ORIGINAL RESEARCH

Contribution of Pharmacy Practice Residents to Resolution of Drug Therapy Problems for Patients: RES-DTP Study

Richard S Slavik, Manish Khullar, Sean K Gorman, Nicole Bruchet, Sarah Murray, Brett Hamilton, and Dawn Dalen

ABSTRACT

Background: Canadian pharmacy practice residency programs promote development of key competencies for direct patient care resulting in resolution of drug therapy problems (DTPs), which is 1 of 8 national clinical pharmacy key performance indicators. There are no Canadian data on the contribution of residents to resolution of DTPs, including DTPs for priority diseases covered in disease-state education modules (PD-DTPs) or quality indicator DTPs (QI-DPTs), as assessed through application of evidence-based interventions proven to reduce morbidity, mortality, or health resource utilization.

Objective: To describe the contribution of pharmacy practice residents to direct patient care using 3 process-of-care measures: resident-resolved DTPs, PD-DTPs, and QI-DTPs.

Methods: This prospective, observational single-group study was conducted across 5 rotation sites within the authors' health authority from September 2, 2013, to June 13, 2014. The primary outcome was number of DTPs resolved. The secondary outcomes were number of PD-DTPs resolved; number of QI-DTPs resolved; numbers of DTPs, PD-DTPs, and QI-DTPs resolved over time; and residents' satisfaction with electronic tracking of resolved DTPs (in terms of training, usability, efficiency, and time requirements).

Results: Four residents completed a total of twenty-one 4-week rotations and resolved a total of 1201 DTPs. Of these, 620 (52%) were PD-DTPs and 479 (40%) were QI-DTPs. Overall, the number of interventions increased for rotations 1–3, decreased for rotations 4 and 5, and increased again for rotation 6. The median score for all questions in all domains of the satisfaction survey was 4 out of 5 ("agree").

Conclusions: Pharmacy practice residents were resolving DTPs, PD-DTPs, and QI-DTPs for patients and were contributing significantly to direct patient care. On the basis of literature evidence, the number and type of interventions observed in this study would be expected to improve clinical and health economic outcomes for patients.

Keywords: pharmacy resident, clinical care, drug therapy problems, clinical pharmacy key performance indicators

RÉSUMÉ

Contexte : Les programmes de résidence canadiens en pratique pharmaceutique encouragent le développement de compétences clés relatives aux soins directs offerts aux patients. Ces compétences entraîneront la résolution des problèmes de pharmacothérapie (DTP), l'un des huit indicateurs clés nationaux de rendement relatifs à la pharmacie clinique. Il n'existe pas de données canadiennes portant sur la contribution des résidents à la résolution des problèmes de pharmacothérapie, notamment ceux relatifs aux maladies prioritaires (PD-DTP) couverts dans les modules d'éducation sur les problèmes de santé, ou les indicateurs de qualité des DTP (QI-DPT), évalués au moyen d'interventions fondées sur des données scientifiques dont il a été prouvé qu'elles réduisaient la morbidité, la mortalité ou l'utilisation des ressources sanitaires. Dans une étude, les intervenants avaient des opinions divergentes concernant la contribution des résidents à la résolution des DTP, des PD-DTP et des QI-DTP.

Objectif : Décrire la contribution des résidents dans le cadre de la pratique pharmaceutique des soins directs offerts aux patients à l'aide de trois mesures spécifiques du processus des soins : DTP, PD-DTP et QI-DTP résolus par les résidents.

Méthodes : Cette étude prospective par observation portant sur un seul groupe a été menée dans cinq sites de rotation compris dans la sphère d'autorité sanitaire des auteurs, du 2 septembre 2013 au 13 juin 2014. Le résultat principal était le nombre de DTP résolus. Les résultats secondaires étaient les suivants : nombre de PD-DTP résolus; nombre de QI-DTP résolus; nombre de DTP, de PD-DTP et de QI-DTP résolus avec le temps; et la satisfaction des résidents à l'égard du suivi électronique de leurs DTP résolus (en termes de formation, de facilité d'utilisation, d'efficacité et d'exigences en matière de temps).

