

VIEWPOINT

From Knowledge to Practice in Chronic Cardiovascular Disease: A Long and Winding Road

Sumit R. Majumdar, MD, MPH,* Finlay A. McAlister, MD, MSc,* Curt D. Furberg, MD, PhD†
Edmonton, Alberta, Canada; and Winston-Salem, North Carolina

Although clinical practices evolve over time, the translation of specific research evidence into clinical practice is unpredictable, inconsistent, and complex. In this paper, we use examples from chronic cardiovascular conditions to: 1) highlight two types of care gaps; 2) describe the most common potential barriers to the application of evidence into clinical care; and 3) outline which of the strategies for translating evidence into clinical care have been shown to be ineffective, which strategies have been shown to be effective and to describe some untested approaches that hold promise. (J Am Coll Cardiol 2004;43:1738–42) © 2004 by the American College of Cardiology Foundation

Although clinical practice does evolve over time, changes in response to published evidence are unpredictable in timing and magnitude, highly variable between geographic areas and individual clinicians, and may even be inconsistent with the evidence (1,2). Indeed, the mere publication of a study is rarely enough to change clinical practice. In this perspective article, we will illustrate the concept of “care gaps” in cardiovascular disease, explore barriers to best practice in the community setting, and examine potential solutions to enhance the transfer of research evidence to clinical practice. The evidence base that defines care gaps in hospitalized patients and defines the means by which the quality of care for acute medical conditions may be improved is relatively robust (3–5). Because care gaps for chronic cardiovascular conditions dealt with in the outpatient setting are larger than for those acute conditions dealt with in hospitals (2) and because less is known about them (3), we chose to focus on them in this article.

WHAT IS A CARE GAP?

A care gap refers to a discrepancy between processes of care that have been defined as best practice on the basis of high-quality evidence (for therapeutics, we define this as one or more randomized clinical trials [RCTs]) and the care provided in usual clinical practice. Care gaps are often described for medications or surgical interventions, but they may also include suboptimal application of tests (e.g., echocardiography in heart-failure [HF] patients, coronary angiography in patients with angina) necessary for either diagnosing or tailoring treatment.

Care gaps include those situations in which proven

efficacious interventions (i.e., those in which the benefits outweighed the harms in RCTs) are under-used or under-dosed. For example, only 34% to 60% of eligible outpatients in Europe, Canada, and the U.S. receive angiotensin-converting enzyme (ACE) inhibitors and beta-blockers for HF, aspirin and beta-blockers for coronary artery disease, or warfarin for atrial fibrillation (2,6,7). Although less common, care gaps also include those situations in which therapies without proven benefit on hard outcomes such as death or hospitalization, or in some cases even potential harm (i.e., those in which the harms outweighed the benefits when evaluated in RCTs), are used. This type of care gap may arise when a therapy comes into vogue on the basis of its effects on surrogate outcomes before the definitive RCT(s) with hard outcomes has been completed (the widespread use of class I antiarrhythmic agents in patients with ventricular ectopy before the Cardiac Arrhythmia Suppression [CAST] trial proved they were harmful is the most widely cited example of this type of care gap) (8,9).

Although they are universally present, the magnitude of care gaps varies within and across individual practices. For example, the use of ACE inhibitors or beta-blockers in HF varies across geographic areas, between specialists and non-specialists, and between patient subgroups defined by age, gender, and co-existing illnesses (6,7,10).

WHAT ARE THE BARRIERS THAT CREATE CARE GAPS?

At the outset, it should be acknowledged that even in cardiology the literature is incomplete and there are many gray areas with insufficient evidence to define “best practice.” However, in those situations where RCT evidence does exist, the barriers to the application of this evidence in patient care can be grouped into four categories (Table 1) (11).

First, the evidence itself may be unconvincing, even when it passes the quality filters endorsed by the Evidence-Based Medicine Working Group (12). This is particularly so when

From the *Division of General Internal Medicine, Department of Medicine, University of Alberta, Edmonton, Alberta, Canada; and the †Department of Public Health Sciences, Wake Forest University School of Medicine, Winston-Salem, North Carolina. Drs. Majumdar and McAlister are Population Health Investigators, supported by the Alberta Heritage Foundation for Medical Research, and New Investigators, supported by the Canadian Institutes of Health Research.

