

# Further Defining Optimal Pharmacist-to-Patient Ratios to Ensure Comprehensive Direct Patient Care in Medical and Surgical Units across British Columbia Hospitals

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## ABSTRACT

**Background:** Patient care ratios for pharmacists are not well defined in Canada. A recent work-sampling study involving 6 medium and large hospitals within the region served by Lower Mainland Pharmacy Services, British Columbia, reported pharmacist-to-patient ratios of 1:13, 1:26, and 1:14 in internal medicine teaching units, hospitalist or internal medicine nonteaching units, and surgical units, respectively.

**Objective:** To determine the pharmacist-to-patient ratios required to provide comprehensive pharmaceutical care to adult patients admitted to medical and surgical units in medium and large hospitals in British Columbia.

**Methods:** In this cross-sectional electronic survey study, participants were asked to provide estimates of the time spent on and the frequency of 17 comprehensive pharmaceutical care tasks identified in the previous study, which was based on a Delphi method. The survey data were used to calculate pharmacy staffing ratios according to the World Health Organization workforce calculator.

**Results:** Fifty-eight pharmacists responded to the survey, of whom 41 (71%) were from medium and large hospitals. The optimal pharmacist-to-patient ratios were calculated as 1:7 for internal medicine teaching units; 1:10 for internal medicine nonteaching, hospitalist, and family practice units; and 1:14 for surgical units.

**Conclusions:** The pharmacist-to-patient ratios calculated in this study, using only pharmacists' self-reported information, were lower than those found previously. Further research is required to determine whether completion of every comprehensive care task is necessary, or if staffing ratios should reflect combinations of comprehensive care tasks based on patient complexity. National consensus guidelines on pharmacist staffing ratios may be valuable, given the current lack of standardization of pharmacy staffing ratios in hospitals.

**Keywords:** pharmacists, hospital pharmacy service, personnel staffing and scheduling, hospitals, workforce

## RÉSUMÉ

**Contexte :** Les ratios de prise en charge des patients par les pharmaciens ne sont pas clairement définis au Canada. Une récente étude par échantillonnage du travail menée dans 6 hôpitaux de moyenne et grande taille dans la région desservie par les Lower Mainland Pharmacy Services en Colombie-Britannique a rapporté des ratios pharmacien-patients de 1:13 dans les unités d'enseignement de médecine interne, de 1:26 dans les unités de médecine interne ou d'hospitalisation sans enseignement, et de 1:14 dans les unités chirurgicales.

**Objectif :** Déterminer les ratios pharmacien-patients nécessaires pour offrir des soins pharmaceutiques complets aux patients adultes admis dans les unités médicales et chirurgicales dans les hôpitaux de moyenne et grande taille en Colombie-Britannique.

**Méthodologie :** Dans cette étude transversale menée à l'aide d'un sondage électronique, les participants ont été invités à estimer le temps et la fréquence consacrés à 17 tâches de soins pharmaceutiques complets, définies dans une étude précédente utilisant la méthode Delphi. Les données recueillies ont été utilisées pour calculer les ratios de personnel en pharmacie selon le calculateur de main-d'œuvre de l'Organisation mondiale de la santé.

**Résultats :** Cinquante-huit pharmaciens ont répondu au sondage, dont 41 (71 %) provenaient d'hôpitaux de moyenne et grande taille. Les ratios pharmacien-patients optimaux ont été calculés comme suit : 1:7 pour les unités d'enseignement en médecine interne; 1:10 pour les unités non enseignantes de médecine interne, d'hospitalisation et de médecine familiale; et 1:14 pour les unités chirurgicales.

**Conclusions :** Les ratios pharmacien-patients calculés dans cette étude, basés uniquement sur les informations autodéclarées des pharmaciens, étaient inférieurs à ceux trouvés précédemment. Des recherches supplémentaires sont nécessaires pour déterminer si l'accomplissement de chaque tâche de soins complets est indispensable, ou si les ratios de personnel devraient refléter des combinaisons de tâches de soins complets en fonction de la complexité des patients. Des lignes directrices nationales sur les ratios de personnel pharmaceutique pourraient être utiles, étant donnée l'absence actuelle de normalisation des ratios de personnel en pharmacie dans les hôpitaux.