Résultats : Quatre résidents ont effectué un total de 21 rotations de quatre semaines et ont résolu 1201 DTP. De ceux-ci, 620 (52 %) étaient des PD-DTP et 479 (40 %), des QI-DTP. Les interventions générales ont augmenté de la 1re à la 3e rotation; elles ont diminué à la 4e et à la 5e rotation; elles ont à nouveau augmenté à la 6e rotation. Le score moyen de toutes les questions posées dans l'enquête de satisfaction, tous domaines confondus, était de 4 sur 5 (ou « d'accord »).

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Conclusions : Les résidents en pratique pharmaceutique résolvaient les DTP, les PD-DTP et les QI-DTP des patients et contribuaient de manière significative aux soins directs aux patients. Sur base de la documentation, on pourrait s'attendre à ce que le nombre et le type d'interventions observées dans cette étude améliorent les résultats cliniques et sanitaires des patients.

Mots-clés : résident en pharmacie, soins cliniques, problèmes de pharmacothérapie, indicateurs clés de rendement relatif à la pharmacie clinique

INTRODUCTION

Priority disease states are medical conditions with a high impact on and/or prevalence in the population that account for a disproportionate number of emergency department visits and hospital admissions, prolong length of stay, and increase health care costs.[1-3] Clinical pharmacists can prioritize the care they provide and add value by making evidence-based pharmacotherapy interventions for patients with priority diseases.[4] Two randomized controlled trials showed that hospital pharmacists providing comprehensive proactive clinical care and identifying and resolving drug therapy problems (DTPs) for patients with priority disease states can improve the overall quality of drug therapy, thereby reducing emergency department visits, hospital visits, drug-related readmissions, hospital readmissions, and total cost of care.[5,6] Most importantly, these trials confirmed that pharmacist-resolved DTPs are a useful process measure in continuous quality improvement projects to evaluate clinical pharmacy services, and represent an acceptable surrogate marker for predicting clinical and economic outcomes.

In addition, pharmacist-resolved DTPs have been recommended in the international literature as a clinical pharmacy key performance indicator (cpKPI) for clinical pharmacy services.[7-11] Measuring and reporting cpKPI activities is beneficial to patients, members of the health care team, pharmacy leaders, managers, pharmacists, and pharmacy students to help improve pharmacy practice and the quality of patient care.[11-13]

Canadian pharmacy practice residency programs combine didactic and experiential elements to help the residents developing the necessary competencies to provide evidence-based direct patient care as a member of interprofessional teams, to manage their own practice of pharmacy, to exercise leadership, to demonstrate project management skills, to provide medication- and practice-related education, and to manage and improve medication-use systems in preparation for real-world practice.[14] Identification and resolution of DTPs and provision of other evidence-based clinical activities constitute a major residency development goal that is aligned with the fundamental role of a pharmacist.[15] Currently, there is no Canadian literature capturing the contribution of pharmacy practice residents to cpKPIs in the area of drug therapy interventions (e.g., resolved DTPs).

As the number of experiential rotations for entry-to-practice Canadian pharmacy students increases because of evolving curricula and increasing enrolment, there is more pressure on hospitals to meet the increasing demand for experiential learning practice sites. As employee learners, residents will increasingly need to add value by contributing tangibly to patient care as they evolve through their training. Residents' progress through clinical training entails development of knowledge, skills, abilities, attitudes, and behaviours, as well as the required competencies to identify and resolve a DTP. There is value to using this latter process measure to evaluate pharmacy residents' contributions to and progression in clinical care over the course of the residency.

If it could be confirmed, through observation, that pharmacy practice residents are contributing to clinical care, future development of residency programs and possibly even their expansion would be justified. Conversely, observations showing that pharmacy practice residents are making suboptimal contributions to clinical care would indicate a need for changes to residency training programs. Therefore, the purpose of this study was to describe the contribution of pharmacy practice residents to clinical pharmacy care, using resolved DTPs as an accepted process-of-care measure.

