RESEARCH PAPER

Geographic Accessibility of Community Pharmacies in Ontario

Accessibilité géographique aux pharmacies communautaires en Ontario

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Abstract

Background: Proximity is an important component of access to healthcare services. Recent changes in generic pricing in Ontario have caused speculation about pharmacy closures. However, there is little information on the current geographic accessibility of pharmacies. Therefore, we studied geographic access to pharmacies and modelled the impact of possible closures.
Methods: We used location data on the 3,352 accredited community pharmacies from the

Ontario College of Pharmacists and population estimates at the census dissemination block level. Using network analysis, we determined the share of Ontario's population who reside in a census dissemination block within three road travel distances of a community pharmacy: 800 m (walking), 2 km and 5 km (driving). We then simulated the effects on these measures of 10% to 50% reductions in the number of community pharmacies in Ontario.
Results: Approximately 63.6% of the Ontario population reside in a dissemination block located within walking distance of one or more pharmacies; 84.6% and 90.7% reside within 2-km and 5-km driving distances, respectively. Randomly removing 30% of Ontario's community pharmacies reduces these estimates to 56.0%, 81.4% and 89.0% for each distance, respectively; a 50% reduction results in 48.3%, 77.1% and 87.2%, respectively.
Conclusions: Pharmacies are geographically accessible for a majority of the Ontario population. Moreover, it appears that modest closures would have only a small impact on geographic access to pharmacies. However, closures may have other impacts on access, such as cost, waiting time and reduced patient choice.

Résumé

Contexte : La proximité est un aspect important de l'accès aux services de santé. Les récents changements dans le prix des médicaments génériques, en Ontario, ont mené à des suppositions sur d'éventuelles fermetures de pharmacies. Cependant, il y a peu d'information sur l'accessibilité géographique actuelle. Ainsi, nous avons étudié l'accès géographique aux pharmacies et nous avons effectué une modélisation de l'impact d'éventuelles fermetures.
Méthodologie : Nous avons utilisé les données sur l'emplacement de 3,352 pharmacies communautaires inscrites auprès de l'Ordre des pharmaciens de l'Ontario ainsi que les prévisions démographiques au niveau de l'îlot de diffusion de recensement. Au moyen de l'analyse de réseau, nous avons déterminé la proportion de la population ontarienne qui réside dans un îlot de diffusion à une distance de trois rues d'une pharmacie communautaire : 800 m (à pied), 2 km et 5 km (en voiture). Nous avons ensuite simulé l'effet, sur ces mesures, d'une réduction de 10 à 50 % du nombre de pharmacies communautaires en Ontario.
Résultats : Environ 63,6 % de la population ontarienne réside dans un îlot de diffusion situé à une distance, pouvant se faire à pied, d'une ou plusieurs pharmacies; 84,6 % et 90,7 % de la population réside à des distances de 2 km et 5 km, respectivement. En supprimant de façon aléatoire 30 % des pharmacies communautaires en Ontario, ces chiffres baissent à 56,0 %, 81,4 % et 89,0 %, respectivement pour chaque distance; une réduction de 50 % des pharmacies donne des résultats de 48,3 %, 77,1 % et 87,2 %, respectivement.
Conclusion : Les pharmacies sont géographiquement accessibles pour la majorité de la population ontarienne. De plus, il semble que la fermeture d'un petit nombre de pharmacies ait un faible impact sur l'accès géographique. Cependant, les fermetures peuvent avoir d'autres types d'impacts sur l'accès, tels que le coût, les temps d'attente et une réduction de choix pour les patients.

Pharmacists provide important health services associated with medicine dispensing and related counselling. Some provinces have also recently granted pharmacists various prescribing privileges. As the sole location of these services in community settings, the accessibility of community pharmacies may be an important determinant of healthcare access and related quality. This issue has been highlighted in recent debates about generic pricing policies, particularly a new Ontario policy that effectively halved the amount paid for generic drugs. In response, pharmacy chains claimed that lost margins on generics would force them to close stores (Howlett and Strauss 2010). This debate has become national in scope as other provinces also consider changes in their generic drug pricing policies (Howlett and Seguin 2010).

Geographic access has been shown to influence use of many healthcare services, including primary care (Arcury et al. 2005), hospitals (Goodman et al. 1997), cardiac revascularization (Gregory et al. 2000) and emergency rooms (Turnbull et al. 2008; Lowe et al. 2009). Distance to pharmacy services has been less studied (Hiscock et al. 2008). One US study found that distance to pharmacy did not influence medicine use by rural populations (Schectman et al. 2002); however, another study in New Zealand found that patients farther from a pharmacy were less likely to use their services (Hiscock et al. 2008). We are unaware of any prior research in Canada on the geographic accessibility of pharmacy services.

