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Innovative DM planning tool

Computer model creates a 'virtual world' for forecasting costs, outcomes

There is no question that health care planners are working diligently to get beyond merely predicting next year's costs and complications. Particularly in the case of disease management, if dollars are spent today, DM planners want to know what their outcomes will be in five years, and how those outcomes translate into ROI.

While predictive modeling programs seem to be attracting the lion's share of attention these days in the evolution of health care forecasting, there is considerable buzz about an innovative computer simulation model that may well be more versatile in the types of information it can provide.

Dubbed 'Archimedes' after the famous Greek mathematician and inventor, the model was developed over the past several years at Kaiser Permanente's Care Management Institute in Oakland, CA. The goal of this project was to come up with a tool that could help the organization better analyze prevention programs and treatment protocols, develop clinical practice guidelines, and establish priorities.

While the model has only just begun to look at many of the complex questions before today's health care decision-makers, observers suggest its greatest potential may well lie in its ability to guide organizations in the way they target and treat chronic illness. In fact, to that end, Kaiser has joined forces with the American Diabetes Association and Bristol-Myers Squibb to apply this powerful new tool toward improving the care of diabetes.

Archimedes a 'simulation' model

Archimedes is different from a typical predictive model in numerous ways, according to **Len Schlessinger**, PhD, the manager of Biomathematics at Kaiser's Care Management Institute and a co-developer of Archimedes with **David Eddy**, PhD, a senior advisor to Kaiser. "This is a simulation model. What it does is generate simulated people and they have all the important characteristics of real people," explains Schlessinger, noting that the model can generate as many as 100,000 simulated people who are modeled after a specific group of real people. "The model is somewhat physiologically based, so each person has a heart and a circulation, and the mathematical model of each heart and circulation are generating a BP."

Another unique feature of the Archimedes model is that it can move these simulated people through time, so that researchers can look at clinical events that happen in scales of years. Additionally, the model works on a level of detail that is designed to be equivalent to the level of detail involved with clinical decision making. "We have tried to include in the model everything that a clinician would need to make a decision. So if, in the course of treatment, a physician checks a patient's BP, his cholesterol, and he does an EKG, then all those things have to be in our model, and they have to be dependent on the other features of the model that the physician could change. I don't believe any model is that detailed," stresses Schlessinger.

Model forecasts 'far into the future'

Of course, built into the model are detailed descriptions of the natural progression of CAD, heart failure, diabetes, and asthma -- each of the diseases that Archimedes has, thus far, been pre-

pared to analyze. Consequently, the computer can use, in its calculations, the effects of various medicines on the progression of disease as well as the impact of certain protocols in treating disease.

"For example, in the CAD model, we have a model of the heart and the heart has coronary arteries that occlude according to the natural progression of heart disease that we have generated using the literature," says Schlessinger. "And when the occluding gets to a certain value, the simulated person will feel pain and call Kaiser. He then might contact the call center and get treated according to the protocols of the call center, and then sent to his PCP. Then the PCP in the model will follow certain protocols and will do certain things to the patient that will change the progression of disease."

Schlessinger emphasizes that Archimedes does not pull its information out of a database during a simulation. Rather, the computer has constructed models based on data that has been mined from the literature. "We cannot manufacture any new fundamental information. We can only forecast things that are near the kind of data we have," he explains. "We would never have been able to predict how Fen-Phen affected the heart, for example. That was a new effect. Archimedes can't predict things like that, but it can forecast far into the future if you are not too far from some of the data you already have."

Analyses can predict ROI

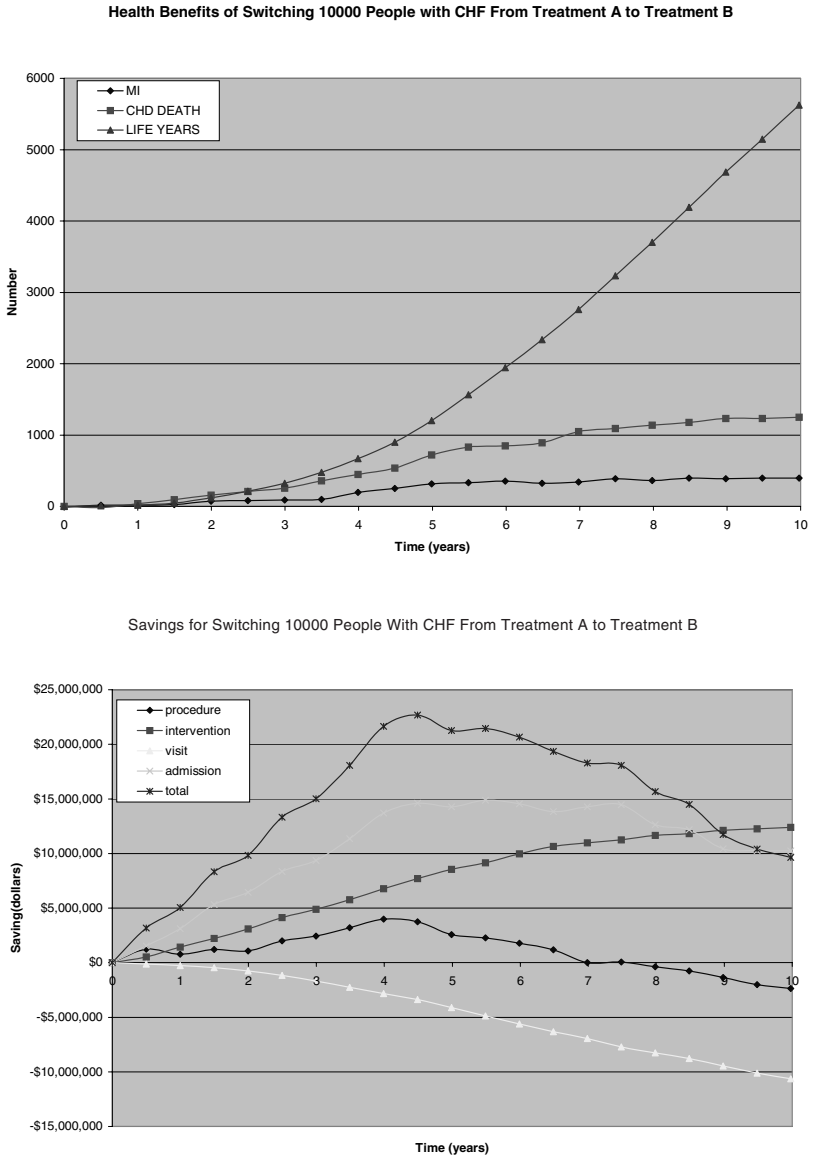
The potential uses for the this type of decision support are almost unlimited. For example, analyses by Archimedes could make health planners feel more comfortable about spending money on a particular program if the model suggests that the program will deliver an ROI in 18 months.