**Mots-clés :** pharmaciens, service de pharmacie hospitalière, dotation en personnel et planification des horaires, hôpitaux, main-d'œuvre

## INTRODUCTION

Over the past several decades, clinical pharmacy has evolved from a product-focused to a patient-focused profession, with the goal of providing comprehensive pharmaceutical care in order to optimize patient outcomes.<sup>1,2</sup> The benefits of clinical pharmacy services are well documented in the literature.<sup>3-8</sup> Interventions such as participating in medical rounds, providing in-service education, and collecting drug histories on admission have all been shown to decrease mortality.<sup>3-5</sup>

In contrast to physicians and nurses, for whom patient care ratios are well established,<sup>9-13</sup> pharmacist staffing ratios are not well defined in Canada. As the scope of practice of hospital pharmacists continues to expand, pharmacists are expected to do more for each patient. However, patient assignments have generally not changed in response to changes in pharmacists' scope, and workload pressures have therefore increased. As such, it is critical to establish optimal pharmacy staffing ratios. Although there have been previous attempts to establish benchmarks for hospital pharmacist workload in Canada,<sup>14</sup> there are no nationally accepted standards in this area. In recent years, groups in Australia<sup>15</sup> and the United Kingdom<sup>16</sup> have investigated optimal staffing ratios in clinical pharmacy practice. However, the applicability of these ratios to Canadian practice is unclear, because of differences in patient populations, hospital funding models, the range of clinical services provided, and pharmacists' scope of practice.

A previous research study used a multiphase method to establish pharmacist staffing ratios: first, a modified Delphi survey to define a list of comprehensive pharmaceutical care tasks, and then a work-sampling, time-and-motion study using pharmacists' self-reported time and task frequencies to calculate pharmacist-to-patient ratios. A total of 31 pharmacists from 6 selected medium and large hospitals within British Columbia participated in the earlier study.<sup>17</sup> The optimal pharmacist-to-patient ratios were determined to be 1:13, 1:26, and 1:14 for internal medicine teaching units, hospitalist and internal medicine nonteaching units (including family practice [FP] units), and surgical units, respectively.<sup>17</sup> The time-and-motion method used in the previous study was regarded as the gold standard for describing workload. However, given the intensive nature of this method, the overall sample size of the previous study was relatively modest.

In the current study, we aimed to further explore these findings by expanding the study setting to include more hospitals in British Columbia and by using a more easily scalable method to further define the optimal patient care ratios for pharmacists working in a medical or surgical unit. Determining pharmacist-to-patient ratios that reflect current clinical practice will empower the profession to advocate for staffing sufficient to provide comprehensive pharmaceutical care and thus to optimize patient outcomes.

The primary objective was to determine the pharmacist-to-patient ratios required to provide comprehensive pharmaceutical care to all adult patients admitted to various types of inpatient medical and surgical units across medium and large hospitals in British Columbia. The secondary objectives were to confirm the list of comprehensive care tasks developed in the previous study,<sup>17</sup> to determine the pharmacist-to-patient ratios in medical and surgical subspecialty units, and to explore whether the pharmacist-to-patient ratios in medium and large hospitals apply to smaller hospitals.

## METHODS

### Study Design

In this cross-sectional electronic survey study, participants were asked to provide estimates of the time spent on and frequency of a set of comprehensive patient care tasks. Participants' demographic information was gathered, including clinical area of practice, hospital size, years of work experience, and current patient care ratios. A list of comprehensive patient care tasks derived from the previous study<sup>17</sup> was presented (see Appendix 1), and participants were asked if they agreed or disagreed with the tasks. "Time" was defined as the amount of time spent performing each comprehensive care task once. "Frequency" was defined as how often each task was performed for a single patient per admission. Participants were asked to provide their best estimate of the average time and frequency for each task (see Appendix 2 for an example), based on their experiences of providing care for a general medical or surgical patient of typical complexity. The self-reported time and frequency data were then input into a validated equation (Figure 1), which was used to calculate pharmacist-to-patient ratios in the medical and surgical units defined in the study.<sup>16,18</sup>

**Time per patient:**  $[\text{Task}_1 \text{ time} \times \text{Task}_1 \text{ frequency}] + [\text{Task}_2 \text{ time} \times \text{Task}_2 \text{ frequency}] + \dots [\text{Task}_n \text{ time} \times \text{Task}_n \text{ frequency}]$

**Pharmacist time:** Length of stay (LOS) in days  $\times$  [total minutes per work day – breaks – nonclinical time – unproductive time spent rounding]

**Pharmacist-to-patient ratio:**  $\frac{\text{Pharmacist time}}{\text{Time per patient}}$

**FIGURE 1.** World Health Organization's Workload Indicators of Staffing Need (WISN) equation, validated for clinical pharmacy staffing.<sup>16,18</sup>

