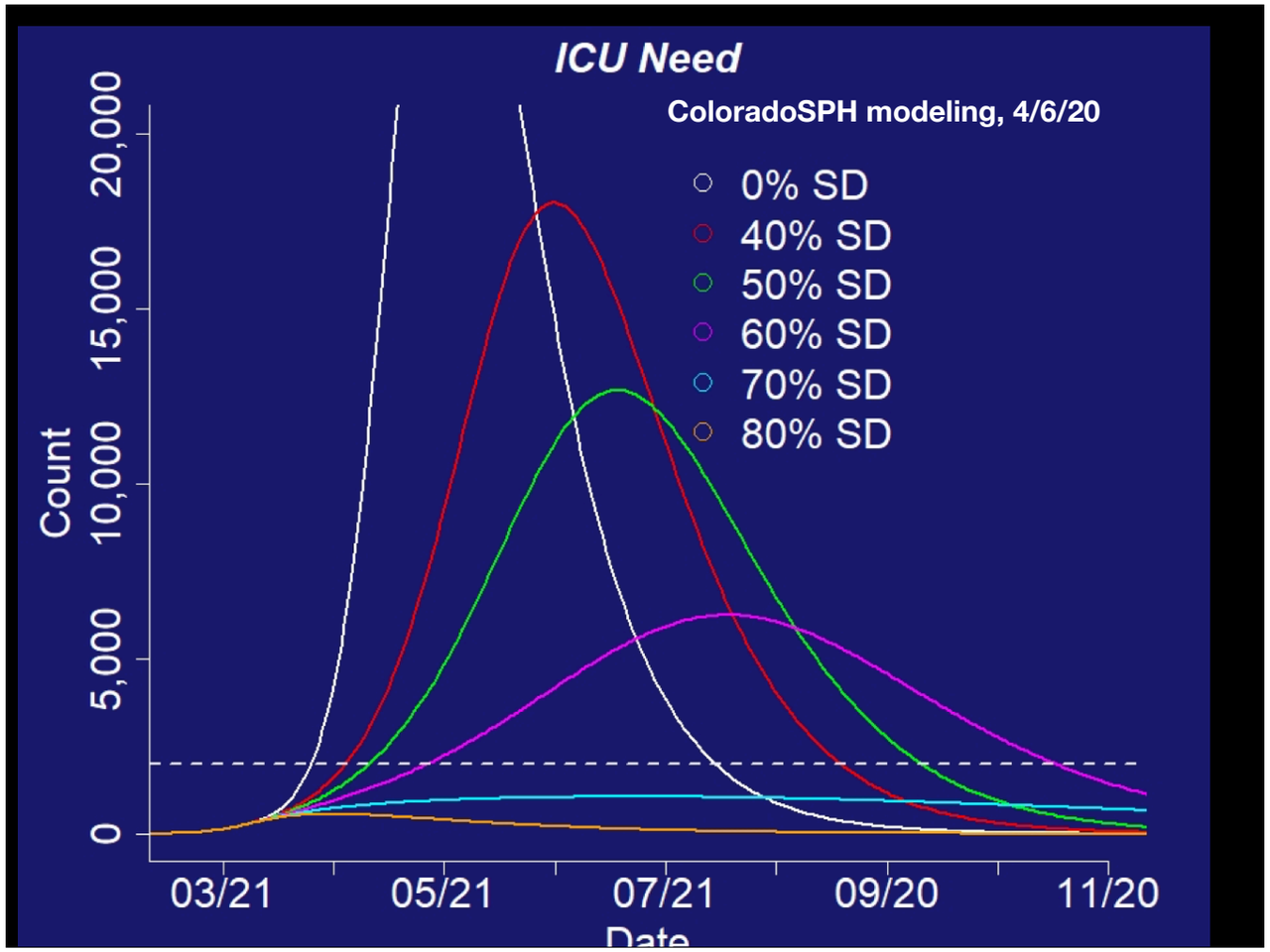
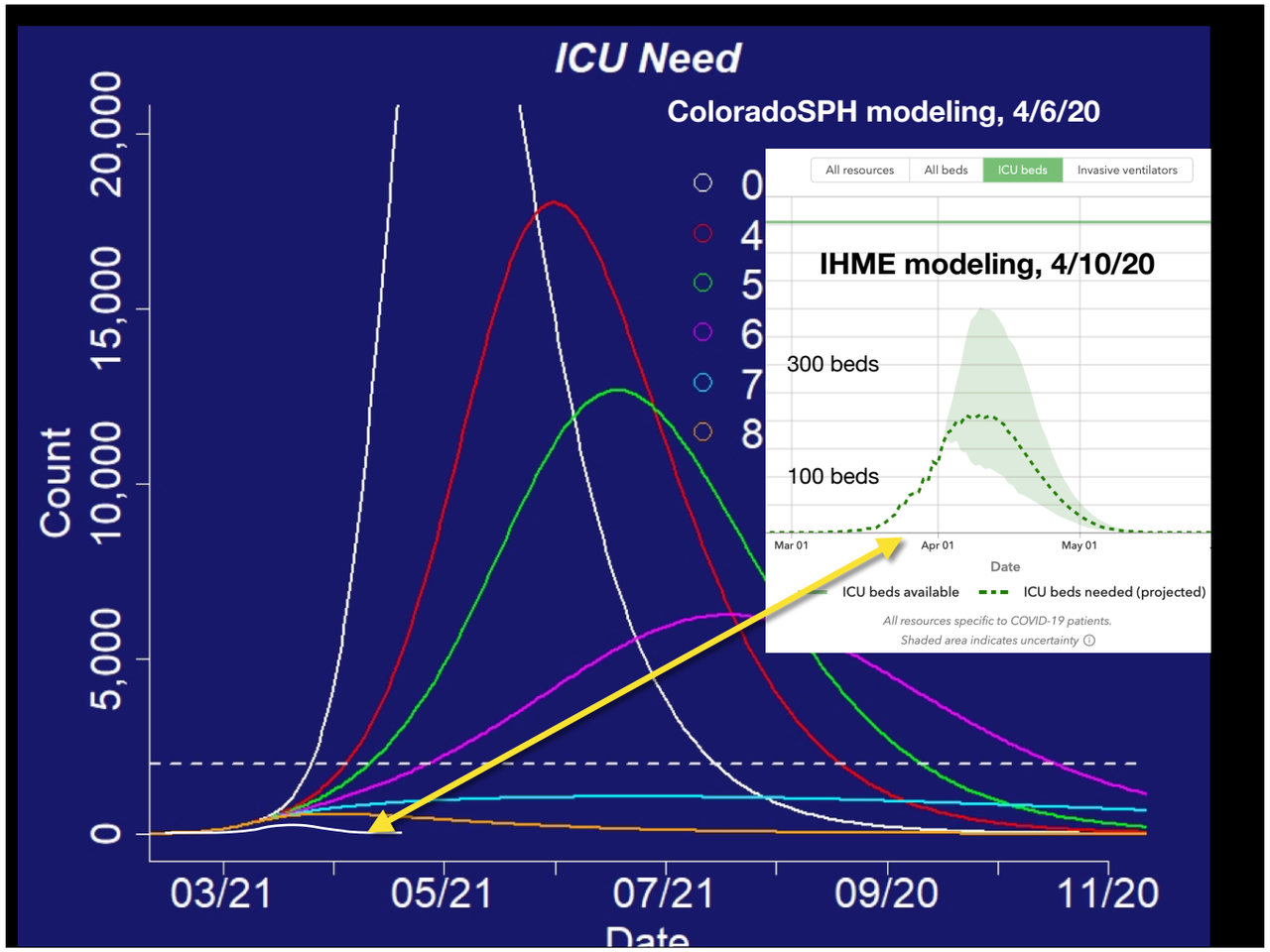
COVID models in CO

