Diabetes Translation Research: Where Are We and Where Do We Want To Be?

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Translation research transforms currently available knowledge into useful measures for everyday clinical and public health practice. We review the progress in diabetes translation research and identify future challenges and opportunities in this field. Several promising interventions to optimize implementation of efficacious diabetes treatments are available. Many of these interventions, singly or in combination, need to be more formally tested in larger randomized or quasi-experimental practical trials using outcomes of special interest to patients (for example, patient satisfaction and quality of life) and policymakers (for example, cost and cost-effectiveness). The long-term outcomes (such as morbidity, mortality, quality of life, and costs) of strategies aimed at improving diabetes care must be assessed. Translation research also needs to incorporate ways of studying complex systems of care. The challenges and opportunities offered by translation research are tremendous.


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We have previously described translation research as comprehensive applied research that strives to translate the available knowledge and make it useful in everyday clinical and public health practice (1). Translation research aims to assess implementation of standards of care, understand the barriers to their implementation, and intervene throughout all levels of health care delivery and public health to improve quality of care and health outcomes, including quality of life.

Translation research may be viewed as an extension of effectiveness research, but in its evolution it has encompassed new dimensions (the Figure shows translation research in the context of other types of research and public health assessments). Translation research 1) is oriented toward understanding solutions to real-world health care delivery problems (as opposed to basic science, epidemiology, and public health surveillance, which aim to characterize the problem); 2) is interested in impact, generalizability, and transferability (for example, application of results to most people with the condition, issues concerning application to diverse settings and situations, and the extent of spread and equity in implementation); 3) focuses on assessing effectiveness and its influence on process and outcomes, and the sustainability of long-term implementation in real-world settings; and 4) emphasizes efficiency (that is, relative value under conditions of finite resources), equity, and facilitation of optimal health and health care for as many people as possible.

Diabetes is a chronic disease with complex causes, manifestations, complications, and management. The disease imposes huge public health and economic burdens despite the availability of numerous efficacious treatments, in part because these treatments are often suboptimally applied in practice (1–4). Recent evidence also provides efficacious interventions to prevent or delay diabetes in high-risk groups, but translating these interventions into practice brings additional challenges (5). All of these factors make diabetes a prototype of chronic diseases, which are the major cause of death, illness, and reduced quality of life in both industrialized and industrializing nations.

Over the past decade, the content and implementation of translation research have evolved considerably (2, 6). The field continues to change and adapt to modern realities and challenges, and today the need for translation research is greater than ever before. We briefly review examples of interventions to reduce the burden of diabetes, review the progress in diabetes translation research, and identify the future challenges and opportunities for this field. Without question, the control of diabetes and other chronic diseases will be a high-priority public health issue in the 21st century.

Gaps in Diabetes Care

Two articles in this supplement describe the enormous health and economic burden posed by diabetes (7, 8). Fortunately, several efficacious strategies to prevent or delay diabetes complications have emerged during the past decade, including control of blood pressure, lipids, and glycemia; early detection and treatment of diabetic retinopathy, nephropathy, and foot disease; therapy with aspirin and angiotensin-converting enzyme (ACE) inhibitors; and influenza and pneumococcal vaccines (1, 2). Although many of these treatments are relatively cost-effective, their implementation remains suboptimal. According to national data, in the United States there is a considerable gap between recommended diabetes care and the care patients actually receive (4). In 1988–1995, for example, 18% of diabetic persons age 18 to 75 years had a hemoglobin A1c level greater than 9.5%, 34.3% were hypertensive (blood pressure ≥ 140/90 mm Hg), and 58% had a low-density lipoprotein cholesterol level of 3.35 mmol/L or greater (≥150 mg/dL). In addition, 63% had a dilated eye examination in the previous year, 54.8% had a foot examination; just 38% were self-monitoring their blood glucose levels; and only 46% and 27% had received influenza vaccine and pneumococcal vaccine, respectively. More recent
data, however, indicate encouraging improvement, with increases in the use of eye examination (increased 7 percentage points), foot examination (6 percentage points), self-monitoring of blood glucose (15 percentage points), influenza vaccine (5 percentage points), and pneumococcal vaccine (15 percentage points) (9).

