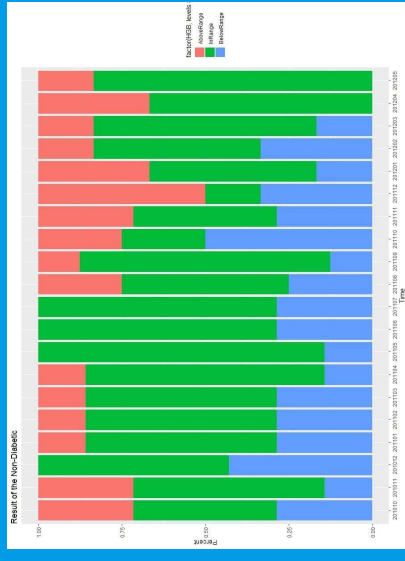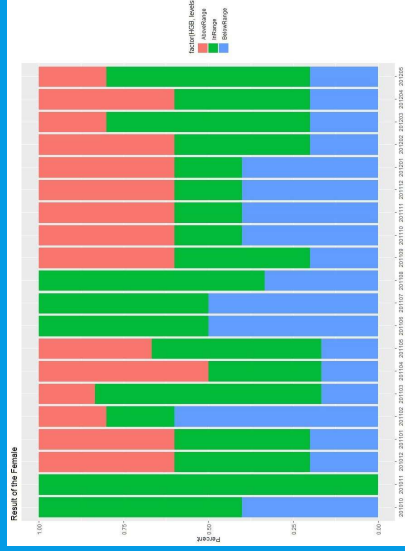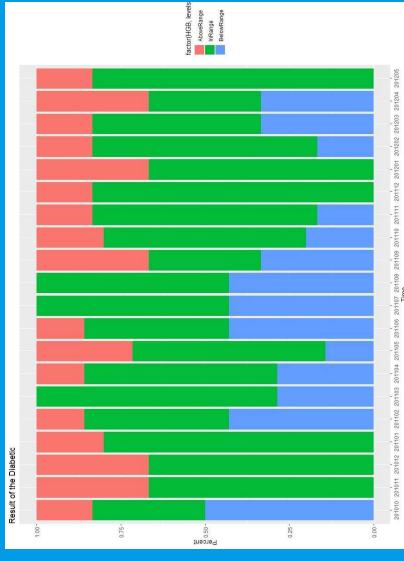

Young (below 60, 12)
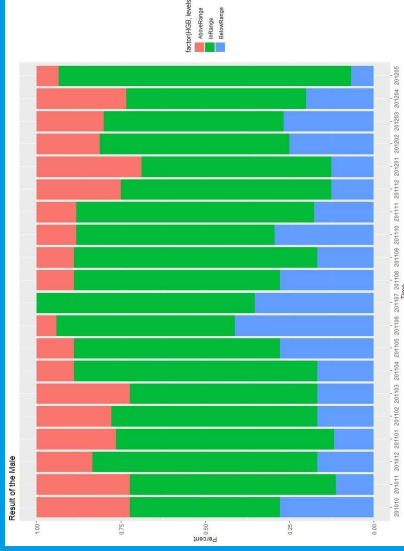v.s. Old (above 60, 11)

Short Dialysis_Vintage
(below 15, 12) v.s.
Long Dialysis_Vintage
(above 15, 11)

Different Factors? - Percent of Time in Range

Male (19) v.s.
Female (6)

Diabetic (7) v.s.
Non-Diabetic (8)

