western boundary current on the overlying atmospheric track is only captured by models that resolve the sharp oceanic temperature front with length scales smaller than 100 km (9, 10). Only in this case can the oceanic mid-latitude warming affect the atmosphere throughout its depth and effectively anchor the storm tracks and the westerly jet to the western boundary current thermal fronts. Thus, long-time, large-scale synchronization of the Gulf Stream and Kuroshio is only captured by coupled models that resolve fast-time, small-scale processes.

The interannual to decadal synchronization of the Gulf Stream and Kuroshio has important implications because the mid-latitude storm-track and jet activities modulate extreme temperature and precipitation over land (11). Low storm-track activity in summer leads to persistent, stationary anticyclones and heat waves. For example, the summer of 2018 was associated with large positive sea surface temperature anomalies just south of the Gulf Stream front, shifting the North Atlantic jet far to the north and leaving northern Europe, the United Kingdom, and Scandinavia under dry, hot conditions for months (12). The widespread concurrent heat anomaly in the North Pacific sector, leading to heat waves in Japan, South Korea, eastern China, and the western United States, was associated with a large positive sea surface temperature anomaly at the Kuroshio front (13).

The analysis of Kohyama et al. indicates that there is no substantial lag between the oceanic temperature anomalies at the Kuroshio and Gulf Stream fronts. Nevertheless, the synchronization of the western boundary current fronts and associated storm-track modulation, enhances our ability to predict increases in the frequency of extreme events on interannual to decadal time scales.

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DEcision SCIENCE

Physicians’ flawed heuristics in the delivery room

Delivery complications can influence later decision-making

By Meng Li and Helen Colby

Clinical decisions require physicians to integrate a complex and changing set of stimuli to determine the best course of action for the patient, often under time pressure. Although physicians are highly trained experts, they are also human, and decades of research have shown that we frequently rely on heuristics or decision rules when making complex decisions. Although efficient and sometimes adaptive given our limited cognitive capacity, heuristics can also lead to suboptimal decisions (1). This understanding of bounded rationality has led to effective interventions in government policy (2), health behavior (3), environmental choice (4), and other domains but has not yet been widely accepted by medical professionals (5).

On page 324 of this issue, Singh (6) demonstrates that physicians delivering babies appear to rely on a suboptimal heuristic, tending to switch to the alternative delivery modality (vaginal versus cesarean) for their next patient if their immediately prior delivery had complications, and this leads to negative patient outcomes.

The relative lack of acknowledgment of potential decision biases in clinical practice may be partially because of the difficulty studying, and thus limited evidence of, physicians’ cognitive biases in real-world clinical settings. Indeed, physician decision research has mostly relied on hypothetical scenarios (7). Using experiments in the clinical setting would cause moral concerns because subjecting physicians to experimental conditions that may elicit suboptimal decisions would mean harming real patients. Using nonexperimental design means relying on analysis of existing medical records, and it is often difficult to definitively identify what the rational medical decision should be for a given patient on the basis of their records alone. Singh overcomes these challenges by focusing on the switching pattern in delivery modality decisions, using more than 86,000 patient health records, from both an urban and a suburban academic hospital, spanning January 2000 to September 2020.

Deliver decision-making is an especially astute context for studying clinical decision biases not only because it has a serious impact on both a mother and a newborn but also because it provides a circumscribed set of decision options—the delivery can only occur by a vaginal birth or a cesarean section. Singh finds that if a physician performed a vaginal delivery that had complications, the physician is more likely to perform the next delivery by cesarean than if the prior vaginal delivery had no complications—and vice versa for when it was an earlier cesarean that had complications. This switching behavior is specific to complications in the patient immediately before the current delivery, and is more pronounced with greater numbers of, and more severe, complications in the prior patient.

Delivery decisions made by physicians are complex and must take into account a wide variety of data, as well as the available resources and the preferences of the patient. In some instances, there may be a clear indication for vaginal or cesarean delivery. However, there are many less-clear-cut situations in which there is considerable physician leeway (8). For example, it is unclear how to optimally balance patient preferences with the speed of labor progression to determine whether to choose cesarean delivery for a patient whose vaginal delivery is progressing slowly. Although there is not a discoverable “correct” method of delivery for each patient, and perhaps exactly because of such ambiguity, delivery mode decisions can be influenced by factors that should not be part of the rational calculation; in this case, Singh found that it is influenced by what happened to the physician’s immediately prior patient.

Singh’s results are of more than just theoretical interest. Delivery modality switching leads to concrete, albeit small, negative patient outcomes for both mother and newborn. Switching after complications leads to an increased probability of death for the mother or baby (by 0.04 SD), a decreased probability of the patient being discharged home (by 0.03 SD), and an increased num-

By

Department of Health and Behavioral Sciences, University of Colorado Denver, Denver, CO, USA. 2Kelley School of Business, Indiana University, Indianapolis, IN, USA. Email: meng.li@ucdenver.edu

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in certain situations (9, 10). In the medical context, this heuristic would be rational if the specifics of the prior patient matched the specifics of the current patient and thus provided a useful learning experience. In that case, if one patient’s delivery went wrong, it can tell the physician that the same delivery plan may not work well with another patient with very similar characteristics and indications. However, two patients who happen to have consecutive deliveries by the same physician are not expected to be so highly similar, and, thus, using the outcome from the immediately prior patient to determine delivery modality for the next patient is a misapplication of an otherwise intuitive and perhaps useful heuristic.

Physicians’ use of the “win-stay-lose-shift” heuristic does not mean that they lack medical expertise or training. Indeed, Singh finds that more experienced physicians use this decision rule more often, even though physicians who rely more on this rule have switching behavior is only present based on the outcome of the immediately prior delivery—but not deliveries two, three, or four patients prior—supports this explanation. In addition, people rely on their affective response to gauge how large a risk is (12), and delivery complications can be highly emotional and thus distort a physician’s estimate of such risk, prompting them to switch to a different delivery mode to avoid the increased perceived risk. A third potential mechanism is confirmation bias, or the tendency to seek out information that provides support for one’s current opinion or position (13). Physicians who are uncomfortable with a modality because they recently had a negative experience with it may inadvertently seek and interpret evidence in a way that is consistent with such fears, which helps them feel comfortable that modality switching is appropriate for the current patient.

How can we help physicians overcome reliance on maladaptive heuristics or decision rules? The first step is to acknowledge the phenomenon without condemning physicians. Although understanding decision biases usually does not entirely ameliorate them (14), teaching doctors about heuristics may promote the acceptance of potential interventions. More research and clinical efforts need to then focus on designing and testing decision aids that are beneficial to patients and user-friendly to physicians in the labor and delivery context. In addition to making sure that the decision aid has a high degree of scientific accuracy in recommending the optimal treatment option, studies also need to examine whether physicians will accept and use such recommendations, because physicians may have understandable concerns about recommendations from a “black box” (15). It is also useful to explore non-algorithm-based decision aids such as decision trees or check lists, which are more transparent (15), although it remains to be seen if such simple decision aids are applicable in the complex labor and delivery environment. In addition, there is a slightly larger delivery-mode shifting effect for consecutive deliveries within 20 hours, and the effect evaporates for deliveries more than 72 hours apart. This suggests that the influence of the delivery with complications fades with time. Further research should explore interventions to help physicians clear their minds between deliveries in a way that is similar to the natural effect of time.

It is time to acknowledge the prevalence of heuristics and decision biases in clinical practice and to view these patterns as predictably human instead of blaming individual doctors. Only then can we start helping doctors improve clinical decisions and, as a result, the health of the public.

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Meng LiHelen Colby

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