- Two main ones prominent publicly: ColoradoSPH group (Colorado School of Public Health, used by the state) and UW's IHME model.
- IWHE seems to indicate no more infections in early May. State model was reported as indicating a "best case" of a peak in September.
- Why the difference? (Short answer: just how good are Coloradans at social distancing?)

Ok, so Bob asked me to say something about stuff we see in the paper and on the news and on the web. I've looked into the papers on probably the two most relevant models for Colorado. There is tons more detail out there, but I'm trying to highlight what appears to my unpracticed eye to be the reasons for disconnects between different statements.



The place where these two model approaches overlap is ICU usage. This is the State of Colorado's (Colorado School of Public Health-led) model's predictions. In their press conference, the 60% SD number was their optimistic case. The dashed line is their estimate of expanded ICU beds (2700—vs. something like 540 in normal times).



Now maybe you have followed the IHME model from the University of Washington and seen that we won't even reach the "normal times" number of ICU beds. WTF?

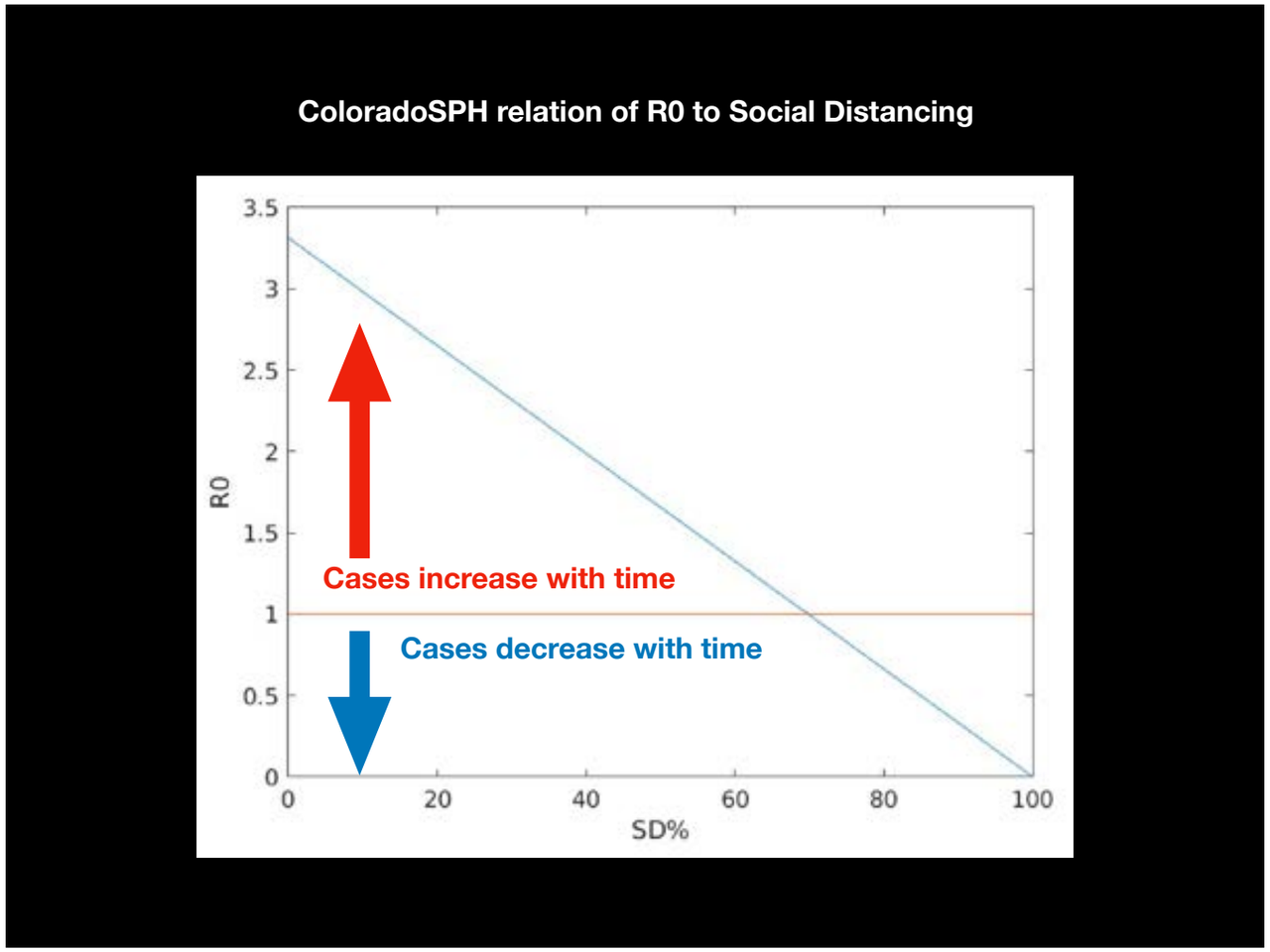
COVID model differences in CO

- ColoradoSPH group works forward from estimates of positive tests, corrects for fraction serious enough to warrant a test, corrects for asymptomatic (assumes 82% of infected 0-29 year old asymptomatic!), then estimates likely hospitalizations (20.7% for 60+ but only 0.6% for 0-29), ICU beds (8% of infected 60+, 0.03% of 0-29 year olds) and deaths (half of ICU admissions). So, in a sense, a forward model.

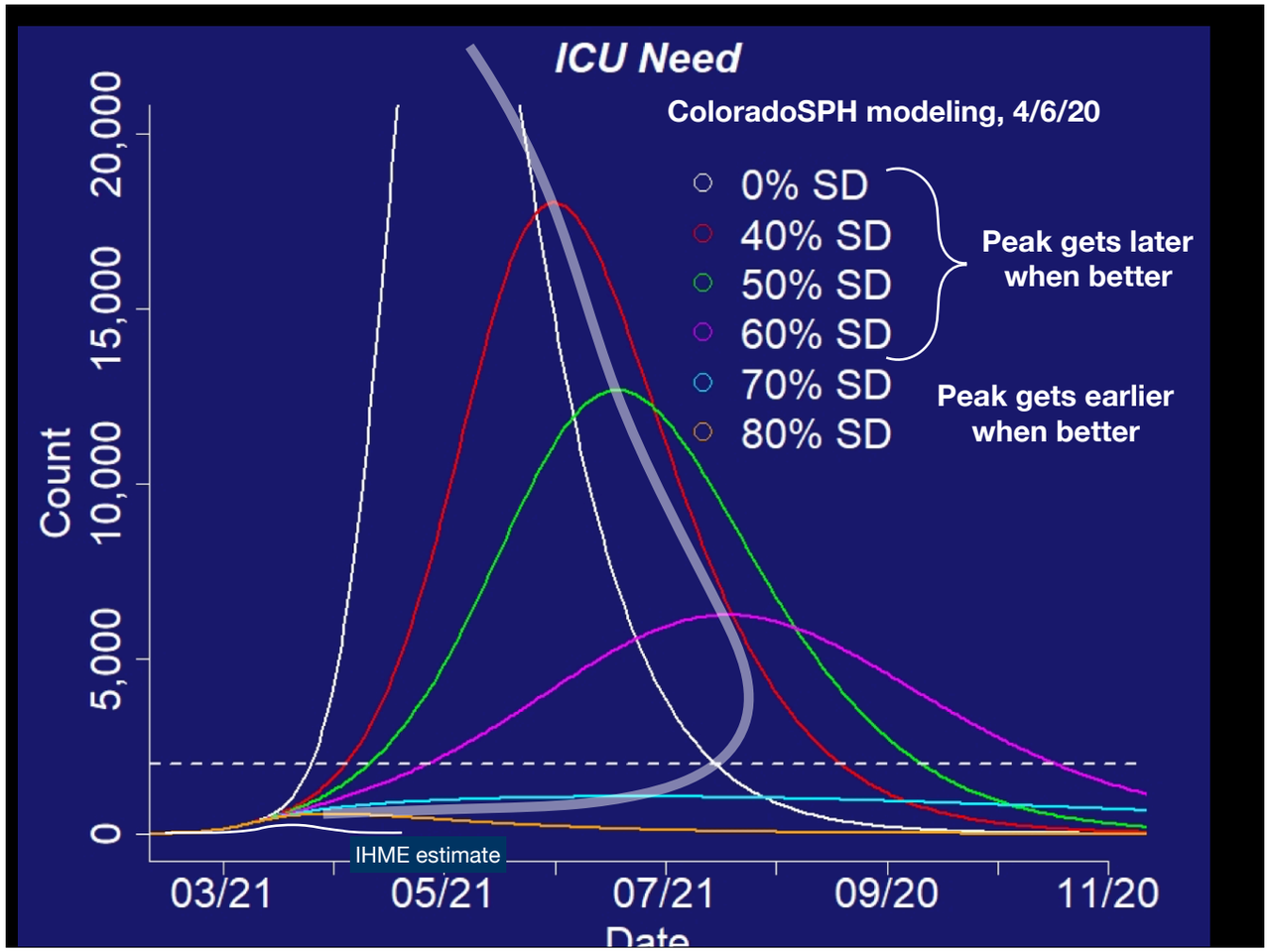
- IWHE works backwards from death data, which it views as more accurate measure than tests. Uses estimates of success of interventions elsewhere (divides into stay-at-home orders, school closures, closures of non-essential services (mainly bars and restaurants), and the deployment of severe travel restrictions) to project deaths and, working backwards, ventilator use, ICU admissions, and hospital admissions. In essence, an empirical inverse model.

