Healthcare advances have seen the emergence of technologies that are highly effective at improving patient outcomes, yet efficient dissemination of these technologies remains challenging. On the one hand, it is essential to ensure appropriate dissemination to provide equitable access to care. Indeed, many innovations are poorly disseminated leading to inequalities in access to these innovations and potentially contributing to inequalities in health outcomes. On the other hand, many novel technologies are also highly specialized and costly; uncoordinated and excessive dissemination of such technologies may result in waste of precious healthcare resources with minimal or no benefit to patients.

**Dissemination of Healthcare Technologies**

**Toward a More Informed Approach?**

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Percutaneous coronary intervention (PCI) is the prototypical example of such a technology that has undergone rapid, yet questionable, expansion. Multiple trials have established the efficacy of PCI for acute reperfusion in patients with ST-segment–elevation myocardial infarction (STEMI) and for revascularization in patients with coronary disease, with the evidence well summarized in clinical guidelines. PCI is now one of the most commonly performed procedures in the United States and one of the most costly in terms of overall healthcare expenditure. The growth in PCI procedures performed has been paralleled by rapid proliferation of PCI programs, with 1669 (36.2%) of hospitals in the United States having a PCI program in 2006, an estimated 44% increase from 2001. However, during this period, timely access to PCI, that is, the proportion of the population living within 1 hour of a PCI facility, increased by 0.9% from 79.0% to 79.9%. This latter observation raises many questions about the efficiency of PCI dissemination that has occurred in the United States for the provision of primary PCI services for STEMI. Specifically, it suggests that many of these new PCI programs were duplicative of existing PCI programs.

In this issue of *Circulation: Cardiovascular Quality and Outcomes*, Concannon et al report findings that further examine dissemination of PCI programs in the United States. They sought to evaluate the yearly increase in the number and cost of new PCI programs commenced in the United States between 2004 and 2008 and to identify hospital, community, and state characteristics where new PCI programs have been introduced. Their results show that 1739 or 37.1% of hospitals had PCI programs in 2008, representing a 16.5% increase in the number of hospitals (n=251) with PCI capabilities compared with 2004. During this period, estimated access to timely PCI increased marginally from 79.1% to 80.9%. Marked state-level variation in timely access to PCI was noted ranging from 30.5% to 100%. Furthermore, the authors show that these new PCI programs were more likely to be introduced in areas that had existing PCI programs, near populations with higher rates of private health insurance, and in new, wealthier, and larger hospitals. In contrast, new PCI programs were less likely to be introduced in states with regulatory mechanisms (Certificate of Need programs) to review implementation of new PCI programs. The authors estimate the cost of a new PCI program to be $7.8 million at hospitals with existing cardiac surgical backup and $16.4 million at hospitals without such facilities. This translated into an estimated total expenditure of $1.9 to 4.1 billion on new PCI programs over the 4-year period between 2004 and 2008 depending on the presence or absence of coexisting cardiac surgical backup facilities.

Several limitations should be considered when interpreting these findings. First, the American Hospital Association survey was used to identify PCI services, although this survey does not distinguish between hospitals that provide PCI services from those that provide primary PCI services, which is clearly important when considering access to PCI for STEMI. Second, by the same token, PCI programs are unlikely to be commenced purely for the provision of primary PCI services, thus the $2 to 4 billion costs of establishing these programs are unlikely to be attributable to the provision of STEMI care alone. Third, spatial data analysis techniques make several assumptions, such as emergency medical services (EMS) response and driving times, and are inherently dependent on the quality and accuracy of the data inputs akin to decision analytic and cost-analysis approaches.

Despite these limitations, the authors should be congratulated for producing a body of work which now clearly suggests that expansion of PCI services in recent times may have been an ineffective and costly population strategy for improving access to PCI for STEMI. Despite the proliferation of PCI facilities and significant capital expenditure, inequality in access seems to have persisted as indicated by the presence of marked state-level variation. It is important to note that the recent expansion of PCI services has occurred in the backdrop of declining demand. Incident acute myocardial infarction, and particularly STEMI, rates have declined over the last...
The in-hospital rates of coronary angiography and PCI in the United States have also declined by 33% and 15%, respectively, from 1997 to 2008. Furthermore, PCI rates in the Medicare population, including outpatient PCI, have declined by 2.5% yearly since 2004. Although PCI is a highly efficacious intervention in the appropriate circumstances, in the context of such a declining need, at least some of the recent expansions in PCI programs are likely to have been surplus to population requirements. Ultimately, the costs of such inefficiencies are passed on to the consumer in the form of greater insurance premiums, Medicare and Medicaid program costs, and out-of-pocket expenses for patients.

