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US Growth in PCI Care—Less than Ideal, but is the Ideal Less?

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An ideal healthcare system aims to provide care that is safe, effective, efficient, equitable, timely and patient-centered.[1] Translation of these aims into practice for patients suffering from ST-elevation myocardial infarction (STEMI) could result in an ideal primary percutaneous coronary intervention (PCI) system of care. In this ideal PCI system of care, PCI centers would be equitably distributed for the population at risk to ensure timely access to primary PCI. Further, PCI centers would care for an adequately sized patient population to achieve minimal volume thresholds, and to provide the procedure safely while ensuring efficient use of healthcare resources. Although an ideal PCI system of care is easy to envision, it is possible that the current primary PCI system of care in the US is not ideally configured.

It would appear that an ideal PCI system of care could be designed in 1 of 2 ways to achieve high-quality care. The first approach involves integrated PCI networks that coordinate care among emergency medical services (EMS), non-PCI-capable hospitals, and PCI-capable centers through the use of established processes to ensure timely transfer of STEMI patients to PCI-capable centers[2]. An established network may increase access to primary PCI, minimize delays in care, and optimize patient outcomes. An example of this approach is the American Heart Association's *Mission: Lifeline* that seeks to improve the healthcare system's timely response to patients with STEMI through the creation and improvement of STEMI systems of care.[3] Another example comes from Denmark, where the development of a STEMI network has optimized patient access to PCI care for the entire country. As shown in the Figure, through coordination of EMS systems and PCI-capable centers, nearly all patients in Denmark have access to primary PCI within 120 minutes of EMS contact (red circles represent <120 minutes by helicopter EMS transport; yellow circles represent <120 minutes by ground EMS transport).[4]

A second approach to increasing PCI access is the development of new PCI-capable centers. Growth in PCI-capable hospitals would not be haphazard in an ideal PCI system of care. Instead, new PCI-capable centers would address gaps in current access to timely PCI for STEMI patients by using disease prevalence and geospatial analyses to determine new sites for PCI hospitals. In this approach, geographic regions with a high-risk patient population for STEMI and without a nearby PCI capable center would be ideal locations for new growth in PCI-capable hospitals. The study by Langabeer et al[5] in this issue of *JAHA* sought to determine if growth in PCI-capable centers was consistent with this approach. The importance of this question is highlighted by the dramatic growth in PCI-capable hospitals over the past decade in the US.

Using geospatial analyses, Langabeer et al modeled the temporal growth and access to primary PCI relative to the population density and MI prevalence at the state level. From 2003 to 2011, the authors determined that the number of PCI-capable hospitals in the US has grown 12.9% from 1750 to 1975 PCI centers. This growth is faster than the population growth (8.3%) and occurred during a period of declining coronary disease prevalence. Furthermore, growth in PCI-capable centers has not been uniform in relation to MI prevalence and distance between PCI facilities. For example, although the annual MI prevalence in Nevada is higher than the median (51 MIs per 1000 persons), the number of PCI facilities in the state is lower than the median (6.8 facilities per 1 million persons) with very long distances between patients and facilities (16.3 PCI facilities per 100 000 square miles). In contrast, the MI prevalence in the District of Columbia is lower than any state (21 MIs per 1000 persons), and yet the number of facilities is high (8.3 per 1 million persons) with a dramatic geographic concentration of PCI facilities (7316.4 PCI facilities per 100 000 square miles). There are clearly limitations to this type of descriptive analysis given the potential care of patients across state lines when

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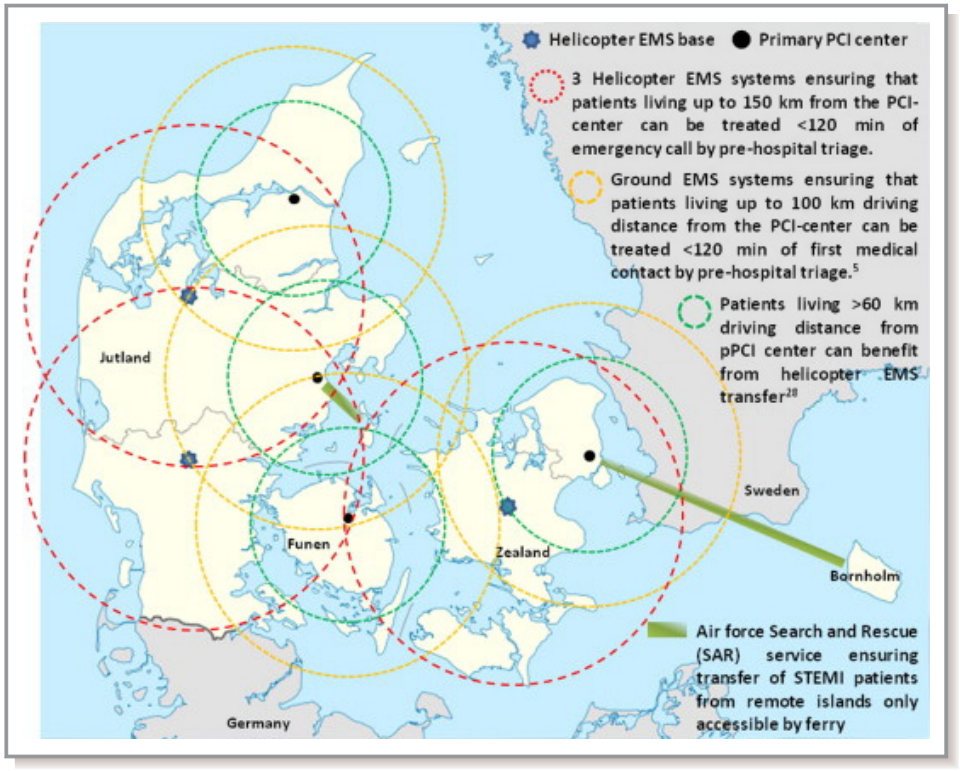