METHODS

Study Design

This was a prospective, observational one-group study that took place across 5 rotation sites within the Interior Health Authority (British Columbia) from September 2, 2013, to June 13, 2014. Ethics approval for the study was obtained from the Interior Health Research Ethics Board and the University of British Columbia Behavioural Research Ethics Board.

Study Population

The Interior Health Pharmacy Practice Residency Program, accredited by the Canadian Pharmacy Residency Board, is delivered at 5 hospitals and ambulatory practice sites across a

single health authority in British Columbia. It consists of 52 weeks of experiential learning, including 30 weeks of direct patient care rotations. All residents must complete core rotations in internal medicine (4 weeks), critical care (4 weeks), infectious diseases (4 weeks), cardiology (4 weeks), and preceptorship skills (2 weeks). Residents are also required to choose 3 elective direct patient care rotations, each of which is 4 weeks in duration. Data about resolved DTPs were collected from all pharmacy practice residents, starting after completion of the first 4-week patient care rotation (internal medicine). Only those residents who consented to participate in an online survey to provide feedback on their perceptions of the DTP tracking experience were included in the study. Resolved DTP data that were un-interpretable or incomplete were excluded.

Clinical Performance Indicator System (DTP Tracker)

In 2009, concurrent with the development of ongoing disease-state education modules for staff professional development, a clinical performance indictor system (DTP Tracker) was developed and implemented to measure clinical pharmacists' effectiveness and efficiency at resolving DTPs for patients. The DTP-related actions captured in the DTP Tracker include discontinuing an unnecessary drug, initiating a new drug, changing a suboptimal or ineffective drug or route, increasing a drug dose, decreasing a drug dose, changing a drug or dose because of an adverse drug reaction (ADR), changing a drug or dose because of a drug interaction, and providing medication adherence strategies. A DTP is deemed to have been resolved if the prescriber accepts the pharmacist's recommendation, with a resultant prescription change, or if the pharmacist provides the patient with medication adherence strategies. According to departmental policy, all pharmacists prospectively capture resolved DTPs in the DTP Tracker (HanDBase software, version 4.8.715, DDH Software, Inc, Wellington, Florida) using an institutional point-of-care device or an institutional desktop version (Microsoft Excel software, version 14.0.7145.5000, Microsoft Corporation, Redmond, Washington). During their residency orientation period before the study, pharmacy practice residents were given initial and ongoing standardized training on use of the DTP Tracker.

For the purposes of the study, a "DTP" was defined as any DTP resolved by a pharmacy practice resident. A priority disease DTP (PD-DTP) was a resolved DTP related to any of the prevalent and high-impact diseases covered in the 8 education modules provided to Interior Health pharmacy staff: heart failure, atrial fibrillation, ischemic heart disease, chronic obstructive pulmonary disease, pneumonia, urinary tract infection, diabetes mellitus, gastroesophageal reflux disease or peptic ulcer disease, and a "general support" disease category for which DTP-related actions included providing venous thromboembolism prophylaxis, immunizations, nicotine replacement therapy, or smoking cessation therapy. A quality indicator DTP (QI-DTP) was a DTP for a priority disease to which the pharmacist could apply an evidence-based intervention that has been proven, in randomized controlled trials or meta-analyses, to improve clinically important outcomes. Any DTP could be subcategorized as a PD-DTP and/or a QI-DTP. For example, any pharmacist-resolved DTP for heart failure would be a PD-DTP, and initiating a β-blocker for heart failure would also be subcategorized as a QI-DTP. According to the organization's process measure data for 2013, clinical pharmacists resolved a total of 29 909 DTPs in that year. Of these, 12 017 (40%) were PD-DTPs and 8682 (29%) were QI-DTPs.

Survey Questionnaire

A nonvalidated 10-question Likert-type questionnaire was developed by the investigators to elicit residents' satisfaction with domains of training, usability, efficiency, and time requirements (Appendix 1). Potential responses ranged from 1 (strongly disagree) to 5 (strongly agree). The survey questionnaire was deployed with SurveyMonkey (San Mateo, California; www.surveymonkey.com).