- Lots of other details. This, however, is not the main difference, it seems. State model asks “what happens under different social distancing behaviors”. IHME assumes we’ll follow others under similar orders.

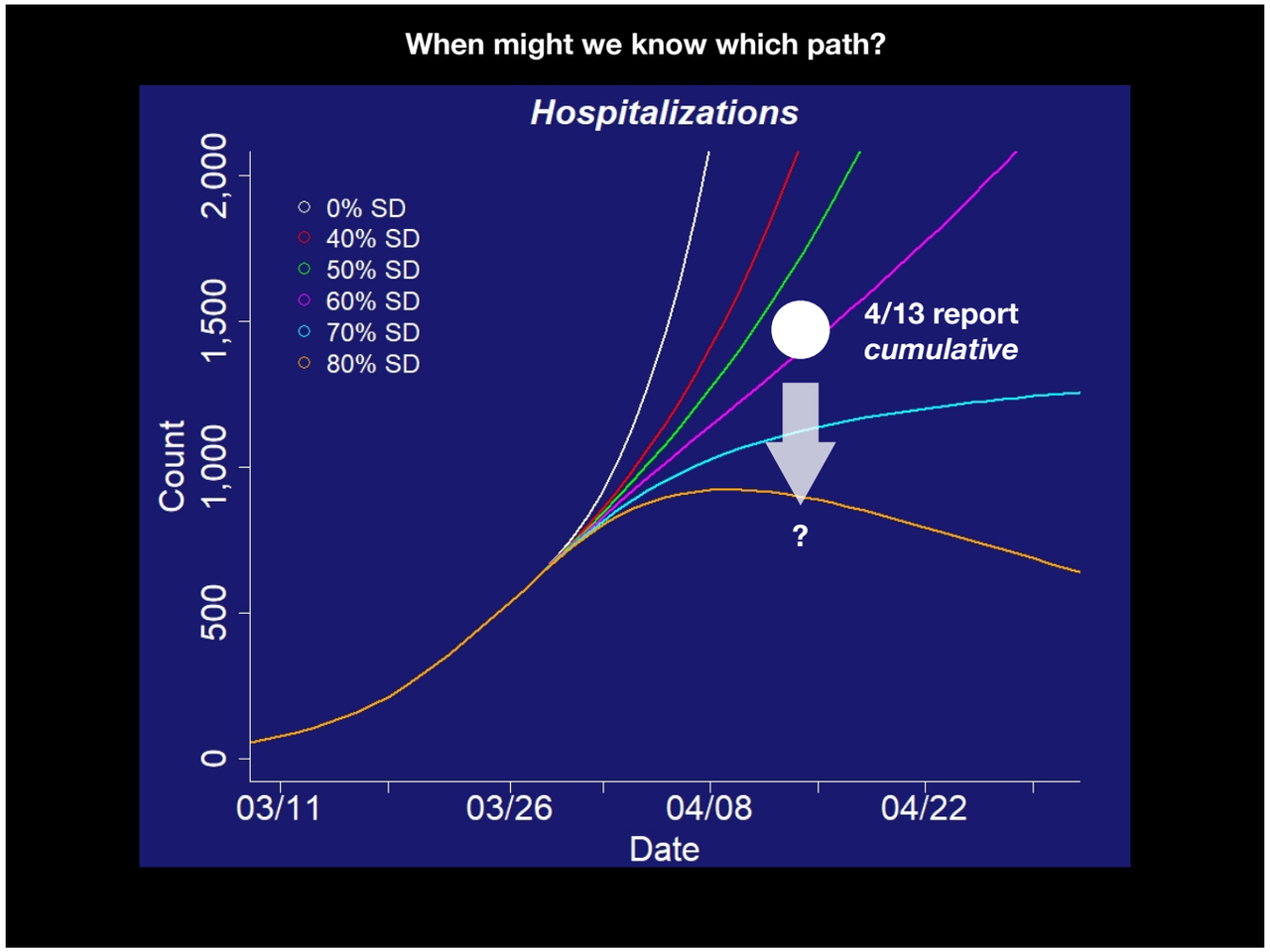
So here is a stab at some of the main differences. The philosophies of these two are diametrically opposite: ColoradoSPH starts from tests and has to assume things to get to ICU beds. IWHE works backwards from deaths—but of course deaths are in the future, so they have to model future deaths to get back to earlier ICU usage and even earlier hospitalizations. So very different assumptions give us some powerful insights into the impact of those assumptions.



