

Electronic Patient-Reported Outcomes as Digital Therapeutics to Improve Cancer Outcomes

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Among patients receiving treatment for advanced cancers, symptoms are common and frequently cause distress, functional impairment, and emergency room visits.¹ Yet cancer patients' symptoms often go undetected and unaddressed by clinicians.²⁻⁴ There is growing international interest in integrating electronic patient-reported outcomes (PROs) into routine practice as digital therapeutics that can increase detection and inform management of symptoms, thereby improving health outcomes and patient experiences and avoiding preventable hospital use.

PROs were initially developed to measure symptoms and functional impairments related to disease and treatment in clinical research. More recently, they have been evaluated as routine practice symptom monitoring tools in several prospective trials.⁵ The PRO symptom monitoring approach generally used in these trials involves a brief symptom questionnaire loaded into a software package that patients can use to self-report from home or at clinic visits by using the Web, a smartphone app, or an automated telephone system. When severe or worsening symptoms are reported (eg, severe pain or dyspnea), the patient's care team is informed via an e-notification and/or via the electronic medical record, reports, or some other secure medium. The care team can then intervene by addressing the symptom early, before it worsens and leads to downstream complications.

Previously, Velikova and colleagues⁶ reported a randomized controlled trial in which integrating PRO symptom monitoring into routine oncology ambulatory visits yielded significantly improved patient quality of life compared with standard care. Cleeland and colleagues⁷ found improved symptom control after cancer surgery. Our group published a finding from a randomized controlled trial that showed significantly improved overall survival and reduced emergency room visits among patients with advanced solid tumors compared with standard care. The improvements were likely related to high rates of nursing intervention in response to PRO e-notifications, which resulted in benefits in physical function and overall health status, along with lengthened tolerability of chemotherapy.^{8,9} Denis and colleagues¹⁰ similarly reported overall survival benefits of using PRO symptom monitoring to trigger imaging in disease monitoring among patients with lung cancer.

Taken together, these trials paint a compelling picture of the benefits of PRO symptom monitoring as a digital therapeutic strategy. However, previous research has largely consisted of prospective studies that enrolled patients via informed consent processes. Missing in the published literature has been a large real-world population-based study in which all comers self-reported PROs across a large health system. Such evidence has been needed to demonstrate the generalizability of findings from previous controlled trials, thereby further justifying implementation in large populations.

Barbera et al¹¹ report just such evidence. In Ontario, Canada, the provincial government supported integration of PROs into practice starting in 2007. Patients with cancer seen at most sites of service in Ontario were invited to report 9 common PRO symptoms at kiosks in clinic waiting areas immediately before visits, and their self-reports were shared with care teams to inform the management of their disease. The study selected patients who self-reported PROs at least once during an ambulatory visit between 2007 and 2015. A comparator group of patients who did not use PROs was generated by using hard and propensity score matching. Among 128,893 available matched patient pairs for the analysis, the authors found a statistically significant 8% reduction in emergency room visits and a 14% reduction in hospitalizations for PRO patients compared with controls who did not provide PROs. This finding is similar to that in a previous randomized trial reporting a 7% reduction in emergency room visits associated with PROs.¹²

On the basis of the article by Barbera et al, we now have evidence from both randomized trials and real-world assessments showing a substantial benefit of PRO symptom monitoring for patients receiving systemic cancer treatment, presumably by catching symptoms early enough to avoid at least some emergency department visits and hospitalizations.

The strength of this study is also its main limitation. It was conducted in a real-world population, so rates of PRO reporting compliance varied. However, most patients completed more than 6 PRO self-reports, and almost 20% completed more than 10 PRO self-reports. The comparison was not prospective or

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randomized, but the authors used rigorous standard approaches for matching and balancing groups. A formal cost analysis or granular report on use of services was not included.

Future challenges are largely related to implementation. Amid competing priorities, how will oncology practices find bandwidth and resources to onboard PRO systems like the one used in previous trials and in the Barbera et al study? An essential component will be reimbursement by payers, because these entities will yield financial savings related to reduced hospital use. Indeed, in the United States, the Medicare program recently suggested including PROs in a proposed payment model in oncology.¹² Medicare should take this a step further and provide or expand a billing code to enable payment for PRO symptom monitoring as a digital therapeutic. Private payers in the United States and non-US payment mechanisms should follow suit. Surgical and palliative care practices should adapt the lessons learned

from oncology to embrace PROs for symptom monitoring in their highly vulnerable patient populations.

It must be noted at this moment of crisis related to the COVID-19 pandemic, that keeping patients out of the hospital is a key goal. PRO symptom monitoring as a strategy can contribute to achieving this goal, particularly if integrated with a patient navigation and/or care coordination program. Moreover, as we widely shift oncology care to a virtual model, PRO symptom monitoring dovetails perfectly with other telemedicine functionalities that allow us to stay connected to patients when they are away from the clinic.

Ontario has led the way for more than a decade in real-world implementation of PRO symptom monitoring in oncology practice. With this study, Ontario continues its efforts by providing evidence of clinical and utilization benefits of its digital therapeutic approach, likely yielding substantial cost savings to the health system and improving experiences for patients.

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AUTHORS' DISCLOSURES OF POTENTIAL CONFLICTS OF INTEREST AND DATA AVAILABILITY STATEMENT

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