This study involved pharmacists working within any of the health authorities in British Columbia and spending 25% or more of their work hours per year providing clinical services within a medical, surgical, subspecialty medical, subspecialty surgical, or mixed medical surgical unit. Medical units consisted of internal medicine (teaching and nonteaching), hospitalist medicine, and family practice (FP) units. Surgical units covered general surgery, vascular surgery, and orthopedic surgery. Subspecialty medical units covered cardiology, neurology, and nephrology. Subspecialty surgical units covered cardiac surgery, neurosurgery, thoracic surgery, and gastrointestinal/hepatobiliary surgery. We excluded pharmacists who worked exclusively in pediatrics, ambulatory care, transplant services, or critical care units (including general intensive care unit [ICU], emergency department, cardiac care unit or cardiac ICU, cardiac surgical ICU, and neurological ICU); we also excluded those whose surveys were incomplete. The study was intended to sample the entire population of eligible clinical pharmacists in British Columbia. With approximately 1120 hospital pharmacists in British Columbia, and assuming that 50% of them perform clinical duties and that among that group, 80% cover medical or surgical units, we estimated a potential sample of 448 eligible participants.<sup>19</sup>

The survey was anonymous and was hosted on the University of British Columbia (UBC) Qualtrics survey platform.<sup>20</sup> Ethics approval was obtained from the UBC Behavioural Research Ethics Board, and operational approval from each of the health authorities. Survey data were collected over 54 days, from December 15, 2022, to February 6, 2023.

### Statistical Analyses

All survey responses were analyzed using descriptive statistics within the UBC Qualtrics survey platform.<sup>20</sup> Continuous variables, such as time and frequency of tasks, were reported as medians with interquartile ranges. The pharmacist-to-patient ratios were calculated with Excel software, version 16.59 (Microsoft), using the World Health Organization's Workload Indicators of Staffing Need (WISN) equation<sup>18</sup> (Figure 1), which has been validated for use in clinical pharmacy staffing.<sup>16</sup>

The ratios were based on the average length of stay (LOS) for each unit type, which was collected from self-reported data in the survey. The following additional assumptions were made in the calculation of ratios: that the pharmacist worked 5 days per week, had 8-hour clinical shifts with no distribution responsibilities, took a 60-minute break daily, and had no teaching responsibilities, and that the department was fully staffed. The assumptions of no teaching responsibilities and a fully staffed department are important because they do not necessarily represent actual practice. Participants were asked to report the time and frequency of tasks based on patients of average or typical complexity.

## RESULTS

### Baseline Characteristics

A total of 58 pharmacists met the inclusion criteria for the study and completed the survey, yielding an estimated response rate of 13%. Forty-one (71%) of these pharmacists were from medium and large hospitals (Table 1). Among the pharmacists from medium and large hospitals, most were residency-trained clinical pharmacists (88%) and had 5 years or less of work experience (51%). In addition, the majority (68%) of pharmacists worked in medical units, with the most common area being internal medicine nonteaching, hospitalist, and FP. Other prespecified subspecialty areas were explored, but there were very few responses from pharmacists working in these areas (Table 1). Also, there were no responses from pharmacists working in surgical units in small hospitals. In the medium and large hospitals, the primary patient assignments for each pharmacist were reported to be 22 patients for those in internal medicine teaching units, 35 patients for those in internal medicine nonteaching, hospitalist, and FP units, and 30 patients for those in surgical units. A majority (56%,  $n = 23/41$ ) of participants from medium and large hospitals were also responsible for providing care for additional patients in a secondary area, often referred to as an off-service unit, with a median secondary patient assignment of 14 patients. For small hospitals, the primary patient assignment was reported to be 36 patients in internal medicine nonteaching, hospitalist, FP units, with 88% ( $n = 15/17$ ) of participants also being responsible for a median of 19 patients in off-service units.

### Confirmation of the Comprehensive Care Tasks

Participants were surveyed to determine their agreement with the list of comprehensive care tasks generated in our previous study<sup>17</sup>; for 13 of the 17 tasks, agreement was 95% or greater. Agreement rates were lower for 4 tasks: cost-effective use of tests (88%), best possible medication history (BPMH) interview (86%), attending disposition rounds (83%), and discharge planning (78%). Agreement with the BPMH interview as a comprehensive care task was lower because participants felt that the BPMH should be compiled by a dedicated BPMH pharmacist or pharmacy technician instead of the clinical pharmacist. Other reasons given by participants for disagreement with specific tasks in the comprehensive care list were that cost-effective use of tests was not within the pharmacist's scope of practice; that discharge planning that involves faxing the discharge prescription should be the responsibility of the unit clerk, patient care coordinator, or care management leader; and that disposition rounds are not relevant to pharmacists.

