

Evaluating a home blood pressure protocol to minimize the white coat effect

Introduction:

Patient self-measured blood pressure (SMBP) is an effective means for confirming a hypertension diagnosis and monitoring medication therapy to reduce influence of the white coat effect. Integrating SMBP monitoring into clinical assessment is recommended by US and international HTN guidelines.

However, there is limited home BP method assessment to reflect a patient's "true" BP reading including the number of readings to take in a sitting, if the first BP reading in a consecutive series should be discarded, the number of consecutive days to monitor, or whether to keep or discard the first day of readings.

SMBP methods for clinical assessment:

Our clinic's home BP monitoring (HBPM) program models NHANES HTN categorization methods to achieve most reliable BP reading: Take 3 BP readings, discard 1st reading, and average the 2nd and 3rd.

Research question:

Is there a difference if the first BP reading in a series is discarded?
Is there a difference in home BP averages when measuring from day to day (up to a 10-day period)?

Study design:

Retrospective review of 196 written home BP log sheets of patients participating in a HBPM program where instructions are to take BP readings in triplicate (3 times in a row) in AM and PM for 10 days.

Patient home BP recording sheet

Day	Measurement	Morning (AM)	Evening (PM)
Day 1	1	Mean systolic (mmHg)	Mean systolic (mmHg)
	2	Mean diastolic (mmHg)	Mean diastolic (mmHg)
	3	Mean pulse (b/min)	Mean pulse (b/min)
Day 2	1	Mean systolic (mmHg)	Mean systolic (mmHg)
	2	Mean diastolic (mmHg)	Mean diastolic (mmHg)
	3	Mean pulse (b/min)	Mean pulse (b/min)
Day 3	1	Mean systolic (mmHg)	Mean systolic (mmHg)
	2	Mean diastolic (mmHg)	Mean diastolic (mmHg)
	3	Mean pulse (b/min)	Mean pulse (b/min)
Day 4	1	Mean systolic (mmHg)	Mean systolic (mmHg)
	2	Mean diastolic (mmHg)	Mean diastolic (mmHg)
	3	Mean pulse (b/min)	Mean pulse (b/min)
Day 5	1	Mean systolic (mmHg)	Mean systolic (mmHg)
	2	Mean diastolic (mmHg)	Mean diastolic (mmHg)
	3	Mean pulse (b/min)	Mean pulse (b/min)
Day 6	1	Mean systolic (mmHg)	Mean systolic (mmHg)
	2	Mean diastolic (mmHg)	Mean diastolic (mmHg)
	3	Mean pulse (b/min)	Mean pulse (b/min)
Day 7	1	Mean systolic (mmHg)	Mean systolic (mmHg)
	2	Mean diastolic (mmHg)	Mean diastolic (mmHg)
	3	Mean pulse (b/min)	Mean pulse (b/min)
Day 8	1	Mean systolic (mmHg)	Mean systolic (mmHg)
	2	Mean diastolic (mmHg)	Mean diastolic (mmHg)
	3	Mean pulse (b/min)	Mean pulse (b/min)
Day 9	1	Mean systolic (mmHg)	Mean systolic (mmHg)
	2	Mean diastolic (mmHg)	Mean diastolic (mmHg)
	3	Mean pulse (b/min)	Mean pulse (b/min)
Day 10	1	Mean systolic (mmHg)	Mean systolic (mmHg)
	2	Mean diastolic (mmHg)	Mean diastolic (mmHg)
	3	Mean pulse (b/min)	Mean pulse (b/min)

Methods:

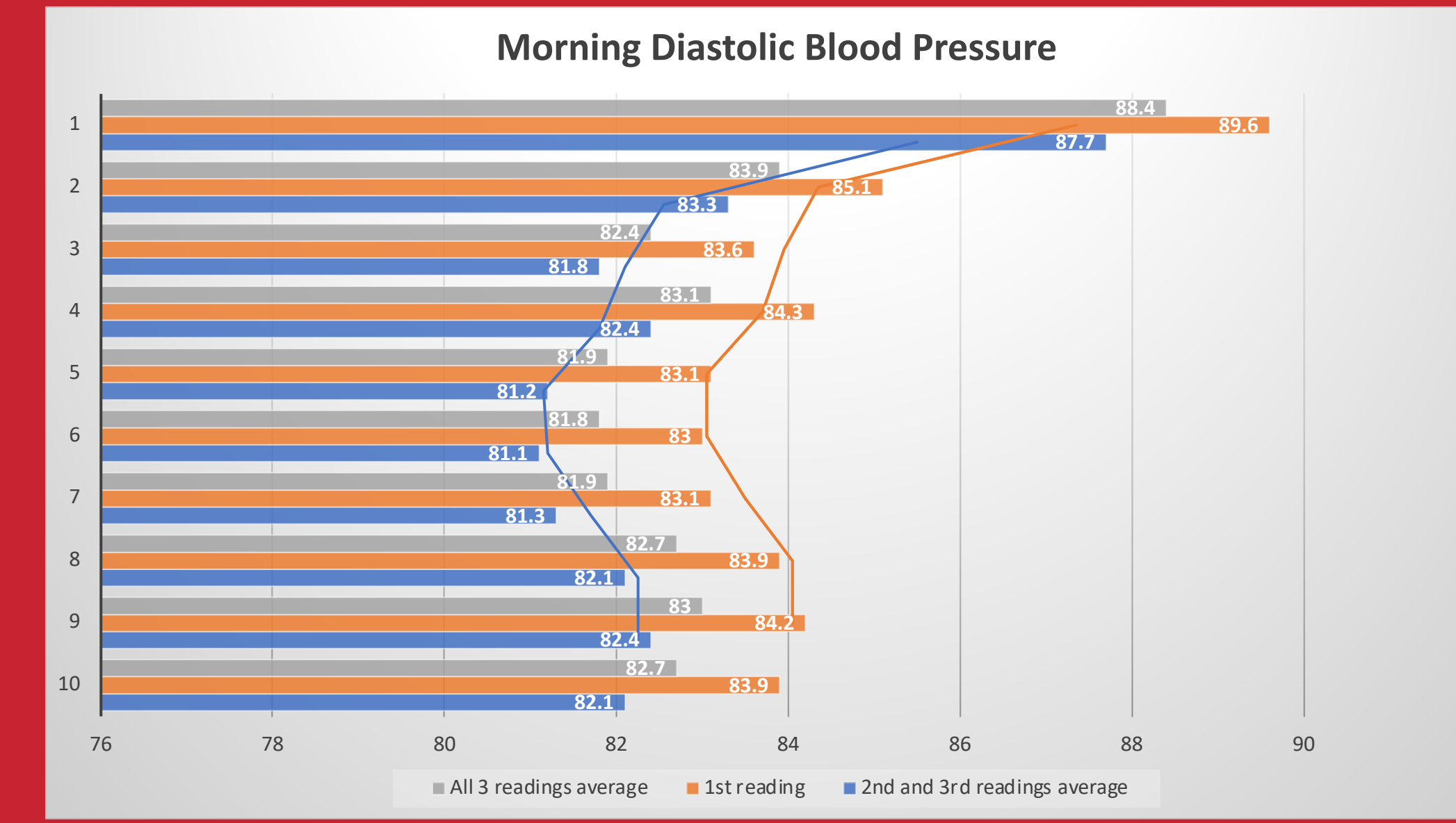
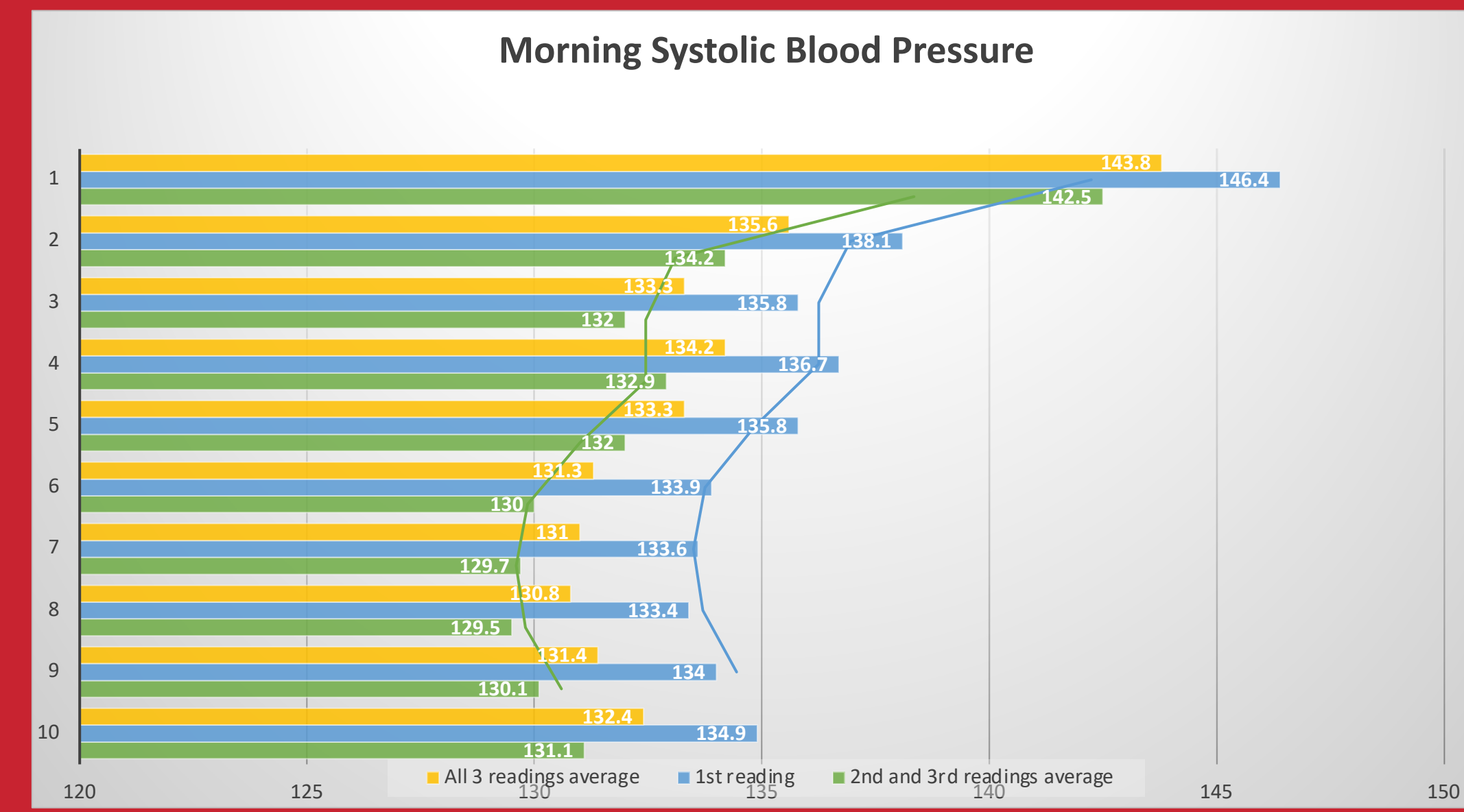
Repeated measures ANOVA analyses evaluating differences in how triplicate BP readings could be interpreted as well as comparing BP averages between days.