In 2008, there were an estimated 8,223 community pharmacies in Canada (IMS Health Canada 2009a). At that time, Canada had 40% more pharmacies per capita than the United States (IMS Health Canada 2009a; Pharmaceutical Commerce 2009). While this disparity may result from differences in geography and population distribution, the level of access to community pharmacies in Canada deserves further investigation. Although long travel distances might cause prescriptions to go unfilled, an oversupply of pharmacies may result if retail mark-ups on medicines induce more firms to enter the market than are necessary to provide reasonable geographic access (Grootendorst et al. 2008). We therefore studied the current state of geographic access to pharmacies in Ontario and simulated the impact of possible closures.

Methods

Data sources

We obtained location data for all Ontario pharmacies from the Ontario College of Pharmacists website and removed all hospital, military and veterinary pharmacies using keyword searches and hand screening (Ontario College of Pharmacists 2010). We geo-coded pharmacy locations using pharmacy addresses, verifying street addresses by phone and Internet inquiries wherever a post office box was listed (DMTI Spatial 2008). Using telephone inquiries and street-level photographs from Google Maps, we manually determined the location for any pharmacy our geo-coding software identified without high precision.[1]

We merged these data with road network data from DMTI Spatial (2009) and 2006 census data from Statistics Canada (2007). We used population estimates at the dissemination block level, which are small areas typically bounded by roads. These are the smallest geographic areas for which population figures are available. In 2006, Ontario had 12,160,282 residents in

126,244 blocks, an average of 96.3 (Statistics Canada 2008). We also used Statistics Canada definitions to classify each dissemination block as either urban or rural (Statistics Canada 2008).

Statistical analysis

We used network analysis, which calculates the road distance between points (pharmacies) and small areas (blocks). Using the Network Analysis tool in ESRI ArcGIS, we constructed walking (800-m) and driving (2-km and 5-km) service areas for each pharmacy (ESRI 2009). Following a similar process to other studies, for each census block we determined whether it was intersected by each pharmacy's service area (McGregor et al. 2005; Schuurman et al. 2006).

We calculated the number and proportion of the Ontario population living in census dissemination blocks within each distance of one to five or more pharmacies. Further, we used Monte Carlo simulation to analyze changes in these proportions under different pharmacy closure scenarios. In these simulations, we randomly omitted a percentage of pharmacies (10%, 20%, 30%, 40% and 50%) from the analysis and recalculated the proportions. We used 10,000 iterations to generate means and confidence intervals for the entire province and stratified based on urban and rural classification.

Results

From the 3,571 records in the original data set, we identified 3,352 community pharmacies. This total number of community pharmacies is very similar to other published estimates for Ontario (IMS Health Canada 2009b). As shown in Table 1, almost two-thirds (63.6%) of Ontarians live in a census block within walking distance (800 m) of one or more community pharmacies. In terms of driving distances, 84.6% and 90.7% of the Ontario population live in a census block within 2 km and 5 km of at least one community pharmacy, respectively. These proportions varied substantially between urban and rural areas. As shown in Table 2, 73.3% of urban residents reside in a census block within walking distance of a pharmacy, and 96.2% are within 2 km. In contrast, only 40.9% of rural residents live in a dissemination block within 5 km of a pharmacy.

TABLE 1. Estimated population (and proportion) living in census dissemination blocks located within walking distance (800 m) and short driving distance (2 km and 5 km) of 1 or more through 5 or more pharmacy locations[2]

Number of Pharmacies	Walking		Driving			
	800 m		2 km		5 km	
	Number	%	Number	%	Number	%
1 or more	7,738,741	63.6	10,288,253	84.6	11,024,318	90.7
2 or more	5,299,770	43.6	9,344,287	76.8	10,487,350	86.2
3 or more	3,603,376	29.6	8,495,017	69.9	10,192,749	83.8
4 or more	2,378,293	19.6	7,507,481	61.7	9,840,298	80.9

TABLE 1. Continued.

