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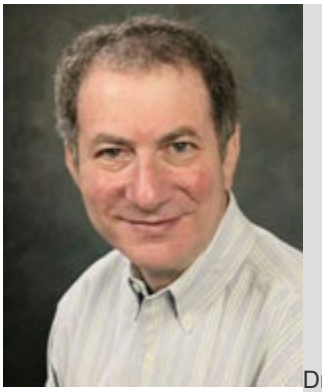
Modeling for Research Success



Dr. Eric J. (Rocky) Feuer

Kentucky has the highest smoking rate in the country. Nearly 29 percent of adults in the Bluegrass State smoke. But what could happen if it significantly strengthened its tobacco control policies? Could that number be appreciably reduced?

According to one complex computer model developed by NCI-funded researchers, the SimSmoke model, markedly enhanced tobacco-control efforts in Kentucky could reduce smoking prevalence there to 14 percent over the next 17 years, saving 17,000 lives in the process. That's a powerful message for the people of Kentucky, particularly its health care professionals and policymakers. And it also demonstrates the utility of modeling as an important tool in biomedical research.

NCI's Cancer Intervention and Surveillance Modeling Network (CISNET) is a large, coordinated program that uses complex multi-cohort modeling to better understand, at the population level, the impact existing and emerging cancer control interventions—whether they are screening modalities, drug therapies, or a multimodal approach to smoking cessation—have on trends in cancer incidence and mortality. Nine years after CISNET was launched, this innovative program is providing important insights on the prevention, diagnosis, and treatment of the four most common cancer types: prostate, lung, colorectal, and breast.

Importantly, the "outputs" that can be generated by these models go beyond mortality, though that is the most important consideration with any cancer intervention. Outcomes such as overdiagnosis, quality-adjusted life years, and the direct costs associated with different interventions or intervention approaches (such as different screening intervals) can also be generated.

The role of modeling—and, consequently, a program like CISNET—has taken on greater importance as cancer interventions become more complex, technology continues to change at a torrid pace, and we gain further insight on the long-term consequences and outcomes of existing interventions.

Modeling also fills an important information gap, because we'll never have evidence from randomized clinical trials for every possible care situation, even those that represent fairly common care scenarios. Modeling research attempts to step into this breach, using surveillance data from programs like SEER as well as usage trends of the interventions being studied, clinical trial results (which remain the gold standard for assessing the efficacy and risks of any intervention), findings from epidemiologic studies, and laboratory research on the biologic and molecular characteristics of precancerous lesions and tumors.

Last year CISNET was commissioned by the U.S. Preventive Services Task Force (USPSTF) to conduct a decision analysis to assess the life-years gained with different screening approaches for colorectal cancer—much like what was done for the updated mammography recommendations issued yesterday. Two "microsimulation models" were used to assess the impact of screening with fecal occult blood testing, sigmoidoscopy, and colonoscopy beginning and ending at different ages and conducted over different time intervals (e.g., every 5 years, 10 years, etc.). The USPSTF used the results, along with an intensive literature review performed by other researchers, to help update its screening recommendations for colorectal cancer.

As this modeling study for colorectal screening demonstrated, using such data and what might be called highly educated assumptions, modeling can do what no other type of study can do: track a population over its entire life course. And when you then have multiple researchers using their own individual models that take into consideration different parameters, something that is often done with CISNET studies, it strengthens the credibility and robustness of the results.

Looking forward, there are some exciting opportunities for CISNET on the horizon. We have had discussions, for example, about a potential collaboration with NCI's Integrative Cancer Biology Program, which supports complex computer models of processes like tumor development at the molecular and cellular level. Another study will use modeling to assess some of the discrepant results between the recently published large U.S. and European clinical trials of PSA screening for prostate cancer.

CISNET is part of NCI's Surveillance Research Program within the Division of Cancer Control and Population Sciences. Programs like CISNET demonstrate that surveillance research is not just a way to demarcate cancer trends. Rather, it is a feedback mechanism for the entire cancer research community. With CISNET, we use modeling to digest surveillance and other data and translate it in ways that otherwise cannot be done. It is an important process that allows us to optimize our research enterprise and obtain the biggest possible declines in cancer mortality in the most effective manner.

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