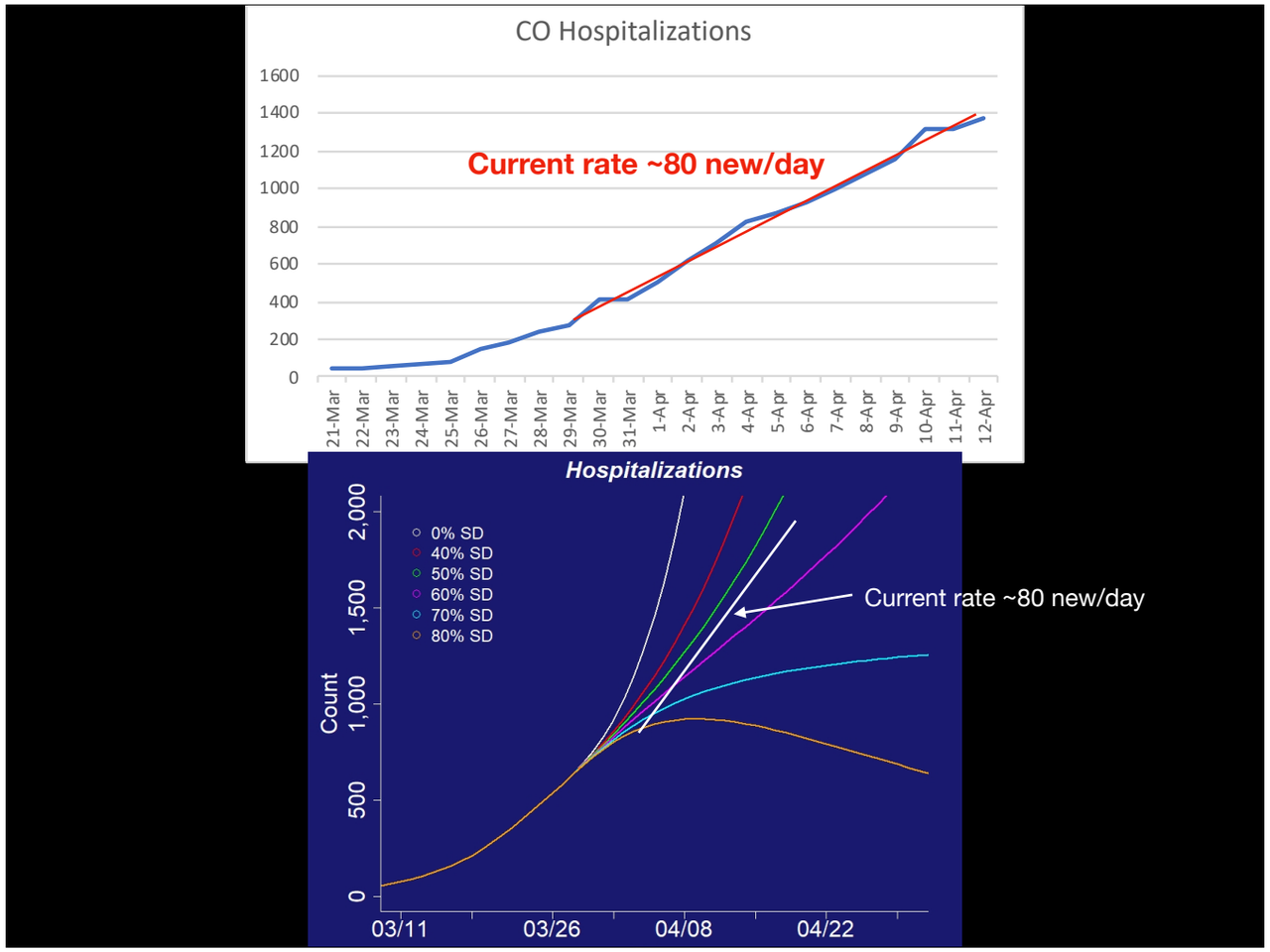
You probably heard of R0, the average number of people any given infected person will in turn infect. If they only infect one person, then the number of infected people remains constant. Infect more and cases grow; infect less and cases will be decreasing. the horizontal axis is the state's social distancing parameter; in essence, they assume a linear relation between how much social interaction you forgo and R0 (so 100% is that you don't interact with anybody; 0% is your normal interaction).



