Making the Crooked Way Straight: Interpreting Geography and Health Care Delivery in CKD

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Clin J Am Soc Nephrol 8: 518–519, 2013. doi: 10.2215/CJN.01830213

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Every valley shall be filled in, every mountain and hill made low. The crooked ways shall become straight, the rough ways smooth.—Luke 3:5

To straighten the crooked you must straighten yourself—*The Dhammapada*

Inequality seems a fact of life. However, our society increasingly expects uniform outcomes, or at least common minimum standards, in many areas, especially medicine. Of all external factors associated with inequalities, geography may be the most bewildering, but one with possibly the greatest impact (1). CKD, just like health care in general (2–6), also demonstrates geographic variability (7). This variation includes exceptions to overall findings (*i.e.*, possible superior survival of black patients undergoing dialysis [8] and diminished disparities in certain health systems [9–11]). Yet more detailed analysis does not always yield expected results. A parallel may be found in the popular depiction of United States political affiliation by state during the last presidential election (12). We might expect that within "blue" (*i.e.*, Democrat) states, for example, most of the counties within that state are also that color. However, this is not the case: Within "blue" states, most of the individual counties are actually "red" (*i.e.*, Republican), with islands of (generally) much more populous blue counties interspersed. Thus, the overall state is "blue" because the unit of measurement is total votes. However, if the unit of measurement were total *counties*, the designation of a state as "red" or "blue" would be very different. Therefore, it may be the population density of one's geographic position, rather than the particular geographic location, that predicts political affiliation.

In this issue of *CJASN*, Yan and colleagues used this concept to see whether it would yield a unifying explanation of variation in pre-ESRD care by geography (13). By merging Area Resource Files (a database containing such attributes as the population for all United States counties) with the United States Renal Data System, the authors assigned counties into four categories based on population: large metropolitan, median/small metropolitan, suburban, and rural. They then associated population density with whether patients were seen by a nephrologist at least 6 or 12 months before dialysis initiation. In patients seen by a nephrologist, they further selected markers of pre-ESRD care (arteriovenous fistula [AVF] at first outpatient dialysis, receipt of dietitian care, and receipt of erythropoietin-stimulating agent [ESA]) as their outcomes, adjusted for demographic, geographic, and clinical factors known or suspected to influence outcomes.

At first glance, the authors' findings are similar to those in previous reports: Pre-ESRD nephrology care was most frequent in median/small metropolitan counties. Subsequent dietitian care and receipt of ESA were most frequent in metropolitan counties, and receipt of AVF for first outpatient dialysis was most frequent in rural counties. The authors confirmed that black patients were less likely to receive pre-ESRD care overall than white patients. They also demonstrated that for ESA use and early nephrology care, disparities were somewhat attenuated (but not negated) after adjustment for employment and health insurance. The authors quite correctly point out that measurement based at county, or even ZIP code, level may mask considerable variation (*i.e.*, residual confounding, or ecological fallacy [14]). The authors did not account for income, although currently that too is available at ZIP code level and therefore is inevitably linked with location; thus, income would have considerable (but not total) overlap with population.

It is also noteworthy, but not emphasized in the discussion, that the number of nephrologists per capita markedly declines between the metropolitan counties and the suburban/rural counties—but that rural nephrologists appear to provide similar care to more patients. With nearly four to five times the number of nephrologists per capita, patients in large metropolitan areas are no more likely to receive early nephrology care than rural patients. In fact, despite the enormous disparity in nephrologists per capita, rural patients are significantly more likely to have a functional AVF at first outpatient dialysis. This finding was seen despite the lack of significant differences in pre-ESRD nephrology care, which in other studies has been associated with increased placement of AVFs (15). Curiously, other factors associated with improved AVF placement were greater availability of nephrologists and

surgeons for a given population (16), along with coordinated care (17), a factor not discernible from the database. O'Hare *et al.* previously reported that despite differences in the structure of dialysis care in rural areas, dialysis facilities in these regions performed at least as well as (if not better than) their urban counterparts on several quality measures (18).

In summary, as Yan *et al.* state, pre-ESRD care outcomes are highly variable among population and geographic categories. Their key finding is that health care policies directed at eliminating pre-ESRD care disparities will not necessarily make "the crooked way straight." The way forward is likely to be anything but straightforward—but there are potential investigative and intervention tools available, including analysis of complex systems and game, or queuing, theory (19–22). For instance, geospatial analysis has been used to quantify current and future health care needs in high-risk regions and identify mismatches between needs and available resources, thus informing resource allocation and policy decisions (23). Telemedicine could potentially improve access to good-quality care to otherwise isolated communities, either rural or urban—allowing effective application of evidence-based guidelines (24). Unfortunately, the current inflexible nature of reimbursement for telehealth may perpetuate existing disparities. Coordinated care, as used in federal health systems, has also been associated with improved metrics, such as AVF placement, despite a globally distributed patient population (17). Perhaps the study and attenuation of disparities can be the "killer app" for such tools.

Disclaimer

The views expressed in this article are those of the authors and do not necessarily reflect the official policy or position of the Department of the Army, the Department of Defense, or the U.S. government.

Disclosures

None.

