Assessing the Public's Health

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KEYWORDS

• Public health • Health care • Health systems

KEY POINTS

- The metrics of public health have evolved to accommodate the changing landscape of health care.
- Single measures imperfectly summarize the health of a population with each seeming to describing only a single aspect.
- Summary measures used by the Global Burden of Disease Study allow comparisons along many other lines for communicable and noncommunicable diseases and their burden.
- Community health has been assessed nationally and around the world in rural and urban communities with differing results and policy implications.
- One area of agreement is the importance of addressing population health needs at the community and neighborhood level, a finding that transcends the world megacities.

INTRODUCTION

The health reform debate continues to focus on finding a way to expand health insurance coverage for all Americans,[1] an access issue that is estimated to account for a minority of mortalities,[2] suggesting the contribution of other factors to adequate health. With up to 95% of health spending directed toward medical care and biomedical research,[2] and an increasing body of evidence that health behavior and environment are responsible for up to 70% of avoidable mortalities, there has been increasing awareness of the contribution of other nonmedical factors related to health promotion and mortality. The tide is turning toward a discourse among public health officials, researchers, and health care providers to address the varied social factors and the impact of economic inequality on health.[3] This article describes approaches to the assessment of domestic and global public health. It is strategically placed in this issue

The authors have nothing to disclose.

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Neurol Clin 34 (2016) 1057–1070

http://dx.doi.org/10.1016/j.ncl.2016.06.007 **neurologic.theclinics.com**

0733-8619/16/$ – see front matter

to follow articles that describe individual diseases and precede descriptions of other national health care systems.

ASSESSING POPULATION HEALTH STATUS

The metrics of public health have evolved to accommodate the changing landscape of health care with no measure perfectly summing the health of a population and each way of estimating seeming to violate some tenet of epidemiology. Measures of risk are generally expressed using mortality rates (MRs) for estimating the frequency of the occurrence of death in a defined population over a specified interval, whether expressed as crude mortality for all causes in a population or a single cause. MRs can be studied in reference to infant and maternal deaths; adjusted for sex, age, race, and ethnicity; or by particular conditions or the proportion thereof to provide insight into public health responses to the leading causes of mortality and health disparities. The global focus on noncommunicable diseases has been driven by the faster rate of decline of communicable, maternal, neonatal, and nutritional causes in an aging world population. It comes as no surprise that global age-standardized MRs significantly increased between 1990 and 2013 for Alzheimer disease and other dementias by 3.2%, and Parkinson disease by 28.2%.[4] According to the National Center for Health Statistics in 2013, the 10 leading causes of death, which accounted for 73.6% of all deaths in the United States (US), included heart disease, cancer, chronic lower respiratory diseases, unintentional injuries, stroke, Alzheimer disease, diabetes, influenza and pneumonia, kidney disease, and suicide. Stroke, the fourth leading cause in 2012, became the fifth leading cause in 2013.[5]

Premature mortality, originally proposed to address the inadequacy of MRs in measuring the burden of disease due to tuberculosis,[6] proved to be a particularly useful way to describe other diseases. In choosing an arbitrary limit to life, the calculation of the difference between the age at death and an arbitrary designated limit measured in years of life lost (YLLs) due to premature mortality became a useful assessment of the impact of premature mortality in a given population. The YLLs rate, which represents years of potential life lost per 1000 populations below an arbitrary endpoint age such as 65 years, was found to be more desirable in comparing premature mortality in different populations because YLLs did not take into account differences in population sizes.[7] Another measure of the burden of disease in a population, disability-adjusted life years (DALYs), captures in a single figure health losses associated with mortality and different nonfatal outcomes of diseases and injuries.[8] DALYs were first described by Murray and Acharya,[8] Murray and Lopez,[9] and Murray and colleagues[10] in the 1990s, with the World Health Organization (WHO) and the Harvard School of Public Health, for the first global burden of disease (GBD) study in 1990 and used in subsequent revisions to the present GBD 2013.

FROM MORTALITY TO DISABILITY MEASURES

Summary measures used by the GBD studies[11,12] of DALYs, such as healthy adjusted life expectancy, are derived from YLL and years lived with disability (YLDs) to compare assessments of broad epidemiologic patterns across countries and time, and to quantify the component of variation in epidemiology related to sociodemographic development. Calculated by adding YLLs and YLDs, DALYs add disability to the measure of mortality and, based on the universal measure of time in life years, have provided a common currency for health care resource allocation and the effectiveness of interventions assessed relative to each other across a wide range of health problems. YLDs, equal to the sum of prevalence multiplied by the general public's assessment

of the severity of health loss, has been used as a primary metric to explore disease patterns over time, age, sex, and geography.[13] It recognizes that aging of the world's population has led to substantial increases in the number of individuals with sequelae of diseases. Because YLDs have been declining much more slowly than MRs, the nonfatal dimensions of disease require more and more attention from health systems. Neurologic disorders accounted for 7.7% of all-cause YLDs in 2013, a 5% increase in age-standardized YLDs from 1990 to 2013 (2.4%–7.9%), with the leading causes being Alzheimer disease, Parkinson disease, epilepsy, multiple sclerosis, migraine, tension and medication overuse headaches, and other neurologic disorders.[12]