**BARRIERS**

The numerous barriers to care at the level of the provider, the patient, and the system help to explain the suboptimal diabetes care in the United States. At the provider level, forgetfulness and time constraints (10–12), a perception of patients as nonadherent (10, 13, 14), and inadequate knowledge (15, 16) may act as barriers. In addition, a study found that primary care providers perceived diabetes as requiring more resources and being more difficult to treat than hypertension (17). The disease is also often accompanied by many comorbid conditions, whose demands for treatment compete with care for diabetes (18).

At the level of the patients, incomplete understanding of the gravity of diabetes, little motivation toward prevention (17, 19), insufficient time, and a lack of socioeconomic resources and support (15, 16, 20) are barriers.

At the level of the health care system, the status of diabetes as a chronic disease constitutes a potential barrier in a system that is better designed for acute care (20–22). In addition, our current health care system often lacks information systems to identify patients, track their status, and prompt providers on ongoing preventive care needs. Use of reminders or other tools to overcome forgetfulness and time constraints help but have not been common in practice (23–25).

**INTERVENTIONS**

The challenge of providing effective diabetes care has thus far defied a simple solution. Already, however, small, regional studies have tested numerous provider-, system-, or patient-level interventions to improve care in primary care and community settings.

**Providers**

Health care providers need to know how to incorporate the latest research into their clinical practice. In addition, they need to feel empowered by believing that they have a role in improving the quality of care they provide; they also must feel that the care they offer has the highest scientific validity. Interventions that include an educational component for providers have been moderately successful at improving adherence to process measures. Interventions to educate providers, however, have usually been part of more complex interventions that also focus on systems and organization of practices, including performance feedback, reminder systems, and consensus development (26–28).

Clinical practice guidelines have been used in many settings (29, 30); most guidelines focus on stepped-intensification programs to improve glycemic control and on use of reminder checklists to improve adherence with screening and other processes of care. Unfortunately, guidelines alone have been only minimally effective in improving care (31), as have consensus recommendations disseminated.
through mass mechanisms (32). When included as part of a multifaceted strategy, however, clinical guidelines have been associated with more success (33, 34). Having providers take an active part in modifying and adapting national guidelines has also empowered providers to lead the translation of research into practice (26, 30). This type of consensus building for guidelines has been associated with improvements in glycemic control and adherence to such process measures as microalbuminuria and lipid levels. Finally, one study looked at the effect of combining provider educational meetings and materials with patient education (35). Hemoglobin A1c and blood pressure improved in the intervention group, but a similar study showed no benefit of combined provider and patient education (36).

Systems

System interventions using continuous quality improvement techniques focused on provider education and feedback and agreed-upon goals and guidelines have been used in managed and primary care settings (37–40). The use of guidelines to educate providers, combined with a performance feedback approach such as continuous quality improvement, has been successful (28, 41, 42).

The use of nurses to provide diabetes care (typically provided by physicians) has improved glycemic control in some patient populations (43, 44). These nurses have used detailed protocols under the supervision of attending physicians. One study used a nurse-administered telephone intervention to educate patients, monitor health status, and facilitate access to physicians (45).

The use of computerized reminder systems for providers alone or combined with a performance feedback program can improve outcomes for patients with diabetes (40, 46, 47). Patient tracking systems or other reminder systems to improve regular follow-up have also reduced no-show rates and improved rates of processes of care, such as retinal examination (44, 48, 49).

Dedicating blocks of time to diabetic patients in a primary care practice has improved both outcomes and processes of care (41, 50, 51). These cluster visit models are part of clinical and public health practice. Although the task of delivering high-quality diabetes care can seem daunting indeed. Fortunately, the scientific base for preventing the complications of diabetes is large and increasing. We have direct evidence that type 2 diabetes itself may be prevented or delayed (5). We also have evidence that type 2 diabetes may be prevented or substantially delayed (5).

Translation research is a way of making evidence a part of clinical and public health practice. Although the field of translation research has progressed considerably, several new avenues must be pursued to meet the challenges of chronic disease control in the 21st century. Beginning with studies aimed at documenting quality of care using nonstandard measures, the field has evolved toward better and more standard characterization of quality of care and better understanding of barriers to improvements in quality of care. Numerous small studies have tested simple

and flow sheets have helped prompt both providers and patients for needed screening tests (54–56).

