Integrating Family Medicine and Pharmacy to Advance Primary Care Therapeutics

L Dolovich[1,2], K Pottie[3–5], J Kaczorowski[6–8], B Farrell[3,5], Z Austin[9], C Rodriguez[1], K Gaebel[1] and C Sellors[2]

The prevalence of suboptimal prescribing of medications is well documented.[1,2] Patients are often undertreated or not offered therapeutic treatments that are likely to confer benefit.[3,4] As a result, drug-related hospital admissions are common and often preventable.[5] Improvements to the health-care system are clearly needed in order to maximize the benefits that can be derived from medications. Many countries are changing their primary health-care systems to improve the quality of health-care delivery.[6,7] One main transformation is the use of multidisciplinary care teams to provide care in a coordinated manner often from the same location or by using the common medical record of the patients. It has been demonstrated that pharmacists can improve prescribing, reduce health-care utilization and medication costs, and contribute to clinical improvements in many chronic medical conditions, such as cardiovascular disease, diabetes, and psychiatric illness.[8–11] However, the effect of integrating a pharmacist providing general services into a primary care group has not been extensively studied. The Integrating Family Medicine and Pharmacy to Advance Primary Care Therapeutics (IMPACT) project was designed to provide a real-world demonstration of the feasibility of integrating the pharmacist into primary care office practice. This article provides a description of the IMPACT project participants; the IMPACT practice model and the concepts incorporated in its development; some initial results from the program evaluation; sustainability of the model; and some reflections on the implementation of the practice model.

IMPACT PROJECT PARTICIPANTS

IMPACT was a demonstration project that placed a pharmacist into each of seven family medical practice sites across the province of Ontario, Canada. The pharmacists worked 2–3 days a week starting 1 June 2004. They were selected through a structured hiring process that emphasized communication and critical thinking skills and a demonstrated willingness to encourage innovation in practice.[12] All the pharmacists had previously worked within a community setting, and also within a hospital or a long-term care setting. The seven family medical practice sites included inner city, urban, and semirural locations. Six were community sites and one was a full academic site. In four of the sites, paper records were used, while the other three used electronic medical records. The number of physicians ranged from 6 to 15 per location.

IMPACT PRACTICE MODEL

The project practice model was composed of four components that were employed concurrently to foster integration and promote optimal prescribing and use of medications (described in detail in **Table 1**). Training and support were provided to assist the pharmacist and others at the location to manage change. A 2-day training workshop was held for the pharmacists to assist them to transition into the unfamiliar environment of a busy family practice. The workshop experience centered on the Family Practice Simulator, an interprofessional curricular innovation in which physicians, pharmacists, and other health-care professionals work with standardized patients and carry out activities over the course of a typical day in family practice.[13] Ongoing support was provided through a mentorship program. Mentors provided emotional support, problem-solving advice, and assistance with developing clinical knowledge and skills. Each pharmacist had access to a provincial drug information center. The pharmacists were also provided with profiles of the medical practices at the relevant locations and a project implementation guide.

In order to preserve the relationship and avoid fragmentation of care, the family physician retained the lead role in diagnosing

[1]Centre for Evaluation of Medicines, St. Joseph's Healthcare, Hamilton, Ontario, Canada; [2]Department of Family Medicine, McMaster University, Hamilton, Ontario, Canada; [3]Élisabeth Bruyère Research Institute, Ottawa, Ontario, Canada; [4]Institute of Population Health, University of Ottawa, Ottawa, Ontario, Canada; [5]Department of Family Medicine, University of Ottawa, Ottawa, Ontario, Canada; [6]Primary Care and Community Research, Child & Family Research Institute, Vancouver, British Columbia, Canada; [7]Department of Family Practice, University of British Columbia, Vancouver, British Columbia, Canada; [8]Department of Health Care and Epidemiology, University of British Columbia, Vancouver, British Columbia, Canada; [9]Leslie Dan Faculty of Pharmacy, University of Toronto, Toronto, Ontario, Canada. Correspondence: L Dolovich (ldolovic@mcmaster.ca)

Received 17 January 2008; accepted 31 January 2008; advance online publication 19 March 2008. doi:10.1038/clpt.2008.29