### Time and Frequency of Tasks

The time spent on and frequency of each comprehensive care task are reported in Table 2. Aside from attending

medical and disposition rounds, the tasks that consistently took the longest time, regardless of hospital size or unit type, were completing the initial care plan and providing patient education. The tasks reported to occur most frequently were resolving drug therapy problems (DTPs) identified by self and others and monitoring patients for adverse

drug reactions or drug–drug interactions. In medium and large hospitals, 100% ( $n = 5/5$ ) of participants from internal medicine teaching units reported attending medical rounds, with a median length of 120 minutes per session; in internal medicine nonteaching, hospitalist, and FP units, 50% ( $n = 8/16$ ) of participants reported attending medical

**TABLE 1. Baseline Characteristics**

Characteristic	Hospital Size; No. (%) <sup>a</sup> of Participants		
	Medium and Large <sup>b</sup> ( $n = 41$ )	Small <sup>b</sup> ( $n = 17$ )	Total ( $n = 58$ )
<b>Health authority</b>			
Vancouver Coastal Health	17 (41)	4 (24)	21 (36)
Fraser Health	14 (34)	2 (12)	16 (28)
Providence Health	3 (7)	0	3 (5)
Interior Health	2 (5)	5 (29)	7 (12)
Island Health	3 (7)	4 (24)	7 (12)
Northern Health	2 (5)	2 (12)	4 (7)
<b>Current role</b>			
Clinical pharmacist <sup>c</sup>	36 (88)	12 (71)	48 (83)
Clinical pharmacy specialist <sup>d</sup>	5 (12)	1 (6)	6 (10)
Dispensary + clinical	0	3 (18)	3 (5)
Other	0	1 (6)	1 (2)
<b>Work experience (years)</b>			
0–5	21 (51)	8 (47)	29 (50)
6–10	8 (20)	4 (24)	12 (21)
11–20	8 (20)	4 (24)	12 (21)
≥21	4 (10)	1 (6)	5 (9)
<b>Medical unit</b>			
	$n = 28$ (68)	$n = 17$ (100)	$n = 45$ (78)
Internal medicine teaching unit <sup>e</sup>	5 (18)	0	5 (11)
Internal medicine nonteaching, hospitalist, or FP unit	16 (57)	15 (88)	31 (69)
Neurology	1 (4)	0	1 (2)
Nephrology	1 (4)	0	1 (2)
Other	5 <sup>f</sup> (18)	2 <sup>g</sup> (12)	7 (16)
<b>Surgical unit</b>			
	$n = 13$ (32)	$n = 0$	$n = 13$ (22)
General	4 (31)	–	4 (31)
Vascular	2 (15)	–	2 (15)
Orthopedic	5 (38)	–	5 (38)
Neurosurgery	1 (8)	–	1 (8)
Other	1 <sup>h</sup> (8)	–	1 (8)

FP = family practice.

<sup>a</sup>Percentages in a given section may not sum to 100 because of rounding.

<sup>b</sup>Small hospital, 1–199 beds; medium hospital, 200–399 beds; large hospital, 400 beds or more.<sup>21</sup>

<sup>c</sup>A clinical pharmacist is a pharmacist who provides patient care that optimizes medication therapy and promotes health, wellness, and disease prevention, as well as an expert in the therapeutic use of medications who routinely provides medication therapy evaluations and recommendations to patients and other health care professionals.<sup>22</sup>

<sup>d</sup>A clinical pharmacy specialist is a clinical pharmacist who provides consultation services to internal and external health care professionals and applies advanced knowledge to assess, plan, implement, and evaluate the delivery of pharmaceutical care in the designated specialty area.<sup>23</sup>

<sup>e</sup>An internal medicine teaching unit (also known as a clinical teaching unit) is a designated internal medicine unit with a team-based approach to care, with team members from all levels of training, focused on teaching.<sup>24</sup>

<sup>f</sup>For the 5 participants who practised in units included in the category “other”, the units were oncology, geriatric medicine ( $n = 2$ ), psychiatry, and urban health. All except psychiatry were included in the ratio calculations for subspecialty medicine.

<sup>g</sup>For the 2 participants who practised in units included in the category “other”, the units were medical/palliative and telemetry. For purposes of calculating staffing ratios, both were included in the category for internal medicine nonteaching, hospitalist, and FP units.

<sup>h</sup>The single participant in the category “other” had a mix of 40% general surgery, 40% orthopedic surgery, and 20% mixed urologic, gynecologic, plastics, gastrointestinal, and vascular surgery.

