

Webinar - June 2, 2020  
Questions and Answers

*If a question was answered live during the webinar, it has not been included here*

Question	Answer
<p>Did you calculate any of the other predictive modeling tools to estimate risk for comparison with the proprietary Epic tools? APACHE, SAPS, Rothman Index, etc...?</p>	<p>Thank you so much for the question. We did look at the Epic sepsis model, which didn't perform as well as the deterioration index model. One advantage of the sepsis model (logistically speaking) is that it is calculated upon arrival to the ER, whereas the Epic deterioration index is not calculated until a patient is admitted to the hospital.</p>
<p>Does EPIC update the deterioration model algorithms and if so how would you adjust?</p>	<p>Thank you for the question. I don't have a definitive answer to your question. I don't believe that the model has been updated but your question gets to a critical point as it relates to computable biomedical knowledge -- it needs to have version numbers attached to it.</p> <p>That's the only way that we would readily know which version of the model we are working with.</p>
<p>What about the data aggregation and training of the model - shouldn't that be a selection criteria?</p>	<p>Assuming you are referring to the need to aggregate sufficient quantities of high-enough quality data to actually build and train a useful model then yes, absolutely, data aggregation is an important consideration. It was the lack of ability to quickly aggregate COVID19 patient data across the US and the world that led to a search for existing models of deterioration instead of going for a COVID19 specific model. One hope is that our capabilities to aggregate data quickly in the face of a pandemic will improve so that sharing learning through data modeling can take place in useful ways.</p>
<p>In considering application-a critical issue is how much clinicians should rely on the model-as a support tool-primary or secondary vs as a primary input-supplement or drive the clinician? What was the goal?</p>	<p>I think given the realities of lack of testing of this model, I would strongly advocate for secondary use. However, it's a moving target as more knowledge accrues.</p>

Question	Answer
<p>A general question on continuous learning. Say that you would develop a model on the first X COVID-19 patients. Then the LHS would allow continuous learning because data is being collected continuously. Have you thought about ways on continuous development / validation of a model, and what do you think are challenges of continuous learning in this context?</p>	<p>Excellent question! Yes, we have thought about models that are "continuously" or frequently updated, e.g., daily updates or weekly updates. Continuous learning or "never-ending learning" has been a part of Machine Learning for over 20 years. (<a href="https://www.cs.cmu.edu/~tom/pubs/NELL_aaai15.pdf">https://www.cs.cmu.edu/~tom/pubs/NELL_aaai15.pdf</a>). However, there are several issues and challenges. One issue is whether there is any value to continuous or frequent updates. This will depend on the model and how it is being used. One challenge is that never-ending learning approaches may be difficult to assess after the fact, e.g., when doing root cause analysis of a medical error. Another challenge is that the complexity of deploying never-ending learning models can be greater than deployment of "static" or infrequently updated models. For example, changes in the data stream feeding never-ending learning models could cause disruptions that do not pertain to "static" or infrequently updated models.</p>
<p>In 2009 I was involved with the H1N1 swine flu pandemic and the speed of decisions (clinical, financial, research etc.) was remarkably fast. It is happening again...for example Oxford Uni and vaccine development. How can LHS realistically improve the speed and quality of decisions when the normal times return?</p>	<p>One important component is to figure out how to keep these issues as a higher priority so that they don't sink into the background.</p>
<p>Is it right to assume that the thresholds used to stratify patients based on Epic Deterioration Index (EDI) were adjusted as more data came in? If yes, how did you manage this update? Was this an issue with clinicians regarding the implementation part (I mostly wonder for clinicians who were reluctant to adopt such EDI thresholds)?</p>	<p>Great question. Local calibration and threshold setting is a matter of process and procedure. Models like this have to be revisited and recalibrated from time to time. Dr. Sharon Davis at Vanderbilt has done some important work in this area. As a recent example of this work, see Davis SE, Greevy Jr RA, Fannesbeck C, Lasko TA, Walsh CG, Matheny ME. A nonparametric updating method to correct clinical prediction model drift. Journal of the American Medical Informatics Association. 2019 Dec;26(12):1448-57.</p> <p>However, to the best of our knowledge, the Epic Deterioration Index has not changed since it was first implemented. If the score were to change, then you are absolutely correct that any thresholds previously determined to be useful would need to be re-evaluated with respect to their performance (e.g., sensitivity specificity, positive and negative predictive value).</p>