To appreciate the importance of summary measures compared with traditional epidemiologic metrics, one need only consider the example of the global burden of stroke among developed and developing world nations. Using world mapping, GBD 2013[14] detailed the geographic patterns of incidence, prevalence, MR, DALYs, YLDs, and their trends for ischemic stroke (IS) and hemorrhagic stroke (HS) for 1990 to 2013. Stroke incidence, prevalence, mortality, DALYs, and YLDs were estimated following the general approach of GBD 2010.[13] Age-standardized incidence, MR, prevalence, and DALYs or YLDs declined between 1990 and 2013. However, the absolute number of people affected by stroke substantially increased across all countries in the world during the same period, suggesting that the global stroke burden continues to increase. There were significant country and regional differences in stroke burden in the world, with most of the burden borne by low-income and middle-income countries. Hence, the global burden of stroke has continued to increase despite dramatic declines in age-standardized incidence, prevalence, MR, and disability. Population growth and age played an important role in the observed increase in stroke burden.

Between 1990 and 2013, the outcome of stroke in adults aged 20 to 64 years, for which it carries a particular significance for working individuals, was revealed in the GBD 2013 report[15] using traditional mortality metrics and DALYs important for planning stroke prevention and management in younger adults. Prevalence, age-adjusted MR, DALYs, and their trends for total IS and HS for 1990 to 2013 in adults 20 to 64 years of age were estimated from available data using statistical models with country-level covariates to estimate country-specific stroke burden. Means and 95% uncertainty intervals were calculated for prevalence, mortality, and DALYs. The median of the percent change and 95% uncertainty intervals were determined for the period from 1990 to 2013. Between 1990 and 2013, there were significant increases in prevalent cases, total deaths, and DALYs due to HS and IS in younger adults aged 20 to 64 years. Death and DALY rates declined in both developed and developing countries but a significant increase in absolute numbers of stroke deaths among younger adults was detected in developing countries. Most of the burden of stroke was in developing countries. In 2013, the greatest burden of stroke among younger adults was due to HS. Although the trends in declining death and DALY rates in developing countries are encouraging, these regions still fall far behind those of developed regions of the world. A more aggressive approach toward primary prevention and increased access to adequate health care services for stroke seems to be needed in developing nations.

Such is the example of all types of stroke in African countries undergoing an epidemiologic transition driven by sociodemographic and lifestyle changes that has led to the increased burden of noncommunicable diseases to include cardiovascular risk factors that lead to increased risk of stroke. Accurate and up-to-date information on stroke burden is necessary for the development and evaluation of effective and efficient preventative acute care and rehabilitation programs for stroke patients. A

meta-analysis[16] focused solely on the prevalence and incidence of stroke in Africa with pooled data, albeit of uneven quality, of new cases of stroke and number of stroke survivors in populations across 5-year age groups. A total of 1.89 million stroke survivors among people aged 15 years or more were estimated in Africa in 2009, with a prevalence of 317.3 (314.0–748.2) per 100,000 population. Comparable figures for the year 2013 based on the same rates amounted to 535,000 (87.0–625.3) new stroke cases and 2.09 million (2.06–4.93) stroke survivors, suggesting an increase of 10.8% and 9.6% of incident stroke cases and stroke survivors, respectively, attributable to population growth and aging between 2009 and 2013. The prevention of stroke and many noncommunicable diseases in Africa has been affected mainly by weak health systems and poor government response. Hypertension is the main risk factor of all stroke subtypes with odds of about 2.64, and this is more prominent among young Africans who present with stroke unaware of their high blood pressure status. There is an urgent need for more research on stroke, and related vascular disease risk factors, to appropriately quantify this burden. An investment in research capacity, basically to conduct and fund higher quality research, may help raise awareness of stroke burden in Africa. An awareness and fair understanding of stroke burden and disease pattern in Africa may further prompt appropriate policy response and scale up current intervention programs.

HEALTH SYSTEMS MANAGEMENT AND QUALITY OF CARE

It can be said that a national health system reflects the values of the nation in which it exists, although it is hard to find a system embraced by all of its stakeholders, including consumers or patients, health care providers, insurers, and hospital mangers, in public or private institutional, or combination, settings. Health policy and management has been on the frontline of the controversy, confronting the gap between theory, policy, and practice,[17] because of perennial efforts to reform health care systems. Chinitz and Rodwin[17] cite 4 dimensions highlighting this gap in the US. First, the dominance of microeconomic thinking in health policy analysis and design that leads to the cyclical return to financial incentives and market mechanisms as solutions to health systems that cost too much and provide too little. Second, the lack of learning from management theory and comparative case studies, including the high performance health maintenance organizations (HMOs), such as Kaiser Permanente in California and Geisinger in Pennsylvania, or the Mayo Clinics and Cleveland Clinics that have all been touted as being high performers in health care but with little success in generalizing their model across the US. Third, the separation of health policy and management from the rank and file of medical professionals, finding it removed from an understanding of what clinicians and health care managers face in the real world of practice. Fourth, the inability to think about individual health systems in a way that more accurately captures the complexity and conflicts embedded within management and health care practices.

Two separate approaches, each with overlapping metrics for understanding the barriers to adequate health care are described, although their application to neurology has only recently been appreciated. The first approach uses 2 metrics[18,19]: preventable readmissions and hospitalizations for ambulatory care sensitive conditions (ACSCs) developed by the US Agency for Healthcare Research and Quality (AHRQ) in response to the Affordable Care Act mandate to monitor the performance of hospitals and to determine payments to them by the Centers for Medicare and Medicaid Services (CMS) for the care of Medicare and Medicaid beneficiaries. However, these metrics have only recently been investigated for applicability to neurologic disorders.