**TABLE 2. Median Times for and Frequencies of Comprehensive Care Tasks, by Hospital Size and Clinical Unit**

Comprehensive Care Task	Medium and Large Hospitals						Small Hospitals		
	Internal Medicine Teaching Unit (n = 5)		Internal Medicine Nonteaching, Hospitalist, or FP Unit (n = 16)		Surgical Unit (n = 13)		Internal Medicine Nonteaching, Hospitalist, or FP Unit (n = 17)		
	Median (IQR) Time per Task <sup>a</sup> (min)	Median Frequency per Admission <sup>b</sup>	Median (IQR) Time per Task <sup>a</sup> (min)	Median Frequency per Admission <sup>b</sup>	Median (IQR) Time per Task <sup>a</sup> (min)	Median Frequency per Admission <sup>b</sup>	Median (IQR) Time per Task <sup>a</sup> (min)	Median Frequency per Admission <sup>b</sup>	Median Frequency per Admission <sup>b</sup>
Conduct BPMH interview	15 (7.5–16.5)	0.87	15 (8.5–20)	0.92	10 (8–17.5)	0.84	14 (10–20)	0.94	
Conduct thorough interview	10 (7.5–15)	0.84	10 (7.25–15)	0.74	10 (8.5–13)	0.98	15 (10–27.5)	0.91	
Document medications, allergies	5 (5–10)	1	15 (8–20)	0.93	10 (6–15)	1.05	10 (5–15)	1.10	
Initial care plan	15 (15–30)	1	16.5 (10–20)	1.13	20 (12.5–20.5)	1.15	20 (15–22.5)	1.37	
Resolve DTPs identified by others	5 (4–13)	3	10 (5.5–15)	2.38	15 (8.5–20)	1.97	15 (9–19)	2.29	
Resolve DTPs identified by self	7 (5.5–15)	3	15 (10–20)	2.30	15 (8–17.5)	2.27	15 (10–17.5)	3.25	
Perform TDM	10 (10–15.5)	1.80	15 (10–20)	1.43	15 (9–17.5)	0.74	10 (9–15)	1.75	
Cost-effective test use	4 (1.5–7.5)	2.68	5 (4.25–8.75)	0.58	5 (1.5–8.5)	0.34	5 (5–5)	0.79	
Cost-effective drug use	5 (4–10)	2.80	10 (5–15)	0.85	6 (5–12.5)	0.81	7 (5–15)	1.17	
Monitor for ADRs and interactions <sup>c</sup>	7 (5–8.5)	2	6 (5–10)	1.07	8 (5–12.5)	0.88	10 (5–12.5)	0.97	
Patient access to medications	9 (5–15)	0.94	10 (5–10)	0.59	5 (5–12.5)	0.47	10 (5–15)	0.69	
Patient education	15 (10–17.5)	1.22	15 (15–20)	0.75	15 (13.5–20)	0.90	15 (10–23.5)	0.97	
Discharge planning	10 (7–12.5)	0.90	9 (5–11.5)	0.67	10 (5–15)	0.49	5 (5–14)	0.69	
Discharge medication reconciliation	10 (5.5–10)	1	10 (10–15)	0.85	10 (8.5–20)	0.78	9 (5–15)	0.93	
Medical rounds (% productivity)	120 min (49%)	Occurs 100%	58 min (46%)	Occurs 50%	40 min (31%)	Occurs 38%	38 min (17%)	Occurs 12%	
Disposition rounds (% productivity)	30 min (5%)	Occurs 80%	60 min (25%)	Occurs 75%	50 min (15%)	Occurs 62%	30 min (45%)	Occurs 47%	
Length of stay (days) (median and IQR)	5 days (5–6)		8 days (7–12.5)		10 days (4.25–12)		7 days (6–12)		

ADR = adverse drug reaction, BPMH = best possible medication history, DTP = drug therapy problem, FP = family practice, IQR = interquartile range, TDM = therapeutic drug monitoring.

<sup>a</sup>The time per task is the amount of time it takes a clinical pharmacist to perform 1 instance of the particular comprehensive care task.

<sup>b</sup>The frequency per admission is how often a clinical pharmacist performs the particular comprehensive care task per patient throughout the patient's hospital stay.

<sup>c</sup>For this task, frequency is expressed as instances per day, rather than instances per admission.

rounds, with a median duration of 58 minutes per session. Participants reported spending a median 66 minutes on nonclinical activities per workday, excluding a 60-minute break, assuming they were not responsible for a pharmacy learner or any distribution-related activities.

