USING BAYESIAN REASONING TO PREDICT WHEN A PATIENT WILL DISCONTINUE THERAPY

Can we predict with any accuracy whether an individual patient is likely to discontinue drug therapy? We're not talking about knowing if a patient has stopped using their meds, but if they're likely to do so. It might sound like something out of "Mission Impossible," but it's just data analytics at work in pharma. Yes, we're that cool.

This is regarding a presentation made at last year's PMSA conference by Jean-Patrick Tsang, founder and president of Bayser, a Chicago-based consulting firm dedicated to pharmaceuticals sales and marketing. JP is an expert in patient-level data and related analyses, and he's focusing on using a novel approach, Bayesian reasoning, to predict when a patient will discontinue therapy.

Look at the persistence curve of any chronic therapy and you'll invariably see a significant drop in the earlier stage of the therapy. We all know there is a slew of events that influence discontinuation. For starters, let's include factors like:

- Admission to an ER
- A visit to another doctor for a second opinion
- A change in dosing
- A side effect
- An increased co-pay
- The drug simply not working
- Negligence (just forgetting to take it)
- Psychology (If I'm taking medication, that means I'm sick.)

We know they have an impact but are not quite sure about the magnitude of the impact. We also sense that the impact of these events may not be the same if the patient is in the early stage or latter stage of the therapy.

Also, we cannot ascertain if the difference is limited to magnitude or also involves directionality. If we could somehow quantify the impact of an event on patient discontinuation while differentiating, say, between early stage (ramp-up) and latter stage (cruising), we would be able to establish which events are material and which ones are not.

We would then be able to focus on the important ones and identify relevant interventions both at the physician and patient levels that would significantly reduce the odds that the patient would discontinue therapy. We could gain additional insights by analyzing the impact on competitive drugs.

Enter Bayesian Reasoning

Bayesian reasoning is about how we update our belief in light of evidence. If we do not know much, we'll assume that each patient has the same probability of discontinuing therapy. We can derive this from the adherence curve of the patient cohort we are tracking.

Using patient data, we know that patient 12345 who is under the care of Doctor John Smith has not filled the prescription for the last two months, has been admitted to the hospital, underwent a procedure, saw a second physician, has been diagnosed with a new diagnosis, was ordered a new lab test, or had another variable happen.

For each of the events, we have a likelihood that says how likely this is to appear if the patient were to discontinue compared with if the patient were to remain on the drug. We combine all the likelihoods and come up with a new probability of discontinuation that is specific to that one patient. This is called the posterior probability. We usually use a threshold to convert the probability into a yes/no answer.

Then What?

Many events that drive discontinuations have strong clinical rationale, including hospitalization and the seeing of additional specialists. But certain events may signal opportunities for intervention, including changes in dosing and change in the days' supply of the drug.

When we know patient 12345 is likely to discontinue with his therapy, we can have targeted interventions. It means contacting the patient's doctor. We can do this through visits from sales reps, emails and other forms of contact that will let the physician know their patient is likely to stop.

Takeaways:

- We can predict discontinuations with high accuracy.
- More work is needed to effectively triage at-risk patients to a specific intervention.
- The analytical path to identify root causes can now be more focused.

"This is a success story that shows that we can indeed predict with great accuracy when a patient will discontinue therapy, which some still have trouble believing we can accomplish," said JP Tsang.

It's about explainability. We need to understand why the algorithm is saying what it's saying. Explainability is very difficult to achieve but we can start with transparency. Bayesian reasoning, we found out, strikes a good balance between accuracy (neural net) and transparency.

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