References

1. Diamond J: *Guns, Germs and Steel: The Fates of Human Societies,* New York, WW Norton, 1997
2. Bharmal N, Tseng CH, Kaplan R, Wong MD: State-level variations in racial disparities in life expectancy. *Health Serv Res* 47: 544–555, 2012
3. Semrad TJ, Tancredi DJ, Baldwin LM, Green P, Fenton JJ: Geographic variation of racial/ethnic disparities in colorectal cancer testing among Medicare enrollees. *Cancer* 117: 1755–1763, 2011
4. Landon BE, Keating NL, Barnett ML, Onnela JP, Paul S, O'Malley AJ, Keegan T, Christakis NA: Variation in patient-sharing networks of physicians across the United States. *JAMA* 308: 265–273, 2012
5. Zhang Y, Baik SH, Fendrick AM, Baicker K: Comparing local and regional variation in health care spending. *N Engl J Med* 367: 1724–1731, 2012
6. Radley DC, Schoen C: Geographic variation in access to care—the relationship with quality. *N Engl J Med* 367: 3–6, 2012 10.1056/NEJMp1204516
7. McClellan AC, Plantinga L, McClellan WM: Epidemiology, geography and chronic kidney disease. *Curr Opin Nephrol Hypertens* 21: 323–328, 2012
8. Kucirka LM, Grams ME, Lessler J, Hall EC, James N, Massie AB, Montgomery RA, Segev DL: Association of race and age with survival among patients undergoing dialysis. *JAMA* 306: 620–626, 2011
9. Abbott KC, Bohen EM, Yuan CM, Yeo FE, Sawyers ES, Perkins RM, Lentine KL, Oliver DK, Galey J, Sebastianelli ME, Scally JP, Taylor AJ, Boal TR: Use of beta-blockers and aspirin after myocardial infarction by patient renal function in the Department of Defense health care system. *Am J Kidney Dis* 47: 593–603, 2006
10. Gao SW, Oliver DK, Das N, Hurst FP, Lentine KL, Agodoa LY, Sawyers ES, Abbott KC: Assessment of racial disparities in chronic kidney disease stage 3 and 4 care in the department of defense health system. *Clin J Am Soc Nephrol* 3: 442–449, 2008
11. Oliver JD 3rd, Neff RT, Leeser DB, Swanson SJ, Yuan CM, Falta EM, Elster E, Reinmuth B, Bohen EM, Jindal RM, Abbott KC: Influence of race on kidney transplantation in the Department of Defense healthcare system. *Am J Nephrol* 29: 327–333, 2009
12. Marble Hill Constitution News. Virginia and Florida 2012 presidential election results, by county. Available at: http://mhconstitution.files.wordpress.com/2012/11/va-and-fl-2012-election-results-by-county-300x296.jpg Accessed February 11, 2013
13. Yan G, Cheung AK, Ma JZ, Yu AJ, Greene T, Oliver MN, Yu W, Norris KC: The associations between race and geographic area and quality-of-care indicators in patients approaching ESRD. *Clin J Am Soc Nephrol* 8: 610–618, 2013
14. Szklo M, Nieto FJ: *Epidemiology: Beyond the Basics*, Gaithersburg, MD, Aspen Publishers, 2000, p 19
15. Inaguma D, Ando R, Ikeda M, Joki N, Koiwa F, Komatsu Y, Sakaguchi T, Shinoda T, Yamaka T, Shigematsu T: Nephrologist care for 12 months or more increases hemodialysis initiation with permanent vascular access. *Clin Exp Nephrol* 15: 738–744, 2011
16. Lopez-Vargas PA, Craig JC, Gallagher MP, Walker RG, Snelling PL, Pedagogos E, Gray NA, Divi MD, Gillies AH, Suranyi MG, Thein H, McDonald SP, Russell C, Polkinghorne KR: Barriers to timely arteriovenous fistula creation: A study of providers and patients. *Am J Kidney Dis* 57: 873–882, 2011
17. Hurst FP, Abbott KC, Raj D, Krishnan M, Palant CE, Agodoa LY, Jindal RM: Arteriovenous fistulas among incident hemodialysis patients in Department of Defense and Veterans Affairs facilities. *J Am Soc Nephrol* 21: 1571–1577, 2010
18. O'Hare AM, Johansen KL, Rodriguez RA: Dialysis and kidney transplantation among patients living in rural areas of the United States. *Kidney Int* 69: 343–349, 2006
19. Jahangoshai Rezaee M, Moini A, Haji-Ali Asgari F: Unified performance evaluation of health centers with integrated model of data envelopment analysis and bargaining game. *J Med Syst* 36: 3805–3815, 2012
20. Peitgen HO, Jürgens H, Saupe D: *Chaos and Fractals: New Frontiers of Science*, Chapter 10.1, New York, Springer –Verlag, 1992, pp 509–519
21. Mandelbrot B: *The Fractal Geometry of Nature. Part 2. How Long Is the Coast of Britain?* New York, W.H. Freeman, 1983
22. Plsek PE,GreenhalghT: The challenge of complexity in healthcare. *BMJ* 323: 625, 2001
23. Rodriguez RA, Hotchkiss JR, O'Hare AM: Geographic information systems and chronic kidney disease: Racial disparities, rural residence and forecasting. *J Nephrol* 26: 3–15, 2013
24. Bernstein K, Zacharias J, Blanchard JF, Yu BN, Shaw SY: Model for equitable care and outcomes for remote full care hemodialysis units. *Clin J Am Soc Nephrol* 5: 645–651, 2010

Published online ahead of print. Publication date available at www.cjasn.org.

See related article, "The Associations between Race and Geographic Area and Quality-of-Care Indicators in Patients Approaching ESRD," on pages 610–618.