### Optimal Pharmacist-to-Patient Ratios

The optimal pharmacist-to-patient ratios required to provide comprehensive pharmaceutical care for medium and large hospitals were calculated to be 1:7 in internal medicine teaching units; 1:10 in internal medicine nonteaching, hospitalist, and FP units; and 1:14 in surgical units (Table 3). The number of participants was insufficient to reliably estimate ratios for subspecialty medical areas outlined in our secondary objectives. Nonetheless, despite the small sample size for the subspecialty subgroups ( $n = 6$ ), we performed the ratio calculation, which yielded an estimate of 1:16 for subspecialty medicine. The estimated ratios for subspecialty surgery were similar to the ratio of 1:14 for general surgical areas, specifically, 1:14 for general and vascular surgery ( $n = 6$ ) and 1:15 for orthopedic surgery ( $n = 5$ ). The pharmacist-to-patient ratio for small hospitals was 1:7 ( $n = 17$ ).

### Ratios Including Preceptor Activities

Pharmacists involved in preceptor activities reported spending an additional 100 minutes per day, on average, on teaching activities. If it is assumed that this is all non-patient care time, the ratios would change to 1:5 for internal medicine teaching units, 1:7 for internal medicine nonteaching, hospitalist, and FP units, and 1:9 for surgical units when pharmacists are serving as preceptors.

### Ratios Excluding the BPMH Task

Several BC sites have hired BPMH pharmacists or technicians to perform and document BPMH interviews. We performed a subgroup analysis to investigate changes to the staffing ratios if the BPMH task were removed from the comprehensive care task list. With this change, the pharmacist-to-patient ratios increased to 1:8 for internal medicine teaching units; 1:11 for internal medicine nonteaching, hospitalist, and FP units; and 1:15 for surgical

units. This scenario will be helpful for estimating the staffing ratios at sites with BPMH pharmacists/technicians who are solely responsible for performing this task.

## DISCUSSION

Pharmacists in many hospitals struggle to manage their large patient workloads, which highlights the need to determine optimal pharmacist-to-patient ratios. There are no established benchmarks for pharmacist-to-patient ratios in the Canadian literature. In this study, we aimed to address this knowledge gap by using a different methodology from our previous study<sup>17</sup> to elucidate the optimal staffing ratios that would enable pharmacists to provide comprehensive pharmaceutical care to all patients in medical and surgical units. We found that pharmacist-to-patient ratios of 1:7 for internal medicine teaching units, 1:10 for internal medicine nonteaching, hospitalist, and FP units, and 1:14 for surgical units would be required to provide comprehensive pharmaceutical care in medium and large hospitals.

The ratios identified in this study were lower than those reported in previous literature; however, it is difficult to compare the ratios from different studies due to methodological and practice differences, as well as differences in patient complexity, LOS, and the patient care tasks on which the ratios are based. In Australia, the corresponding ratios were 1:19 and 1:23 for medical and surgical pharmacists, respectively.<sup>15</sup> Compared with the previous Canadian study,<sup>17</sup> the ratios determined here were lower, with the exception of surgical units, which had identical ratios of 1:14. The difference may be due to methodological differences between the 2 studies. In the current survey study, pharmacists were estimating or recalling the optimal time spent on each task, whereas the previous work-sampling, time-and-motion study used the actual observed time, as recorded by pharmacists. Self-reported times may be subject to recall bias or may represent the ideal if time is unlimited, which may be longer or shorter than the time taken in practice. It could be argued that using time-and-motion data from the previous Canadian study<sup>17</sup> might have been more accurate than data based on recall. However, the pharmacists

**TABLE 3. Optimal Pharmacist-to-Patient Ratios for Inpatient Medical and Surgical Units by Hospital Size**

Pharmacist-to-Patient Ratio	Hospital Size; Type of Unit; Staffing Ratio (Range of Ratios by IQR of LOS) <sup>a</sup>			
	Medium and Large Hospitals			Small Hospitals
	Internal Medicine Teaching Unit	Internal Medicine Nonteaching, Hospitalist, or FP Unit	Surgical Unit	Internal Medicine Nonteaching, Hospitalist, or FP Unit
<i>Including</i> medical rounds	1:7 (1:6–1:7)	1:10 (1:9–1:18)	1:14 (1:7–1:17)	1:7 (1:6–1:14)
<i>Excluding</i> medical rounds	NA	1:12 (1:10–1:20)	1:15 (1:8–1:18)	1:8 (1:6–1:15)

FP = family practice, IQR = interquartile range, LOS = length of stay, NA = not applicable.

<sup>a</sup>Parenthetical range shown in each cell reflects the range of ratios based on the interquartile range of the length of stay.

in that previous study were not working under conditions of optimal staffing ratios; as such, the times they recorded may have been shorter (relative to the times reported in the current study) as a result of rushing activities, if they had adapted their workflow to the high patient load for which they were responsible.