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Abbreviations and Acronyms

ACE	= angiotensin-converting enzyme
HF	= heart failure
HOPE	= Heart Outcomes Prevention and Evaluation study
MI	= myocardial infarction
RCT	= randomized clinical trial

the RCT evidence is of uncertain clinical significance due to small sample sizes, short or incomplete follow-up, comparisons with inappropriate control groups, reporting of surrogate outcomes rather than clinical end points, or findings that are statistically significant but of questionable clinical relevance (13). Moreover, the evidence may be of questionable import when limited to one intervention while patients with that condition are usually treated with multiple therapies concurrently (13) or when multiple trials yield different results (14). Further, most RCTs are conducted in highly selected subsets of patients, and questions frequently arise about the applicability of this RCT evidence to “real-world” patients, many of whom would not have been eligible for enrollment due to age, co-existing illnesses, or concomitant medication use (15). Moreover, interventions that are complex or very costly are less likely to be adopted in practice even if the supporting evidence is strong. Finally, it has been repeatedly shown that the format of data presentation also influences physician interpretation, with greater enthusiasm engendered by RCTs reporting relative treatment effects rather than absolute effects (16).

Table 1. Barriers to the Application of Evidence in Clinical Care*

Barrier	Examples
The Evidence	Evidence of uncertain clinical significance Evidence inconsistent between trials Limited scope of the evidence Lack of evidence in clinically relevant subgroups Intervention complex or costly Evidence inappropriately framed Competing promotional influences
The Clinician	Lack of motivation/clinical inertia Lack of awareness or knowledge of the evidence Disagreement with the intervention Lack of self-efficacy† Overemphasis on potential side effects Competing promotional influences
The Patient	Patient preferences/expectations/knowledge Patient adherence Competing promotional influences
The Setting	Access to health care Affordability (for the individual and the system) Emphasis on acute symptoms rather than prevention in most ambulatory care settings Lack of time or resources Lack of incentives to change Lack of opinion leaders Competing promotional influences

*Based on references 3, 11, 25, and 38. †The belief that one cannot adequately perform a given recommendation.

Second, clinicians must be motivated to alter their practice in light of new evidence. Although clinician age, gender, and year of graduation appear to be associated with practice variation in some, but not all, studies, it is recognized that prescribing patterns (and sometimes clinical outcomes) do vary by physician specialty, even after adjusting for differences in case mix (17). Of note, although there is a relatively rich database documenting differences between specialties in the management of hospitalized patients with acute myocardial infarction (MI) or HF (17–19), the evidence base is less robust for differences in outpatient care and is an area of active research (20,21). Although being aware of new evidence is a prerequisite to changing practice, studies examining physician knowledge while simultaneously measuring clinical practice have found remarkably consistent gaps between what we know and what we do, with a median absolute difference of 28% (22). Further, although both specialists and generalists tend to overestimate the baseline risks of their patients (23,24), and at least two surveys have demonstrated that both groups estimated similar relative benefits for specified therapies, non-specialists tended to substantially over-estimate potential side-effects (25,26). As a further example, while over 60% of European primary care physicians were aware of the survival benefits of beta-blockers in HF, two-thirds expressed reluctance to prescribe these agents without specialist input, and only 21% of beta-blocker prescriptions were initiated by the primary care physician (6). The reluctance of primary care physicians to apply new evidence (“therapeutic conservatism”) may be partially attributable to the fact that patients seen in primary care are often older and have more unrelated co-existing illnesses than the patients seen by specialists or the subjects entering RCTs (19).