Table 1 A description of the IMPACT practice model

Intervention component	Intervention level	Detailed description of intervention component
Individual patient medication assessments	Patient	The provision of comprehensive medication assessments, ongoing on-location collaboration with the health-care team, and collaborative implementation of the pharmacist's recommendations to resolve drug therapy problems. This involved a review of the medical chart; interview with the patient to gather information on current and past medication history; adherence to medication regimen and patient-reported medication issues; identification of drug-related problems and therapeutic dilemmas; solution-oriented recommendations for optimization of drug therapy being provided to the physician through verbal discussion and written documentation; and working with the physician and other team members to develop and implement medication changes, education, and monitoring of medication use
Health-care provider education	Provider	Education and dissemination of new therapeutics evidence to health-care providers (including physicians) and patients
System-level practice enhancements	Practice	System-level activities aimed at improving drug prescribing and use throughout the practice site (e.g., clinical care paths, administrative efficiencies) or through seamless care in other settings, such as hospitals or community pharmacies
Integration activities	Practice	Focused activities aimed at enhancing the integration of the pharmacist into the practice

IMPACT, Integrating Family Medicine and Pharmacy to Advance Primary Care Therapeutics.

illness, prescribing medications, and consulting with the pharmacists. When dealing with individual patients, the physician was asked to review the advice provided by the pharmacist and determine the management approach, including consultation with the patient where appropriate.

CONCEPTS AND FRAMEWORKS UNDERLYING THE IMPACT PRACTICE MODEL

The IMPACT practice model was based on previous research experience in pharmacy practice[14–16] and methods of facilitating change in family practice.[17] It also used a knowledge translation framework incorporating IMPACT program activities, with the aim of encouraging the uptake of evidence to improve the prescribing and use of medication. The activities carried out in the IMPACT practice model reflected the use of a multifaceted, multilevel approach (i.e., activities focused at the levels of patient, provider, and practice) that is well recognized as being capable of fostering behavior change; in this case, changing the prescribing and use of medication.[18–20] Activities of the pharmacists were also aligned with the current state of pharmacy practice, which invokes a patient-centered approach in optimizing pharmaceutical care.[21–24]

The development of the interdisciplinary IMPACT practice model utilized a knowledge translation framework to encourage the integration of the pharmacist into the family practice site and to bring about the intended changes in the prescribing and use of medication. The framework drew on theories from education, epidemiology, behavioral sciences, marketing, social learning and innovation, and organizational behavior.[18,25–27] Each theory provided a focus of attention and a rationale for including an additional element in the family practice model (**Table 2**).

The project received ethical approval from the McMaster University Research Ethics Board, and all the patients provided informed consent.

IMPLEMENTATION OF THE PRACTICE MODEL

Initial experiences of pharmacists

An analysis of qualitative data from monthly narrative reports written by each pharmacist[28] showed that the first 4 months were an emotional roller coaster for the pharmacists. They fluctuated between feeling underutilized and out of place to feeling highly valued and accepted. They recognized the need to improve their skills and proactively sought to work with project staff, mentors, and others in managing clinical uncertainties, communicating with their fellow health-care team members, prioritizing recommendations, implementing recommendations, ensuring proper documentation, and taking on a higher level of responsibility for patient care.

Initial experiences of physicians

Physicians recognized many interprofessional benefits by working with a pharmacist directly integrated into their practice.[29] An analysis of qualitative data from semistructured interviews conducted with 12 participating physicians 12 months after a pharmacist began working in the practice identified several perceived benefits: having a colleague who provided reliable drug information, getting fresh perspectives, and increased clinical security. Benefits for the practice included improved education for the group as a whole, a liaison with the community pharmacy, and an enhanced sense of being a part of the team. Persistent operational challenges included finding time to learn about the pharmacist's role and skills, and insufficient space within the premises to accommodate the pharmacist. Serial quantitative analyses of physicians' responses showed an increase in their perceptions of pharmacists' contributions to medication-related processes in the practice.[30]

Patient referrals

The IMPACT intervention led to 1,554 patients being referred to the pharmacist for a comprehensive assessment over the course of the 24 months of the project. Of these, 969 (62.4%) assessments were completed by the pharmacists for patients who provided informed consent. Further details about the flow of patient referrals are provided in **Supplementary Data S1** online. Of the patients assessed by the pharmacist, 56% (n = 538) of the referrals were prompted through a chart auditing process. Further details about the chart auditing process are provided in **Supplementary Data S2** online. The other 44% of the patients

Table 2 Knowledge translation framework for aspects of IMPACT pharmacist integration practice model[25–27]