Outcome Measures

The primary outcome was the total number of DTPs resolved by pharmacy practice residents during 24 weeks of direct patient care rotations from September 2, 2013, to June 13, 2014. Excluded from the analysis were the first 4-week core rotation (internal medicine) and the 2-week preceptorship rotation, the latter because it focused on developing residents' teaching skills rather than providing direct patient care. The secondary outcomes were number of PD-DTPs resolved; number of QI-DTPs resolved; the progression in terms of numbers of DTPs, PD-DTPs, and QI-DTPs resolved by the residents during sequential rotations over time; and feedback from survey respondents about the DTP tracking experience across domains of training, usability, efficiency, and time requirements.

Statistical Analysis

Summary descriptive statistics with median and ranges for ordinal survey data were calculated.

RESULTS

During the study period, all 4 residents consented and participated in the study. DTP data were captured by 1 resident who completed 3 clinical rotations and 3 residents who completed 6 clinical rotations, for a total of twenty-one 4-week rotations with data capture. Pharmacy practice residents resolved a total of 1201 DTPs during the study period. Of these, 620 (52%) were PD-DTPs and 479 (40%) were QI-DTPs. As depicted in Figure 1, the monthly group counts for all DTPs, PD-DTPs, and QI-DTPs increased over time for the first 3 rotations, decreased for rotations 4 and 5, and increased for rotation 6.

Figure 2 illustrates the results for the DTP Tracker satisfaction survey. The median score for all questions was 4 ("agree"). For questions 1 and 2, the response was 4 for all participants; for questions 3 and 4, the response was 3 or 4 for each participant; and for questions 5 through 10, the response was 4 or 5 for each participant. In addition, all residents responded "yes" to a summary question about satisfaction with the DTP Tracker across all 4 domains (data not shown).

Given the variability in progression of resolution of DTPs, PD-DTPs, and QI-DTPs over time (Figure 1), post hoc analyses of totals by individual resident (Table 1) and by rotation (Table 2) were performed. Table 1 shows that 2 of the residents had similar productivity, with the third resident generating slightly lower numbers of resolved DTPs, and the fourth resident (who completed only 3 rotations) having the lowest numbers. Table 2 shows that the numbers of resolved DTPs, PD-DTPs, and QI-DTPs varied depending on the type of rotation. The highest numbers of resolved DTPs were generated during rotations in cardiology, critical care, and community medicine, and the lowest totals were generated in ambulatory care and a remedial medicine rotation.

DISCUSSION

The purpose of this study was to describe the contribution of 4 pharmacy practice residents to clinical pharmacy care, using resolved DTPs as an accepted process-of-care measure. During the twenty-one 4-week rotations, participating residents resolved a total of 1201 DTPs, a median of 346 per resident over 6 months. Of these 1201 resident-resolved DTPs, 620 (52%) were PD-DTPs and 479 (40%) were QI-DTPs (Tables 1 and 2). For perspective, according to DTP Tracker data for January to June 2014, the proportions of DTPs that were PD-DTPs and QI-DTPs were higher for residents than for staff pharmacists: 52% versus 33% for PD-DTPs and 40% versus 23% for QI-DTPs, respectively. The residents accounted for 7% (1201/17 197) of all pharmacist-resolved DTPs, 10% (620/6114) of all PD-DTPs, and 11% (479/4525) of all QI-DTPs in the health authority.

On the basis of the pharmacy practice literature, these numbers of resolved DTPs would be expected to translate into clinical and economic benefits for patients. Gillespie and others[6] demonstrated that 240 pharmacist-resolved DTPs over 6 months translated into a 47% reduction in emergency department visits, a 16% reduction in hospital visits, and an 80% reduction in drug-related readmissions, with a net overall saving of $230/patient. In the Interior Health Authority, the number of resolved DTPs per resident over 6 months was even higher, at a median of 346. Furthermore, 52% of the resident-resolved DTPs in this study were for priority disease states, with 40% involving evidence-based interventions proven to reduced mortality, morbidity, and health resource utilization. In the study by Makowsky and others,[5] 728 pharmacist-resolved DTPs over a 6-month period translated into a 45% increase in the quality of drug therapy for 5 targeted conditions and led to a 20% reduction in 3-month readmission rates. Although that DTP resolution rate was almost double the median number of DTPs resolved by each Interior Health pharmacy practice resident, the pharmacists in the study by Makowsky and others[5] had 5–8 years of experience.