	Walking		Driving			
	800 m		2 km		5 km	
	Number	%	Number	%	Number	%
5 or more	1,599,884	13.1	6,593,040	54.2	9,594,944	78.9
Total Population	12,160,282					

TABLE 2. Estimated population (and proportion) living in both urban and rural census dissemination blocks located within walking distance (800 m) and short driving distance (2 km and 5 km) of 1 or more through 5 or more pharmacy locations

Urban

Number of Pharmacies	Walking		Driving			
	800 m		2 km		5 km	
	Number	%	Number	%	Number	%
1 or more	7,585,689	73.3	9,961,187	96.2	10,283,876	99.4
2 or more	5,258,622	50.8	9,209,679	89.0	10,029,999	96.9
3 or more	3,588,829	34.7	8,423,621	81.4	9,853,061	95.2
4 or more	2,373,481	22.9	7,470,877	72.2	9,591,387	92.7
5 or more	1,597,607	15.4	6,572,847	63.5	9,396,857	90.8
Total Population	10,351,135					

Rural

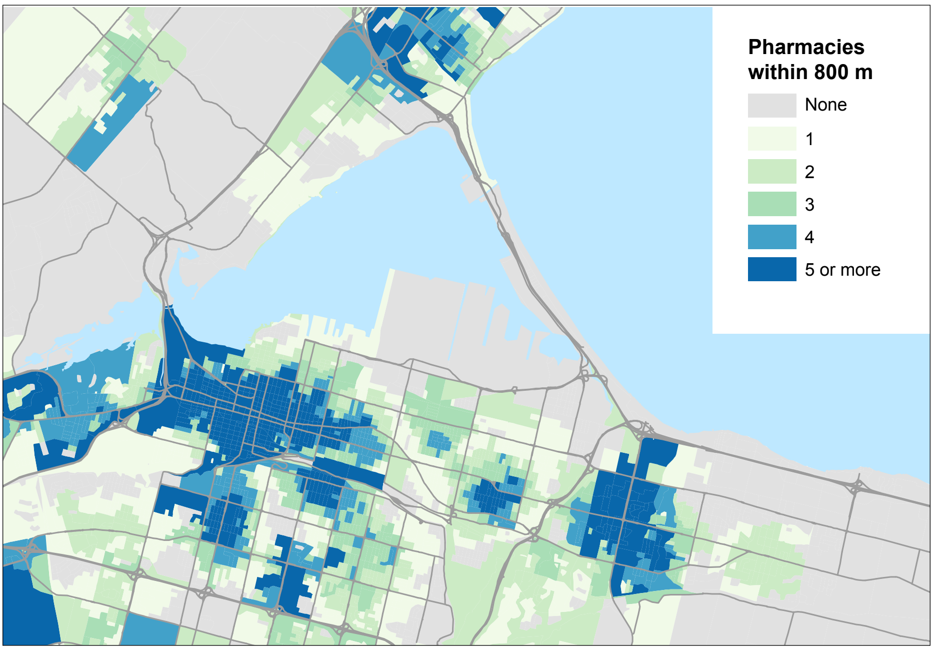
Number of Pharmacies	Walking		Driving			
	800 m		2 km		5 km	
	Number	%	Number	%	Number	%
1 or more	153,052	8.5	327,066	18.1	740,442	40.9
2 or more	41,148	2.3	134,608	7.4	457,351	25.3
3 or more	14,547	0.8	71,396	3.9	339,688	18.8
4 or more	4,812	0.3	36,604	2.0	248,911	13.8
5 or more	2,277	0.1	20,193	1.1	198,087	10.9
Total Population	1,809,147					

Beyond a single pharmacy, 43.6% of the Ontario population live in a census block within walking distance of two or more pharmacies; the similar figures for 2 km and 5 km are 76.8%

and 86.2%, respectively. A notable 54.2% of Ontarians live in census blocks within 2 km, and 78.9% live within 5 km, of five or more community pharmacies.

Community pharmacies are particularly concentrated within urban areas zoned for commercial activity. For example, Figure 1 illustrates the access statistics for census blocks within the city of Hamilton (see Appendix A for other maps). As seen in the figure, significant portions of the city are within walking distance of five or more pharmacies.

FIGURE 1. The number of pharmacies within an 800 m road travel distance of census dissemination blocks in Hamilton, Ontario



As illustrated in Table 3, geographic access decreases less than proportionally with the closure of community pharmacies. For example, a random closure of 20% of community pharmacies would reduce the population with walkable access to one or more pharmacies by only 4.6%, from 63.6% to 59.0% (95% CI: 58.4%–59.5%). A random closure of 40% of community pharmacies would reduce it by 11.1%, from 63.6% to 52.5% (95% CI: 51.7%–53.3%). For 2-km driving distances, these reductions are much smaller: from 84.6% to 82.7% (95% CI: 82.3%–83.1%) and 79.6% (95% CI: 78.8%–80.2%). Finally, for 5 km, closing 50% of the pharmacies reduces the rate of geographic access from 90.7% to 87.2% (95% CI: 86.6%–87.8%) – a change of only 3.4%.