"It will allow [health planners] to investigate the consequences of those decisions to see what the effects might be 10 or 15 years down the line," notes Schlessinger. "But it can also tell them what to look for in years one, two and three to see if they are on track."

As an example, Schlessinger notes that the model could look at the financial and clinical impact of a particular intervention designed to improve a population's glycemic control. "The model could say that in one and a half years you should expect to see fasting plasma glucose levels go down by 11%. You won't see a change in admissions until year 3, but then you will see money saved and you will see the number of photocoagulation surgeries going down by 22%."

Researchers are, in fact, already using Archimedes to study the impact of various care management interventions for heart failure. "There are certain goals -- like making everyone compliant with ACE inhibitors and beta blockers, and there are certain activities such as nurse triage or patient education. We take each one of those things and show what the effect of increasing the amount of that would be," explains Schlessinger. "So you can see what would happen if

Figure 1: Example of Archimedes Output



Source: Kaiser Permanente's Care Management Institute, Oakland, CA.

you changed the compliance rate of ACE inhibitors by 10% -- how much that would affect health outcomes and costs in 10 years. Or you can look at what would happen if you increased the compliance rate with beta blockers by 10%, or increased nurse triage."

Using these building blocks, Schlessinger notes that health planners could put together a program that allows them to plug in services and programs that, theoretically, will result in the best outcomes at the lowest cost. **(See Figure 1.)**

Simulations can not be generalized

Given the level of detail that goes into the Archimedes calculations, providers must be careful not to generalize the results to other populations. "We can put in the exact demographics of a local medical center, and also the details on all the care processes they use. Those vary so much from place to place that it is hard to generalize a set of conclusions from one place to somewhere else," comments Schlessinger, noting that researchers have carefully evaluated the distinct care practices at a number of individual Kaiser facilities.

Also, it is important to point out that gathering and inputting this level of detail into the Archimedes model can be labor intensive. "If we went to a particular setting, it would take a while to get all the processes of care they have included in the model to make sure we have the right interval between physician appointments, and what they do when a person goes to the ER, what protocols are followed, and so on."

In fact, when compared to a predictive model, an Archimedes analysis takes much longer to complete. "Predictive models may take at most a few minutes or maybe an hour to run. A disadvantage of our model is that it is very time consuming. It follows 10,000 to 100,000 people through every episode of health care, so it takes a relatively long time -- say 24 to 48 hours to run, or even longer because every time you change a parameter, you've got to wait for two or three days to get the results."

Early evidence of model's validity

How do researchers know the calculations of Archimedes are valid? By comparing its calculations to those of already completed randomized controlled trials, researchers have good evidence that the model's analyses are credible. However, Schlessinger notes that he is eager to obtain further evidence that the computer's forecasts are reliable.

"The way to gain confidence that your predictions are accurate would be to make a set of predictions, wait for five years, and then compare them with the results. And we have not done that yet because we have not used Archimedes for four or five years yet," he explains, noting that the model has only been making calculations for about two years thus far.

Work on diabetes set to begin

In its work with the ADA and Bristol-Myers Squibb, Kaiser's Archimedes team will be evaluating various protocols in an attempt to learn what the most effective models of care for this disease are, and what would happen in years one, two, and three after each of these models was implemented. Further, they will look at screening procedures, the impact of various medicines, and a whole range of important issues that pertain to optimal management of this disease. "If you could only do one thing for a person with diabetes, what might you do? Control their BP, control their glucose, or their lipids? We will be trying to answer questions like that," says Schlessinger.

Further, Archimedes will continue to guide Kaiser on establishing its priorities in the coming years in terms of what guidelines it should develop, what care management processes should be implemented, and what indicators the organization should look at to improve quality. Archimedes will be used, adds Schlessinger, to "help managers wisely choose the most effective course to take to provide the best care." ❖