Third, although patient preferences and expectations are important to elicit for chronic therapies and should not be viewed as a barrier to the provision of quality health care, it must be acknowledged that patients do not always agree with their physicians as to which therapies may be indicated for their conditions and may decline proven efficacious therapies even when presented with all of the evidence (27–29). On the other hand, well-informed and activated patients may influence their clinicians to prescribe therapy when they may not have otherwise done so (29). Thus, patient factors may represent a two-edged sword in attempting to translate evidence into clinical care. This is an area in need of further research. Finally, although it is beyond the scope of this manuscript, patient adherence to chronic preventive therapies is often suboptimal, and there is a burgeoning evidence base on strategies to improve medication adherence (30).

The hurried and harried nature of current medical care systems are well known to the reader. Although traditionally it had been thought that the system barriers to best practice largely resulted from lack of access to health care, recent studies have shown that even when patients are seen regularly for chronic conditions such as hypertension, their

treatment may be suboptimal (31,32). Thus, access to health care is not in and of itself enough to ensure the closure of a care gap. Lack of health care provider time, in fact, may be the greater barrier. For example, in a recent simulation, it was shown that primary care providers would need to spend 7.4 h per day to provide all the preventive services recommended by the U.S. Preventive Services Task Force before they could even start on their patients' acute or chronic problems (33). In the current health care environment, structured and adequately resourced models of care, such as disease management programs for HF (34), hold substantial promise for the closure of care gaps and achievement of better disease-specific outcomes than individual clinicians.

Finally, the reader will note that we have mentioned competing promotional influences under all four barrier categories in Table 1. Although this includes the obvious pharmaceutical industry promotional activities (for example, advertisements directed to providers or direct to consumers, detailing visits, or provision of free samples), it should be recognized that organizations or trial investigators also engage in promotional activities, and, when both types of promotion work in concert, the effects may be substantial. For example, we have recently demonstrated that, after the publication of the Heart Outcomes Prevention and Evaluation (HOPE) trial, ramipril prescriptions increased by a much greater rate in Canada (where HOPE and ramipril were more actively promoted by the pharmaceutical industry and study investigators) than the U.S. (approximately 12% vs. 5% increase per month) (35,36). Needless to say, promotional activities are not always a negative factor and, in many cases such as with ACE inhibitor prescribing post-HOPE, serve to benefit individual patients and the health care system.

WHAT CAN BE DONE TO CLOSE CARE GAPS?

The well-described (22) gaps between knowledge and practice would imply that methods that rely solely on increasing physician knowledge through the passive transfer of unsolicited, generic, and/or didactic information are unlikely to have a substantial impact on practice. This is, in fact, the case (3,37–39). Passive knowledge transfer strategies, such as attending traditional continuing medical education lectures or creating and disseminating clinical practice guidelines, have almost uniformly been demonstrated to have little or no effect on clinical practice (3,37,38).

What must be understood is that lack of knowledge is but one barrier to the adoption of best evidence, and it may not be as important as many of the other barriers outlined earlier in Table 1. For example, in the management of MI, cardiologists have greater knowledge of current evidence than do generalists (40); however, when their actual practices are compared, and differences in case-mix accounted for, it becomes apparent that this greater knowledge translates into very small differences in clinical practice (19,41). Indeed, specialists may simply have a tendency to adopt new

Table 2. Examples of Ineffective, Effective, and Potentially Effective Knowledge Transfer Strategies*

Ineffective (or Minimally Effective) Strategies
Traditional didactic continuing medical education lectures (38)
Dissemination of newsletters
Dissemination of clinical practice guidelines (46)
Computerized guidelines (45)
Training in critical appraisal
Medication profiles
Drug utilization review, retrospective or prospective (39)
Effective Strategies
Audit and feedback with comparison to local peers (42)
Real-time clinical reminders, computerized or paper-based (47,48)
Face-to-face educational outreach (academic detailing)
Local opinion leaders (43)
Disease management approaches (34)
Computerized physician order entry (48)
Critical pathways
Multifaceted interventions, i.e., two or more strategies
Potentially Effective Strategies That Need to be Better Studied
Use of lay media to influence patients and physicians
Generic samples and other forms of countermarketing
Patient decision aids and other forms of patient "activation" (49)
Continuous quality improvement strategies
Computerized decision support and other "E-health" strategies (47,48)
Incentives, financial or otherwise, to promote best practice
Disincentives, financial or otherwise, to restrict suboptimal practice
Expanded roles and responsibilities for nonphysician providers (e.g., nurse practitioners, community-based pharmacists) (50)