Finally, Table 4 shows that random pharmacy closures would have a greater impact on rural dissemination blocks. For example, a random closure of 40% of community pharmacies reduces the urban population within a 5-km driving distance by only 1.5% (from 99.4% to 97.9%). In contrast, this same reduction reduces the number of rural residents within 5 km of a community pharmacy by 4.3% (from 37.5% to 33.2%).

TABLE 3. Estimated proportion of Ontario residents living in a 2006 census dissemination block located within walking distance (800 m) and short driving distance (2 km and 5 km) of 1 or more pharmacy locations. We calculated pharmacy reduction scenarios by randomly selecting pharmacies for closure and using identical methods over 10,000 iterations of Monte Carlo simulation.

Pharmacy Reduction	Walking		Driving			
	800 m		2 km		5 km	
	Estimate	95% CI	Estimate	95% CI	Estimate	95% CI
None	63.6%	–	84.6%	–	90.7%	–
10%	61.5	(61.1, 61.9)	83.8	(83.5, 84.0)	90.2	(90.0, 90.4)
20%	59.0	(58.4, 59.5)	82.7	(82.3, 83.1)	89.7	(89.3, 89.9)
30%	56.0	(55.4, 56.7)	81.4	(80.8, 81.9)	89.0	(88.6, 89.4)
40%	52.5	(51.7, 53.3)	79.6	(78.8, 80.2)	88.2	(87.8, 88.7)
50%	48.3	(47.4, 49.1)	77.1	(76.3, 77.9)	87.2	(86.6, 87.8)

TABLE 4. Estimated proportion of both rural and urban Ontario residents living in a 2006 census dissemination block located within walking distance (800 m) and short driving distance (2 km and 5 km) of 1 or more pharmacy locations. We calculated pharmacy reduction scenarios by randomly selecting pharmacies for closure and using identical methods over 10,000 iterations of Monte Carlo simulation.

Urban

Pharmacy Reduction	Walking		Driving			
	800 m		2 km		5 km	
	Estimate	95% CI	Estimate	95% CI	Estimate	95% CI
None	73.3%	–	96.2%	–	99.4%	–
10%	70.9	(70.4, 71.3)	95.4	(95.1, 95.7)	99.1	(98.9, 99.2)
20%	68.0	(67.4, 68.7)	94.4	(93.9, 94.8)	98.8	(98.5, 99.0)
30%	64.7	(63.9, 65.4)	93.0	(92.4, 93.6)	98.4	(98.0, 98.7)
40%	60.7	(59.8, 61.6)	91.2	(90.4, 91.9)	97.9	(97.4, 98.2)
50%	55.8	(54.8, 56.8)	88.6	(87.6, 89.5)	97.1	(96.6, 97.6)

Rural

Pharmacy Reduction	Walking		Driving			
	800 m		2 km		5 km	
	Estimate	95% CI	Estimate	95% CI	Estimate	95% CI
None	8.5%	–	18.1%		40.9%	
10%	7.8	(7.5, 8.1)	17.0	(16.5, 17.4)	39.3	(38.5, 40.0)

TABLE 4. Continued.

Pharmacy Reduction	Walking		Driving			
	800 m		2 km		5 km	
	Estimate	95% CI	Estimate	95% CI	Estimate	95% CI
20%	7.2	(6.7, 7.6)	15.8	(15.1, 16.4)	37.5	(36.5, 38.4)
30%	6.5	(6.0, 6.9)	14.5	(13.8, 15.2)	35.5	(34.2, 36.6)
40%	5.7	(5.2, 6.2)	13.1	(12.3, 13.9)	33.2	(31.8, 34.6)
50%	4.9	(4.4, 5.5)	11.6	(10.7, 12.4)	30.5	(29.1, 32.0)

Conclusions

Geographic access to pharmacies is important to ensure access to medicines and related professional services. We found that the majority of Ontario residents can access community pharmacies within reasonable travel distances, both walking and driving. Owing to concentrations of competing pharmacies in areas zoned for commercial activity, our simulation results showed that reductions in the number of pharmacies would have only modest effects on geographic access to pharmacies in Ontario. However, it also shows that the effect of closures may be more pronounced on people living in rural areas.

