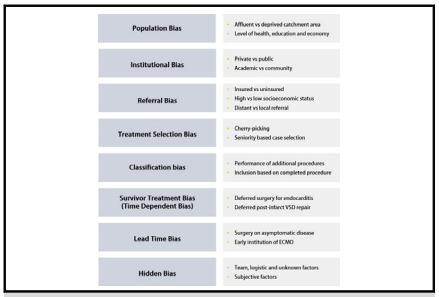
The vagaries of patient selection in cardiovascular surgery

Anelechi C. Anyanwu, MD, FRCS

From the Department of Cardiovascular Surgery, Mount Sinai Medical Center, New York, NY.
Disclosures: Author has nothing to disclose with regard to commercial support.
Received for publication March 14, 2016; accepted for publication March 15, 2016; available ahead of print April 22, 2016.
Address for reprints: Anelechi C. Anyanwu, MD, FRCS, Department of Cardiovascular Surgery, Mount Sinai Medical Center, 1190, Fifth Ave, New York, NY 10029 (E-mail: anelechi.anyanwu@mountsinai.org).
J Thorac Cardiovasc Surg 2016;152:842-6
0022-5223/$36.00

http://dx.doi.org/10.1016/j.jtcvs.2016.03.032



Selection bias.

Central Message

Patient selection is a great confounder in surgical outcomes research. This editorial argues that patient selection rather than technical excellence is the dominant driver of differential outcomes.

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See Editorial Commentary page 681.

People who inject drugs face increased risk of dying from both acute and chronic illnesses—in a pooled analysis they were more than 14 times more likely to die per year than similar persons who did not inject drugs.[1] The most common causes of death are drug-related, unintentional injuries, and suicide (accounting for more than 85% of deaths).[2] Infections (predominantly bloodborne viral illnesses, but including endocarditis and other bacterial infections) account for <10% of deaths. If injection of drugs confers such negative prognosis why, as Kim and colleagues report,[3] is the 10-year survival after surgery for endocarditis in patients who inject drugs similar to that of patients with endocarditis who did not inject drugs (70% vs 69%)? This occurred despite a high incidence of valve reinfection in the drug-injecting group (60% by 8 years). Very similar observations were recently reported in a cohort of patients operated in Cleveland.[4] Could a 10-year survival of 69% after surgery for endocarditis in patients who inject drugs be plausibly expected? The high recurrence rate of endocarditis after surgery on drug injectors reported by Kim and colleagues[3] likely symbolizes a high recidivism rate in their cohort, so one would expect most patients undergoing operation to remain with a long-term elevated hazard associated with drug injecting, independent of the valve surgery. There is no plausible mechanism whereby heart valve disease or heart valve surgery would offer a long-term protective effect from hazards of habitual drug injection, so these patients would still be expected to have a high mortality rate from drug-related, suicidal, accidental, and other causes. I argue that the short- and long-term outcomes in this, and many other surgical series, are primarily a reflection of selection bias (Figure 1).

CATCHMENT AREA, POPULATION, AND INSTITUTIONAL BIASES

The question arises in any observational study of surgical operations as to whether patients reported are representative of all patients with an indication for the procedure, or whether they are a selected group. Were patients undergoing operation in the 2 major academic Boston hospitals that contributed to this report[3] reflective of a typical population of people who inject drugs? A report on drug use in Boston in a similar timeframe reported that 25% of drug injectors were women, 39% of nonwhite ethnicity, and 70% younger than age 40 years,[5] whereas in the current study 39% were women, only 13% nonwhite, and mean age was 36 years in patients undergoing operation for endocarditis who injected drugs.[3] This implies a bias toward predominantly older, white women. The outcomes of surgery could conceivably be different in younger male patients from ethnic minority groups. Disparity in application of tertiary health care may be reflective of social, economic, and logistic factors such as differential access to health care, social status, income, ability to pay for health care, and family support—all factors that can also influence outcomes of surgical therapies. In the United States, it is well recognized that uninsured patients are more frequently cared for in public city hospitals compared with academic and private hospitals,[6] so it is probable that cohorts undergoing operation for endocarditis in academic centers include a disproportionately higher representation of patients who have resources to pay for health care, and therefore may have overall better health compared with a typical patient who injects drugs. Consequently, a public city hospital performing operations for endocarditis on predominantly uninsured or indigent patients is unlikely to achieve similar success to that