*Based primarily on references 3 and 37, which are systematic reviews of studies addressing each of the individual strategies. Some strategies that were not reviewed in detail in references 3 and 37 have been referenced individually in the Table.

practices more quickly—whether or not justified by the available evidence (19). Again, if lack of knowledge is not the primary determinant of the care gaps in cardiovascular medicine, it is unlikely that simply increasing access to the evidence or training housestaff or busy community-based physicians in the precepts of critical appraisal will lead to improvements in quality of care.

That is not to say that physician practice cannot be changed. Indeed, active and multifaceted knowledge implementation strategies do consistently change practice, although the effects are often modest (Table 2) (3,37). For example, computerized real-time reminders in the office or on the ward and practice audits with feedback that include comparisons to local peers can modify practice (3,37). The former have more to do with convenience and a "secretarial" function than increasing knowledge per se; the latter tend to work because realistic goals that can be achieved by one's local peers are presented as a benchmark rather than the unattainable goal of "100% adherence" to guidelines (3,42). Of interest, the most consistently effective methods to change physician practice appear to be short face-to-face educational visits ("academic detailing") and the use of opinion leaders (3,37). Why? Perhaps because these two methods rely on using sociologically influential people (i.e.,

academic detailers involved in quality improvement studies tend to be independent pharmacists who meet in person with physicians and provide unbiased advice, while opinion leaders are educationally influential local specialists whose practice is emulated by their peers) to actively transmit simple messages that *convince* physicians that it may be worthwhile to apply the knowledge that they already have. For example, one cluster-randomized controlled trial that tested the influence of locally nominated opinion leaders on improving management of patients with MI demonstrated improvements in the use of aspirin and beta-blockers (43). It is surely not a coincidence that detailing physicians and influencing local opinion leaders are two methods routinely used by the pharmaceutical industry to change physician practice—to the tune of one billion dollars per month in the U.S. alone (35).

We need to accept that changing physician practice has less to do with detailed knowledge of the evidence and more to do with being convinced that a particular patient may benefit by applying the evidence when the opportunity arises in our clinics. If so, the medical community needs to find more convincing ways to promote good evidence. Because primary care physicians rely on the opinion of peers or local opinion leaders over all other information sources (44), perhaps this activity can be facilitated by creating a cadre of respected local specialists with the time and resources to appraise the evidence in their discipline on an ongoing basis and then actively promote it in their communities. Of course, this is a testable hypothesis that should be subjected to a controlled trial.

In Table 2, we present some other potentially effective interventions that are either currently being tested or ought to be tested in controlled studies of knowledge transfer (34,38,39,42,43,45–50). Of note, the physician practice change literature is strewn with many other good ideas that seemed promising at first but when studied rigorously were found wanting (3,37). For instance, a cluster-randomized trial recently demonstrated that computerized guidelines for secondary prevention of coronary artery disease were no better than usual care when introduced into busy physicians' offices (45). Thus, we believe there is a need to rigorously test those interventions that show promise before promoting their widespread adoption.

CONCLUSIONS

In summary, the translation of research evidence into clinical practice is unpredictable, inconsistent, and complex. Gaps between best practice and usual practice are not solely due to knowledge deficits and, by extension, efforts to enhance the application of evidence need to focus on multifaceted implementation schemes that recognize this. Thus, publication of a study in a journal should be seen as the beginning of the journey to best practice, not the end. It is heartening to see that funding agencies are recognizing the need for more attention to, and more resources for,

research into knowledge transfer. The road ahead is long and winding, and much remains to be defined in this field.

Reprint requests and correspondence: Dr. Finlay A. McAlister, Division of General Internal Medicine, Department of Medicine, University of Alberta, 2E3.24 Walter Mackenzie Health Sciences Centre, 8440-112th Street, Edmonton, Alberta, Canada, T6G 2B7. E-mail: finlay.mcalister@ualberta.ca.

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