Question	Answer
Can you elaborate on the role and responsibilities of librarianship?	Thank you for this question. Yes! Consider a future for LHSs when hundreds or thousands of models like the Epic Deterioration Index are being used by the typical health system or hospital. In that case, best practices in knowledge organization (model organization) and knowledge management (model management) will be needed to keep track of these types of models and their state of use. Good librarianship includes responsibility for organizing, managing, describing, and curating models in large numbers, and also includes responsibilities for making models transparent, open, and accessible as possible to all stakeholders, and to making models findable through search, accessible as appropriate, interoperable in as many different systems as possible, and reusable by policy, license, etc.
The implementation of this project was very quick and it appears it did not have a lot of time to plan. What lessons learned do you gain when you need to implement a complex intervention quickly?	I would say that understanding the level of motivation and interest was very important. Harnessing this and deepening it would be very important for the future.
Apologies for all the questions, just generally interested! What does the work you've done in validating the model, sharing of the model, and the use of implementation science make that your system can be considered a learning healthcare system, rather than a, say more standard, research trajectory to go from developing a model to getting it implemented in clinical practice?	Very good question. To the extent that what we talked about reflects reality I would call this a nascent learning health system, not yet fully engaged. Further reflection and engaging clinicians, patients, families, health system decision makers are all aspects that could be enhanced.
Is the Learning Health Community participating in deterioration index study a continuing "community of practice" collecting and sharing knowledge still?	Yes, in many respects, although not as a formal system. Supporting it is a key opportunity.
When we created a novel Pediatric Early Warning Score. A pediatric deterioration model. It became a better tool than all the previous iterations of PEWS. Our challenge when mapping patient outcomes ICU transfers and rapid response team called. We couldn't eliminate clinician variance in risk - essentially when should they transfer and how early should rapid response be called. Were you able to come up with an objective set of criteria for ICU transfer required? or simply did the event happen?	The brief answer is no. I think that the deterioration index score was considered, but the decisions really were based on patient status and the immediate judgement of the clinical team.

Question	Answer
<p>In addition to the patient's health history if available, did genomics play a role in the model or do you see the value of genomics in predicting outcomes in the future?</p>	<p>Excellent question. For the Epic Deterioration Index, genetic determinants were not included. We are doing some other work on genetic determinants related to drug selection and drug dosing. One of the many challenges we face is that only a small subset of patients currently undergo genetic testing to provide the germline genetic information needed for model-making and model use.</p>
<p>Should you use/work with a commercial model you do not know the content of. Is that scientifically/ethically defensible?</p>	<p>Great question! There are certainly some ethical dilemmas that we face when it comes to using proprietary models that provide logic of which model users are not completely aware. For example, what if it were shown that a commercial (closed, proprietary) model - when used - brought improved health outcomes even though its users were unaware of precisely how the model worked? One could argue that NOT to use a model that brings improved health outcomes is an ethical problem. Overall, though, our recent work with other members of the Mobilizing Computable Biomedical Knowledge (MCBK) community (<a href="http://mobilizecbk.org">mobilizecbk.org</a>) includes a call to make biomedical models used in research, education, clinical care, and public health transparent and open. We must stipulate that open is not the same as "free", however. Open means that fees for access may be applied so that model-makers can sustain their activities and support appropriate, ethical use of biomedical models.</p> <p>In the particular case of the Epic Deterioration Index, we knew what variables went into the model from documentation that was provided to us but did not know the parameters (or variable weights) or its functional form (regression model versus random forest, etc.). The variables included in the model seemed defensible, so the main questions we faced were 1) Is the final result of the model accurate? 2) Is the model biased in any way against specific vulnerable groups and how? We addressed question #1 in our preprint that is available online. We also evaluated question #2 and will be sharing details in the next version of the preprint.</p>
<p>What happens to this prediction model once the Covid19 pandemic ends and case counts are significantly reduced?</p> <p>How much work needs to be done to use this predictive model for a new infectious disease in the future?</p>	<p>My answer- - a lot! I think it's probable that new diseases will require re-assessment. However, hopefully, our ability to do this would be faster.</p>