We note several limitations. First, we used only residence as the locus of access, which ignores individual travel patterns. However, this approach would only impart a conservative bias on results because individuals may have pharmacies located near their workplaces or physicians' offices, for example. Second, we used population data from the 2006 census. Owing to recent population growth patterns, however, these data likely understate the current degree of urbanization, and therefore pharmacy accessibility. Using census data also limited our analysis to census blocks and not individual addresses; however, this is the standard method in these types of analyses (Schuurman et al. 2006). Further, the publicly released census data do not contain information on the age, income or sex composition of dissemination areas. However, closures of pharmacies in areas with a high concentration of elderly residents are less likely than closures in other areas because the average per capita retail spending on prescription drugs per elderly Canadian is 4.5 times the average for non-elderly Canadians (Morgan et al. 2008).

Despite our manual checking of locations, our geo-coding procedure may not have been exact for every pharmacy. However, we have no reason to believe this would introduce any systematic bias into our results. We used a uniform probability of pharmacy closure in our Monte Carlo simulations. This approach ignores the fact that pharmacies would likely close in areas with the greatest concentration of competitors per medicine user. These areas may include both low-density rural areas with small patient populations and high-density urban areas with many pharmacies. However, if pharmacy closures did occur in more competitive areas, our estimates would again be conservative. Finally, because our analysis focused only on Ontario, the effect of closures on other provinces may differ. However, Ontario currently has fewer pharmacies per capita than every other province except Quebec and British Columbia (Ontario's Community Pharmacies 2010).

Our findings are important in the context of recent debates about generic drug pricing and pharmacy reimbursement in Canada. Our results – made under conservative assumptions – indicate that if reductions in the price paid for generic drugs did result in some reduction in the number of pharmacies, there would likely be only a modest impact on geographic access to pharmacies themselves. To address concerns about access to pharmacist services in rural and remote areas, governments should seriously consider implementing mechanisms – such as those in Australia and those in Ontario – that provide additional professional compensation for these pharmacists (Mossialos et al. 2004). In the future, governments should consider whether the other impacts of pharmacy closures due to price reductions, such as choice, cost, wait time and convenience, justify the resources that could be used in other health and social programs.

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NOTES

[1] We manually determined the location for any pharmacy DMTI identified with "CanMap street low precision" or worse (GIS Precision Codes 200+), as well as pharmacies identified as using street aliases in their address (GIS Codes 60–70).

[2] Based on these estimates, 36.4%, 15.4% and 9.3% of the population do not currently live in a census dissemination block within 800 m, 2 km and 5 km of a pharmacy, respectively.

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Appendix

FIGURE A1. The number of pharmacies within an 800 m road travel distance of census dissemination blocks in Toronto, Ontario

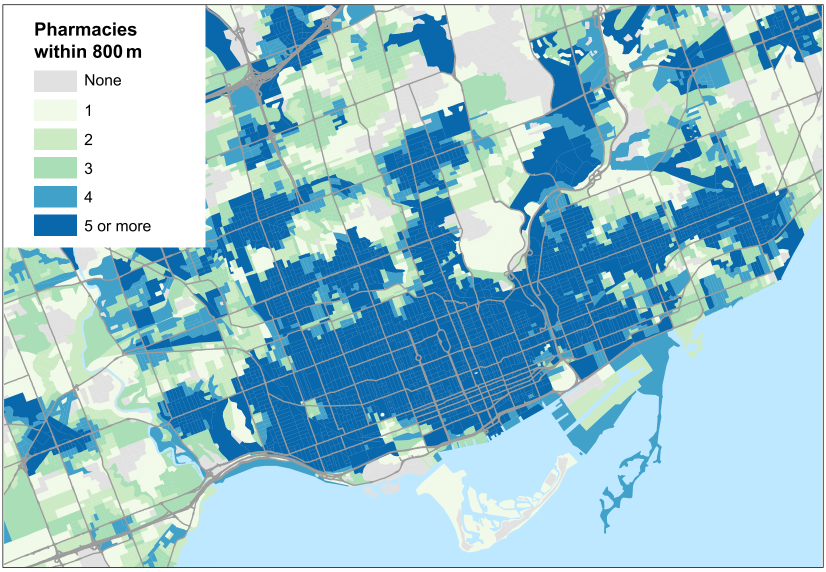

FIGURE A2. The number of pharmacies within an 800 m road travel distance of census dissemination blocks in Ottawa, Ontario