Overall, the pharmacy practice residents in the current study resolved DTPs at a rate and with an importance that would be expected to translate into clinically important benefits, according to our interpretation of the COLLABORATE study.[5] Previous literature indicates that a resolved DTP is a process measure that represents a beneficial change in a patient's medication regimen. More specifically, a PD-DTP is a resolved DTP for a prevalent and impactful disease, and a QI-DTP is a resolved DTP linked to strong guideline recommendations, based on moderate to

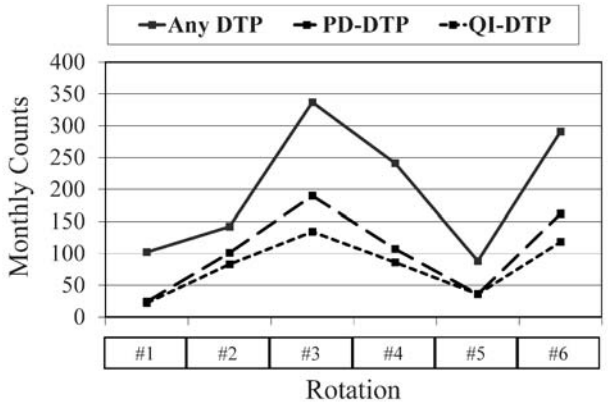

Figure 1. Monthly counts of resident-resolved drug-therapy problems (DTPs), priority disease drug therapy problems (PD-DTPs), and quality indicator drug therapy problems (QI-DTPs) over time, by resident rotation number.

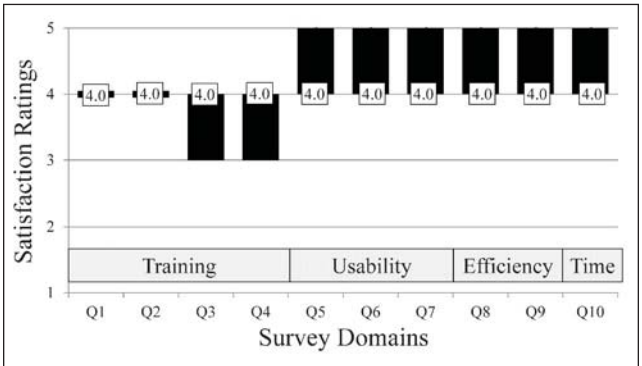

Figure 2. Satisfaction ratings for the DTP Tracker, showing minimum, maximum, and median values. The numbered questions are provided in Appendix 1.

Table 1. Numbers of Drug Therapy Problems, by Resident

	Type of DTP*; No. (%) of DTPs		
Resident	**All DTPs**	**PD-DTPs**	**QI-DTPs**
Resident 1 (6 rotations)	433	240 (55.4)	192 (44.3)
Resident 2 (6 rotations)	426	220 (51.6)	175 (41.1)
Resident 3 (6 rotations)	265	133 (50.2)	96 (36.2)
Resident 4 (3 rotations)	77	27 (35.1)	16 (20.8)

DTP = drug therapy problem, PD-DTP = priority disease drug therapy problem, QI-DTP = quality indicator drug therapy problem.
*For each resident, there were some DTPs categorized as both PD-DTP and QI-DTP. In addition, there were some DTPs not categorized as either PD-DTP or QI-DTP.