Theories	Theoretical element that was a focus in the IMPACT integration intervention	Specific examples in IMPACT
Educational (adult learning theories)	Intrinsic motivation of professionals	Discussion of needs of each practice location Pharmacist–physician one-to-one review of individual patient assessments Training program centered on active situation-based learning
Epidemiological (cognitive theories)	Rational information-seeking and decision-making	Dissemination of evidence through tools such as one-pagers for both health-care provider and patients Encouraging the justification for pharmacist recommendations with evidence from literature and the patient's situation Access to drug information center
Behavioral (psychological stages of change, social cognition)	Intrinsic beliefs	Use of profiles of the practice to show overall performance for various indicators of medication prescribing and use Mentor role modeling and support The contributions of the pharmacist and the practice to improvements over time in definitions of roles and responsibilities and preparation of an implementation guide Projects aimed at improving the practice, prioritized based on consensus among practice members
Marketing (health promotion, innovation, and social marketing theories)	Attractive product adapted to needs of target audience	Presentation and discussion of pharmacist integration intervention with all the members of the practice group Multiple methods of communication used for implementing drug therapy change recommendations Recognition of where physicians and others are along the adoption of innovation continuum Adapting of resources and approaches from one practice location to another
Behavioral (learning theory)	Controlling performance by using external stimuli	Implementation of reminder and monitoring prompts for prescribing issues where possible Providing the practice with financial reimbursement to offset costs associated with participation; holding back part of the reimbursement until project deliverables accomplished
Social interactions (social learning and innovation theories, social influence/power theories)	Social influence of significant peers/ role models	Formalizing the role of the key opinion leader within each practice as project liaison Providing role-modeling through a mentorship program Encouraging inter-practice communication through teleconferences and meetings to generate positive peer influence Prioritizing areas of change in the organization (improvements) to create some initial early successes Ensuring that key policy makers are well informed and take appropriate steps to minimize unhelpful influences
Organizational (management theories, system theories)	Creating structural and organizational conditions to improve care	Defining roles and responsibilities in the practice for pharmacist, administrators, and physicians Encouraging frequent communication and dialogue between pharmacists and other health-care providers to encourage team building Recognizing the need for some flexibility in integration across varying practice locations Encouraging regular review of the integration process so as to generate continual improvements Providing strong leadership and support from the central project management Project staff and mentors acting as facilitators of the change management process Providing the tools (e.g., practice profiles and implementation guide) for a framework for the model structure

IMPACT, Integrating Family Medicine and Pharmacy to Advance Primary Care Therapeutics.

were referred by their physicians, without prompting and without restrictions attached to the reason for referral. The number of referrals for the seven practice sites ranged from 133 to 260 per site. Sixty of the sixty-four physicians (94%) across the seven practice sites referred at least one patient to the pharmacist before the end of the project.

The average age of the patients who were assessed by the pharmacist was 72 (s.d. 11) years and 62% of them were women. Patients had an average of 4.8 (s.d. 2.3) medical conditions and was taking an average of 7.0 (s.d. 3.8) prescription medications and 3.4 (s.d. 3.2) over-the-counter medications at their first encounter with the pharmacist. On the basis of a 10-item medication-related risk questionnaire,[31] 63.1% of the 907 patients who completed the questionnaire reported three or more medication-related risks. For example, 26.5% of patients were unclear about the need for all of their medications and 15.7% found it difficult to follow their medication regimen or sometimes chose not to.[32]

Presence of drug therapy issues as identified by the pharmacist

At least one drug-related problem (DRP) was identified and assessed by the pharmacists in 909 (93.8%) patients. A total of 3,974 DRPs were identified, making an average of 4.4 DRPs per patient. The most common DRPs identified included patients in whom there were indications requiring a therapy but who were not receiving it (27.0%), patients who were not taking or receiving the prescribed drugs appropriately (16.5%), and patients who were receiving too low a dose of the drug (16.2%).

