PEDIATRICS PERSPECTIVES

Bias in Physician Workforce Research

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Physician workforce research often generates marked interest across multiple specialties and policy makers. Data are used to argue for or against proposed changes in funding for undergraduate or graduate medical education, to define areas of shortage or surplus in the health care delivery system, and to forecast future needs. In my experience, investigators or policy makers may present workforce research results, for which they may be unaware of their data sources and accuracy, to describe the current workforce or make inferences or predictions of the future workforce. Often, little is known regarding the methods of how the data were obtained or analyzed nor what standards of rigor are needed to achieve validity of the results presented.

Usually, flaws in methodology create uncertainty regarding the accuracy and validity of results. Recognition of these flaws can help place results in context and temper tendencies of researchers and/or advocates to draw strong inferences. Determining the precise degree of inaccuracy requires the use of >1 data source, preferably with one that can function as a gold standard. For example, a data source commonly used by the federal government and the Dartmouth Atlas Project to determine counts and distributions of physicians was shown to have a misattribution rate of ~30% for a specific pediatric subspecialty.[1]

Regardless, for those who either produce or use workforce research, it is important to be aware of and understand common methodologic pitfalls that can affect the accuracy of both the results and the inferences deduced from them. These problems fall into 5 basic categories: (1) selection bias, (2) nonresponse bias, (3) aggregation bias, (4) designation bias, and (5) head-count bias. When >1 type of bias is present at the same time, they can act in an additive or multiplicative fashion, making the results more suspect. Understanding the potential biases in a study can assist in knowing which results to believe and which should raise skepticism.

SELECTION BIAS

Selection bias occurs when the population selected for study is not necessarily representative of the population intended to be analyzed.[2] In workforce research, this can occur when an investigator is trying to understand the attitudes, practices, or behaviors of a specific group of physicians via a survey, observational, or demographic study. For example,

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when working to get a listing of those physicians for whom to send a survey, the investigator decides to use a specialty society roster of those physicians.

However, such a list likely only contains those physicians who are members of that specialty society. Because membership is not mandatory and requires annual dues, not all qualifying physicians will be members. The proportion of physicians in a given specialty who are members of their specialty society can vary markedly. Furthermore, the proportions can also vary further when assessing specialties that have multiple subspecialties, such as pediatrics and internal medicine. The proportion of those in each subspecialty who are members will also affect how representative a sample for study might be. In pediatrics, the proportion of active pediatricians who are members of such groups are often in the range of 30% to 65%. Thus, the potential for selection bias is high.

Other examples of selection bias are surveys or other data collection efforts conducted at meetings of professional societies. Pediatricians who attend either national or regional meetings may be different in a variety of ways from those who do not. Inferences regarding characteristics such as part-time work, academic affiliation, or even job satisfaction may not be generalizable beyond those attending the meeting.

This is an important issue for study validity because some types of physicians may be more likely to be members of their specialty society than others are. The differences could be characteristics such as full- versus part-time, older versus younger, or male versus female physicians or even among those in different regions of the country. Although sometimes these factors may be demographic, in other instances, they may not. For example, those who choose not to be members may be more independent minded or simply not agree with the positions of the professional society. Thus, a study that begins by having a potentially biased sample based on membership may yield results that only reflect a certain group or type of physician and may not be reflective of the specialty as a whole.

It is often difficult to determine the proportion of general pediatricians or any specific pediatric subspecialty who are members of a specialty society or other membership organization. This is because accurate counts of members can vary year to year, and data on the overall number of those pediatricians may be difficult to obtain or interpret. Numbers of those who have completed training in a specific subspecialty may not be reflective of actual numbers who are currently clinically active. A further complication arises when an investigator makes seemingly generalizable statements about either the demographic makeup or degree of clinical activity of members of a particular society without knowing the characteristics of the group overall.