Figure Map over Denmark with geographical zones covered by ground and airborne emergency medical systems. Figure reproduced with permission from Clemmensen et al.[4] EMS indicates emergency medical services; PCI, percutaneous coronary intervention.

PCI facilities are near state borders, yet these findings still raise a concern of disparate primary PCI access.

The findings of Langabeer et al are consistent with those of Concannon et al, which recently demonstrated significant duplication in access to primary PCI.[6] The study by Concannon demonstrated 98% of new PCI-capable centers were introduced in areas that already had a PCI program. Furthermore, new PCI programs were more likely to be located near populations with higher rates of private insurance; suggesting new centers seek procedural dollars, rather than ideal care.

These studies clearly implicate less than ideal growth of PCI centers as it relates to care of patients with STEMI. Further, the present study offers a reasonable strategy to increase access to primary PCI through (1) further expansion of PCI networks or (2) development of PCI capable centers that are nonoverlapping with the population of patients served by established centers. Before considering development of nonoverlapping PCI-capable centers, it is important to acknowledge the population density of currently underserved areas for primary PCI. These areas often lack adequate numbers of STEMI to achieve necessary procedural thresholds for proficiency and efficient use of healthcare resources. Thus, expansion of primary PCI networks may provide a more effective, safe, and efficient strategy to improve primary PCI access for currently underserved regions. In fact, analyses from *Mission: Lifeline* suggests network STEMI systems provide coverage to many of regions identified as underserved in the Langabeer study.[7] Overall, these findings suggest that ideal growth in PCI-capable centers for STEMI care may be fewer PCI centers rather than more.

If the growth in PCI-capable centers for STEMI care has been less than ideal, is it reasonable to say that overall growth in PCI centers should be less? This is far more challenging, largely due to the other important roles of PCI in clinical care for patients with NSTEMI and chronic stable angina. While time to PCI among patients with NSTEMI is not as urgent when compared with STEMI patients, early invasive therapy (within 12 to 24 hours of hospital admission) may reduce the risk of ischemic complications among high-risk NSTEMI patients. This contrasts with timely access to elective PCI for chronic stable angina, which is measured in days to weeks. Further, the goals of elective PCI for chronic stable angina are different than they are for MI and primarily focused on symptom relief. In addition, the clinical risk and benefit of PCI for stable ischemic heart disease must be weighed in relation to the benefit of optimal medical therapy for symptom control. Finally, ideal PCI care avoids inappropriate use of the procedure among patients without anticipated benefit (eg, asymptomatic patients).

Thus, design of overall PCI care must also ensure equitable access for the symptomatic disease burden of the population

without incentivizing inappropriate procedural use. Although the population density and frequency of STEMI may be able to inform the "right" number of PCI-capable hospitals for primary PCI access, this does not necessarily translate into optimal PCI design to minimize population symptom burden and maximize quality of life. Additionally, as the benefits of PCI for stable ischemic heart disease are not time dependent in the same fashion as NSTEMI or STEMI, close geographic access to PCI centers for nonacute indications may not be necessary. Future work is necessary to understand the prevalence of patient-reported symptoms on a population level in relation to PCI access to further optimize delivery of PCI care for chronic stable angina.

Finally, it is important to consider the implications of new care delivery and reimbursement models in the future growth of PCI access. Previously, fee-for-service was the predominant care delivery model. Given widespread concerns that fee-for-service care delivery incentivizes overuse without incentivizing quality or outcomes, policymakers have proposed Accountable Care Organizations (ACOs) as an alternative payment and care delivery model.[8] In ACOs, provider groups accept responsibility for the coordination, quality, and cost of care for a patient population. In this context, developing new PCI capable centers must be considered in relation to the value (outcomes relative to cost) offered to the patient population.[9] If similar survival and symptom burden outcomes can be achieved at lower cost through partnerships between practice groups rather than development of a new PCI-capable center, this may better serve the interest of payers and patients. Whether ACOs can spur collaboration and integration remains to be seen. Study of provider groups within integrated healthcare settings with capitated reimbursement (eg, VA or Kaiser Permanente) may help to inform the design and implementation of ACOs to strike the ideal balance in PCI care. These provider groups are incentivized and cooperatively organized like ACOs. Identification of provider groups with high quality of care and patient outcomes despite lower costs of care may inform strategies to achieve ideal PCI care.