The total number of adverse drug reactions or potential adverse drug reactions identified was 315 (7.9% of all DRPs identified). Pharmacists identified adverse drug reactions in 241 patients (26.5%). The most frequently reported types of adverse drug reactions addressed by the pharmacists were those associated with over-the-counter medications, nonsteroidal anti-inflammatory drugs, and the use of benzodiazepines. Further

Table 3 Types of adverse drug reactions identified (*n* = 315)

Adverse drug reaction	*n* (%)
Muscle cramps or myalgias associated with statin use	10 (3.2)
Adverse reactions associated with NSAIDs	
Increased blood pressure	10 (3.2)
GI effects (including ulcers and bleeding)	9 (2.9)
Changes in renal function	9 (2.9)
ACE-I cough	5 (1.6)
Side effects of benzodiazepine use	20 (6.3)
GI upset and use of metformin	6 (1.9)
Side effects of antihypertensive medications	
Fatigue/dizziness	11 (3.5)
Edema	8 (2.5)
Changes in renal function[a]	14 (4.4)
Others	20 (6.3)
Dry mouth from incontinence medications	4 (1.3)
Adverse reactions associated with OTC use	47 (14.9)
Side effects from use of amitriptyline[b]	12 (3.8)
Bisphosphonate intolerance	7 (2.2)
Bruising/bleeding and ASA use	5 (1.6)
Others[c]	118 (37.5)

ACE-I, angiotensin-converting enzyme inhibitor; ASA, acetyl salicylic acid; GI, gastrointestinal; NSAIDs, nonsteroidal anti-inflammatory drugs; OTC, over-the-counter.

[a]Includes increases in uric acid (due to reduced renal clearance), changes in CrCl, and so on. [b]Includes dry mouth, constipation, fatigue, and so on. [c]Some examples: serotonin syndrome; nightmares with use of ranitidine; use of protein pump inhibitors (PPIs) in gallbladder disease; selective serotonin reuptake inhibitor (SSRI) use and sexual dysfunction; elevated triglycerides (TGs) and rosiglitazone; and phenytoin toxicity.

details are provided in **Table 3**. There were 142 (3.6% of all DRPs identified) actual or potential drug interactions identified in 118 patients (12.1%). The two drugs that were mainly involved in drug interactions were warfarin and levothyroxine, identified in 24 and 9 patients, respectively.

System-level improvements in practice methodology

The process of effecting changes in the practice involved a complex series of steps for both physicians and pharmacists and took time to evolve. Medication-focused practice enhancements emerged from the practice to facilitate behavior change in related practice processes.These processes and tools were intended to increase the efficiency and effectiveness of both prescription and use of medications. Some examples of system-level practice enhancements developed during IMPACT included: a diabetes care monitoring system; a medication switching protocol (i.e., drug discontinuation or recall); computer system alerts; a prescription renewal process; drug sampling procedures; and drug plan administration processes.

DISCUSSION

IMPACT was a large-scale demonstration project that helped encourage the integration of pharmacists within interdisciplinary health-care teams as part of primary health-care reform in Ontario, Canada. The pharmacists provided care to patients who were at a high level of medication-related risk. The patients' drug therapy problems were addressed, and various improvements emerged within the family medical practice settings in relation to optimization of the prescribing and use of medication. Theoretical concepts and data from earlier research on pharmacy practice and behavioral change in primary care provided a strong foundation from which to develop the IMPACT practice model, training program, support system, and evaluation of the IMPACT intervention. The explicit approach to optimization of the system of prescription and use of medication recognized that the required change involved people across disciplines, especially the participating pharmacists and family physicians. It also recognized that changes in the prescription and use of medication could be achieved when attention was focused on multiple levels: the patient, the provider, and the practice.

Successful integration was defined *a priori* as comprising both a functioning office system and the development of a collaborative working relationship between physicians and pharmacists. A functioning office system was characterized by having clear roles and levels of responsibility regarding medication use processes for each member of the team; mechanisms to identify, prevent, address, and resolve DRPs; and the capability to innovate, such as by identifying unresolved problems for further action (i.e., continuous quality improvement). The program evaluation found that all the IMPACT locations had demonstrated an initial level of success in integrating the pharmacist into the practice. IMPACT pharmacists provided consultation for patients who were on a complex therapeutic regimen, offered timely and tailored drug information, and implemented useful medication-focused improvements in the system. The evaluation of the process of integration allowed for identification of challenges and incorporation of solutions during the project. Further analyses are under way to examine collaborative working relationships over time; patient satisfaction; costs; and the effectiveness of such integration of pharmacists into primary care practice in improving medication monitoring, prescribing of medications, and clinical outcomes for patients.