A second approach has used metrics developed by the World Cities Project (WCP), including discharges for avoidable hospital conditions (AHCs),[20] avoidable hospitalizations,[21] avoidable mortality (AM),[22] and the relation of infant mortality and income.[23,24] The goal of the WCP has been to compare the health, social services, and quality of life in neighborhoods of the urban cores of the world megacities of Paris, Manhattan, and London to better understand the performance of health systems serving population cohorts and potential barriers to adequate health care.

United States Agency for Healthcare Research and Quality Indicators

There are an estimated 6.8 million survivors and approximately 795,000 new and recurrent strokes identified annually.[25] It is among the 10 largest contributors to Medicare costs and, in the elderly, is a leading cause of hospitalization. Reducing readmission rates is a goal of national health care reform. Risk-standardized readmission rates (RSRRs) after hospital discharge are publically reported by the CMS and are used as an indicator of the quality and efficiency of hospital-level care for cardiovascular conditions. The CMS uses risk-adjusted hospital readmission rates as a marker of health care quality.[26,27] The current program uses financial penalties as incentives for hospitals to reduce 30-day readmission rates. Readmissions for myocardial infarction, pneumonia, and congestive heart failure have been the focus of initial CMS tracking; however, neurologic disorders are likely future targets.[28] Readmissions may have little to do with the actual index hospitalization and depend instead more on the quality of follow-up care after discharge. Socioeconomically disadvantaged patients often do not have easy access to outpatient health care and, therefore, are more prone to return to inpatient care. Although it can be argued that this CMS initiative will encourage hospitals to work to improve outpatient care in their communities, this assumes a type of closed network of a host of cooperative payers and patients that most academic hospitals simply do not have in place.[29] Understanding readmissions may eventually help stakeholders involved in the care of neurologic patients anticipate and enact change to maximize the quality of inpatient neurologic care. Although high readmission rates may, in part, reflect unresolved problems at discharge or the quality of immediate after hospital care, they may also reflect a more chronically ill population, social or economic issues, or a combination of these factors.

Lichtman and colleagues[30] analyzed 30-day readmissions for Medicare fee-for-service (FFS) beneficiaries aged 65 years and older who were discharged alive with a primary diagnosis of IS between December 2005 and November 2006. Random-effects logistic regression was used to determine patient-level factors associated with preventable readmissions. Among 307,887 IS discharges, 44,379 (14.4%) were readmitted within 30 days, 5322 (1.7% of all discharges) were the result of a preventable cause, and 39,057 (12.7%) were for other reasons. In multivariate analysis, older age and cardiovascular-related comorbid conditions were strong predictors of preventable readmissions. Preventable readmission rates were highest in the Southeast, mid-Atlantic, and US territories and lowest in the Mountain and Pacific regions. Patient-level proportional hazards analyses confirmed that older age, female sex, and having comorbid conditions often associated with stroke or cardiovascular disease were associated with an increased likelihood of being readmitted for a preventable reason. Those readmitted for a preventable cause were more likely to have congestive heart failure, myocardial infarction, diabetes, and renal failure. Patients with a preventable readmission had a longer length of stay for the index stroke and were more likely to be discharged to a skilled nursing or intermediate care facility. Only a small proportion of readmissions after IS were classified as preventable. The

investigators concluded that hospital-level programs intended to reduce all-cause readmissions and costs should target high-risk patients.

Lichtman and colleagues[31] studied FFS Medicare rural and urban beneficiaries aged 65 years and older designated to have access to emergency and inpatient care at a critical access hospital (CAH) or non-CAH, respectively, and discharged with a primary diagnosis of IS in 2006. The investigators performed hierarchical generalized linear models to calculate hospital-level risk-standardized MRs (RSMRs) and RSRRs. Among 10,267 IS discharges from 1165 CAHs and 300,114 discharges from 3381 non-CAHs, the RSMRs of CAHs were higher than non-CAHs (11.9% ± 1.4% vs 10.9% ± 1.7%; $P<.001$) but the RSRRs were comparable (13.7% ± 0.6% vs 13.7% ± 1.4%; $P = .3$). The RSMRs for the 2 higher volume quartiles of non-CAHs were lower than CAHs (posterior probability of RSMRs higher than CAHs = 0.007 for quartile 3; $P<.001$ for quartile 4), without differences for lower volume hospitals; RSRRs did not vary by annual hospital volume. Rural residents tended to be older, uninsured, and have more limited access to primary care services; and rural hospitals had limited availability of specialty caregivers, diagnostic technologies, and acute stroke care teams. Rural and urban gaps were also more likely to adhere to evidence-based guidelines for stroke treatment, although compliance with secondary stroke preventive therapies is similar. There was no difference in stroke mortality between CAHs and similarly sized non-CAHs, suggesting that lower volume, instead of than CAH status per se, explains much of the difference in RSMR and RSRR.