Table 2. Numbers of Drug Therapy Problems, by Rotation Type

	Type of DTP*; No. (%) of DTPs		
Rotation	**All DTPs**	**PD-DTPs**	**QI-DTPs**
Cardiology (4 rotations)	360	285 (79.2)	228 (63.3)
Critical care (3 rotations)	297	110 (37.0)	56 (18.9)
Community medicine (4 rotations)	152	54 (35.5)	54 (35.5)
Infectious diseases (3 rotations)	123	58 (47.2)	58 (47.2)
Nephrology (2 rotations)	96	31 (32.3)	19 (19.8)
Cardiac surgery (1 rotations)	94	48 (51.1)	42 (44.7)
Ambulatory care (3 rotations)	54	17 (31.5)	16 (29.6)
Medicine (1 rotation)	25	17 (68.0)	6 (24.0)

DTP = drug therapy problem, PD-DTP = priority disease drug therapy problem, QI-DTP = quality indicator drug therapy problem.
*Within each rotation, there were some DTPs categorized as both PD-DTP and QI-DTP. In addition, there were some DTPs not categorized as either PD-DTP or QI-DTP.

high-quality evidence, that translates into improved quality of medication therapy (outcome measure) and fewer readmissions (health resource utilization measure).[5] In our study, the number of DTPs, PD-DTPs, and QI-DTPs increased during the first 3 rotations, dropped transiently, and then recovered (Figure 1). This pattern may indicate that as the year progressed, residents became more knowledgeable about various disease states and more confident in identifying and resolving DTPs. This progressive increase might also have been due to the residents becoming more efficient in tracking their DTPs as they became more familiar with the device and the tracking process. Finally, the variability in numbers over time might have been due to the low number of rotations for one resident, who did not contribute data after rotation 3, and to the variability in intervention opportunity and yield of DTPs, PD-DTPs, and QI-DTPs for different rotations because of differences in practice settings and practitioners (Table 2). Most of the residents had "lower-yield" rotations scheduled for rotations 4 and 5, which might explain these results. Additionally, reporting bias due to competing duties (e.g., research project work) during rotations 4 and 5 could have influenced the results. It should be noted that the contribution of preceptors to improving the residents' clinical competencies required to independently identify and resolve DTPs was likely variable across rotations, despite standardized tools and processes for competency assessment. In addition, this aspect could not be practically controlled, nor could pertinent data be collected or reported. Finally, the results of the survey concerning DTP Tracker satisfaction (Figure 2) indicated that DTP tracking by residents was well accepted across the domains of training, usability, efficiency, and time. This acceptance would support ongoing use of DTP tracking by residents as a longitudinal process measure for pharmacy practice residents throughout their residency.

To our knowledge, no Canadian literature has captured the contribution of pharmacy practice residents to cpKPIs in the area of drug therapy interventions (e.g., resolved DTPs). Some studies have demonstrated the practice contribution of US entry-to-practice PharmD students and postgraduate residents.[16-19] Taylor and others[16] described the impact of pharmacy faculty, residents, and students (referred to as the education group) on the number and types of interventions at a community hospital. Interventions included discharge counselling and education, provision of formal consultations to physicians, therapeutic recommendations, IV-to-oral conversion, provision of drug information by pharmacists, antibiotic recommendations, follow-up pharmacokinetics, dosage adjustments, and laboratory monitoring.[16] Of the 2873 accepted interventions provided by the education group, the residents contributed 877 (30.5%), while PharmD students contributed 1344 of the total (46.8%).[16] However, the authors did not show breakdowns by specific types of interventions for each group. Maack and others[17] described the contributions of one post-graduate year 1 pharmacy practice resident in an assisted living facility. The interventions were related to ADR/adherence issues, appropriateness of doses, appropriateness of laboratory monitoring, appropriateness of length of therapy, cost issues, drug

contraindications or drug allergies, drug-drug interactions, indications for and appropriateness of all medications, missing drug therapy, responding to requests for patient follow-up visits, and therapeutic duplications.[17] Of the 125 recommendations made by the pharmacy practice resident, 72 (57.6) were accepted.[17] In a systematic review, Mersfelder and Bouthillier[18] showed that PharmD students contributed to direct patient care by providing drug information, recommending therapeutic alternatives/changes, obtaining medication histories, and providing patient education. Individual students made between 1.2 and 16 recommendations to prescribers each week, with an acceptance rate ranging from 32% to 98%.[18] The weekly number of recommendations increased over time, from 1.8 per student in the first week to 6.2 per student in week 5.[18] Finally, Delgado and others[19] described the contribution of pharmacy students and residents to direct patient care in a new practice model. The number of interventions increased from 0.9 to 1.4 per patient-day after learners became involved in providing direct patient care. Although these studies offer a general sense of the clinical activities, recommendations, and acceptance rates for pharmacy students and residents over time, they did not reliably quantify the number, type, and impact of clinical care interventions provided by pharmacy practice residents, or the specific contribution of residents to resolving identified DTPs for patients to improve their drug therapy.