Patients

Interventions that empower patients can be successful components of diabetes programs (57, 58), and the addition of patient-oriented interventions to provider- and system-based programs can lead to improvements in process and outcome measures (56). One study found improved outcomes when nurses called patients monthly to educate them, remind them of their medical regimen, and reinforce upcoming appointments (45).

A more systems-oriented approach has included manual or computerized systems that remind patients to make follow-up appointments and to prompt staff to generate reminder cards for patients (46, 59). These programs improve adherence to follow-up and enhance efficiency for office practices. Reminders for patients improved the rate of annual dilated eye examinations in one setting (49); this study found that calling patients was superior to repeatedly sending letters about missed appointments. Use of a prompting database that sent reminders directly to patients to have them provide blood and urine sample increased annual measurements of hemoglobin A1c and screening for microalbuminuria (59).

Education in self-management, including skill building, has helped improve glycemic control and patients’ abilities to cope with chronic disease. Specific teaching programs have shown improvements in quality of life, glycemic control, and adherence to screening recommendations (60–63).

DISCUSSION

Like most chronic diseases, diabetes is complex in its biology. This complexity; the lifelong nature of the disease; the numerous challenges in treating and managing it; and the importance and interplay of the role of the patient, the provider, and the system, the task of delivering high-quality diabetes care can seem daunting indeed. Fortunately, the scientific base for preventing the complications of diabetes is large and increasing. We have direct evidence that currently available efficacious treatments can be comprehensively implemented in real-life settings, and this can reduce vascular events by at least 50% (64). We also have evidence that type 2 diabetes itself may be prevented or substantially delayed (5).

Translation research is a way of making evidence a part of clinical and public health practice. Although the field of translation research has progressed considerably, several new avenues must be pursued to meet the challenges of chronic disease control in the 21st century. Beginning with studies aimed at documenting quality of care using nonstandard measures, the field has evolved toward better and more standard characterization of quality of care and better understanding of barriers to improvements in quality of care. Numerous small studies have tested simple
patient-, provider-, and system-level interventions to improve care. Some of the more advanced development in diabetes translation includes multicenter studies using a common protocol and the testing of integrated models of care. Other studies have documented the feasibility of implementing system-wide re-engineering and its beneficial effect on diabetes care (65). The long-term impact on health outcomes, quality of life, and cost of strategies aimed at improving diabetes care at patient, provider, and system levels is not known.

Small single-site studies have shown the promise of several interventions at the patient, provider, or system level for improving care. Where individual studies may provide less compelling evidence on the benefit of interventions, comprehensive systematic reviews and meta-analysis may play a vital role. For example, a systematic review by Renders and colleagues (66) found that multifaceted professional interventions may enhance the performance of providers in managing diabetes care; organizational interventions that involve regular calling and reviewing of patients (central computerized tracking systems or nurses who regularly contact the patient) can also improve diabetes management; patient-oriented interventions can lead to improved patient outcomes; and nurses can play an important role in patient-oriented interventions by educating patients or facilitating patient adherence to treatment.

A variety of these interventions, alone or in combination, must be more formally tested in larger randomized practical trials or replicated in several settings so that the findings are more generalizable. Such studies should include multiple outcomes, including those of special interest to patients (such as patient satisfaction and quality of life) and policymakers (such as cost and cost-effectiveness). One ongoing observational, multicenter cohort study, TRIAD (Translating Research Into Action for Diabetes) (6), is examining many of these issues.

Over the past century, our health care system has evolved from the management of acute diseases and is not optimally suited for managing chronic disorders. The Institute of Medicine (67) has argued strongly that newer systems of care and newer ways of thinking are needed to tackle complex diseases such as diabetes. This means that translation research, which should incorporate the principles of complex systems (68–71), must be designed to understand the system as a whole and not simply its parts. The model for process of change in a simple mechanical system is woefully inadequate for dealing with the complex, interactive, interconnected, and adaptive systems in which the prevention and treatment of diabetes operate. As a result, we will need translation research that is sufficiently multidisciplinary to include new science such as complexity, leadership, and the management of change while continuing to draw on epidemiology, health service research, sociology, policy science, economics, operational research, and other fields. The challenges and opportunities offered by translation research are tremendous, and we need to grapple with them to stop the onrushing tide of diabetes both in the United States and around the world.

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