Modeling Local Health System Dynamics

What is the Right Geographic Focus?

When modeling a local health system, an immediate challenge is to find the right geographic focus. This is rarely an easy decision because most salient risks, needs, and resources vary widely from place to place. Also, there may be significant migration when accessing health care services into and out of a particular region. Still other considerations focus on data availability, which tends to be increasingly difficult at smaller scales.

Within the ReThink Health modeling project, our goal is to help local leaders understand what collaborations and new structures may be necessary to get the most impact from of their investments and avoid situations where, over time, their efforts are undermined by events occurring outside of their traditional sphere of influence.

In many circumstances, a contiguous Health Service Area (HSA) may be the right catchment geography. An HSA is relatively complete and self-contained from the standpoint of services demanded and services supplied. This sort of logic drove our decision to model Pueblo County, Colorado (population 160,000), rather than just Pueblo City (population 100,000).

Within Pueblo, there are many types of people: the poor and the non-poor, the uninsured and the insured, the young and the old, etc. The current model specifies ten different subgroups to keep track of those differences and their varying implications for health system change. In other words, we model these distinctions because different types of people have widely different health needs and healthcare experiences. Those differences are important not only from the standpoint of understanding health disparities, but also because the needs and expenses of one group can affect the experience of another group.

Everyone in an HSA or in the same general healthcare catchment area shares not only the same tertiary-care hospital, but also to a large degree overlap with respect to the primary-care and specialist doctors they use. Thus, for example, if one subgroup is putting a lot of demand on PCPs in the area, to the point of there being a PCP shortage, then reducing the demand from that subgroup could help all other subgroups to have easier access to PCPs in the area.

The various subgroups thus affect one another through the healthcare resources that they share. But they can also affect one another because one subgroup may flow into another: the young become older over time, there are flows between uninsured and insured, and there are flows between poor and non-poor. What you do for one subgroup, affecting their health, can thus eventually start affecting other subgroups as well. This sort of carryover effect is vitally important for understanding the future health of the region.

Of course, no given catchment area is going to be perfectly self-contained. In the case of Pueblo, we discovered that a fair number of Pueblo residents are hospitalized outside Pueblo County (with its two major hospitals) because they were referred or transferred to Colorado Springs; this amounts to about 25% of the hospitalizations of the residents of Pueblo County. That was not a fatal problem for our model because an outflow like this can be easily represented. It would also be easy enough to model leakage outward for PCP or specialty physician care.

A more difficult situation to model would be if there were significant leakage *inward* to Pueblo from Colorado Springs or other areas -- which there is not. We would then have had to ask what assumptions to make about the future trajectory of that inward demand. For instance, if a big chunk of the demand for Pueblo specialists came from Colorado Springs, we would have had to make assumptions about how that inflowing demand might change in the future -- in effect, modeling the changing population of the Springs and its appetite for specialty care.

Furthermore, let's say we were doing things in Pueblo to try to reduce the use of specialty care, but those same things were not being done in the Springs. As a result, the efforts in Pueblo would be significantly diluted. From a policy standpoint, then, the true catchment area would have to contain both Pueblo and the Springs, because in this made-up example you couldn't achieve the desired progress in Pueblo without also achieving similar progress in the Springs.

The upshot of this is that one should try to find a population that is as self-contained as possible, and in particular one that has minimal inflows of healthcare demand from outside. If the modeled geography is too small, and there are relatively big demand inflows coming from elsewhere, the actions taken inside the area will be diluted by the lack of such actions outside. In this situation, the area can only achieve its full potential by seeing itself as tied together with a broader population. In other words, in this situation, the two areas should be modeled together.

What are the implications if one decides to model an entire county, but initiatives are targeted or funded in such a way that they mainly affect only a particular neighborhood? That is not a problem for the ReThink Health model, because by knowing who (from the standpoint of age, income, and insurance segments) lives in the specified neighborhood vs. the rest of the county, we can specify who (from a segment standpoint) will be most affected by the initiatives.

In that situation, we might build a correspondence table showing how our segments correspond to the target area vs. the rest of the county, and thereby accurately represent the effect of initiatives that may be aimed primarily or wholly at the smaller neighborhood.

By modeling an entire county, we may see just how much impact one can have for the people of a particular area by acting primarily or wholly there and compare that strategy to one that affects the entire population, albeit perhaps less intensively in the particular neighborhood of interest. It may be that one needs to act not only in particular neighborhood but also beyond it to most beneficially impact the residents of a particular area.

This goes back to the argument above about the sharing of resources and the fluidity of population categories. For example, if there is a fair amount of physical migration between the targeted neighborhood and the rest of the county, then one may help the people of that neighborhood, only to see a lot of them then move out, or conversely, many new people that had not been addressed as intensively may move into the neighborhood.

We will never eliminate all such dilution effects, but it is important to try to find a catchment area big enough that those dilution effects don't come to dominate the analysis and so that one can adequately investigate the need for policies (and funding) to reach beyond one particular neighborhood.

Aside from the sharing of healthcare resources and the interflow of different population subgroups over time, there is also the important issue of data availability. Even if Census data can go down to the level of a neighborhood or even certain census tracts within that neighborhood, we need much more than just Census data to calibrate the model. Many important data are available at the county or metropolitan level but not at lower geographic levels.

- Jack Homer