Comparisons were made between:

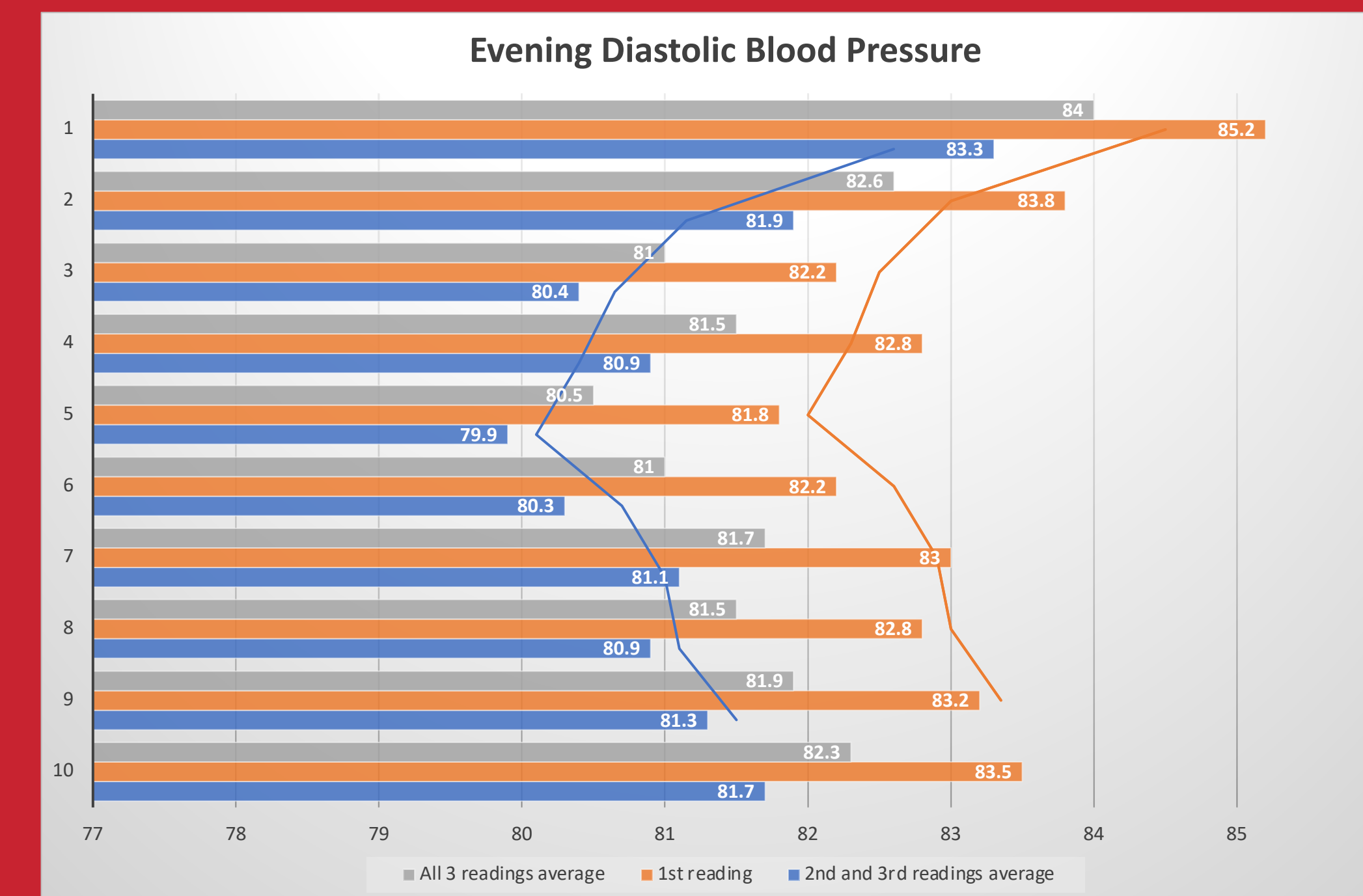
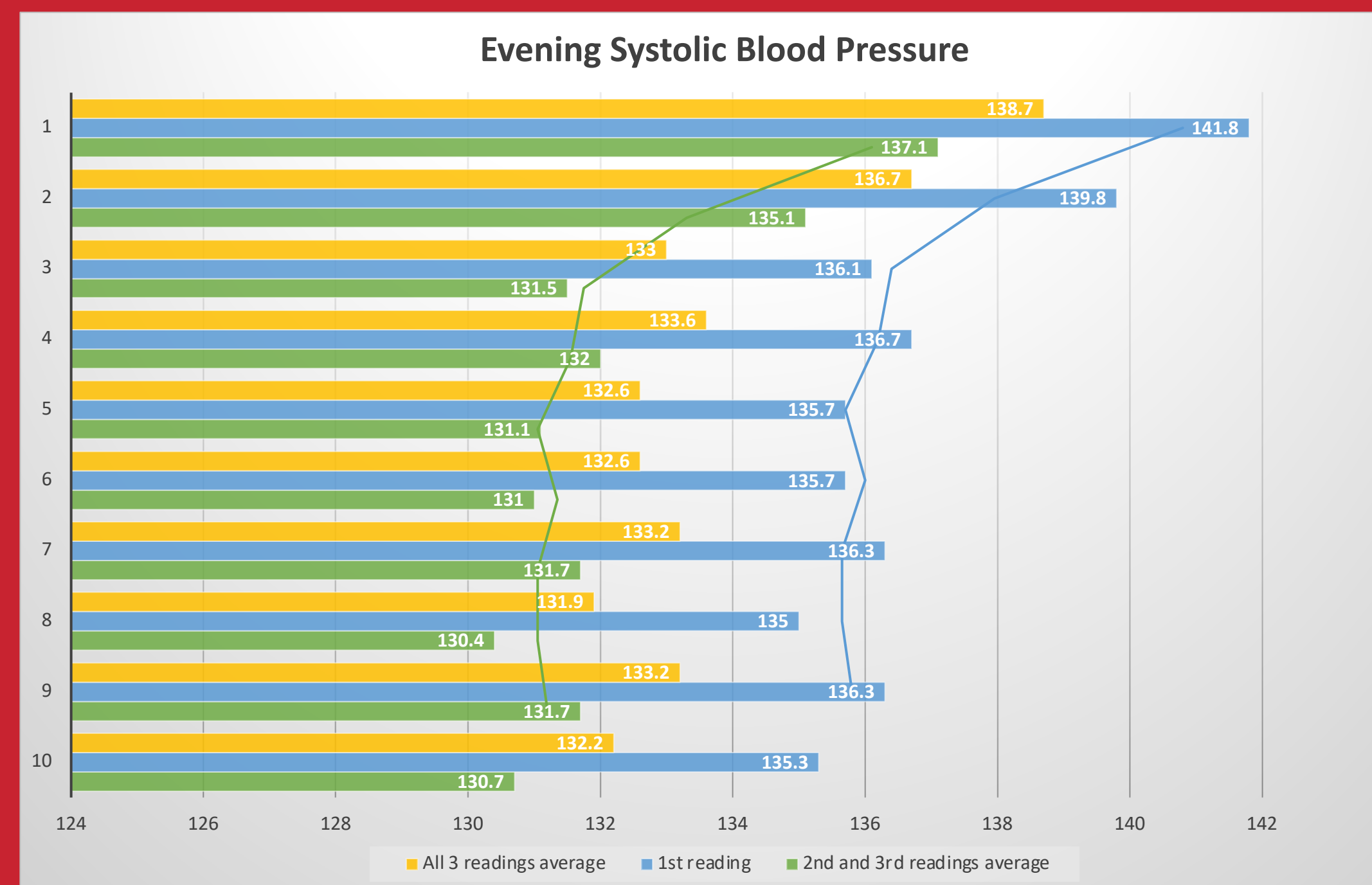
- The first BP reading
- The average of the second and third BP readings
- The average of all 3 BP readings
- The overall daily BP averages between Day 1 through Day 10.