NONRESPONSE BIAS

Nonresponse bias occurs when those who do not respond in a survey study differ in meaningful ways from those who do respond.[3] This can occur regardless of the method (ie, mail, telephone, or e-mail) used. Validity is threatened when significant numbers of potential respondents choose not to participate. As a result, the data collected may not be reflective of the broader population intended to be studied. In general, response rates of $<60\%$ generate some concern regarding validity.[4] However, increasingly, surveys with response rates $<50\%$ and some as low as 30% are being published in some peer-reviewed journals with the results being implied as reflective of the study population. As more studies with poor response rates are published and presented, they have become the "new normal," providing a circular argument for believability. The new studies justify their results with comparisons to similar studies with equally invalid response rates.[5]

Of recent concern is the growth in the number of Internet surveys of physicians that are presented at national meetings or published in the peer-reviewed literature. These types of studies have become increasingly popular because they are inexpensive, use the frequent availability of Internet addresses, and require minimal effort for data collection. However, response rates for Internet studies of physicians are exceedingly low, thus creating a new floor for validity. Interestingly, some investigators using Internet surveys with low response rates (eg, $<25\%$) have sought to create credibility and/or the perception of validity by citing an obscure article that notes that Internet surveys of physicians frequently have a response rate of $<20\%$. The logic follows that because the low response rates are the norm, it is not really a limitation of importance to the validity of the study. The reality, however, is that biased results simply become the norm. Readers should be especially cautious regarding studies with low response rates combined with selection bias.[4]

Another strategy to address low response rates has been the effort of some investigators and professional organizations to develop panels of individuals who are willing to respond to surveys. Although response rates are typically higher in studies that use such panels, the response rates of the initial invitation to join a panel are often low. Thus, the sample from which subsequent surveys are fielded is not representative. This may result in an array of studies with "hidden" selection bias yet high response rates.

AGGREGATION BIAS

Aggregation bias (also known as ecologic fallacy) is the assumption that what is true for a group as a whole must also be true for subgroups of the whole as well.[6] It is called aggregation bias because the investigator is using aggregated data and extrapolating it inappropriately. One of the most common instances of this type of bias occurs when generalizations regarding the entire workforce of physicians or nurses are made. These may involve a variety of issues, including sex, compensation, and surpluses or shortages.

For pediatrics specifically, this occurs when all primary care physicians are aggregated so that shortages in adult care may be inferred as also applying to care of children. Another example is aggregating all pediatric subspecialties when assessing shortages or other aspects of the workforce. Both types of actions have the potential to give false and/or misleading perceptions of workforce adequacy.

DESIGNATION BIAS

Designation bias occurs when significant portions of a sample are erroneously designated as a specific specialty or subspecialty. In pediatrics, this occurs most commonly when national data sets of physicians designate (1) individuals to a particular pediatric subspecialty when they have not completed training or (2) adult subspecialists as pediatric subspecialists because they provided care to children in the past or market themselves as currently providing pediatric care.[1]

This type of bias has the potential to overestimate the actual number of individuals in a pediatric subspecialty and the adequacy of the workforce.

HEAD-COUNT BIAS

Head-count bias occurs with the assumption that the total number of individuals trained, licensed, or certified in a particular (sub)specialty are employed full-time. This occurs in pediatrics with studies attempting to assess the adequacy of clinical capacity in the care of children. In reality, a growing proportion of the pediatric workforce works part-time and/or may have other roles that impact the portion of their professional effort devoted to clinical care.[7] Such nonclinical roles may include research, education, administration, or work in an industry or public health or at any level of government.

CONCLUSIONS

Although seemingly simple, workforce research has many nuances that affect validity. And although it is increasingly easy to produce answers to workforce questions, the accuracy of those answers is at issue. As such, those who attempt to conduct workforce research, and especially those who intend to use it, should be wary of threats to the validity of any results presented. Efforts to reduce the potential biases and methodologic flaws in any workforce study will result in more useful and valuable data.

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