Sustainable practice change

The efforts of IMPACT, in conjunction with other local initiatives and policy changes, have helped produce sustained change in health-care delivery. In Ontario, Canada, the use of multidisciplinary care teams comprising various health-care providers providing care in a coordinated manner has manifested as interdisciplinary practice groups called Family Health Teams (FHTs). To date, 150 FHTs have been created in Ontario, Canada. All the practice locations involved in IMPACT became FHTs and have elected to include a pharmacist position within their FHTs. To date, sixty-seven full-time equivalents for pharmacist services have been approved for FHTs across Ontario, Canada. A toolkit containing guides for pharmacists, lead physicians and location managers, a physician information pamphlet, and sample documents, as well as a Practice Enhancement Guide are available on the IMPACT website at http://www.impactteam.info. IMPACT team members also participate in provincial drug and primary care policy advisory committees. In conjunction with the Canadian Society of Hospital Pharmacists and the Canadian

Pharmacists' Association, IMPACT facilitated the founding of the Canadian Primary Health Care Pharmacists Network. IMPACT pharmacists are mentors to newly hired pharmacists to aid their integration into their new roles within FHTs.

Future opportunities

Once integrated, the pharmacists can act as change agents to promote linkages with community pharmacists, hospital pharmacists, or clinical pharmacologists to widen the circle of care, promote other health-care providers to improve medication management, and encourage the participation of pharmacists in interdisciplinary initiatives. Pharmacists integrated into primary care practice can foster components of chronic disease management, health promotion, and illness prevention, or patient self-management interventions, so as to optimize prescribing and use of medication. Aspects of this model are applicable to other settings that incorporate clinical pharmacologists, hospital pharmacists, or community pharmacists into multidisciplinary teams.

Supplementary Material is linked to the online version of the paper at http://www.nature.com/cpt

ACKNOWLEDGMENTS

This article was written on behalf of the IMPACT team members: (Integrating Family Medicine and Pharmacy to Advance Primary Care Therapeutics). IMPACT was a large-scale demonstration project funded by the Ontario Ministry of Health and Long-Term Care (MOHLTC) through the Primary Health Care Transition Fund. The views expressed in the article are the views of the authors and do not necessarily reflect those of the Ontario MOHLTC.

CONFLICT OF INTEREST

The authors declared no conflict of interest.