Results: Measuring home BP readings in triplicate

Morning: Average BP over 10 days



Evening: Average BP over 10 days



- The first of 3 BP readings is significantly higher compared to The averaged second and third readings ($p < 0.05$)
- All 3 readings averaged together ($p < 0.05$)
- All 3 readings averaged together is significantly higher compared to the averaged second and third readings ($p < 0.05$)
- This is consistent for AM or PM readings, and for SBP or DBP.

Results: Comparing home BP readings from day to day

- Comparing the overall BP average from day to day suggests that Day 1 ($p < 0.05$) and Day 2 ($p < 0.05$) is higher than all other days*.
- There was no difference between Day 3 through Day 10.

Day	1 st readings		2 nd and 3 rd readings		All readings	
	mean	95% CI	mean	95% CI	mean	95% CI
1*	144.1	143.5-144.7	139.8	139.2-140.5	141.3	140.6-141.9
2*	138.7	138.0-139.3	134.4	133.7-135.0	135.8	135.2-136.5
3	135.8	135.2-136.5	131.6	130.9-132.2	133.0	132.4-133.7
4	136.4	135.7-137.0	132.1	131.4-132.7	133.5	132.9-134.2
5	135.6	134.9-136.2	131.3	130.6-131.9	132.7	132.0-133.4
6	134.5	133.8-135.2	130.2	129.5-130.9	131.6	130.9-132.3
7	134.8	134.1-135.6	130.5	129.8-131.3	132.0	131.3-132.7
8	134.0	133.2-134.8	129.7	128.9-130.5	131.2	130.3-132.0
9	134.9	134.0-135.8	130.6	129.7-131.5	132.1	131.2-133.0
10	134.7	133.7-135.7	130.4	129.4-131.4	131.9	130.9-132.9

Day	1 st readings		2 nd and 3 rd readings		All readings	
	mean	95% CI	mean	95% CI	mean	95% CI
1*	87.4	86.9-87.9	85.5	85.0-86.0	86.1	85.6-86.6
2*	84.4	83.9-84.9	82.5	82.0-83.0	83.1	82.6-83.6
3	82.9	82.4-83.3	80.9	80.5-81.4	81.6	81.1-82.1
4	83.3	82.8-83.8	81.4	80.9-81.9	82.0	81.5-82.5
5	82.3	81.8-82.8	80.4	79.9-80.9	81.0	80.5-81.5
6	82.7	82.1-83.2	80.7	80.2-81.3	81.4	80.9-81.9
7	83.0	82.4-83.5	81.1	80.5-81.6	81.7	81.2-82.3
8	83.1	82.5-83.8	81.2	80.6-81.8	81.9	81.2-82.5
9	83.6	82.9-84.3	81.7	81.0-82.4	82.3	81.6-83.0
10	83.5	82.7-84.2	81.6	80.8-82.3	82.2	81.5-83.0

Systolic Blood Pressure: Average Combined (AM + PM)

Diastolic Blood Pressure: Average Combined (AM + PM)

Discussion:

- HTN is a chronic condition that has serious consequences if untreated.
- Inaccurate BP readings may lead to over-diagnosis, over-prescribing, or may subject a patient to unnecessary costs and/or adverse drug events.
- SMBP monitoring is very feasible to integrate into clinical HTN assessment, relatively inexpensive, reliable, reflective of cardiovascular risk and mortality, can produce multiple readings over many days, and engages patient in their care.

What are the best methods for SMBP monitoring?

- The literature is inconsistent and not grounded in well designed studies.
- General recommendation is to check BP readings at home twice daily and to check multiple readings each time (2 or 3 readings) 1 minute apart, for several days.
- SMBP method recommendations from CDC, AHA: Take 2 BP readings, one minute apart. Average the two together.
- It has also been recommended (but not consistently) to discard the first day or the first reading (if multiple readings are taken in one sitting).
- NHANES HTN classification data recommends to discard the initial BP reading bc 34% of patients with Stage 1 HTN by initial BP reading were re-classified to non-HTN BP when repeated.
- Several recommendations for duration of consecutive home readings suggest a minimum of 3 days (4 days if first day of readings is discarded) with 7 days preferred.

What we have learned / Conclusion:

- The initial home BP reading is significantly - and consistently - higher than subsequent readings.
- SMBP should entail taking 3 BP readings at each measured sitting.
- When evaluating:
 - Discard the initial BP reading (result: + reliability of data)
 - Discard the first day, and potentially the second day of readings (result: + reproducibility of data)
- Consecutive reproducible readings are measured post day 3. 7 days would be a preferred duration to clearly evaluate a consistent trend. Beyond 7 days is unnecessary.

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