The most striking difference in ratios between the 2 studies was for the internal medicine nonteaching and hospitalist (including FP) units (1:10 vs 1:26). There are 3 potential explanations for this difference. First, the DTP resolution time of 10–15 minutes in our study was double to triple the 5 minutes reported in the previous study,<sup>17</sup> which may again be attributed to recall bias. Additionally, ambiguity in the survey questions may have led to clinical assessment time, which should only be included in the initial care plan task, being double-counted in the DTP resolution task, resulting in a falsely prolonged DTP resolution time. Second, the LOS in our current study (8 days) was much shorter than in the previous study (13 days). The impact of LOS on the ratios is discussed below. Third, the ratio for internal medicine nonteaching and hospitalist (including FP) units in the previous study did not account for the occurrence of medical rounds, which was reported to be 58 minutes per session in our current study. Because attendance at medical rounds was reported by only 50% of participants from nonteaching units, we calculated the ratio excluding medical rounds to be 1:12, which was higher than 1:10 (with inclusion of medical rounds), but still lower than the 1:26 ratio in the previous study.<sup>17</sup>

In addition to recall bias, discussed above, our study had other limitations. First, the ratios were highly dependent on LOS, which varies across different units and hospitals. For instance, for 2 similar units with differing LOS of 5 days and 10 days, respectively, the ratios can vary drastically, which is reflected in the range of ratios in relation to the interquartile range of the LOS (see Table 3). The ratios increase as the LOS increases because pharmacists would have more time over which to perform patient care tasks in a longer hospitalization period. We therefore performed a sensitivity analysis to determine whether differences in DTP resolution time or differences in LOS had greater impact on the ratios; we found that LOS was more likely to be the greater contributor. Therefore, when applying these ratios to different institutions, it is important to consider them in relation to the LOS of clinical units. It is also important to acknowledge that patient complexity is a confounding factor that may affect LOS, because more medically complex patients tend to have longer LOS. In the survey, we asked participants to provide data points based on their experience working with “patients of average complexity in [their] day-to-day practice”; however, the term “average complexity” was not defined, and hence this term is subjective and open to interpretation. For future research, it may be worthwhile to consider calculating pharmacist-to-patient ratios

per day of hospital stay, based on a standardized national LOS average for each type of unit and level of acuity.

Furthermore, in our study we adjusted the LOS by deducting 2 days from every 7 days of the stay, based on the assumption of a 5-day work week for clinical pharmacists in British Columbia. However, this approach did not capture the 11 statutory holidays per year in this province, which would result in less time available for pharmacists to provide patient care, thus affecting the staffing ratios.

A second limitation was that for several tasks, participants reported a frequency of less than 1, which suggested that the tasks were not always performed for every patient on each admission. We acknowledge that in order to provide comprehensive pharmaceutical care, all of the tasks in the comprehensive care task list must be performed at least once during each hospitalization. However, in our survey questions, we decided to honour participants who may have disagreed with the inclusion of certain tasks in the comprehensive care task list; participants were given the option to indicate such disagreement when reporting task frequency. In addition, the area of practice and the team with which a pharmacist is working may dictate which tasks are prioritized, which would in turn affect the task frequency. Finally, the DTP resolution time was much shorter in internal medicine teaching units than in internal medicine nonteaching, hospitalist, and FP units (5–7 minutes vs 10–15 minutes). This may have been due to differences between practice settings, whereby prescribers were more readily available and medical rounds occurred more frequently in teaching units than in nonteaching units; therefore, DTPs could be resolved more efficiently in the teaching units.

Among our secondary objectives, we estimated the pharmacist-to-patient ratio for small hospitals at 1:7; however, this finding had low certainty due to the lack of dedicated clinical coverage, the heterogeneity of wards in small hospitals, and the variation in practice patterns across smaller hospital sites. Additionally, there was low certainty for the estimated ratios for subspecialty units, given the lack of participants from the prespecified areas and the heterogeneity of the unit types reported across different health authorities. Because some sites had designated BPMH pharmacists, we performed a subgroup analysis to explore how the removal of the BPMH task might alter the ratios. Surprisingly, this adjustment increased the ratios by just 1 for all 3 unit types, which was not a substantial change. It could be that because the BPMH task was only done once per admission (in contrast to other tasks, such as resolving DTPs, that were done more frequently), removing the BPMH task had only a minimal effect on the denominator (time per patient) in the ratio calculation.