So how does one maximize access to PCI services if establishing more PCI programs is futile as the data suggest? The answer is perhaps counterintuitive but readily apparent by closer examination of the study data. A reported 50% to 67% of patients with acute myocardial infarction fail to use EMS and self-present to their nearest hospitals. Furthermore, in the absence of prehospital triage systems, most EMS will also transport patients to the nearest hospital. However, as the data show, nearly two thirds of US hospitals are non-PCI hospitals that presumably provide fibrinolysis. Thus, on the basis of the balance of probability alone, a patient is likely to present to a non-PCI hospital and receive fibrinolysis. Indeed, although the authors show that 80.9% of the population lived within 60 minutes of a PCI hospital, only 50% had a PCI hospital as the nearest hospital. The latter figure is perhaps a more conservative yet realistic measure of access to PCI for STEMI. Thus, to maximize access to reperfusion by PCI for the population, investment needs to occur in EMS prehospital triage capabilities and in interhospital transfer systems, such that patients who would normally present to a non-PCI hospital are preferentially diverted to PCI centers. Trial data and guidelines readily support both direct EMS transfer of patients to PCI facilities and interhospital transfer. Such diversion methods are cheaper and maximize the use of existing PCI facilities by increasing volumes, which is associated with lower mortality and lower costs per procedure. Unfortunately, such systematic and regionalized approaches to maximize access to PCI remain infrequent despite the wealth of supporting evidence.

These challenges, however, are not unique to the US healthcare system. Australia, which in contrast to the United States has a highly regulated healthcare system and provides universal healthcare coverage, faces similar challenges. The last decade has seen the expansion of PCI services, and now an estimated 71% of residents in Australia live within 1 hour of a PCI hospital and 82% within 2 hours. However, many inequalities remain, for example, outside of major cities, timely access to PCI is poor (12.8%–23.8%). Furthermore, even in cities where many people live within 60 minutes of a PCI hospital, coordinated investment in strategies to divert patients to PCI hospitals has failed to occur. In this scenario, timely access to PCI in Australia may be as low as 40%, with many PCI hospitals remaining underutilized and many patients continuing to receive fibrinolysis. Like the United States, establishing new PCI programs is unlikely to improve access to PCI in STEMI. For example, strategies to preferentially direct patients to PCI hospitals are projected to increase access to PCI by 19% to 23% compared with a 3.7% increase in timely access to PCI by a 25% increase in PCI facilities nationwide. The presence of shared features of inefficient dissemination between the United States and Australia, despite vastly different healthcare funding and regulatory structures, suggests that these factors alone are unlikely to be the mediators of such inefficiencies.

This study is also thought provoking as it highlights the unintended consequences of technology dissemination without adequate planning. Expansion of PCI services has occurred in the context of tremendous rises in healthcare expenditure in the United States, Australia, and many other developed countries. The excess spending has partially been attributed to frequent use of highly expensive technologies. However, PCI is only one of numerous innovations in medicine. Cardiac surgical programs in the United States increased by 30% from 1993 to 2004 with no improvement in geographical access and in the context of declining coronary artery bypass grafting rates. Many of these were duplicative as 55% opened within 10 miles of an existing program. Furthermore, in the field of cardiology alone, numerous technologies continue to proliferate—transcatheter valve replacement, ablation therapy for various arrhythmias, left ventricular assist devices, and CT coronary angiography just to name a few. To what extent does uncoordinated and inefficient dissemination of such technologies, as alluded to in this article, contribute to excessive healthcare spending? Can such waste be minimized by adoption of more informed and systematic approaches? Decisions on implementation of technologies are often made on clinical efficacy alone, which partially reflects the lack of robust methods to incorporate population-specific factors into the decision-making process. The emergence of spatial data analysis techniques, as used by the authors and others, may overcome such barriers. These methods, although still not widely used, have the capacity to detect, track, and predict the population impact of specific interventions. It is unknown whether such methods will ultimately lead to more efficient technology dissemination. However, this heralds a substantially more informed approach, which may better guide decision making and health policy innovation concerning technology dissemination.

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References


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