important to evaluate long-term data to ensure that it is leading to improved outcomes.

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1. Black WC, Welch HG. Advances in diagnostic imaging and overestimations of disease prevalence and the benefits of therapy. N Engl J Med 1993;328:1237-43.

2. Vaccarella S, Franceschi S, Bray F, Wild CP, Plummer M, Dal Maso L. Worldwide thyroid-cancer epidemic? The increasing impact of overdiagnosis. N Engl J Med 2016; 375:614-7.

3. Hamdy FC, Donovan JL, Lane JA, et al.

10-Year outcomes after monitoring, surgery, or radiotherapy for localized prostate cancer. N Engl J Med 2016;375:1415-24.

4. Merrill AL, Esserman L, Morrow M. Ductal carcinoma in situ. N Engl J Med 2016; 374:390-2.

5. Ryser MD, Worni M, Turner EL, Marks JR, Durrett R, Hwang ES. Outcomes of active surveillance for ductal carcinoma in situ: a computational risk analysis. J Natl Cancer Inst 2015;108:djv372.

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Managing Uncertainty — Harnessing the Power of Scenario Planning

Margaret L. Schwarze, M.D., M.P.P., and Lauren J. Taylor, M.D.

The greatest danger in times of turbulence is not the turbulence, it is to act with yesterday's logic. — Peter Drucker

When he got behind the wheel that evening, Father Andrew had no way of knowing how the drive would end. At age 87, he still drove to the grocery store, remained active in church, and lived independently. He could not have anticipated waking up in intensive care with tubes in his chest and down his throat. Sadly, his condition was worse than broken ribs. Chest radiographs revealed metastases exacerbating his tenuous respiratory status.

The following day, the trauma surgeon sat at his bedside, her voice cutting through the methodic ebb and flow of the ventilator. The risk of death, she said, for a person in his 80s increased linearly with the number of fractured ribs. For him, it was over 90%. Father Andrew, remarkably alert, listened intently. He scrawled on his notepad in unsteady script, "What about my car? When can I drive again?" His sister commented: "You see . . . he's a fighter."

Although prognostic certainty remains elusive, many clinicians use statistics to quantify outcomes. We strive to achieve increasing precision with risk calculators and use the best available evidence to report probabilities of discrete complications. Decision aids allow us to share these predictions with patients and facilitate comparison between treatments. Although numbers quantify uncertainty, they offer little guidance to patients for managing this uncertainty. Moreover, these strategies fail to illuminate logical connections between the patient's current condition, downstream outcomes, and events experienced along the way.

When confronted with new, overwhelming information, people often develop blind spots for poor outcomes.¹ Patients struggle to interpret the most dire forecasts, often assuming that 90% mortality means a 10% chance that life will be just as it was before, even when "life as usual" is simply not possible. Achieving decisions that accord with patients' goals requires more than current decision supports provide. Better predictive models and more accessible representation of outcomes are not enough to engage patients in strategic deliberation or prepare them for the unthinkable. Instead of more information, patients need more interpretation of the available data.²

Similar to risk prediction, traditional economic forecasts aim to assist business managers by extrapolating from observed trends. If the price of oil rose by \$5 per barrel last month and \$2 per barrel the month before, economists use these data in sophisticated models to calculate the expected price next month. Though such projections can be useful, they do not allow decision makers to prepare for alternative outcomes or anticipate the ramifications of major shifts.

In the turbulent 1970s, Pierre Wack, an economist for Shell Oil, popularized "scenario planning" to translate vast probabilistic information and facilitate strategic decisions.^{3,4} Rather than emphasizing precise prognostication, this technique generates multiple plausible futures. Each scenario helps decision makers visualize what might happen under various sets of assumptions — discovery of new oil fields, say, or turmoil

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in the Middle East — challenging their view of reality. By considering a range of scenarios, Shell's managers could perceive how interrelated events influenced longerterm outcomes and could anticipate major changes.

With epidemiologic data and evidence from clinical trials, our "forecasts" for health care decisions are arguably more robust than those for economic trends. Still, like forecasting during periods of market volatility, our predictions often fail patients in the setting of a serious illness, such as a traumatic injury or a new cancer diagnosis, or when they face high-risk treatment. Although many patients can weigh probabilities, even the most accurate prediction does not emotionally prepare them for treatment burdens or reveal the interplay between acute illness, coexisting conditions, and health outcomes. Examining possible scenarios can help patients look beyond isolated risks to imagine a new potential reality.

Scenario planning asks us to accept uncertainty and use it as part of our reasoning. To do so, we must first distinguish irreducible uncertainties from "predetermined elements" — events that have already happened or are likely to occur but whose sequelae have yet to unfold.³ Identifying these elements promotes insight by highlighting the interaction between forces that drive change and provides an organized way to consider alternative futures.

Scenario planning permits advisors (economists, physicians) to say "I cannot predict the future, but if all goes well, this is what is likely to follow, and if things go poorly, this is what we can expect." Instead of quoting a 75% chance of respiratory failure, we can generate best- and worst-case narratives to demonstrate the logical connection between events (rib fractures, pneumonia) and underlying conditions (cancer) to reveal what may follow, after isolating what is unknown (questionable respiratory status). Scenarios allow decision makers (managers, patients) to appreciate causal relationships and imagine a range of outcomes on the basis of sound analysis of the present.