While addressing access to PCI care, we must concurrently work to improve the other domains of high-quality care (safe, effective, efficient, equitable, and patient-centered) to achieve ideal care delivery. The safety of PCI can be improved through greater use of radial arterial access—a patient-preferred approach that remains underused despite benefits of reduced bleeding complications.[10,11] Currently, elective PCI for stable ischemic heart disease is often performed for inappropriate clinical indications (eg, patients without anticipated clinical benefit), suggesting ineffective and inefficient use of resources and unnecessary procedural risk for patients.[12,13] At the same time, we lack population measures of symptom burden that may identify underuse and inequitable use of elective PCI. Work to support proper patient selection in the use of PCI care may ensure the effective, efficient, and equitable use of this important procedure to optimize patient outcomes. Finally, PCI care is not patient-centered as evidenced by patient misconceptions about the anticipated benefit of elective PCI for stable coronary disease.[14] Shared decision making may improve patient engagement and knowledge in support of a patient-centered treatment decision. Continuous assessment of how PCI care is delivered relative to the ideal is critical to identify future opportunities to close the gap and achieve the best care for patients.

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References

1. Institute of Medicine, Committee on Quality Health Care in America. *Crossing the Quality Chasm: A New Health System for the 21st Century*. Washington DC: National Academy Press; 2001.
2. Jacobs AK, Antman EM, Faxon DP, Gregory T, Solis P. Development of systems of care for ST-elevation myocardial infarction patients: executive summary. *Circulation*. 2007;116:217–230.
3. Mission: Lifeline Home Page [Internet]. Available at: http://www.heart.org/HEARTORG/HealthcareResearch/MissionLifelineHomePage/Mission-Lifeline-Home-Page_UCM_305495_SubHomePage.jsp. Accessed October 29, 2013.
4. Clemmensen P, Schoos MM, Lindholm MG, Rasmussen LS, Steinmetz J, Hesselfeldt R, Pedersen F, Jørgensen E, Holmvang L, Sejersten M. Pre-hospital diagnosis and transfer of patients with acute myocardial infarction—a decade long experience from one of Europe's largest STEMI networks. *J Electrocardiol*. 2013;46:546–552.
5. Langabeer JR, Henry TD, Kereiakes DJ, Dellifraine J, Emert J, Wang Z, Stuart L, King R, Segrest W, Moyer P, Jollis JG. Growth in percutaneous coronary intervention capacity relative to population and disease prevalence. *J Am Heart Assoc*. 2013;2:e000370 doi: 10.1161/JAHA.113.000370.
6. Concannon TW, Nelson J, Kent DM, Griffith JL. Evidence of systematic duplication by new percutaneous coronary intervention programs. *Circ Cardiovasc Qual Outcomes*. 2013;6:400–408.
7. Jollis JG, Granger CB, Henry TD, Antman EM, Berger PB, Moyer PH, Pratt FD, Rokos IC, Acuña AR, Roettig ML, Jacobs AK. Systems of care for ST-segment-elevation myocardial infarction: a report from the American Heart Association's Mission: Lifeline. *Circ Cardiovasc Qual Outcomes*. 2012;5:423–428.
8. Berwick DM. Launching accountable care organizations—the proposed rule for the Medicare Shared Savings Program. *N Engl J Med*. 2011;364:e32.
9. Porter ME. What is value in health care? *N Engl J Med*. 2010;363:2477–2481.
10. Rao SV, Ou FS, Wang TY, Roe MT, Brindis R, Rumsfeld JS, Peterson ED. Trends in the prevalence and outcomes of radial and femoral approaches to percutaneous coronary intervention: a report from the National Cardiovascular Data Registry. *JACC Cardiovasc Interv*. 2008;1:379–386.

11. Maynard C, Bradley SM, Bryson CL. The practice of transradial percutaneous coronary intervention in the Washington State Clinical Outcomes Assessment Program. *Am Heart J*. 2013;165:332–337.

12. Chan PS, Patel MR, Klein LW, Krone RJ, Dehmer GJ, Kennedy K, Nallamothu BK, Weaver WD, Masoudi FA, Rumsfeld JS, Brindis RG, Spertus JA. Appropriateness of percutaneous coronary intervention. *JAMA*. 2011;306:53–61.

13. Bradley SM, Maynard C, Bryson CL. Appropriateness of percutaneous coronary interventions in Washington State. *Circ Cardiovasc Qual Outcomes*. 2012;5: 445–453.

14. Rothberg MB, Sivalingam SK, Ashraf J, Visintainer P, Joelson J, Kleppel R, Vallurupalli N, Schweiger MJ. Patients' and cardiologists' perceptions of the benefits of percutaneous coronary intervention for stable coronary disease. *Ann Intern Med*. 2010;153:307–313.

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