This study had inherent limitations related to its design. Because of the nature of the study, the data collected about resolved DTPs may have been incomplete or inaccurate. Measurement bias may have been present, given that not all residents entered all of their resolved DTPs in the DTP Tracker, and some who delayed data entry may not have recalled or entered all of their DTPs. Given that the study took place over a period when experiential rotations were completed, clinical maturation or proficiency bias could have contributed to differential effects over time, as well as social desirability bias. Given that this study was observational, it is acknowledged that many of these potential biases could not be practically measured or controlled for in the analysis and that they are nondirectional. Furthermore, the investigators were most interested in the real-world impact of residents' contributions to resolution of DTPs, PD-DTPs, and QI-DTPs, and their feedback on the feasibility of the DTP Tracker.

CONCLUSION

This study has demonstrated that pharmacy practice residents at the study institution contributed directly and significantly to clinical care, as measured by resident-resolved DTPs, PD-DTPs, and QI-DTPs for patients. They are implementing evidence-based recommendations on drug therapy for patients with priority disease states and are contributing to a significant proportion of the DTP interventions by all pharmacists in the health authority. Residents' DTP interventions appeared to increase over time but varied by rotation. Based on randomized controlled trials in pharmacy practice, it is our opinion that the magnitude and impact of these resident-resolved DTPs, PD-DTPs, and QI-DTPs would be expected to improve clinical and health economic outcomes for patients. DTP tracking by residents was well accepted, in terms of training, usability, efficiency, and time requirements. Health authorities should use these data to help justify residency program expansion to meet future staffing needs. Future research should focus on describing the contribution of hospital pharmacists and pharmacy practice residents to clinical pharmacy care using the 8 recommended cpKPIs. Such an analysis would provide a more balanced dashboard of quality indicators shown to improve patient outcomes.

References

1. Broemeling AM, Watson D, Black C. Conclusion. In: *Chronic conditions and co-morbidity among residents of British Columbia*. Vancouver (BC): Centre for Health Services and Policy Research; 2005. p. 26.
2. Broemeling AM, Watson DE, Prebtani F; Health Outcomes Steering Committee of the Health Council of Canada. Population patterns of chronic health conditions, co-morbidity and healthcare use in Canada: implications for policy and practice. *Healthc Q*. 2008;11(3):70-6.
3. *DAD/HMBD hospitalization rate, average length of stay, top 10 high volume inpatient hospitalizations and surgeries, and hospital-based newborn rate, 2013–2014* [preformatted table]. Ottawa (ON). Canadian Institute for Health Information; ©1996–2015 [cited 2015 Nov 12]. Available from: https://www.cihi.ca/en/quick-stats
4. Slavik RS, LeBras M, Gorman SK. Clinical pharmacy activities: we know what to do, but for whom should we do it? *Can J Hosp Pharm.* 2016: 69(2):176-8.
5. Makowsky MJ, Koshman SL, Midodzi WK, Tsuyuki RT. Capturing outcomes of clinical activities performed by a rounding pharmacist practicing in a team environment: the COLLABORATE study. *Med Care*. 2009; 47(6):642-50.
6. Gillespie U, Alassaad A, Henrohn D, Garmo H, Hammarlund-Udenaes M, Toss H, et al. A comprehensive pharmacist intervention to reduce morbidity in patients 80 years or older: a randomized controlled trial. *Arch Intern Med.* 2009;169(9):894-900.
7. Ng J, Harrison J. Key performance indicators for clinical pharmacy services in New Zealand public hospital: stakeholder perspectives. *J Pharm Health Serv Res.* 2010;1(2):75-84.
8. Fernandes O, Gorman SK, Slavik RS, Semchuk WM, Shalansky S, Bussières JF, et al. Development of clinical pharmacy key performance indicators for hospital pharmacists using a modified Delphi approach. *Ann Pharmacother.* 2015;49(6):656-69.
9. Fernandes O, Toombs K, Pereira T, Lyder C, Bjelajac Mejia A, Shalansky S, et al. *Canadian consensus on clinical pharmacy key performance indicators: knowledge mobilization guide.* Ottawa (ON): Canadian Society of Hospital Pharmacists; 2015 [cited 2019 Sep 19]. Available from: https://www.cshp.ca/sites/default/files/files/CSPH-Can-Concensus-cpKPI-Knowledge-Mobilization-Guide.pdf
10. Fernandes O, Toombs K, Pereira T, Lyder C, Bjelajac Mejia A, Shalansky S, et al. *Canadian consensus clinical pharmacy key performance indicators: quick reference guide.* Ottawa (ON): Canadian Society of Hospital Pharmacists; 2015 [reissued 2017; cited 2019 Sep 19]. Available from: https://www.cshp.ca/sites/default/files/files/publications/Official%20Publications/CPKPI/CSPH-Can-Concensus-cpKPI-QuickReferenceGuide_June_2017.pdf
11. Lo E, Rainkie D, Semchuk WM, Gorman SK, Toombs K, Slavik RS, et al. Measurement of clinical pharmacy key performance indicators to focus and improve your hospital pharmacy practice. *Can J Hosp Pharm.* 2016; 69(2):149-55.
12. Doucette D. Should key performance indicators for clinical pharmacy services be mandatory? The "pro" side. *Can J Hosp Pharm.* 2011;64(1):55-6.
13. Millen B. Should key performance indicators for clinical pharmacy services be mandatory? The "con" side. *Can J Hosp Pharm*. 2011;64(1):56-7.