Question	Answer
<p>After implementing a digital intervention (deterioration model) in a clinical setting and found that the performance is not effective, how can we track down or narrow down where the problem is? Do we need to evaluate each step D2K, K2P, P2D before moving to the next step, or is there a way to measure the effectiveness as a whole loop?</p>	<p>This is an important reason not to just use data to try to understand this, but to talk to people as well. They can often pinpoint the problem long before we can work through all the points of the cycle using existing data.</p>
<p>Regarding the ethics part, I wonder on which ethical basis could someone decide to provide clinical guidelines using an unvalidated metric (as EDI would be at least at the beginning of the crisis)?</p> <p>P.S. I am not criticizing. I am impressed as I think that this is a very difficult decision to make (and a very risky one) and this is why I am wondering...</p>	<p>Although there isn't published literature on the validation of the Epic Deterioration Index, Epic does provide estimates of validity to customers who implement the EDI. So from the standpoint of many health centers, I imagine they would believe that they had sufficient data on the validation of EDI more generally (pre-COVID) to be able to apply it to COVID patients.</p> <p>In our case, we waited to make any recommendations about how to use the model score until we had validation results from 174 COVID patients, which gave us an opportunity to operationalize this shortly prior to when our field hospital was expected to open.</p> <p>The ethical issues supporting the use of a model in this setting would relate to maximizing the good for the greatest number of people (the utilitarian approach). To an extent, these principles are pervasive in the field of disaster medicine. In a disaster scenario where you reached a patient census &gt;3x your hospital's capacity, clinicians may not be able to comprehensively evaluate and triage patients effectively. If the alternative was to transfer patients to a field hospital randomly or on a first-come-first-serve basis, many sick patients may end up being transferred to lower acuity care, which wouldn't be optimal. If you could effectively risk-stratify patients, you would be able to send less-sick patients to a field hospital, which would benefit the health of those patients who you chose not to transfer.</p> <p>More: Of course there are other approaches to ethical reasoning that must be considered. Disability activists, among others, worry about the use of utilitarianism in making triage decisions, fearing they will be discriminated against, their lives seen as less valuable. See: <a href="https://www.ijfab.org/blog/author/jackieleachscully/">https://www.ijfab.org/blog/author/jackieleachscully/</a></p>

Question	Answer
<p>For Dr. Platt: Very much appreciate shining a light on health and mortality disparities that you highlighted. I'm curious if any in the community have examined the risks, significantly increased infection rates (i.e. over 25% COVID cases in Washtenaw Co. are healthcare providers), variation in infection rates among different healthcare professional roles and ethics surrounding providing care and potentially putting healthy patients and community members at risk? Would there be a value in risk stratifying/scoring colleagues to understand family/community risk?</p>	<p>Great question. I'm not aware of this analysis, but it will be important to look at how COVID is affecting different groups, understanding risk, and whether and how we're supporting people who get the disease.</p>
<p>Slightly unrelated to today's presentation, are there any predictions/models on how the protests will lead to an increase of COVID19? Will there only be a slight increase as these protests are outdoors?</p>	<p>I don't think we know, but we will likely find out.</p>
<p>Hub: How can we learn if we do not know the content of a model???</p>	<p>Thank you for the question. If this question relates to the Epic Deterioration Index (or any proprietary prediction model), there is a lot that we can learn about the model even in the absence of complete information about it. We know what variables go into the model. We have time-stamped predictions from the model for patients. With only that information, there's a lot we can learn. For instance, we can figure out: 1) Is the final result of the model accurate? 2) Is the model biased in any way against specific vulnerable groups and how? We addressed question #1 in our preprint that is available online. We also evaluated question #2 and will be sharing details in the next version of the preprint.</p> <p>I do not mean to defend proprietary models in this response. Rather, I'm just pointing out that even knowing just the prediction model score and the actual outcomes gives us the ability to discover key characteristics about the model.</p>
<p>Great presentations!! How has this pandemic influenced the policy, patient privacy, and ethics when it comes to contact tracing?</p>	<p>Great question - Contact tracing has a long history of policy and ethical considerations. New in the context of COVID-19 is the role and of technologies and private companies (smart phones, geo-location, apps, etc.) I think we're still learning the answers...</p>

<b>Question</b>	<b>Answer</b>
The next big covid question regards test and trace. Do you anticipate using the learning cycle to find super spreaders and change population level behavior?	(partial answer) Great question! Epidemiologists have studied contact tracing through network analysis, to find the minimum set of nodes or clusters (that could be considered “super spreaders”) that if quarantined, would minimize the spread. However, these have primarily been retrospective analyses and not been tested “live” as a disease spread. There are also many unresolved privacy and ethics related implications that need to be considered.