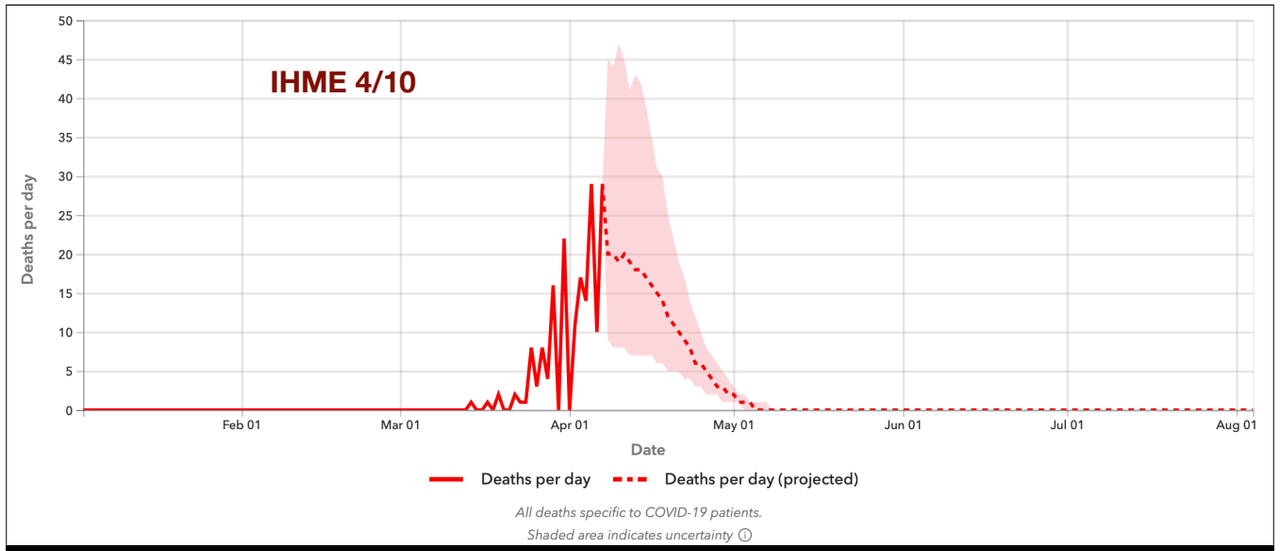
What the state health folks focus on are those awful cases with SD% under 60%. In those cases, the peak of impact grows later the more successful you are. Hence their happy news a few days ago that the peak will be no earlier than May. Except if you were looking at IHME you are told that we are **past** the peak! May would seem to be bad. If you look at that tiny IHME peak, it is in essence assuming SD% above 80%—H0 of 0.5 or maybe lower. Is that really where we are?



Well, we have a problem. The state does not report ICU bed use. It does not report current numbers of patients in hospitals. It does not track discharges. It does track admissions, so the state daily tells us how many COVID-19 patients have entered a hospital. This of course means that the number currently in the hospitals is lower (probably, at minimum, by the number who have died, currently ~300). So how far down that arrow are we? What else can we look at?

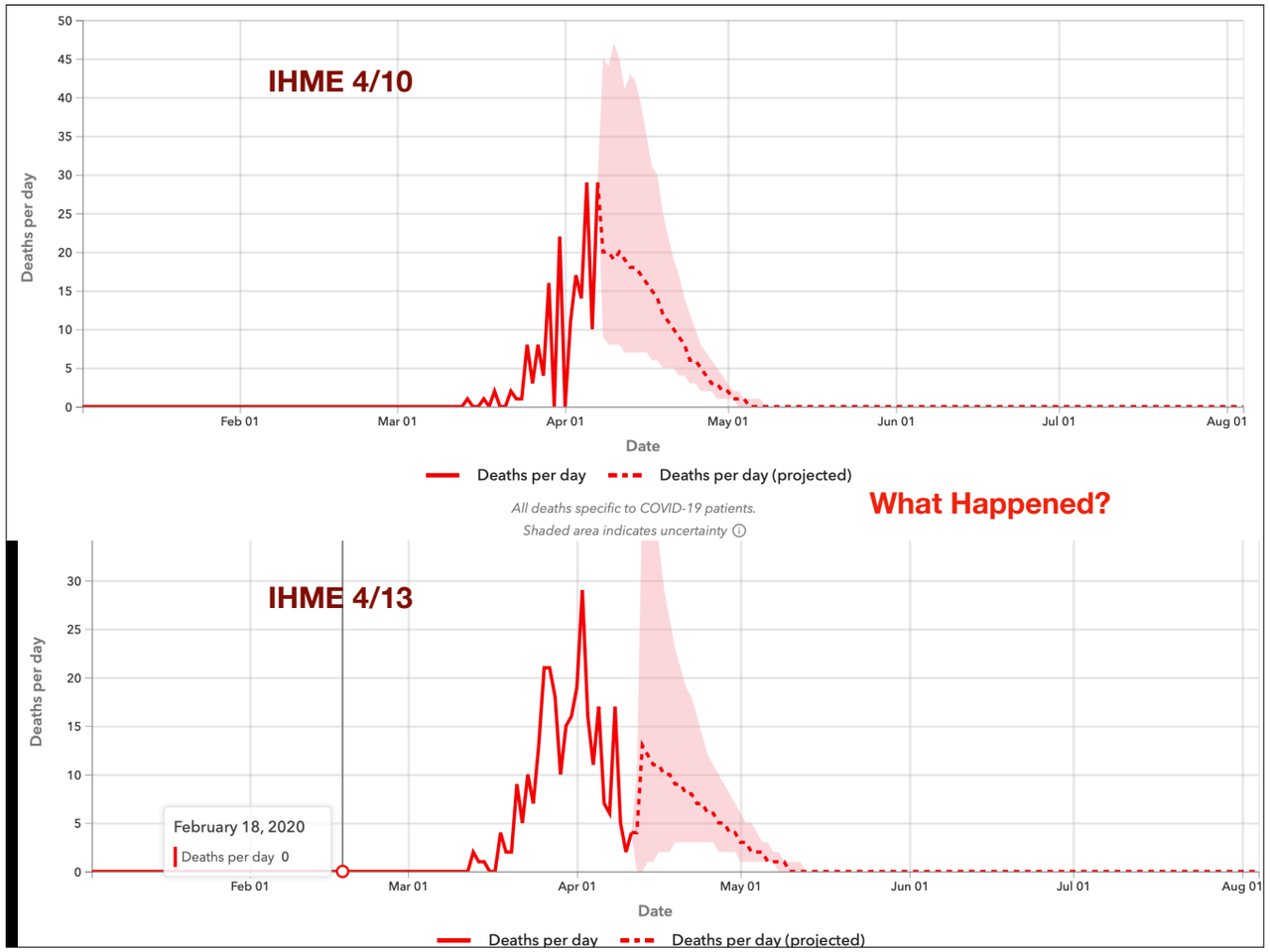


From the daily announcements, we can learn how many have entered the hospitals (of course, we aren't sure this is really up to date, but for now we'll assume it is). Over the last two weeks, about 78 new admissions per day has been the rate. Putting a line of that slope on the model plot tells us that we are no worse than SD = 50%—which would still be a gruesome outcome. But again, this is the *steepest* slope as we don't know of discharges.