Guterman and colleagues[32] examined national 30-day readmission rates for 554,399 index neurologic admissions from October 2011 to January 2015, noting an unplanned readmission rate of 11% in those aged 65 years and older. Of patients hospitalized with neurologic disorders, rates of unplanned readmission were highest for patients with peripheral nerve disorders (21.9%), central nervous system (CNS) neoplasms (21.0%), nonhypertensive encephalopathy (15.5%), arterial stenosis (15.4%), and bacterial CNS infections (14.5%). With all patients grouped together, median readmission rates increased from minor (6.5%, interquartile range 5.7%–8.9%) to extreme severity of illness (17.3%, interquartile range 14.6%–19.5%, $P<.001$). With patients split by diagnostic category, this same stepwise escalation in readmission rate with higher severity of illness was observed for most diagnoses, although there were some exceptions. For example, some patients with CNS neoplasms and minor severity of illness had higher readmission rates (25.8%) than those with CNS neoplasms and extreme severity of illness (18.8%). Multivariable regression examined predictors of readmission rates by age, race, insurance type, and severity of illness. The severity of illness remained significantly associated with readmission rate in the regression model. Cases with an extreme severity of illness were 2-fold times more likely to be readmitted (odds ratio [OR] 2.4, 95% confidence interval [CI] 2.3–2.5) compared with those with minor severity of illness. Using severity of illness as an ordinal variable in the regression model confirmed this finding, demonstrating increasing readmission with increasing severity of illness (OR 1.9, 95% CI 1.9–2.0). Readmission rates also varied significantly among patients based on primary insurance provider. Patients who were covered by Medicare (OR 1.4, 95% CI 1.3–1.4) and Medicaid (OR 1.2, 95% CI 1.1–1.2) had significantly higher rates of readmission compared with those who carried other insurance types. Although age was not found to be a significant predictor of 30-day readmission, a subset analysis revealed that older age was associated with a lower risk of readmission in both the Medicare (OR 0.5, 95% CI 0.5–0.5) and Medicaid (OR 0.6, 95% CI 0.5–0.7) group. This was not the case for those carrying commercial health insurance (OR 1.0, 95% CI 0.9–1.0). The higher readmission rates among patients with public insurance, and those older

in age in particular, might reflect less frequent use of primary and preventative care, unrecognized comorbid illness, and less robust transitions of care, as well as fewer outpatient safety nets. There were demonstrated differences in health care utilization for young adults across race and insurance type and these data suggested that the differences likely extended to inpatient hospitalization as well. The investigators commented that these data should provide insight into management of neurologic disease nationally, offering policymakers realistic goals for standards of care and challenging health care providers to develop systems-based solutions that will improve transitions of care for those at highest risk of readmission with neurologic disease.

Hospitalization admission for ACSCs was studied by Basu and colleagues,[33] who conducted a multivariate cross-sectional design, using compositional factors describing the hospitalized populations and the contextual factors, all aggregated at the primary care service area level in small geographic areas in 2 cross-sections spanning 11 years (1995–2005) using hospital discharge data from the Healthcare Cost and Utilization Project of the AHRQ for Arizona, California, Massachusetts, Maryland, New Jersey, and New York. The investigators noted that ACSC admission rates were inversely related to the availability of local primary care physicians (PCPs), and managed care was associated with declines in ACSC admissions for the elderly. Minorities, aged elderly, and patients under the federal poverty level were found to be associated with higher ACSC rates. The conceptual models for ACSC hospitalizations addresses aspects of supply and demand for outpatient services to explain the variations of admission rates. Consumers, including patients and families, seek, use, and pay for services, whereas PCPs, managed care plans, and hospitals supply services and sometimes make decisions on behalf of patients. ACSC hospitalization occurred when the demand for primary care exceeded its supply or when it was rational not to use primary care because hospital care would be available and better paid for by the insurance. There may be economic, cultural, and social barriers to prevent utilization of primary care. Some of the factors affecting the demand for outpatient care and, inversely, hospitalization for ACSC conditions include poverty, education level, and public and private insurance.[34]

Riley and colleagues[35] noted that, compared with FFS, HMO enrollees were diagnosed at earlier stages for cancer sites for which effective screening services are available. The earlier detection of certain cancers among HMO enrollees resulted from coverage of screening services and promotion by HMOs of such services. Medicare-managed care enrollment was associated with less use of hospitals for ACSC conditions.[36] The supply factors associated with ACSC admissions were inpatient bed supply, PCPs, and physician practice patterns, such that, if all else is equal, a greater supply of PCPs would tend to make primary care more accessible and reduce average prices for primary care for potential patients who could be treated in an ambulatory setting, relative to hospital inpatient stays. Characteristics such as being elderly in poverty or in rural locations would be expected to exert important influences on increased rates of ACSC or preventable admissions. The degree of remoteness and rural or urban residence is expected to be positively associated with ACSC admissions,[37] whereas population density is negatively associated with ACSC admissions.[38]

It is clear from the previously described studies that the indicators of preventable readmissions and hospitalization for ASCS address the fundamental aspects of the barriers to adequate primary care. They also show the difficulties posed by differing severities of hospitalized patients with IS returning to potentially challenged community care settings, which reflects the urgency for adequate community assessment and neighborhood support.