Focus on EPO-dosing

```
         stat.desc.epo_prior.EPO_Dose.
nbr.val               2437.0000000
nbr.null                 0.0000000
nbr.na                   0.0000000
min                   2000.0000000
max                  28000.0000000
range                26000.0000000
sum               20055000.0000000
median                6000.0000000
mean                  8229.3803857
SE.mean                165.1891117
CI.mean.0.95           323.9256558
var               66499497.6865281
std.dev               8154.7224163
coef.var                 0.9909279
```

```
         stat.desc.epo_post.EPO_Dose.
nbr.val               2256.000000
nbr.null                 0.000000
nbr.na                   0.000000
min                   2000.000000
max                  28000.000000
range                26000.000000
sum               13206000.000000
median                3000.000000
mean                  5853.723404
SE.mean                126.381695
CI.mean.0.95           247.836594
var               36033582.582441
std.dev               6002.797896
coef.var                 1.025467
```

Client's Main Questions:

1. Does the intervention improve patient outcomes?

- What is the percent of time the patients are in range?
- Is there a reduction in cycling?
- Does the intervention minimize the time patients spend below 10 g/dL?
- Do we see improvements on the group level/individual level?

2. Does the intervention decrease ESA usage in dialysis patients?

- Is there a decrease in the average ESA dose per treatment?
- Did the average weekly ESA dose decrease post-intervention, and if so, can that be attributed to the intervention?

How to handle ESA doses

- We now have a 'Week' column
- The combination of 'Year', 'Month', and 'Week' will let you know which ESA doses were administered to a patient in a given week.
  - Not all patients receive 3 doses of ESA each week.
- He has not included 'missed' doses or 0 doses, but if there is a patient with no doses at all during a week you can count that as a 0 units of ESA administered

Instead of an average dose per treatment, he thinks it would make more sense to look at weekly total ESA dose per patient

Concerns:

- How to handle the fact that things change month-to-month
- There is not a clear trend (e.g., all hemoglobin values coming in to range)
- For instance in the plot of monthly hemoglobin values, 2010-11 looks quite similar to 2011-09 despite one month being pre-intervention and one month being post-intervention

Group Discussion

Please get into groups, we will take 20 minutes to discuss the best approach to answering the client's questions.

Groups:

Question 1:	Group 1	Group 2	Group 3	Group 4
	Haoyu Wang Sophie Youk Yuqi Lin Shawn Anand	Jeff Niznik Andrew Meyer Oliver Knocklein Ken Brunson	Leo Jiahui Liao Yanxi Lu Andrew Shao Luoyu Liang	Adam Simon Lai Zhao Xu Zhu Xingchen Zhou
Question 2:	Group 5	Group 6	Group 7	Group 8
	Max Zhai Hongxuan Lou Bo Li Shulei Yang	Yubo Jiang Shenghao Ye Zheng Chen Haotian Jiang	Yameng Zhang Yisha He Jingze Diao Zeren Miao Yishu Hu	Shuxuan Huang Shijie Xiu Haoran Zhu Ren He

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Potential Analytical Methods

1. Does the intervention improve patient outcomes?

What is the percent of time the patients are in range?

- Plot percentage in range over time
- Give him a summary statistic with a confidence interval

Is there a reduction in cycling?

- Unlikely that we will be able to confirm this, given the small time window
- Cycles can have a range of 1-2 years

1. Does the intervention improve patient outcomes?

Does the intervention minimize the time patients spend below 10 g/dL?

- Develop a model that relates previous EPO dose with the time delay of Hgb
- Create a two way table analyzing patients above/below 10 g/dL and pre/post treatment

Do we see improvements on the group level/individual level?

- Can go by individual level and figure out which patients improved (basic success rate)
- By group - two way table with median polish

2. Does the intervention decrease ESA usage in dialysis patients?

Is there a decrease in the average ESA dose per treatment?

- Summary statistic
- Decrease in average ESA dose per treatment per patient between pre/post recommendations

Did the average weekly ESA dose decrease post-intervention, and if so, can that be attributed to the intervention?

- Summary statistic
- Decrease in average weekly ESA doses per patient between pre/post recommendations

Cautions:

- Need to determine robustness to model assumptions

- Pay attention to subject effect

- Make sure to answer his **broad** questions as well as the sub-questions

Questions?