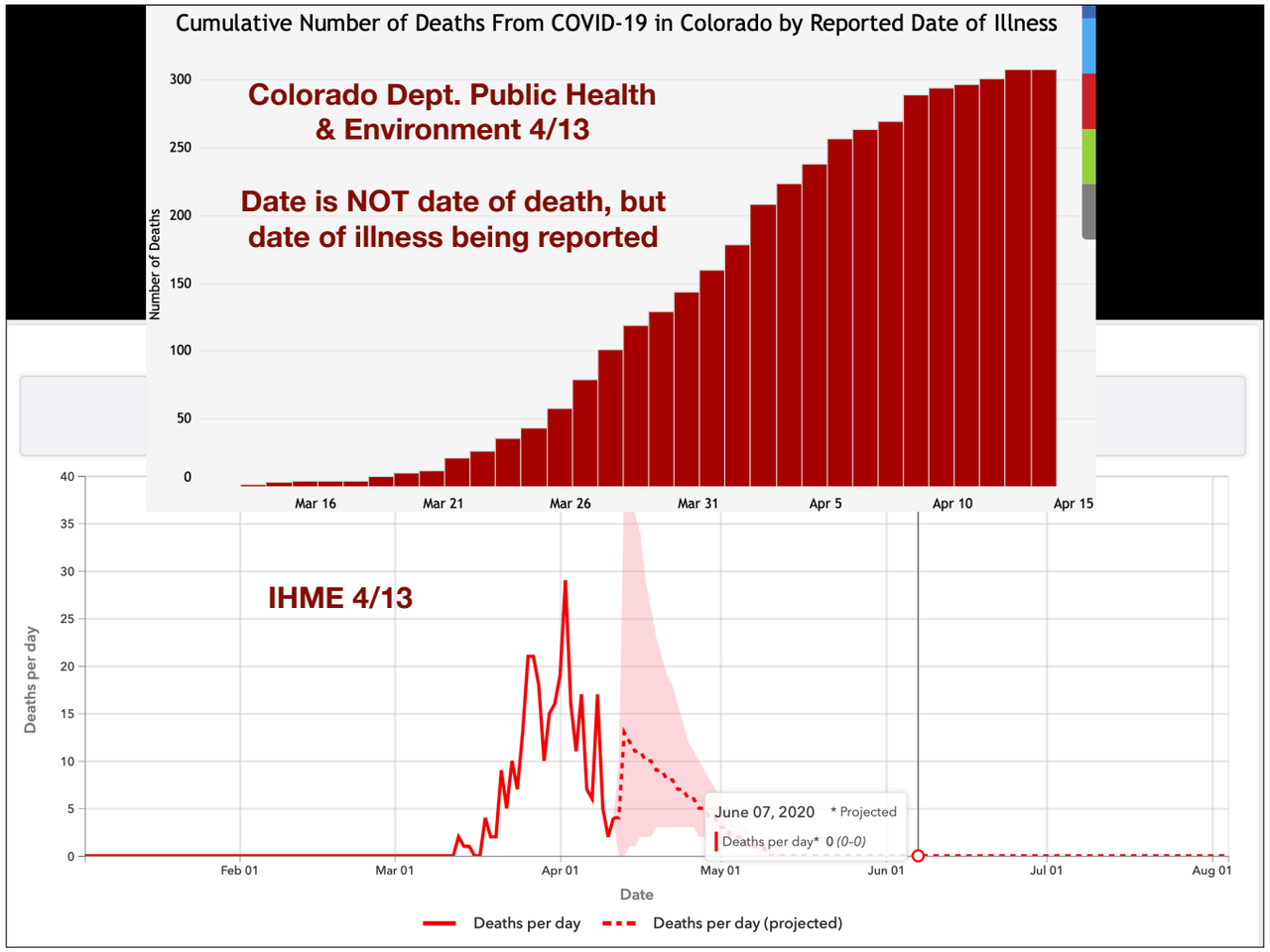


- So maybe we are at SD ~85-90%? So maybe IHME model is best? Um…watch out for misaligned data!