14. Canadian Pharmacy Residency Board. *Accreditation standards for pharmacy (year 1) residencies.* Ottawa (ON): Canadian Society of Hospital Pharmacists; 2018 [cited 2019 Mar 25]. Available from: https://www.cshp.ca/sites/default/files/residency/FINAL%20-%20CPRB%20Pharmacy%20(Year%201)%20Residency%20Standards(06May2018).pdf
15. Cipolle RJ, Strand LM, Morley PC. *Pharmaceutical care practice: the clinician's guide*. 2nd ed. New York (NY): McGraw-Hill Companies Inc; 2004.
16. Taylor CT, Church CO, Byrd DC. Documentation of clinical interventions by pharmacy faculty, residents, and students. *Ann Pharmacother*. 2000; 34(7-8):843-7.
17. Maack B, Miller DR, Johnson T, Dewey M. Economic impact of a pharmacy resident in an assisted living facility-based medication therapy management program. *Ann Pharmacother.* 2008;42(11):1613-20.
18. Mersfelder TL, Bouthillier MJ. Value of the student pharmacist to experiential practice sites: a review of the literature. *Ann Pharmacother.* 2012;46(4):541-8.
19. Delgado O, Kernan WP, Knoer SJ. Advancing the pharmacy practice model in a community teaching hospital by expanding student rotations. *Am J Health Syst Pharm.* 2014;71(21):1871-6.

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Appendix 1: Questions for a survey about the DTP [Drug Therapy Problem] Tracker.

Training

1. The training information was *relevant* for me to appropriately use the DTP Tracker.
2. I am more *competent* in my knowledge, skills, and abilities to use the DTP Tracker after this training.
3. I am more *confident* in entering data into the DTP Tracker after this training.
4. I am *satisfied* with the training I received for the DTP Tracker.

Usability

5. The DTP Tracker is *easy* to use.
6. The DTP Tracker is *convenient* to use.
7. I am satisfied with the *usability* of the DTP Tracker.

Efficiency

8. The tracking of DTPs *interfered* with other required activities.
9. The DTP Tracker is *efficient* to use.

Time Requirements

10. I am satisfied with the time required to track data in the DTP Tracker.

Note: All questions were answered using a 5-point Likert scale:
1 – strongly disagree
2 – disagree
3 – neutral
4 – agree
5 – strongly agree