Metrics of the World Cities Project

According to Rodwin and Gusmano,[24] comparing world mega-cities of wealthier nations of the Organization for Economic Cooperation and Development (OECD) is important for 3 reasons. First, it reveals a deeper understanding of emerging global trends in urbanization, health risks, and population aging. Second, each of the cities exert a dominant influence on developing nations globally. Third, it is important to create a foundation to understand their comparative health systems. The framework for the WCP is based on comparisons of urban cores from which inequalities in health care use and health status can be ascertained at neighborhood levels, representing the diversity of socioeconomic strata of the larger urban core and community. Manhattan, London, and Paris are the largest cities of the higher income nations of the OECD and represent enormous and diverse city regions. Paris was originally selected as a prototypical urban core against which those of Manhattan and Inner London would be matched. The definition of the respective urban cores of each world city conformed to 5 criteria.[24] First, each represented historic centers of their respective metropolitan regions. Second, their populations were similar in size, ranging from 1.5 million in Manhattan to 2.1 million in Paris. Third, the urban cores of these cities combined a mix of high-income and low-income populations marked by wide variation in average household income. Fourth, each functioned as a central hub for employment with large numbers of commuters. Fifth, each served as a center for medical resources within their respective regions and nations, having large numbers of teaching hospitals and medical schools, and high rates of acute hospital beds and physicians per capita.

Despite similarities, the WCP investigators[24] found that these cities exist within very different health systems. Manhattan has a high proportion of uninsured patients, whereas those with insurance are covered by a patchwork system of public and private indemnity insurers and managed care organizations. Those residing in Paris are typically covered by National Health Insurance (NHI), whereas Londoners are generally eligible to receive care through the National Health Service. There are differences between the cities in the specialty mix of physicians and the relative size of the public hospital sector that, among other factors, affect use of health services. A similar measure of pretax average household income by neighborhood subunit was available for Manhattan and Paris but absent in London, leading WCP investigators to use a deprivation index. In each city, income strata or deprivation indices were referred to quartiles for comparisons.

Gusmano and colleagues[20] analyzed AHCs as an indicator of access to primary health care in Manhattan and Paris. The selection of AHCs was a dimension of health system performance and a recognized valid indicator of access to primary care.[35] Citing their similarities, Gusmano and colleagues[20] noted that, with populations of 8.0 million and 6.2 million, Manhattan and Paris were, respectively, 2 of the largest cities among the higher income countries of the OECD. Their respective urban cores were centers of medical excellence with a disproportionate share of hospitals, physicians, and indigent patients in comparison with their surroundings. Their per capita rates of physicians and acute hospital beds were virtually the same. Both cities were destinations for large immigrant communities from around the world. Despite their similar characteristics, the investigators[20] noted that the primary care system in France was much stronger than in Manhattan, with approximately 50% of physicians in primary care compared with 30% for Manhattan. NHI, which covers the entire population legally residing in France who met residency requirements, is complemented by a system that resembles Medigap for US Medicare beneficiaries but differs in that French

NHI coverage increases when a patient's costs increase without deductibles, and drug benefits are extensive. French patients with debilitating or chronic illnesses are exempted from coinsurance if they consult physicians who accept NHI reimbursement as payment in full. Patients who choose to consult with physicians who require coinsurance are typically eligible for some coverage under complementary insurance. If this constitutes a financial barrier, they can choose physicians who accept NHI rates as payment in full or can consult physicians at any of 50 health centers located in every arrondissement of the city. In 2000, NHI was extended to the 3% to 4% of Parisians who were previously not covered. In addition to greater income inequality in Manhattan than in Paris, 24% of the population is uninsured, and gaps in access to primary care exist, despite the presence of a strong safety net, including the largest US public hospital system. The calculation of comparative hospital discharge rates for AHCs for the Manhattan and Paris health systems used the definition of AHCs developed by Weissman and colleagues.[39]

Gusmano and colleagues[20] tabulated discharge rates for the marker conditions of appendicitis, gastrointestinal obstruction, and hip fractures; and for referral-sensitive procedures, including lower-extremity joint replacements and organ transplants. The investigators noted that, for people age 18 years and older, the age-adjusted discharge rate for AHCs in Manhattan was more than 2 and a half times that of Paris, a much greater difference than among large US cities. Discharge rates for marker conditions were 20% higher in Manhattan than in Paris, whereas those for referral-sensitive procedures were identical in the 2 cities. Gusmano and colleagues[20] noted that discharge rates for AHCs were higher in lower-income neighborhoods of Manhattan and Paris but the differences among residents of below-median-income neighborhoods compared with residents of above-median-income neighborhoods were 56% greater in Manhattan and 20% greater in Paris. There was no difference in Manhattan and very little difference in Paris between higher and lower income neighborhoods for discharges related to marker conditions. There were 20% fewer discharges for referral-sensitive procedures among residents of lower-income areas in Manhattan. In Paris, however, there was virtually no difference between residents of higher and lower income areas for these procedures. Multiple logistic regression analysis showed a statistically significant influence for age, indices of severity of illness, and number of physicians per 1000 population. Female patients had decreased odds of admission for an AHC by about 30%. The neighborhood income and education variables were not significant in Paris. The odds of AHC discharges were 29% higher among blacks and 47% higher among Hispanics than whites. The odds of AHC discharges for uninsured people were 82% greater than for people with private insurance; and the odds of AHCs were 39% among Medicaid recipients and 21% higher among Medicare beneficiaries than among people with private coverage. Although AHCs were related to neighborhood-level income in both cities, the magnitude of the disparity among high-income and low-income neighborhoods was higher by a factor of 2 in Manhattan compared with Paris. The higher rates of AHCs in Manhattan were explained by multiple barriers to care, including race and ethnicity, income of residence, sex, and insurance status. Medicare beneficiaries, Medicaid recipients, and the uninsured are all more likely than the privately insured to be hospitalized for AHCs. Inadequate insurance coverage and lack of timely effective primary care can thus result in unnecessary illness, loss of productivity, and costly hospitalizations.