1. Huang, B., Bachmann, K.A., He X., Chen, R., McAllister, J.S. & Wang, T. Inappropriate prescriptions for the aging population of the United States: an analysis of the National Ambulatory Medical Care Survey, 1997. *Pharmacoepidemiol. Drug Saf.* **11**, 127–134 (2002).
2. Piecoro, L.T., Browning, S.R., Prince, T.S., Ranz, T.T. & Scutchfield, F.D. A database analysis of potentially inappropriate drug use in an elderly medicaid population. *Pharmacotherapy* **20**, 221–228 (2000).
3. Gupta, K. & Gupta, S. Undertreatment of hypertension: a dozen reasons. *Arch. Intern. Med.* **162**, 2246–2247 (2002).
4. Rochon, P.A. *et al.* Use of beta-blocker therapy in older patients after acute myocardial infarction in Ontario. *CMAJ* **161**, 1403–1408 (1999).
5. Winterstein, A.G., Sauer, B.C., Hepler, C.D. & Poole, C. Preventable drug-related hospital admissions. *Ann. Pharmacother.* **36**, 1238–1248 (2002).
6. Schoen, C., Osborn, R., Huynh, P.T., Doty, M., Peugh, J. & Zapert, K. On the front lines of care: primary care doctors' office systems, experiences, and views in seven countries. *Health Aff. (Millwood)* **25**, w555–w571 (2006).
7. Doran, T. *et al.* Pay-for-performance programs in family practices in the United Kingdom. *N. Engl. J. Med.* **355**, 375–384 (2006).
8. Sokar-Todd, H.B. & Einarson, T.R. Community pharmacy practice research: a systematic review of the past 32 years. *CPJ* **136**, 26–38 (2003).
9. Beney, J., Bero, L.A. & Bond, C. Expanding the roles of outpatient pharmacists: effects on health services utilisation, costs, and patient outcomes. *Cochrane Database Syst. Rev.* **3**, CD000336 (2000).
10. Machado, M., Bajcar, J., Guzzo, G.C. & Einarson, T.R. Sensitivity of patient outcomes to pharmacist interventions. Part I: systematic review and meta-analysis in diabetes management. *Ann. Pharmacother.* **41**, 1569–1582 (2007).
11. Machado, M., Bajcar, J., Guzzo, G.C. & Einarson, T.R. Sensitivity to patient outcomes to pharmacist interventions. Part II: systematic review and meta-analysis in hypertension management. *Ann. Pharmacother.* **41**, 1770–1781 (2007).
12. Babcock, K., Farrell, B., Dolovich, L. & Sellors, C. Hiring a pharmacist to work in primary care: application for ambulatory and hospital pharmacy. *CPJ* **139**, 46–48 (2006).
13. Austin, Z. *et al.* Teaching and assessing primary care skills in pharmacy: the Family Practice Simulator model. *Am. J. Pharm. Educ.* **69**, 500–507 (2005).
14. Dolovich, L., Levine, M., Burns, S., Sellors, J. & Marshman, J. A randomized controlled trial of pharmacotherapy specialist team consultation integrated into primary care practice settings versus specialty service provided in a hospital outpatient clinic. Canadian Health Services Research Foundation <http://www.chsrf.ca/final_research/ogc/pdf/dolovich_c.pdf> (2001).
15. Sellors, C., Dalby, D.M., Howard, M., Kaczorowski, J. & Sellors, J. A pharmacist consultation service in community-based family practices: a randomized controlled trial in seniors. *J. Pharm. Technol.* **17**, 264–269 (2001).
16. Sellors, J. *et al.* A randomized controlled trial of a pharmacist consultation program for family physicians and their elderly patients. *CMAJ* **169**, 17–22 (2003).
17. Lemelin, J., Hogg, W. & Baskerville, N. Evidence to action: a tailored multifaceted approach to changing family physician practice patterns and improving preventive care. *CMAJ* **164**, 757–763 (2001).
18. Grol, R. Beliefs and evidence in changing clinical practice. *BMJ* **315**, 418–420 (1997).
19. Cook, D.J., Montori, V., McMullin, J.P., Finfer, S.R. & Rocker, G.M. Improving patients' safety locally: changing clinician behaviour. *Lancet* **363**, 1224–1230 (2004).
20. Wagner, E.H. Chronic disease management: what will it take to improve care for chronic illness? *Eff. Clin. Pract.* **1**, 2–4 (1998).
21. Hepler, C.D. & Strand, L.M. Opportunities and responsibilities in pharmaceutical care. *Am. J. Hosp. Pharm.* **47**, 533–543 (1990).
22. Winslade, N.E., Strand, L.M., Pugsley, J.A. & Perrier, D.G. Practice functions necessary for the delivery of pharmaceutical care. *Pharmacotherapy* **16**, 889–898 (1996).
23. American College of Clinical Pharmacy. A vision of pharmacy's future roles, responsibilities, and manpower needs in the United States. *Pharmacotherapy* **20**, 991–1022 (2000).
24. Cipolle, R.J., Strand, L.M. & Morley, P.C. *Pharmaceutical Care Practice* 2nd edn. (McGraw-Hill, Toronto, ON, 2004).
25. Grol, R. & Grimshaw, J. From best evidence to best practice: effective implementation of change in patients' care. *Lancet* **362**, 1225–1230 (2003).
26. Robertson, N., Baker, R. & Hearnshaw, H. Changing the clinical behavior of doctors: a psychological framework. *Qual. Health Care* **5**, 51–54 (1996).
27. Kitson, A., Harvey, G. & McCormack, B. Enabling the implementation of evidence based practice: a conceptual framework. *Qual. Health Care* **7**, 149–158 (1998).
28. Pottie, K., Haydt, S., Farrell, B., Dolovich, L., Sellors, C. & Hogg, W. The use of narrative reports in monitoring and evaluating the integration of pharmacists into family practice settings. *Ann. Fam. Med.* (in press).
29. Pottie, K. *et al.* Physicians' perspectives on collaborative practice during the integration of pharmacists into family practices in Ontario. *Can. Fam. Physician* (in press).
30. Farrell, B. *et al.* Development and initial validation of a tool to assess professional contributions related to medication-related processes in family practice. *J. Interprof. Care* **22**, 17–19 (2008).
31. Barenholtz Levy, H. Self-administered medication-risk questionnaire in an elderly population. *Ann. Pharmacother.* **37**, 982–987 (2003).
32. McCarthy, L., Dolovich, L., Haq, M., Thabane, L. & Kaczorowski, J. Frequency of risk factors that potentially increase harm from medications in older adults receiving primary care. *Can. J. Clin. Pharmacol.* **14**, e283–e290 (2007).