Although the ratios established in this study were low, we demonstrated that lower ratios are required to provide comprehensive pharmaceutical care, which was treated as an all-or-nothing concept. In reality, pharmacists can only

provide “pieces” of the comprehensive patient care package while managing the large patient workloads assigned to them. The biggest barrier to implementing these lower staffing ratios is a lack of resources, and acquiring additional resources may be challenging from a health system perspective. However, the ratios established in this study can provide insight into the staffing ratios required to provide comprehensive patient care; they can also serve as a reality check on the level of care that is achievable with existing ratios. The results also highlight the need to bridge the gap between providing the theoretical, gold standard comprehensive care to every patient and a more realistic approach that recognizes current staffing resource limitations. Further research should focus on determining whether completing every comprehensive care task is necessary for all patients or if ratios should reflect combinations of comprehensive care tasks appropriate to patient priority or complexity.

## CONCLUSION

This study determined optimal pharmacist-to-patient ratios in BC hospitals to be 1:7 in internal medicine teaching units; 1:10 in internal medicine nonteaching, hospitalist, and FP units; and 1:14 in surgical units. These ratios were lower than those reported previously, possibly due to methodological differences. Given the lack of Canadian literature on hospital pharmacy staffing ratios, it may be valuable to develop national consensus guidelines on appropriate pharmacist-to-patient ratios to guide pharmacy staffing.

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## APPENDIX 1: Comprehensive pharmaceutical care task list, derived from Damji and others.<sup>1</sup>

1. Conducts patient interviews to obtain the **best possible medication history (BPMH)** and/or perform medication reconciliation
2. Conducts patient interviews to obtain **relevant subjective information** (e.g., symptoms, history of presenting illness) and **detailed medication use history**
3. **Documents an accurate and complete list of medications**, discrepancies between the prescribed and actual list, allergies, prior adverse drug reactions
4. Completes an **initial pharmaceutical care plan** by assessing patient data to identify medication-related problems
5. **Resolves drug therapy problems (DTPs)** identified by **others** or by targeted drug reports or worklists by recommending evidence-based medication therapy
6. **Resolves drug therapy problems (DTPs)** identified **independently and proactively** by recommending evidence-based medication therapy
7. Establishes and documents **patient-specific and measurable outcomes<sup>a</sup>**
8. **Therapeutic drug monitoring:** coordinates the timing and collection of drug concentration samples, interprets results, and adjusts medication doses or makes recommendations regarding adjustments
9. Advocates for rational and **cost-effective use of tests** (laboratory tests, culture and sensitivity tests, pharmacogenomics)
10. Practises **cost-effective drug-related decision-making**
11. **Monitors** patients for adverse drug reactions and drug interactions (drug–drug, drug–food, drug–device, drug–disease, drug–laboratory)
12. Advocates for **patient access to medications** by facilitating use of preferred medications on prescription drug plans and patient assistance programs
13. Participates in interprofessional patient care rounds: **disposition planning rounds**
14. Participates in interprofessional patient care rounds: **medical rounds** during which medical problems are discussed
15. Provides disease and medication **education** to patients
16. Performs **discharge planning** by liaising with the community pharmacy to ensure continuity of care
17. Performs **discharge medication reconciliation**

<sup>a</sup> In the current survey study, participants were asked to provide the time taken to perform each patient care task, including documentation time (if applicable). As such, the current study did not collect data independently for task 7.

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**APPENDIX 2: Example of survey questions concerning time spent on and frequency of a specified task.**

Q25 5. **Resolves each drug therapy problem (DTP) IDENTIFIED BY **OTHERS** or by targeted drug reports or worklists by recommending evidence based medication therapy** E.g. a) Resolves a therapeutic issue brought to the attention of the pharmacist by any of the following means: flag from a dispensary pharmacist, target drug list, specific drug information request, specific pharmacy consult or page, therapeutic issue identified by another member of the healthcare team. b) Makes this therapeutic recommendations in person, during rounds, over the phone, or by writing a note. c) Writes order for recommendation. Please include the time to **assess each problem and resolve it**

Minutes

0 1 3 4 5 6 8 9 10 11 13 14 15 16 18 19 20 21 23 24 25

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If *greater* than 25 minutes, please specify (in minutes): ( ) 

**(A) Time for resolution of drug therapy problem (DTP).**

Q40 5. **Resolves drug therapy problems (DTPs) IDENTIFIED BY **OTHERS** or by targeted drug reports or worklists by recommending evidence based medication therapy** E.g. a) Resolves a therapeutic issue brought to the attention of the pharmacist by any of the following means: flag from a dispensary pharmacist, target drug list, specific drug information request, specific pharmacy consult or page, therapeutic issue identified by another member of the healthcare team. b) Makes this therapeutic recommendations in person, during rounds, over the phone, or by writing a note. c) Writes order for recommendation.

**Once** per admission (1)

**More than once** per admission, **please specify** (frequency) (2)

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May **not** be required for every patient on every admission (3)

I don't believe this task needs to be performed (4)

**(B) Frequency of DTP resolution.**