Weisz and colleagues[22] studied the association between AM and an income-related variable in the urban cores of Paris, London, and Manhattan. The investigators[22] obtained mortality data from vital statistics sources for each geographic area for the

periods from 1988 to 1990 and 1998 to 2000 to assess the correlation between area of residence and age-adjusted and gender-adjusted totals and AM rates. They used regression models to analyze the association of a neighborhood income-related variable expressed as the exponential of the estimate, the estimated incident rate ratio (IRR), that is, the ratio of the value of the AM rate in the low-income (or high-deprivation) areas to that of the ratio of the value of the AM rate in the low-income or high-deprivation areas to that of the rest of the city. Weisz and colleagues[22] noted that, compared with the US and the United Kingdom, France had the lowest age-adjusted and gender-adjusted MRs. Over the 2 periods (1988–90 and 1998–2000), the rates of AM declined in all 3 urban cores but Manhattan experienced the greatest decline (20%) in comparison with Paris (16%) and London (13%). Negative binomial regression results revealed that residence in a low-income neighborhood, compared with the remainder of the city, was significantly associated with increased AM rates per 1000 population in all 3 urban cores, and that the IRR was greatest in Manhattan, followed by London, and least in Paris. The observed differences between France and the US and their world cities were greater with respect to AM than to total mortality, supporting a hypothesis that part of the difference between these countries could be attributed to differences in their health systems. The health of residents of Inner London, measured in terms of total and AM, was worse than that of Manhattan residents, which was not surprising given the concentration of poverty in London, and its reputation for poor primary care. Inequality of access to timely and effective medical care seemed to be a much greater problem in Manhattan than either London or Paris. Weisz and colleagues[22] observed that, in contrast to Inner London and Paris where there was universal access to health care, those living in the lowest income neighborhood of Manhattan exhibited a significantly higher percentage of avoidable deaths than people living in the rest of the borough. This might be related to barriers in access to health care services, poor knowledge of the system's operation, or poorer ability to communicate with providers. Despite the recognition of the steep inverse association between social and economic status,[40,41] and mortality from a wide range of diseases, Weisz and colleagues[22] make compelling arguments for the disparities in AM based on access to disease prevention services and health care to improve population health in these 3 world cities.

EXAMINING COMMUNITY-LEVEL HEALTH INDICATORS

Although epidemiologic studies have traditionally identified risk factors for major disease, only recently have the individually based risk factors been contextualized to devise effective interventions and improve health outcomes by focusing on what puts people at risk of risk. In their theory of fundamental causes, Link and Phelan[42] (1995) argued that the association between socioeconomic status (SES) and mortality has persisted despite improvements in disease outcome and modification of individual risk factors because higher SES protects health no matter what mechanisms are relevant at any given time. Marmot[43] noted that the social determinants of health may be relevant to communicable and noncommunicable disease alike, therefore health status should be of concern to policy makers in every sector, not solely those involved in health policy. The report of the WHO Commission on Social Determinants of Health, contextualized by Marmot and colleagues,[44] concluded that social inequality underlies much of the health inequalities in and among nations. That SES and other similar determinants so prominently affect health inequality and are potent predictors of adverse health outcomes, and even individual diseases, probably stems from their embodiment of multiple mechanisms. Phelan and colleagues[45] advocated

policies to promote medical health-promoting advances while weakening the link between these advances and socioeconomic resources by reducing disparities in socioeconomic resources. Heavily influenced by the foregoing observations, public health researchers have been charged with developing interventions to examine health status and health needs of populations by identifying those contextual factors that contribute to health risks and health status of subpopulation groups, particularly those experiencing the greatest disparity in health. Doing so may require drilling down from community levels to examine living conditions and social circumstances that put communities at risk for poor health outcomes, as well as identifying community level needs and assets that provide opportunities for community level interventions to ameliorate or reduce those risks.