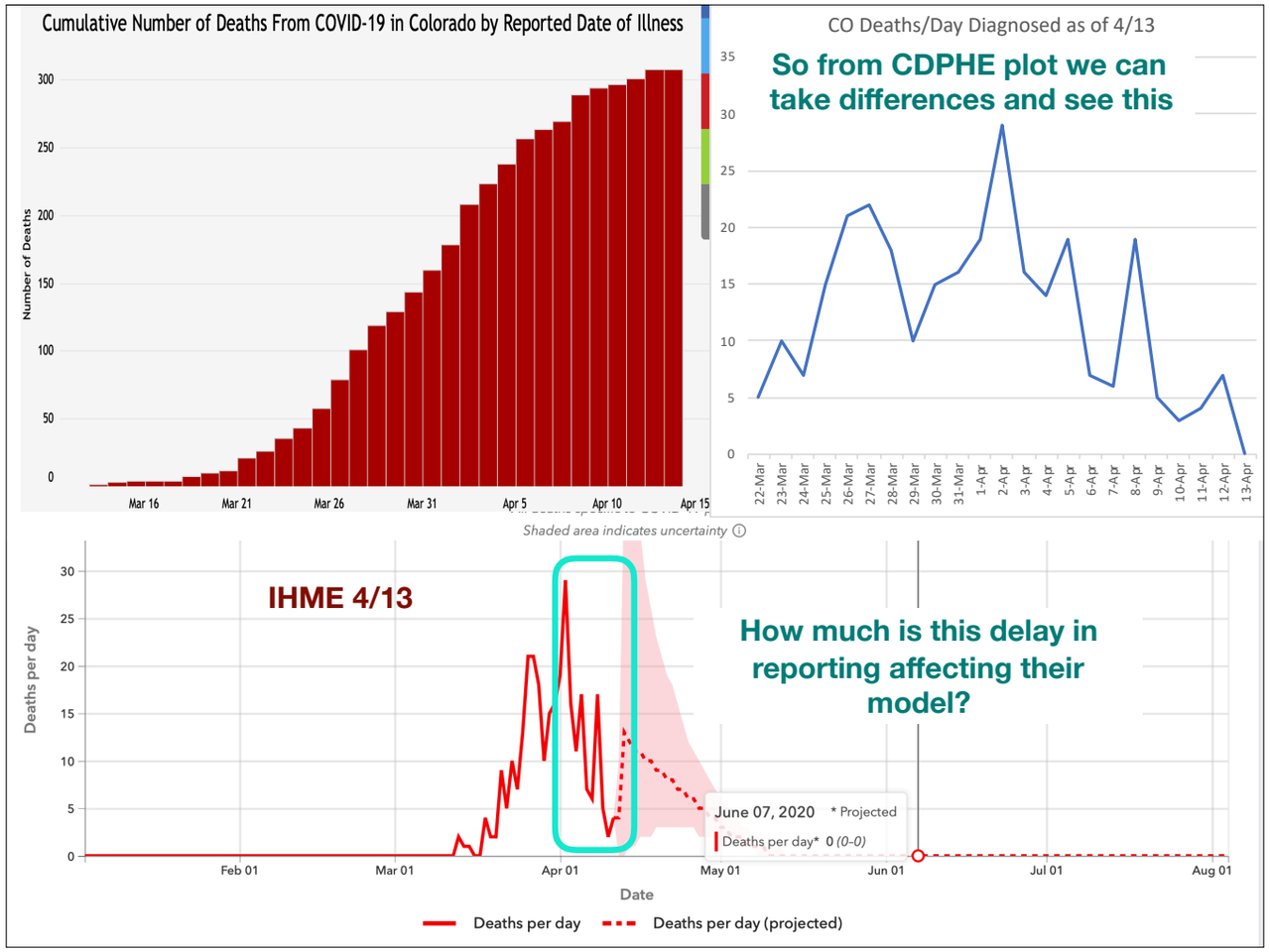
So with all those problems, maybe the IHME model is going to really be more useful? Well…no, and it is a garbage-in, garbage-out problem. This is the plot from a few days ago, which reflected the daily announcements from the state.



And on the bottom is a more recent version. It looks a lot different and really looks like we passed the peak on 1 April! Except we did **no such thing!**



Here is what happened: the IMHE group (perhaps following the same change by the Denver Post) shifted to the derivative of the curve put out daily by the state…except the dates are not dates of death (and so the derivative is NOT deaths per day) but date when the deceased was first reported to be ill. Which was days or weeks before death occurred! Even worse, the state gets death data days or even weeks after death. So each day many of the bars get higher!



To check this, here is the derivative of the 4/13 State chart. Sure looks like the IHME plot! But recall that the IHME model is built around the death data—and if they are assuming that this data is really deaths per day, their model is basically screwed. [Have they addressed this screwy reporting? Hard to say—while they are very open with adjustments, state-by-state peculiarities of states outside the top 5 in deaths are probably below notice. But maybe they have some clue as that future curve projects back above the “known” deaths]

Takeaways

- Appears social distancing is dropping infection rate down; SD% looks to be above 50% and possibly >80%
- Hospitalization data likely will be first real indication of when peak of first round will occur. Odds are with the kinds of data being reported this might not be totally clear until early May—but the coming week might give big clues.
- Data reporting is a confusing mess. State of Colorado does not share date of death, discharges of COVID patients, or any current hospital numbers (beds, ICUs, ventilators). Because this is different from other states, IHME model for Colorado could be far too optimistic.

And this is without getting into all the other weeds out there.

References/Useful sites

- ColoradoSPH report: https://drive.google.com/file/d/19ST3tRnntUGV3h7YI0tQHJDnCoL5dRE7/view
- IMHE paper: https://www.medrxiv.org/content/10.1101/2020.03.27.20043752v1
- Daily state numbers: https://covid19.colorado.gov/case-data
- IMHE Colorado model: https://covid19.healthdata.org/united-states-of-america/colorado
- Very user-friendly COVID data plotter: http://valis.pub

Repeated for pdf:
ColoradoSPH report: https://drive.google.com/file/d/19ST3tRnntUGV3h7YI0tQHJDnCoL5dRE7/view
IMHE paper: https://www.medrxiv.org/content/10.1101/2020.03.27.20043752v1
Daily state numbers: https://covid19.colorado.gov/case-data
IMHE Colorado model: https://covid19.healthdata.org/united-states-of-america/colorado
Very user-friendly COVID data plotter: http://valis.pub