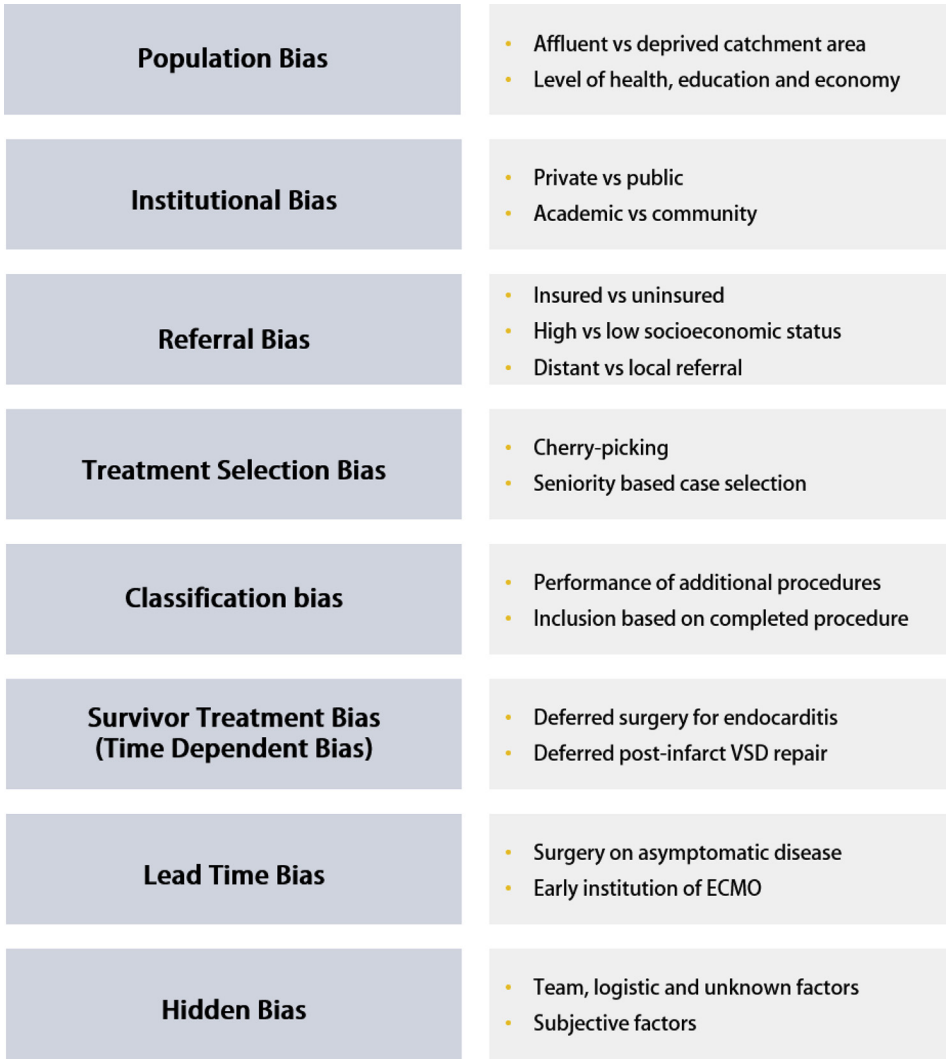

FIGURE 1. Forms of selection bias in cardiovascular surgery and examples. *VSD*, Ventricular septal defect; *ECMO*, extracorporeal membrane oxygenation.

reported in academic centers. Such selection is invariable, and is beyond the control of individual surgeons. However, rarely do surgical studies report socioeconomic demographic characteristics, such as wealth, insurance, employment, or family support. These are all key elements in both patient selection and early and long-term survival. A disadvantaged social background has been associated with reduced long-term survival after valve replacement.[7] Although commonly reported patient demographic characteristics and computed risk profiles may seem similar across hospitals and surgical series, patient selection has invariably occurred for a patient to end up in 1 country, town, locality, or hospital as opposed to another. The forces that drive the selection are often unmeasured but also drive outcomes; for example, in the current study,[3] it is unknown whether the long-term survivors reflect a selected group of people who had the resources to seek and maintain good health despite continued drug use, which is a possible explanation for the good long-term survival.

REFERRAL BIAS

Within any given locality, socioeconomic group, or clinical subgroup, further patient selection occurs in referral patterns. Factors that drive referral to a certain surgeon or center as opposed to another may sometimes have a bearing on outcomes. Tertiary centers, by definition, benefit positively from referral bias. Other than those for whom the tertiary center is also the local hospital, to be treated in a tertiary center, patients must first be well enough to be transferred from the referring hospital or clinic, and they must survive the transfer. This process thereby excludes some of the sickest patients (who would either have to be treated locally, die in transfer, or be inoperable