Northern Manhattan Stroke Study

Important health indicators to consider in population health are socioeconomics, insurance coverage, and access to adequate primary care in individual neighborhoods. This information can only be gathered by conducting large-scale detailed community assessments and epidemiologic investigations that are rarely available in most neighborhoods. An exception is a study of urban Northern Manhattan, which has been a source of epidemiologic interest to investigators of the Northern Manhattan Stroke Study (NOMASS)[46] that was designed to address IS risk factor and prognosis in that multiethnic population. Using the 1990 census,[47] the initial population of about 260,000 people were racially and socioeconomically heterogeneous and served by the consortium of hospitals and clinics of New York Presbyterian/Columbia Presbyterian Medical Center, the only hospital in the region. They have been exhaustively studied epidemiologically for nearly 2 decades by NOMASS collaborators from the Departments of Neurology and Public Health from Columbia University, the Miller School of Medicine, and the College of Global Public Health of New York University to assess risk factors and prognosis related to IS. Detailed US census survey and descriptive health appraisal data derived from updated versions of Take Care New York community health appraisal of Northern Manhattan, gathered by the New York City Department of Health and Mental Hygiene,[48] made Northern Manhattan a unique setting for the study of IS and emblematic of the potential for community and epidemiologic activism in understanding the dynamics of a community to appropriately target public health and socioeconomic needs. In an exemplary study of the interaction of SES and physiologic predictors of adverse health outcomes in the multiethnic community of Northern Manhattan, Rodriguez and colleagues[49] investigated increased left ventricular mass (LVM) and lower SES as predictors of cardiovascular morbidity and mortality. Socioeconomic data of 1,916 black, Hispanic, and white subjects in a NOMAS population-based sample were characterized based on educational attainment, whereas echocardiography-defined LVM was indexed and analyzed as a continuous variable. LVM varied by race and educational level (P trend = 0.0004) with a significant inverse and graded association between mean LVM and SES. Lower SES was an independent predictor of increased LVM among hypertensive and normotensive blacks. Hispanics carried a higher burden of increased LVM than whites at a level similar to that of blacks. The investigators noted that, although their findings did not establish a causative role for SES in the pathogenesis of increased LVM there was a link between SES and LVM. The opportunities for research into socioeconomic and ethnically based risk factors, as well as more aggressive monitoring of cardiovascular risk factors and earlier intervention for those at greatest cardiovascular risk, was suggested.[49]

REFERENCES

1. Schroeder SA. The medically uninsured: will they always be with us? N Engl J Med 1996;334:1130–3.
2. McGinnis JM, Williams-Russo P, Knickman JR. The case for more active policy attention to health promotion. Health Aff 2002;21:78–93.
3. Special Report: World Economy. For richer, for poorer. The Economist 2012;3–24.
4. Wang H, Dwyer-Lindgren L, Lofgren KT, et al. Age-specific and sex-specific mortality in 187 countries, 1970-2010: a systematic analysis for the Global Burden of Disease Study 2010. Lancet 2012;380:2071–94.
5. National Center for Health Statistics. Mortality in the United States, 2013. Atlanta (GA): Department of Health and Human Services; National Center for Health Statistics; 2014. Data Brief No. 178.
6. Dempsey M. Decline in tuberculosis. The death rate fails to tell the entire story. Am Rev Tuberc 1947;56:157–64.
7. National Center for Health Statistics. Health, United States. Hyattsville (MD): Department of Health and Human Services; National Center for Health Statistics; 2004. Available at: http://www.cdc.gov/nchs/hus.htm.
8. Murray CJ, Acharya AK. Understanding DALYs (disability-adjusted life years). J Health Econ 1997;16:703–30.
9. Murray CJL, Lopez AD. The global burden of diseases: a comprehensive assessment of mortality and disability from diseases, injuries and risk factors in 1990 and projected to 2020, vol. II. Cambridge (MA): Harvard School of Public Health on behalf of the World Health Organization; World Bank (Global Burden of Disease and Injury Series; 1996.
10. Murray CJL, Lopez AD, Jamison DT. The global burden of disease in 1990: summary results, sensitivity analysis and future directions. Bull World Health Organ 1994;72(3):495–509.
11. GBD 2013 DALYs and HALE Collaborators, Murray CJ, Barber RM, Foreman KJ, et al. Global, regional, and national disability-adjusted life years (DALYs) for 306 diseases and injuries and healthy life expectancy (HALE) for 188 countries, 1990-2013: quantifying the epidemiological transition. Lancet 2015;386:2145–91.
12. Global Burden of Disease Study 2013 Collaborators. Global, regional, and national incidence, prevalence, and years lived with disability for 301 acute and chronic diseases and injuries in 188 countries, 1990-2013: a systematic analysis for the Global Burden of Disease Study 2013. Lancet 2015;386:743–800.
13. Vos T, Flaxman AD, Naghavi M, et al. Years lived with disability (YLDs) for 1160 sequelae of 289 diseases and injuries 1990–2010: a systematic analysis for the Global Burden of Disease Study 2010. Lancet 2012;380:2163–96.
14. Feigin VL, Mensah GA, Norrving B, et al, GBD 2013 Stroke Panel Experts Group. Atlas of the global burden of (1990-2013): the GBD 2013 study. Neuroepidemiology 2015;45:230236.
15. Krishnamurthi RV, Moran AE, Feigin VL, et al, GBD 2013 Burden of Disease 2013 Study. Stroke prevalence, mortality and disability-adjusted life years in adults aged 20-64 years in 1990-2013: Data from the Global Burden of Disease 2013 Study. Neuroepidemiology 2015;45:190–202.
16. Adeloye D. An estimate of the incidence and prevalence of stroke in Africa: a systematic review and meta-analysis. PLoS One 2014;9(6):e100724.
17. Chinitz DP, Rodwin VG. On health policy and management (HPAM): mind the theory-policy-practice gap. Int J Health Policy Manag 2014;3:361–3.