What would happen if all went well for Father Andrew? He would need ventilator support for many days. He would have pain and be unable to talk to his family. He might gain enough strength to be extubated, but given his age and pulmonary function, he would never regain the independence he has enjoyed. His cancer would continue to grow, and he would die — it's hard to say exactly when, but sooner than he hoped. In this way, we can show the limits of possibility with both best- and worst-case scenarios and then build a story line corresponding to what is most likely.

A scenario should be realistic and accessible to patients; it must span the distance between their personal story and the realm of health and illness. Well-constructed scenarios manage complexity by prioritizing the deepest concerns and values of the decision maker. This personalization helps patients create new perceptions about how their illness might progress and the implications for daily life. By exposing obstacles, scenarios promote the strategic thinking that is essential in considering treatments for complex health problems.

Using scenarios is a tool for engaging decision makers. The aim is not to develop the "correct" scenario, but to describe a range of stories illustrating how the future might unfold. A major strength of this approach is its flexibility in tailoring descriptions of outcomes to each patient's circumstances; but scenario construction is influenced by the clinician's perspective. Though there is some evidence that the variability among physician-generated scenarios is minor,⁵ it's unclear how important the variation is to patients.

Physicians may find scenario planning intuitively appealing, and some will claim that they already do it. This perceived ease and enthusiasm are a blessing and a curse. As Wack noted,^{3,4} scenario planning and forecasting are as different as judo and boxing; telling patients there is a 25% chance of the best-case outcome is not scenario planning. When it comes to implementing novel health care delivery strategies, users need to appreciate the challenge of developing the skills required to deploy them correctly.

The surgeon returned to talk with Father Andrew and his family. Still alert and engaged, he listened attentively as she described the best, worst, and most likely scenarios for his current care plan. In the best case, he would make it out of the hospital, but given how the tumors compromised his breathing, he would need substantial nursing care; he would never drive again. The worst case included a constellation of setbacks and procedures; he would remain intubated and die. The surgeon carefully explained how the breathing tube would make it difficult to talk with family or say goodbye. She then described what was most likely: he would improve somewhat, but would ultimately struggle to breathe on his own and would die within

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days. She also described the best, worst, and most likely scenarios for a comfort-focused plan. Recognizing how important it was

An audio interview with Dr. Schwarze is available at NEJM.org

to him to interact with people — communication with

others had been his life's work — Father Andrew asked to be extubated. He died later that day, surrounded by family. The patient's name has been changed to protect his privacy.

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1. Schwartz P. The art of the long view: planning for the future in an uncertain world. New York: Doubleday–Currency, 1991.

2. Russ AJ, Kaufman SR. Family perceptions of prognosis, silence, and the "sudden-

ness" of death. Cult Med Psychiatry 2005;29: 103-23.

3. Wack P. Uncharted waters ahead. Harvard Business Review. September 1985 (https:// hbr.org/1985/09/scenarios-uncharted-waters -ahead).

 Wack P. Shooting the rapids. Harvard Business Review. November 1985 (https://hbr .org/1985/11/scenarios-shooting-the-rapids).
Levin TT. Discussing cancer prognosis. Oncology (Williston Park) 2015;29:142-4.

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Certain about Dying with Uncertainty

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Mrs. C., a woman with whom we'd had a long-standing patient-physician relationship, one of us for over 25 years, died recently in the 87th year of her life. A woman who had always maintained her cheerful spirit even in the midst of quite trying medical setbacks, she was one of our favorite patients. But what made her most special was her perspective on life and death: we learned a lot from her.

Mrs. C. was a child of the early 20th century. Born in 1930, she was in her formative years when World War II ended. She lived north of Boston, married there, and raised her family. As was common at that time, her father and siblings smoked, and she started smoking as a teenager. By the time she was 20, she was at a pack a day, sometimes more. It was not until 1995, more than 30 years after Surgeon General Luther Terry's report documenting that smoking posed a health hazard, that she quit.

But the damage had already been done. By the early 1990s, her FEV_1 was 35% of the predicted value, and she was short of

breath walking on a level surface at a modest pace. The damage went beyond her lungs: she had coronary artery disease and ischemic cardiomyopathy. Despite these challenges, she was unusually optimistic and continued living a rich and full life.

Nevertheless, when her husband died of a brain tumor about 5 years ago, she witnessed the good and the not-so-good that medicine had to offer. She saw interventions that improved things slightly for a short while but did not provide meaningful and sustained benefit. After he died, we had "the conversation"; we had broached the subject before but had never discussed it in great depth.

She knew what she wanted. She told us and her family that she had enjoyed a good life and if an event came along that was the medical equivalent of a flat tire, we should fix it. But if something happened that required major intervention, she didn't want it. We vowed to keep our part of the bargain. If we had only known how hard that would be.

The next few years were largely

uneventful, save for minor COPD flares, so her care was easy. Then, several months ago, her daughters brought her in with massive lower-extremity edema and hypoxemia. Her hematocrit was 18; she was in florid cor pulmonale. Blood transfusions, oxygen, and diuresis brought her back, and soon she was home but without a firm diagnosis explaining her anemia. She initially thought of this event as a flat tire, but we knew there was more going on. Our training taught us to find the cause, and we spoke with her about the next steps in her evaluation. If she had cancer, given her coexisting conditions, it would be hard, if not impossible, to treat or even palliate. But it was possible that she had a benign and treatable condition and her former life could be restored.

This is where she became the teacher, and we her pupils. Our diagnostic uncertainty might have been uncomfortable for us, but it wasn't for her. She was at home and not struggling for every breath. She could tolerate the absence of a firm diagnosis because she was not interested in paying the physi-

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