18. Centers for Medicare and Medicaid Services. Readmissions reduction program. Available at: http://www.cms.gov/Medicare/Medicare-Fee-for-Service-Payment/AcuteInpatientPPS/Readmissions-Reduction-Program.html. Accessed August 1, 2013.
19. Leung KS, Parks J, Topolski J. Preventable hospitalizations among adult Medicaid beneficiaries with concurrent substance use disorders. Prev Med Rep 2015;2:379–84.
20. Gusmano MK, Rodwin VG, Weisz D. A new way to compare health systems: avoidance hospital conditions in Manhattan and Paris. Health Aff (Millwood) 2006;25:510–20.
21. Rosano A, Loha CA, Falvo R, et al. The relationship between avoidable hospitalization and accessibility to primary care: a systematic review. Eur J Public Health 2013;23:356–60.
22. Weisz D, Gusmano MK, Rodwin VG, et al. Population health and the health system: a comparative analysis of avoidable mortality in three nations and their world cities. Eur J Public Health 2008;18:166–72.
23. Rodwin VG, Neuberg LG. Infant mortality and income in 4 world cities: New York, London, Paris and Tokyo. Am J Public Health 2005;95:86–90.
24. Rodwin VR, Gusmano MK. The World Cities Project: rationale and design for comparison of megacity health systems. J Urban Health 2002;79:445–63.
25. Go AS, Mozaffarian D, Roger VL, et al. Heart disease and stroke statistics—2013 update: a report from the American Heart Association. Circulation 2013;127:e6–245.
26. Kocher RP, Adashi EY. Hospital readmissions and the Affordable Care Act: paying for coordinated quality care. JAMA 2011;306:1794–5.
27. Williams MV. A requirement to reduce readmissions: take care of the patient, not just the disease. JAMA 2013;309:394–6.
28. Centers for Medicare and Medicaid Services. Readmissions Reduction Program, Medicare Program; hospital inpatient prospective payment systems for acute care hospitals and the long term care hospital prospective payment system and proposed fiscal year 2014 rates; quality reporting requirements for specific providers; hospital conditions of participation; Medicare program; FY 2014 hospice wage index and payment rate update; hospice quality reporting requirements; and updates on payment reform; proposed rules. Fed Regist 2013;78:27485–823.
29. Josephson SA, Johnston SC, Hauser SL. The neurologic revolving door: time to pay attention to readmissions. Ann Neurol 2013;73:A5–6.
30. Lichtman JH, Leifheit-Limson EC, Jones SB, et al. Preventable readmissions within 30 days of ischemic stroke among Medicare beneficiaries. Stroke 2013;44:3429–35.
31. Lichtman JH, Leifheit-Limson EC, Jones SB, et al. 30-day risk-standardized mortality and readmission rates after ischemic stroke in critical access hospitals. Stroke 2012;43:2741–7.
32. Guterman EL, Douglas VC, Shah MP, et al. National characteristics and predictors of neurologic 30-day readmissions. Neurology 2016;86:1–7.
33. Basu J, Mobley LR, Thumula V. The small area predictors of ambulatory care sensitive hospitalizations: a comparison of changes over time. Soc Work Public Health 2014;29:176–88.
34. Billings J, Zeitel L, Lukomnik J, et al. Impact of socioeconomic status on hospital use in New York City. Health Aff 1993;12:162–73.

35. Riley GF, Potosky AL, Lubitz JD, et al. Stage of cancer at diagnosis for Medicare HMO and fee-for-service enrollees. Am J Public Health 1994;84:1598–604.
36. Basu J, Mobley L. Do HMOs reduce preventable hospitalizations for Medicare beneficiaries? Med Care Res Rev 2007;64:544–67.
37. Ansari Z, Laditka JN, Laditka SB. Access to health care and hospitalization for ambulatory care sensitive conditions. Med Care Res Rev 2006;63:719–41.
38. Schreiber S, Zielinsky T. The meaning of ambulatory care sensitive admissions: Urban and rural perspectives. J Rural Health 1997;13:276–84.
39. Weissman JS, Gatsonis C, Epstein AM. Rates of Avoidable Hospitalization by Insurance Status in Massachusetts and Maryland. JAMA 1992;268:2388–94.
40. Marmot MG, Smith GD, Stansfield S. Health inequalities among British civil servants: the Whitehall II study. Lancet 1991;337:1387–93.
41. Pappas G, Queen S, Hadden W. The increasing disparity in mortality between socioeconomic groups in the United States, 1960 and 1986. N Engl J Med 1993; 329:1032–109.
42. Link BG, Phelan J. Social conditions as fundamental causes of disease. J Health Soc Behav 1995;Spec No:80–94.
43. Marmot M. Social determinants of health inequalities. Lancet 2005;365:1099–104.
44. Marmot M, Bell R, Goldblatt P. Action on the social determinants of health. Rev Epidemiol Sante Publique 2013;61(Suppl 3):S127–32.
45. Phelan JC, Link BG, Tehranifar P. Social conditions as fundamental causes of health inequalities: theory, evidence, and policy implications. J Health Soc Behav 2010;51(Suppl):S28–40.
46. Sacco RL, Boden-Albala Bernadette B, Gan R, et al. Stroke incidence among white, black and Hispanic residents of an urban community. Am J Epidemiol 1998;147:259–68.
47. Bureau of the Census. 1990 census of population and housing. Washington, DC: Bureau of the Census; US Department of Commerce; 1990.
48. Community Health Profiles. Take care New York. Inwood and Washington heights. 2nd edition. Manhattan (NY): Department of Health and Mental Hygiene; 2006.
49. Rodriguez CJ, Sciacca RR, Diez-Roux AV, et al. Relation between socioeconomic status, race-ethnicity, and left ventricular mass: the Northern Manhattan study. Hypertension 2004;43:775–9.